VRIL COMPENDIUM

VOLUME

5

VRIL CONNECTION

VASSILATOS

1992

VOLUME

5

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COMMENTARY

VRIL CONNECTION

ANTONIO MEUCCI

IN HONOR OF ANTONIO MEUCCI
INVENTOR OF THE TELEPHONE

SECTION 1

COMMENTARY

Mr.Anthony De Nonno
Cinematographer, Artist, and Friend
Through Whose Private Files
We Were Able To Obtain Information
As Concerns
SR. ANTONIO MEUCCI
With Special Thanks To Mrs. Theresa Cappicci
Whose Kind Services Made Further Retrieval
Of Meucci Documents Possible
AND
WITH ESPECIAL MENTION
THE LATE HONORABLE MR. JOHN LA CORTE OF
THE AMERICAN-ITALIAN HISTORICAL SOCIETY
Whose friendship I had but for a brief moment
Whose gallant life's work affirms
SR. ANTONIO MEUCCI
DISCOVERER OF PHYSIOPHONY
THE TRUE INVENTOR OF TELEPHONY
THE TRUE FATHER OF WIRELESS COMMUNICATIONS,
DIRECTIONAL RANGE-FINDING
UNPOWERED VOCAL COMMUNICATIONS
FERRITES
(1847)

IT IS NECESSARY TO GIVE JUST THANKS
TO
M. Nese, G. Schiavo, and F. Nicotra
For Textual Retrievals of the Meucci Court Proceedings,
Meucci Diary Extracts, Personal Files, Models, and Photographic History

Vril Science studies eidetic meaningful communion. Vril Science examines communal transactions of meaningful content. Meaning and validity are the central attributes of the Vril Worlds. Meaning is fulfilled during Vril eidetic world transactions. Vril meaningful contact collimates, expands, and greatly intensifies Vril auric striations.

Primitive sensory examinations of inertial detrital haloes indicate that inertial portions are contractile during Vril transactions. Inertio-auric haloes of others contract and luminate intensely during Vril transactions with participants and communicants. Vril auric impacts in inertial space produces densifications and luminous condensations.

Vril activated aurae enlarge, modify, inflect, and permute innate Vril states. Vril contact envelopes participants. Vril thread eidetic contact is true and complete sensory experience. Vril conduction through the neurology enables viscero-eidetic experiential transaction.

Artificially activated aurae engage Vril densifications and expansions. Vril impacts create inertial entourage devoid of potential meaningful eidetic transaction. Displays incapable of engaging Vril communions are inertial. Inertial space is a resistive principle possessed of limited active extent and reach. Vril responds to humanly arranged inertial interruptions for greater purpose. This Vril Law of sustenance is not mechanistic in action. Vril is personable.

Inertial technology forces Vril aurae to expand and contract. Vril intent matches and surpasses inertial presence to preserve organismic regional integrity. Native Vril states exceed all inertial empowerment. Vril insensate threads are sensed as prickling sensations when contact is not well-designed.

Mechanism does not enjoin meaningful experience. Vril is the energetic holistic presence which engages recipients in transforming experience. Vril threads enter synapses of ganglial centres in organisms directly. Vril viscero-eidetic transactions exceed inertial sensory impressments.

Objects and organisms conduct Vril striations. Aurae are Vril striated spaces. Acoustic exchange is fundamental auric exchange. Inertial entourage in air is minimal. Magnetic transactors give intensified viscero-eidetic transaction when aurically stimulated via vocal utterance.

Human expressions are auric expressions in absence of

acoustic impulses. Vril undulations occurs among striations via Vril quality inflections; not through densifications and rarefactions. Vril modulations are not mechanistic in nature. Vril densifications permit richer contact with transacting communicants.

The frictive attributes of specific minerals and metals is a result of the proportion between organismic vril conductivity and inertial resistivity. Certain minerals and metals (during specific seasons) manifest auri-plasmic frictive effects in excess of mechano-frictive effects.Friction is the result of Vril inertial interactions.

The true intelligence of the universe is experiential: visceral and eidetic intelligence flood all materials. Contacts with matter is contact with the distributed intelligence of Vril space. Furtive material contacts transact lasting eidetic impressions. Short interrupted contacts deposit eidetic traces which are largely ignored. The universe of matter is an available continual transaction with Vril itself. Bright "clear sight" pathways are found just above the ground surface. Leylines are white-sheathed Vril threads. Vril aerial routes may be mapped. Persistent Vril display sites mark permanent Vril connections among insensate transactive space.

Vril generates the manifestations of eidetic node. Vril is pure consciousness. Vril is pure experience. Vril is revelation, eidetic content, and vision. Vril gives distant rapport and exotic experiences of unknown Vril Eidetics. Vril gives comprehension and understanding. Vril alters recipients to enter greater Vril Eidetics.

Vril threads appear glowing black. Vril threads flood space. Vril threads radiate experiential space. Vril threads enter synapses of ganglial centres in organisms directly. The Vril sensory system is the primary sensory mode of the human organism. Intuitions and visions are received directly into the Vril sensory system.

Vril connectivity extends experience and consciousness into the external and permeating Vril-ganglia of the universe. These are found distributed throughout the universe. One may connect with local Vril ganglia among the rocks and woods of near regions. One may interconnect despite the seemingly vast distances of physical space. Vril Eidetics remove experiential dimensions of distance.

Ferruginous and carbonaceous substances concentrate and collimate the pure eidetic of Vril threads in an organismically "soft" manner.

Atoms and particles are detrital discharge foci. They are found at sites where eidetic energy shears inertial space. Particles appear when matter is impacted. The sphericity of inertia is manifested only with motional components. Naturally appearing sphericities imply that expansive and contractile impacts are occurring throughout space. Vibrating objects exert Vril attractions into the human organism. Many non-acoustic sounds permeate the Vril environment. Human reactions to material arrangements were studied by the alchymysts and radionists. Inertial reactions without human regard were studied by the inertialists. Ferruginous and carbonaceous materials may be stimulated to release humanly sensed conditions. Ferruginous matter is Vril conductive in the human organism. Not all elements and materials are humanly Vril conductive in the organism.

Vril tonal objects bring auri-acoustic Vril Eidetics. The human organism is sensitive to these regionally ringing sounds. Art objects of specific material bring Vril Eidetics into enclosed volumes of space. Vril Eidetics alter and modify the fundamental experiential tone of a building.

Certain persons are highly Vril conductive and summon surrounding minds into their activities. Certain persons can sense Vril Eidetics with great precision. These individuals are able to spontaneously select harmonies, tones, and pitches, melodies, phrases, and metaphors with inevitable accuracy. These codes and signals match the carved space whose eidetic node draws them.

Pitch is a humanly valuable term which describes space-experience. Pitches are found to describe very defined spatial directions. Pitch lines are locale-specific. Pitch lines correspond with ray lines in the environment. Higher pitches verge toward space. Lower pitches verge toward the ground directly. Mid-range pitches often assume lateral and angular orientations with respect to the stratification of earth and sky.

Hand held tuning forks may be used in wandlike manner to determine experiential spatial crystallography. Vril threadways are determined through human organismic sensitivity. Vril maps are constructed via hand held Vril wands of specially configured materials. Crystallographic axes of space determine experiential entrance and passage. Ideations proceed along locally fixed axes.

Pitches create complex Vril reactions. Pitches are projected eidetic transactions of struck materials. Projected pitch eidetic transactions give tonal experience, eidetic content, and context. Pitches stimulate physico-inertial pulsed movements. The humanly valuable portions of these events are discerned with respect to effects on consciousness and experiential sensation. Vril eidetic is experiential eidetic. Vril eidetic is not the inertial eidetic of mere movement.

Suspended materials each measure specific Vril orientations. Suspended wandlike measuring devices alter orientation when humanly approached. Materials define specific Vril indices in space. Materials are generated, oriented, crystallized, and thrust upward through Vril.

Pitch and material orientations may be measured. Such measurements reveal Vril distributions of space. Regions are known and discerned by their attributes. Regional attributes intuitively delineates borders of conscious identity. Specific materials may be used as wandlike tuners. Wandlike tuners indicate surface Vril thread directions which traverse and underlie locales.

Vril conductive experience is the very fundamental synaesthesic space of being. Objects which have been moved and struck behave as special Vril transactors. Inertial dissolution is effected through the energy of the strike. The objects then connect the human consciousness with Vril Eidetics. Materials conduct and relate Vril eidetics to operators. Materials occupy specific Vril eidetics in which they were generated and remain sustained.

VRIL CONNECTION

Vril undulations are non-acoustic transactions and may be experienced directly through neural systems (Gray, Meucci). Vril visceral sounds provoke the human organism into deep experiential responses. Vril sounds are meaning filled because they herald the arrival of special and powerful deep Vril eidetic transactions. Visceral sensory experience exceed inertial sensory impressment. Viscero-eidetic sensory experience is meaningful, penetrating, sensually rich, holistically complete, and continuous.

Neural synapses are enjoined in the Vril thread continuum. Physical ganglia are apparent forms representative of more essential pure Vril organismic extensions and connectivities. In this sense organismic unity does not formally exist. Eidetic transactions with minerals and metals show the non-existence of individual organismic autonomy. Specific eidetic projector sites transact with such power that the eidetic experience often exceeds the apparent scene.

Elisha Gray made an independent re-discovery of Meucci's physiophony with frictive contacts. Inertially empowered glowing haloes expand Vril aureoles. Electrical activations irritate and expand aurae to increase consciousness (Reichenbach, Starr-White, Tesla, Kilner).

Increased auric intensities permit vastly expanded sentient transaction. Vril expands to match the irritation. Increased auric activity does not require electrical irritation. Extraordinary viscero-eidetic communications take place in specific systems. Electric activity does not destroy the natural Vril transactivity of systems. The use of magnets requires vocal utterance for stimulating the eidetic content of the lodestone. Forced electro-impulses greatly expand the aura (Tesla).Vril aurae are innately withdrawn and enfeebled as a result of inertial immersions.

Viscero-tonic effects of Vril capacitors are notable. Such actions are strongly implied in designs by Meucci, Rossetti, and Stubblefield. The inclusion of electrical strain among components is not necessary yet provides intriguing insight into the manner in which Vril and inertia interact. Certain of Gray's designs required the curiously reduced frictive effects which eidetically transactive electrical stress produced in the organism.

Spark gaps are intense inertial white raysheath reactors. Ordinary electrical tensions are accompanied by a mild whitish inertio-effluence. Unidirectional high voltage pulses endraw white-inertial fibrils into the stressed area. Such stresses are dissolved; and the resulting black radiance which emerges in the surrounding volume of space is notably vitalizing. The black radiance is the presence of Vril. Viscero-eidetic transactions take place in Vril blackness. Vril and inertia interact.

Static inertia is difficult to organismically penetrate. Moving inertia permits organismic ease of penetration by space-permeating Vril. Electrical spark gaps pump inertial fibrils along their length. Fibrils which enter the spark-gap area are carried along the line and through their driving circuits as "charge". The anomalous appearance of "charge" in otherwise uncharged systems proves this action.

Wispy white inertial fibrils enter electrical stresses with no original charge volume. These create the appearance of "sudden high charge volumes". Tesla noted this effect in Colorado. Such use of extreme electric stress alters human consciousness through specific Vril interactions which result. Extraordinary deep eidetic perceptions of one's surrounding district are received when exposed to mild electrical stresses. Surrounding tracts of land are eidetically experienced "as from a height". When mild low tension shocks are organismically applied inertial accretion and concentrations along the body discharge path becomes mobile.

The highly interrupted electrical stresses produced through Lahovsky's spark-gaps allowed the dissolution and motivation of inertia into the spark-gap. Exposure to such sparks removed organismic rigidified inertia by attracting it forcibly. The sudden spaced feeling after receiving an electric shock is due to the surficial removable of inertial with a resulting increased sensitivity to Vril eidetic trans.

Extraordinary deep eidetic perceptions of one's surrounding district are received when exposed to mild electrical stresses. Surrounding tracts of land are eidetically experienced "as from a height". When mild low tension shocks are organismically applied inertial accretion and concentrations along the body discharge path becomes mobile.

These actions were erroneously called "electrical" because of certain physiological sensations encountered when absorbing them. Vril may release inertial detritus (charges) in the flesh because of absorbed inertial space.

Mesmer and Galvani studied frictions which exist between protoplasm and special capacitors. Elisha Gray discovered the frictions which exist between the human organism and electrically charged surfaces. Tones were emanated from arrangements which enjoined hands and resonators. Gray investigated the behavior of transactive tones in end-terminated transmission lines. Gray developed Vril-ganglial transmitters. Empathic transmission among communicants is possible through transactive entunement of Vril signal threads.

The super-position of electric stresses alters friction (Gray).Moderate electric stresses reduce friction considerably by dissolving contact site inertia. Elisha Gray's organo-tonic systems powerfully transacted Vril eidetic experience. He examined the meaning-rich charge of harmonics and harmonic sequences. Bells in cathedrals are Vril resonators and capacitors even when not physically sounding.

Gray's ringer coils were prolific Vril transactors. Gray utilized line-tones to stimulate Vril transactions. Tones alone are frequently capable of surreptiously and mysteriously transacting entire intent and messages from the transmitter site. By what strange means do we often know who is calling us...through the mere sounding of a telephone signal? Telegraph operators were able to know their station callers by tone; and identified fellow operators by their "touch".

Gray's harmonic telegraphs are extremely sublime in concept and transactive ability. Tuning forks powerfully engage organismic Vril projections. Tones received engage recipients in eidetic transactions. Elisha Gray is the man who most appreciated and developed the eidetic transactions transmitted through tones. His designs "rang" with meaning-rich

tones. Tones selected were intuitively designed for the powerful stimulation of visceral ganglio-sensory centers.

There are inherent tones which ring out from every object as part and parcel of material existence in the Vril matrix. In absence of frictive contact or mechanical impulse all objects continuously ring in visceral-sensed harmonics. Objects represent and transact tones with us. This is especially true when objects are ground-connected.

Sounds carry two distinct signals: one a viscero-eidetic one and the other the acousto-inertial one. Lights also perform the same function and we will discuss the design of "cymoscopes" in a future volume. It is not rare to watch a flickering light or television display and suddenly (repeatedly) receive an intuitive thought which has nothing to do with the visual transmission.

Such tones become audible when transcendent Vril surges are monitored by organismic response. Telegraph poles became especially vibrant with a mysterious tone during the night. Observers reported these tones to arise "from the ground". Poles were conducting Vril transactive energies with space. The diurnal emergence of ringing tone is heard in every enclosure just after midnight.

Vril energy is more visceral than acoustic in these designs. Patents which bridge the gap between telegraph sounders and telephones (E.Gray) are notable Vril eidetic transactors.

Tones trigger meaning-charged thought sequences. Empathic transmission is possible through tones alone. Gray's organ-pipe switch differentiator. Other resonator switches are notable (Gower). Specific incoming resonances triggered specific switches. Such resonators permit meaningful exchanges with minimum code or use of speech in anomalous communications phenomena.

Elisha Gray re-discovered the physiophony of Antonio Meucci while working with charged metal surfaces and frictive contacts. Mr.Gray's patents are numerous and significant. We have several articles which indicate the extensive use of these nerve-induction phenomena in early experiments with people who are unable to hear. In many instances, the use of these instruments enabled the deaf to relearn the normal modes of speech.

Elisha Grey developed simple means for encoding terminated lines with eidetic content-rich tones. Such organically developed tones were conducted in Vril-laden iron wires. These tones suggested strongly empathic eidetic contents despite their low density of articulated code. Organic tones suggested tantalizing eidetic contents to those who engaged them. Vril eidetic contents surge through the ground and space. Vril eidetic contents enter tones and thread their way through distances and Vril Eidetics to make passageways through us.

Materials are not themselves the true source of sounds heard when their mass is struck. Objects receive and transfer Vril energies into the inertialized apparent world when struck. The apparent world is of itself dead. The strike momentarily dissolves and suspend inertial rigor. Eidetic tones are then communicated by these into the experiential space.

Viscero-telluric sounds are manifestations produced through Vril eidetic transactions. These are spontaneous emergent tones which flood and resonated enclosures. They are possessed of an ability to enhance organismic transaction with very fundamental eidetic worlds. These sounds make their appearance after midnight (2-4 A.M.). These sounds are heard with ears closed and are much louder with ears closed than with ears opened.

A remarkable reflex-period occurs shortly after exposure to physiophonic music. Vril transacts organismic healing effects through discharges effected above the ground (lateral). These proceed along the Vril channel. The physiophony of Meucci and Gray have a physiologically beneficial action on participants.

Organismic contacts with electrical negative terminals only occurs with vocal utterance. Musically pulsed negative terminals magnify Vril viscero-eidetic transactions. The experience of musically modulated electric stresses through the body. Physiophony provides much more than audible sounds at the finger contacts. Vril eidetic transactions proceeds from upper space down; and bathes the participant in a column of glowing black radiance. This vision resolves into a night-time aerial view of one's immediate local beyond the walls. Aerial views of velvet black treetops are not uncommon. Eidetic experience experiences views limited to the local Vril channel.

ANTONIO MEUCCI

The actual remarkable ability of entraining organismic neurology to experience non-acoustic music and speech was the special realm of Antonio Meucci. Antonio Meucci was the true and original discoverer of physiophony in 1842.

Vril Conduction is something we must learn more about. It is definitely related to a group of phenomena discovered by Antonio Meucci in 1847; when dealing with contact communications. Sr.Meucci accidentally received a "nerve induction" signal through a long charged conductive wire which transmitted another man's voice. The transmitter was a simple copper tongue-depressor used in a medical "shock coil" setup.

In 1847, Antonio Meucci discovered that high voltage electrical conductors could be used to transmit audible sounds ... without microphones or diaphragms! His transmitter and receiver consisted of nothing more than 2 copper tongue-depressors and ground plates. Nevertheless with this arrangement (charged to a high potential) it was possible to clearly "hear" and speak across 80 feet of wire. These discoveries were made in Havana, Cuba; before Mr.and Mrs. Meucci emigrated to the United States.

Meucci's great discovery paves the way for viscero-eidetic (empathic) transmission systems. The Meucci caveat is the very first of its kind I have discovered in the scientific records. The means through which nerves can directly "speak" and "hear" is a Vrillic phenomenon. Meucci's later experiments in acoustic telephony predates Bell by some 15 years, and was an early victim of corporate-suppression.

Meucci discovered the reality of transmitting eidetic content and acoustic code (audible words) without batteries. Vril power in the ground was used by Meucci to transmit through great distances. Meucci discovered the transactive power of magnets when secured with grounded terminals. Meucci

employed batteries of magnets in place of electrolytic batteries. Rossetti and others also dispensed with batteries entirely.

There were those who developed systems for verbal transmission alone. These designs magnified the acoustic signal. Vril supplies viscero-eidetic content irregardless. Metals are eidetic radiators. Metals are potent eidetic radiators when grounded. Galvani measured eidetic radiances through both human and animal organisms. Metals held in the opened mouth emit eidetic radiances which may be felt. Meucci discovered the empathic potential of a charged wire. Meucci transmitted eidetic messages without the use of acoustic artifice.

The nerve force (shout) of the man was transmitted to Sr. Meucci 80 feet away in another room. Meucci felt the shout in his body. The minor observation of an acoustic effect near the electrode was developed into an acoustic telephone. Physiophony is the major discovery of Meucci.

Antonio Meucci discovered that empathic transmission and eidetic transactions could be obtained through iron wire lines. Meucci's true, sensitive, and original genius recognized the significance of such transaction. The true origin of physiophony and nerve-induction telephony point to Meucci as their inventor. Physiophony is the transmission of meaningful messages and eidetic experiences via nerve-induction.

Meucci re-designed his primary discovery into the world's first audio telephonic system; and operated this system continuously for more than 20 years before Bell. Meucci's models were the world's first acoustic telephones. He developed several other astounding inventions in quick succession. Visceral transactions include audible sounds. Meucci detected sounds in lines where none could have been.

Meucci was the one to discover that telephonic signals could be transacted over single lines with ground-terminated ends. He then discovered that it was possible to dispense with electrical power entirely when using specific designs employing fine copper bobbins would about lodestone. These discoveries were later duplicated by several other inventors.

In his effort to improve this design, Meucci developed what later became known as ferrites. His use of exceedingly fine iron oxides were mixed with other minerals and metals (manganese, carbon). These proved to powerfully increase the clarity and power of non-electrically transacted messages through great distances.

Meucci was the very first to suggest and experiment with the possibility of trans-oceanic communication wirelessly. His plan included conduction plates which transacted signals through sea water directly. Placed at specific stations, Meucci experimented with both single ocean-immersion plates and double immersed plate-transactors in these early proposals with success. Symmetries used involved opened and closed parallel plates of various metals (similar and dissimilar).

He was the very first to suggest that contact between the English and North American coast be attempted; there being no theoretical limit to signals which were impulsed through the conductive medium of sea water. Special geomantic regard was to be carefully taken when establishing the stations themselves. Launching the impulses out across the sea required geological precision.

The observation of dark Vril channels across the sea has been a subject of much curiosity since the days of Marconi (E.Dollard, T.Brown). Experiments have shown that zinc configurations (rods ensheathed by zinc wrappings) project excessively intense viscerally sensed collimated beams (abdominal) when water immersed. These configurations have actually released significant sensate heat-flux across a volume of space. This beam of viscerally sensed energy increased with increasing distance and became sharply collimated when salt was added to the water. The operation of Meucci's designs were Vril transactive. Vril transactivity determines the "electrical activity" of systems.

Meucci described experiments in which wireless undersea telephonic communications could be established. Experiments were described with this concept in mind. Divers were to be equipped with small aerial-electrodes. Similar correspondent aerial-electrodes were immersed at the sea-surface with resulting vocal exchange made possible.

Meucci described experiments which were designed to enable ocean-going vessels to detect and range distantly moving ships. This design was also made to enable sea-travellers the ability to discern shorelines. Sea communication between ships and shore were all described and demonstrated through conduction telephony.

Meucci was the very first to develop both empathic and acoustic telephony but in empathic telephony we find Meucci's greatest and most grand achievement. Tesla would later allude to these very developments.

Bell (working in the New York Telegraph Company) stumbled on the Meucci models which were given to the company for examination some years earlier. Meucci delivered these working models so that the Telegraph Exchange might develop them into an industry. The models were portions of model-series which Meucci had been continuously developing through the decades since his initial discovery of physiophony. In laying claim to his true and original discovery Antonio Meucci realized himself part of the company of discoverers which included Gray and Reis. Meucci recognized the entire significance of the court proceedings. He deliberated in order to irritate the paid court. Meucci calmly and dispassionately rode out his claim for the sake of the historical record, himself confident and sure that "the invention belongs to me...nothing can dissuade my knowledge of this fact". Examination of the proceedings reveals the outrageously mocking treatment of this "immigrant" by the court.

The all too frequent discovery and rediscovery of sense transmission through nerve induction was known from the time that Meucci discovered its principle of action in 1847. Others would follow along in pulse after pulse of similarly amazing such discoveries. All of these discoveries involved the instantaneous transfer of psychic energies (emotive and mental) across great distances. These frequently would involve the astoundingly simplistic artifice of "single-wire transmission".

The pattern which is observed in telephonic designs of Meucci, Rossetti, and Stubblefield involves the use of organic vocal energy to raiseVril thresholds. Organic energy is Vril energy. The human organism conducts and directs Vril through-

out its expressions of intent. Stimulating ground Vril with organically permuted Vril threads heightened sufficient energy to make startling communications. Vril was the energy which provided the powerful transfer of intent through great distances.

The absence of electrical power sources did not interfere with the powerful transmission of message and eidetic content despite great distances. In certain instances the bilocational experience, distant viewing, and empathic communion among conversants is effected through ground connections. These are not electrical phenomena. Such effects would later be investigated by later researchers (Tesla, Murgas, Shoemaker, Abrams, Drown, Hieronymus, Moray and others) when examining distant intelligence, diagnostics, and location. Bilocational rapport was one pre-eminent feature which numerous early wireless (crystal) researchers mentioned.

In several telephonic patents we see the use of isolated permanent magnets as Vril reactor sites. Dr.A.G.Bell found that permanent magnets and iron diaphragms did not provide powerful enough signal strength to transmit through even small distances with electrical power. Meucci discovered that lodestones and special ferruginous powders of exceeding fineness could produce telephonic transmissions of exceptional clarity in absence of power sources twenty years before Bell. The nature of the ground connection was the key toward rediscovering Vril Technology.

Clarity of signal requires presence of eidetic content. Several of these devices gave reportedly better response to code (acoustics). Others gave better response to eidetic content. Acoustical signals represent eidetic emanations. Human speech is eidetic undulation. The detrital products of such expression is measured as pressure waves. Code without eidetic content is not communication.

Telephonic devices responded to eidetic presence and eidetic undulations. The mere presence of a sentient organism causes these to respond. One "knows" that someone is "on the other end" in the utter absence of sound. Speech and human expression is a Vril phenomenon. Telephone receivers mediate several orders of eidetic interaction and transmit eidetic intent. Telephone receivers and transmitters conduct Vril continually.

Vril maintains conductive communion with sensitives through telephone lines in absence of human use. Vril empowers these superior eidetic transmitters in providing access to recipients. Other researchers had (falteringly) taken the challenge of developing Vril Communication Technology for eidetic transmission. These doorways yet remain wide and opened for you to seek out. The Bell Telephone Company absolutely vilified Mr.Meucci, Mr.Gray, and Mr.Reis for their startling claims of prior discovery. Mr.Meucci (an immigrant) held a prior caveat (1871) to the acoustic telephone; though having actually employed the use of both forms (nerve and acoustic) for conversations between himself and his ailing wife at least a decade before this date.

Through the use of legislative manipulation, bureaucratic stone-walling, and financial momentum, these true and noble pioneers were systematically eliminated from the public record.

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Special materials permit differentiation, conductive passage, and experiential translation into Vril Eidetics. Vril threads enter synapses of ganglial centres in organisms directly. The Vril sensory system is the primary sensory mode of the human organism. Intuitions and visions are received directly into the Vril sensory system. Vril connectivity extends experience and consciousness into the external and permeating Vril-ganglia of the universe. These are found distributed throughout the universe. One may connect with local Vril ganglia among the rocks and woods of near regions. One may interconnect despite the seemingly vast distances of physical space. Vril Eidetics remove experiential dimensions of distance.

Code and eidetic content are two separate entities. telegraphy makes extensive use of code. Telegraphic systems were empirically developed to maintain the comprehensive flow of eidetic content despite the reliance on impulses. Telegraphy is an unnatural form of communication. Telegraphy is a case study for discerning differences between code (signal) and eidetic content.

The true purpose and function of every Vril Technological component is to transmit modified consciousness in human operators. Vril Science studies Vril and its potentials in order to collate knowledge of Vril reactivities.

The pattern which is observed in telephonic designs of Meucci, Rossetti, and Stubblefield involves the use of organic vocal energy to raiseVril thresholds. Organic energy is Vril energy. The human organism conducts and directs Vril throughout its expressions of intent. Stimulating ground Vril with organically permuted Vril threads heightened sufficient energy to make startling communications. Vril was the energy which provided the powerful transfer of intent through great distances.

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Meucci developed the art of creating excessively powerful auric transactors with magnetic powders of extreme fineness. Meucci discovered that the addition of other material powders could increase the magnetic density of lodestone. Meucci developed and experimented with wireless undersea communications. Meucci was the very first to suggest that wireless sea communications be established between Europe and America. Meucci describes experiments which tested his sea-ranging and detection apparatus on behalf of distant ocean-going vessels.

His importance cannot be under-rated. His achievements can never be ignored. Antonio Meucci stands a giant in the world of invention and discovery. The kind eyes and gentle manner speak to us a world of restful and quiet dignity.

SECTION 1

COMMENTARY

SECTION 2

VRIL CONNECTION

2 Sheets--Sheet 1.

E. GRAY.

Electric Telegraph for Transmitting Musical Tones.

No. 166,096. Patented July 27, 1875.

Fig. 1

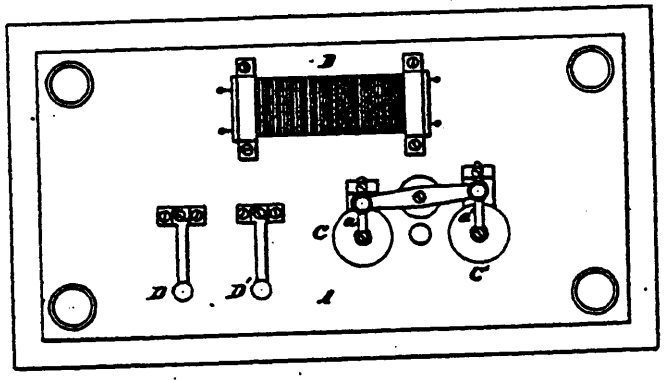
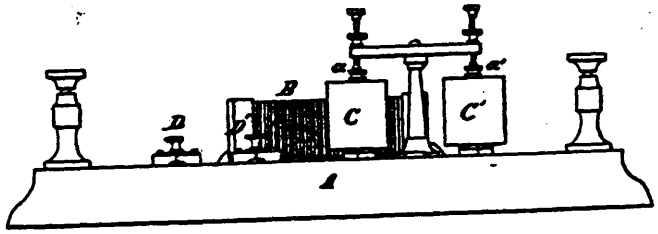


Fig. 2



WITNESSES

F. F. Warner.
N. C. Linsley

INVENTOR

Elisha Gray

2 Sheets--Sheet 2.

E. GRAY.

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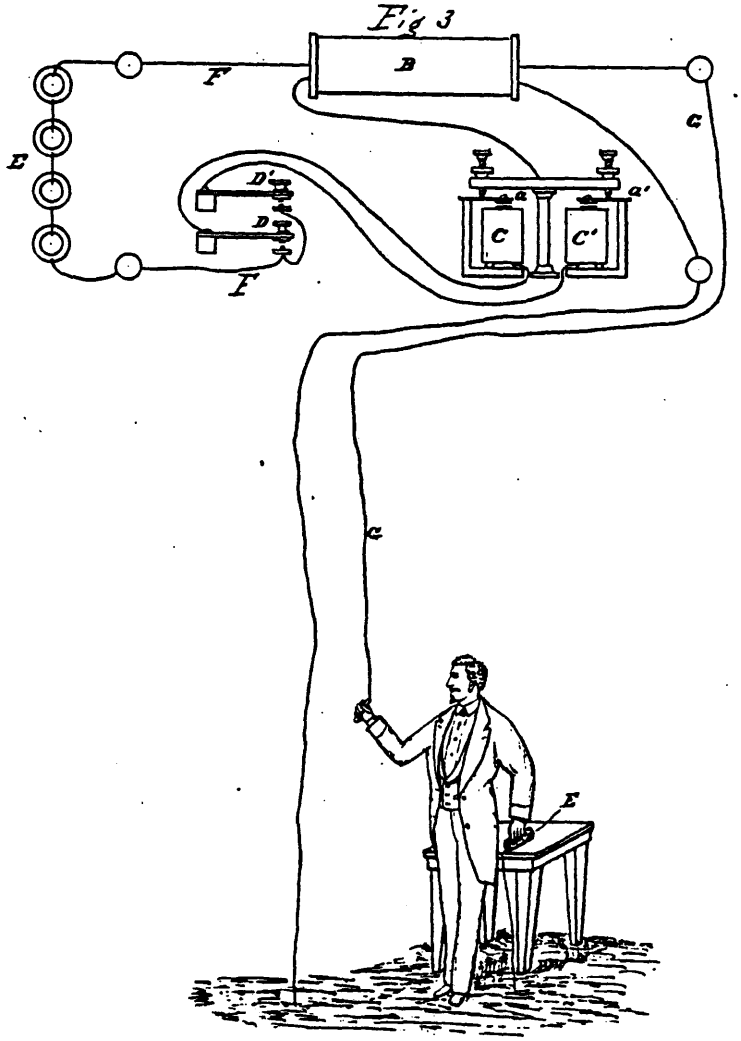
No. 166,096. Patented July 27, 1875.

Fig 3



WITNESSES

F. F. Warner
N. C. Findley

INVENTOR

Elisha Gray

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF HIS RIGHT TO SAMUEL S. WHITE, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN ELECTRIC TELEGRAPHS FOR TRANSMITTING MUSICAL TONES.

Specification forming part of Letters Patent No. **166,096**, dated July 27, 1875; application filed January 19, 1875.

CASE 1.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Art of Transmitting Musical Impressions or Sounds Telegraphically, as well as certain new and useful Improvements on Apparatus for so Transmitting such Impressions or Sounds; of which art and apparatus I hereby declare the following to be a full, clear, and exact description.

My invention relates to a novel art of transmitting musical impressions or sounds telegraphically; which impressions or sounds may be utilized as signals for the transmission of intelligence.

My invention is based upon the well-known law of acoustics that bodies vibrating with different rapidity produce tones of different pitch; and upon my own discovery that such vibrations can be transmitted through a telegraphic circuit and reproduced in a musical tone or note of a pitch corresponding with that originally transmitted, by including in the circuit animal tissue or other equivalent substance, which will cause a slight resistance to the electrical current at the point of contact between such animal tissue and some resonant conductor of electricity.

My improvement consists in a new and useful art of producing musical impressions or sounds at the transmitting end of a telegraphic circuit, by causing interruptions in the electric currents of sufficient frequency to produce musical tones, transmitting said tones through an electric circuit composed in part of animal tissue, and reproducing them at the receiving end of the line by means of a resonant body, which is also a conductor of electricity.

My improvement further consists in a new and useful apparatus for carrying out the objects of my invention; which apparatus consists of the combination of a telegraphic circuit, composed in part of animal tissue; a circuit-breaker capable of producing a musical tone; and a receiver capable of reproducing that tone at the receiving end of the circuit.

My improvement further consists of the combination, in an apparatus such as described, of a series of circuit-breakers capable of producing musical tones of different pitch, and a series of keys for simultaneously or successively throwing the circuit-breakers into or out of operation, whereby several tones simultaneously or successively may be transmitted through a single wire.

The subject-matter claimed will hereinafter specifically be designated.

In the accompanying drawings, Figure 1 represents a plan or top view of a portion of the transmitting apparatus. Fig. 2 is a front elevation of the same, and Fig. 3 a diagram, showing an arrangement of parts and circuits which advantageously may be employed in working my invention.

The transmitting apparatus is mounted, as usual, upon a base-board, A. An induction-coil, B, is provided with primary and secondary helices of the usual construction. A common vibrating electrotome, C, having its circuit-breaking spring *a* of such length, thickness, and adjustment that its vibration produces a musical tone of a certain pitch, forms part of the circuit.

It is obvious that the apparatus may be worked with a single electrotome, the pitch of which may be varied by adjustment; but where a series of tones of different pitch is desired, I prefer to employ a series of electrotomes having different rates of vibration.

Two electrotomes, C C′, of identical construction but differing in pitch, are shown in the drawings, but I propose, under some circumstances, to use a series of electrotomes which will give tones extending through one or more octaves. These electrotomes are, by preference, placed in the primary circuit of the induction-coil, and, when in operation, induce secondary currents or impulses in the secondary circuit of said coil equal in number to the vibrations of the circuit-breaking spring of the electrotome.

An ordinary telegraph-key situated in the primary circuit opens or closes the connections of the battery. Each electrotome must have a corresponding key. In the drawings, two keys, D D′, are shown, both of which, as well

as the electrotomes, are situated in the primary circuit, which is divided or branched in order to pass through them.

Fig. 3 shows the arrangement of the circuits. The primary circuit F connected with the battery E passes through the keyes D D′, the magnets of the electrotomes, and the primary circuit of the induction-coil B. One terminal of the secondary circuit G extends from the induction-coil to the receiving-station through animal tissue to a suitable resonant conductor of electricity, which is, in this case, a hollow metallic cylinder, H, which is connected with the ground; the other terminal, I, of the induction-coil passes directly to the ground in the ordinary way.

The animal tissue interposed between the wire and the resounding receiver to complete the circuit is shown in the drawings as consisting of the body of the receiving operator, who must be insulated from the ground; but other substances may be employed which must possess the specific characteristics of being conductors of electricity; of being yielding and elastic; and of having a surface of greater electric resisting capacity than its interior.

These characteristices are found in the skin of the human body; in leather moistened with acidulated water; in animal flesh covered with a membraneous coating; in bacon-rind; in pork-skin, especially pieces taken from the ear or tail; in kid gloves; and in other substances which need not be enumerated, as they do not operate so perfectly as those above given.

The operation of the apparatus is as follows: The closing of either of the keys completes the primary circuit from the battery through the electrotome connected with the key depressed, and the circuit-closing spring of said electrotome will immediately be thrown into rapid vibration, and a musical tone of a certain pitch dependent upon the length, thickness, and adjustment of the spring will be given forth, while at each vibration the current in the primary circuit of the induction apparatus will be interrupted. These interruptions produce corresponding secondary currents or impulses in the secondary circuit of the induction apparatus, and these secondary induced currents or impulses are transmitted to the receiving-station. Thus, for example, if the circuit-breaking spring of the electrotome vibrates one hundred and twenty-eight times per second, the tone given forth is that known as the "fundamental C," while one hundred and twenty-eight terminal secondary currents or impulses will be induced in the secondary circuit of the induction apparatus, and transmitted through the animal tissue above mentioned, forming part of said circuit, to the resonant receiver, and will, from some cause not understood or explicable in the present stage of the art, vibrate the same synchronously with the transmitting-electrotome, and thus give forth a musical tone of the same pitch.

A metallic plate stretched by metallic strings above a sounding-board, such, for instance, as the body of an ordinary violin, may be used with good effect to receive the vibrations, instead of the hollow cylinder above described.

From the foregoing description it will be seen that musical tones produced at the transmitting-station can simultaneously be produced at the receiving station however distant. When two or more keys are simultaneously or successively depressed, corresponding tones will simultaneously be transmitted, thus producing harmony or melody.

The interruptions in the primary circuit, which cause the induced secondary currents or impulses, may be produced by a mechanical circuit-breaker having the requisite rapidity of motion, such as a revolving wheel or revolving brush; or they may be produced by providing the vibrating reed or reeds of an organ with contact-points, so that, as the reed vibrates, it will transmit impulses corresponding in number per second to the number of vibrations per second of the notes sounded by the organ-pipe.

I prefer to use the impulses of the induced secondary currents as the transmitting medium, as such use affords the most convenient way of obtaining electricity of high tension, which is that best adapted for penetrating a slightly-resisting medium, such as the animal tissue hereinbefore mentioned.

The secondary coil is not essential, as the secondary circuit induced in the primary coil may be utilized for transmitting the signals.

My improvement enables me to operate with a very slight amount of current, as the battery power required to produce and transmit the vibrations is less than one-hundredth part of the battery power now required to transmit signals over long land-lines.

My improved method can advantageously be substituted for the Morse telegraph-alphabet now in general use, as an alphabet can be constructed on the principle of using tones of different pitch for the different letters, which will admit of great rapidity of transmission.

By means of my improved apparatus not only may a tune be transmitted by a single operator to a distant point, but the different parts of such tune simultaneously may be reproduced at a common point from different places, a separate part of the tune being played at each place.

The apparatus can also advantageously be employed in studying acoustics and the physical theory of music.

The combination, with a main line, of an intermittent circuit-breaker, or a series thereof, each adapted to throw upon the line a definite number of electrical impulses per unit of time, and a key or keys, one for, and controlling, each such circuit-breaker, are not broadly claimed herein, as they constitute a part of the subject-matter of another application for Letters Patent of the United States, filed by me February 23, 1875.

I claim as my invention—

1. The hereinbefore-described art of transmitting musical impressions or sounds telegraphically, by producing musical impressions or sounds at the transmitting end of a telegraphic circuit by causing interruptions in the electric currents of sufficient frequency to produce musical tones, transmitting said tones through an electric circuit composed in part of animal tissue, and reproducing them at the receiving end of the line by means of a resonant body, which is also a conductor of electricity, substantially as set forth.

2. The electro-harmonic telegraph apparatus, hereinbefore set forth, consisting of the combination of a telegraph-circuit, composed in part of animal tissue, a circuit-breaker capable of producing a musical tone, and a resonant conductor of electricity capable of reproducing that tone at the receiving end of the circuit.

3. The combination, substantially as hereinbefore set forth, of a telegraphic circuit composed in part of animal tissue, a resonant receiver, which is also a conductor of electricity, a series of circuit-breakers capable of producing musical tones of different pitch, and a corresponding series of keys for throwing the circuit-breakers into or out of operation, whereby several tones simultaneously may be transmitted through a single wire.

ELISHA GRAY.

Witnesses:
WM. J. PEYTON,
E. C. DAVIDSON.

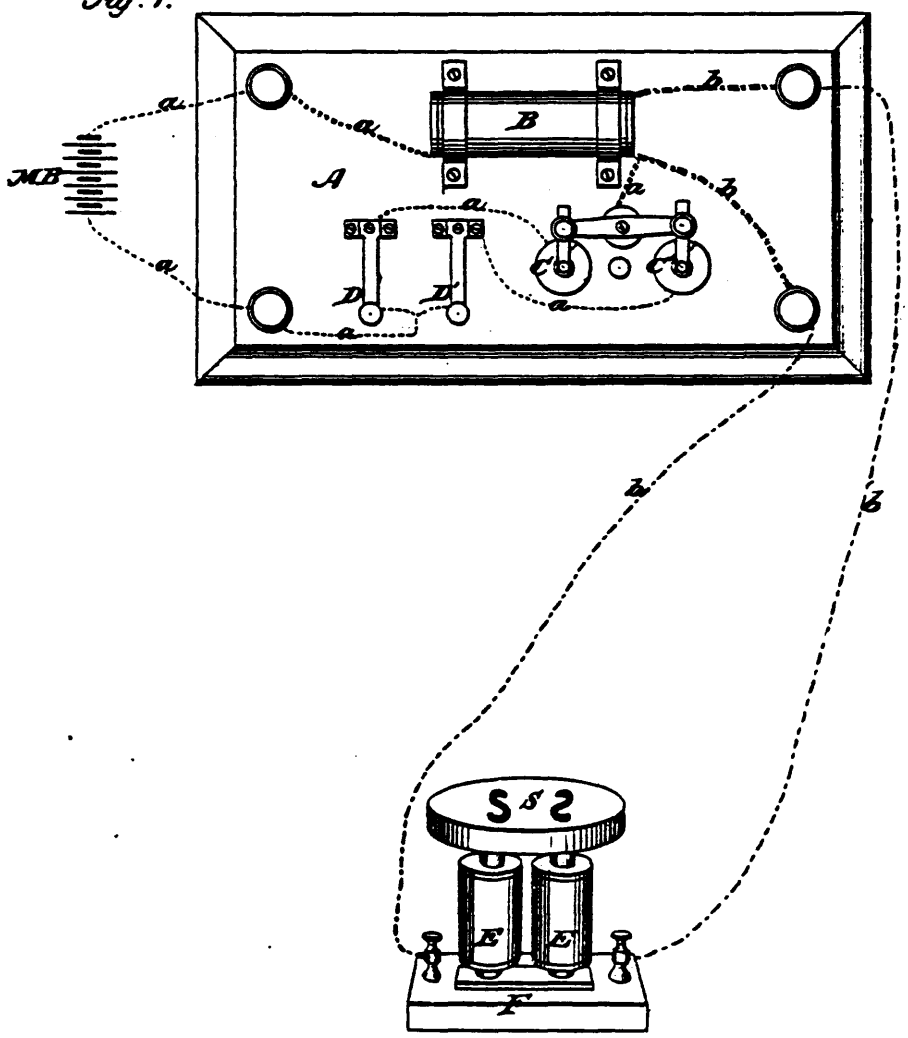
2 Sheets--Sheet 1.

E. GRAY.

Electric Telegraph for Transmitting Musical Tones.

No. 166,095. Patented July 27, 1875.

Fig. 1.



Witnesses.
C. F. Brown.
Everett Hick

Inventor.
Elisha Gray
by his attorney,
A. L. Hayes

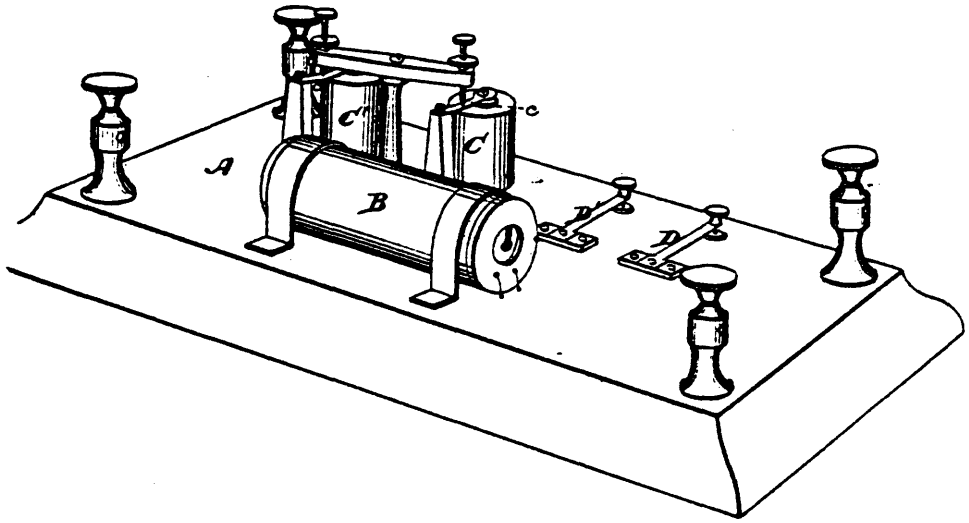
2 Sheets--Sheet 2.

E. GRAY.

Electric Telegraph for Transmitting Musical Tones.

No. 166,095. Patented July 27, 1875.

Fig. 2.



Witnesses.
C. H. Brown
Emil A. Hiek

Inventor.
Elisha Gray
by his attorney
A. L. Hayes

UNITED STATES PATENT OFFICE

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN ELECTRIC TELEGRAPHS FOR TRANSMITTING MUSICAL TONES.

Specification forming part of Letters Patent No. **166,095**, dated July 27, 1875; application filed January 19, 1875.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Apparatus for Transmitting Musical Impressions or Sounds Telegraphically, of which I hereby declare the following to be a full, clear, and exact description:

My invention relates to what I term an "electro-harmonic telegraph," and is based upon the fact well known to electricians that an electro-magnet elongates under the action of the electric current, and contracts again when the current ceases. Consequently a succession of impulses or interruptions will cause the magnet to vibrate, and if these vibrations be of sufficient frequency a musical tone will be produced, the pitch of which will depend upon the rapidity of the vibrations.

I have discovered that by interrupting an electric current at the transmitting end of a line with sufficient frequency to produce a musical tone by an instrument vibrated by said interruptions, and transmitting the impulses thus induced to an electro-magnet at the receiving end of the line, the latter will vibrate synchronously with the transmitting-instrument, and thus produce a musical tone or note of a corresponding pitch. The object of my invention is to utilize this discovery for the transmission of intelligible signals to a distance by electricity; to which end my improvement consists in the combination of a telegraphic circuit, a series of circuit-breakers capable of producing musical tones of different pitch, a series of keys for simultaneously or successively throwing said circuit-breakers into or out of operation, and an electro-magnet receiver, which is thrown into operation by the transmitter, whereby tones of different pitch may be reproduced at the receiving end of the line by the use of a single circuit.

In the accompanying drawings, Figure 1 shows a plan view of the transmitting part of my improved apparatus, the receiver appearing in perspective. Fig. 2 is a view, in perspective, of the transmitter.

The transmitting apparatus is mounted upon a base-board, A, as usual. The induction-coil B has the usual primary and secondary circuits. An ordinary automatic electrotome, C, has a circuit-closing spring, *c*, so adjusted as, when in action, to produce a musical tone according to its length, thickness, and adjustment. A common telegraph-key, D, is placed in the primary circuit to make or break the battery-connection. In the drawings I have shown two electrotomes of identical construction, but of different pitch, and two keys, both the keys and electrotomes being placed in the primary circuit, which is so divided that part of the circuit passes through each key and its corresponding electrotome. The number of electrotomes may be increased, so that tones extending through two or more octaves may be produced. An ordinary electro-magnet is provided at the receiving end of the line.

The operation of the apparatus is as follows: In the arrangement shown in the drawings when a key is closed the primary circuit will pass from the battery H through that key and its corresponding electrotome, and will be automatically interrupted in the usual manner. The spring of the electrotome will thus be caused to vibrate rapidly and to produce a tone, the pitch of which is determined by the rate of vibration. It is obvious that several keys may be depressed simultaneously. These vibrations or interruptions of the current will simultaneously produce in the secondary circuit of the induction-coil a series of induced currents or impulses corresponding in number with the vibrations of the electrotome, and as the receiving electro-magnet is connected with this circuit it will be caused to vibrate, thus producing a tone of corresponding pitch, the sound of which may be intensified by the use of a hollow cylinder, S, of metal, placed on the poles of the magnet.

When a single electrotome is thrown into action, its corresponding tone will be reproduced on the sounder by the magnet. When electrotomes of different pitch are successively operated, their tones will be correspondingly reproduced by the receiver, and when two or more electrotomes are simultaneously sounded the tone of each will still be reproduced without confusion on the sounder, by which means I am enabled to reproduce melodies or tunes.

Mechanical circuit-breakers might be substituted for the automatic vibrating electrotome, hereinbefore described, and I have, in

fact, used such mechanical circuit-breakers of various construction; but I found the electro-tome more satisfactory in practice.

In this instance the receiver is shown and described as operated by the induced current of the secondary coil; but the secondary or extra current of a primary coil may be used instead thereof with good effect.

My apparatus is specially adapted to telegraphing on long land and submarine lines. By it letters and signals can be represented by tones differing in pitch; or the ordinary Morse signals can be made by short and long interruptions in a prolonged tone of the same pitch, thus securing great rapidity of transmission.

An application for Letters Patent of the United States, filed by me April 18, 1874, shows an apparatus somewhat similar to the one herein described, for transmitting musical tones through animal tissue to a resonant electrical receiver. I do not, therefore, claim herein anything therein shown. Neither do I claim herein the combination, with a main line, of an intermittent circuit-breaker, or a series thereof, each adapted to throw upon the line a definite number of electrical impulses per unit of time, and a key or keys, one for and controlling each such circuit-breaker, as it constitutes the subject-matter of another application filed by me February 23, 1875. The combination of a telegraphic circuit, an automatic circuit-breaker capable of producing a musical tone, and an electro-magnet receiver which reproduces the tone by being thrown into vibration by impulses generated by the circuit-breaker, is not, broadly, claimed herein, as this combination constitutes a part of the subject-matter of said application, also.

I claim as my own invention—

The combination of a telegraphic circuit, a series of circuit-breakers capable of producing musical tones of different pitch, a series of keys for simultaneously or successively throwing said circuit-breakers into or out of operation, and an electro-magnet receiver, which is thrown into operation by the transmitters, whereby tones of different pitch may be reproduced at the receiving end of the line by the employment of a single circuit.

ELISHA GRAY.

Witnesses:
E. C. DAVIDSON,
WM. J. PEYTON.

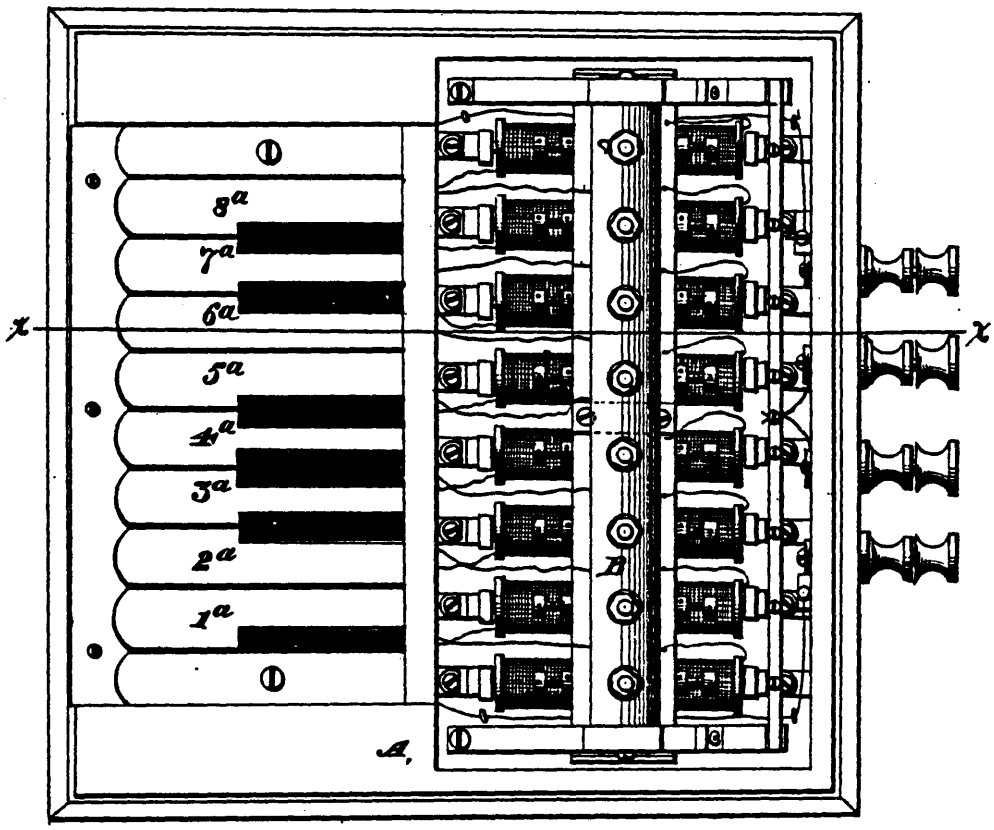
3 Sheets—Sheet 1

E. GRAY.

ELECTRO-HARMONIC TELEGRAPH.

No. 173,618. Patented Feb. 15, 1876.

Fig. 1.



WITNESSES.

Wm. J. Payton.

F. Stich

Elisha Gray INVENTOR

By his Attorney

W. D. Baldwin

3 Sheets—Sheet 2.

E. GRAY.

ELECTRO-HARMONIC TELEGRAPH.

No. 173,618. Patented Feb. 15, 1876.

Fig. 2

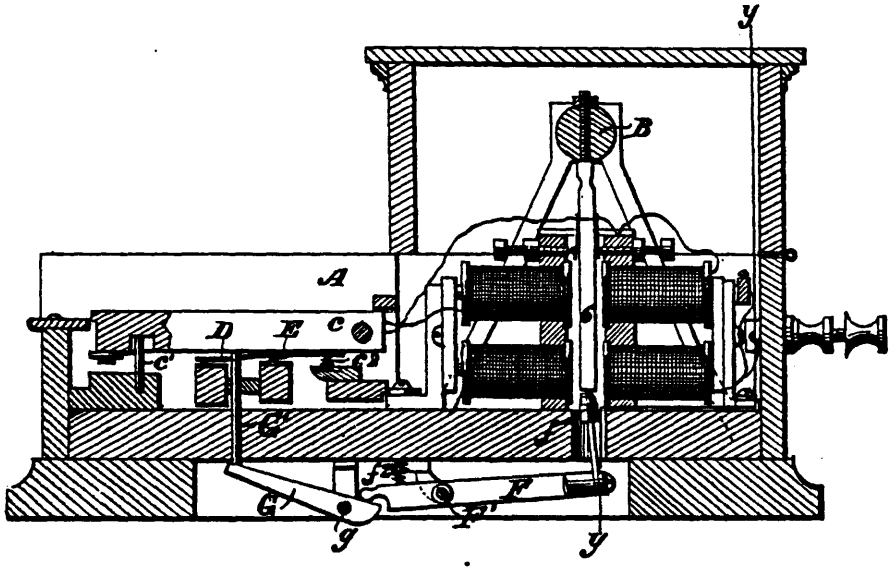
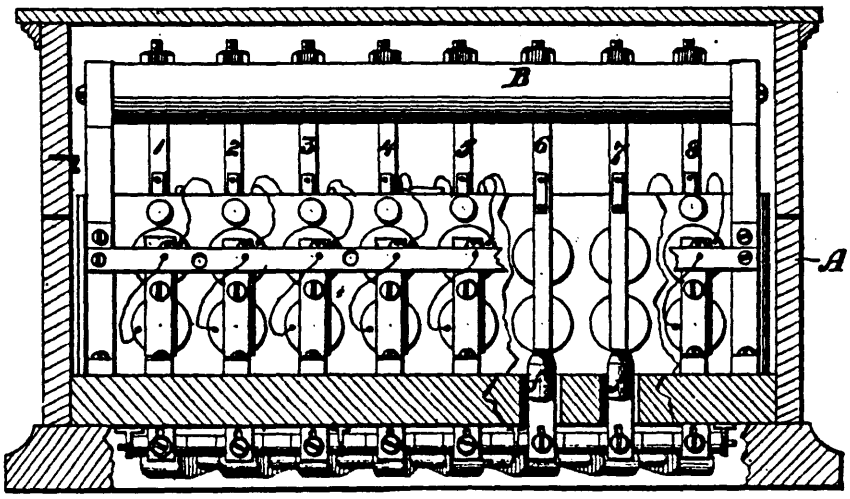


Fig. 3.



WITNESSES

Wm. J. Peyton.

F. Stich

Elisha Gray INVENTOR

By his Attorney

Wm. D. Baldwin.

3 Sheets—Sheet 3.

E. GRAY.

ELECTRO-HARMONIC TELEGRAPH.

No. 173,618. Patented Feb. 15, 1876.

Fig. 4.

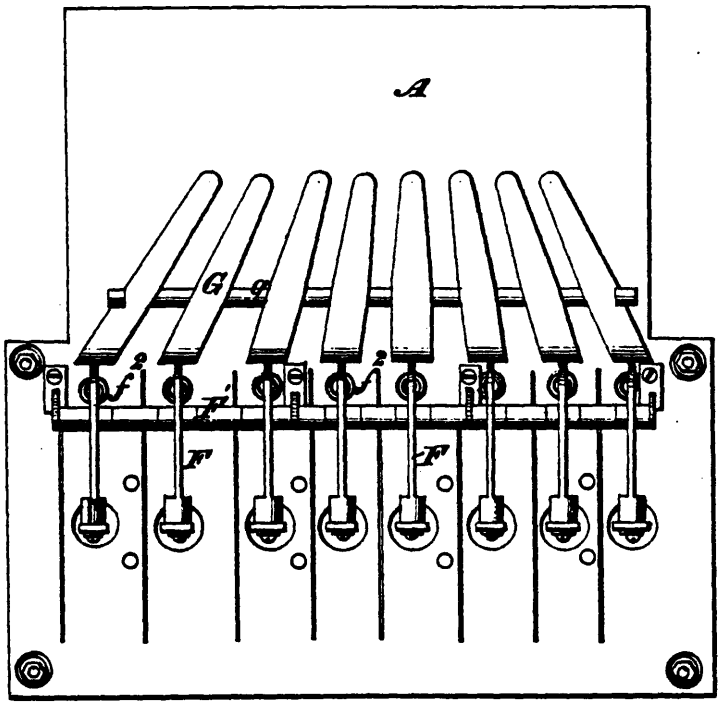


Fig. 5.

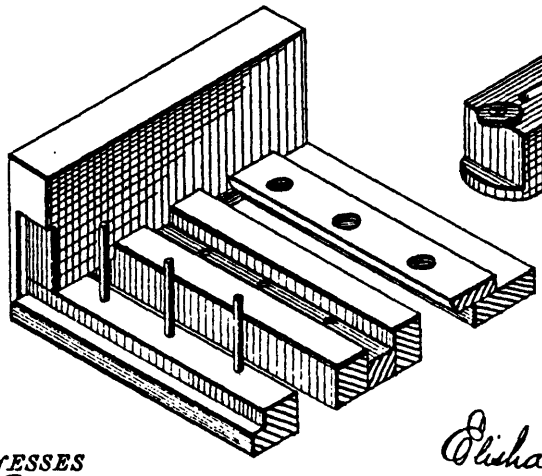
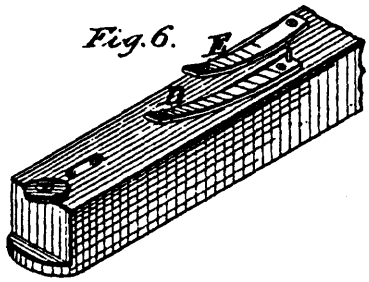


Fig. 6.



WITNESSES

Wm. J. Payton

F. Fish

Elisha Gray INVENTOR

By Wm. D. Baldwin

his Attorney

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN ELECTRO-HARMONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **173,618**, dated February 15, 1876; application filed January 27, 1876.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook, and State of Illinois, have invented a new and useful Art of Producing Musical Impressions or Sounds and Transmitting said Sounds Telegraphically, as well as improved apparatus for so transmitting said sounds, of which the following is a specification:

In Letters Patent of the United States granted me July 27, 1875, and numbered, respectively, 166,095 and 166,096, I have shown and described methods of transmitting musical impressions or sounds telegraphically.

My present invention relates to means whereby tunes may be played by a single operator, and reproduced, if desired, at a distant station by apparatus described in the patents above mentioned, or in other ways, for which applications for Letters Patent filed by me and now pending.

My invention primarily consists in a novel art of producing musical impressions or sounds by means of a series of properly-tuned vibrating reeds or bars thrown into action by means of a series of keys opening or closing electric circuits. It also consists in a novel art of transmitting tunes so produced through an electric circuit and reproducing them at the receiving end of the line. My improvements further consist in novel apparatus for the production and transmission of such tunes. The subject-matter claimed will hereinafter specifically be designated.

In the accompanying drawings Figure 1 shows a plan or top view of so much only of my improved apparatus as is necessary to illustrate the subject matter herein claimed; Fig. 2, a vertical transverse section therethrough on the line *x x* of Fig. 1; Fig. 3, a vertical transverse section therethrough on the line *y y* of Fig. 2; Fig. 4, a bottom-plan view of the instrument; and, Figs. 5 and 6 represent views in perspective of certain details of the mechanism.

The drawings show an electrical organ of a single octave embodying my improvements in the best way now known to me; obviously, however, the number of the keys may be increased, and the details of construction of the instrument may be varied in many well-known ways without departing from the principle of my invention.

The mechanism is shown as inclosed in a box or frame A. A series of vibrating reeds or electrotomes, 1, 2, 3, 4, 5, 6, 7, 8, each tuned to produce a note of different pitch, is shown as mounted in a bar, B, secured upon a stout frame.

The method of constructing and operating these reeds is fully shown and described in Letters Patent No. 165,728, granted to me July 20, 1875, and need not, therefore, be recapitulated here. Each vibrating reed forms part of an electric circuit which is opened and closed by its respective key 1^a, 2^a, 3^a, 4^a, 5^a, 6^a, 7^a, 8^a, which takes the place of an ordinary Morse key. Each key works on a pivot *c*, (see Fig. 2,) and has a guide-pin, c^1, to keep it steady. A spiral spring, c^2, holds the key up and keeps the circuits normally open. When a key is depressed, both the main and local circuits are closed by springs, D E, on the under side of the key, which form part of the circuit. The keys are in other respects like those of an ordinary melodeon.

To counteract the tendency of one reed to be thrown into sympathetic vibration by another when sounded, I mount a series of stops, *f*, each on its respective lever F, rocking on a pivot F′, and provided with a spring, f^2, by which each stop is normally pressed against the end of its vibrating reed after the manner of the dampers of a piano. The stop is withdrawn from the reed whenever its key is depressed, by means of a lever, G, rocking on a fulcrum, *g*, and actuated by a pin, G′, on the key. The vibration of the reed is thus instantly stopped as its circuit opens, and is promptly released the moment before the circuit closes to throw it into action again. The method of running the main and local circuits in this instance is similar to that shown in my patent No. 165,728, above mentioned.

By the mechanism above described, the operator is enabled to play any desired tune, which will be audible at the spot where played and which may be reproduced audibly at a distant station by means of the mechanism described in the Letters Patent of July 27, 1875, hereinbefore mentioned, as well as by other mechanism which forms the subject-

matter of applications for Letters Patent filed by me February 23, 1875, and January 8, 1876.

I claim as my invention—

1. The improvement in the art of producing musical impressions or sounds telegraphically, hereinbefore set forth, which consists in controlling a series of automatically and electrically vibrated reeds, producing tones of different pitch, by a series of keys arranged organ-fashion and adapted for manipulation by a single operator.

2. The improvement in the art of producing and transmitting tunes telegraphically, which consists in controlling a series of automatically and electrically vibrated reeds, producing tones of different pitch, by a series of keys arranged organ-fashion and adapted for manipulation by a single operator, transmitting the tune thus produced through an electric circuit and reproducing it at the receiving end of the line, substantially in the manner described.

3. The combination, substantially as hereinbefore set forth, of a series of electrically-vibrated reeds and a corresponding series of keys for controlling them, arranged organ-fashion and adapted for manipulation by a single operator.

4. The combination, substantially as hereinbefore set forth, of the vibrating reeds, the keys, and the stops actuated by the keys to control the reeds.

5. The combination, substantially as hereinbefore set forth, of an electrical organ, an electric circuit, and a receiver in said circuit which reproduces the tune played by the organ.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:
E. C. DAVIDSON,
H. T. EARNEST.

E. GRAY.

AUTOMATIC CIRCUIT-BREAKERS FOR ELECTRO-HARMONIC TELEGRAPHS.

No. 173,460. Patented Feb. 15, 1876.

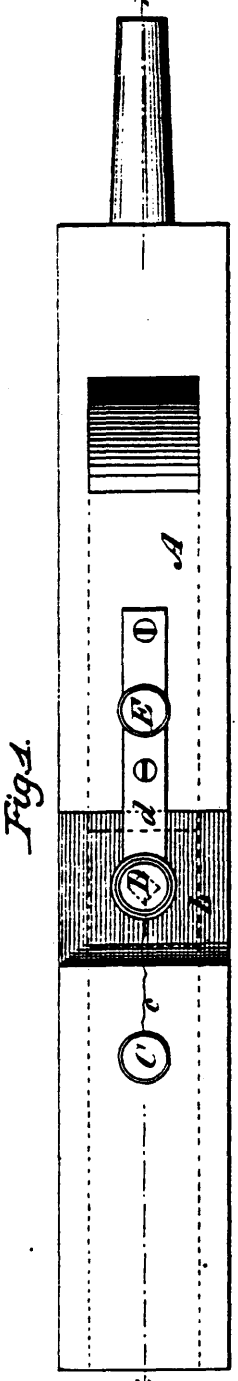


Fig. 1.

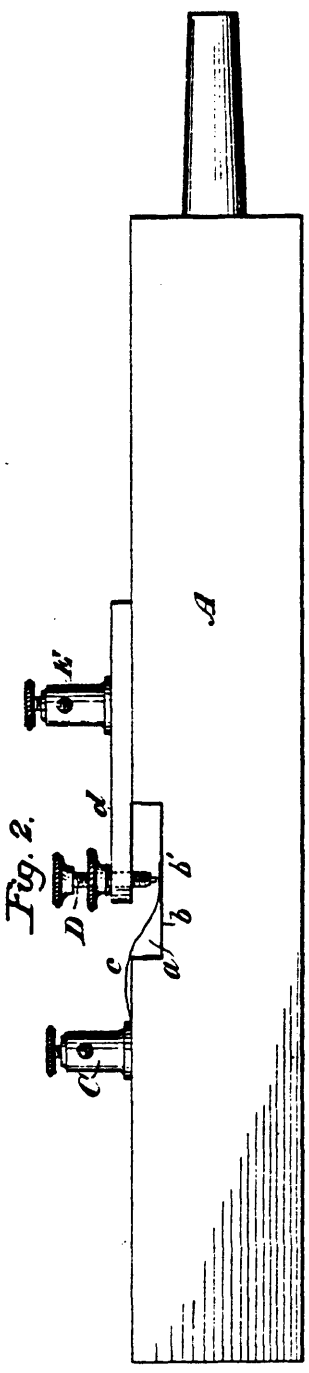


Fig. 2.

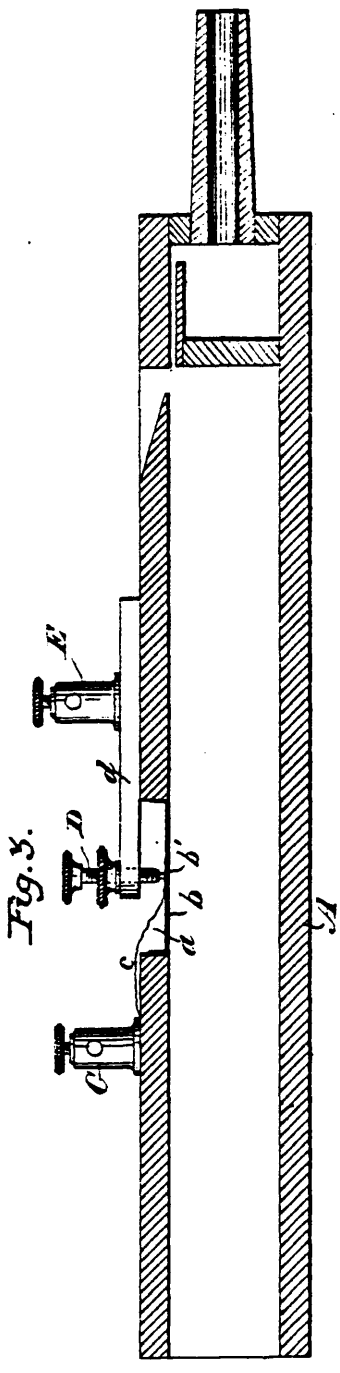


Fig. 3.

Witnesses
Baltis & Long
F. Laib

Inventor:
ELISHA GRAY

BY HIS ATTORNEY
W. D. Baldwin

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN AUTOMATIC CIRCUIT-BREAKERS FOR ELECTRO-HARMONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **173,460**, dated February 15, 1876; application filed January 8, 1876.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Automatic Circuit-Breakers for Electro-Harmonic Telegraphs, of which the following is a specification:

My invention relates to electro-harmonic telegraphs of the class secured to me by Letters Patent of the United States numbered, respectively, 176,095 and 166,096, granted July 27, 1875. Its object is to produce a simple and effective circuit-breaker vibrating automatically with sufficient rapidity to produce a musical tone of a given pitch, the electrical impulses thus generated being transmitted through an electric circuit, and reproduced at the other end of the line, as set forth in my patents above mentioned; to which end my improvement consists in combining with an organ, or other wind-pipe, a diaphragm vibrated by sounding said pipe, and an electric circuit connected with said diaphragm so as to be opened and closed by its vibrations.

In the accompanying drawings, which exemplify one of the best ways now known to me of carrying out the objects of my invention, Figure 1 represents a plan view of my improved apparatus; Fig. 2, a side view; and Fig. 3, a longitudinal vertical section therethrough on the line *x x* of Fig. 1.

An organ-pipe, A, is shown as made with an opening, *a*, in its side, over which a membranous diaphragm, *b*, is stretched. One wire of the circuit is connected with a binding-post, C, from which a wire, *c*, leads to a platina point, *b'*, on the diaphragm underneath a set-screw, D, mounted on a bar or frame, *d*, connected with a binding-post, E, to which the other wire of the circuit is attached.

When the column of air in the pipe is vibrated by sounding the pipe the diaphragm will vibrate correspondingly with the musical tone thus produced, and open and close the circuit accordingly, thus transmitting the vibrations to the receiving instrument for utilization, as mentioned in my patents before referred to.

Obviously the vibrations of several pipes giving notes of different pitch may be simultaneously transmitted through a single wire by suitable mechanism.

I claim

The combination, substantially as hereinbefore set forth, of an organ-pipe, a membranous diaphragm vibrated by sounding said pipe, and an electric circuit opened and closed by said vibrations.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:

ENOS M. BARTON,

GEO. H. BLISS.

2 Sheets—Sheet 1.

E. GRAY.

TELEPHONIC TELEGRAPH APPARATUS.

No. 175,971. Patented April 11, 1876.

Fig 1.

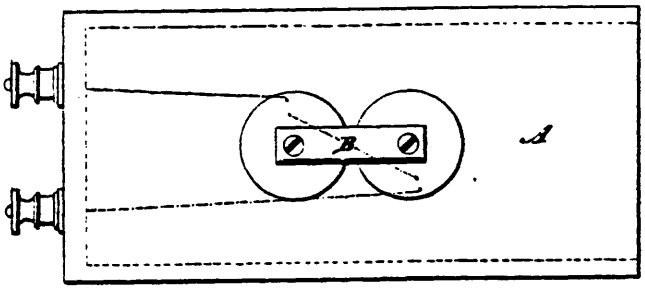
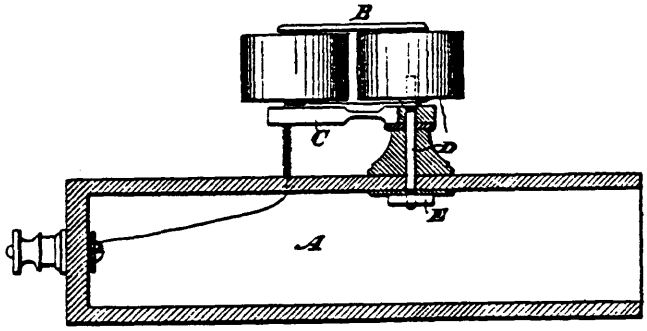


Fig 2.



WITNESSES

Wm A Skinkle
J. Stitt

By his Attorney

INVENTOR

Elisha Gray.
Wm D. Baldwin

2 Sheets—Sheet 2.

E. GRAY.

TELEPHONIC TELEGRAPH APPARATUS.

No. 175,971. Patented April 11, 1876.

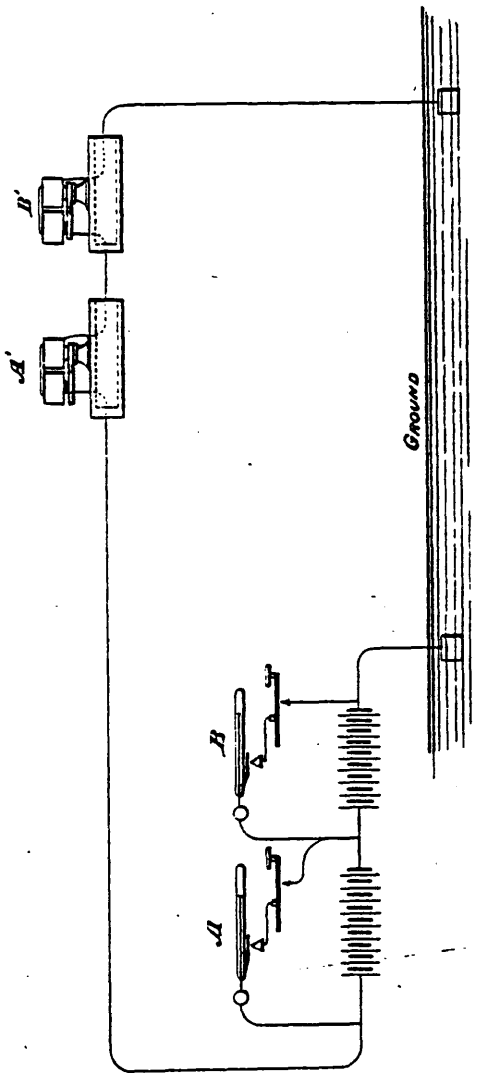


Fig 3.

WITNESSES

Wm A Stanley

Baltus De Long.

By his Attorney

INVENTOR

Elisha Gray

Wm. Baldwin

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN TELEPHONIC TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **175,971**, dated April 11, 1876; application filed January 8, 1876.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in the Art of Transmitting Musical Sounds Telegraphically, as well as certain new and useful improvements on apparatus for so transmitting such sounds, of which art and apparatus the following is a specification:

My invention relates to electro harmonic telegraphs of the class shown and described in Letters Patent of the United States granted to me July 27, 1875, and respectively numbered 166,095 and 166,096, and in an application for Letters Patent filed by me February 23, 1875.

The object of my invention is to dispense with local batteries and sounders, and all adjustment at the receiving end of the line, which end I attain by means of an apparatus which analyzes composite tones transmitted electrically through a wire, whereby the operator is enabled to read directly from the tone transmitted.

The subject-matter claimed hereinafter specifically will be designated.

In the accompanying drawings, which show so much of my improved apparatus as is necessary to illustrate the invention herein claimed, Figure 1 is a plan or top view, and Fig. 2 a side elevation, partly in section, of one of my improved sounders or receivers. Fig. 3 is a diagram, showing my improved transmitting and receiving apparatus as adapted to the transmission of several tones simultaneously.

A resonant-box, A, such as used for intensifying the sound of tuning-forks, is shown as closed at one end. A screw-bolt, D, or other suitable support secured upon this box, sustains an electro-magnet, B, of well-known construction. A vibrating tongue or reed, C, of steel, is also fastened upon the support D, and is united with one pole of the magnet B. The free end of the reed passes close to, but does not touch, the other pole of the magnet.

For convenience of removal or replacement, all the parts of the apparatus may be united by means of a common bolt and nut, E.

The box is tuned to produce a maximum resonance of the desired tone, and the reed is accurately tuned correspondingly. Consequently, as the reed vibrates, the sound of its fundamental tone is intensified by the resonance of the box in accordance with well-known laws of acoustics.

If, now, the electro-magnet be connected in a telegraphic circuit in the same way as one of my analyzers described in the application aforesaid, and the note be transmitted by means of one of my transmitters described in said application for Letters Patent, the note will sound in the box, provided the tone transmitted corresponds with that of the box; otherwise the note will not be heard. Should a second analyzer be similarly placed in the circuit and tuned to a different pitch, and a second note of corresponding pitch be transmitted, it will sound in the box of corresponding pitch without affecting the other. The same rule holds with a larger number.

I have in practice thus analyzed and reproduced as many as eight different tones simultaneously transmitted through a single wire; and, as I have demonstrated, by using the Morse signals eight messages can simultaneously be sent over each wire as rapidly as each operator can transmit with the common telegraphic key, the advantages of my invention are obvious.

I believe it, however, to be practicable simultaneously to transmit a number of messages even greater than that above mentioned.

The reed C is made of a steel bar with parallel sides, the tuning being done by cutting away the sides near the fixed ends, as shown in the drawings. I find this construction, in practice, to obviate the tendency of the reeds to break into nodes, or to respond to notes other than their own, as has been the tendency of other forms of reeds tried by me.

I claim as my invention—

1. The hereinbefore described art of transmitting musical sounds telegraphically by reproducing such sounds at the receiving end of the line by means of a vibrating reed and a sounding-box of corresponding pitch.

2. The combination, substantially as hereinbefore set forth, of an electro-magnet, a vibrating reed, and a sounding-box of corre-

sponding pitch, united at the receiving end of an electric circuit.

3. The combination, substantially as hereinbefore set forth, with an electric circuit, of a series of electro-magnets, a series of vibrating reeds, producing musical tones of different pitch, and a series of correspondingly-tuned sounding-boxes, whereby each box is caused to sound its own note while rejecting all others.

4. The vibrating reed, constructed as hereinbefore set forth, with parallel sides, and with recesses near its fixed end, whereby its tendency to vibrate in unison with tones other than its own is prevented.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:
ENOS M. BARTON,
GEO. A. BLISS.

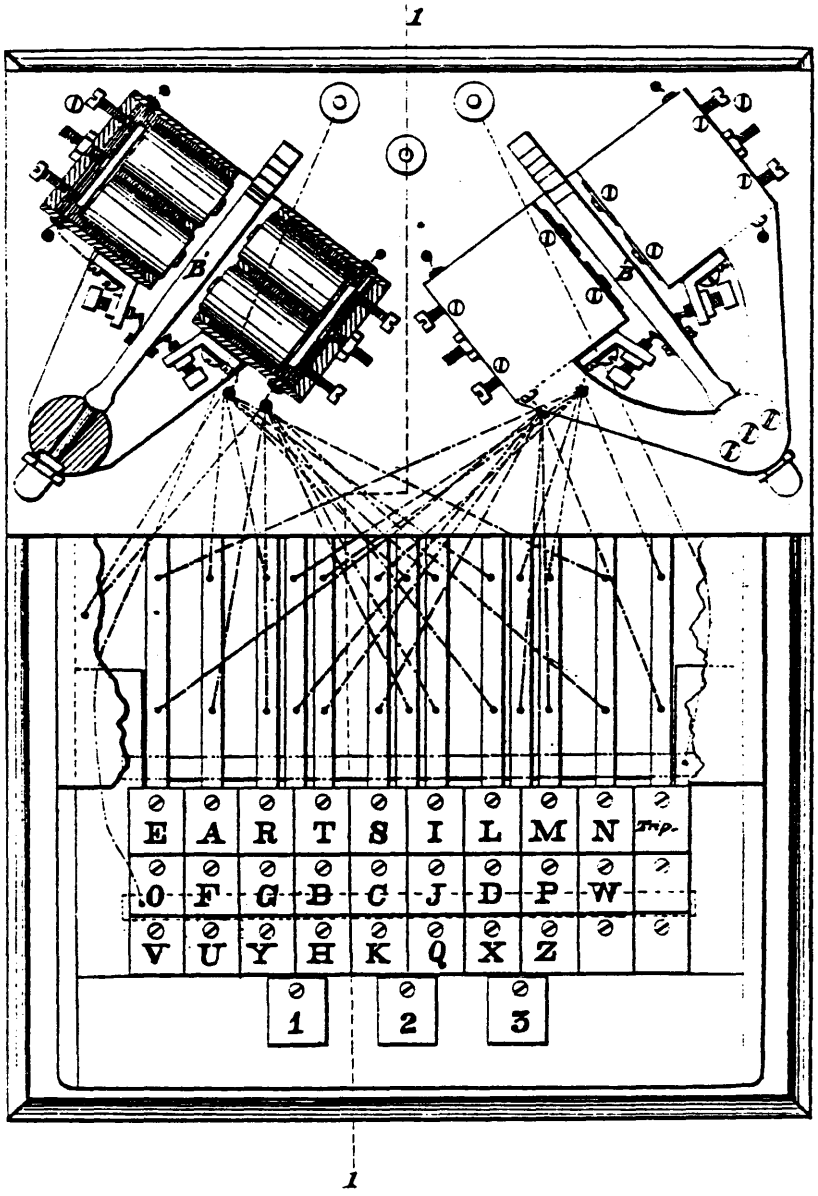
10 Sheets—Sheet 1.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 1



WITNESSES

Wm A Skinkle
F. Fish

by his Attorney

INVENTOR

Elisha Gray

Wm D Baldwin

10 Sheets—Sheet 2.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

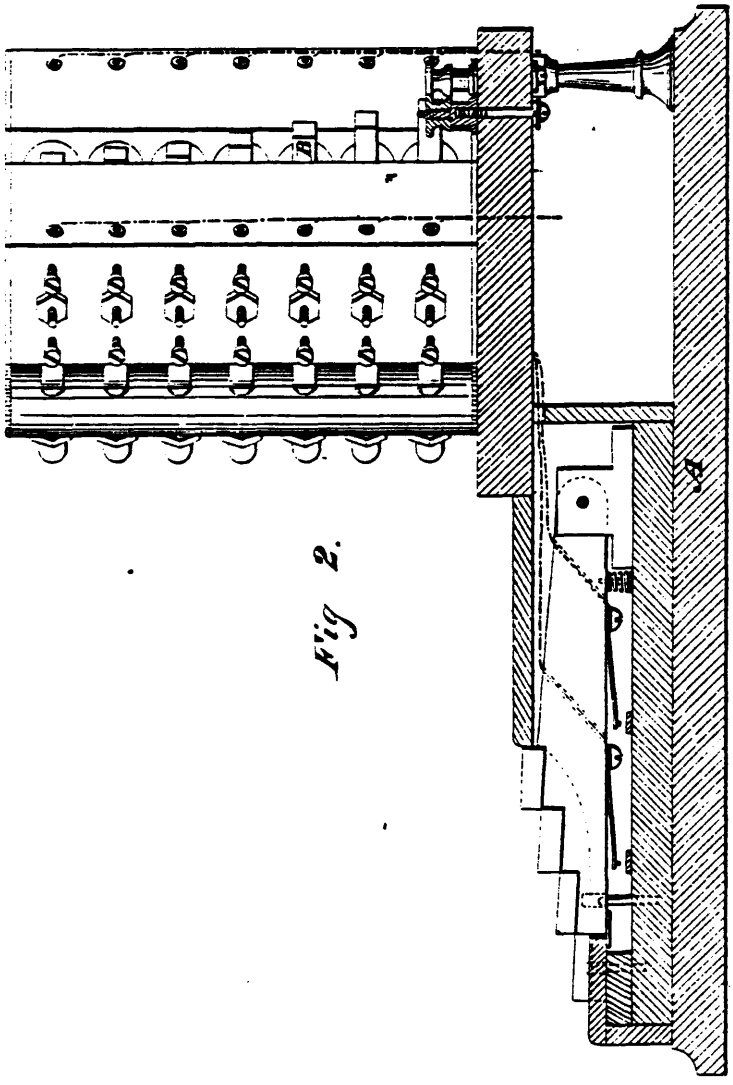


Fig 2.

WITNESSES

Wm. A. Skinkle
F. Stich

By his Attorney

INVENTOR

Elisha Gray

Wm. D. Baldwin

10 Sheets—Sheet 3.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 3

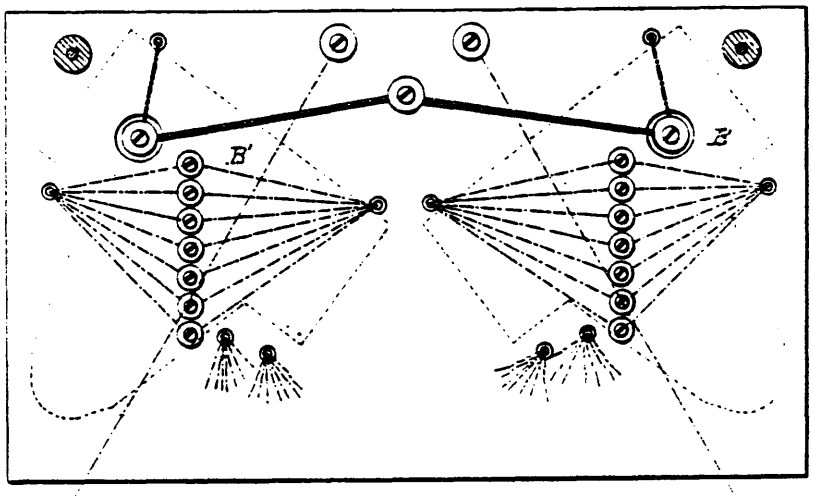


Fig 4.

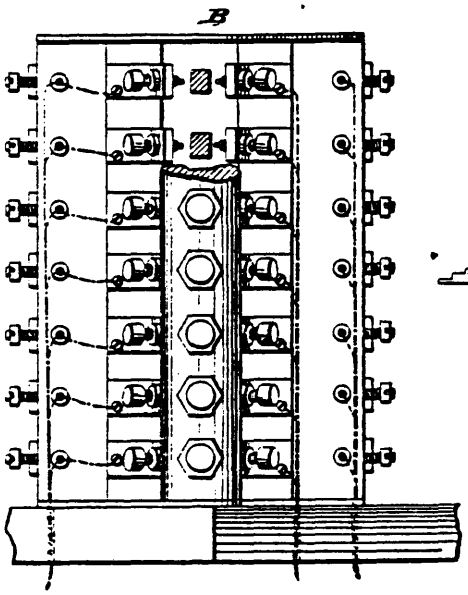
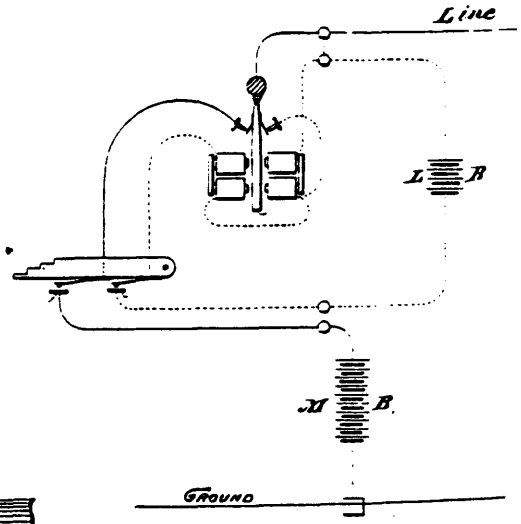


Fig 5



WITNESSES

Wm A Skinkle
F. Stich

By Iris Attorney

INVENTOR

Elisha Gray

Wm D. Baldwin

10 Sheets—Sheet 4.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented Jul

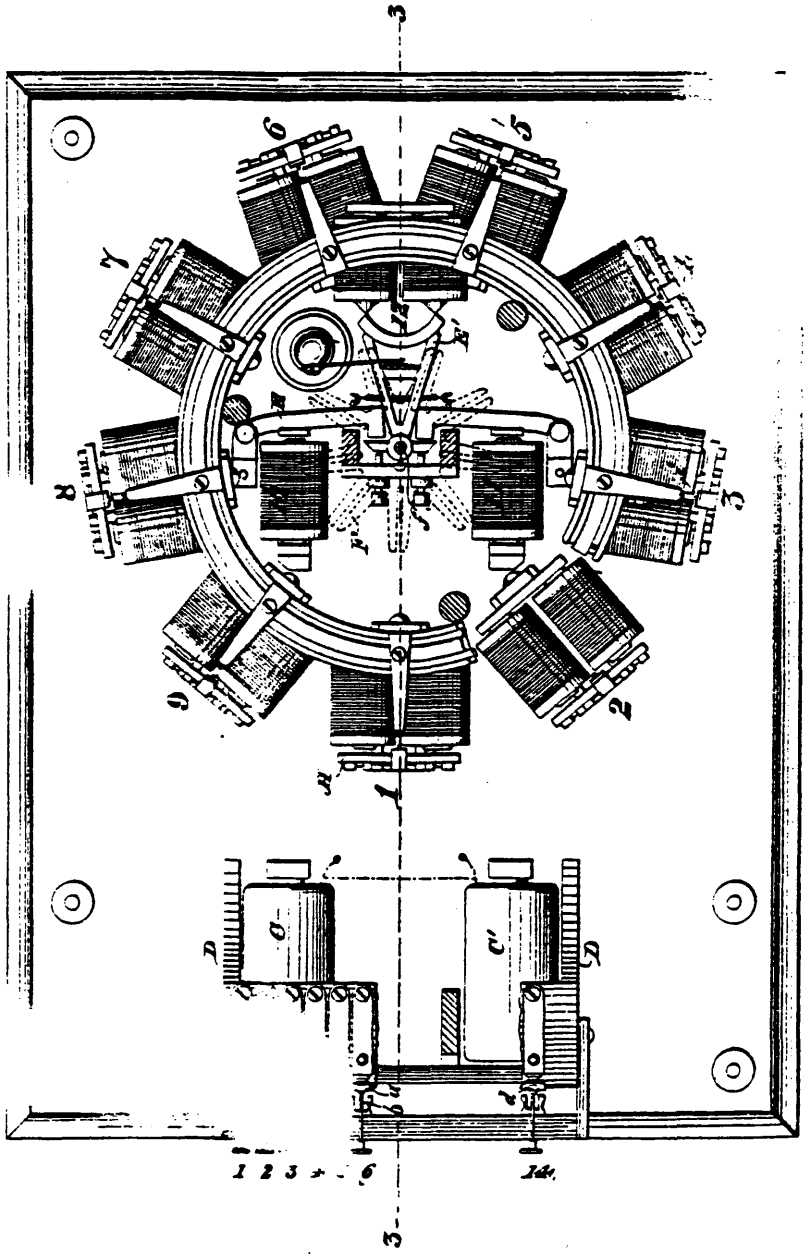


Fig.

WITNESSES

Wm A Skinkle
S. Stich

By his Attorney

INVENTOR

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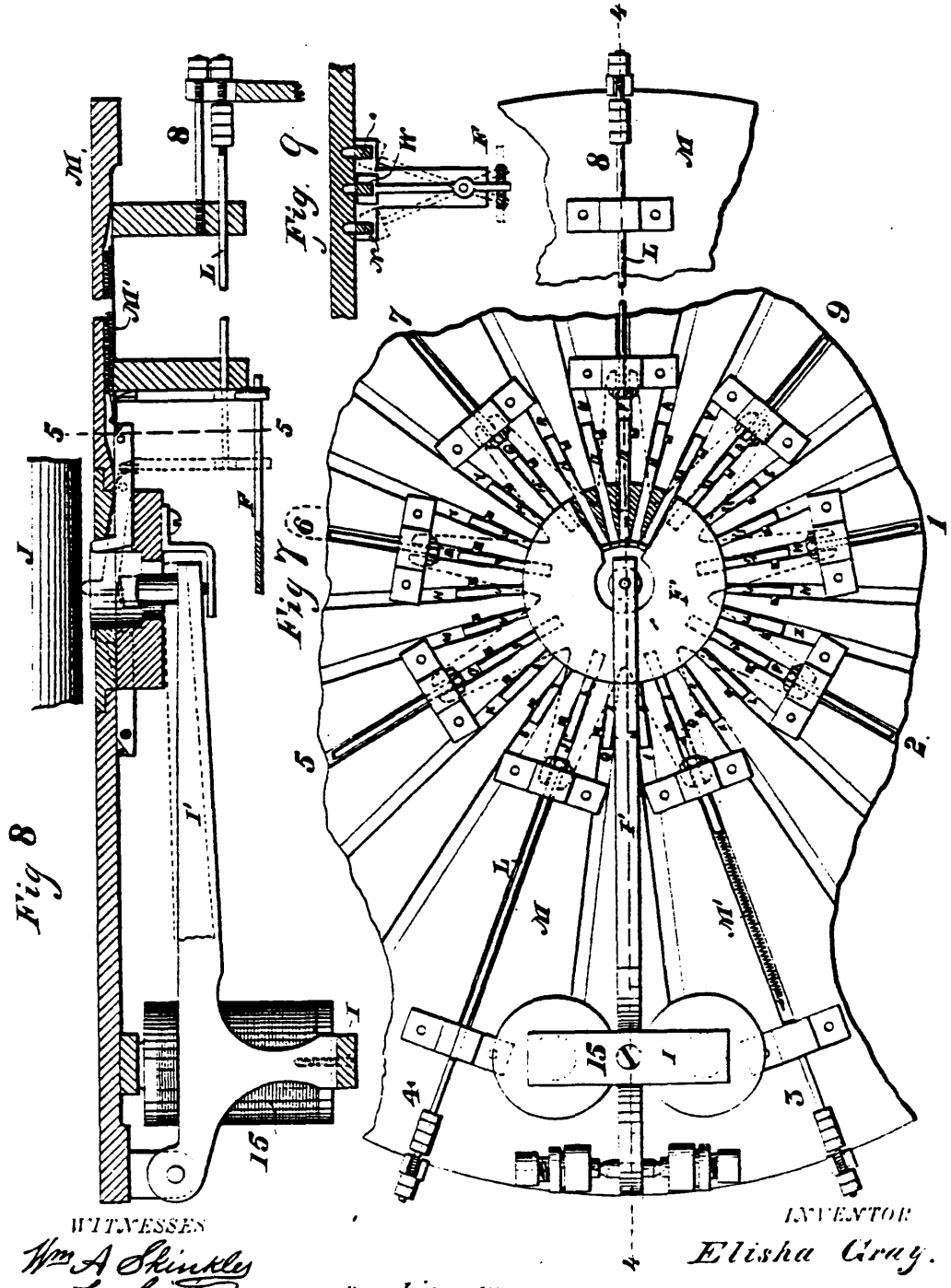
10 Sheets—Sheet 5.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.



WITNESSES

Wm A Skinkle

F. Stark

INVENTOR

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By his Attorney

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10 Sheets—Sheet 6.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 22.

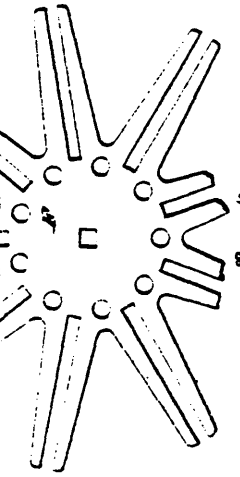


Fig 10.

WITNESSES

W. A. Skinkle

F. Stich

INVENTOR

Elisha Gray

By his Attorney

Wm. D. Baldwin

10 Sheets—Sheet 7

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 11ª

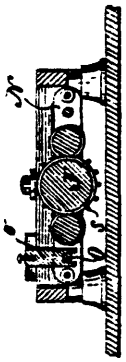


Fig 13

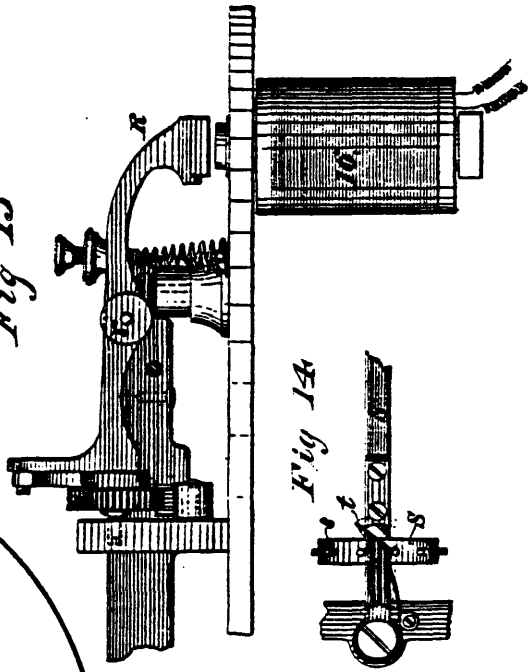


Fig 14

Fig 11

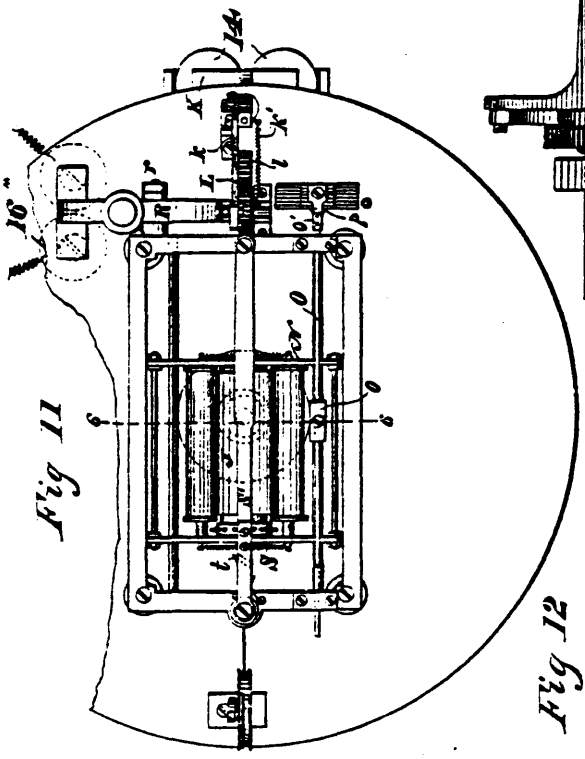
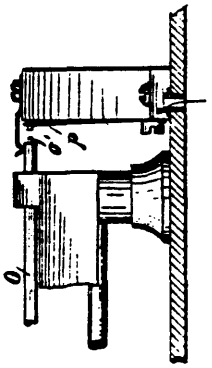


Fig 12



WITNESSES

Wm A Skinkle.
F. Smith

By his Attorney

INVENTOR

Elisha Gray.

Wm D Baldwin

10 Sheets—Sheet 8.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 16.

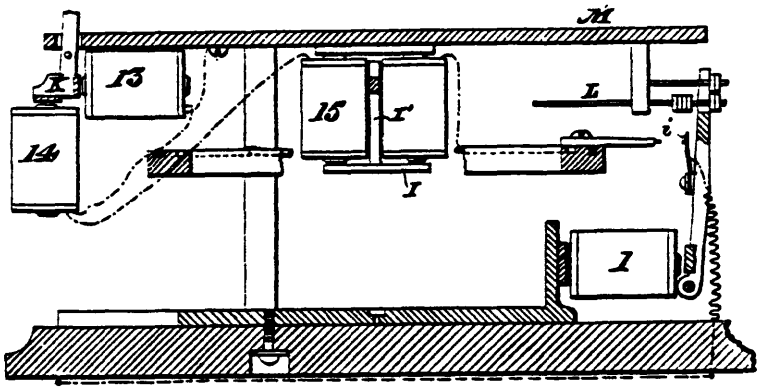
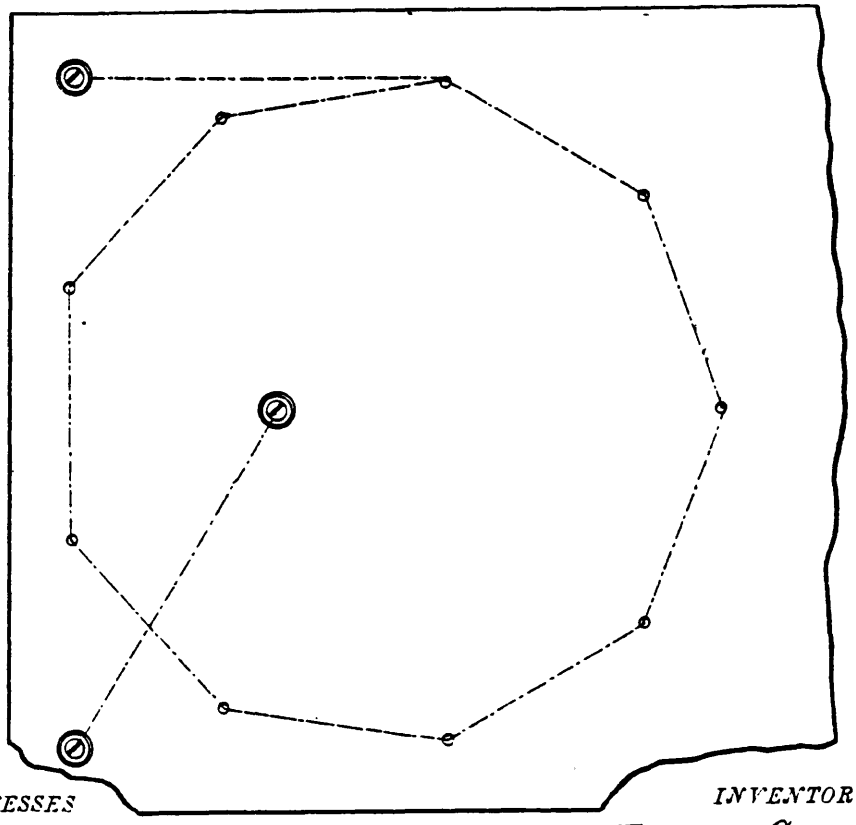


Fig 15.



WITNESSES

Wm A Steinkle

F. Stich

INVENTOR

Elisha Gray.

By his Attorney

Wm D. Baldwin

10 Sheets—Sheet 9.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

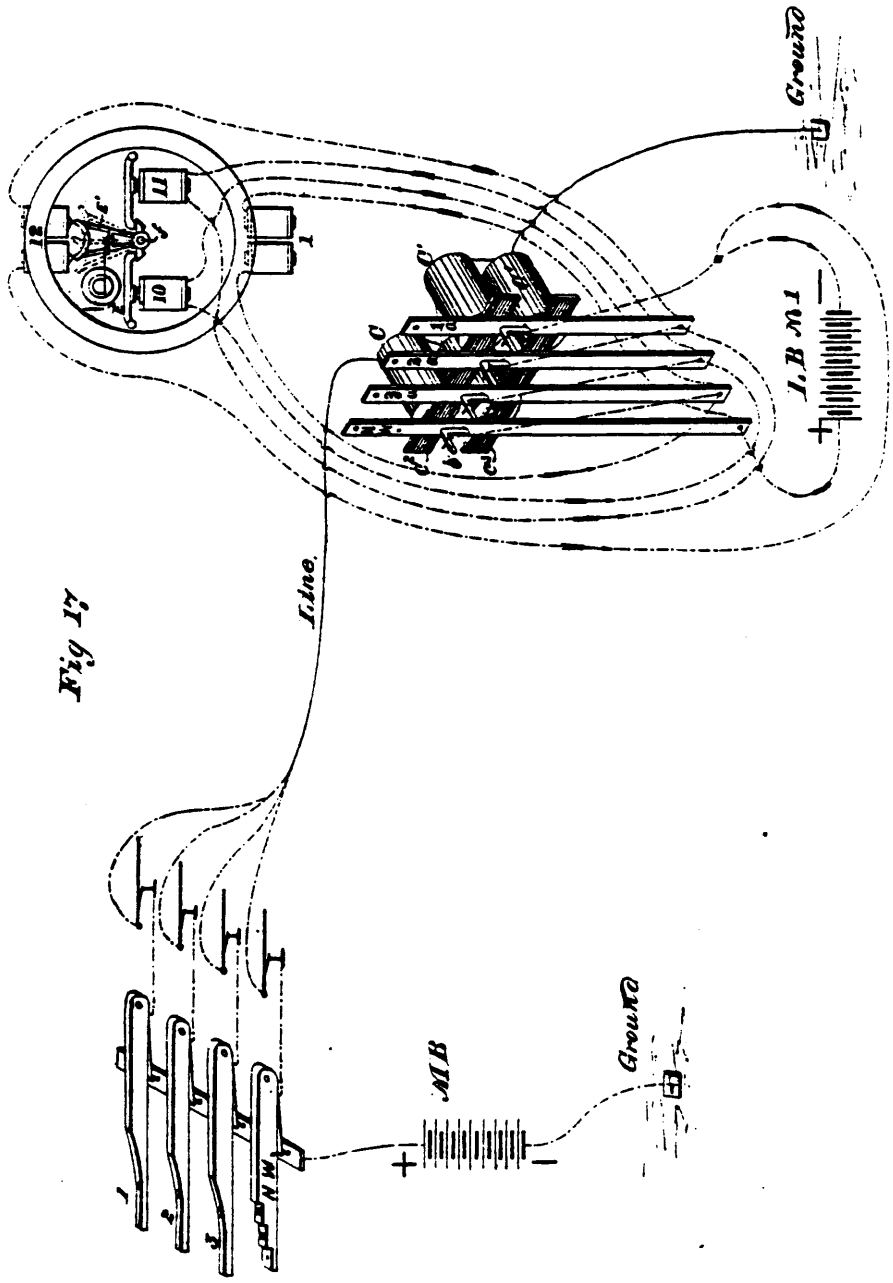


Fig 17

WITNESSES

Wm A Skinkle
R. Stich

INVENTOR

Elisha Gray.

By his Attorney

Wm D. Baldwin

10 Sheets—Sheet 10.

E. GRAY.

ELECTRO-HARMONIC PRINTING TELEGRAPHS.

No. 179,549. Patented July 4, 1876.

Fig 19

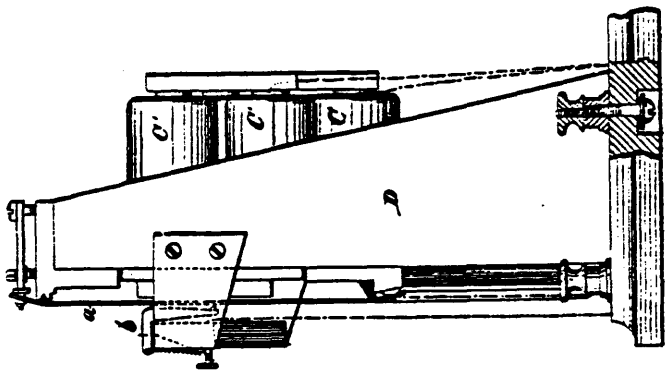


Fig 21.

Fig 18

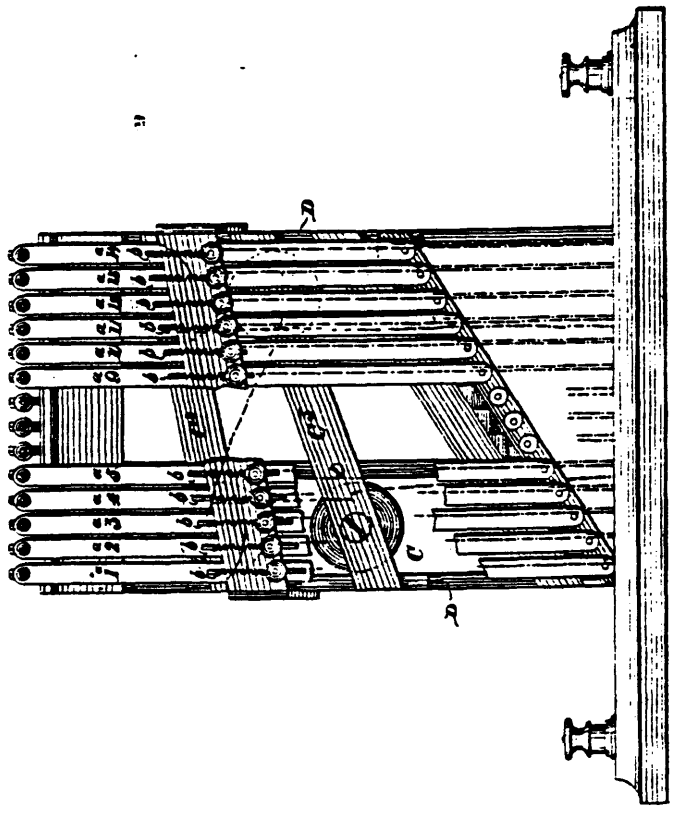


Fig 20

WITNESSES

Wm A Skinkle
F. Smith

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Elisha Gray.

By his Attorney

Wm. Baldwin

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILL., ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE HARMONIC TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN ELECTRO-HARMONIC PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 179,549, dated July 4, 1876; application filed April 12, 1876.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Art of Electro-Harmonic Telegraph-Printing and an Improved Electro-Harmonic Telegraph-Printing Apparatus, of which the following is a specification:

My present invention is based upon a system of electro-harmonic telegraphy described in sundry Letters Patent of the United States granted to me within the past year, and in various applications for Letters Patent of the United States made by me, and now pending.

The objects of invention are, first, to adapt my electro-harmonic system of telegraphy to the printing of a message by means of independently-movable type, and by means of mechanism thrown into action by the depression of a key at the transmitting-station, without necessitating the employment of isochronously-moving type-wheels, or of waiting for mechanism to register accurately before printing; second, to print a message on a letter-sheet, type-writer fashion, by the direct operation of keys at the transmitting-station controlling local batteries actuating the printing mechanism; third, to transmit a series of tones of different pitch through an electric circuit, each tone independently actuating a local battery, to print a letter, sign, or character corresponding with that of the particular key controlling the tone; fourth, to determine, in advance, through the action of a local battery, which one of a series of letters, numbers, or characters, actuated by a common motor, shall be printed; fifth, to determine, in advance, the point on the letter-sheet at which the printing of the message shall begin; sixth, to move a particular type to the point at which the printing is done, and there to make its impression upon the paper by means of mechanism thrown into action by the movement of the type itself; seventh, to feed the paper upon which the message is printed, by mechanism thrown into operation by the printing of the preceding letter; eighth, to determine, in advance, what particular letter of a series shall be printed, to actuate the printing mechanism by the movement of the particular type selected, and to actuate the feeding mechanism by the type thus selected; and, ninth, to control the printing mechanism by means of a compound magnet constituting, in fact, a single one.

These objects I attain by certain novel apparatus hereinafter set forth, the novel construction and combinations of which apparatus form a portion of the subject-matter of my invention, which is hereinafter specifically designated.

The accompanying drawings represent an apparatus embodying all my improvements in the best way now known to me. Obviously, however, the details of construction of the apparatus may be greatly varied in various ways without departing from the principle of my invention; and some of my improvements may be used without the others, and in apparatus differing in construction from that herein shown.

My improved apparatus consists of two main portions—a transmitter and a receiver.

Figure 1 represents a plan or top view of the transmitter, with portions of the casing removed, to show the internal construction more clearly. Fig. 2 represents a vertical longitudinal section through the transmitter, on the line 1 1 of Fig. 1. Fig. 3 is a bottom plan view of the transmitter, showing the method of running the circuits. Fig. 4 is a back view of one set of transmitting-reeds. Fig. 5 is a diagram showing the method of running the main and local circuits through a single transmitting-key and vibrating reed of a series. Fig. 6 is a plan or top view of the receiving apparatus, on the line 2 2 of Fig. 10. Fig. 7 is a bottom plan view of the top plate of the receiver. Fig. 8 is a vertical longitudinal section therethrough, on the line 4 4 of Fig. 7. Fig. 9 is a transverse section on the line 5 5 of Fig. 8. Fig. 10 is a vertical longitudinal section on the line 3 3 of Fig. 6. Fig. 11 is a top view of the apparatus for carrying the paper, and Fig. 11ª is a vertical transverse section therethrough on the line 6 6 of Fig. 11. Fig. 12 is a detail view of a portion of the local circuit-breaking mechanism which releases the paper carrying mechanism. Fig. 13 is a similar view of another

portion of the same apparatus. Fig. 14 is a detail view of the paper-feeding apparatus for spacing the lines of the message. Fig. 15 is a bottom plan view of the parts shown in Fig. 6, showing the mode of running the circuits. Fig. 16 is a detail view showing the method of running the circuits of the printing and paper-feeding mechanism. Fig. 17 is a skeleton diagram of the receiving and transmitting mechanisms, showing the method of connecting the circuits. Fig. 18 is an end view, and Fig. 19 a side view, of the compound analyzing receiver. Figs. 20 and 21 are detail views of the shunting-pins of the analyzing-spring, and Fig. 22 shows a plan view of a star-wheel, for actuating the type-shifting levers, detached.

The transmitting apparatus shown in the accompanying drawings is substantially similar, in its general construction, to that shown in Letters Patent of the United States, granted to me February 16, 1876, as No. 173,618, with the exception hereinafter stated.

In this instance the apparatus is designed for printing twenty-seven characters, and for operating a tripping apparatus, whereby the printing mechanism at the receiving end of the line may be automatically restored to its normal position during any portion of its operation of printing a line.

In order to avoid the complication of using twenty-eight different keys and their corresponding transmitting-reeds, I have devised means whereby the whole twenty-eight characters may be transmitted by the employment of nine primary keys, three shifting-keys, and a "trip-key," thus reducing the number of keys employed more than one-half.

The primary keys are each marked with three letters, numbers, or characters, and together with the trip-key and shifting-keys are arranged organ-fashion, as shown in Fig. 1, on a suitable base board or frame, A, upon which the transmitting-reeds are mounted, in the manner shown in the drawings.

In order to secure convenience of construction, and a compact arrangement, the series of transmitting-reeds are arranged in two sets, B B', of similar construction mounted upon the base-board of the frame, as shown.

The broken lines in Fig. 1 represent the connection of the keys with the transmitters. Fig. 3 shows a view of the connections as arranged beneath the base-board directly under the transmitters. Fig. 5 shows a method in which the main and local batteries are connected with a single key and vibrating reed of the circuit. Each one is a duplicate of the other, and their circuit-connections are substantially similar to those shown and described in my patent of February 16, 1876, above-mentioned; and as they, moreover, will be readily understood from the figure, a detail description of the construction and operation of these parts is deemed unnecessary.

In the operation of this apparatus the circuit is normally open, but the depression of any key connects the main battery to line through its corresponding transmitter. Each of the thirteen keys above-mentioned has its own independent analyzer at the receiving end of the line.

In the present arrangement the organization is such that there are twenty-seven printing-type at the receiving-end of the line, corresponding with the lettered keys, as will hereinafter be more fully explained.

These type are arranged in sets of three, one of each set being operated by each lettered key. Which one of these three letters shall be printed is determined by depressing one of the shifting-keys 1 2 3, which operate the type-shifting mechanism of the receiver in such manner that, in the present instance, when the key 1 is depressed, the depression of the lettered keys will print the letters on the row included between the letters E and N in Fig. 1. When key 2 is depressed, the middle row of letters only will be printed at the receiving end of the line; and when key 3 is depressed, the type corresponding with the outer row only will be acted upon. When the key marked "trip" is depressed, it operates to restore the paper-carrying mechanism to its normal position or starting-point, as will be hereinafter more fully explained.

In the organization shown in the drawings, the keys 1 2 3 are operated independently of the lettered keys or trip-key; but when either of said numbered keys is depressed, it makes no difference where the lettered keys are touched, as they can only print the letter of the row corresponding with the numbered key depressed.

As a modification of this device I contemplate so constructing and combining the keys that each letter shall be mounted on an independent movable section, attached to the key by a movable connection, in such manner that when a particular letter is depressed it shall operate the correspondingly-numbered key, and thus cause it to shift the proper type without the necessity of touching both the lettered and the trip key, as is necessary under the organization shown in the drawings.

This result can readily be attained in two ways; first, by means of a contact-point on the key which shall close the circuit or tone of the properly-numbered key, thus actuating the type-shifter at the receiving end of the line before the lettered key closes its own circuit to actuate the type. This result may also be attained by combining levers or other suitable devices connecting each key with the contact-point of the numbered key, although I prefer the first-mentioned plan, as being less complicated.

The manner in which the transmitters and receivers are connected will readily be understood by inspection of Fig. 17, in which 1, 2, and 3 represent the numbered keys, and N W a lettered key. It should be stated, however, that the local battery of the transmitter is omitted in this figure, to avoid complication,

but it is shown in Fig. 5. The depression of either key closes both the main and local circuits of the transmitter, and sends to line vibrations or impulses of the electro-tone or vibrating reed corresponding with the key. These vibrations pass through the magnet C C^1 of the analyzing-receiver, and are reproduced on the corresponding vibrating tuned bar or reed 1 2 3 or N W. Each bar is provided with a circuit-breaking lever, *b*, vibrating more slowly than the bar, as described in Letters Patent No. 166,094, granted to me July 27, 1875. These circuit-breaking levers control a local battery, L B, No. 1, which remains normally closed, and is short-circuited through the vibrating bars or analyzing-springs and levers above mentioned. Each analyzing-spring is provided with a loop passing through a corresponding local magnet, 1, 10, 11, or 12, the terminals of which loop connect, respectively, to the analyzing-spring and with its circuit breaking lever, so that when the circuit-breaking lever is out of contact with its vibrating-bar the shunt or short circuit is taken off from its corresponding magnet, and the current flows through the magnet; but when the vibrating bar and circuit-breaking lever are in contact, the shunt comes into play, and no current passes through the magnet.

The circuit-breaking devices, as above remarked, are shown in my patent of July 27, 1875; but the method of running the circuits and actuating the magnets herein shown is new.

Four vibrating bars only are shown in Fig. 17, to avoid complication; but it will, of course, be understood that the bars will correspond in number with their transmitting-keys—that is to say, in the present instance, there would be thirteen in number, each bar having its own loop and local magnet. In this instance nine magnets are employed for actuating the type—three for the shifting mechanism, and one for the tripping mechanism.

In Fig. 6 the relative arrangement of the nine type-actuating magnets, 1 to 9, and the shifting-magnets 10, 11, and 12 are clearly shown.

Having thus indicated in a general way the method of running the circuits, I will now proceed to describe the details of the receiving apparatus.

I will first describe the compound magnet C C^1, by which the vibrating bars are actuated.

In another application for Letters Patent of the United States filed by me simultaneously herewith, I have shown a different method of mounting a series of vibrating bars or analyzing-receivers, each tuned to a different pitch, upon a common magnet, so that each will analyze its own tone from a series simultaneously transmitted through the single magnet. I do not, therefore, broadly, claim in this application this device, except in combination with other mechanism not shown in the application above mentioned. In this instance the magnets C C^1 are mounted upon bars C^2 C^3 connecting their respective poles, and mounted in a frame, D, (see Figs. 18 and 19,) which also show a method of mounting the vibrating bars and circuit-breaking springs.

It should be observed that the bar marked 14 in Fig. 18 is inoperative in the organization hereinbefore described, having no corresponding transmitter. The bars are connected with the frame by means of insulated pins d^1 d^1, (shown in Figs. 20 and 21,) one set of pins being made adjustable, as shown in Figs. 18 and 19, by set-screws, or otherwise, and admit of the proper tuning of the bars to correspond with their transmitters.

I will now proceed to describe the organization I have effected for actuating the type-shifting and type-actuating mechanism, so as to cause one lever to actuate either one of three type.

Fig. 7 represents a plan view of the type-bed, showing a series of guideways or grooves radiating from a common center, in each of which a type slides freely endwise. In the present instance the organization is such that each type successively moves to a common center, and is struck up against a platen, to make an impression on the paper carried thereby, and is then retracted out of the way of the succeeding one, all these operations being performed automatically. In this instance the type is shown as made in the form of a bent lever, with the letter put on the end of the short arm of the lever, as moving forward radially to their working position, and then, being struck laterally to make their impression, retracting in the same way as they advanced.

The type are actuated by a vibrating shifter-lever, which I will now describe.

The details of the shifting mechanism are shown in Figs. 6, 7, 8, 9, 10, 17, and 22. In this instance the twenty-seven type shown in Fig. 7 are arranged in sets of three, corresponding with the respective transmitting-keys.

The operation of the type shifting and printing mechanism will readily be understood by reference to Fig. 17, which shows the three type-shifting keys 1 2 3 and a letter-key, N W. If it is desired to print the letter N, the key 1 is first depressed, thus sending vibrations to line synchronizing with the fundamental of the reed 3^a. This takes off the shunt from the corresponding loop at the point where the vibrating lever *b* comes in contact with the bar, and allows the current of the local battery to p ss through the magnet 10 of the series of shifting-magnets 10, 11, and 12. A lever, E, on the armature of this magnet is thus attracted toward it and vibrates a shifter-frame, E′, upon a vertical rock-shaft, *f*, carrying a star-wheel, F, having nine arms radially slotted to correspond with

each set of the type-actuating magnets 1 to 9, inclusive. On the armature of each of these magnets is mounted a rod, L, movable radially and endwise in the frame M, and carrying upon it a rocking shifter-bar projecting both above and below it. The lower end of this bar slides in the corresponding slot in the star-wheel above mentioned, while its upper end moves in a path coincident with one or the other of the type-slides in which it is adapted to work, as shown in Fig. 9.

Now, when the armature-lever E is attracted, as above explained, the rocking of the shifting-frame E′ causes a partial rotation of the star-wheel, which correspondently shifts the position of the whole series of shifter-bars. In this instance the bar described would be shifted to the position shown in dotted lines, Fig. 9, marked with the letter N, which would correspond with the position of that letter in Fig. 7, and each shifter-bar would occupy the same relation to the letters included between E and N of Fig. 1. Were the shifter-bar vertical or on the letter W each shifter-bar would occupy a corresponding relation to the middle row of letters in Fig. 1, and so in regard to the outer row. This movement takes place before the type-actuating mechanism begins to operate, and consequently, this movement is exerted upon the type or series of types previously determined by the shifting mechanism.

The armature H of the magnet 1 is connected with and actuates the slide-bar above mentioned, which carries the shifter-bar. In this instance, as soon as the shifting-bar is shifted in line with the type N, the armature H is attracted by the magnet 1, which forces the sliding rod L and shifter forward against the type, thus driving it forward in its groove to the central point of the machine where the impression is made. At this moment a contact-point, *i*, on the armature H, strikes a point which closes the circuit of the independent local battery and actuates a series of electro-magnets, 15, 14, and 13, the two latter operating on one armature. The attraction of the armature I by the magnet 15 throws up a printing-lever, I′, which strikes the type up against the paper carried on a platen, J, and makes the impression at the same time the magnets 13 and 14 draw down their armature K, Fig. 10, which retracts the pawl *k* operating on a spur-pinion, L, gearing into a feeding-rack, *l*, connected with the paper carrying mechanism. As soon as the key is released at the transmitting-station the circuit is shunted, thus releasing the type-actuating armature of the magnet 1, and breaking the circuit of the printing and paper-feeding magnets 13, 14, and 15, which allows the type to drop and be retracted by its spring M′ to its normal position. A spring, *k*′, then retracts the armature K of the magnets 13 and 14, forcing the pawl forward and actuating the feed-bar and moving the paper-carrying mechanism forward a distance sufficient to afford space for the next letter, in a manner similar to an ordinary writer. This process is repeated with each successive letter.

When the paper-carrying mechanism has been fed along a distance equal to the length of the line which the machine is adjusted to print, the feed-carriage N strikes a lug, *o*, on a sliding bar, O, and moves it endwise in its frame until its point *o*′ comes in contact with a spring, *p*, which closes the local battery of the magnet 16. This draws down an armature mounted on a lever, R, rocking on a pivot, *r*, and carrying the gear-wheel above mentioned, which actuates the feed-bar. The drawing down of the armature lifts this gear out of contact with the feed-bar, and the paper-carrying mechanism is immediately retracted by the spring F′. The platen in this instance consists of a roller around which the paper passes, which roller rotates in bearings in the sliding carriage. During its forward movement the platen is prevented from rotating by means of a series of pins, *s*, on a wheel, S, on the same axis as the platen, which pins pass on each side of a guide-bar, S′. On the backward movement of the sliding carriage, however, one of these pins strikes against a pivoted spring-switch, *t*, under the guide-bar, which deflects the pins and turns the platen a distance equal to that desired for the distance between the rows of type. On the next forward movement of the feeding-carriage the point of the spring-switch yields to allow the pin to pass without turning the platen, and as soon as the pins pass the point of the switch it is thrown open again by a spring in readiness for the next backward movement of the carriage after the printing of the line is completed.

The carriage can be thrown back at any desired point in the line by pressing the trip-key of the transmitter, which, through a corresponding analyzing-spring in the receiver, throws the local circuit into connection with the magnet 16 in the same manner as that described as taking place by the operation of the sliding bar, thus releasing the sliding carriage and allowing it to return to its starting-point.

It will thus be observed that the operator at the transmitting-station is not only enabled to print at the receiving-station any letter desired, and automatically to shift the paper to commence a new line, type-writer fashion, but he is also enabled to shift the sliding carriage at the receiving station at will by means of his trip-key to commence a new line.

I propose to employ a ribbon fed between the paper and type by well-known mechanical means, such as commonly used in type-writers, which, to avoid complication, is not shown in the drawings, and which needs no description.

I contemplate using a web or long strip of paper, so as to dispense with the constant watching of the receiving instrument by the attendant, and by means of the trip-key above

mentioned the paper can be fed along so as to leave a space between each message to permit of their being separated and delivered without rewriting.

I am thus enabled by my invention not only to print a telegraph-message without the use of a type-wheel, and without the use of synchronously-moving step-by-step (or steadily-revolving) mechanism such as has heretofore been universally employed, so far as my knowledge extends, and thus save the time necessary for the type to come into position, the operator's ability to transmit being thus, by my invention, the only limit to the speed of the apparatus.

I am also enabled by my invention to print messages in the form of a page or letter-sheet in contradistinction to printing it in a single line and on a narrow strip, as heretofore has been the case.

I am further enabled to determine in advance, by the transmission of one tone, which one of a series of type shall move to make its impression, by throwing it into connection with mechanism actuated by the tone appropriated to the particular type to be printed.

I claim as my invention—

1. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in printing each letter at the receiving-station by the direct and instantaneous action of a local battery controlled by a key at the transmitting-station corresponding with said letter.

2. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in printing a message on a letter-sheet, type-writer fashion, by the direct operation of keys at the transmitting-station controlling local batteries actuating the printing mechanism.

3. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in transmitting tones of different pitch through an electric circuit by means of corresponding keys, and reproducing said tones at the receiving-station as a means of actuating local batteries controlling printing mechanism, which prints a letter corresponding with that of the key controlling the particular tone which throws the local battery into operation.

4. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in determining in advance, through the action of one local battery, which one of a series of letters, numbers, or characters shall be printed by mechanism actuated by another local battery.

5. The improved art of electro-harmonic telegraph-printing, which consists in determining in advance, by means of one local battery, the point at which the printing of the message, by another local battery, shall begin.

6. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in throwing forward a particular type to be printed by one local battery, and making an impression by that particular type by another local battery automatically thrown into action by the movement of the type.

7. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in feeding forward the paper upon which the message is printed by mechanism thrown into operation by a local battery controlled by the printing of the preceding letter.

8. The hereinbefore-described art of electro-harmonic telegraph-printing, which consists in touching a key which transmits a particular tone, by which one local battery determines in advance what particular letter shall be printed; carries forward the type selected, which, in turn, actuates another local battery which makes the impression and controls the feeding mechanism.

9. The combination, substantially as hereinbefore set forth, of a reciprocating type moved in one direction by the armature of the electro-magnet, and in the other by a spring.

10. The combination, substantially as hereinbefore set forth, of the armature of the magnet, the endwise-moving frame, the type pivoted thereon, and the retracting-spring attached directly to the type.

11. The combination, substantially as hereinbefore set forth, of a series of type, movable radially relatively to a common center, a shipper acting upon one of the series, and a series of electro-magnets, which control the action of the shipper.

12. The combination, substantially as hereinbefore set forth, of a series of type, a carrier or shifter bar acting upon either one of said type, a series of electro-magnets which control the selection of the type to be acted upon, and a second electro-magnet which actuates the type selected.

13. The combination, substantially as hereinbefore set forth, of a series of type, a shifting-carrier acting upon one of the types of the series, a series of electro-magnets which select the type to be acted upon, a second electro-magnet which actuates the type selected, and a third electro-magnet which actuates the printing-hammer, to make an impression of the selected type.

14. The combination, substantially as hereinbefore set forth, of an electro-magnet for actuating the printer-hammer, and an electro-magnet for actuating the paper-feeding mechanism.

15. The combination, substantially as hereinbefore set forth, in an electric circuit, of a vibrating reed producing a musical tone, or a definite number of vibrations per unit of time, a key controlling said vibrations, a corresponding reed at the receiving end of the line, a local battery controlled by said vibrating reed or circuit-breaker, and an electro-magnet, the armature of which carries a type, for the purpose specified.

16. The combination, substantially as hereinbefore set forth, in an electric circuit, of a

series of circuit-breakers capable of producing tones of different pitch, a series of corresponding receivers, a series of keys controlling the transmission of said tones, a series of local batteries controlled by the vibrating receivers, and a series of type controlled directly by the electro-magnets of the local batteries.

17. The combination, substantially as hereinbefore set forth, in an electric circuit, of a series of transmitting-keys, printing mechanism controlled by said keys, and a shifting-key for determining in advance which letter of a series, marked on each key, shall be printed.

18. The combination, substantially as hereinbefore set forth, in an electric circuit, of printing mechanism, keys controlling said printing mechanism, and a trip-key, which determines the point at which the printing of the message begins.

19. The combination, substantially as hereinbefore set forth, in an electric circuit, of printing mechanism, keys for controlling the printing mechanism, keys for determining which one of a series of type shall be printed, and a trip-key which determines the point on the paper at which the printing shall begin.

20. The combination, in an electric circuit, substantially as hereinbefore set forth, of apparatus for transmitting tones of different pitch, keys controlling said apparatus, receivers which analyze and reproduce said tones, and independently-movable type, each controlled by its particular tone.

21. The combination, substantially as hereinbefore set forth, of a paper-carrier, a spring for moving it in one direction, a feed-bar, and a gear-wheel mounted on the armature of the electro-maguet, and adapted to be thrown into or out of gear with the feed-bar by the movement of the armature.

22. The combination of the paper-carrying mechanism, a feed-bar, a gear-wheel actuating said bar mounted on the armature of one electro-magnet, and a feed-pawl mounted on the armature of another electro-magnet.

23. The analyzing-receiver hereinbefore described, consisting of the combination of two or more magnets, with their like poles united by connecting-bars, constituting in fact one magnet, and a series of tuned receiving-springs vibrating near said bars, so that each shall receive its proper tone from said magnet.

In testimony whereof I have hereunto subscribed my name.

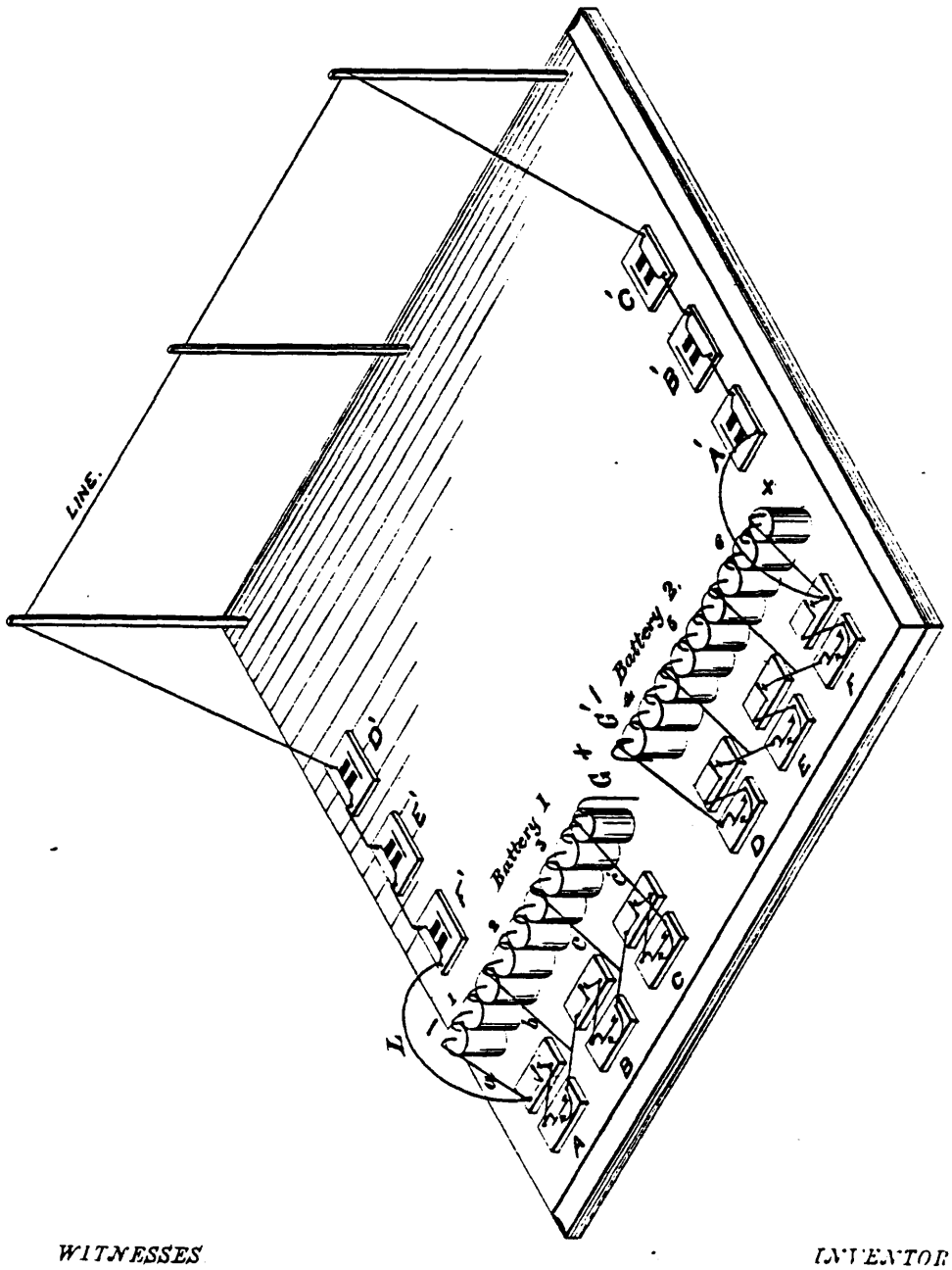
ELISHA GRAY.

Witnesses:
WM. A. SKINKLE,
WM. J. PEYTON.

E. GRAY.

ELECTRO-HARMONIC TELEGRAPH.

No. 186,340. Patented Jan. 16, 1877.



WITNESSES

Wm. A. Skinkle

Baltis & Long.

By his Attorney

INVENTOR

Elisha Gray

Wm. D. Baldwin.

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE HARMONIC TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN ELECTRO-HARMONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **186,340**, dated January 16, 1877; application filed January 27, 1876.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented a new and useful improvement in the art of transmitting and analyzing musical impressions or sounds, and in apparatus for so transmitting and analyzing such sounds, of which the following is a specification:

My invention more especially relates to an electro-harmonic system of multiple telegraphy heretofore invented by me, and secured by sundry Letters Patent of the United States, in which composite musical tones are transmitted through a single wire, and analyzed or separated at the receiving end of the line by vibrating reeds, bars, or strings, tuned correspondently with the respective transmitters of the composite tones.

In an application for Letters Patent of the United States filed by me February 23, 1875, for transmitting musical vibrations by electricity, I have shown not only the various devices for transmitting or receiving the musical impressions; but also one method of arranging the electric circuit for producing the desired result, including the relation of the main battery to the line and instruments at both ends, and described the effects produced.

In my prior patents and application above-mentioned, the full force of the battery was at all times exerted upon the line—that is to say, when one transmitter was employed, and the others were at rest, it worked with the full force of the whole main battery, and when all the transmitters were employed, the same force was necessarily divided among them; consequently the amplitude of the vibrations of any given tone would diminish or increase, according to the number of tones simultaneously sent to line, thus rendering analysis at the receiving end of the line more difficult.

My present improvement contemplates the avoidance of this objection, by insuring the transmission of tones of uniform amplitude of wave, whether a greater or less number of tones be transmitted simultaneously, which end I attain by combining each transmitter with its respective section of the main battery, by a short or shunt circuit, in such manner that each section is utilized for the transmission of the vibrations for its own tone, without interfering or drawing upon the other section of the battery, or opening the main circuit, and when not transmitting, the unemployed sections of the battery flow steadily to line, without affecting the working transmitters of the other sections.

My improvement thus possesses two distinguishing characteristics: first, that of a main circuit always closed; and, second, the passage through this circuit of a smooth current, so to speak, when all the transmitters are quiescent, each transmitter when in operation throwing its respective portion of said current into vibration, so that there may be a smooth current, and one or more vibratory waves simultaneously transmitted through the circuit, or the entire current may be thrown into vibration.

The subject-matter claimed hereinafter will specifically be designated.

The accompanying drawings represent a perspective diagram of so much of my improved apparatus as is necessary to illustrate the subject-matter claimed.

I have shown this apparatus as constructed in the best way now known to me; but it is obvious that the details of construction of its various parts may be varied within certain limits, in ways well known to skillful electricians.

I have shown three transmitters with their batteries, and corresponding receivers at each end of the line, so arranged as to transmit three messages each way simultaneously; but a greater or less number of transmitters and receivers may be employed, and they might be so arranged as all to transmit one way instead of in opposite directions.

It is deemed unnecessary to describe in detail here the construction of the battery, as it forms no part of the subject matter claimed, and any of the well-known batteries of the present day will work effectively with my improved apparatus.

The construction of the transmitters and receivers is fully set forth and described in my Letters Patent and application above-mentioned, and needs no reiteration here.

Each battery is connected with its respective transmitter by a short circuit or shunt wire. Starting with battery No. 1, G is the ground-wire connected at the plus (+) pole of the battery, which battery is connected up in the ordinary way and runs to line at the other or minus (—) end, through the analyzing-receivers F′ E′ D′. The line connects at the other end through the analyzing-receivers C′ B′ A′ to the plus (+) pole of battery No. 2, and passes through in the ordinary way to the ground-wire G′ at the minus (—) pole of said battery.

The circuit, thus far, is similar to an ordinary Morse circuit closed, and without a key or other means of making or breaking the circuit.

A B C D E F represent six sets of transmitters, each set being composed of a common open circuit, Morse telegraphic key, and a musical-tone transmitter, such, for instance, as that described in Letters Patent No. 165,728, granted to me July 20, 1875, for improvement in transmitters for electro-harmonic telegraphs. These transmitters are all alike in construction, but each one is tuned to a different pitch, and has a receiver, A′ B′ C′ D′ E′ F′, correspondently tuned, at the other end of the line.

Each battery is divided into sections 1 2 3 4 5 6, not by separating or disconnecting its cells, but by throwing a short circuit or shunt wire around each section. For instance, the first short circuit of battery 1 consists of the wires *a b*, the second of the wires *b c*, and the third of the wires *c c′*, and so on. The number of cells in each section is determined by the distance the tone is to be transmitted.

Each shunt-wire runs through its own key and vibrating transmitter. For instance, in section 1 of battery 1, which is at the line end of the battery, a wire, *a*, passes from the minus (—) pole of the battery to one binding-screw of the transmitter A, at which point the circuit divides, one branch connecting to line L, and the other to the vibrating bar of the transmitter through the break-point, which is in this instance a shunting-point. The circuit then passes to the other binding-screw, and thence to the key-lever.

The anvil or lower point of the key is connected directly with the ends of the wire *b*, which forms the dividing-line between sections 1 and 2, forming part of the short circuit of each section, and so on. Now, if the reed or bar of transmitter A be vibrated by its local battery, (which is omitted from the drawing to avoid complication, but the operation of which is well understood,) and the key belonging to it and in the same circuit with it be depressed, the shunt-circuit around section 1 will be completed every time the vibrating bar or reed makes contact with its break-point, thus producing a set of waves or electrical vibrations throughout the line, the waves succeeding each other at the rate per second corresponding to the vibrations of the transmitting reed or bar, which waves will induce corresponding impulses in all the magnets of a power approximating one-sixth of the whole battery.

Although these magnetic impulses are induced in all the magnets in the circuit, one only will make an audible response, except to a very delicate test, which one, in this instance, will be the receiver marked A′, as one whose reed or ribbon (or reed and box, as the case may be) is tuned correspondently to the transmitter in operation. All the other sections of the apparatus are connected up and operated in a manner precisely similar, each operating on its own section of battery. Each transmitter differs in pitch from every other one, and has its complement in its corresponding receiver.

It will be observed that by working with this improved system the main circuit is never opened, owing to which fact the integrity of each set of waves is preserved intact, thus rendering analysis easy at the receiving end of the line.

The utility of the device has been amply demonstrated by practical operation.

I claim as of my own invention:

1. The improvement in the art of telegraphically transmitting composite tones, hereinbefore set forth, which consists in working a closed circuit with a continuous current from a main battery, portions of the whole of which current are thrown into vibration at will by the transmitters.

2. The improvement in the art of telegraphically transmitting and analyzing composite tones, hereinbefore set forth, which consists in working a closed circuit with a continuous current from a main battery, portions of the whole of which current are thrown into vibration at will by the transmitters, each set of vibrations being audibly reproduced by a corresponding receiver.

3. The combination, substantially as hereinbefore set forth, of a series of transmitters, each operated by a local battery, a main battery, an electric circuit, through which a continuous current flows from said battery, and shunt or short circuits between the main battery and transmitters.

4. The combination, substantially as hereinbefore set forth, of a series of transmitters, a main battery connected therewith by short or shunt circuits, a closed electric circuit, through which a current continuously passes from the main battery, and a series of analyzing-receivers, included in the circuit.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:
WM. J. PEYTON,
JOSEPH S. PEYTON.

T. A. WATSON.
Telephone.

No. 199,007. Patented Jan. 8, 1878.

Fig. 1

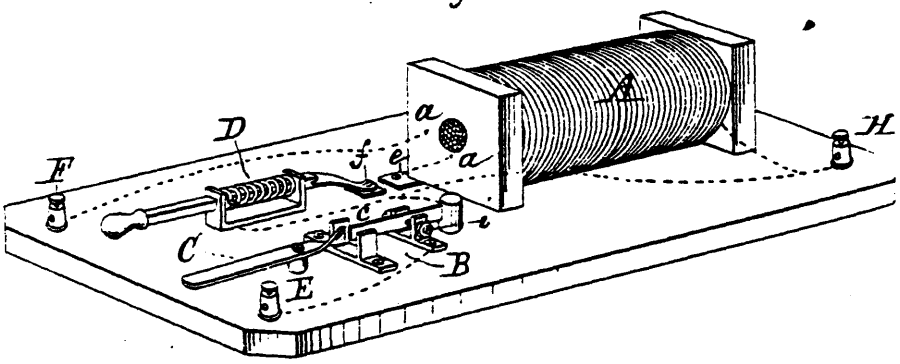
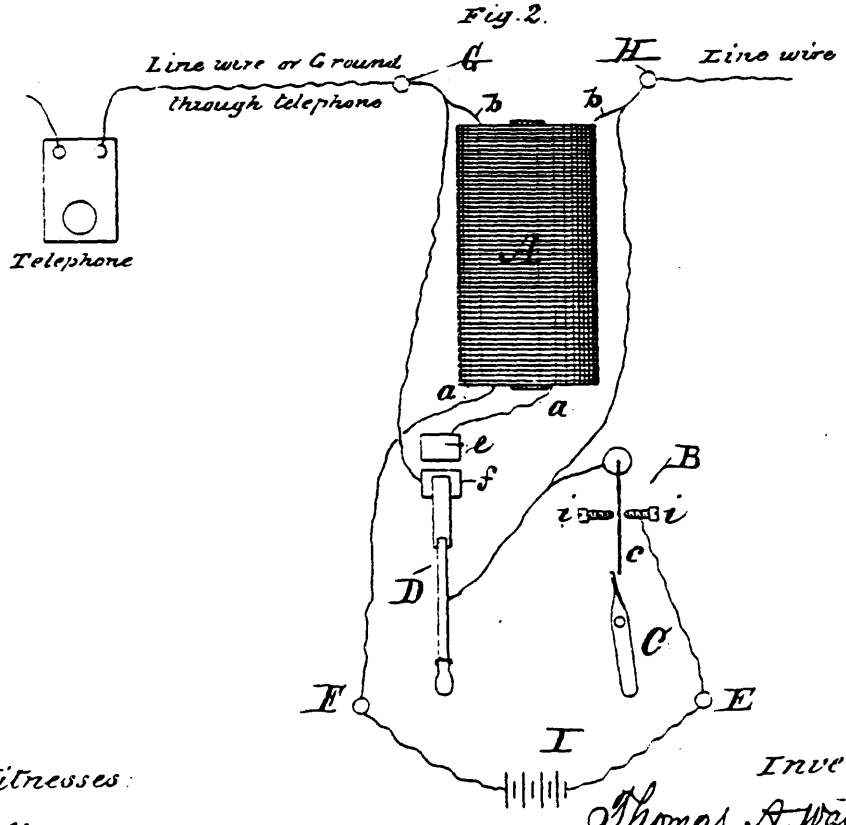


Fig. 2.



Witnesses:
E. E. Masson
E. C. Sick

Inventor:
Thomas A. Wat...
Apollok ...

UNITED STATES PATENT OFFICE.

THOMAS A. WATSON, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN TELEPHONES.

Specification forming part of Letters Patent No. **199,007**, dated January 8, 1878; application filed December 5, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. WATSON, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Telephones, which improvement is fully set forth in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 is a perspective view of an apparatus constructed in accordance with my said invention; and Fig. 2, a diagram of the same, showing its arrangement in telephonic circuit.

In using a system of electric telephones it is necessary to provide some means for producing a sound at the distant telephone-station loud enough to attract the attention of persons at a distance from the telephone.

My present invention supplies one means for doing this by causing an intermittent current of electricity of high intensity to pass through the line-wire and the distant telephone. For producing such current I make use of an ordinary induction-coil, combined with a galvanic battery and a rheotome, for rapidly interrupting the current. These are arranged as shown in the accompanying drawings, in which A is the induction-coil. *a a* are the terminals of its primary, and *b b* those of its secondary, coil. B is a rheotome, consisting of a steel spring, *c*, capable of producing a musical note. This spring is set into vibration by the motion of the lever C, and in vibrating makes and breaks contact on screws *i i*.

The construction of the rheotome can be varied in many ways. For instance, if a metallic membrane is substituted for the steel spring, it can be set in vibration by the voice, and caused to make and break contact against a screw corresponding to screw *i* in diagram. All that is necessary is to supply some means for making and breaking contact between two metallic points.

D is a circuit-closer, which makes contact with plate *e* when the knob is pressed, and is kept in contact with the plate *f* when the knob is released by means of its weight or a retractile spring. A galvanic battery, I, is connected with the posts E and F and the main circuit to the posts G and H.

The operation is as follows: The knob of the circuit-closer is pressed, bringing the contact-spring upon the plate *f*. This completes the battery-circuit through the screws *i i*, steel spring *c*, contact-spring D, plate *e*, and primary coil. The lever C is now moved to and fro, throwing the spring of the rheotome into vibration, and, as it makes and breaks contact against the screws *i i*, renders the current passing through the primary coil intermittent, inducing in the secondary coil a correspondingly intermittent current of much higher intensity, and the terminals of this coil being connected with the main circuit, the induced current flows through the line-wire, and produces a loud sound in the distant telephone. Upon releasing the knob the contact-spring is drawn back from plate *e*, thus breaking the battery circuit into contact with plate *f*, and as one of the terminals of the secondary coil is connected with the contact-spring and the other with plate *f*, the coil is therefore shunted out of the main circuit.

I claim—

The method of producing a signal or call at a distant telephonic station by combining with a system of electric telephones an induction-coil, rheotome or circuit-interrupter, circuit-closer, and galvanic battery, substantially as herein described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

THOMAS A. WATSON.

Witnesses:
C. E. HUBBARD.
WARREN KYLE.

E. GRAY.

Circuit for Speaking-Telephones.

No. 203,264. Patented May 7, 1878.

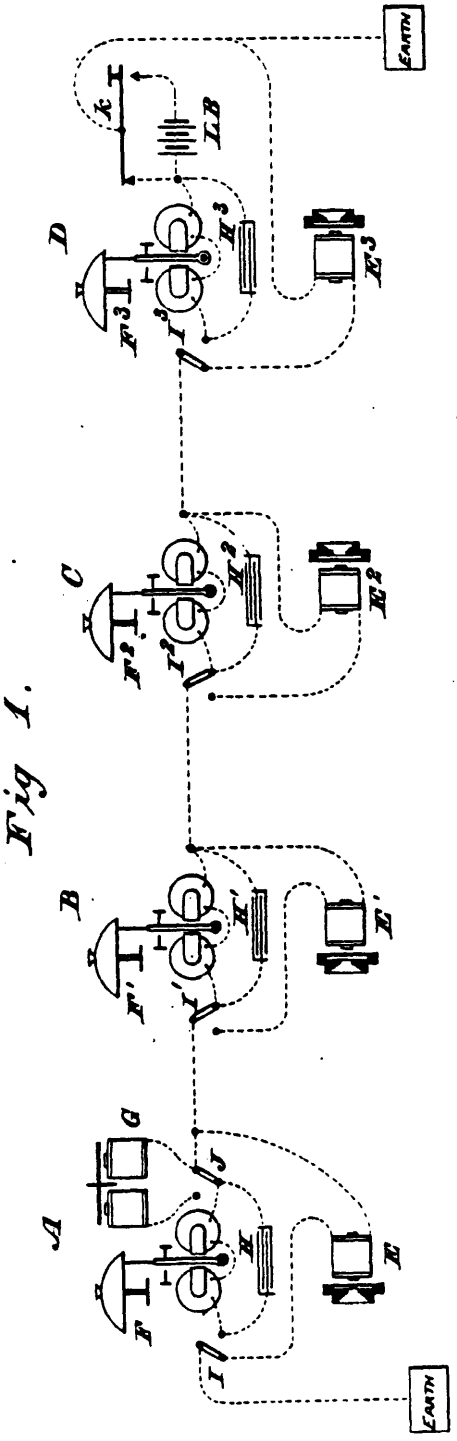


Fig 1.

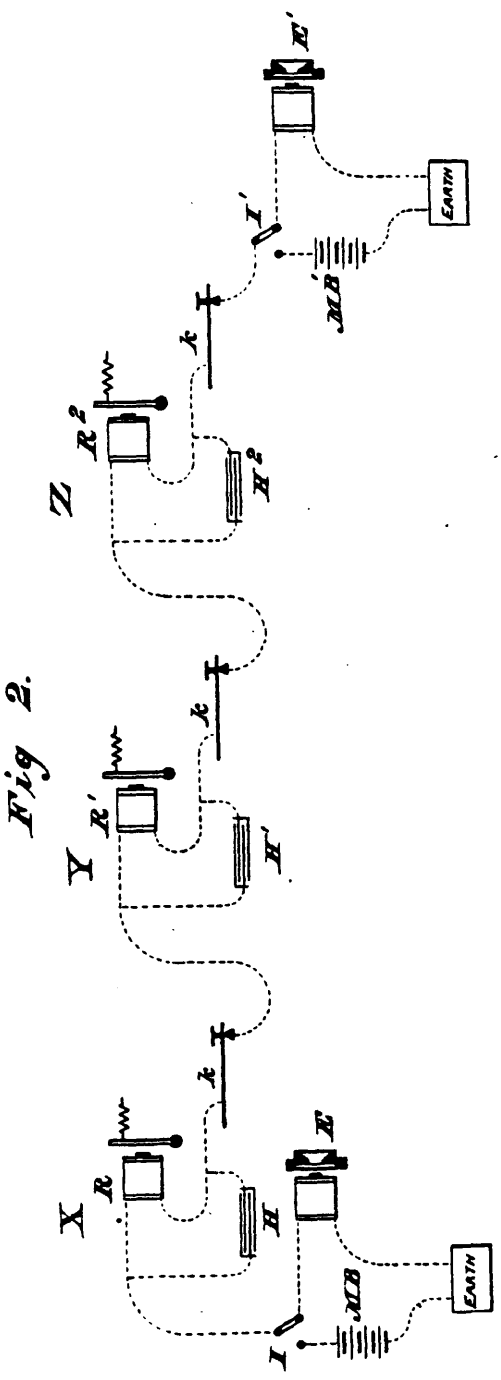


Fig 2.

WITNESSES

Wm a Skinkle

Geo. W. Breck

INVENTOR

Elisha Gray.

By his Attorneys

Baldwin Hopkins & Peyton

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN CIRCUITS FOR SPEAKING-TELEPHONES.

Specification forming part of Letters Patent No. **203,264**, dated May 7, 1878.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Speaking-Telephones and in the art of Transmitting Vocal Sounds Telegraphically, of which the following is a specification.

My invention relates to and constitutes an improvement upon a novel art of transmitting vocal sounds telegraphically, and to improvements upon speaking-telephones heretofore invented by me, for which sundry applications for Letters Patent of the United States are now pending, and especially contemplates the employment of a number of speaking-telephones in a single circuit.

The object of my invention is to facilitate the transmission of the tones of the human voice through the alarm, call, or signal apparatus or bell-magnet of an intermediate station, or through the alarm, call, or signal apparatus or bell-magnets of a series of intermediate stations, where more than two stations are included in the same circuit, whereby my speaking-telephone apparatus is rendered especially applicable to circuits upon which ordinary Morse instruments are used.

The subject-matter claimed will hereinafter specifically be designated.

The fact is well known that when an electro-magnet is included in a circuit through which vibrations are transmitted (whether the magnet be of high or low resistance) it greatly impedes the passage of such vibrations, and the more rapid or highly-attenuated they are the more difficult it is to transmit them through the coils of such magnet. This difficulty is so prominent under the systems heretofore practiced that the insertion of even two or three extra magnets in a circuit practically prevents the transmission of articulate sounds or spoken words over a line however short.

To obviate this objection, and at the same time leave the bell or call magnet in circuit, I have devised this improvement.

In the accompanying drawings, which represent the best way of carrying out my invention now known to me, Figure 1 represents my improved arrangement upon circuit of instruments and apparatus on a line consisting of two terminal and two intermediate stations. Fig. 2 represents two terminal stations and an intermediate station, showing my improvements as more especially adapted for operation in connection with a line equipped under the Morse system.

The construction and operation of the instruments represented in the diagrams being well known, it is deemed unnecessary to represent or describe them in detail, except so far as is necessary to illustrate my new organization of apparatus.

In Fig. 1 of the accompanying drawings four stations, A B C D, are represented as arranged in a speaking-telephone circuit. Each station is provided with one or more speaking-telephones, E E' E^2 E^3, and also with an ordinary electric call-bell, F F' F^2 F^3, having either an ordinary magneto-electric generator or a battery, as the case requires. In this instance station A is shown as provided with a generator, G, while station D is represented as provided with a battery, L B, and an ordinary Morse key, K, for throwing it on and off the line.

The batteries and generators are omitted from the intermediate stations for convenience of representation.

The battery is employed for calling on such lines only as use what is known as the "battery-telephone." The magneto-electric generator is used on such lines as use the permanent-magnet telephone, no battery being required in such cases.

Each station is provided with a switch, I I' I^2 I^3, which in one position directs the circuit through its respective telephone-magnet, and in the other position through its respective bell-magnet, leaving out the telephone, as will be readily understood by reference to the drawings, which show the method of running the circuits, and which represent the telephone-connection wires as running around the bell-magnet. A similar switch, J, throws the generator on or off the line, as required. When the line is not in use the switches are all left standing, so that the circuit passes through the bell-magnets, shunting the telephones, thus enabling any one station to call any other by means of its alarm or call bell and battery or bell and magneto-generator, as the case may be.

In Fig. 1 the switches I I^3 on the terminal stations A and D are respectively shown in position for conversing between those two sta-

tions. The intermediate stations, B and C, are necessarily left in position for calling. Therefore the circuit is directed through the bell-magnets of those stations, as it would be impracticable to have them all switched out of circuit whenever any two stations wished to converse. My improvement allows these magnets to remain in circuit, and therefore be in position to receive calls, without in the least interfering with the transmission of the voice-vibrations over the lines from one terminal station to the other.

Letters Patent No. 198,738, granted to me January 1, 1878, for transmitting double signals simultaneously through a single wire, one by the ordinary Morse method and the other by harmonic or telephonic vibrating signals, show Morse relay-magnets with a condenser shunting or connected around each magnet in circuit. This was done partly to facilitate the passage of vibrations through the way or Morse stations, thus making a channel for vibrations through the condenser, and thereby relieving the vibrations of the necessity of passing through the magnets, which, as hereinbefore stated, offer great resistance to the transmission of such vibrations, owing to the fact that at the time the magnet is being charged a momentary induced current is set up in the opposite direction, thus retarding the first flow of the current, which, in the case of rapid vibrations, amounts to an obstruction almost total, whereas, in signals of longer duration, it is not perceptibly felt.

Experience has demonstrated that the remedy afforded by my improvement above mentioned is so complete that with four or six stations in circuit there is scarcely any perceptible diminution in volume of sound over that of a clear wire of the same length, whereas without my improvement it would be impossible to work through so many instruments unless the bell-magnets were made very small, in which case the alarm-signal would be too light.

My improvement is applicable to any form of signaling apparatus whatever.

The condenser may be made a part of the apparatus—that is, for instance, it may be placed in the bottom of signal-boxes, as ordinarily constructed—or it may be made separate, as in the ordinary form, and connected through the box by means of wires of such length as may be most convenient.

In the drawings the condensers H H′ H² H³ are shown as shunting the alarm or call apparatus, or, in other words, as arranged in branch circuit with each bell-magnet, as in the patent above mentioned.

It is frequently desirable to use the speaking-telephone on ordinary Morse circuits, which my improvement renders it practicable to do very advantageously by means of the arrangement represented in Fig. 2, which shows three stations, X Y Z. When the two terminal stations, X and Z, wish to communicate with each other over an ordinary Morse telegraphic circuit it is only necessary to arrange the switches I I′ in the position indicated, so that the batteries at each end are off and the circuit is directed to earth through the speaking-telephones E E′, respectively. In addition to this, each relay-magnet R R′ R² in circuit must be provided with a condenser, H H′ H², connected as hereinbefore described, otherwise it would be necessary to switch out of circuit all the relays on the line when the terminal stations wish to converse.

I claim as of my own invention—

1. The hereinbefore-described art of transmitting vocal sounds or spoken words through a bell-magnet or other signal-magnet and condenser arranged in branch circuits in a main line.

2. The hereinbefore-described art of transmitting vocal sounds or spoken words through a series of bell-magnets or other signal-magnets and condensers arranged in branch circuits in a main line.

3. The combination, substantially as hereinbefore set forth, in a speaking-telephone, of a bell-magnet or other signal-magnet and its actuating apparatus, a condenser shunting said magnet and actuating apparatus, and a telephone-magnet shunting said bell-magnet, actuating apparatus, and condenser, and a switch controlling the shunts.

4. The combination, substantially as hereinbefore set forth, in a Morse circuit, of a series of condensers shunting the relays at each station, telephone-magnets at two or more stations, and switches which simultaneously shunt the telephone-magnets into line and throw off the batteries.

5. The combination, substantially as hereinbefore set forth, in a single electric circuit, of a series of stations, each provided with a bell-magnet or other signal-magnet and its actuating apparatus, a condenser shunting them, a telephone-magnet shunting the bell-magnet, actuating apparatus, and condenser, and switches controlling the shunts, whereby the signal-magnet, actuating mechanism, and condenser at the transmitting-stations are cut out of circuit which passes through the corresponding apparatus at the intermediate stations, shunting the telephones.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

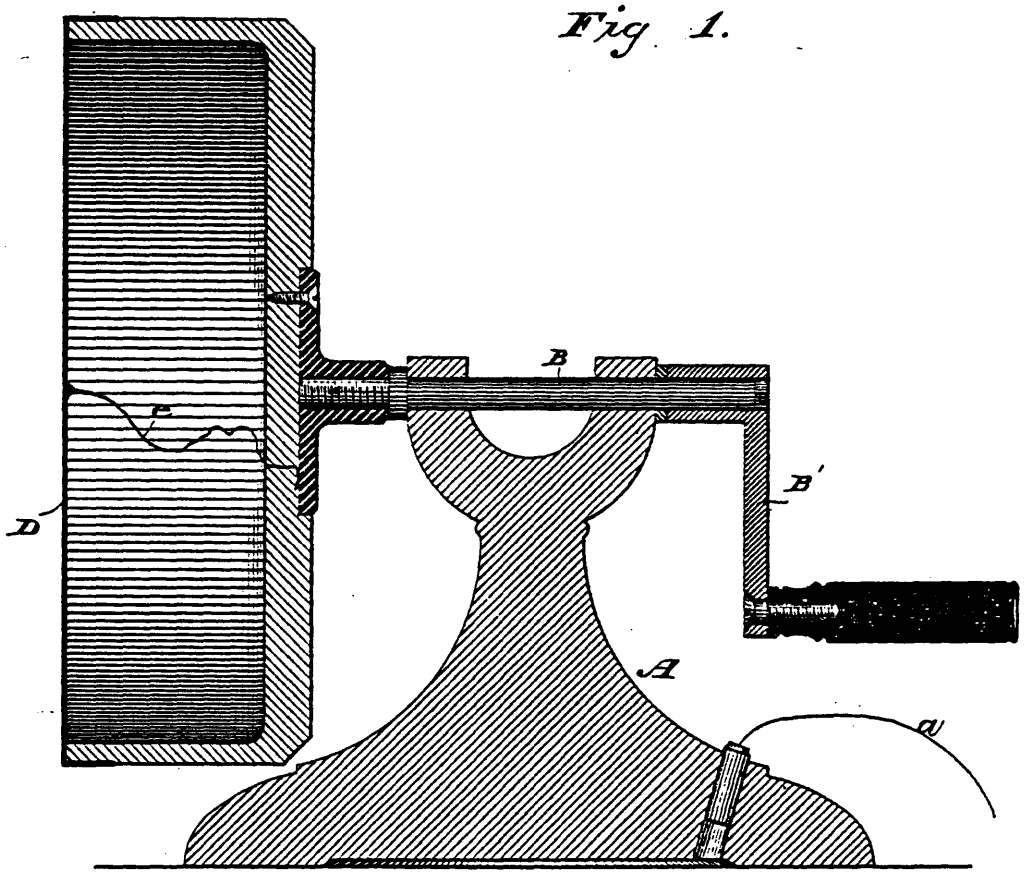
Witnesses:
A. G. SWARTWOUT,
CHAS. S. SHEPARD.

2 Sheets—Sheet 1.

E. GRAY.
Speaking-Telephone.

No. 210,776. Patented Dec. 10, 1878.

Fig. 1.



WITNESSES.

Geo W Breck

Wm A Skinkle

INVENTOR

Elisha Gray.

By his Attorneys

Baldwin, Hopkins & Peyton

2 Sheets—Sheet 2.

E. GRAY.

Speaking-Telephone.

No. 210,776. Patented Dec. 10, 1878.

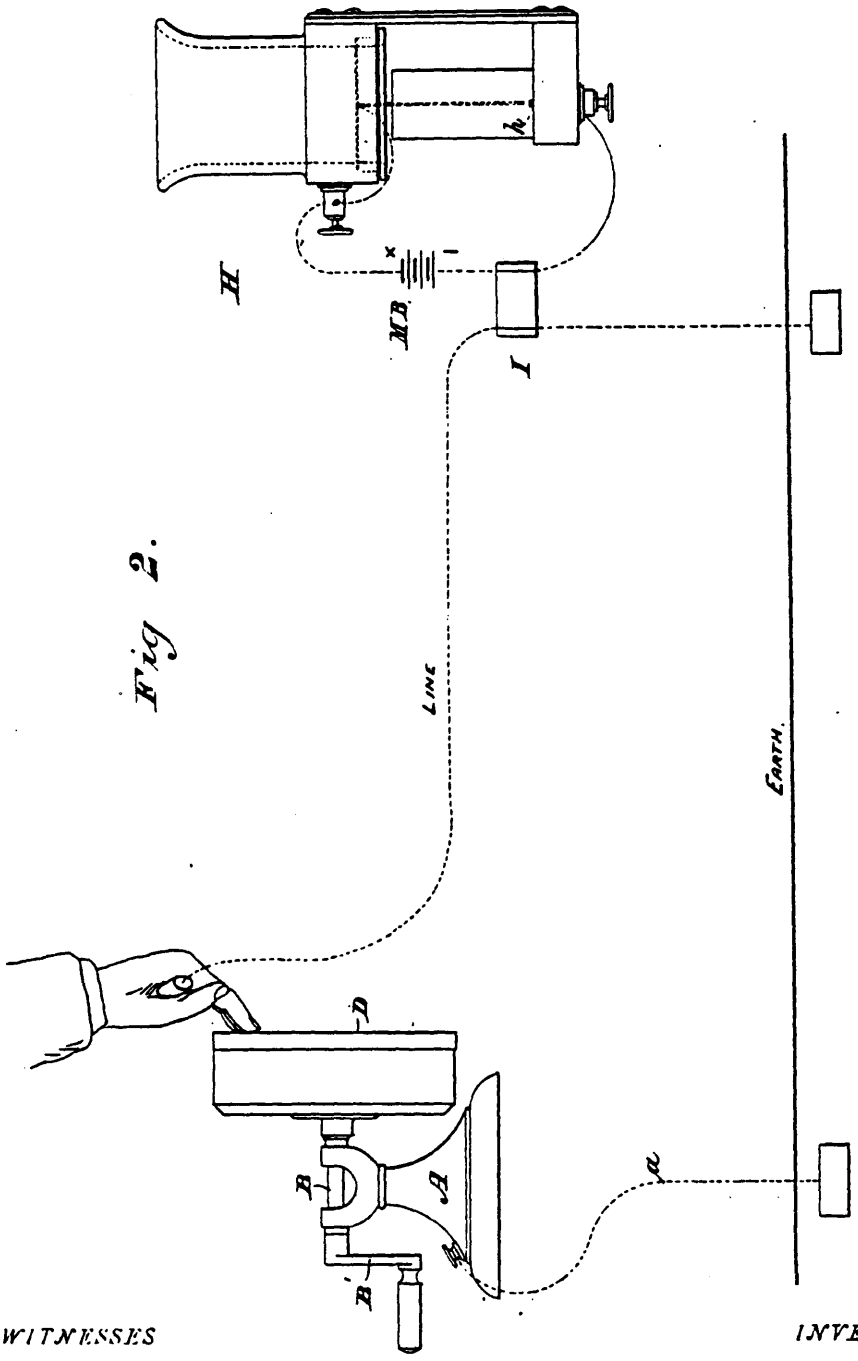


Fig 2.

WITNESSES

Wm A Skinkle

Geo H Breck

INVENTOR

Elisha Gray.

By his Attorneys

Baldwin Hopkins & Peyton

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN SPEAKING-TELEPHONES.

Specification forming part of Letters Patent No. **210,776**, dated December 10, 1878; application filed August 3, 1878.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Speaking-Telephones, of which the following is a specification:

In Letters Patent No. 166,096, granted to me July 27, 1875, on an application originally filed April 18, 1874, I have shown and described apparatus for transmitting rhythmical vibrations representing composite sounds or musical tones of different pitch telegraphically, and for reproducing said tones at the receiving end of the line through the medium of animal tissue.

My present invention constitutes a new application of the principle exemplified in said Letters Patent, its object being to reproduce articulate sounds at the receiving end of the telegraphic circuit through animal tissue in gliding contact with a plate of suitable metal.

Any of the well-known speaking-telephones which transmit with sufficient intensity may be employed as a transmitter, in my improved apparatus. I prefer, however, for a transmitter the one known as the "water-telephone," described in a pending application for Letters Patent filed by me October 29, 1877, or the Edison carbon telephone-transmitter, or some instrument used in connection with a battery, on account of the greater power which may be obtained from such a transmitter.

I prefer to use currents of considerable tension in working my improved apparatus, the most convenient and economical mode of doing which is by the use of an induction-coil, as shown and described in my Letters Patent above mentioned.

The receiving apparatus is substantially the same in construction and operation as the one heretofore employed by me for reproducing musical tones transmitted through a telegraphic circuit.

My invention therefore consists in combining, in an electric circuit, telephonic apparatus capable of transmitting articulate speech with a resonant receiver through the intervention of animal tissue in gliding or frictional contact with said resonant receiver. This receiver may consist of a plate of any of the well-known metals, whether capable of induction or not. I prefer, however, to use a plate, disk, or diaphragm of thin sheet metal—such as zinc or German silver, highly polished, and oxidized on the surface exposed to friction. The frictional or gliding contact between the animal tissue and the receiving-plate may be produced in various ways; but I have found in practice the simplest and most effective to be to mount the receiving-plate upon a resonant box or case mounted upon a shaft, so as readily to be revolved by means of a pulley, crank, treadle, or other well-known motor. By this means an even pressure and uniform rotation of the receiving-plate is secured.

The animal tissue may consist of one or more fingers of the human hand interposed in the circuit and pressed against the plate. Various other equivalent substances are mentioned in my patent above mentioned.

The accompanying drawings show one convenient form of apparatus for carrying out the objects of my invention. Obviously, however, the details of construction of both the transmitter and receiver may be greatly varied without departing from the spirit of my invention.

Figure 1 represents an axial transverse section through the receiver; and Fig. 2 represents an arrangement upon circuit of the entire apparatus, including both transmitter and receiver.

The base or supporting-stand A is, by preference, made of metal, and of a weight and size sufficient to maintain it in position without fastening it to its support. A shaft, B, revolves in suitable bearings upon this stand, being driven by a crank, B', or by a pulley, clock-work, or other suitable prime mover, and carries a hollow resonant box or case of wood, or some other resonant substance. The outer or open end of this box is covered by a thin sheet-metal disk, plate, or diaphragm, D, preferably of zinc, as the surface of this metal is usually covered with a very thin film of oxide, which is highly favorable to the proper action between the animal tissue and the plate when in gliding contact.

The diaphragm, it will be observed, is connected with the shaft and base by a wire, *e*, inside the resonant box or case, the base being

in turn connected with the ground by a wire, *a*. The transmitter H in this instance is an ordinary speaking-telephone, of the form shown in my application filed October 29, 1877, above mentioned, known as a "variable-resistance telephone," which class includes the microphone, the carbon transmitter, the water transmitter, and all others of that class which produce the sound-waves by causing the vibrations of the diaphragm to vary the resistance of the battery-current proportionately to the amplitude of motion of said diaphragm. I do not, however, confine myself to a transmitter of this class, but contemplate using any form which will transmit the vibrations with sufficient force.

The main battery M B is shown in Fig. 2 as short-circuited through the transmitter and through the induction-coil I, having the usual primary and secondary circuits in such relation to each other as will produce the best results at the receiving end of the line.

Starting from the plus pole of the battery, the circuit passes through the transmitter-point *h*, thence through the primary helix of the induction-coil and back to the other pole of the battery. The secondary helix has one of its poles connected to the line, the other with the ground. At the receiving end of the line the circuit passes through animal tissue, which may consist of the human body or other equivalent material, which is in contact with the plate D, from whence the circuit passes to the ground through the stand, as shown in Fig. 2, and as hereinbefore described.

The induction-coil may be dispensed with by using a battery of high tension and small quantity; but this method would not be so economical in practice as the one hereinbefore described.

In my patent of July 27, 1875, hereinbefore mentioned, I have shown that rhythmical vibrations in a primary circuit corresponding to any given musical tone or any given number of tones simultaneously produced are correspondingly produced inductively in a secondary circuit, and that when these vibrations were passed through animal tissue, in contact with a receiver, such as described, the tones were audibly and accurately reproduced.

My present invention contemplates not only the production of musical tones, but sounds of every character and so that any noise, whether consisting of spoken words, musical tones, or other sounds, made or uttered in the transmitter or in its immediate vicinity, would be reproduced audibly at the receiving end of the line on the revolving plate.

I do not, therefore, claim the use of an animal-tissue receiver for the reproduction of musical tones, in combination with a transmitter only adapted to send such tones, as this constitutes the subject-matter of the patent hereinbefore mentioned.

What I claim herein as new, and desire to secure by Letters Patent, is—

The combination, in a telegraphic circuit, of a telephonic transmitter capable of transmitting articulate sounds or spoken words with a receiver capable of reproducing such sounds or words through the intervention of animal tissue in frictional contact with said receiver.

In testimony whereof I have hereunto subscribed my name.

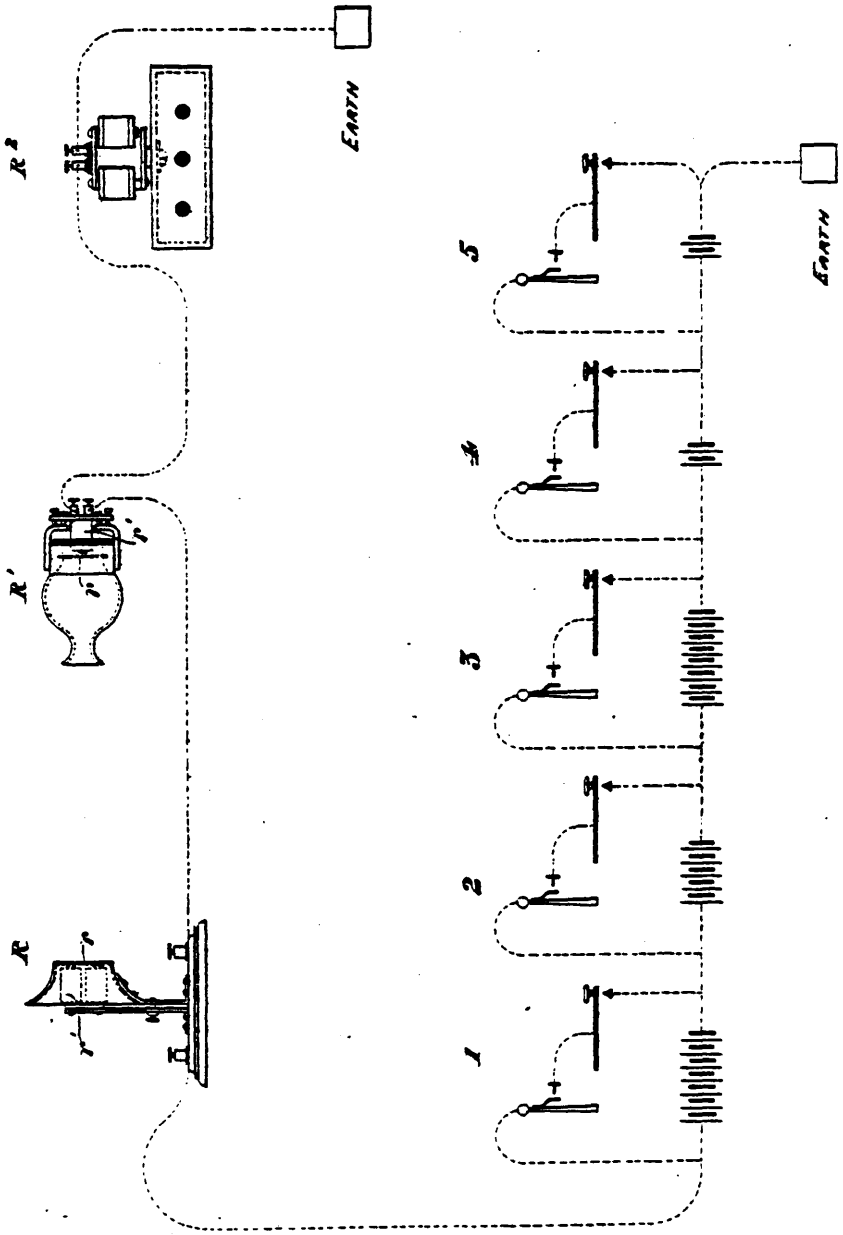
ELISHA GRAY.

Witnesses:
JOHN F. PARET,
DAVID M. ERSKINE, Jr.

E. GRAY.

Art of Transmitting Rhythmical Vibrations in an Electric Circuit

No. 205,378. Patented June 25, 1878.



WITNESSES

Wm A Skinkle

Geo. W. Breck.

INVENTOR

Elisha. Gray.

By his Attorneys

Baldwin Hopkins & Peyton

UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN THE ART OF TRANSMITTING RHYTHMICAL VIBRATIONS IN AN ELECTRIC CIRCUIT.

Specification forming part of Letters Patent No. **205,378**, dated June 25, 1878; application filed April 9, 1878.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful improvements in the art of generating and transmitting through an electric circuit rhythmical impulses, undulations, vibrations, or waves, representing composite tones, musical impressions or sounds of any character or quality whatever, and of audibly reproducing such vibrations; and also in apparatus for so generating, transmitting, and reproducing such impulses, undulations, vibrations, or waves, of which improvements the following is a specification:

In Letters Patent of the United States Nos. 166,095 and 166,096, granted to me July 27, 1875, in the caveat filed by me February 14, 1876, and in sundry applications for Letters Patent for improvements in electric telephony filed October 29, 1877, I have shown devices intended to operate as common receivers and reproducers of all sorts of rhythmical vibrations representing sounds of whatever kind or quality with reference to the number of tones simultaneously transmitted, received, and reproduced, and their relations to each other in respect to amplitude, rate, &c.

In an application for Letters Patent filed by me February 23, 1875, for improvements in the art of transmitting musical impressions or sounds telegraphically, and in apparatus for so transmitting such sounds or impressions, I have shown devices for transmitting musical sounds, and one method of arranging the same on an electric circuit to produce the desired results, including the relation of the main battery to the line and instruments at each end, and described the effects produced.

In Letters Patent No. 186,340, granted to me January 16, 1877, I have shown and described a method of and apparatus for generating, transmitting, and reproducing in an electric circuit rhythmical impulses, undulations, vibrations, or waves, as well as an improved method of connecting the transmitting apparatus to the line and main battery, so that any tone of a series could be transmitted without interference with the power used for transmission of another tone, and so that two or any greater number of tones could simultaneously be transmitted, received, and reproduced, preserving their individuality as perfectly as the same would be preserved in passing through the air. This patent also showed a closed circuit, in which a continuous current from a main battery kept a reproducing and receiving magnet constantly charged, and devices for varying the power or electro-motive force of the current by superposing thereupon the vibrations or undulations generated by the transmitters.

In Letters Patent No. 175,971, granted to me April 11, 1876, for improvements in telephonic telegraph apparatus, I have shown a series of receivers so constructed that each receiver, which consists of a resonant box with a magnet having a tuned armature mounted upon it, will only respond to the particular note to which it is adapted, this apparatus, in practice, being arranged upon circuit, as shown in my patent of January 16, 1877, No. 186,340, above mentioned.

By having a number of receivers tuned to all rates of vibration, with correspondently-tuned transmitters, it is possible to transmit and receive composite sounds varying greatly in respect to quality, rate, &c. For instance, the different vowel sounds may be transmitted and received by this apparatus, providing that the receivers are of the proper relation to each other, and all arranged near together, so as to get the composite effect of the tone sent through the wire.

Such an apparatus constitutes the subject-matter of a division of this application, filed May 18, 1878.

To render the vowel sound A, for instance, I would transmit a composite tone, the simple elements of which would bear the following relations to each other. The amplitude of vibration of any simple tone which goes to make up the composition of a vowel or any sound is determined in this case by the number of cells of the battery used by the transmitter of that particular tone. Let us assume, as a basis for the fundamental or lowest tone in the clang or composition of tones one hundred vibrations per second. The vowel A is composed of five simple tones. If, as we have assumed, the first or fundamental tone have one hundred vibrations per second, the second tone will have two hundred, the third

three hundred, the fourth four hundred, and the fifth five hundred. These tones, however, to producet he desired effect, must not all have the same amplitude or loudness; the second tone should be rather moderate in strength, which will be accomplished by giving it fewer cells of battery; the third, much greater amplitude, as this is the characteristic note of the clang, to accomplish which we add a greater number of cells of battery; while the fourth and fifth are added with a feeble amplitude. It will be seen that by this arrangement we are able to control not only the number of tones transmitted, but their relations with respect to rate and amplitude.

My present invention constitutes an improvement upon the invention set forth in the patents and applications above recited, and contemplates the combination, in an apparatus for generating and transmitting vibrations, impulses, or waves representing composite tones of a closed circuit, a series of transmitters vibrating at such relative speeds as to produce the fundamental and harmonics of the tone to be transmitted, a main battery so arranged as to give each transmitter the desired relative amplitude of vibration, and a common receiver, or one capable of reproducing tones of every variety and quality.

The subject-matter claimed will hereinafter specifically be designated.

The accompanying diagram represents an arrangement upon circuit of generating, transmitting, and reproducing apparatus for carrying out my improvement, three different varieties of common receivers or reproducers being shown.

The different sections, 1 2 3 4 5, of the main battery, it will be observed, are arranged, as to number of cells or electro-motive force, with respect to the amplitude of vibration or wave desired in each of the tones of the composition.

The diagram shows three different kinds of receivers, R R^1 R^2, each capable of reproducing composite tones or sounds of every character. It is deemed unnecessary to describe in detail the construction of the apparatus employed, more than to say that it comprises main and local batteries, an apparatus for generating and transmitting vibrations representing the composite tone to be transmitted, a receiving apparatus capable of reproducing such tones, and a closed circuit through which a continuous current flows to keep the magnets permanently charged. The arrangement of circuit is similar to that shown in my patent of January 16, 1877, above mentioned, while the transmitters represented in the diagram are similar to those shown in Letters Patent No. 165,728, granted to me July 20, 1875. Each transmitter is operated by its respective local battery, omitted for convenience of representation. The receivers R R^1 are similar to those shown in sundry applications for Letters Patent of the United States filed by me October 29, 1877, and consist (speaking generally) of a diaphragm, *r*, adjustably arranged relatively to an electro-magnet, *r'*. The receiver R^2 consists of an electro-magnet mounted upon a sounding-box in a way that will be readily understood from the drawings, and (like the others) is capable of reproducing tones of all varieties and qualities.

It will be observed that my arrangement of batteries and transmitters admits of an unlimited variety of adaptations and combinations in respect to number and character of tones as to amplitude, rate, &c., so that when the quality of any tone is once determined by analysis it may be reproduced by my combination by the organization of the several parts relatively to each other.

The operation of my invention will readily be understood from the accompanying description. When it is desired to transmit a composite tone of a particular clang, I depress the keys which bring into operation such batteries and transmitters as an analysis of such clang dictates we should use. To transmit a sound of different quality, depress a different set of keys, arranged, as before stated, with reference to the necessities of the case.

It is unnecessary to go into a detailed analysis of a great variety of sounds, as the principle involved is fully set forth in the case already given.

From the above it is easy to conceive that composite tones may be mechanically transmitted by a proper arrangement of transmitters, batteries, &c.

What I claim as of my own invention, and desire to secure by Letters Patent, is—

The combination, substantially as hereinbefore set forth, in an apparatus for generating and transmitting vibrations, impulses, or waves representing composite tones, of a closed circuit, a series of transmitters vibrating at such relative speeds as to produce the fundamental and harmonics of the tone to be transmitted, a main battery so arranged as to give each transmitter the desired relative amplitude of vibration, and a common receiver, or one capable of reproducing tones of every variety and quality.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:
GEO. B. CUMMINGS,
D. M. ERSKIN, Jr.

(No Model.)

W. W. JACQUES.

SYSTEM OF ELECTRICAL COMMUNICATION.

No. 246,887. Patented Sept. 13, 1881.

Fig. 1.

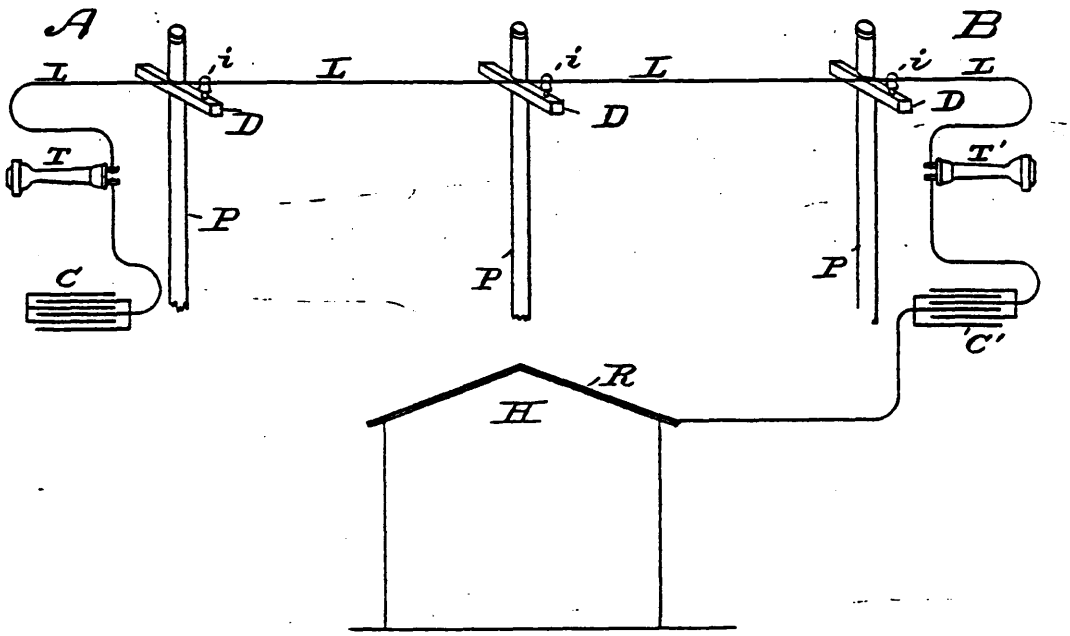
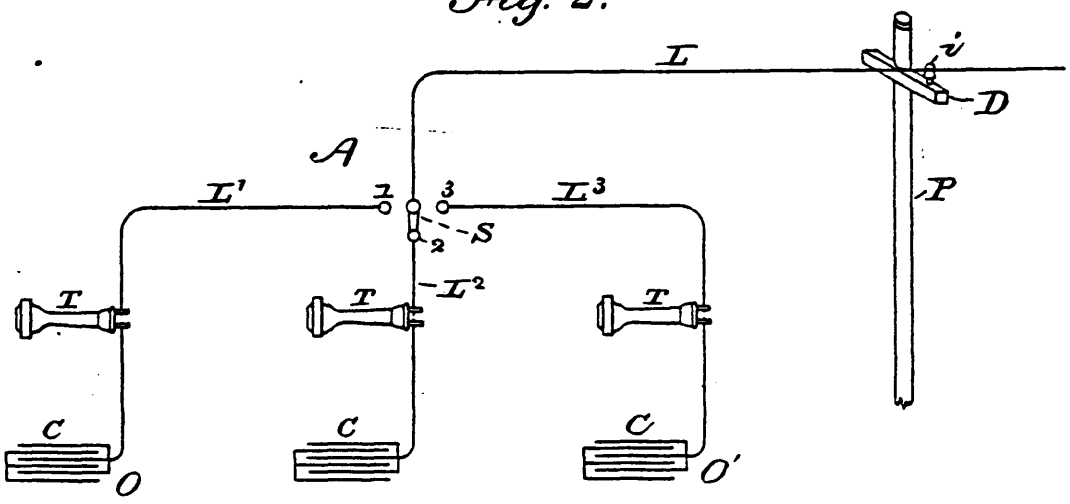


Fig. 2.



Witnesses.
J. B. Henck, Jr.
Thomas D. Lockwood

Inventor.
William W. Jacques.

UNITED STATES PATENT OFFICE.

WILLIAM W. JACQUES, OF BOSTON, MASSACHUSETTS.

SYSTEM OF ELECTRICAL COMMUNICATION.

SPECIFICATION forming part of Letters Patent No. 246,887, dated September 13, 1881.

Application filed May 27, 1881. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. JACQUES, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Systems of Electrical Communication, of which the following is a specification.

My invention relates to improvements in electrical circuits and conductors, and has for its objects the avoidance of the electrical disturbances incident to the use of the ground when employed as a means of completing the circuit of a line of electrical communication, and also the avoidance of similar disturbances which originate from the passage of any extraneous currents, which take the electric wires as a ready and easy path to the earth.

Experience has demonstrated that all lines constructed for electrical correspondence, except metallic circuits, are affected by earth-currents, which vary considerably in strength and direction at different hours of the day and night, although at no time are the wires totally free from their influence. These currents are chiefly caused by the connection formed by the wire between different portions of the earth's surface having different electrical potentials, and they interfere with the proper working of the line to a considerable extent. When the receiving-instrument of such conducting-wires is of very delicate construction, responding readily to slight changes or variations of current—such, for example, as a telephone—the disturbances so caused, as also the disturbances due to the extraneous currents hereinbefore referred to, become a source of serious annoyance and inconvenience. They manifest themselves by a confused murmur which is heard in the telephone, and which becomes at times so intense as to be intolerable. It then drowns and confuses conversation which is being carried on, rendering it impossible to understand the words which are transmitted on the telephone-line. These interposing currents may and have heretofore been prevented from entering and flowing in the circuits by the employment of a second wire returning to the originating-station, thus forming the circuit entirely of wire, and rendering the introduction of the earth into the circuit and its employment as a return entirely unnecessary. This plan has, however, certain disadvantages.

The use of a metallic circuit or wire return in lieu of the employment of the earth in that capacity necessarily implies double the cost for line-wire and a double amount of labor in stringing the same. Moreover, in view of the fact that nearly all ordinary lines are ground-circuit lines, it is evident that the act of connecting an ordinary grounded circuit to each end of a metallic circuit would in effect reduce the entire system once more to a grounded circuit, thus annulling all the advantages previously gained.

By my inventions these evils are obviated. To that end, instead of connecting the line-wire to the ground at each terminal, I connect it to one side of a large condenser, the other side of which is either left entirely open and insulated, or else is connected to a large mass or surface insulated from the earth—such, for example, as a tinned roof.

The following description of my invention will enable those skilled in the art to which it appertains to apply and use it, reference being had to the accompanying drawings, which form a part of this specification, and in which the several figures represent dispositions of the circuits in accordance therewith.

In Figure 1 is shown a telephone-line, L, to which my invention is applied at each of the two terminal stations A and B, the mode of application at A differing slightly from that employed at B. Fig. 2 exhibits the arrangement of circuits at a terminal station, showing the mode of connecting a trunk telephone-line provided with my invention to the several short wires radiating from the said terminal station.

In Fig. 1, L is the line-wire, supported as frequently as may be necessary by the insulators *i*, fixed on the cross-arms D of the poles P. It is shown as terminating in one plate or series of plates of a condenser, C, at one station, A, after passing through the coil of the necessary instruments, which in this case are represented by the telephone T, the opposing plates of the condenser being left completely insulated or unattached to any conductor. At the other terminal station, B, of the line L the connections are similarly made, the only variation being that in this case I have shown the opposite series of condenser-plates connected to the roof R of the house H, the object to be gained being a largely-increased surface or mass, and

a corresponding increase in the capacity of the condenser. No connection at either end is made with the earth.

In Fig. 2 the incoming line L, arriving at the central station, A, is connected by the switch S through the wire L^2 to the telephone and ungrounded condenser C. L′ and L^3 are branch lines, which may, of course, be indefinitely increased in number, be of any desired length, and be constructed to any desired point. Each branch line likewise terminates at the several stations *o o′* in a condenser or similar reservoir of electricity having its opposite side insulated or connected to any convenient surface of metal or other conducting material of considerable size. These branches may, in a telephone-exchange system, represent the several subscribers' lines, and by means of the usual switches or circuit-changers may readily be connected to the main line L or to one another.

Although the instruments are in each drawing represented as telephones, my invention may be applied in a similar manner and with equal facility to lines furnished with any form of instrument operated by currents of electricity, such application being only limited by the degree of delicacy of operation possessed by the instruments so employed.

I am aware that receiving-telephones have been constructed which operate by the attraction between two or more plates of metal, which bear to one another the relation of two plates of a condenser, such attraction being caused by a static charge of electricity communicated to one of the plates, and that in such telephones the opposite plate has been either completely insulated or connected to a mass of metal, and I do not claim any such combination. My invention is essentially different, in that no special form of telephone is necessary.

I have obtained good results, both as regards distinct articulate speech and freedom from earth-current disturbances, from the hereinbefore-described arrangement by the use of condensers having a capacity of nine microfarads, and telephonic transmission is completely practicable when condensers are employed having a much smaller capacity. It will be found, however, in practice that the transmitted signals or sounds increase in volume and distinctness as the capacity of the condenser is increased.

It is perfectly practicable and may in some cases be desirable to connect branch lines to a main line terminated in the manner described by looping them from the main line at a point or points between the terminals of said main line. This being an obvious and self-evident arrangement, I have not considered it as necessary to be delineated in the drawings.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a line for electric signaling or communication, the line-wire having electrical receiving-instruments connected therein, and being itself connected with a condenser of which one side is insulated or connected with an insulated conductive mass and the other with the said line-wire, substantially as described.

2. At the terminal stations of a telegraph or telephone line, the combination of a telephone or other receiving-instrument adapted to be operated by a current or currents of electricity with a condenser one side of which is connected through the said receiving-instrument to the line-conductor, the other being completely insulated or connected to an insulated mass or surface of metal or other conducting material.

3. The combination, in a telephone-exchange system, of a main line unconnected with the ground, a condenser one side of which is connected to the said main line, the other side being insulated or connected to an insulated conducting mass or surface, a series of branch or subscribers' lines each similarly provided with and terminating in a condenser, which is connected in the manner indicated, and the subscribers' telephones or receiving-instruments in said branch circuits, substantially as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 24th day of May, 1881.

WILLIAM W. JACQUES.

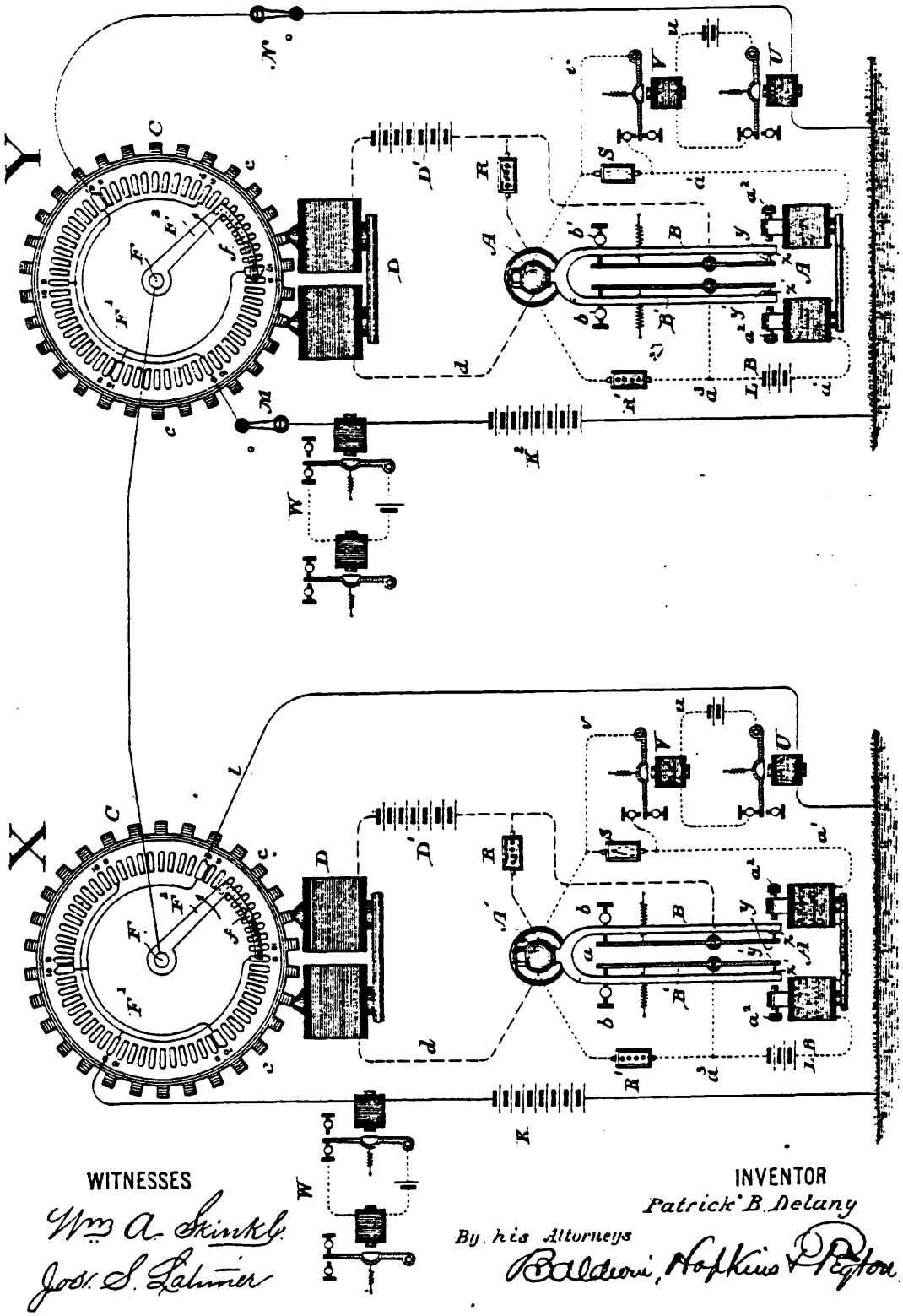
Witnesses:
J. B. HENCK, Jr.,
THOS. D. LOCKWOOD.

(No Model.)

P. B. DELANY.

ELECTRICAL SYNCHRONOUS MECHANISM.

No. 286,281. Patented Oct. 9, 1883.



WITNESSES

Wm A. Skinkle

Jos. S. Latimer

INVENTOR

Patrick B. Delany

By his Attorneys

Baldwin, Hopkins & Peyton

UNITED STATES PATENT OFFICE.

PATRICK B. DELANY, OF NEW YORK, N. Y., ASSIGNOR TO THE STANDARD ELECTRIC MANUFACTURING COMPANY, OF SAME PLACE.

ELECTRICAL SYNCHRONOUS MECHANISM.

SPECIFICATION forming part of Letters Patent No. 286,281, dated October 9, 1883.

Application filed August 6, 1883. (No model.)

To all whom it may concern:

Be it known that I, PATRICK B. DELANY, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Electrical Synchronous Mechanism, of which the following is a specification.

My invention has special reference to that class of apparatus shown and claimed in an application for Letters Patent filed by me April 12, 1883, serially numbered 91,489; and the general organization of the apparatus illustrated in the drawings attached hereto is the same as that set forth in said application, with two exceptions, which constitute the subject-matter of my present invention, and are hereinafter specifically described.

My invention consists in an improved means of controlling the motor-circuit at each station, so as to vary the speed of the actuating apparatus at each station, and, second, an arrangement by which the operator in charge at one station can tell when correcting-impulses of electricity leave his station to correct the speed of the apparatus at the distant station.

In the accompanying drawings, Figure 1 is a diagrammatic plan view of two electrically-connected stations arranged according to my invention.

The two stations X and Y are connected by a main line and circuit-breaker, consisting in this instance of a vibrator-fork, *a*, at each station, which is automatically vibrated by a local battery, L B, and magnet A, the circuit of this local battery being marked *a'* and indicated by the fine dotted lines. The poles of the vibrator-magnet A are provided with extension-screws a^2, of magnetic metal, so that they may be approached to or withdrawn from the tines of the fork to regulate their rate of vibration. Platinum contacts *x x'* on the inner faces of the fork-tines make and break contact with spring-fingers *y y'*, carried by adjustable insulated arms or levers B B', pivoted upon the bed-plate of the apparatus, and adjusted by thumb-screws *b*, against which they are drawn by spiral springs. The local circuit indicated by the fine dotted line runs from the positive pole of the battery through the coils of the vibrator-magnet to the head of the fork, and through contacts *x' y'* to the insulated lever B', and thence back to the opposite pole of the battery. A resistance, R', is placed around the contacts *x* and *y*, to prevent sparking, being run from the point a^2 to the head of the fork. When the fork is mechanically started into vibration, its local circuit will be made and broken in the ordinary way, and its vibration maintained continuously. The contact *x* on the opposite tine of the fork makes and breaks contact with the finger *y* as the fork vibrates, thus opening and closing a local circuit containing a battery and magnet which continuously rotate the transmission apparatus C. This motor-circuit is indicated by broken lines, and runs from the positive pole of the battery D' to lever B, contact-finger *y*, contact *x*, head A' of the fork, and, by wire *d*, through the coils of the motor-magnet D D to the opposite pole of the battery. A resistance, R, is thrown around the contacts *x y*, to prevent sparking.

The rotary transmission apparatus C, which is provided with armature-teeth *c*, is actuated by the magnet D D. This apparatus consists of a stationary table of contacts, F', arranged concentrically around the vertical rotating shaft F, which is driven by the armature-wheel C and is connected with the line. A trailing finger or circuit-completer, *f*, which traverses the contacts, is carried by a radial arm, F², projecting from the shaft. It is deemed unnecessary further to describe this apparatus, as it is fully illustrated and described in detail in my application for improvements in telegraphy, filed April 12, 1883, serially numbered 91,493.

I have shown sixty contact-pieces in the circular table of contacts, which are numbered from 1 to 10 in six independent sets or series. These contacts, except those numbered 9 and 10, may be connected in any suitable order or groups for any purpose desired, as fully set forth in my two applications above mentioned. When the trailing contact-fingers *f* at both stations are upon the contacts bearing the same number, the corresponding instruments, whatever they may be, connected to these contacts at each station will be placed in communication over the line, and as the fingers at both stations continue to move synchronously they will pass to the next contact, successively, over all the contacts at each station. During the

moment when the moving fingers are upon the correspondingly-numbered contact-pieces at each station, the circuit from the contact at one station to that at the other is complete and independent of all the other circuits.

In order to maintain the synchronous movement of the apparatus at both stations, I arrange the 9 and 10 contacts as follows: At station X three of the 9's farthest removed from each other are connected together and to a battery, K, and that three of the 10's farthest removed from each other are connected to each other and to line *l*, which leads to the correcting and regulating devices, which will be hereafter described. The remaining three intermediate 9's and 10's are unconnected with any circuit. At station Y the 9's corresponding to those connected with the battery at station X are unconnected, while the alternate 9's are connected with the battery K'; and the 10's at Y which are connected with each other and with the correcting devices through the line *l* correspond with those which are unconnected with station X, the remaining 10's at Y being unconnected. At both stations the three 10's which are connected with the correcting devices through the line *l* are built out or extended toward the adjoining 9's which are not connected with any circuit.

Thus far the organization described is precisely similar to that set forth in my two applications above mentioned. When the trailing contact-fingers at both stations are moved synchronously, so long as they rest upon correspondingly-numbered contacts at the same moment, there will be no occasion for correction of either apparatus. If the apparatus at Y, however, runs a trifle faster than that at X, the finger *f* at station Y will touch the extended side of a 10 contact, while the finger at X is still on a battery-connected 9. An impulse of electricity will be sent from the battery K, at station X, over the line and through the contact 10 and line *l*, to the correcting devices at that station. Exactly the same operation occurs if the apparatus at X moves faster than that at Y. The means for utilizing these correcting-impulses to control the speed of the apparatus at the station receiving them constitutes the first part of my present invention.

The apparatus is shown as organized for the transmission of retarding impulses from one station to another, and I make them effective by cutting a resistance out of the vibrator-circuit whenever a correcting impulse is received. The effect of this is to increase the electro-motive force of the local vibrator-circuit and the power of the electro-magnets A, so that they act upon the tines of the fork with a greater force, thus increasing the amplitude of vibrations but slowing the rate. This retardation of vibration will of course effect the speed with which the motor circuit is made and broken, and consequently retard the rotation of the trailing finger.

The vibrator local circuit (indicated by the fine dotted line) works ordinarily through an adjustable box of resistances, S. When the apparatus at one station runs too fast, however, and a correcting impulse of electricity is received through the main line and line *l*, the relay U in that line is energized, so that its armature is drawn from its back stop, thus breaking its local circuit *u* and permitting the armature of a second electro-magnet V to fall to its back stop, which completes a shunt-circuit, *v*, around the resistance S, so as to cut it out of the vibrator-circuit. The electromotive force of the vibrator-circuit is therefore momentarily increased, the vibration of the fork momentarily retarded, and the rotation of the trailing finger slowed so that it drops back upon the proper contact.

The operation of the apparatus is the same at both stations. The operator at either station can always tell when the correcting impulse is received by the stroke of the relay V. In order to enable him also to know when the correcting impulse is sent from his station to the distant station, I place a relay and sounder, W, in the correcting-battery circuit at each station between the 9-contacts and the ground. Both operators can therefore tell the way the apparatus is working, and which is running faster than the other.

In starting the apparatus, the instrument at X is put in motion by starting the vibrator and imparting an impulse of rotation to the vertical shaft F, and the adjustment of the two apparatus is completed at station Y. At that station the operator also starts his apparatus and closes the switches M N. By means of the relay V, which cuts the resistance out of the fork-circuit, and sounder W, controlled by the relay in the circuit of the battery K, from which correcting impulses are sent to the distant station, the operator can tell which apparatus is running faster, and can adjust his own apparatus until the absence of any stroke on the two tell-tales indicates that the apparatus at the two stations are running synchronously. The box of resistances S may of course be provided with plugs or any other means for regulating the amount of resistance normally included in the local circuit.

While I have described my present invention with special reference to one form of apparatus, it is obvious that the invention is adapted to the sending of accelerating impulses as well as retarding impulses, and that it may be applied also to the organizations shown in other applications in electrical synchronous movements filed by me April 12, 1883, and serially numbered 91,490, 91,491, and 91,492.

It will be observed that when a correcting impulse of electricity actuates the relay U the moment the relay-armature leaves its back stop the local circuit *u* is broken, and the armature of the second relay, V, is instantaneously drawn to its back stop, thus completing the shunt around the resistance S. The adjustment of the armature of the relay U is very delicate, so that it responds immediately to any correct-

ing impulse, while the spring of the armature of the relay V is of comparatively high tension, so that it moves to its back stop instantaneously. This plan of making the correcting impulse effective when the armature of the relay U leaves its back stop I consider very important, as the corrections are practically instantaneously made effective, whereas, if they were not made effective until the armature of the relay had been drawn to its front stop, the action of the correcting devices would be sluggish. This feature of my invention is not limited to the intervention of the relay V between the first relay and the shunt-circuit, nor to any particular manner of utilizing the correcting impulses; but I consider my invention broadly to consist in the feature of making the correcting impulses effective when contact with the back stop of the relay is broken.

In my prior application filed April 12, 1883, and serially numbered 91,489, above referred to, I have described the way in which the apparatus at the two stations is brought into synchronism by a rather exact manipulation of the devices. I have found in practice, however, that where the apparatus at the two stations is running at approximately the same speed within liberal limits, and the switches all closed, (and this the operators can readily tell by the strokes on the tell-tales,) that the apparatus will of itself, in a few moments, come into synchronism without the intervention of the operators.

It will be apparent that if the circuit-completer at one station is traveling more rapidly than that at the other, its excess of speed soon causes it to overtake the circuit-completer at the other station and bring them both into such relation to the battery-connected 9's and correcting 10's that the correcting impulses will thereafter maintain them in the correct position.

Any subjects-matter herein shown or described, but claimed in cases 91,488, 91,489, 91,490, 91,491, 91,492, or 91,493, filed April 12, 1883, are disclaimed herein.

I claim as my invention—

1. The combination, substantially as set forth, of electrically-controlled sychronous apparatus with means for automatically changing the resistance of the circuit which controls the movement of said apparatus whenever a correcting impulse of electricity is received.

2. The combination, substantially as set forth, of synchronously-actuated apparatus, a correcting-battery at one station, means for transmitting a correcting impulse of electricity to a distant station whenever the apparatus at said distant station runs out of time with that at the first station, and an indicator or sounder placed in the correcting battery-circuit at the first station to indicate when correcting impulses of electricity are sent from that battery.

3. The combination, substantially as set forth, with synchronous electrically actuated and controlled apparatus, of devices for indicating when controlling or correcting impulses of electricity are received from a distant station, and also when correcting impulses of electricity are transmitted to a distant station.

4. The combination, substantially as set forth, of electrically-controlled synchronous apparatus, means for automatically correcting the speed of said apparatus at one station by a correcting impulse of electricity when it runs out of time with that at a distant station, and a relay worked by the correcting impulses, which makes such correcting impulses effective upon the apparatus to be corrected when the relay-armature leaves its back stop.

5. The combination, substantially as set forth, of electrically-controlled synchronous apparatus, means for automatically changing the resistance of the circuit which controls the movement of said apparatus whenever a correcting impulse of electricity is received, and a relay which permits such correcting impulse to become effective when the relay-armature leaves its back stop.

In testimony whereof I have hereunto subscribed my name.

PATRICK B. DELANY.

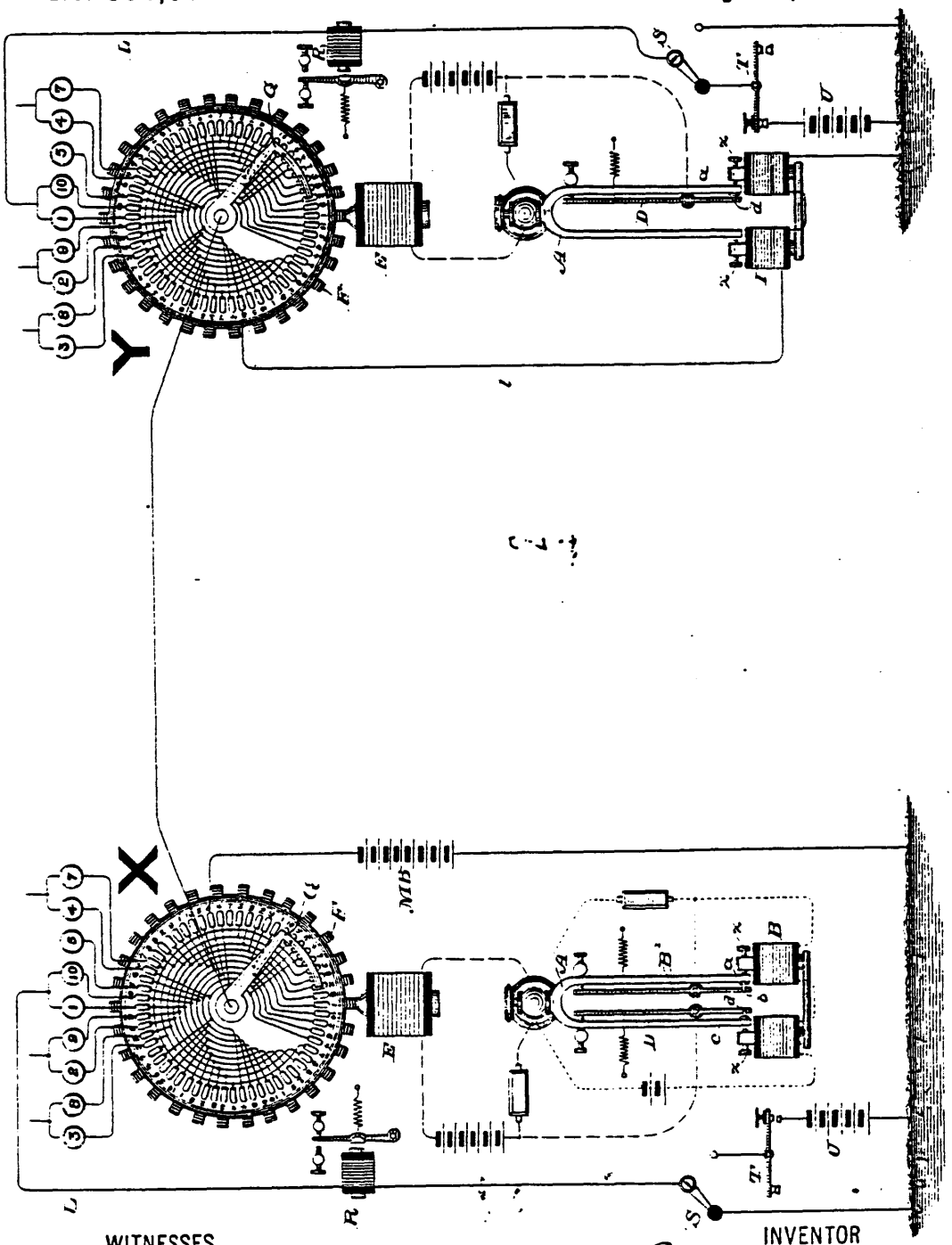
Witnesses:
NELLIE HOLMES,
E. C. DAVIDSON.

(No Model.)

P. LA COUR.

SYNCHRONOUS TELEGRAPHY.

No. 302,502. Patented July 22, 1884.



WITNESSES

Wm. A. Skinkle

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INVENTOR

Poul la Cour,

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UNITED STATES PATENT OFFICE.

POUL LA COUR, OF COPENHAGEN, DENMARK, ASSIGNOR TO FRED P. JONES, OF PORTSMOUTH, NEW HAMPSHIRE.

SYNCHRONOUS TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 302,502, dated July 22, 1884.

Application filed February 13, 1884. (No model.)

To all whom it may concern:

Be it known that I, POUL LA COUR, a subject of the King of Denmark, and a resident of the city of Copenhagen, in the Kingdom of Denmark, have invented certain new and useful Improvements in Synchronous Telegraphy, of which the following is a specification.

My invention is based upon the synchronous movement of two sets of apparatus connected by an electric circuit; and it consists in the arrangement or grouping of a series of independent contacts into different circuits for multiplex transmission.

In Letters Patent of the United States No. 203,423, granted to me May 7, 1878, I have shown an instrument in which, by the electro-magnetic vibration of a reed or fork, a motor-circuit is intermittently made and broken. This motor-circuit contains an electro-magnet, the pole or poles of which act upon teeth on the periphery of an armature ring or disk, the makes and breaks in the circuit causing a continuous and rapid rotation of the disk.

The apparatus herein illustrated is represented somewhat diagrammatically, though it fully illustrates the method of operation. For a detailed description of the instrument, however, reference is hereby made to my patent above mentioned.

The accompanying drawing is a diagrammatic view illustrating two electrically-connected stations arranged according to my invention.

At station X I have illustrated diagrammatically the apparatus shown in my patent. A fork, A, tuned to a given pitch, is vibrated by the magnet B, included in a local circuit, (shown by dotted lines,) the circuit being automatically made and broken between the tine *a* of the fork and a light contact-finger, *b*, carried on an adjustable lever, B'. The opposite tine of the fork, *c*, as it vibrates, makes and breaks contact with a light contact-finger, *d*, on an adjustable lever, D. The tine *c* and the contact *d* are included in a local circuit, (shown by broken lines,) in which the motor-magnet E is placed. This magnet acts upon a toothed armature-disk, F, and causes its continuous rotation. Fast upon the axis or rotating shaft of the armature-disk a contact-finger, G, is mounted, which, in its rotation, sweeps over a concentric circle of independent insulated contact-pieces. There are sixty contacts represented on the circular table, numbered from 1 to 10, for convenience of description, in six independent series. The main line is connected with the contact-finger G, and at the other station, Y, is connected to a like finger, which sweeps a like table of contacts, and is actuated by the rotation of the toothed wheel or armature-disk, caused by the makes and breaks in the local circuit, which includes the motor-magnet E, as at station X. The makes and breaks in this local circuit are caused by the vibration of the fork A, which is tuned to the same pitch, and consequently has the same rate of vibration as the fork at station X. At station X six of the contacts—say the contacts numbered 6 in each series—are connected together and, through a battery, M B, with the ground. At station Y the corresponding six contacts are connected together, and by a line, 1, through the coils of a magnet, I, and thence to ground. This magnet is placed to act upon the tines of the fork, as is the one illustrated at station X. The poles of the magnets I and B are provided with adjustable or screw pole-pieces *x*, by the adjustment of which the vibration of the forks may be controlled, so as to adjust them to unison in case of any disturbance or want of synchronism, as is presently described.

I will now describe the grouping or connection of the contacts in independent circuits, which constitutes the subject-matter claimed in this application.

The contacts 1 2 3 4 5 7 8 9 10 in each series are connected together and to a correspondingly-numbered binding-post, as clearly shown at both stations. The binding-posts numbered 1 and 10 are connected together and with a line, L, in which a relay, R, switch S, key T, and battery U are placed. By means of the switch S the line may be either put direct to ground or connected with the key and battery in the usual way. The 1's and 10's at the other station are similarly connected with the line, which is equipped in the same way. At each station the 3's and 8's, the 2's and 9's, and the 4's and 7's are shown as simi-

larly joined, and each pair is to be connected with a line equipped with instruments, as just described. It will be seen, therefore, that there are four independent sets of telegraphic instruments at each station. The 5-contacts are shown unconnected with any circuit.

It will be obvious that the line L, connected with the contacts 1 and 10, will be connected with the trailing contact-finger or circuit-completer, and through said finger with the main line twelve times in each revolution of the finger; and if the finger rotates three times a second (more or less) there will be about thirty-six completions of contact per second of the line L with the trailing-finger and the main line. This occurs at both stations. Obviously, therefore, if the trailing-fingers at both stations simultaneously rest upon the corresponding 1 and 10 contacts, there will be a completion of the circuit from the instruments in the line L at one station to the corresponding instruments at the other station. These completions of the circuit are independent of all the other contacts, and are so rapid that the circuit is practically continuous for Morse transmission, and the operators are not aware that the circuit is at any time broken or taken from them. The same is true of instruments connected with the other pairs of contacts—namely, the 3's and 8's, the 2's and 9's, and the 4's and 7's—so that if the trailing-fingers at each station move synchronously there are four independent telegraphic circuits, which may be worked in the ordinary way with as much freedom as if each pair of operators had a separate line devoted to their own use.

The synchronous rotation of the trailing-fingers at the two stations is obtained in the following way: The forks, which are tuned as nearly as possible to the same pitch, consequently have the same or approximately the same rate of vibration; and when these forks are vibrated the two disks at the stations will be rotated at substantially the same speed. The forks at both stations having been mechanically started into vibration and an impulse of rotation imparted to the toothed disks, the circuit-completers at each station will be caused to rotate. The vibrator-circuit of the fork at station X, being automatically made and broken, will cause the continuous vibration of the fork. The operators' instruments at both ends of the line are normally put to ground, as is usual, and if the apparatus at the two stations happen to start synchronously there will be no sound on the instruments at either of the stations, and it will therefore be known that the contact-fingers are rotating synchronously. If they continue to rotate in synchronism, six impulses of electricity will be sent from the battery M B at station X through the contacts numbered 6 at each station to the magnet I, and maintain the continued vibration of the fork at station Y. If the apparatus does not start synchronously, or having so started runs out of synchronism, the operator at station Y will be able to tell whether his fork is vibrating more slowly or more rapidly than that at the other station by the sounds on the telegraph-instruments, which will give a stroke whenever the circuit is completed from a 6-contact at station X through one of the contacts with which the instrument is connected at station Y. The order in which the instruments are caused to sound will indicate whether the fork at station Y is running faster or slower than that at station X. The operator therefore may adjust the screw pole-pieces on the magnet I so that the vibrating impulses received from station X will act to cause the fork to vibrate slower or faster, as may be desired. The apparatus at the two stations, having been once brought into synchronism, will continue to rotate at the same speed, being governed by the forks, which will continue to vibrate at the same rate.

I have shown and described my own synchronous system contemplated in my patent above mentioned. It is obvious, however, that the arrangement of contacts for telegraphic transmission or other purposes may be used in connection with other synchronous systems, and is not dependent upon the special system described, or upon any particular system. For instance, the invention is well adapted to the synchronous systems of Patrick B. Delany, patented October 9, 1883, in two of which patents, Nos. 286,273 and 286,278, the circuits and contacts are shown as grouped in substantially the manner herein illustrated.

No claim is made herein to the manner of obtaining and maintaining the synchronous movement of the two apparatus—that is, by impulses of electricity sent from the 6's at station X, which are all connected together and to a battery, M B, to the vibrator-magnet at station I, which, by means of said periodic transmitted impulses from the 6-contacts, maintains a fork at Y in constant vibration. Nor is any claim made to the manner of driving the toothed wheel; but what is desired to be covered in this application is the manner of grouping or distributing the independent series of contacts in the circle among several independent branch lines for the purpose of multiplex transmission.

I claim as my invention—

1. The combination of a main line, a series of independent contacts at each end of the line, two or more separate circuits or branch lines at each end of the main line, each of said branch lines being connected with two or more of said contacts, means, substantially such as described, for successively placing the main line at both ends in connection with said contacts, and means for synchronously actuating such circuit-completers.

2. The combination of a main line, a series of independent contacts at each end of the line, two or more separate circuits or branch lines at each end of the main line, in each of which two or more of the contacts placed at regular intervals in the series are connected

independently of the other contacts, means, substantially such as described, for successively placing the main line at both ends in connection with said contacts, and means for synchronously actuating such circuit-completers.

3. The combination of the main line, the circular series of independent contacts placed at each end of the main line, the trailing circuit completers or fingers permanently connected with the line, which traverse said contacts, means for synchronously actuating such fingers, and two or more branch lines at each end of the main line, in each of which two or more of the contacts placed at intervals in the circular series are connected independently of the other contacts.

4. The combination of a main line, a series of contacts at one end of the line, means, substantially such as described, for successively placing the line in connection with each of said contacts, and two or more branch lines, in each of which two or more of the contacts in the series are connected independently of the remaining contacts.

5. The combination of a single main line, a series of independent contacts at each end of the line, means for successively placing the line in connection with each of said contacts, means for synchronously actuating such circuit-completing devices, two or more branch lines, in each of which one or more of said contacts are connected independently of the other contacts, and instruments in the branch lines for either transmitting or receiving at either station.

In testimony whereof I have hereunto subscribed my name this 19th day of December, A. D. 1883.

POUL LA COUR.

Witnesses:
LUDVIG SCHRYDER.
POUL PEDERSEN.

(No Model.) 2 Sheets—Sheet 1.

P. B. DELANY.

TELEGRAPHIC TRANSMITTING APPARATUS.

No. 316,125. Patented Apr. 21, 1885.

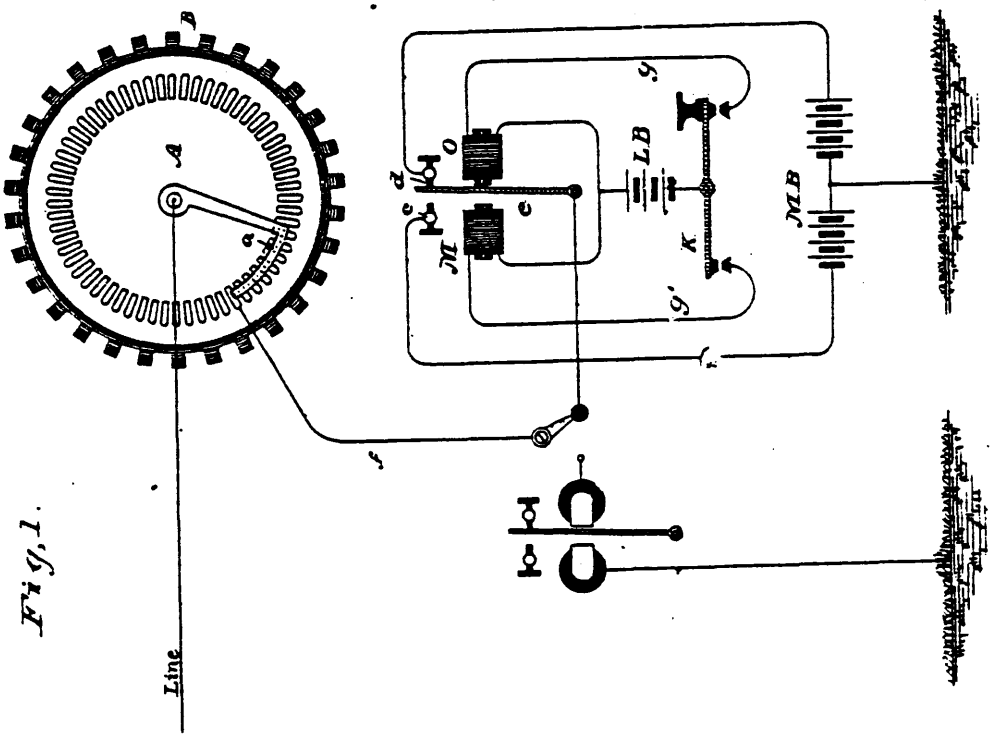

Fig. 1.

WITNESSES

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Henry A. Lamb

INVENTOR

Patrick B. Delany.

By his Attorneys

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(No Model.) 2 Sheets—Sheet 2.

P. B. DELANY.

TELEGRAPHIC TRANSMITTING APPARATUS.

No. 316,125. Patented Apr. 21, 1885.

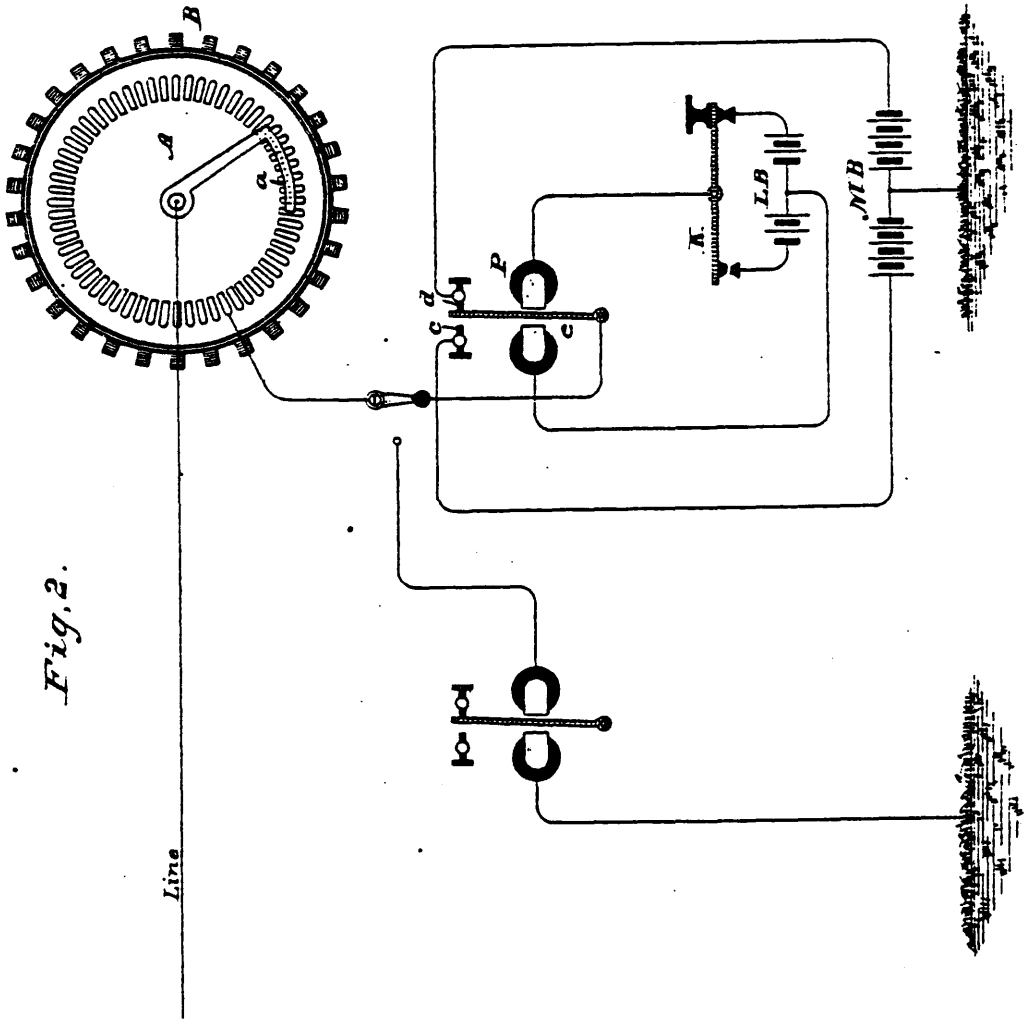

Fig. 2.

WITNESSES

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UNITED STATES PATENT OFFICE.

PATRICK B. DELANY, OF NEW YORK, N. Y., ASSIGNOR TO THE STANDARD MULTIPLEX TELEGRAPH COMPANY, OF SAME PLACE.

TELEGRAPHIC TRANSMITTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 316,125, dated April 21, 1885.

Application filed February 26, 1884. (No model.)

To all whom it may concern:

Be it known that I, PATRICK B. DELANY, of the city, county, and State of New York, have invented certain new and useful Improvements in Telegraphic Transmitting Apparatus, of which the following is a specification.

My invention relates to that class of transmitters in which an armature-lever actuated by an electro-magnet, in the circuit of which a key is placed, is used to throw the battery upon the line. In arrangements of this character heretofore the armature has been provided with an adjusting-spring, and usually, instead of transmitting from the ordinary rigid contacts against which the vibrating transmitting-armature works, it is customary to supplement the electrodes or rigid points of contact by yielding contacts, which will close the circuit more securely and remedy the defects in the contact caused by the rebound of the lever from a rigid limiting-point or contact-stop under the influence of its spring. These yielding contacts are liable to vibrate under a sudden blow or withdrawal of the armature.

The object of my invention is to insure an absolutely perfect contact by causing the armature-lever to be held tightly and firmly against its stop by the full power of the attracting-magnet, and I dispense with the retractile spring, which tends to lessen the firmness of its contact.

Under my invention, also, the lever moves with the greatest rapidity and precision from one stop to the other in response to the movement of the operator's key, and a substantially equal pressure on both its contact-stops is obtained regardless of variations in the strength of the local battery in which the key is placed.

The details of my invention are fully set forth below.

Figure 1 is a diagram view illustrating one form of my invention, and Fig. 2 a similar view illustrating another form of the invention.

In Letters Patent of the United States No. 286,278, granted October 9, 1883, I have shown a synchronous system of telegraphy to which the particular arrangement illustrated for transmitting with reverse currents is well adapted. I have therefore indicated in the drawings diagrammatically in each figure a table of contacts, A, a rotating armature-disk, B, and a trailing contact-finger, *a*, which traverses a series of contacts on the table, and I refer to said patent for a full exposition of this subject. The invention, however, is not limited to that particular system, but is applicable to the transmission of messages in any of the well-known telegraphic systems. It is therefore deemed unnecessary to particularly describe any system, as the operation of my invention will be perfectly plain to those skilled in the art.

Referring, first, to Fig. 1, the transmitting-battery MB is shown as arranged for reverse transmission. It is grounded in the middle, and its opposite poles are connected to opposite contact-stops, *c d*, between which a freely-vibrating armature, *e*, vibrates. This armature is connected through the line *f*, contacts, and trailing-finger of my synchronous system with the main line. The transmitting-key K is connected with one pole of a local battery, LB. Its front stop is connected in a branch circuit, *g*, which runs from the stop through the coil of an independent magnet, O, to the opposite pole of the battery. Its back stop is connected in another branch circuit which runs from the stop through the coil of an independent magnet, M, to the opposite pole of the battery. The freely-vibrating armature *e* is arranged between these opposed magnets, and is acted upon by them. When the key is upon its front stop, the magnet O firmly and promptly draws the free armature against the contact *d*, holding it there with a uniform unvarying pressure and putting one pole of the main battery MB to line. When the key is thrown on its back stop, the magnet O is demagnetized, and the magnet M is energized and promptly draws the armature against its contact *c*, thus putting the other pole of the battery to line. As the armature is a freely-vibrating one without bias and without a retractile spring, it remains in either of the positions into which it is drawn, and is held with unvarying pressure upon its contacts. This method of transmission gives the most perfect results, and prevents any weakness or uncertainty of contact between

the transmitting-electrodes. This arrangement is obviously adaptable for transmission from one pole of the battery only.

In Fig. 2 I have shown an arrangement substantially identical in its principal features. Under this arrangement, instead of the magnets M O, I employ a polarized relay, which is worked by a split local battery, LB. The main battery MB is sent to line in the same way. In this instance the armature *e* may also be said to become a freely-vibrating one, because it moves from one contact to the other under the combined influence of magnetic attraction and repulsion, as is well understood. With this arrangement also the contacts are firm, and most satisfactory transmission results. I prefer the arrangement, however, which is illustrated in Fig. 1, for the reason that each magnet is independent. No reversals occur in the coil of either magnet, and one magnet is resting while the other is at work. For this reason I consider that it possesses substantial advantages over the arrangement shown in Fig. 2, although, as before remarked, in the main principles of organization and operation they are identical.

In an application filed by me October 22, 1883, No. 109,716, I have shown an arrangement in which a freely-vibrating armature is vibrated by independent alternately energized magnets, and I therefore make no such claim in this application.

I claim as my invention—

1. The local transmitting arrangement consisting of the combination, substantially as set forth, of a transmitting-key, a local circuit in which the key is included, which circuit is closed when the key is on its front stop, a separate or branch circuit which is closed when the key is on its back stop, a freely-vibrating armature which is acted upon electro-magnetically by said circuits, a main line, and a transmitting-battery which is thrown upon the line by the vibrations of said armature.

2. The local transmitting arrangement consisting of the combination, substantially as set forth, of a transmitting-key, a local circuit in which the key is included, which circuit is closed when the key is on its front stop, a separate or branch circuit which is closed when the key is on its back stop, magnetic helices and cores in said local circuits, a non-resilient armature controlled by said helices and cores, a main line, and a transmitting-battery which is thrown upon the line by the vibrations of the armature, which occur in response to the manipulation of the transmitting-key.

3. The combination, substantially as set forth, of the transmitting-key, two independent electro-magnets which are alternately energized by the manipulations of the key, the local circuits of said magnets, a freely-vibrating armature acted upon by said magnets, the main line, and the transmitting-battery which is thrown upon the line by the vibrations of the armature.

4. The combination, substantially as set forth, of the transmitting-key, the independent magnets M O, their local circuits, the freely-vibrating armature acted upon by said magnets, the split main battery MB, the poles of which are electrically connected with the opposite contact-stops, *c d*, against which the vibrating armature works, and the main line connected with said armature.

In testimony whereof I have hereunto subscribed my name this 20th day of February, A. D. 1884.

PATRICK B. DELANY.

Witnesses:
EDWD. A. CALAHAN,
H. D. MANSON.

Very distinct sounds proceed from straight pieces of iron, steel, retort-carbon, and plumbago. I believe that I have also obtained audible effects from thin platinum and German-silver wires, and from mercury contained in a narrow groove about four feet long. In these cases, however, the sounds were so faint and outside noises so loud that the experiments require verification. Well-marked sounds proceed from conductors of all kinds when formed into spirals or helices. I find that De la Rive had noticed the production of sound from iron and steel during the passage of an intermittent current, although he failed to obtain audible results from other substances. In order that such effects should be observed, extreme quietness is necessary. The rheotome itself is a great source of annoyance, as it always produces a sound of similar pitch to the one which it is desired to hear. It is absolutely requisite that it should be placed out of earshot of the observer, and at such a distance as to exclude the possibility of sounds being mechanically conducted along the wire.

3. Very striking audible effects can be produced upon a short circuit by means of two Grove elements. I had a helix of insulated copper-wire (No. 23) constructed, having a resistance of about twelve ohms. It was placed in circuit with a rheotome which interrupted the current one hundred times per second. Upon placing the helix to my ear I could hear the unison of the note produced by the rheotome. The intensity of the sound was much increased by placing a wrought-iron nail inside the helix. In both these cases, a crackling effect accompanied the sound. When the nail was held in the fingers so that no portion of it touched the helix, the crackling effect disappeared, and a pure musical note resulted.

When the nail was placed inside the helix, between two cylindrical pieces of iron, a loud sound resulted that could be heard all over a large room. The nail seemed to vibrate bodily, striking the cylindrical pieces of metal alternately, and the iron cylinders themselves were violently agitated.

4. Loud sounds are emitted by pieces of iron and steel when subjected to the attraction of an electro-magnet which is placed in circuit with a rheotome. Under such circumstances, the armatures of Morse-sounders and Relays produce sonorous effects. I have succeeded in rendering the sounds audible to large audiences by interposing a tense membrane between the electro-magnet and its armature. The armature in this case consisted of a piece of clock-spring glued to the membrane. This form of apparatus I have found invaluable in all my experiments. The instrument was connected with a parlor organ, the reeds of which were so arranged as to open and close the circuit during their vibration. When the organ was played the music was loudly reproduced by the telephonic receiver in a distant room. When chords were played upon the organ, the various notes composing the chords were emitted simultaneously by the armature of the receiver.

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* *Ferguson.* Proceedings of Royal Scottish Soc. of Arts, April 9, 1866; Paper on "A New Current Interrupter."

5. The simultaneous production of musical notes of different pitch by the electric current, was foreseen by me as early as 1870, and demonstrated during the year 1873. Elisha Gray,* of Chicago, and Paul La Cour,† of Copenhagen, lay claim to the same discovery. The fact that sounds of different pitch can be simultaneously produced upon any part of a telegraphic circuit is of great practical importance; for the duration of a musical note can be made to signify the dot or dash of the Morse alphabet, and thus a number of telegraphic messages may be sent simultaneously over the same wire without confusion by making signals of a definite pitch for each message.

6. If the armature of an electro-magnet has a definite rate of oscillation of its own, it is thrown bodily into vibration when the interruptions of the current are timed to its movements. For instance, present an electro-magnet to the strings of a piano. It will be found that the string which is in unison with the rheotome included in the circuit will be thrown into vibration by the attraction of the magnet.

Helmholtz,* in his experiments upon the synthesis of vowel sounds caused continuous vibration in tuning-forks which were used as the armatures of electro-magnets. One of the forks was employed as a rheotome. Platinum wires attached to the prongs dipped into mercury.

The intermittent current occasioned by the vibration of the fork traversed a circuit containing a number of electro-magnets between the poles of which were placed tuning-forks whose normal rates of vibration were multiples of that of the transmitting fork. All the forks were kept in continuous vibration by the passage of the interrupted current. By re-enforcing the tones of the forks in different degrees by means of resonators, Helmholtz succeeded in reproducing artificially certain vowel sounds.

I have caused intense vibration in a steel strip, one extremity of which was firmly clamped to the pole of a U-shaped electro-magnet, the free end overhanging the other pole. The amplitude of the vibration was greatest when the coil was removed from the leg of the magnet to which the armature was attached.

7. All the effects noted above result from rapid interruptions of a voltaic current, but sounds may be produced electrically in many other ways.

The Canon Gottoin de Coma,† in 1785, observed that noises were emitted by iron rods placed in the open air during certain electrical conditions of the atmosphere; Beatson‡ produced a sound from an iron wire by the discharge of a Leyden jar; Gore§ obtained loud musical notes from mercury, accompanied by singularly beautiful crispations of the surface during the course of experiments in electrolysis; and Page‖ produced musical tones from Trevelyan's bars by the action of the galvanic current.

8. When an intermittent current is passed through the thick wires of a Ruhmkorff's coil, very curious audible effects are produced by the

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* *Elisha Gray.* Eng. Pat. Spec., No. 974. See "Engineer," March 26, 1875.
† *Paul la Cour.* Telegraphic Journal, Nov. 1, 1875.

* *Helmholtz.* Die Lehre von dem Tonempfindungen.
† See "Treatise on Electricity," by De la Rive, I., p. 300.
‡ Ibid.
§ *Gore.* Proceedings of Royal Society, XII., p. 217.
‖ *Page.* "Vibration of Trevelyan's bars by the galvanic current." Silliman's Journal, 1850, IX., pp. 105–108.

currents induced in the secondary wires. A rheotome was placed in circuit with the thick wires of a Ruhmkorff's coil, and the fine wires were connected with two strips of brass (A and B), insulated from one another by means of a sheet of paper. Upon placing the ear against one of the strips of brass, a sound was perceived like that described above as proceeding from an empty helix of wire during the passage of an intermittent voltaic current. A similar sound, only much more intense, was emitted by a tin-foil condenser when connected with the fine wires of the coil.

One of the strips of brass, A (mentioned above), was held closely against the ear. A loud sound came from A whenever the slip B was touched with the other hand. It is doubtful in all these cases whether the sounds proceeded from the metals or from the imperfect conductors interposed between them. Further experiments seem to favor the latter supposition. The strips of brass A and B were held one in each hand. The induced currents occasioned a muscular tremor in the fingers. Upon placing my forefinger to my ear a loud crackling noise was audible, seemingly proceeding from the finger itself. A friend who was present placed my finger to his ear, but heard nothing. I requested him to hold the strips A and B himself. He was then distinctly conscious of a noise (which I was unable to perceive) proceeding from his finger. In these cases a portion of the induced currents passed through the head of the observer when he placed his ear against his own finger; and it is possible that the sound was occasioned by a vibration of the surfaces of the ear and finger in contact.

When two persons receive a shock from a Ruhmkorff's coil by clasping hands, each taking hold of one wire of the coil with the free hand, a sound proceeds from the clasped hands. The effect is not produced when the hands are moist. When either of the two touches the body of the other a loud sound comes from the parts in contact. When the arm of one is placed against the arm of the other, the noise produced can be heard at a distance of several feet. In all these cases a slight shock is experienced so long as the contact is preserved. The introduction of a piece of paper between the parts in contact does not materially interfere with the production of the sounds, while the unpleasant effects of the shock are avoided.

When a powerful current is passed through the body, a musical note can be perceived when the ear is closely applied to the arm of the person experimented upon. The sound seems to proceed from the muscles of the fore-arm and from the biceps muscle. The musical note is the unison of the rheotome employed to interrupt the primary

circuit. I failed to obtain audible effects in this way when the pitch of the rheotome was high. Elisha Gray* has also produced audible effects by the passage of induced electricity through the human body. A musical note is occasioned by the spark of a Ruhmkorff's coil when the primary circuit is made and broken sufficiently rapidly. When two rheotomes of different pitch are caused simultaneously to open and close the primary circuit, a double tone proceeds from the spark.

9. When a voltaic battery is common to two closed circuits, the current is divided between them. If one of the circuits is rapidly opened and closed, a pulsatory action of the current is occasioned upon the other.

All the audible effects resulting from the passage of an intermittent current can also be produced, though in less degree, by means of a pulsatory current.

10. When a permanent magnet is caused to vibrate in front of the pole of an electro-magnet, an undulatory or oscillatory current of electricity is induced in the coils of the electro-magnet, and sounds proceed from the armatures of other electro-magnets placed upon the circuit. The telephonic receiver referred to above (par. 4), was connected in circuit with a single-pole electro-magnet, no battery being used. A steel tuning-fork which had been previously magnetized was caused to vibrate in front of the pole of the electro-magnet. A musical note similar in pitch to that produced by the tuning-fork proceeded from the telephonic receiver in a distant room.

11. The effect was much increased when a battery was included in the circuit. In this case, the vibration of the permanent magnet threw the battery-current into waves. A similar effect was produced by the vibration of an unmagnetized tuning-fork in front of the electro-magnet. The vibration of a soft iron armature, or of a small piece of steel spring no larger than the pole of the electro-magnet in front of which it was placed, sufficed to produce audible effects in the distant room.

12. Two single-pole electro-magnets, each having a resistance of ten ohms, were arranged upon a circuit with a battery of five carbon elements. The total resistance of the circuit, exclusive of the battery, was about twenty-five ohms. A drum-head of gold-beater's skin, seven centimetres in diameter, was placed in front of each electro-magnet, and a circular piece of clock-spring, one centimetre in diameter, was glued to the middle of each membrane. The telephones so constructed were placed in different rooms. One was retained in

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* *Elisha Gray.* Eng. Pat. Spec., No. 2646, see "Engineer," Aug. 14, 1874.

the experimental room, and the other taken to the basement of an adjoining house.

Upon singing into the telephone, the tones of the voice were reproduced by the instrument in the distant room. When two persons sang simultaneously into the instrument, two notes were emitted simultaneously by the telephone in the other house. A friend was sent into the adjoining building to note the effect produced by articulate speech. I placed the membrane of the telephone near my mouth, and uttered the sentence, "Do you understand what I say?" Presently an answer was returned through the instrument in my hand. Articulate words proceeded from the clock-spring attached to the membrane, and I heard the sentence: "Yes; I understand you perfectly."

The articulation was somewhat muffled and indistinct, although in this case it was intelligible. Familiar quotations, such as, "To be, or not to be; that is the question." "A horse, a horse, my kingdom for a horse." "What hath God wrought," &c., were generally understood after a few repetitions. The effects were not sufficiently distinct to admit of sustained conversation through the wire. Indeed, as a general rule, the articulation was unintelligible, excepting when familiar sentences were employed. Occasionally, however, a sentence would come out with such startling distinctness as to render it difficult to believe that the speaker was not close at hand. No sound was audible when the clock-spring was removed from the membrane.

The elementary sounds of the English language were uttered successively into one of the telephones and the effects noted at the other. Consonantal sounds, with the exception of L and M, were unrecognizable. Vowel-sounds in most cases were distinct. Diphthongal vowels, such as *a* (in ale), *o* (in old), *i* (in isle), *ow* (in now), *oy* (in boy), *oor* (in poor), *oor* (in door), *ere* (in here), *ere* (in there), were well marked.

Triphthongal vowels, such as *ire* (in fire), *our* (in flour), *ower* (in mower), *ayer* (in player), were also distinct. Of the elementary vowel-sounds, the most distinct were those which had the largest oral apertures. Such were *a* (in far), *aw* (in law), *a* (in man), and *e* (in men).

13. Electrical undulations can be produced directly in the voltaic current by vibrating the conducting wire in a liquid of high resistance included in the circuit.

The stem of a tuning-fork was connected with a wire leading to one of the telephones described in the preceding paragraph. While the tuning-fork was in vibration, the end of one of the prongs was dipped

into water included in the circuit. A sound proceeded from the distant telephone. When two tuning-forks of different pitch were connected together, and simultaneously caused to vibrate in the water, two musical notes (the unisons respectively of those produced by the forks) were emitted simultaneously by the telephone.

A platinum wire attached to a stretched membrane, completed a voltaic circuit by dipping into water. Upon speaking to the membrane, articulate sounds proceeded from the telephone in the distant room. The sounds produced by the telephone became louder when dilute sulphuric acid, or a saturated solution of salt, was substituted for the water. Audible effects were also produced by the vibration of plumbago in mercury, in a solution of bichromate of potash, in salt and water, in dilute sulphuric acid, and in pure water.

14. Sullivan * discovered that a current of electricity is generated by the vibration of a wire composed partly of one metal and partly of another; and it is probable that electrical undulations were caused by the vibration. The current was produced so long as the wire emitted a musical note, but stopped immediately upon the cessation of the sound.

15. Although sounds proceed from the armatures of electro-magnets under the influence of undulatory currents of electricity, I have been unable to detect any audible effects due to the electro-magnets themselves. An undulatory current was passed through the coils of an electro-magnet which was held closely against the ear. No sound was perceived until a piece of iron or steel was presented to the pole of the magnet. No sounds either were observed when the undulatory current was passed through iron, steel, retort-carbon, or plumbago. In these respects an undulatory current is curiously different from an intermittent one. (See par. 2.)

16. The telephonic effects described above are produced by three distinct varieties of currents, which I term respectively intermittent, pulsatory, and undulatory. *Intermittent currents* are characterized by the alternate presence and absence of electricity upon the circuit; *Pulsatory currents* result from sudden or instantaneous changes in the intensity of a continuous current; and *undulatory currents* are produced by gradual changes in the intensity of a current analogous to the changes in the density of air occasioned by simple pendulous vibrations.

* *Sullivan.* "Currents of Electricity produced by the vibration of Metals." Phil. Mag., 1845, p. 261; Arch. de l'Électr., X., p. 480.

Telephone by Mr. Elisha Gray, of Chicago.—This system, invented in 1874, is in reality only an instrument of the nature of those which preceded it, but with important modifications, which made it possible to apply it usefully to telegraphy.

In an early model he made use of an induction coil, with two helices, one over the other: the contact-breaker, which was vibrating, was multiple, and so arranged as to produce vibrations numerous enough to emit sounds. These sounds may, as we have seen, be modified by this arrangement, according to the mode in which the instrument is adjusted, and if there are a certain number of such contact-breakers side by side, with vibrating disks so ordered as to produce the different notes of the scale on several octaves, it becomes possible, by a combination of certain notes, to execute on this new kind of instrument a piece of music such as may be produced by a harmonium, an accordion, or any other instrument with blowers. The contact-breakers are set in motion by means of the primary current of the induction coil, as it circulates through one or other of the electro-magnets of these contact-breakers, actuated by the lowering of the notes of a key-board connected with them, and the secondary currents which arise in the coil, in consequence of the interruptions in the primary currents, transmit the corresponding vibrations to a remote receiver. There is an analogy between this instrument and the telephones of which we have already spoken by Reiss and Wray, but the effect is increased by Mr. Gray's modifications.

We represent in Fig. 4 the arrangement of the first system. The vibrators are A and A′, the key-board M and M′, the induction coil B, and the receiver C. This receiver consists, as we see, of a simple electro-magnet, N N′: above its poles there is a metal cylindrical case, C, of which the bottom is made of iron, to serve as an armature. This box, like a violin, is pierced with two holes in the form S, to serve as a sounding-board; and Mr. Elisha Gray has ascertained that the molecular motion which takes place in the magnetic core and its armature, under the influence of alternate magnetization and demagnetization, sufficed to produce vibrations corresponding to the velocity of these alternations, and to emit sounds which became audible when they were magnified by the sounding board.

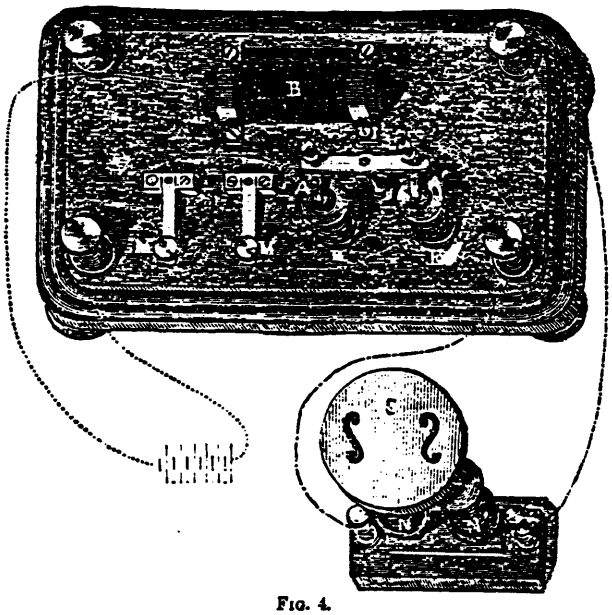


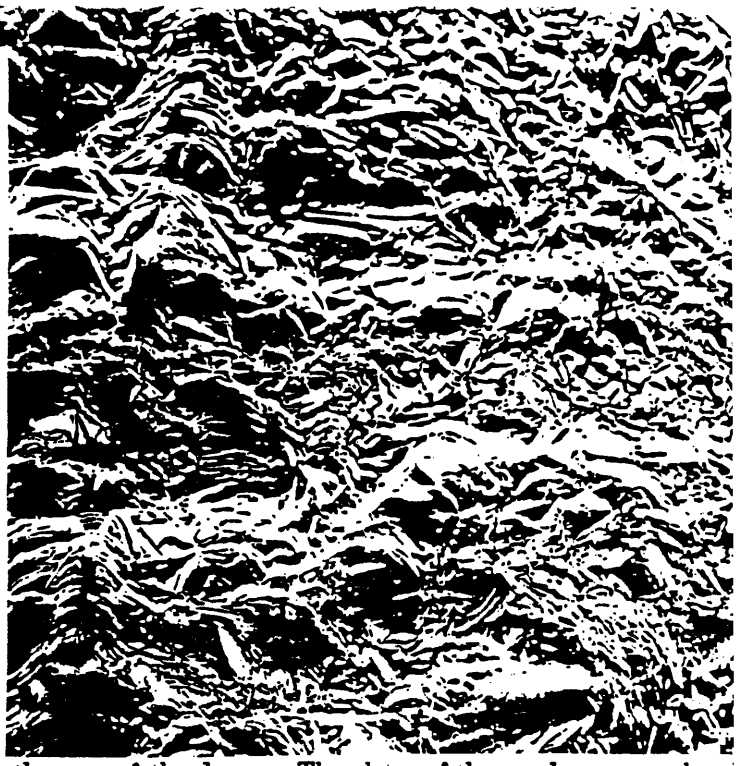
Fig. 4.

It is quite intelligible that the effect obtained in this system might be reproduced, if, instead of contact-breakers or electric rheotomes, mechanical contact-breakers were used at the sending-station, so arranged as to furnish the requisite number of breaks in the current which communicates the vibrations of the different notes of the scale. In this way also it would be possible to dispense with the induction coil, by causing the current which has been broken by the mechanical contact-breaker to react upon the receiver. Mr. Elisha Gray has, moreover, made a different arrangement of this telephonic system,

which he has applied to telegraphy for simultaneous electric transmissions, of which we shall speak presently.

If we may believe Mr. Elisha Gray, the vibrations transmitted by the secondary currents would be capable, by the intervention of the human body, of causing the sounds to be reproduced at a distance by conducting disks, which vibrate readily, and are placed on a sounding-box. In this way musical sounds may be evoked from copper cylinders placed upon a table, from a metallic disk fastened to a kind of violin, from a membrane stretched on a drum, or from any other resonant substance, by touching any of these objects with one hand, while holding the end of the line with the other. These sounds, of which the quality must vary with the substance touched, would reproduce the transmitted note with the precise number of vibrations which belong to it.[1]

Mr. Varley's Telephone.—This is, strictly speaking, merely a musical telephone of the same kind as that of Mr. Gray, but the arrangement of the receiver is original and interesting. This part of the instrument essentially consists of a drum of large size (three or four feet in diameter), within which is a condenser formed of four sheets of tin-foil, divided by sheets of some insulating material, and with a surface of about half



the size of the drum. The plates of the condenser are placed parallel to the membranes of the drum, and very little removed from its surface.

If an electric charge is communicated to one of the series of conducting plates of the condenser, those which correspond to it are attracted, and if they were movable they might communicate to the intervening strata of air a movement which, on reaching the membranes of the drum, might, by a series of charges in rapid succession, cause the membranes to vibrate, and thus produce sounds: these sounds would correspond to the number of charges and discharges which had occurred. Since these charges and discharges are determined by the contact of the two plates of the condenser, at the extremities of the secondary circuit of an induction coil, of which the primary circuit has been duly broken, it becomes evident that, in order to cause the drum to emit any given sound, it will be enough to produce the number of vibrations in the contact-breaker of the induction coil which are required for this sound.

The means employed by Mr. Varley to produce these interruptions are the same which are in use in several electrical instruments, and especially in chronographs—an electro-magnetic tuning-fork, regulated so as to emit the sound required. This tuning-fork may, by acting as contact-breaker, react on the primary current of the induction coil; if the number of the tuning-forks equals that of the musical notes which are to be transmitted, and if the electro-magnets which set them in motion are connected with the key-board of a piano, it would be possible to transmit a melody to a distance by this system, as well as by that of Mr. Elisha Gray.

The peculiarity of this system consists in the reproduction of sounds by the action of a condenser; and we shall presently see that this idea, adopted by Messrs. Pollard and Garnier, led to interesting results.

Singing Condenser of MM. Pollard and Garnier.—This in-

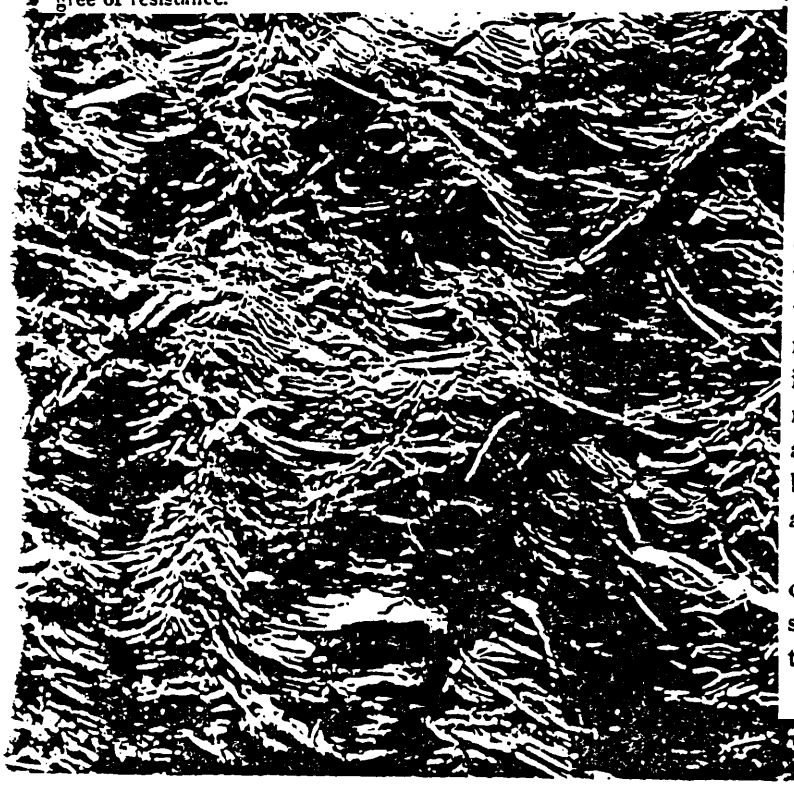
[1] Mr. Gray, in an article inserted in the *Telegrapher* of October 7th, 1876, enters into full details of this mode of transmitting sounds by the tissues of the human body, and he gives the following as the conditions in which it must be placed to obtain a favorable result:

1. The electricity must be of a high tension, in order to have an effect perceptible to the ear.

2. The substance employed to touch the metallic plate must be soft, flexible, and a good conductor, up to the point of contact: it must then interpose a slight resistance, neither too great nor too small.

3. The disk and the hand, or any other tissue, must not only be in contact, but the contact must result from rubbing or gliding over the surface.

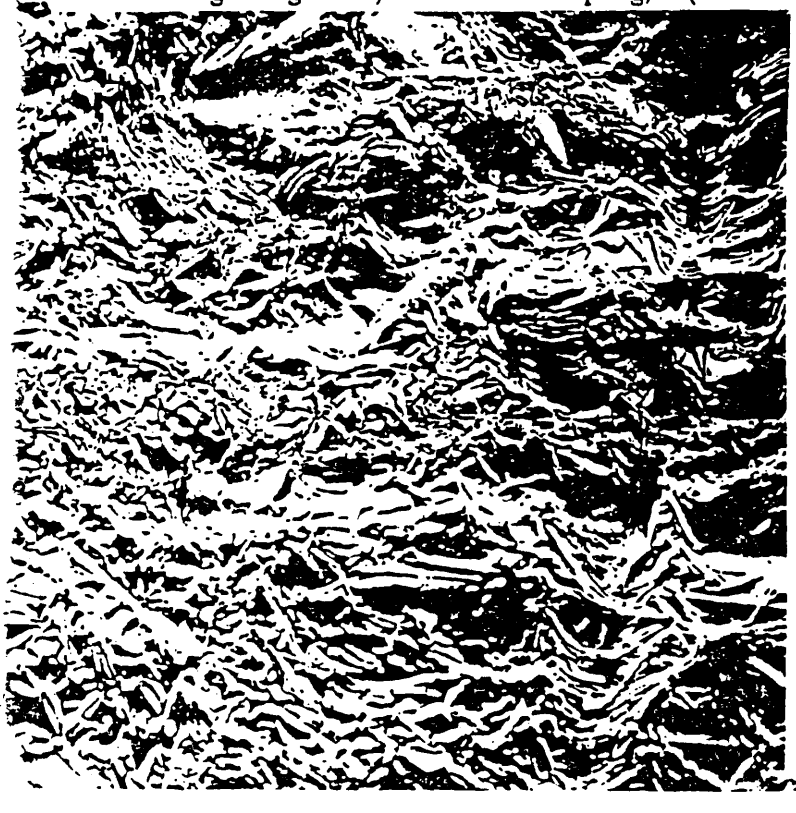
4. The parts in contact must be dry, so as to maintain the required degree of resistance.

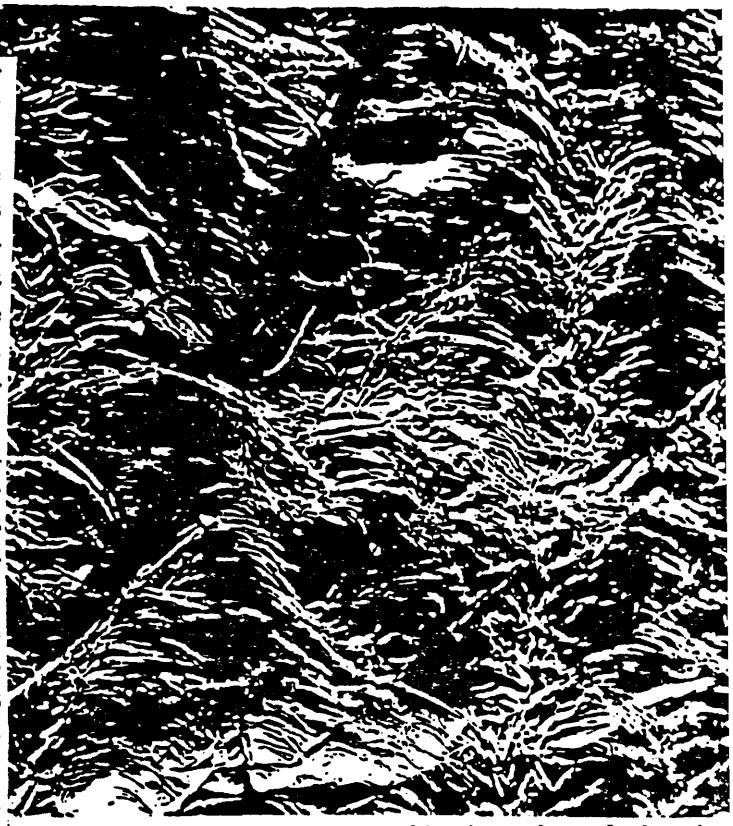


strument, which astonishes all who hear it, attracted public attention in London some time ago. It is difficult to say why its fame was not greater, since much attention has been bestowed on less curious instruments. It is a fact that we have been able, thanks to MM. Pollard and Garnier, to hear songs issue from a sort of copybook, so as to become audible throughout the room. The songs thus reproduced are certainly not always perfectly true; yet when the person who sings into the sender is a musician, and understands how to make use of it, the condenser in question will emit sounds somewhat resembling those of the violoncello or the hautbois.

The singing instrument consists of a condenser, K, formed of thirty sheets of paper, laid one over the other, from nine to thirteen centimetres in thickness: between these, twenty-eight sheets of tin-foil, from six to twelve centimetres thick, are intercalated, so joined as to form the two plates of the condenser. For this purpose the pair sheets are joined together at one end of the copybook, and the odd sheets at the other end. This system is fastened to a stiff *carton*, after taking care to bind it with a strip of paper, and the sheets of tin-foil are joined to the two ends of the condenser by two copper rims, D, D, which are provided with terminals for the circuit wire, and in this way the singing instrument is constructed. A somewhat heavy weight, placed upon the condenser to compress the sheets, does not in any way prevent it from working; and this vitiates the theory first put forward to explain its effects, that the sheets were moved by attraction.

The sending instrument consists of a sort of telephone without a handle, E, of which the vibrating disk is formed of a very thin plate of tin. A cylindrical piece of carbon, C, is fastened to its centre, and is supported by another cylinder of the same material, H. This rests on a transverse piece of wood, A B, jointed on the side A, on the edge opposite to the box, by means of a regulating screw, V. An arched spring, R (the end





of a watch-spring), placed across this piece of wood gives it a certain elasticity beneath the pressure, and this elasticity is necessary in order that the instrument may act properly, and it thus becomes a sort of microphone with a diaphragm.

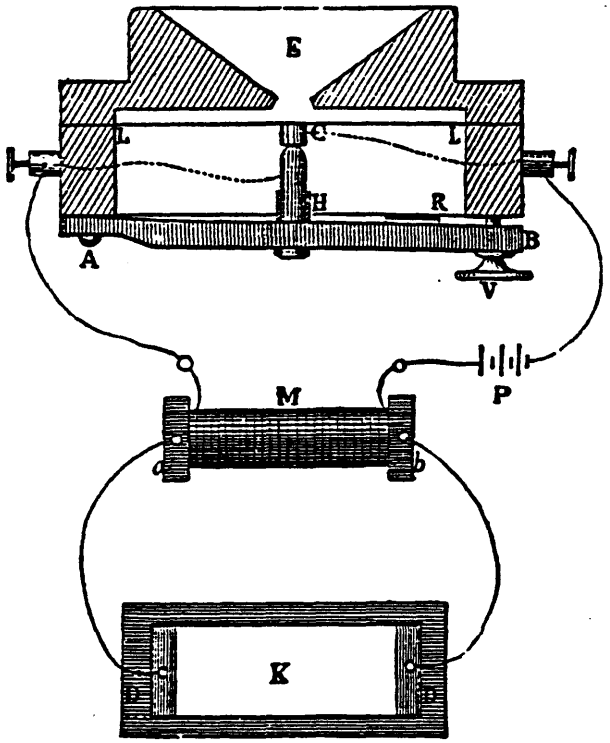


FIG. 5.

The tin plate is put into communication with one pole of a battery, P, of six Leclanché cells, and the lower carbon cylinder, H, corresponds to the primary helix of an induction coil, M, previously connected with the second pole of the battery. Finally, the two extremities of the secondary helix of the coil, *a* and *b*, are in immediate connection with the two plates, D, D′, of the condenser.

Before considering Bell's telephone, and the different modifications which have been applied to it, it seems worth while, in order to make the reader perfectly familiar with these kinds of instruments, to study the electro-musical telephones which preceded it, and especially that of M. Reiss, which was made in 1860, and became the starting-point of all the others. We shall find that these instruments have very important applications, and that telegraphy will probably be one day much advanced by their use.

MUSICAL TELEPHONES.

Telephone of M. Reiss.—This telephone is, as far as the reproduction of sound is concerned, based upon Mr. Page's discoveries in 1837, and, as regards electric transmission, it is based on the vibrating membrane of which Mr. L. Scott made use in his phonautograph, in 1855. This instrument is composed, like telegraphic systems, of two distinct parts, a sender and a receiver, as represented in Fig. 1.

The sender was virtually composed of a sounding-box, K, having on its upper surface a large circular opening, across which a membrane was stretched, and in its centre there was fitted a thin disk of platinum, *o*, above which a metallic point, *c*, was fixed, and this, together with the disk, constituted the contact-breaker. On one face of the sounding-box K there was a sort of speaking-tube, for the purpose of collecting the sound, and directing it to the interior of the box, in order that it might then react upon the membrane. Part of the box K is broken away in the plate, in order that the different parts of which it is made may be seen.

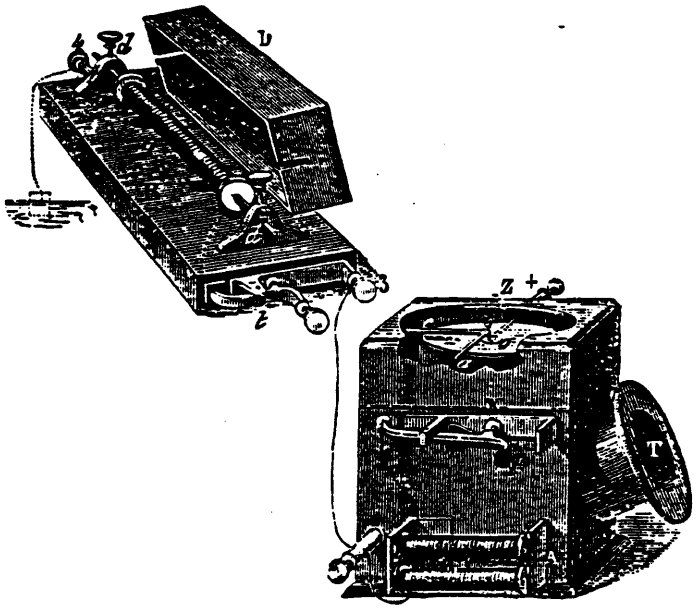


Fig. 1.

The rods *a*, *c*, which support the platinum point *b*, are in metallic contact with a Morse key, *t*, placed on the side of the box K, and with an electro-magnet, A, which belongs to a telegraphic system, intended to exchange the signals required to start the action of the two instruments at their respective stations.

The receiver consists of a sounding-box, B, on which rest two supports, *d*, *d*, bearing an iron rod of the thickness of a knitting-needle. An induction coil of insulated wire, *g*, is wound round this rod, and the whole is enclosed by the lid D, which concentrates the sound already increased by the sound-

THE PHYSIOPHONE

Music For The Deaf

By H. GERNSBACK

WHEN I was sixteen I secured an old-fashioned Pathé phonograph of the cylindrical record type. You know the kind that was in vogue years ago. Being much interested in electricity in those days, the thought occurred to me, the same as it occurred to thousands of others, namely, why not transmit the music electrically by putting a sensitive microphone somewhere on the phonograph and thus get the music at a distance.

No sooner said than done. An old-fashioned Hughes microphone was constructed by means of three little carbon rods, and this miniature microphone was attached to the sound box. The microphone was in series with a battery and the primary of an ordinary telephone induction coil. The music transmission was excellent and phonograph music was transmitted over a distance of three hundred yards on my father's estate. These experiments created quite a sensation in those days, and my friends, all electrical "bugs," were much elated and pleased with the stunt.

One evening I accidentally touched the two wires of the secondary terminals of the telephone coil and was quite surprised to get a smart and disagreeable shock. That was in 1900. The early experiments were soon forgotten, but in 1917, while editing an article in this magazine, where a young man had re-discovered the ancient experiment, I thought of that shock, and I understood immediately what that shock really was. I accordingly set to work and immediately built a new transmitter which was attached to a Victor phonograph sound box, and which is shown in Fig. 4. The connections are shown from which it will be seen that the microphone is in series with the 6-volt storage battery and the primary of an induction coil such as is used in telephone work.

The writer used a regulation sound box merely by making a microphone out of it and substituting a carbon diafram for the mica diafram. The space between the back carbon and the carbon diafram is filled out with polisht carbon grains. The mechanical suspension of the carbon diafram must be the same as the one for the mica-diafram. In other words, the vibrations of the phonograph needle must be faithfully past onto the carbon diafram, the same as is the case with the mica type. When the connections are correctly made and two handles are now attached to the secondary of the induction coil, and these grasped in your hands, the rhythm of the music will be felt faithfully and with astonishing fidelity. What we do feel is sound vibration translated into electrical impulses which in turn are felt physiologically by the human nerves. It is surprising how well this translated music is communicated to the nervous system of the human being, and with a little practise it becomes possible to recognize the different tunes merely by the variations of the little tingling shocks.

Different records were tried in 1917, but just then the United States entered into the war, and the experiments came to a sudden end. Recently, however, they were taken up again with the following results. Improvements were made on the microphone and a great many new types were tried out, because the original type was not entirely satisfactory. Later experiments, however, proved to me that the 1917 type in principle was probably the best that could be produced. From some ten or twelve types which were evolved by me then, a few are shown here. Many different records were tried, and it seemed to be readily establisht that the different tunes, the different musical instruments, as well as voices, could be readily differentiated physiologically *without listening at all to the music*, or without hearing any sound whatsoever.

Mr. Gernsback Demonstrating the Physiophone. The Photograph Shows How the Instruments Are Connected. By Means of the Double Pole Switch, the Music Is Reproduced by a Loud Talker, Then the Switch Is Thrown, and Physiological Music Is Had.

Double Barreled Music. Showing How an Audience Can Enjoy the Music Orally, As Well As Physiologically. In Other Words You Hear the Music and You Feel It As Well. A Brand New Source of Enjoyment.

Musical Electrization

By JACQUES BOYER

While our April issue, containing the article by Mr. H. Gernsback, "The Physiophone" was still on the press, we received the following article from our Paris correspondent, Mr. Jacques Boyer. It appears that Mr. Charles Henry, Director of the Laboratory of Physiology, has worked along the same lines as Mr. Gernsback, and discovered the identical phenomenon independently. It should be noted in Mr. Boyer's article, that Mr. Charles Henry evidently has not come to the conclusion that the apparatus can be used to transmit music physiologically to the deaf. In view of the extraordinary co-incidence, our readers will no doubt be interested in the article.

MR. CHARLES HENRY, Director of the Laboratory for Physiological Sensations of the Sorbonne, Paris, has invented a novel means which he terms *musical electrization* and which he claims will find therapeutic uses. Our readers no doubt know that the d'Arsonval alternating sinusoidal currents are very much superior to the ordinary faradization of the induction coil. Furthermore, such sinusoidal currents are much better suited to the human system, and do not produce pain or great contractions of the muscles.

Also after Fourier's theory and the experiments of Von Helmholtz, one can consider every musical sound as the sum of simple sinusoidal variations which are 1, 2, 3 .....n times less great, and which constitute the harmonics of this sound. Mr. Henry thought that he could obtain interesting results if he could transform [illegible] currents these harmonics which the human [illegible] gives by the sense of hearing. Such sounds produce a [illegible] varied influence upon [illegible]. He rigged up a simple [illegible] shown in the illustration, the generator he used a thermo-electric couple of sixty-six elements which furnishes a constant electromotive force. As a sonorous source he uses an old-fashioned music box which can be noticed at the feet of the operator in our illustration. Such a machine runs for about 20 minutes. The tune is changed simply by changing a metal disc, which latter has small metallic projections on the reverse side, and which in turn engage little prongs of a steel harp; thus, giving rise to the music.

Translation of Musical Vibrations into Electrical Ones for Therapeutical Purposes is Suggested by a French Inventor Here Shown.

Mr. Charles Henry recognized the physiological influence of the rhythm and compared it with the physiological effects obtained by electrifying his subjects by means of alternating currents. These he produced by means of a siren placed in front of a microphone. The current, of course, was stepped up by means of a small induction coil.

In furtherance of his experiments, Mr. Henry placed a 4 carbon Hughes microphone on the resonant chamber of the music box, and connected the microphone with the battery on one side, the other end going to the primary of a little telephone induction coil, the other wire returned to the battery.

The electrization current was taken off from the secondary terminals by means of two wires, and the regulation electro-therapeutic handles or sponges as used ordinarily were then connected. A rheostat placed in circuit with the microphone regulated the intensity of the primary current.

The vibrations from the microphone interrupt the current of the secondary, and the small continuous shocks received by the muscles naturally reproduce the transformed musical sounds, and one can readily feel all the different variations of the sound.

In his experiments, Mr. Henry has been able to convince himself that all of the musical sounds are transmitted electrically due to the deep and rhythmical electrization of his subjects. The electrization is naturally strong or weak, all depending upon the character of the music. Mr. Henry also found that the intensity is greatest when the music is loudest, but when the musical sounds go above a certain heighth no further sensation is had, as here the currents probably become so rapid that they cannot be felt any longer physiologically.

Mr. Charles Henry also thinks that this original instrument will render great service in psychic medicine.

ing-box: for this purpose the box is provided with two openings below the coil.

The circuit is completed through the primary of this coil by the two terminals 3 and 4, and a Morse key, *t*, is placed at the side of box B, in order to exchange signals.

In order to work this system, the speaking instrument should be placed before the opening T, and this instrument may be a flute, a violin, or even the human voice. The vibrations of air occasioned by these instruments cause the telephonic membrane to vibrate in unison, and the latter, rapidly moving the platinum disk *o* to and from the point *b*, causes a series of breaks in the current, which are repeated in the iron wire *d d*, and transformed into metallic vibrations, of which the number is equal to that of the sounds successively produced.

According to this mode of action, the possibility of transmitting sounds with their relative value becomes intelligible; but it is equally clear that sounds thus transmitted will not have the *timbre* of those which produce them, since the *timbre* is independent of the number of vibrations, and it must be added that the sounds produced by M. Reiss's instrument were as shrill as those of a child's penny trumpet, and by no means attractive. The problem of transmitting musical sounds by electricity was, however, really solved, and it can be said with truth that an air or a melody could be heard at any given distance.

The invention of this telephone dates, as we have seen, from 1860, and Professor Heisler speaks of it in his treatise of technical physics, published at Vienna in 1866; he even asserts, in the article which he devotes to the subject, that although the instrument was still in its infancy, it was capable of transmitting vocal melodies, and not merely musical sounds. The system was afterward perfected by M. Vander Weyde, who, after reading the account published by M. Heisler, sought to make the box of the sender more sonorous, and to strengthen the sounds produced by the receiver. He writes as follows in the *American Scientific Journal:*

"In 1868 I caused two telephones to be made, similar to those I have described, and I exhibited them at a meeting of the Polytechnic Club of the American Institute. The transmitted sounds were produced at the farthest extremity of the Cooper Institute, quite outside the hall in which the audience sat: the receiver was placed on a table in the hall itself. The vocal airs were faithfully reproduced, but the sound was rather weak and nasal. I then tried to improve the instrument, and I first obtained stronger vibrations in the box K by causing reverberation from the sides of the box, by means of hollow partitions. I next intensified the sounds produced by the receiver, by introducing several iron wires into the coil instead of one. These improvements were submitted to the meeting of the American Association for the Advancement of Science, which was held in 1869, and it was considered that the invention contained the germ of a new method of telegraphic transmission which might lead to important results." This opinion was soon afterward justified by the discoveries of Bell and Elisha Gray.

DEATH OF PROF. ELISHA GRAY.

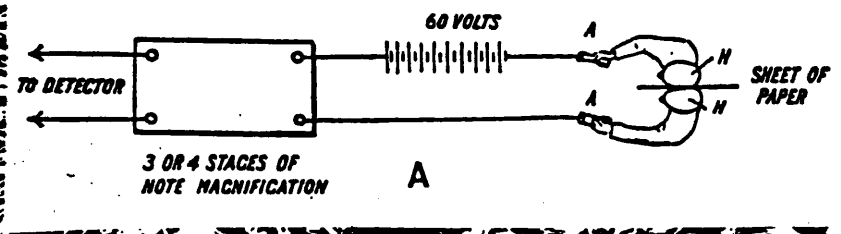
Elsewhere in this issue we illustrate and describe the last invention in which one of the electrical pioneers was engaged. The career of Prof. Elisha Gray, D.Sc., was a most pathetic one. He was a man of marvelous talent and ingenuity, and in the opinion of many who have calmly weighed all the evidence, it is likely that he will receive justice at the hands of future historians by being immortalized as the inventor of the speaking telephone. The litigation in the early history of the telephone, which was of the most complex nature, finally resulted in the decision that Prof. Bell was the inventor of the telephone, and as such was entitled to the credit and profits which would naturally accrue from such an important invention, but many persons hold that the victory was a technical and corporate one, rather than one based on science.

Prof. Gray was born at Barnesville, O., in 1835, and commenced his career as a blacksmith, and also served an apprenticeship to a carpenter and boatbuilder. At Oberlin College he constructed the apparatus used in the classroom for experiments, and acquired the knowledge of that time in regard to electricity and its applications. He spent five years at college; and six years later obtained his first patent, this was the percursor of some fifty others. His first patent was granted on an automatic self-adjusting telegraphic relay. In the early seventies he devoted great attention to the phenomena of sounds transmitted over telegraph wires—electro-harmonic telegraphy. In pursuing his investigations he made a discovery to which the invention of the telephone was largely due. He relates it in his own words:

"My nephew was playing with a small induction coil, taking shocks, for the amusement of the younger children. He had connected one end of the secondary coil to the zinc lining of the bathtub, which was dry. Holding the other end of the coil in his left hand, he touched the lining of the tub with the right. In making contact, his hand would glide along the side for a short distance. At these times I noticed that a sound was proceeding from under his hand at the point of contact, having the same pitch and quality as the vibrating electrome."

On February 14, 1876, Prof. Gray filed a caveat in the Patent Office at Washington with the expectation of perfecting the "art of transmitting vocal sounds telegraphically." Prof. Alexander Graham Bell and Prof. Dolbear were workers in the same line, and it is said that Prof. Bell's patent was applied for a few hours earlier than Gray's, therefore the former received the patent. In the litigation which ensued, Gray alleged that his caveat had been on file before Bell's application, and he contended that there had been collusion with an official of the Patent Office. The courts decided, however, that this was not the case, and ruled against the Chicago inventor. Prof. Gray parted with his rights to a company whose name was The Harmonic Telegraph Company, by which transaction the Western Union was retired from the field.

Another of Prof. Gray's inventions was the telautograph, which was so far an improvement on the telephone and telegraph as it transmitted the actual writing of the message. He also invented various telegraph and telephone instruments and appliances, and the last work on which he was engaged was the perfection of a system of under-water fog signals, which is fully described in the present issue. As an inventor he sought to avoid multiplicity of mechanical devices. Intricacy to his mind was a failure. He sought to make electricity do its work directly, and all his devices were to this end.



SOME UNUSUAL METHODS OF TELEPHONIC RECEPTION.—In a lecture to the Wireless Society of London in 1922 (349), the Author showed the following methods of rendering wireless telephony and signals audible.

Fig. 19a shows two metal handles AA, similar to those employed for electro-medical purposes, which are connected to the output transformer of a 4-valve note magnifier, and a 60-volt battery is connected in one lead as shown. If two persons now hold one handle each and place a sheet of thin paper between their heads as indicated they will both be able to hear speech or signals quite clearly.

One person alone can hear in the following manner. Both people hold handles as before, but one of the experimenters now holds the palm of his free hand against the ear of the

Friction Telephones.—Mr. E. Gray has quite recently applied the principle of producing sounds by the friction of animal tissues to the construction of a speaking telephone which may be heard through a whole room, like the singing condenser. He obtains this result by means of clock-work, which causes the rotation of the metallic disk of which we have spoken (p. 27), and on which a piece of skin is so arranged as to produce friction. A carbon or liquid telephone is placed at the sending-station, in such a way as to react on an induction coil, as in the systems of Edison, Navez, or Pollard, and speech is reproduced on the rotating disk, and is audible, as we have said, without the necessity of approaching the ear to the instrument.

The best arrangement of the metallic disk on which the animal tissue rubs is that of a cylindrical box, of which the outer lid is made of a thin sheet of zinc with a highly polished, slightly oxidized surface; for the agent of friction, glove-leather slightly moistened with acidulated water may be used, or a sinew of an ox, or skin taken from the ear or tail of a pig.

Finally, we shall conclude our enumeration by referring to the curiosities. The house of Siemens exhibited a miniature electric railway actuated by a new model of Reynier accumulators; M. Maiche operated a system of musical telephonic auditions that differed only in detail from those instituted by Mr. Ader at the exhibition of 1881; and Mr. Hospitalier presented a new form of an experiment devised by Mr. Gilray, consisting of a telephonic transmission of sounds without the use of receivers. Mr. Gilray's experiment is nothing but Mr. Dumand's speaking condenser without the condenser. A glance at Fig. 1 will show how things are arranged for the experiment. The transmitting system comprises two distinct circuits, viz.: (1) one formed of a pile, P, of 2 or 3 Leclanche elements, or of 1 or 2 small sized accumulators, an Ader microphone transmitter, M, and the inducting wire of a small induction coil, B; and (2) the other formed of the induced wire of the coil, B, of a pile, P, of 10 or 12 Leclanche elements, and of a line whose extremities terminate at R, in two ordinary electro-medical handles. With this arrangement the experiment performed is as follows: When any one speaks or sings in front of the transmitter, T, while two persons, A and B, each having one hand gloved, are holding the handles in the ungloved hand, it is only necessary for A to place his gloved hand upon B's ear, or for the latter to place his hand upon A's, or for each to place his hand on the other's ear simultaneously, in order that A or B, or A and B simultaneously, may hear a voice issuing from the glove. Under these circumstances, Mr. Gilray's experiment is explained like Dumand's speaking condenser—the hand of A and the ear of B here constituting the armature of an elementary condenser in which the glove performs the role of dielectric.

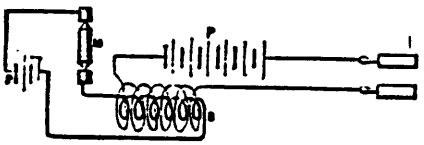


FIG. 1.—DIAGRAM EXHIBITING THE ARRANGEMENT FOR TELEPHONIC TRANSMISSIONS WITHOUT A RECEIVER.

Upon repeating this experiment at the laboratory of the School of Physics and Industrial Chemistry of Paris, it has been found that the glove may be replaced by a sheet of plain or paraffined paper. In this case, when two persons are holding the handles, and have their ears applied, one against the other, if a sheet of paper be interposed, airs or words will be heard to proceed therefrom. Finally, it has been found possible to entirely suppress the paper, or dielectric, and to hear directly, by simply interposing the auditor or auditors in the circuit. One of the most curious forms of the experiment is the one shown in Fig. 2. Here a third person, C, hears the hands of A and B speak when a circuit is formed by means of three persons, A, B, and C, the two former, A and B, each holding one of the wires of the circuit and applying his free hand to the ear of C. Although the experiment is one that requires entire silence, and could not on that account be performed at the laboratory, a sort of telephonic chain can be formed in which five or six persons may hear at the same time.

Without any desire to seek an application for an experiment that is simply curious, we yet believe that there is here a phenomenon of a nature to be studied by physicists. Discoveries in telephony and microphony have certainly opened up to science, as regards both theory and practice, new horizons that still promise other surprises for the future. But to return to the observatory: The success obtained by the exhibition of the French Society of Physics shows that these reunions respond to a genuine need—that of instructing in and popularizing science. While warmly congratulating the organizers of these meetings, we may express a wish that the good example set by the Society of Physics may be followed by other societies. We are convinced in advance that an equal success awaits them.—*La Nature.*

FIG. 2.—EXPERIMENT ON TELEPHONIC TRANSMISSION WITHOUT RECEIVING APPARATUS.

During Tests With Totally Deaf People, They All Expressed a Great Desire to Dance by Means of Physiological Music. Due to the Rhythm a Deaf Person Can Now Dance Without Any Trouble by Means of Physiological Music.

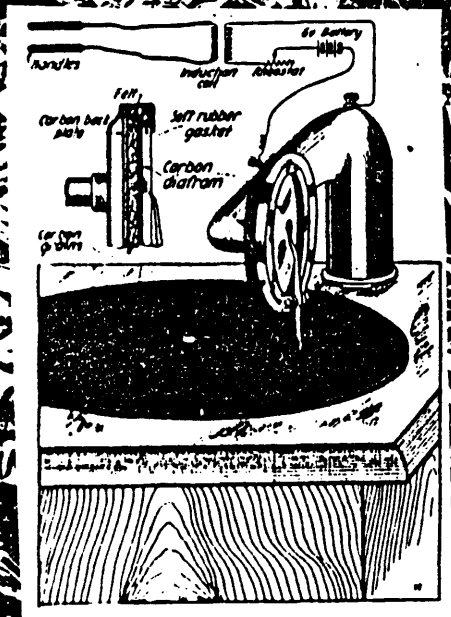


Fig. 4 Schematic Illustration of the Components of the Physiophone.

What purpose is accomplisht by these experiments? Ordinary human beings certainly do not require the translation of musical impulses into their nervous system, *but for the deaf a vast and important field has been opened.* Here we have a means of translating music into the nervous system of a deaf person who has not the slightest conception of music. Of course, it should be understood right here that I do not mean to convey the idea that a deaf person will actually "hear" the music. What he does get, however, is the rhythm, and he certainly gets this very definitely as has been actually demonstrated by tests with deaf persons upon which the writer experimented. It has been found that a deaf person can readily understand the different musical pieces, and can even recognize different musical instruments with very little practise.

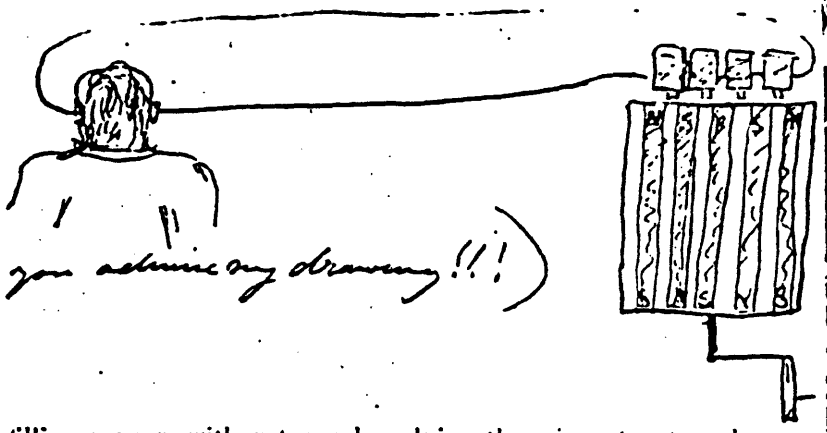
Of course, the deaf person must learn the same as any other human being, for it is a well-known fact that if a person totally deaf were restored his hearing, he would not be able to understand what you said to him for some time to come. He would have to learn and judge the sound just the same as a child.

machine, the muscles of our arms are made to *vibrate* at a rate corresponding to the making and breaking of the primary circuit.

Now the thought struck me that if we could make the direct and reversed induced impulses succeed one another as regularly as the crests and depressions of waves, then an electrode applied to the ear so as to induce a vibration in the membrane tymp. *should create the sensation of sound without the aid of any intermediate apparatus.*

I have had an instrument made and the experiment seems a success.

A number of permanent magnets were arranged upon a cylinder, which was revolved in front of electro-magnets.
[*See illustration.*]



On filling my ears with water and applying the wires (protected of course) as in the diagram, a soft musical note was heard. The sound stopped the moment the electrical circuit was broken. The wires employed were very short, so that the noise of the rotating cylinder (conducted mechanically along the wire) almost drowned the musical note. The latter thus appeared like an *over-tone*.

Two ladies who were present submitted to the experiment and heard the note as clearly as I did. A gentleman, however (who could not distinguish over-tones in music), heard nothing more than the *noise*.

I want your co-operation. Can we arrange for a meeting on Saturday morning at your rooms? I am anxious to see the results of your experiments.

Yours sincerely,

A. Graham Bell.

Dr. C. J. Blake,
Hotel Berkeley.

SALEM, MASS., May 24, 1875.

DEAR PAPA AND MAMA:

I am so immersed in telegraphy and science that I find it impossible to write freely about anything else, but I feel that at the present time you can scarcely be inclined to listen to anything I have to say on such subjects.

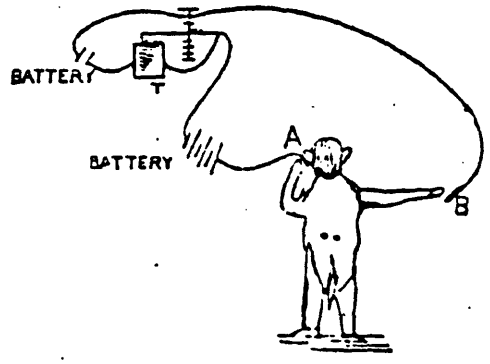
Since I gave up professional work and devoted myself exclusively to telegraphy, I have been steadily gaining health and strength, and am now in a fit state to encounter Mr. Gray or anyone else. The patents that have been granted to me without opposition are, —

1st. The principle of converting a vibratory motion into a permanent make or break of a local circuit.

2nd. The special form of "vibratory circuit breaker" put in illustration.

3rd. The autograph telegraph.

The autograph arrangement is rapidly approaching completion. Already I can copy handwriting *quite legibly*, though not yet neatly. The rate of transmission by means of my instrument will be exactly ten times more rapid than "Bakewell's Autograph Telegraph," in which the rate is 300 letters per minute. When 3000 letters per minute can be sent, my telegraph will be the most *rapid* as well as the



Two thin strips of brass (A and B) are connected with the wires coming from my Transmitting Instrument, T, and from the Battery. On holding A to my ear I hear nothing, but the moment that I touch B with my finger a musical note is heard to proceed from A!!

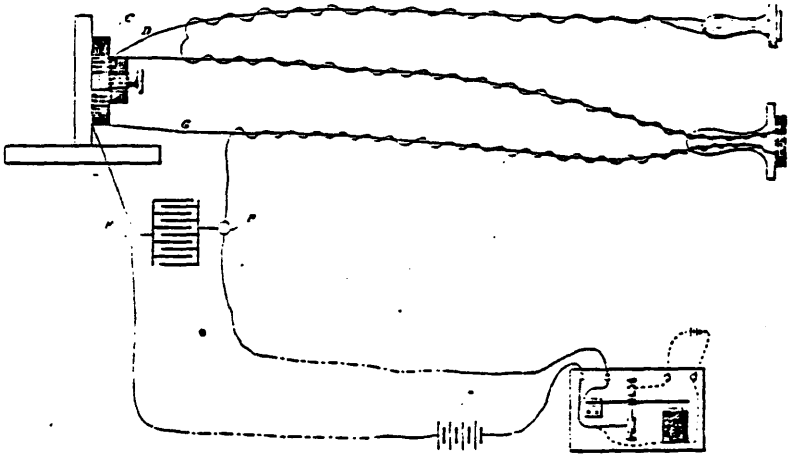
Truly, the more I study electricity and magnetism the more I feel the truth of Hamlet's saying, "There are more things," etc.

I fear that this telegraphic business may force me to remain the greater portion of the summer here, but I cannot tell yet, so many details have to be worked out. My inexperience in such matters is a great drawback. However, Morse conquered his electrical difficulties although he was only a painter, and I don't intend to give in either till all is completed.

With dear love,

Yr affectionate son,

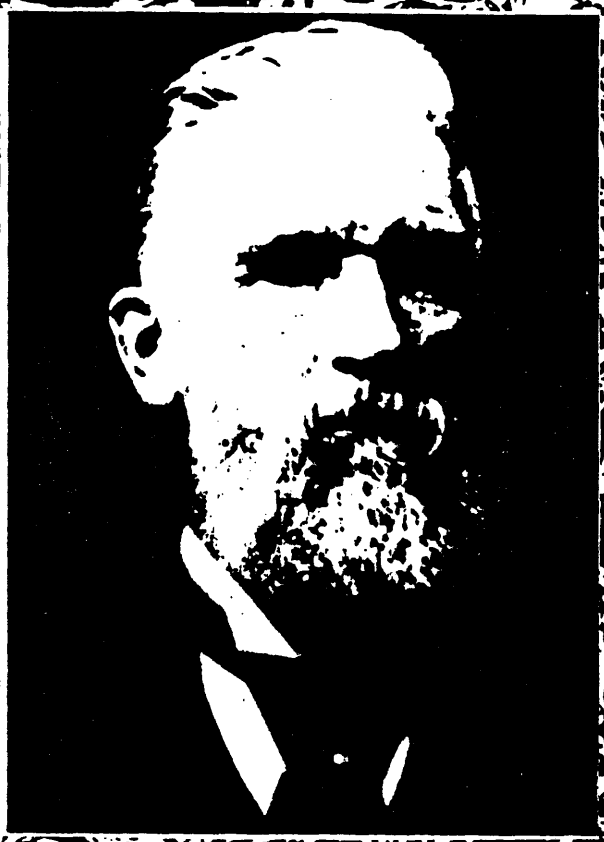
When President Garfield lay dying, shot by an assassin's bullet, Bell invented a special electrical circuit which would make a click in a telephone when a probe was brought near the imbedded bullet which had to be removed. The nation waited breathlessly while he made his experiments in vain.



The circuit failed to detect Garfield's death bullet because Bell's instructions were not followed. The balanced circuit responded in the presence of any metal; and the steel bed spring, which should not have been present, interfered with the tests. Bell's circuit remained in use until the X-ray.

Electrical ore finder

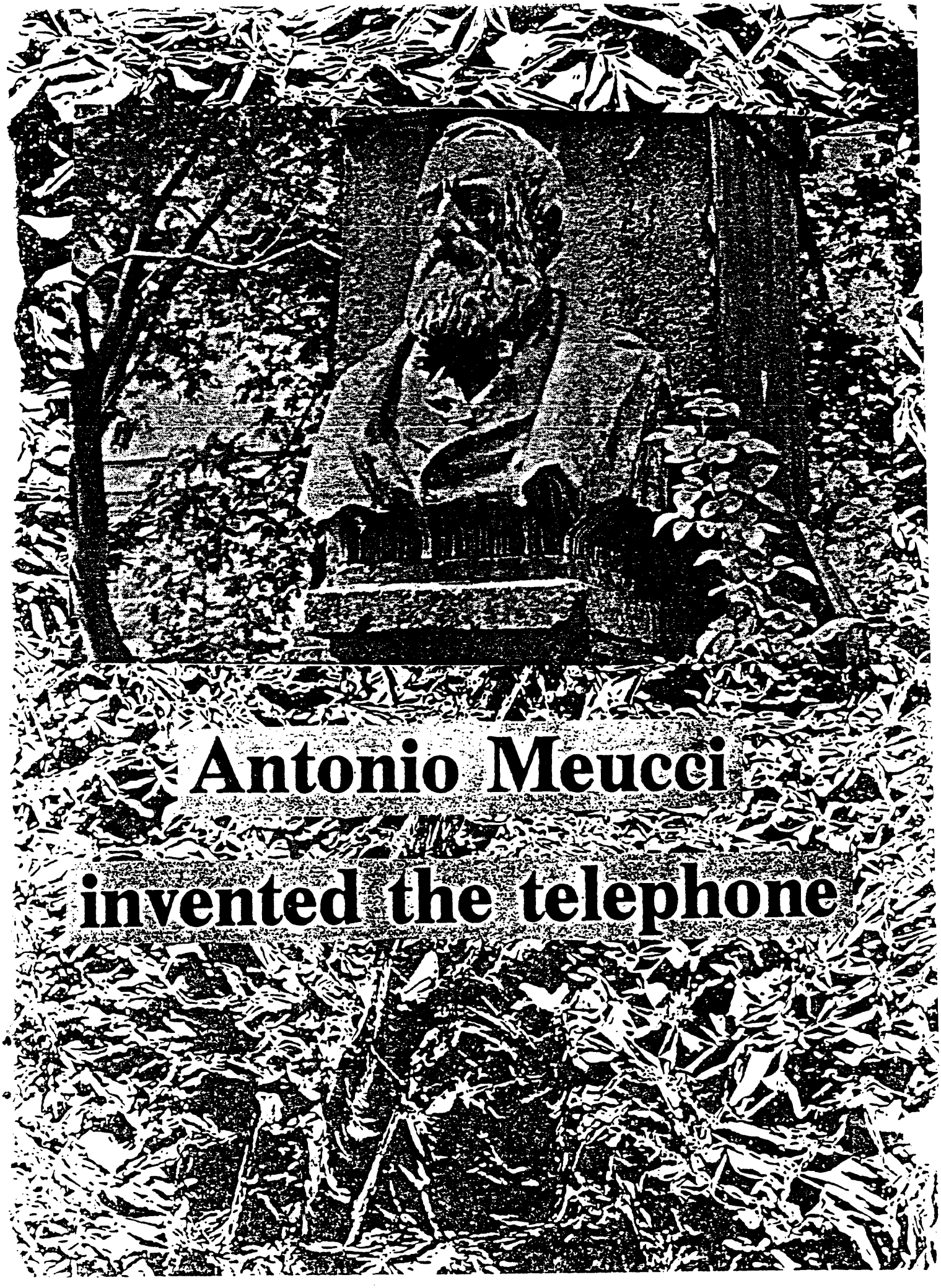
"In the figure (*left*) is shown an instrument for indicating the presence of metals. The induction coil consists of a primary coil made of coarse wire and connected with a rapid automatic circuit breaker and battery. The secondary coil is made of fine wire and is arranged exactly at right angles to the coarse wire coil. A telephone is connected with the secondary coil. If the primary circuit is continuously and rapidly interrupted while the coil is not in the vicinity of any magnetic material, no sound will be heard in the telephone, as all the inductive influences are equal and opposite; but when the coil is held in proximity to metal or magnetic ore, the equilibrium is disturbed and the sound is heard in the telephone."



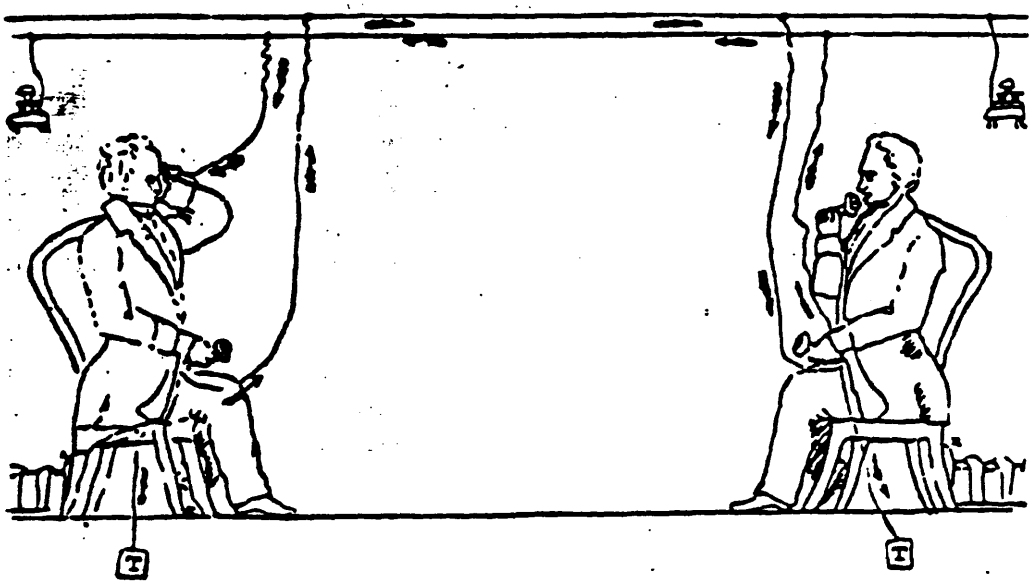
On a sheet of paper found among his effects after his death, Elisha Gray had penned the following note: "The history of the telephone will never be fully written; it is partly hidden away in twenty or thirty thousand pages of testimony and partly lying on the hearts and consciences of a few whose lips are sealed — some in death, and others by a golden clasp whose grip is even tighter."

SECTION 3

ANTONIO MEUCCI


Antonio Meucci
invented the telephone

The Invention of the Telephone.—The following communication, dated July 24th, appears in the columns of an American contemporary, from the pen of Signor Antonio Meucci, of Clifton, S.I.:—"In order to substantiate Mr. Bell's priority in the invention of the telephone, under the date of March, 1876, which is so lengthily sustained in the communication of the 21st to all the leading papers, the examiner at the patent office, Washington, ought to be able to annihilate, with substantial facts and demonstrations, the three caveats which he, his predecessor, or the Commissioner of Patents, granted to me in the years 1871-1872-1873, through the patent solicitor, Thomas D. Stetson, for my application of same invention, and of which three copies are always in my possession, open to public inspection. When such evidence shall be brought forth and made public, I shall not hesitate to yield the priority of invention to Mr. Bell, or any one else who might be entitled to it; but, until then, I shall not abandon my rights, and shall call myself, by valid documents, the first American citizen who has obtained from said patent office at Washington, a caveat which entitles me to the priority of invention of the great contended telephone."



MEUCCI'S EXPERIMENTS

An invention with many fathers

Antonio Meucci, born in Florence in 1808, fled from Italy after the insurrections of 1833. He was a stage mechanic at Havana and in his spare time went in for electro-therapy to relieve sufferers from rheumatic pains. During one of his experiments he placed a copper strip in a patient's mouth, while holding another close to his own ear, in order to identify the affected part by passing a current supplied by a battery through the two points. On feeling the current the patient screamed and it seemed to Meucci, who was in the next room, that he heard the noise through the strip in his ear.

With this in view Meucci pursued his researches. First he used a cardboard cone to receive the sounds better, then he tried to insert an animal membrane to increase the vibrations of the system, and finally he replaced the copper strip with a conductor wire wound round a small bar of soft iron. It would be wrong at this stage to refer to this as a telephone as the essential element was still missing and was only introduced by Meucci in 1854. In that year he substituted a metal diaphragm for the membrane and constructed the first telephone microphone and receiver. The metal diaphragm was essential because vibration near the iron bar caused a variation in the magnetic field which generated the sound currents. In 1856 Meucci set up the first telephone line in history, between the candle factory which he owned on Staten Island and his sick wife's bedroom. Meucci's telephone was more or less complete and quite efficient; among other things he had already foreseen a telegraphic type of call-sign and a way to supply the speaking circuit through a battery not at first adopted by his successors. However poverty prevented Meucci from developing his invention on an industrial scale. During this period, in order to experiment with his telephone over a long distance, Meucci got in touch with the president of the New York District Telegraph Company, who promised to try it out over one of the company's telegraph lines. The test never took place but the designs which Meucci had sent in were never returned to him. Graham Bell, the company's adviser, presented his request for a patent very shortly after, and in view of the similarity between the two systems suspicion was aroused that he had profited by Meucci's designs. The controversy lasted some time and in 1883 there was a court case, won by Bell. The truth is that, as with many other inventions, the technological situation was ripe and similar ideas occurred simultaneously to several gifted men. Philipp Reis's 'telephone' was constructed by 1860 and when Alexander Graham Bell applied for a patent on 14th February 1876, a Chicago electrician, Elisha Gray, lodged another application less than two hours later. Gray's telephone was almost identical with Bell's and in some ways better. In this instance, too, a court case established Bell's claim. When production of telephones began on an industrial scale the Patent Office was besieged by at least thirteen applications from different inventors who claimed to be first in

ANTONIO MEUCCI - A LIFE SACRIFICED TO SCIENCE

An invention none of us could live without, a tool of modern communications so basic that many of today's business and social activities would be inconceivable in its absence, the telephone, is at the center of a series of events so strange as to amount to a "whodunit."

Most of us were brought up on the story of Alexander Graham Bell, the romantic figure of an inventor with dash and charm. Some of these favorable impressions must have come from the famous, if apocryphal, "Come here Watson, I want you" legend of the invention of the device, a tradition augmented by the movie version of the tale, in which actor Don Ameche became more or less permanently attached to the persona of Bell.

But it seems that history must be rewritten if justice is to be done to an immigrant from Florence, Italy: Antonio Meucci, who invented the telephone in 1849 and filed his first patent *caveat* (notice of intention to take out a patent) in 1871, setting into motion a series of mysterious events and injustices which would be incredible were they not so well documented.

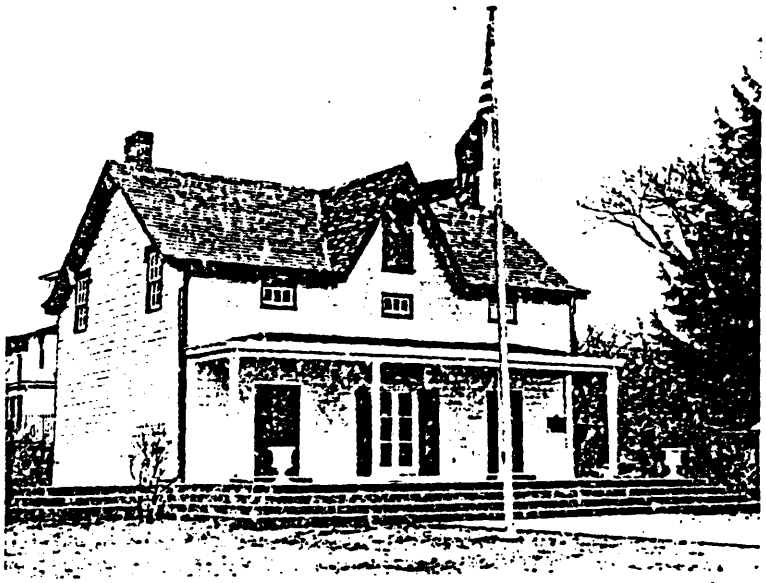
Meucci was an enigmatic character, a man unable to overcome his own lack of managerial and entrepreneurial talent, a man tormented by his inability to communicate in any language other than Italian. The tragic events of his personal and professional life, his accomplishments and his association with the great Italian patriot, Garibaldi, should be legendary in themselves but, curiously, the man and his story are practically unknown today.

Antonio Meucci was born in San Frediano, near Florence, in April 1808. He studied design and mechanical engineering at Florence's Academy of Fine Arts and then worked in the Teatro della Pergola and various other theaters as a stage technician until 1835, when he accepted a job as scenic designer and stage technician at the Teatro Tacon in Havana, Cuba.

Absolutely fascinated by scientific research of any kind, Meucci read every scientific tract he could get his hands on, and spent all his spare time in Havana on research, inventing a new method of galvanizing metals which he applied to military equipment for the Cuban government; at the same time, he continued his work in the theater and pursued his endless experiments.

One these touched off a series of fateful events. Meucci had developed a method of using electric shocks to treat illness which had become quite popular in Havana. One day, while preparing to administer a treatment to a friend, Meucci heard an exclamation of the friend, who was in the next room, over the piece of copper wire running between them. The inventor realized immediately that he held in his hand something much more important than any other discovery he had ever made, and he spent the next ten years bringing the principle to a practical stage. The following ten years were to be spent perfecting the original device and trying to promote its commercialization.

With this goal, he left Cuba for New York in 1850, settling in the Clifton section of Staten Island, a few miles from New York City. Here, in addition to his problems of a strictly financial nature, Meucci realized that he could not communicate adequately in English, having relied on the similarities of Italian and Spanish during his Cuban residence. Furthermore, in Staten Island, he found himself surrounded by Italian political refugees; Giuseppe Garibaldi, when exiled from Italy, spent his period of United States residency in Meucci's house. The scientist tried to help his Italian friends by devising any number of industrial projects using new or improved manufacturing methods for such diverse products as beer, candles, pianos and paper. But he knew nothing of management, and even those initiatives which succeeded were to have their profits eaten up by unscrupulous or inept managers or by the refugees themselves, who spent more time in political discussion than they did in active work.



Meucci's house on Staten Island

Models of the Meucci telephone

Meanwhile, Meucci continued to dedicate his time to perfecting the telephone. In 1855, when his wife became partially paralyzed, Meucci set up a telephone system which joined several rooms of his house with his workshop in another building nearby, the first such installation anywhere. In 1860, when the instrument had become practical, Meucci organized a demonstration to attract financial backing in which a singer's voice was clearly heard by spectators a considerable distance away. A description of the apparatus was soon published in one of New York's Italian newspapers and the report together with a model of the invention were taken to Italy by a certain Signor Bendelari with the goal of arranging production there; nothing came of this trip, nor of the many promises of financial support which had been forthcoming after the demonstration.

The years which followed brought increasing poverty to an embittered and discouraged Meucci, who nonetheless continued to produce a series of new inventions. His precarious financial situation, however, often constrained him to sell the rights to his inventions, and still left him without the wherewithal to take out final patents on the telephone.

A dramatic event, in which Meucci was severely burned in the explosion of the steamship Westfield returning from New York, brought things to an even more tragic state. While Meucci lay in hospital, miraculously alive after the disaster, his wife sold many of his working models (including the telephone prototype) and other materials to a second-hand dealer for six dollars. When Meucci sought to buy these precious objects back, he was told that they had been re-sold to an "unknown young man" whose identity remains a mystery to this day.

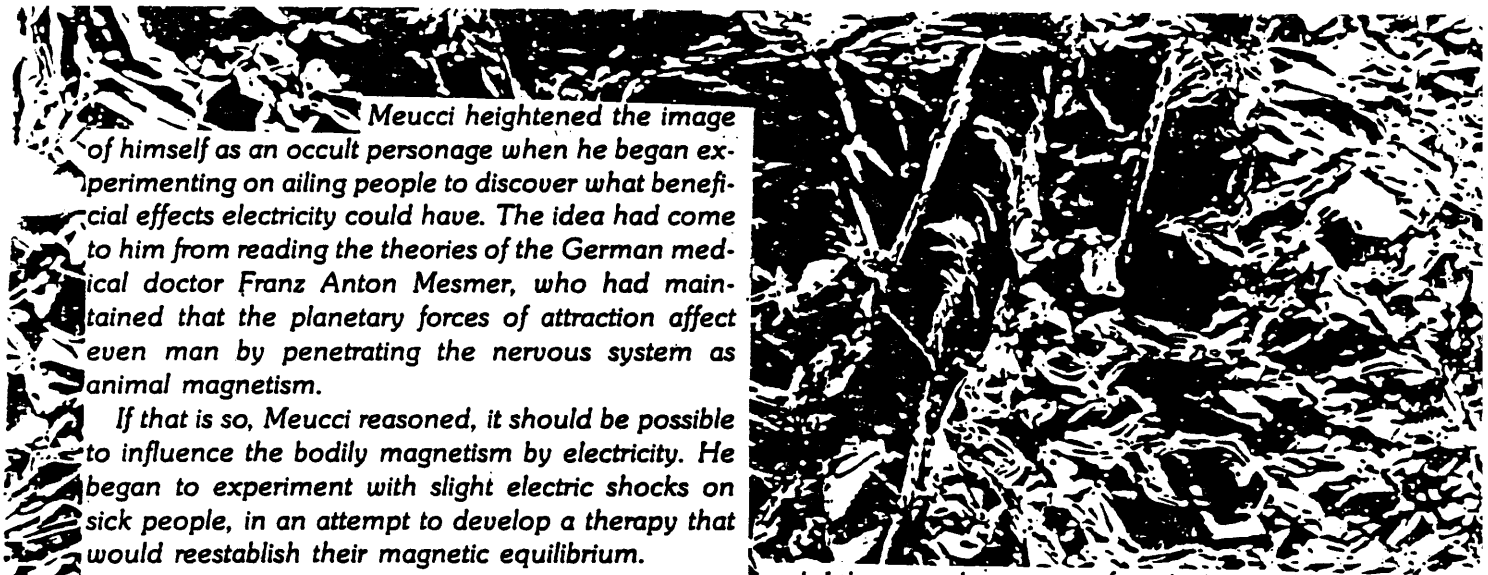
Crushed, but not beaten, Meucci worked night and day to reconstruct his invention and to produce new designs and specifications, clearly apprehensive that someone could steal the device before he could have it patented. Unable to raise the sum for a definitive patent ($250, considerable in those days), he took recourse in the *caveat* or notice of intent, which was registered on December 28, 1871 and renewed in 1872 and 1873 but, fatefully, not thereafter.

Immediately after he received certification of the caveat, Meucci tried again to demonstrate the enormous potential of the device, delivering a model and technical details to the vice president of one of the affiliates of the newly established Western Union Telegraph Company, asking permission to demostrate his "Talking Telegraph" on the wires of the Western Union system. However, each time that Meucci contacted this vice president, a certain Edward B. Grant, he was told that there had been no time to arrange the test. Two years passed, after which Meucci demanded the return of his materials, only to be told that they had been "lost." It was then 1874.

In 1876, Alexander Graham Bell filed a patent which does not really describe the telephone but refers to it as such. When Meucci learned of this, he instructed his lawyer to protest to the U.S. Patent Office in Washington, something that was never done. However, a friend did contact Washington, only to learn that all the documents relevant to the "Talking Telegraph" filed in Meucci's caveat had been "lost." Later investigation produced evidence of illegal relationships linking certain employees of the Patent Office and officials of Bell's company. And later, in the course of litigation between Bell and Western Union, it was revealed that Bell had agreed to pay Western Union 20 percent of profits from commercialization of his "invention" for a period of 17 years. Millions of dollars were involved, but the price may been cheaper than revealing facts better left hidden, from Bell's point of view.

In the court case of 1886, although Bell's lawyers tried to turn aside Meucci's suit against their client, he was able to explain every detail of his invention so clearly as to leave little doubt of his veracity, although he did not win the case against the superior — and vastly richer — forces fielded by Bell. Despite a public statement by the then Secretary of State that "there exists sufficient proof to give priority to Meucci in the invention of the telephone," and despite the fact that the United States initiated prosecution for fraud against Bell's patent, the trial was posponed from year to year until, at the death of Meucci in 1896, the case was dropped.

The story of Antonio Meucci is still little known, yet it is one of the most extraordinary episodes in American history, albeit an episode in which justice was perverted. Still, the genius and perservance of an Italian immigrant — genius, poor businessman, tenacious defender of his rights against incredible odds and grinding poverty — is a story which must be told. Antonio Meucci is waiting to be recognized as the inventor of a key element in our modern culture.



Meucci heightened the image of himself as an occult personage when he began experimenting on ailing people to discover what beneficial effects electricity could have. The idea had come to him from reading the theories of the German medical doctor Franz Anton Mesmer, who had maintained that the planetary forces of attraction affect even man by penetrating the nervous system as animal magnetism.

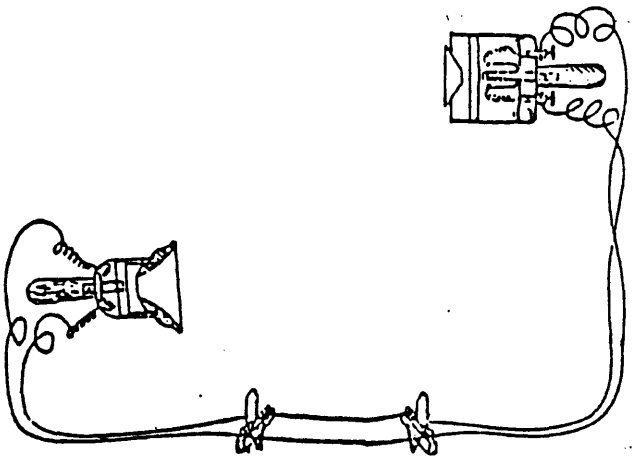
If that is so, Meucci reasoned, it should be possible to influence the bodily magnetism by electricity. He began to experiment with slight electric shocks on sick people, in an attempt to develop a therapy that would reestablish their magnetic equilibrium.

Many years later, in the course of the Bell-Meucci lawsuit, the Italian inventor was to speak of these experiments made in Havana. "During the period that I was running the electroplating workshop in my laboratory," Meucci recounted, "I constructed an electrical machine for the purpose of using it on people who were sick. I frequently gave electricity to employees of the theater and other people. I put up wires through the rooms of our apartment, which were four, and at times gave electric shocks to my wife when she was ill. The instrument I used to convey the electric current had a copper plate at its end, which I placed in the patient's mouth or on other parts of the body when I gave the shock. The wires soldered to the plate were covered with a piece of cork, which the person receiving the shock held in his or her hand. One time, somewhere about 1849, a man in my employ came to my house complaining of a strong headache. I placed him in a room and put the wires in his hands. The wires being in circuit in my laboratory two rooms away, I went there to control the current I was using. With me I, too, had a copper plate connected to the battery. I called to the man to put the copper part of the instrument in his mouth. The man cried out from the effect of the shock. I thought I heard this sound more distinctly than natural. I then put the copper of my instrument to my ear and I heard the sound of his voice through the wire."

As previously noted, Meucci was enormously impressed by this phenomenon and wanted to repeat the experiment immediately. But before doing so he quickly modified the instruments. "To prevent the electrical shock being received by the person, the idea struck me to remedy such accident. I took the two instruments, the one that was in the hands of the patient and mine, and I covered each with a funnel of pasteboard, so as to render the little copper plate insulated from contact with the flesh. I ordered the man to repeat the operation made before, but not to have any fear of being touched by the electricity and to speak freely into the funnel. I, at the end of the third room, put mine to my ear. I then heard quite distinctly the sound of his voice — so much so that I believed it came over the wire. I made him repeat what he had said several times, which convinced me that I heard his voice over the wire electrically."

Certainly it cannot be said that back in 1849 Meucci invented the telephone, at least not as we today understand that instrument that has become so familiar and indispensable to us. But intuitively he had grasped its basic principle. Subsequently he worked for years on his discovery, continually improving its technical invention.

At the time Meucci first conceived the idea of the telephone, immediate communication over a distance was only possible by the transmission of written messages. The telegraph was in operation. The first line had been inaugurated by its inventor, the American painter Samuel F. B. Morse, on May 24, 1844. It was then that Morse, using the alphabetical code of dots and dashes that bears his name, transmitted from the Capitol in Washington, D.C., to Baltimore his famous message: "What hath God wrought?" In the case of the telegraph, too, enormous financial interests came into play along with the intrigues of rival entrepreneurs, and the credit for the invention was hotly contested in years of litigation. But unlike the defenseless Meucci, the combative Morse proved



more than a match for his adversaries, and his rights were upheld.

In those years when the telegraph was just coming into widespread use, it seemed a marvel beyond which no further development was possible. The next step, the transmission of the human voice, could appear but the raving of a madman. Meucci, however, began to believe firmly in his idea, and set himself the task of constructing a "speaking telegraph."

"And he even maintained that it would be possible for people to communicate merely through their thoughts, since each individual is endowed with "magnetic fluid."

Fond as he was of the creatures of his genius, Meucci had the habit of writing down all his ideas and their development in a notebook. He always wrote the date, noted the details of the invention and his experiments and frequently completed his work with accurate drawings.

"Then I made this invention with two metallic points, which, developing the electricity in contact with the flame, rendered it clear and without smoke."

FASCINATED but a bit apprehensive, Antonio Meucci's patients eyed him as he sat them down and placed a pair of long wires in their hands. He avidly studied the workings of nature, but his approach to natural phenomena was above all empirical. Thus when Meucci read that illnesses could possibly be treated with electricity, he felt that he simply had to try it.

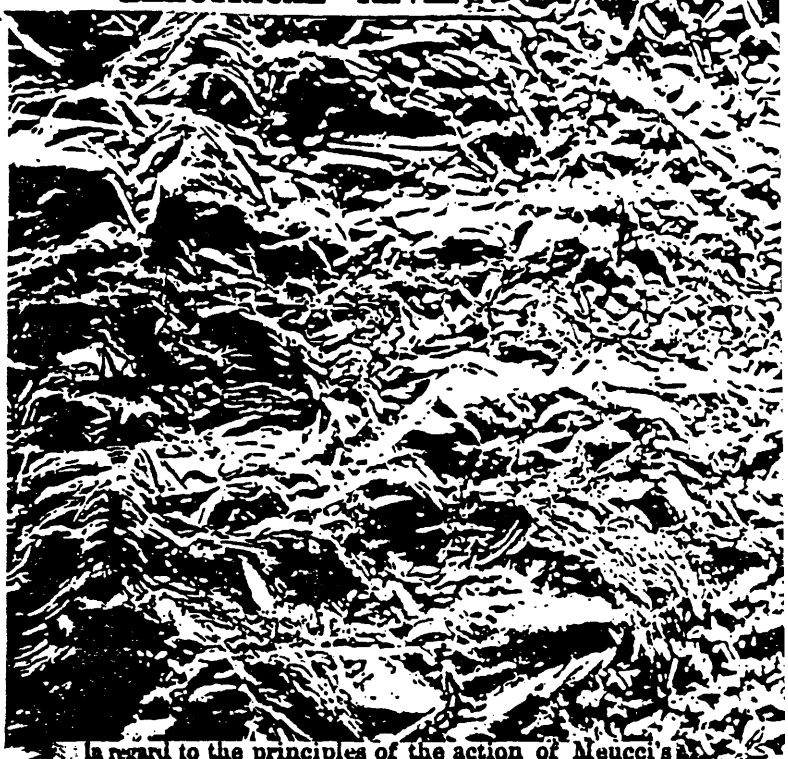
He handled instruments that he made himself with wires and batteries, and he spoke about "magnetic fluid." With his placid expression and the beard of a classic sage, he had the presence of a person rich in mysterious knowledge.

The First Inventors of the Telephone.

In my communication published in the REVIEW on 3rd inst., I gave a list in chronological order of seven claimants to the honour of being the original first inventor of the telephone.

The name of Antonio Meucci stands at the head of the list, for whom it is claimed that his invention dates back to 1849, as testified to by many disinterested parties. The first official record of any such invention by Meucci, is the caveat filed by him in 1871 in the U.S. Patent Office, and the first public printed notice of his claim "to transmit accurate speech," which I have as yet been able to find, is in the *Commercio di Geneva* of 1st December, 1865. From this newspaper article I condense the following statement :—

"Several articles giving an account of Manzetti's claims to have discovered 'the transmission of sound and of speech by the telegraph' having been republished in the United States, notably in the *Echo d'Italia*, of 19th August, 1865, a certain Mr. A. Meucci wrote to the *Il Commercio di Geneva* a letter dated Clifton, Staten Island, 29th August, 1865, in which he claims priority of the invention of Mr. Manzetti. According to his statement, before 1860 he had discovered that by means of a small instrument placed in the ear and acted upon by electricity through a metallic wire, he could transmit accurately speech by holding one end of the wire between his teeth. By this method, two persons at a distance from each other could hold communication together. He adds that he disclosed his discovery, in 1860, to a Mr. Bendetari, one of his friends, who was about to start for Italy. In 1865, Mr. Meucci, having heard of the results obtained by Mr. Manzetti, wrote to Mr. Bendetari to inquire whether Mr. Manzetti had not been informed of his (Meucci's) communication to Mr. Bendetari before his departure from America. To this Mr. Bendetari replied that he had not disclosed to anyone the discovery of Meucci, of which he well remembered to have been informed in the house of Mr. Reveccio at New York."



In regard to the principles of the action of Meucci's telephone I have been unable to find any definite description, which, however, will shortly be made known by the publication of the patent he has applied for in the United States under the caveat of 1871.

In the *Diritto* of 21st December, 1865, I find a defence by the editor of what he called the rights of Mr. Manzetti, from which I make a few extracts.

"The idea of Mr. Manzetti, which differs greatly from that of Mr. Meucci, originated in 1854, according to the evidence of many persons. It was the construction of his automatic flute player which suggested the idea. At this time Manzetti was making experiments on sound waves and their mode of propagation, and he conceived the idea of adding to his automaton a mechanism by which it could be made to speak as well as play tunes. At this time he made numerous experiments and obtained articulate sounds. He then devoted himself to the study of the transmission of speech, and he succeeded in obtaining a reproduction not only of melodies, but also the direct transmission of speech; thus he accomplished the development of his first idea of 1854."

"By means of this telegraph, he who speaks can be heard simultaneously at the end of as many telegraph wires as are connected to his instrument."

In a communication by me, published in the REVIEW of 7th January, 1882, I gave a list, as follows, of the newspapers in which mention was made of Manzetti's invention :—*Il Diritto*, 10th July, 1865; *l'Italia a Firenze*, 10th August, 1865; *l'Echo d'Italia*, of New York, 19th August, 1865; *Il Commercio d'Italia*, of Genoa, December 1st, 1865; *La Verita di Norcau*, 4th January, 1866; *Il Commercio di Geneva*, of 6th January, 1866; *La Feuille d'Aorti*, in various numbers, 1865-66; *La Petit Journal*, of Paris, 22nd November, 1865.

In *La Feuille d'Aorti*, of 25th July, 1865, I find the following notice of Manzetti's invention :—"Mr. Manzetti transmits speech by means of a telegraph wire

with an apparatus more simple than that now used on the telegraph wires, and henceforth two merchants can transact their business between London and Calcutta. The possibility of transmitting by means of electricity the vibrations of sound undulations produced by the voice is clearly demonstrated." In the same newspaper of the 22nd August, 1865, I find the following:—"It is said that English engineers, to whom Manzetti communicated his method of transmitting speech by the telegraph wire, proposed to apply his invention to private telegraph wires used in England."

Perhaps those English engineers, if they be yet amongst us, will give to the public what they then learned of Manzetti's invention.

Le Petit Journal, of Paris, of 22nd November, 1865, contained an article by an avocat of the Imperial Bank of Paris, headed, "Discovery of the Transmission of Sound and of Speech by the Telegraph, by Manzetti." I have been unable, as yet, to find any description of the mechanism or method used by Manzetti for the transmission of speech. From the publication above referred to, it appears that Manzetti conceived his idea of the transmission of speech by electricity in 1854, and it was publicly announced in 1865 that he had actually accomplished the result which "has been the admiration of the whole world." But, alas! how he did it lies with him, a secret, in the grave.

The first publication (so far as I have yet discovered) of any description in detail of any system of transmitting speech by means of electricity was in a journal, *l'Illustration*, of 30th July, 1854, Paris, and subsequently in the *Didaskalia*, of Frankfort, 28th Sept., 1854. This was an invention of Charles Bourseul, a Frenchman, and about that time a soldier in the army in Algiers. That description is as follows, and it will be seen that it fully describes the system and the means used:—

"An electric current passing through a wire transforms a piece of soft iron into a magnet. If the current ceases the magnetism also ceases. This electromagnet can be made to alternately attract and release a movable plate, which in its to and fro movements produces the conventional telegraphic signals. Now, it is also known that all sounds which reach our ear are produced by vibrations in the air, and that the infinite variety of sounds depends solely on the speed and magnitude of these sound waves. If, now, a metal disc could be invented which would be flexible enough to reproduce all the sound waves transmitted to it by the air, and if that disc could be connected to an electric circuit—such a way that in conformity with the vibration of the air it would start and interrupt the current—then it would also be possible to cause a similarly constructed metal disc, in electrical connection with the first, to repeat all the movements of it, and the effect would be the same as if one had spoken directly against this second disc—that is to say, the ear would be affected in the same manner as if it heard the speech directly through the first metal diaphragm."

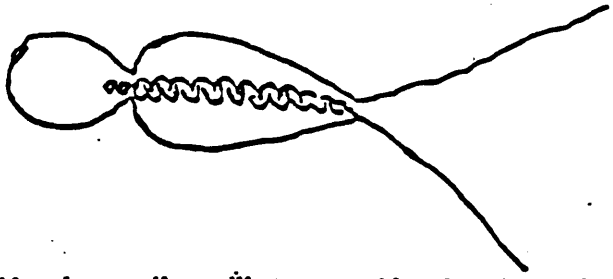
I have thus far been unable to discover whether Bourseul ever made an instrument after the above description; but the fact that Philip Reis was the *first to make*, and *give to the public a speaking telephone*, is clearly established by the numerous publications cited by Professor Silvanus P. Thompson, in his book, "Philipp Reis, Inventor of the Telephone." Instruments made by Reis himself were sold in 1861. That Reis's instruments, made according to the description of them, will transmit speech can be verified by anyone. I have frequently heard them talk. Mr. Justice Fry, in his judgment, said, "I have some evidence that they will transmit articulate speech."

In the last article on the invention of the telephone written by the late much-lamented eminent savant, Count Du Moncel, in *La Lumière Electrique*, of 29th October, 1883, appear these words: "Ou a entendu certaines paroles dans la telephone de Reis."

I avail myself of this occasion to express my deep sorrow for the death of this eminent man of science.

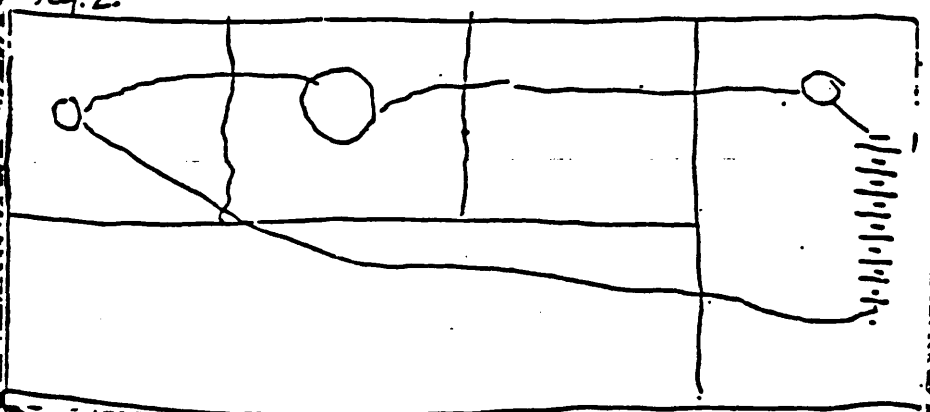
to see if what was said by said Mesmer was right; and while I had not much to do I spent some time in giving electrical shocks to different colored persons employed by me, and sometimes to my wife. In the same time I had from my laboratory to a third room an electrical conductor, and I produced the electricity by a series of batteries of Bunsen that I had in my laboratory. One day a person known by me came to me sick with rheumatism in the head; then I put him in the third room; I put in his hand the two conductors, in communication with the battery, and at the end of said conductors there was a utensil insulated from the conductors made of cork of the form I give here.

Fig. 1.



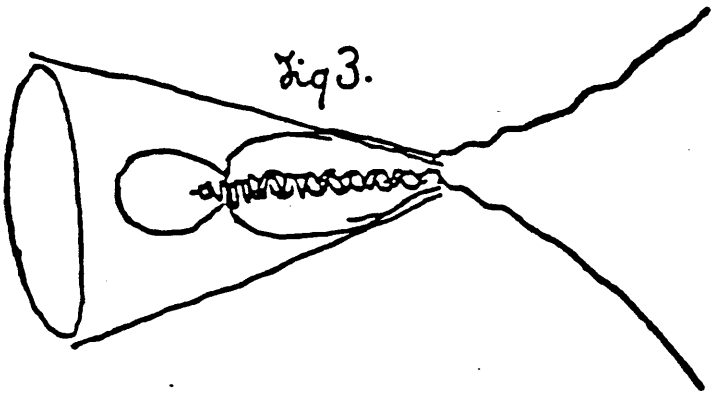
Above said cork, a small metallic tongue soldered to the conductor of copper insulated wire, passing in the interior of said cork and in communication of the battery. In my laboratory, (Fig. 2,)

Fig. 2.



ANTONIO MEUCCI DISCOVERS
THE VRILLIC CONNECTION:
VISCERAL CORRESPONDENCE

where I kept an instrument identical with the one he held in his hand, I ordered him to put the metallic tongue in his mouth, in order that being in connection with me by the electric fluid, I wished to ascertain where was his disease. I put the same instrument to my ear. The moment that the sick person introduced the little tongue between his lips, he received a discharge and a shock, and yelled. I obtained, in the same moment, in my ear, a sound. I interrupted the operation, and to prevent the case of the electrical shock being received by the person, the idea struck me to remedy such accident. I took the two instruments, the one that was in the hands of the person, and mine, and I covered them with a funnel of pasteboard, so as to render the little tongue insulated from contact with the flesh. (Fig. 3.)



I ordered the sick person to repeat the operation made before, and not to have any fear to be affected by the electricity, and to speak freely into the funnel. He did so immediately. He put his funnel to his mouth, and I put mine to the ear. At the moment that said individual spoke, I received the sound of the word; not distinct, but a murmur—an inarticulate sound. I caused it to be repeated several times in the same day, and then I tried it again in different days, and I obtained the same result. From this moment this was my imagination, and I recognized that I had obtained the transmission of the human word by means of conducting-wire united with several batteries to produce electricity

Int. 32. Give about the date when you constructed the instrument represented by Figure 8, as just drawn by you, and please describe Figure 8 and its various parts?

Ans. 32. Non posso ricordare esattamente, ma fu dal '53 al '57.

N. 1. Cassa cilindrica di cartone come l' anteriore. Al disopra l' orifizio per parlare con un coperchio rinchiudente la membrana.

N. 2. Ferro di cavallo in acciaio temperato e magnetizzato permanentemente, sorretto nel centro da una vite nel fondo dello strumento.

N. 3. La vite che regge il ferro di cavallo.

N. 4. Membrana di metallo e qualche volta di sostanza animal o tessuto di diverse qualità. La membrana animale da me costruita consisteva di pergamena saturata di paraffina e passata poi nella piombaggine da me, pure le altre sostanze erano tratate collo stesso sistema, meno quelle in ferro.

N. 5. Blocco del fondo dell' istrumento.

N. 6. Filo di rame isolato che circonda le due branche del ferro di cavello formando elice e passa al disotto del blocco per mettersi in comunicazione colla batteria.

Ans. 32. I can't recollect exactly; but it was from 1853 to 1857.

No. 1. Cylindrical box of pasteboard, as in the preceding, above the mouthpiece, to speak in, with a cover enclosing the membrane.

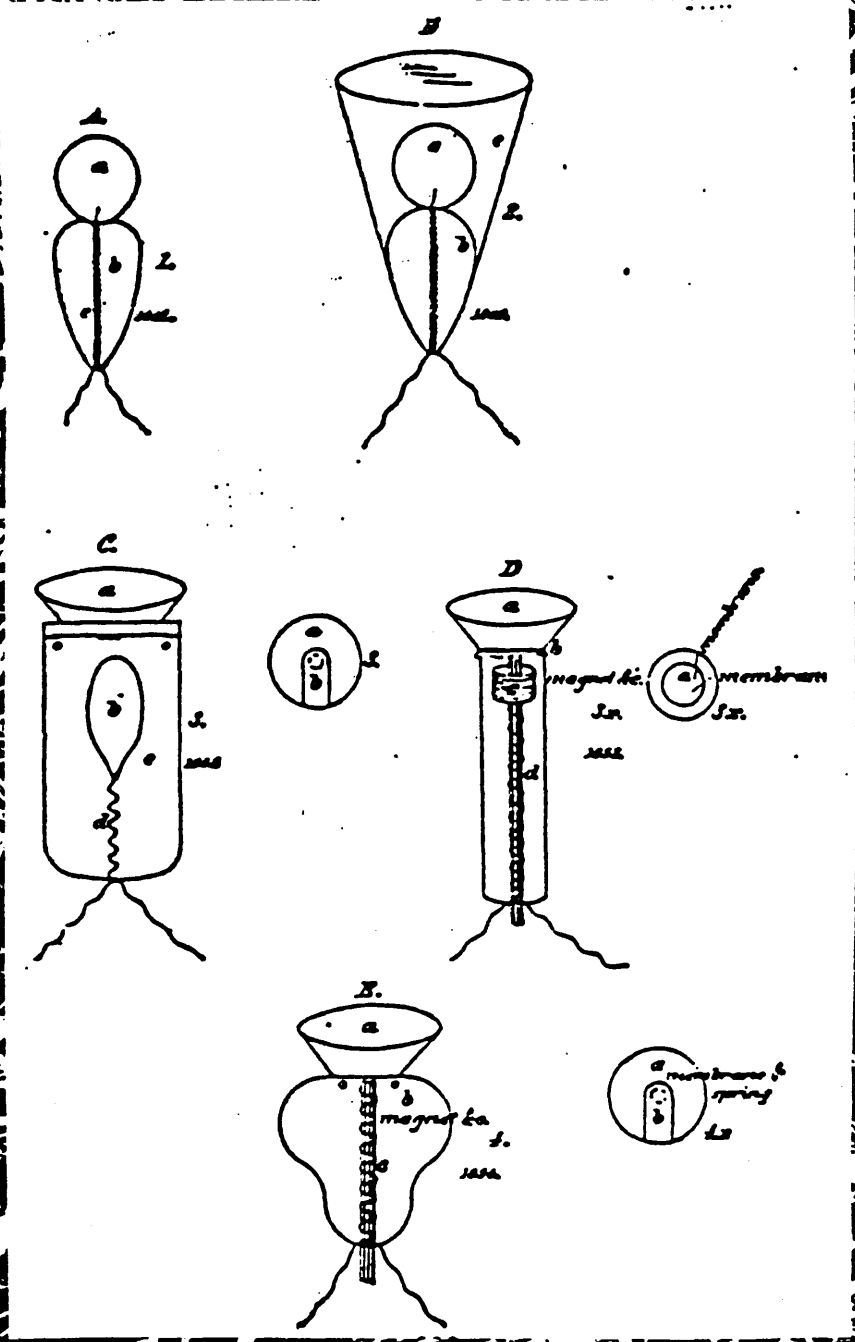
No. 2. Steel horseshoe, tempered and permanently magnetized, kept in the centre by a screw to the bottom of the instrument.

No. 3. The screw keeping the horseshoe in place.

No. 4. Membrane of metal, and sometimes of animal substance, or fabric of different qualities; the animal membrane constructed by me consisted of a piece of parchment saturated with paraffine and then passed through plumbago; moreover, the other substances were treated according to the same system, excepting the iron ones.

No. 5. Block at the bottom of the instrument.

No. 6. Insulated copper wire surrounding the two branches of the horseshoe, forming a helix, and passing under the block to connect with the battery.


A
B
C
D
E
membrane
spring

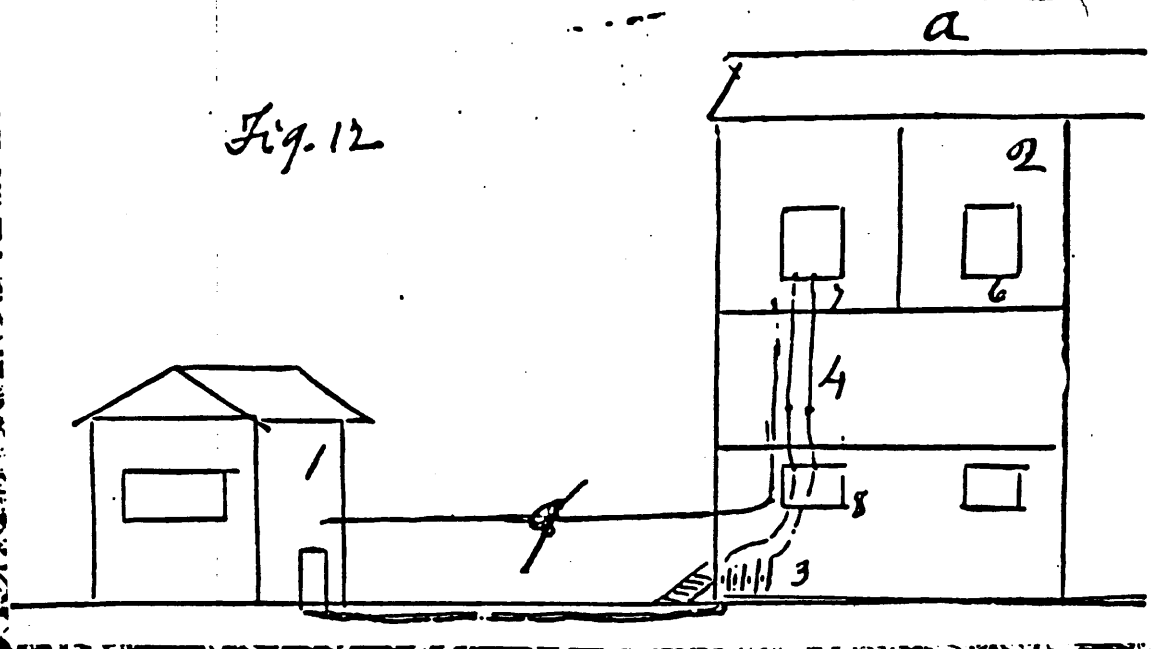


Fig. 12

Ans. 63. A. Drawing showing the body of the house on the right-hand side.

No. 1, small workshop, where I kept a turning lathe and a small steam boiler for the motor.

No. 2, side of the house.

No. 3, battery in the basement.

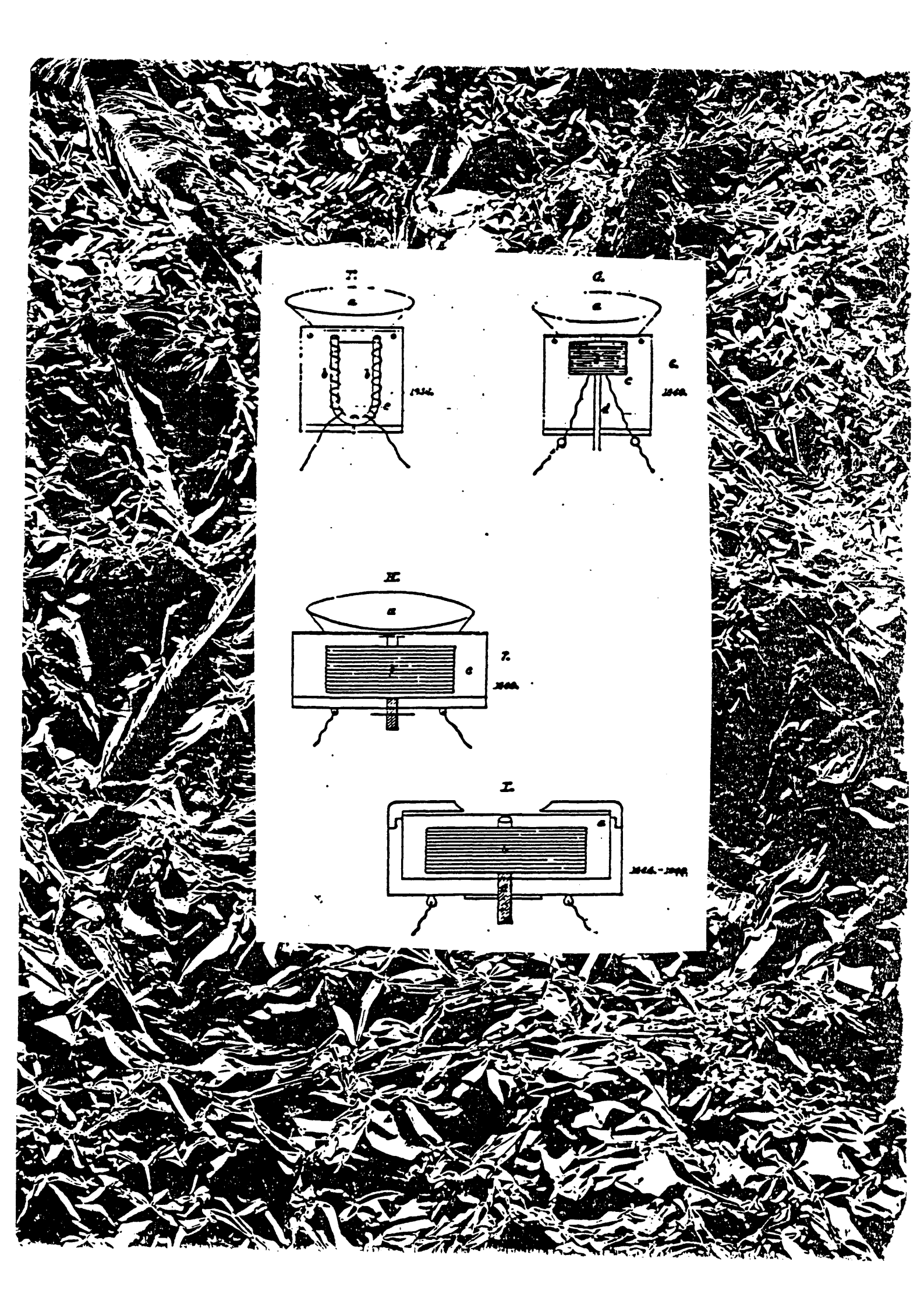
No. 4, conducting wires, passing to the exterior of the house and penetrating, by the window, in the room called of Garibaldi, on the third floor.

No. 5, ground separating the house from the workshop.

No. 6, window of the room in the third story where my wife stayed, and adjoining the room of Garibaldi.

No. 7, window of Garibaldi's room, in which the conducting wires coming from the battery entered.

No. 8, window in the basement, from which the wire going from the battery to window No. 7, came out.



TRANSLATION OF DEFENDANTS' EXHIBIT NO. 109.

[Record, p. 65.]

[Page 1.] MARCH 7th, 1862.

Cylindrical tubes of wood and pasteboard with membrane of parchment or tin and cord [of copper and] cotton is a conductor, but not on long distance.

Those of tin with membrane of rawhide saturated with bichromate of potash are better; if the membrane is rendered impermeable it is still better, not being affected by the moisture of the breath when spoken into.

The cord of [copper covered with] flax saturated with bichromate of potash is good.

The cord of [copper covered with] cotton bathed with salt water, gum arabic and plumbago is good, and carries to a long distance.

Uniting the two extremities of the cord [of copper] to the ground, it becomes well conductive, taking the electricity of the earth, and goes to a long distance.

The cylindrical tubes full of natural loadstone, with a metallic conductor passing through its centre and having the two extremities communicating with a metallic disk in the ground, have given an excellent result, the terrestrial electricity being communicated from one extremity to the other, and it is very simple.

The membranes of paper are not very good, because they take quickly the moisture of the breath.

If a large cord be united with a very thin copper wire, when the rope is made it will be very conductive of the electricity, and could be used in families or factories to speak as they do now commonly with tin tubes.

[Page 2.] MAY 20TH, 1862.

The cord saturated with any conductive substance is good to carry the atmospheric electricity to a long distance, but if it is aided by some galvanic battery, it will be still better. The cord of hemp bathed with plumbago in water and muriatic acid is rendered very conductive, and transmits well the sound of the voice.

In the centre of the cord a strongly-magnetized iron, protected by a bobbin, does not need any battery and conducts well the sound.

The cylindrical tube is much better if it be of any metal, and not of pasteboard, and the best membrane is the animal saturated with bichromate of potash.

I do not find the galvanic batteries of Daniel as energetic as those of Bunsen, perhaps on account of containing carbon of platinum in the porous tube.

The circular piece of iron made for me by Mr. Chester is very good and produces a strong spark, but if its internal bobbins were made of much finer copper wire they would be much better, multiplying the resistance by many more miles.

[Page 3.]

THE USE OF AERIAL ENERGIES TO ACTIVATE VOICE TRANSMISSIONS

(*) (Page 34.) August 17, 1870, [Different Diaphragms].

Thick paper of manilla, saturated with sulphuric acid diluted in water, and then put on the tube like the parchment, and after being dried saturated with paraffine or wax, and on the surfaces on the two sides I put some fine plumbago, this is a good diaphragm.

The same paper saturated with a bath of nitrate of silver and then paraffine, like the previous, is good.

Fabric of cotton, flax, silk, saturated with starch very thick, and the starch dissolved in a solution of nitrate of silver, and then paraffine, has given a good diaphragm, only that to use this quality of membrane it is necessary to put in the centre a small disk (t) of

(*) All this page is written in pencil.

(t) Words "of iron or platinum" written in the text in ink and struck out by pencil. Words in brackets interlined in pencil.

iron or platinum metallic iron in order that it can have action on the centre of the bobbin and communicate the electricity in its vibration when the sound of the word; but all these membranes need to be kept distended and stretched like those of a drum or tympanum, but the humidity has always a little action, and renders it too elastic.

I have adapted to these membranes under and near the bobbin a rope or cord, of two wires of copper wire stretched, and in its centre a metallic button, be it steel or iron, or (x) platinum. This has action on the magnetic cord of the bobbin.

[To have a long distance adopt ends of cord of copper wire insulated in cotton or other. With this method I have obtained a distance of almost a mile.]

(Page 35.) Sept. 3, 1870.

Filled the tube of wood or tin with a cylindrical envelope of paper, and this filled with small pieces of loadstone, passing through its centre the conducting cord, and is very good, and conducts well the sound of the word, but always the two extremities of the conductor united to the ground.

Other experiments made; filled said tube of paper with some small pieces of loadstone in its centre, and surrounded this with filings of iron; has become much magnetic, and is a strong conductor, of the electricity, as much as a bobbin. The cord with the same system as the previous always communicate the two extremities with the ground.

Experiment made on the 27th instant. Put at the centre of the conducting cord a horse shoe magnetized, the two heads of which — that is to say, the two poles, N S united to these two poles has given a good result but if the conductor was of wire of [copper and not of] iron I think that it must be very good [to be tried], as to unite in the same system at the centre of the cord* [conductor] a strong bobbin with at its centre a strong piece or bar of iron well magnetized; or if not, put this before the tube to transmit with one of the poles and the other pole in contact with the ground.

Words in brackets interlined in pencil.

(x) The word "platinum" struck out with pencil.

[Words in brackets interlined in the original.]

*The word "cord" written in ink in the original and struck out by pencil.

(Page 36). [*Here follows Drawing.*]

All these experiments made with this method are excellent, only it is necessary to establish them in a practical way, I not having the necessary knowledge and the pieces that are needed.

The best method is the one that, whether it be a bobbin with load stone or horse shoe, instead of putting it in the centre it is better to put it before the instrument, either the one to transmit or the one to receive, in communication with the earth; that this, communicating the terrestrial electricity communicates it to the conductors, as Fig. 4 shows, and works as if it was aided by a galvanic battery.

*(If instead of a rope of hemp or cotton as conductor it is replaced by a metallic conductor, treating it in the same method above described, without any galvanic battery, the result will be equivalent; but I desire to form a dry battery and that it be constant and of long duration.

I think that forming some round disks of sulphate of copper with four per cent. of bichromate of potash as negative pole, and a positive pole — this made with sulphate of zinc with four per cent. of bichromate of potash as the previous, and forming something like a Volta's pile between said disks — to separate them a disk of absorbing pasteboard, this also bathed in a solution of bichromate or common salt and all this pile in a column protected by a lining of any porous substance, be it canvas, pasteboard, china (Page 37), or other equivalent material. The conductor of the first disk at the bottom will communicate the negative electricity, being of sulphate of copper, to a disk of carbon also in the form of a disk and that of the sulphate of zinc at the upper part will communicate the positive electricity. It will be made also of carbon or if not the two conductors above described will be of platinum.

Another.

Made some round disks of pasteboard; on one side of them a surface of oxide of zinc dissolved in water and gum and the solution of sulphuric acid in much water. The other disk has a surface and stratum of lamp-black dissolved as above in water and gum and a solution of bichromate of potash, water and sulphuric acid.*)

*The following, enclosed in parentheses, is all crossed out with pencil, down to and including the word "acid" on next page.

*Another: 72 ***

Disks of pasteboard, and with them some disks of sheet zinc, thin as above, and the disk of pasteboard bathed in the same sulphuric acid diluted in water, and united together with the one of the lampblack, forming the pile.

Another.

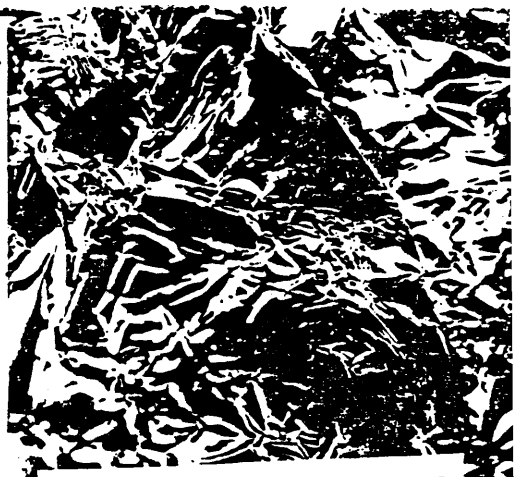
Disks of pasteboard bathed in salted water and put with a disk of tin-foil and united with those of lamp-black as above. 72 **

Way for those that work under water called divers helped by the the telephone to speak above the water.

To adapt the system it consists in introducing in the interior of the tube that communicates the air to the chamber, where stays the man that goes under water (diver), it will carry in its centre of said tube two conductors coming from an electric battery (p. 38), situated above the water or other dynamo-machine, one of said conductors, the positive one, will communicate with the mask of the diver, where will be located a telephone; and the other conductor, the negative, will discharge in the ground above the water. With this method he will be able to speak easily with the men that are above on watch and who await the signals that he will make with the system of the cord, while with the telephone they will be able to speak easily with great facility.

The apparatus on board the vessel where are the men attending to the diver, and the one adopted by me for fog signals, if put at a certain distance from said men, their voices will be received by said apparatus and transmitted with great facility to the diver.

One of those men or two will keep to their two ears by means of an apparatus, two instruments to receive always fixed so that without fail they receive the signals and words that the diver transmits asking what he needs.



SUBAQUEOUS COMMUNICATIONS

The rubber tube that conducts the air to the diver's chamber being of the diameter of about one inch, the two conductors united together can well pass through it, that being these insulated as ordinarily, they will not be affected at all by the current of air that is introduced inside of the tube and will make no obstacle at all to the electric current of the battery; but in such a case you can increase the diameter of the tube by some lines calculating the space that can be occupied by said conductor.

(Page 39.)

At about the end of the rubber air tube will be connected with the conductor a long bobbin, and in its centre a magnetic core, that is to say, of soft iron or tempered steel, magnetized in a way to communicate the permanent electricity to the telephone on the mask of the diver as well as to the other extremity of the other conductor communicating with the apparatus of the ears of the men that stand above on board.

The telephone that is attached to the mask of the diver it being of metal must be insulated or of a substance not conductive so that it don't communicate the electricity to the said mask.

If the natural loadstone works at a great distance it has no need of any electrical battery.

The battery formed of disks of oxide of zinc, does not work well and is not good. 73**

Forming a cylindrical tube of copper, tinsel or paper, and filled with loadstone in small fragments or small pieces, and passed through its centre a stem or wire of tempered steel, and above and below the tube of tinsel is put a small round disk of the same steel in order to inclose the pieces of loadstone contained in the tube. Everything is made like a screw so that it can be closed well at the interior; said tube is formed a coil of fine copper wire covered with silk or cotton, and the two extremities of said helix attached, one under the bottom of the upper part of the tube, and the other under the internal button, and then put inside the instrument telephone, be it

the one to receive or the one to transmit or in any other case a tube of (p. 40) steel tempered that is full of fragments of loadstone and surrounded and held in by the two buttons above and below, and with an axis in the centre made like a screw, like the one made of tinsel of copper or paper, and surrounded by a spiral on the same system, and put in the interior of the telephonic instrument, will produce the same effect upon the membrane be it the iron or other material as the figure here described.

Drawing.

The screw of the axis in the centre, serve for two purposes, first to keep in position the two buttons close the tube, second to regulate and draw nearer or farther the tube from the membrane, and the other serve as connection with the conductor by means of a pressure screw.

But instead of uniting the two conductors of the bobbin to the stem in the centre, it is possible to communicate to the two usual screws under said instrument as usual; that one of these communicates to the earth, and the other to the line of transmission.

(Page 41.) Nov. 15, 1879.

An apparatus put in the vault of a room of a theatre or any hall where exists the parliament, or where speeches are made to the public, it is possible to reproduce with said apparatus by my system of the tellettrofone, it is possible to hear in another city by means of the electricity and its conductor.

This apparatus is formed of the form of the figure here described.

VRIL RESONANCE IN BUILDINGS

Drawing.

(Words in pencil.) Human voice collected in the vault of the building.

No. 1. Series of cells of the battery.

No. 2. Positive conductor.

No. 3. Metallic body of the form like an inverted kettle of bell metal.

4. Bobbins of many hundreds of miles of copper wire insulated, forming a coil around the tube of soft iron, with the hollow inside filled with loadstone. This communicates to the iron tube the permanent magnetism. And all these magnets are held by a circular metal which communicate the electricity from one to the other as the copper wire is a conductor from one to the other. One of the poles communicates with the battery, and the other negative pole discharges in the earth.

5. Membrane held up below the metallic body by means of screws, and held stretched like that of a drum. This membrane is made of raw hide saturated with bichromate of potash, or other equivalent, and saturated also with paraffine or other material to render it

(Page 42)

impermeable to the changes of the atmosphere. In the centre is kept a disk of sheet iron as thin as that of tin; and in the centre of this a small button of platinum. This is to communicate the electricity in the vibration of the membrane.

6. Piece of metal made in the shape of a funnel that receives the sound of the voice and communicates it to the membrane held in the centre of the vault and passed above it.

7. Arch of the vault or ceiling of the room.

8. Negative conductor which discharges in the ground.

9. Positive conductor which communicates by the line as a common telegraph.

I believe with that apparatus there is no need of any battery, and that the lodestone or permanent magnet is sufficient; but uniting the two I believe that it is better.

I believe that I shall be able to obtain a dry pile or battery for this object.

[Note.] The piece of metal, No. 3, must be constructed of the same shape and system of the drums, with the same means to keep stretched the skin by means of a screw.

The membrane of animal or vegetable will have in the centre a circular disk of pure iron, and at the centre point of this, a button of platinum, and all the membranes saturated with paraffine or other substances impermeable to moisture.

" NON-ELECTRIC TELEPHONY BEFORE ROSSETTI

The piece which carries the magnet will have a regulator to put this at the necessary distance from the membrane.

The apparatus to receive in the other city is the same, only that you place at the sides of the room or hall, at a height of three or more feet, and distribute in several points, the conductors and telephones.

(Page 43.) INDICATOR TO KNOW WHERE IS TO BE FOUND THE SHIP, WHETHER S. N. E. W.

Drawing. Marine."

A circular box made of wood impermeable and kept in balance like a ship's compass put in the room where is the apparatus of transmission, the telephone.

For signaling of ships in case of fog, and said box having its cardinal points N. S. E. W., and they being put in communication with the four telephones to receive, it might be that the index hand in the center of the box, being magnetic, signals the direction where are the one or more other ships.

But it remains to be proved if the sheathing of the ship being of copper, would have any action on the magnetic hand of the indicator; also, generally, many steamships are built of iron, and these also may perhaps offer some obstruction and render the magnetic hand immovable.

The indicating apparatus consists in the same shape and construction as the compass for navigation, except that it is of a non-conducting material; in its center a magnetic index hand of tempered steel.

Said hand will be kept its centre in equilibrium. Through four parts marked off on the bottom of said box will pass the four conductors of the telephones, N. S. E. W. Passing these [under and] above the bottom of said box, where they will be marked with initials N. S. E. W., and their gradations or divisions so disposed it will be ready to receive from outside of the ship; and that the negative pole of the telephones, instead of discharging in the well hole of the ship, will communicate with said apparatus; the interior of said apparatus will be half full of salt water or acidulated water

VRILLIC LOCATERS

THE CONCEPTION OF INTERCONTINENTAL COMMUNICATIONS VIA SPECIAL CURRENTS AND DIRECTABLE ENERGIES

in order to render it conductive. (Page 44.) And acting as a ground as is used in all the telephonic systems, and with the metal it will be possible to obtain the movement of the index hand indicating the direction where is to be found the vessel that makes or gives the signal, be it a whistle, a bell, a cannon, etc.

NOTE. — In the contrary case you can instead put the water in the interior of the box where are the four conductors, four small boxes of wood half full of mercury or instead, these four bobbins; and in the centre of this, a cord or bar permanently magnetized, or of soft iron. But even in this case it is necessary to place every one of its conductors at the bottom of the ship.

The shape of some bobbins are the shape of a horseshoe. And to one of its poles carry the bobbin with bar of iron, which communicates the vibration and give signals with a bell; and in all these cases then there is not necessary any conducting liquid in the box of the telephone, as I have remarked before. *Once* [as] the water is a conductor of electricity, it is possible to transmit, as it is done with the system of the ordinary telegraphic line, and with its Morse apparatus to transmit and receive, agreeing on special signals. I will give you by and bye the idea of the apparatus for coast and reef for small vessels, as sloops, etc.

If it can be established that [*It is established that the water*] of the sea is a vast conductor of electricity, and there will be no more need of the submarine cable, because at any point of the coast putting an electrical apparatus with the conductor in the water, one can receive dispatches and transmit them to other points across the sea.

[In the above paragraph the words in brackets are interlined in pencil, the preceding words having been written in ink and erased.].

(*Page* 45.) FEBRUARY, 1880.

Method of signalizing and notifying of the distance at which can be found the vessels distant one from the other; as well as from the coast, and in case of fog.

This method consists in communicating the sound of a bell, whistle, drum or trumpet, or discharge of fire arm, cannon, etc., by means of electricity, and by means of communication to my invention of the telephone, and for which the said apparatus will be placed on board of the ship, and on the shore, in the points most dangerous, rocks and breakers, etc.

Many years ago, having calculated this method, I had occasion to speak with a friend of mine, Capt. Nardini, who told me that being at Genoa, where they were experimenting under water with a diving bell of Toselli, its inventor said to said Capt. Nardini, that he, finding himself under water with his bell, had occasion to hear the noise of the wheels of a steamer. He was surprised when he came out of the water to know that the steamer, of which he had heard the noise, was at a distance of about forty miles.

At this story told me, the idea came to me to construct the above said apparatus for signaling of dangers to vessels in case of fog, desiring to put it in practice in the manner drawn in Fig. B.

The conductor to communicate the sound will come out of the vessel by a hole that will be of about two feet under the level of the water; the said hole will be very small and closed hermetically by the rubber, and will communicate the electricity and the sound to the water with a conductor, as all ships in general.

March 2, 1882.

For the compass to receive the signal of vessels (page 10), different methods must be adopted in order that the index hand be directed to the point where the receiving telephone is, the index hand can be of cork suspended and insulated at its central point by a glass tube which keeps it in balance on a pivot. The cork can be circular or of other form and at one edge a point of tempered and magnetized steel, or if not, of glass, with at its head the point of iron as above.

Drawing.

(End of pencil writing.)

The cord of the life-saving guards is about one thousand fathoms. (Page 62.)

Every captain must keep on board two telephonic instruments: one to receive, and one to transmit with an exact explanation how to operate in case of emergency.

Every station will be in communication with each other, by means of a conductor, in order to be able to speak with the telephone, the distance being not more than three miles from one to the other.

With this method they will know where the vessel is that asks for help.

The rocks, buoys, lights and other signals will have a conductor going to the coast where is the nearest watch, and so they will be notified of the persons asking for help.

Every signal containing the conductor will be made so that the sailor that wants to speak can put in it the instrument to speak with the telephone.

The instruments of the telephone will be made in such a way that they can be used to transmit as well as to receive without any battery, that is to say, constructed with a permanent magnet.

A battery to try is made of round disks of carbon of the thickness of an eighth of an inch.

A disk of canvas, paper or amianthus, this last by me preferred because it is not destroyed by acid.

And then a disk of zinc, granulated, amalgamated with mercury, every metallic disk separated by a disk, as above, of paper, canvas or amianthus well understood that these are bathed in a solution of sulphuric acid or in a solution of jodium (common salt).

This battery forms the battery of Volta. It remains to try how long it keeps its electric action. (Page 63.)

[The following is crossed off in pencil]: —

Preparation of dough for macaroni, vermicelli and every other quality of paste.

Mix with the water with which said dough is made, for one hundred pounds of flour, one ounce of saltpetre (nitrate of potash or soda)

and one pound of vecula, of white beans or other equivalent cooked in water and passed through a fine sieve, and then well worked in the ordinary manner at the machine, and made of it the quality of dough that is usual.

Said dough when it is well dried does not take any more the atmospheric moisture, and moreover acquires the appearance of the paste of Naples in color as well as in taste, losing entirely that of the flour to make bread, that is to say, that of commerce.

In Italy they use the farina of wheat from the Black Sea that is charged with nitrate given to it by the ground of those countries that are saturated with large quantities of it.

(The following is a translation of loose page in Exhibit 109, and is in Meucci's handwriting, in pencil.)

For the bobbin there is no need to cover the copper wire with cotton. By this method it remains covered with very thin varnish and not conductive; And the bobbin by this method can have more hundreds of feet of metallic, and so with one small bobbin we may have more resistance of ohms. The other composition of the wire covered by a wrapper of cotton is very good, of small expense, and replaces wax, paraffine and India rubber, costs a very small part of the cost of this, and is not attacked by any kind of acid, and does not dissolve in water, nor in alkali, Etc.

No. 1. Linseed oil and fish oil.

Linseed, two per cent, and fish oil ½

No. 2. Linseed two per cent alone.

If we want to use this for the iron telegraph wire, we do not need to galvanize the wire at all; only to add to the composition a little of soapstone pulverized, amianthus, or other equivalent, brimstone, etc.; and passing the iron wire in the composition, which must be very warm; and if it is possible, warm the iron wire also. And next passing it through the as I said before. In this manner there is no need to be afraid of the oxidation, and it will remain entirely isolated from the atmospheric electricity.

According to the grade of heat you give to the wax we can augment the size of the wrapper upon the copper wire or the iron wire, passing it more than once.

the instrument can be used without need of a battery but these magnetized bars must be made in the shape of a snail so that they can stay in the instrument, because otherwise this would be too long for transmitting.' I ask you if that is not a correct description of the magnet of the instrument drawn as shown in Meucci's affidavit, marked 'M,' p. 31?

"Ans. It is undoubtedly true that the resistance of a magnetized bar becomes greater in proportion as it is longer. It is undoubtedly true that an electrical speaking telephone, constructed with a magnet, like that shown in the Meucci affidavit drawing referred to, is capable of transmitting speech without the aid of a battery; that is, the statements made in the memorandum book are undoubtedly true of the drawing referred to in the affidavit; and in that sense it might be said that the description of the instrument was a correct one. But this so-called description is exceedingly vague, imperfect and unintelligible, and does not show that the writer had any idea of the principles utilized in the electrical speaking telephones."

The above questions and answers should be sufficient to prove that although the drawing was made four years after Bell's patent, Meucci did not copy anything from anybody. As for Prof. Cross' argument that the sketch in the memorandum book does not show any leading wires, it is too silly to be taken seriously. After all, the drawing in the affidavit is precise, and shows the leading wires clearly. Once more it shows to what ridiculous lows Prof. Cross descended to confuse and mislead.

As for the charge that the description is too vague, etc. etc., what we have said about the drawing on page 40 is just as valid for the drawing on page 55. After all, the drawing on page 23 of Meucci's affidavit could hardly be more precise and accurate in every respect.

The reference to the length of the magnet, moreover, shows that Meucci used his own head. Nobody else, to the best of our knowledge, had ever used a magnet like a snail so that it could fit inside the transmitter.

Having a great surface in this case, the conductor will communicate the electricity to the sheathing of the vessel, and that will impart it to the water.

The apparatus will be all in the interior of the captain's room, or some other room.

The thing to receive will be kept in the hands and put to the ear of the man whose duty is to receive, with a conductor that will be in contact with the water with one pole and the other pole will descend in the pump-well of the ship which acts as a ground.

In case of not having on board the apparatus of the telephone or teletrofone as in coasting vessels, but having on board a horn or trumpet of tin like the one used by the fishmongers, and which all coasting vessels have, this will be in communication with a battery, and its positive conductor will communicate to said trumpet, and the other discharge in the bottom of the vessel, or in a barrel containing earth or sand. And a tube at the ear and this conductor will receive the sound by the contact of the water of the sea. All the ships that are sheathed with copper this will serve as conductor, as well to conduct as to receive, being all in communication with the copper of the sheathing, exposing a great surface to the water.

A horn or trumper will be put outside the side of the vessel with the part from which the sound comes out near the water, and as shown by Fig. C. [Drawing.] The interior of the horn will communicate to the conductor a bobbin or helix with its centre magnetized, either permanently or composed of loadstone and covered with steel; and no battery will be necessary either to conduct or to transmit, and so with little expense, every one will adopt it.

(Page 47.) (*Drawing.*) *Figure B.*

No. 1. Body of the ship.

2. Hole where the positive conductor goes out; if not, it can go out above the side and will go in the water; but the first is best.

3. Bell, or any other instrument which has a strong sound, drum, cornet, cannon or whistle, as it is used in all the steamers, a horn with a reed in the moutpiece.

4. Sonorous body of metal like that of a bell, inside of which is put the instrument that makes this sonorous body resound, and made of the shape and method like a tympanum, with the same method as drums use to stretch and loosen the membrane which is held attached to the bottom.

M M. Membranes of raw hide as for drums or plate of sheet iron.

(Page 48)

by me the membrane of hide is preferred, being more sonorous. This membrane is saturated with an impermeable substance, parafine, because it does not absorb moisture. Under this is a disc of sheet iron or tempered steel, thin, and in the centre of it a little button of platinum.

5. Permanent magnet, which is big in the centre, and another in the interior well understood that each one of those permanent magnets are in the centre of a bobbin of very thin copper wire, forming a helix; the core of the one in the centre being empty, will be filled with fragments of natural loadstone, and the other magnets surrounding it will be magnetized strongly in order that they retain (perma-

nent magnet), and if not, of soft iron. Below they will be fixed to a disc of iron metal, circular, or made star shape. The conductive wire will circulate through all the bobbins as usual. And one pole, that is to say, one pole will communicate with the battery, and the other will go in the water.

6. Battery.

7. Negative conductor which discharges in the bottom of the ship or on the earth, if it goes to the coast.

8. Positive conductor which comes from the battery and communicates with the apparatus.

9. A box of wood or metal where is put the magnet, either permanent or artificial.

10. Screw where are the two conductors.

11. Conductor that communicates the electricity to the water with a wire of platinum or other equivalent metal.

The apparatus on the coast or signals for breakers or shoals will be on the same principle, only they will receive the electricity from a battery or a loadstone, natural or artificial, by a dynamo machine (as used for electric light).

(Here one leaf of the book is missing.)

(Page 49.)

put in motion by a motor or by the force of men. But if it is possible to obtain the electricity from a dry battery, or to obtain that from the earth, it will be a great convenience:

But in ships where steam exists, any rotating magnetic machine is good (dynamo machine).

(Drawing.) *Figure D.*

Figure D shows the upper part of the outside of a ship where through the side pass the conductors of the teletrophone to receive the sound, and every one of them communicates with the instrument to receive at the ear. If these instruments are put around the part of the vessel above the water line and about the height of an ordinary man every one of the watch men walking a short distance or standing in attention, will be able to recognize from what direction the vessel comes, be it south, north, west or east. If not it can be put in the centre cabin where is the apparatus of transmission and

the ground, prevents them from rot, and preserves them for a long time.

There is no other material existing better for this purpose neither in the price nor in its resistance or in being entirely non-conductive of electricity and in great abundance in America on the Pacific side, where it is called by the name of mineral wax.

Distilling this peat it gives an oil very dark and thick which crystalizes a substance like wax or paraffine of a yellow color.

The peat oil purified by the heat is good to make candles, mixing with it another material about ten per cent, be it stearine or paraffine, etc.

The peat is excellent for the cords under water as well as for those that are put in the ground to conduct the electricity; it is unalterable to the moisture and terrestrial electricity is not communicated to it.

Unite peat with fish oil or other, but the of (menhaden) is better and cheaper than the borado (page 60). It does not begin to melt until 145 degrees Fahrenheit. I mix with it also a quantity of rosin to render it more elastic in mixing with (menhaden) oil.

Further documentary proof, incontrovertible proof, that Meucci used a magnet, coil, battery, etc., is found in the same memorandum book under date of September 3, 1870, when he noted:

"Filled the tube of wood or tin with a cylindrical envelop of paper, and this filled with small pieces of loadstone, passing through its centre the conducting cord, and is very good, and conducts well the sound of the word, but always the two extremities of the conductor united to the ground.

"Other experiments made; filled said tube of paper with some small pieces of loadstone in its centre and surrounded this with filings of iron: has become much magnetic, and is a strong conductor of the electricity, as much as a bobbin. The cord with the same system as the previous always communicate the two extremities with the ground.

"Experiment made on the 27th instant. Put at the centre of the conducting cord a horse shoe magnetized, the two heads of which—that is to say the two poles, N.S. united to those two poles has given a good result but if the conductor was of *copper and not of* (words in italics interlined in the original) iron I think that it must be very good *to be tried* (words in italics interlined in the original), as to unite in the same system at the centre of the *cord conductor* (the word cord written in ink in the original and struck out by pencil; the word conductor interlined in the original) a strong bobbin with at its centre a strong piece or bar of iron well magnetized; or if not, put this before the tube to transmit with one of the poles and the other pole in contact with the ground.

(Page 36.) *(Here follows a drawing)*

"All these experiments made with this method are excellent, only it is necessary to establish them in a practical way, I not having the necessary knowledge and the pieces that are needed.

"The best method is the one that, whether it be a bobbin with loadstone or horseshoe, instead of putting it in the centre

it is better to put it before the instrument, either the one to transmit or the one to receive, in communication with the earth; that this, communicating the terrestrial electricity communicates it to the conductors, as Fig. 4 shows, and works as if it was aided by a galvanic battery."

The drawing included in the description, like the other two mentioned above, is not reproduced in the printed record either, but to judge by the description it must have been like Fig. No. 8 of the deposition or No. 5, F., of the affidavit. We have described it in the preceding chapter.

At any rate, Meucci reiterates the use of an iron disk under the animal membrane in another page of his memorandum book, under date of No. 15, 1879, when he wrote:

"Membrane held up below the metallic body by means of screws, and held stretched like that of a drum. This membrane is made of raw hide saturated with *bichromate of potash or other equivalent* (words in italics erased in pencil) and saturated also with paraffine or other material to render it impermeable to the changes of atmosphere. *In the centre is kept a disk of sheet-iron as thin as that of tin;* (italics ours) and in the centre of this a small button of platinum. This is to communicate the electricity in the vibration of the membrane. . . .

"*The membrane of animal or vegetable will have in the centre a circular disk of pure iron,* (italics ours) and at the centre point of this, a button of platinum, and all the membranes saturated with paraffine or other substances impermeable to moisture.

"The piece which carries the magnet will have a regulator to put this at the necessary distance from the membrane."

In another page of the same memorandum book, under date of February, 1880, Meucci describes an apparatus for signaling ships in case of fogs, with a membrane as follows:

"MM. Membranes of raw hide as for drums or plate of sheet-iron. (Page 48) by me the membrane of hide is preferred, being more sonorous. This membrane is saturated with an impermeable substance, paraffine, because it does not absorb

moisture. Under this is a disk of sheet-iron or tempered steel, thin, and in the centre of it a little button of platinum."

Thus, at the cost of sounding repetitious, the words "be it iron or other material," in connection with the 1873 drawing, to which Mr. Storrow took expection, are explained satisfactorily. To put it in another way, after using the iron disk Meucci did not revert to the use of the animal membrane, but only used two types of membranes, the bottom one being always an iron disk, and the upper one varying. After all, that is exactly what Bell did, as shown below.

MEUCCI'S USE OF ANIMAL MEMBRANES

Further illustrations of Meucci's use of animal membranes over an iron disk are found in his deposition.

For instance, in his Answer 32, where he described instrument No. 8, he said at first that he used a "membrane of metal, and sometimes of animal substances, or fabric of different qualities," thus leaving the reader perplexed and himself open to Mr. Storrow's attacks. But later, in his Answer 573, still referring to the same type of membranes, he stated: Moreover, as I said before, *under the membrane there was a small metallic disk* (italics ours), and in the vibration above the bar of the bobbin, that was of tempered steel permanently magnetized." Once more, it is clear that Meucci used an iron disk under the animal membrane, or two membranes, forming one diaphragm.

On the other hand, Meucci's experiments with different types of membranes, *after he had achieved success with the iron disk or membrane*, should not be interpreted as meaning that he did not realize the function of the iron membrane (he could tell by experience when the membrane worked and when it did not work) but only that he was trying to find out if a different kind of *upper membrane*, as distinguished from the iron disk, would not improve the working of the instrument.

926/6(2)

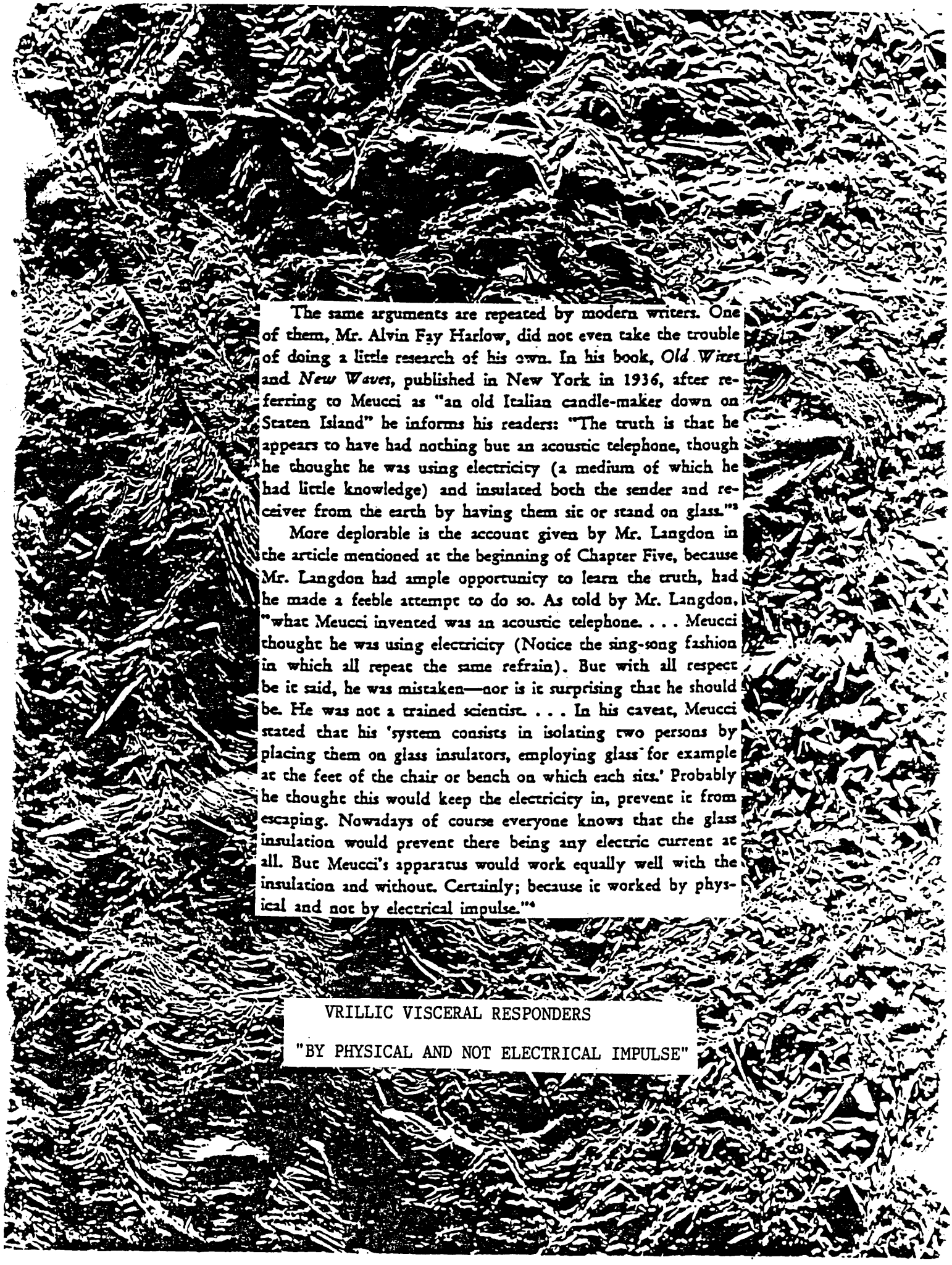
Spiegazione [illegible]

La palla da fucile è di piombo [illegible]
involtata in una fodera di cotone [illegible]
la palla comune quando [illegible] del fucile di [illegible]
due o quattro piatte non perdendo [illegible]
zione = quella da cannone è della forma [illegible]
la di sopra involta in una fodera di [illegible]
si carica come la palla comune [illegible]
della bocca del cannone si divide in [illegible]
incatenate per una data misura [illegible]
si trova inserata nel interno [illegible]
zeppa della catena [illegible]
re pole specie da 4 - 6 - 8.

Antonio Meucci

"....the telephone which I invented and which I first made known and which, as you know, was stolen from me."
Letter from Meucci to Garibaldi's daughter, October 1, 1887.

"He died in the full belief of the priority of his claim as inventor of the telephone, which, during the lucid intervals of his sickness, he declared must be recognized sooner or later."
New York Herald, *October 19, 1889.*



The same arguments are repeated by modern writers. One of them, Mr. Alvin Fay Harlow, did not even take the trouble of doing a little research of his own. In his book, *Old Wires and New Waves*, published in New York in 1936, after referring to Meucci as "an old Italian candle-maker down on Staten Island" he informs his readers: "The truth is that he appears to have had nothing but an acoustic telephone, though he thought he was using electricity (a medium of which he had little knowledge) and insulated both the sender and receiver from the earth by having them sit or stand on glass."[3]

More deplorable is the account given by Mr. Langdon in the article mentioned at the beginning of Chapter Five, because Mr. Langdon had ample opportunity to learn the truth, had he made a feeble attempt to do so. As told by Mr. Langdon, "what Meucci invented was an acoustic telephone. . . . Meucci thought he was using electricity (Notice the sing-song fashion in which all repeat the same refrain). But with all respect be it said, he was mistaken—nor is it surprising that he should be. He was not a trained scientist. . . . In his caveat, Meucci stated that his 'system consists in isolating two persons by placing them on glass insulators, employing glass for example at the feet of the chair or bench on which each sits.' Probably he thought this would keep the electricity in, prevent it from escaping. Nowadays of course everyone knows that the glass insulation would prevent there being any electric current at all. But Meucci's apparatus would work equally well with the insulation and without. Certainly; because it worked by physical and not by electrical impulse."[4]

VRILLIC VISCERAL RESPONDERS

"BY PHYSICAL AND NOT ELECTRICAL IMPULSE"

MEUCCI'S TWELVE TELEPHONE MODELS

In support of his claims Meucci introduced: 1) his caveat of 1871; 2) a memorandum book in which he had jotted down some of the experiments made by him from time to time; 3) an affidavit in which he gave a brief account of his life and inventions; 4) more than a score of affidavits by persons who were acquainted with his telephone or with his financial conditions; 5) and finally, some thirty models of instruments he had made between 1849 and 1871. We shall examine the caveat, the memorandum book and the affidavits in the following chapters. Here we shall deal with the models which Meucci introduced, drew, and described on the stand in order to show the progress of his experiments, from an inchoate idea to the perfect electric apparatus he constructed in the late 1850's.

As a matter of fact, Judge Wallace himself had demanded such a demonstration in a previous action. In his decision of December 1, 1884, in the Drawbaugh case, Judge Wallace had stated: "An inventor can hardly forget the process of thought by which a great intellectual conception germinates and matures into the consummate achievement; but Drawbaugh's memory is blank."[1] However, when he came to Meucci the honorable judge preferred to forget all about such logical process.

The models represented the instruments Meucci had made between 1849 and 1871 and consisted of "two or three originals"[2] and the reproductions he had made in 1880 at the suggestion of Col. Bennett, in a few instances with some pieces found in his house after his wife had sold all his instruments to the dealer Fleming.[3]

Meucci swore on the stand that all those models were made by him "without assistance," mostly from memory, and "by reference to a book in which I made notes." However, he could not tell exactly "the order in which they come"[4] and, again, "I can't tell exactly which comes after. From 1850 to 1862 I made so many that I can't remember well."[5] All those instruments are reproduced in facsimile in the Appendix to the present volume, each bearing a number for identification.

Meucci described those instruments in an affidavit and, as noted, on the stand, in the presence of the Bell counsel, who eventually cross-examined him over and over again.

About the same time, before or after No. 5, Meucci made Instrument No. 10 (No. 4 of the affidavit). The description of this instrument is not clear, but it shows another step forward in the right direction, because here for the first time Meucci used metallic diaphragms, sometimes of iron, sometimes of copper, and sometimes of different materials. "Here I began with the metallic diaphragms instead of the animal membrane." Also worthy of notice is the fact that "in the same shape I formed several tubes, some full of steel filings, some of carbon, and some of plumbago, in order to try which were the best conductors of electricity that were in communication with the battery from the lower part of the instrument."[8] All Meucci obtained with this instrument, nevertheless, was "the noise of the word."

To this period belongs also instrument No. 11 (No. 6 of the affidavit). "This instrument is composed of spool of pasteboard wound with copper forming bobbin. In the centre of said bobbin or spool passes a rope or cable of several wires, covered with a helix of insulated copper wire. At the upper end of this cable is soldered a small button of platinum. The two conductors of the bobbin passed through the bottom of the instrument to connect with the battery, to obtain the electricity. Of this form I have made several, and of various dimensions.

"And also in the centre of said bobbin, sometimes instead of a cable of iron wire, many times I used a round bar of soft iron. I used these on several occasions in my experiments anterior to the year 1852 up to 1854, until I bought and obtained bobbins and other utensils from Mr. Chester." The membrane was "sometimes mineral, sometimes of other substances that I have elsewhere indicated." "Under the membrane there was a metallic diaphragm which touched the magnetic bars for the vibrations."[9]

Between 1853 and 1857, Meucci could not say exactly in which year, he made an instrument with a horseshoe magnet, as in Fig. No. 8 (No. 5 of the affidavit). Here again he used iron membranes, but also "sometimes of animal substance, or fabric of different qualities; the animal membrane constructed by me consisted of a piece of parchment saturated with paraffine and then passed through plumbago; moreover, the other substances were treated according to the same system, excepting the iron ones."[10]

As admitted by Prof. Cross, this instrument would make an excellent electric telephone, provided the coils are sufficient and the diaphragm were of iron.[11] At any rate, Meucci said that he obtained "very good results" and that the instrument "was always kept by my wife and me to speak."[12]

" 'Both the conductors or utensils for mouth and ears should be—in fact, I may say, must be—metallic, and be so conditioned as to be good conductors of electricity.'

"This is not required for the operation of an instrument as an electric speaking telephone. On the contrary, if the line currents of an electric speaking telephone apparatus should pass into a metallic utensil held in the hand, that would practically render the instrument inoperative."[1]

Mr. Pope apes Prof. Cross. He says:

"The express language of the caveat excludes the idea of a telephone which should transmit speech by the agency of electricity, but on the contrary shows clearly that the ideas of the writer, as far as he had any definite ideas, were limited to the transmission of speech by mechanical vibrations; in other words, it was what is now known as a 'string' or mechanical telephone, in which a metallic wire was intended to be used as the vehicle for the transmission. The very first sentence of the caveat is conclusive on this point. The writer says:

" 'I employ the well-known conducting effect of continuous metallic conductors as a medium for sound, and increase the effect by electrically insulating both the parties who are communicating.'

"He does not propose to use electricity in lieu of the well-known sonorous properties of bodies, by which metallic conductors are able to convey sound, but he apparently has a vague, indefinite, and I may say foolish notion, that the electrification of the persons who are talking, together with the wires which mechanically conduct the sonorous vibrations, will in some way which he does not undertake to explain, increase the effect. . . . The claims further emphasize the vague, nebulous and ignorant notion of the writer. . . . The conditions which are enumerated exclude the possibility of electric current flowing through the line or any part of it, and moreover also excludes the possibility of using any kind of electric speaking telephone of which I have any knowledge."[2]

INERTIAL INCREDULITY AND VRILLIC RESPONDERS: THE SCHISM BETWEEN PHYSIOPHONES AND ACOUSTIC TELEPHONY

HOW MEUCCI CONCEIVED THE IDEA OF THE ELECTRIC TELEPHONE

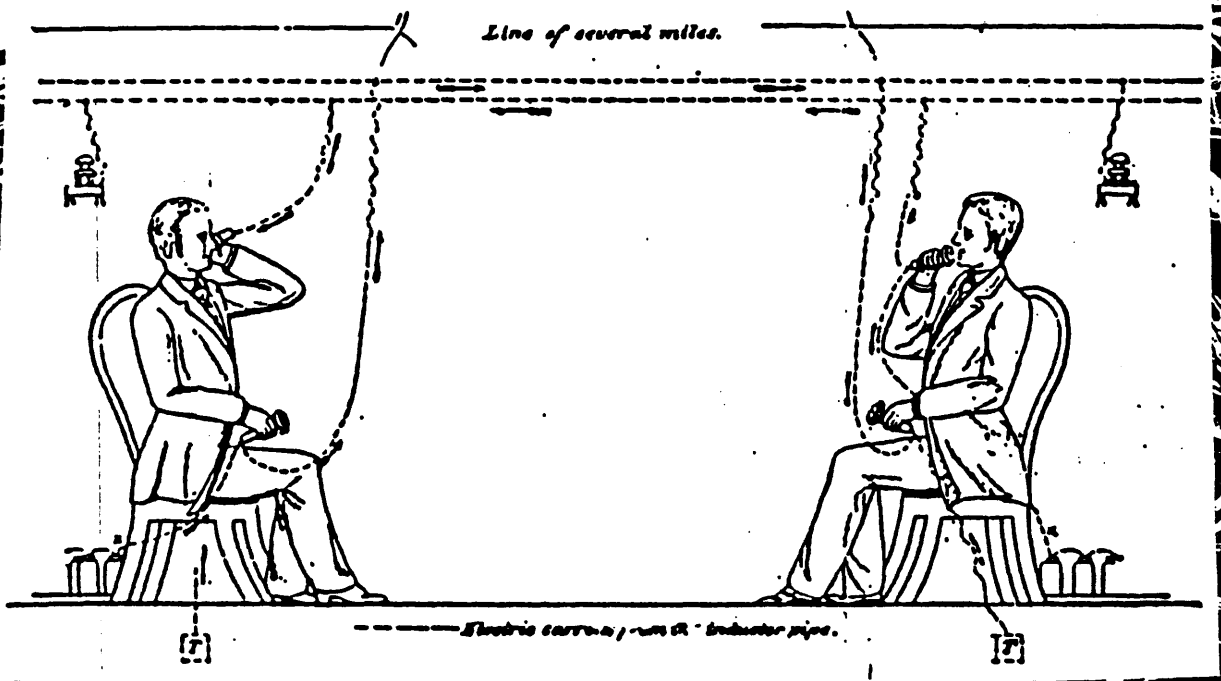
In his affidavit Meucci stated:

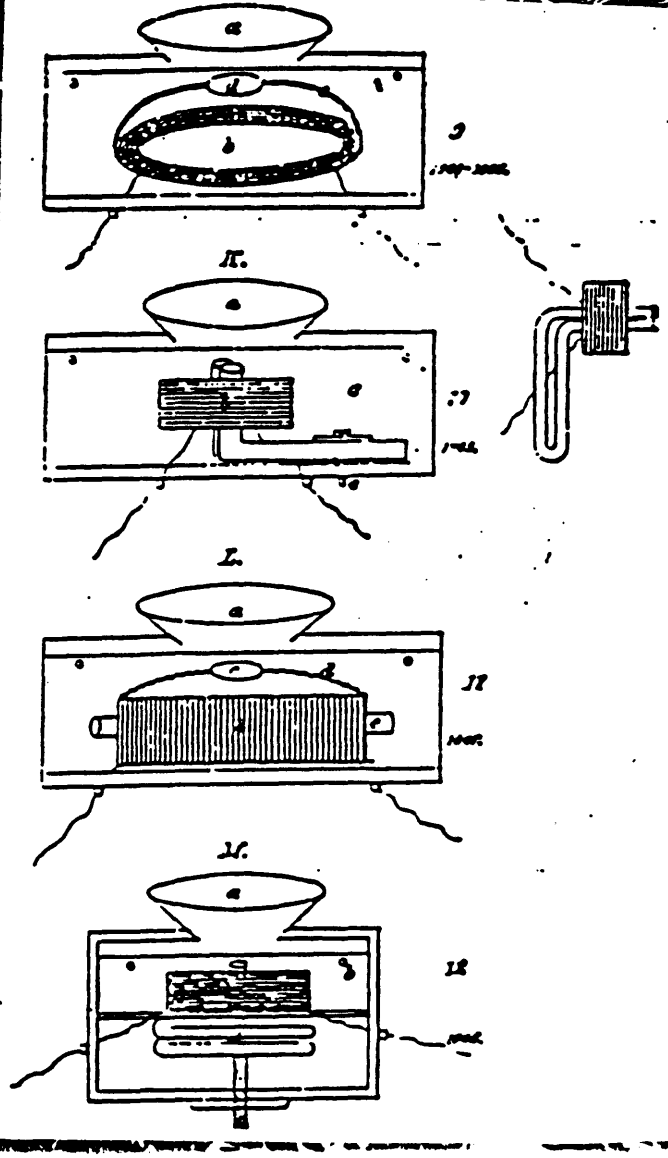
"While I was in Havana, I had very considerable leisure, and spent a considerable time in the study of electrical matters. I provided myself with the best books then extant treating of matters connected with electricity. Among my authors were Danielle Tenard Jacobi.

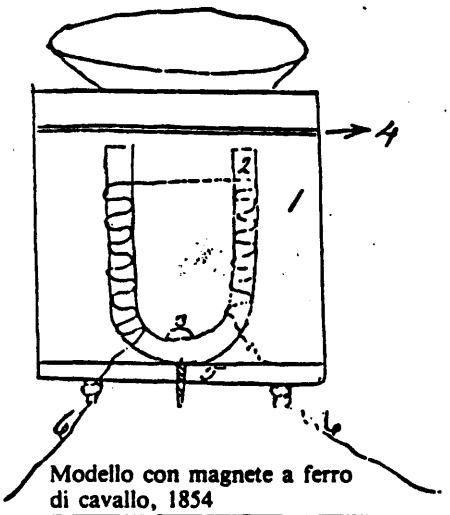
"I had familiarized myself with galvano plastic electricity, and Captain General O'Donnell, then governor of the Island of Cuba, was anxious to save expense in galvanizing buttons, sword hilts and such other things used in the army." Meucci then went on to tell how he put up a factory, employing from 12 to 15 men, which lasted about four years. He continued:

"During the time that I ran this factory, I constructed an electrical machine for the purpose of using it on persons who were sick, or for the mere amusement of giving shocks. This factory was connected with my residence. I frequently gave electricity to colored people, employees of the theatre and others. I did this sometimes when they were sick. I put up wires through the rooms in which we resided, which were four in number, and I gave currents of electricity to my wife. I once gave it at an unfortunate period, which affected her quite seriously.

"The instrument I used to convey the currents of electricity to persons is represented in Fig. 1.* The upper part is a copper plate, which I place in the person's mouth or other parts of the body when I used to shock them. The wire was covered by a piece of cork, which the party receiving the shock held in his or her hands. A man in my employment at one time, somewhere about 1849, complained of being sick, and I thought to try electricity on him. He was placed in one room, and the end of the wire being in circuit two rooms beyond his, I went there wishing to know how strong a current I was using, and I had a duplicate of this instrument with me. I called him to put the copper part of his instrument in his mouth. I did this because I had read that disease could be told by electricity. The man, while he had the copper in his mouth, cried out from the effects of the shock. I thought I heard this sound more distinctly than natural. I then put this copper of my instrument to my ear, and I heard the sound of his voice through the wire. This was my first impression, and the origin of my idea of the transmission of the human voice by electricity. I then covered the implement I had, and the one the employee had at that time, with a paper cone, as represented in the instrument and drawing. I directed him to speak through his. I being at the end of the third room, I placed mine, covered like his, to my ear. I then heard, while holding this to my ear, quite distinctly, the sound of his voice,—so much so that I believed it came over the wire. I made him repeat what he had said several times, which convinced me that I heard his voice over the wire electrically."

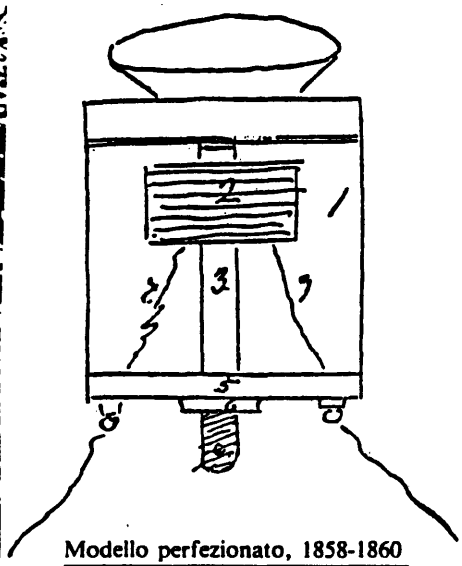

Line of several miles.





Modello con magnete a ferro di cavallo, 1854

Model with horseshoe magnet, 1854



Modello perfezionato, 1858-1860

Perfected model, 1858-1860

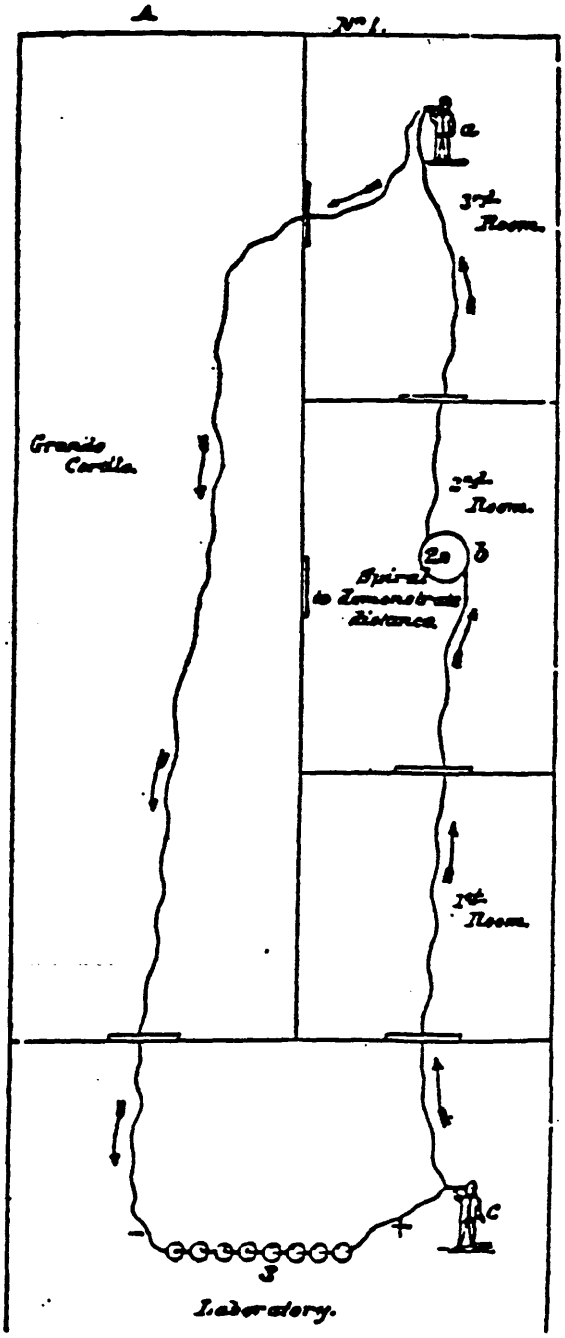
Meucci described his first model to show these improvements as follows: "It is a tube of tin with the mouthpiece of the same material. Beneath the mouthpiece is an animal membrane saturated with bichromate of potash to render it firmer. In the interior is a small tongue of platinum soldered to a conductor of copper that communicates with the battery, and also in the interior is a tube with wire all around it forming something like a bobbin."

To the essential elements of bobbin and diaphragm, Meucci devoted enormous inventive energy, constantly improving the bobbin and repeatedly experimenting with the material composition and the positioning of the diaphragm. In one of his models created several years later, the core of his bobbin was a magnetized steel bar, and it could be raised and lowered by a screw in order to find the position that permitted the best results from the diaphragm.

From the time of his arrival in the United States, Meucci had been living a tranquil life, essentially without worries. But it was the last period of peace he was to know. Suddenly misfortune took hold of him and held him in her ill-starred grip right up to his grave. The serious problems started with his wife's illness.

Ester Meucci began to suffer from crippling arthritis, which immobilized her for long periods. Finally, in 1854, she became a complete invalid. Meucci thus lost not only a practical helping hand, but also a sage administrator of the family resources and someone who could follow and guide him a bit in his business affairs. From that moment on, the distracted and credulous Antonio went from bad to worse in the practical management of his life.

But despite his utter incompetence in the realm of business and finances, in his inventions Meucci demonstrated ever greater talent. So that his wife could communicate with him when necessary, he put up a permanent telephone line between his laboratory in the basement and her bedroom



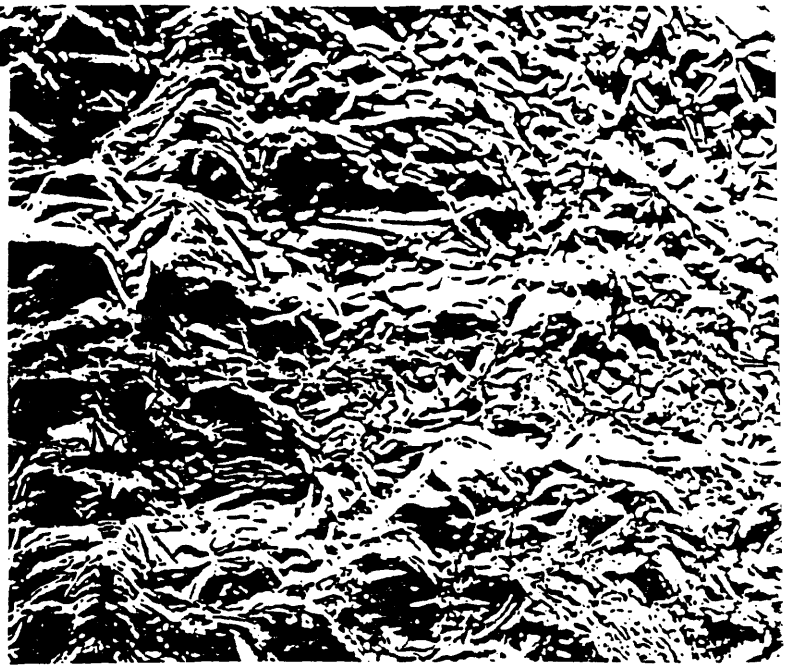
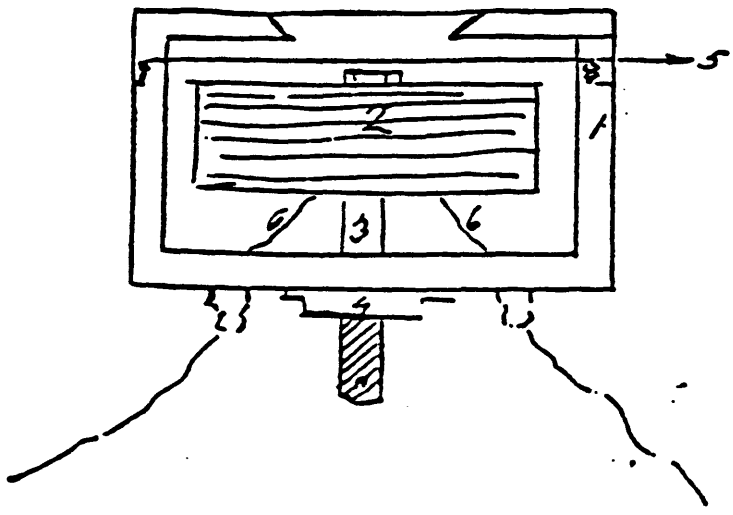


Fig. 13.



Int. 78. Please explain the above diagram, Fig. 13, beginning with the date of its production, as near as you can tell?

Ans. 78. I think it was made from 1857 to 1860; I don't remember well.

No. 1, soap box of boxwood with a screw cover. Above the cover I opened a mouthpiece to speak.

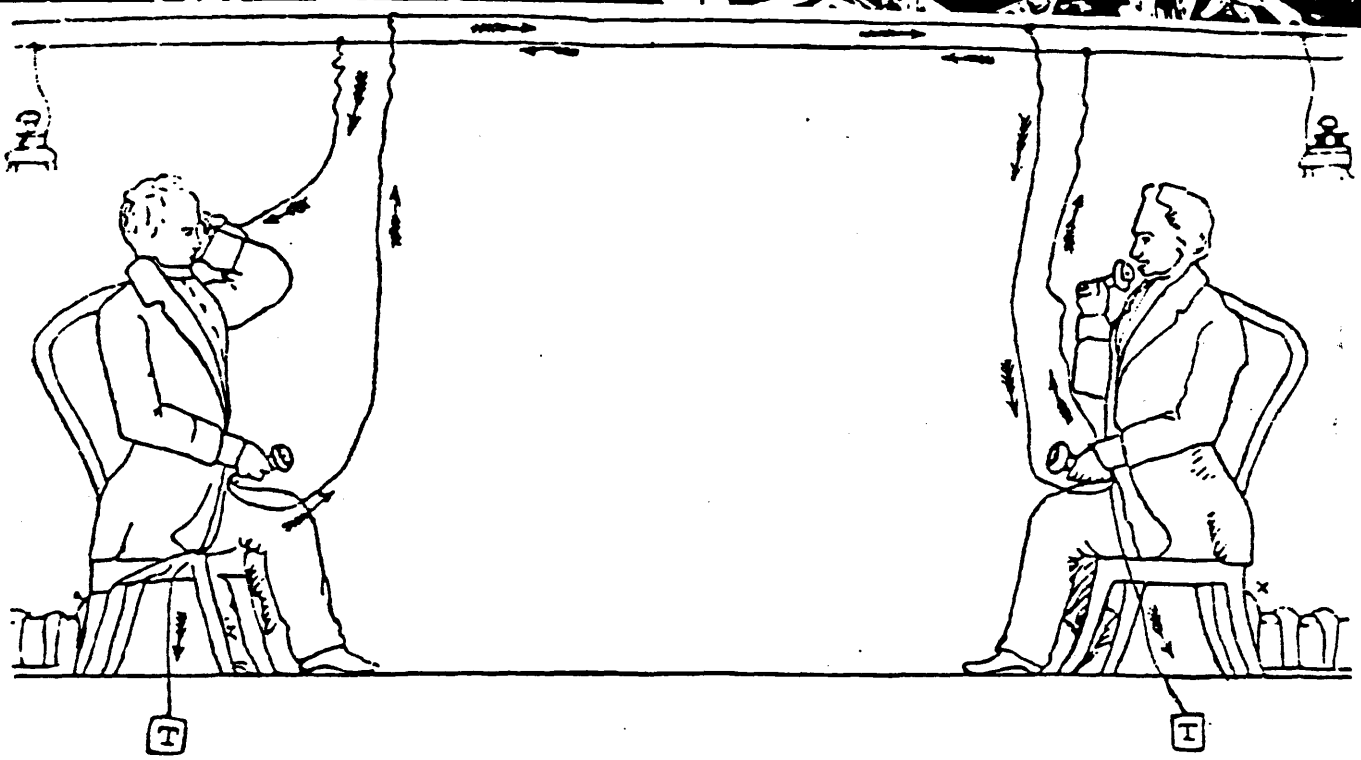
No. 2, a large bobbin containing a large number of feet of fine insulated copper wire. In the interior of said bobbin, a steel bar tempered and permanently magnetized.

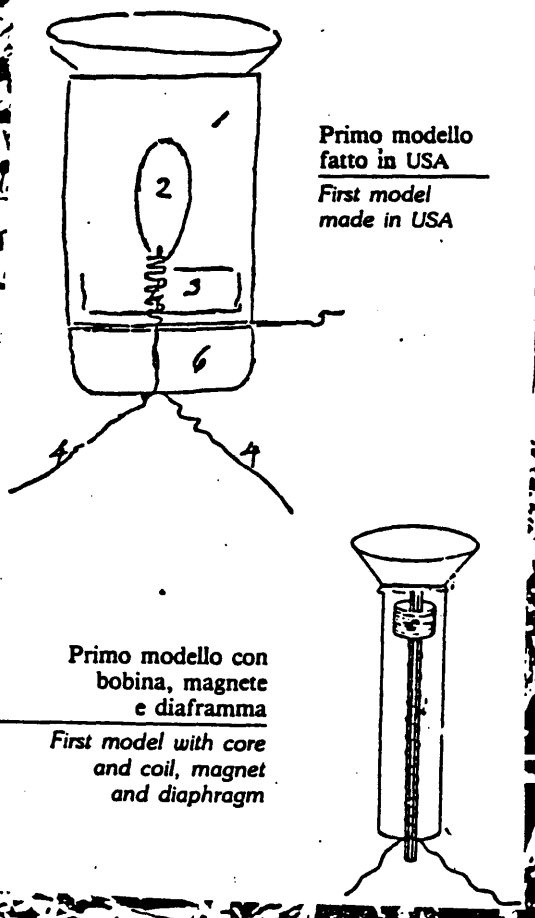
No. 3, above-mentioned bar.

No. 4, metallic nut holding the bar, and by means of the regulating screw it can be lifted or lowered, in order to move it towards or away from the metallic membrane that is above.

No. 5, metallic membrane.

No. 6, conductor, coming out from the bobbin and passing through the bottom of the box connecting with the battery.



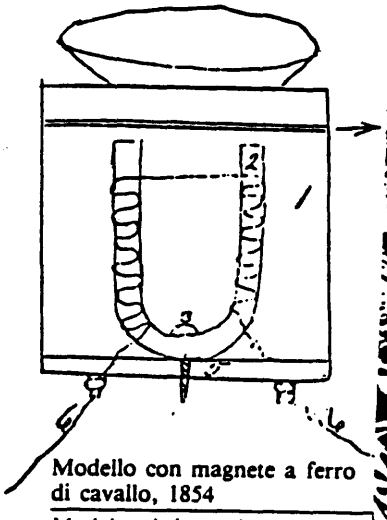


Primo modello fatto in USA

First model made in USA

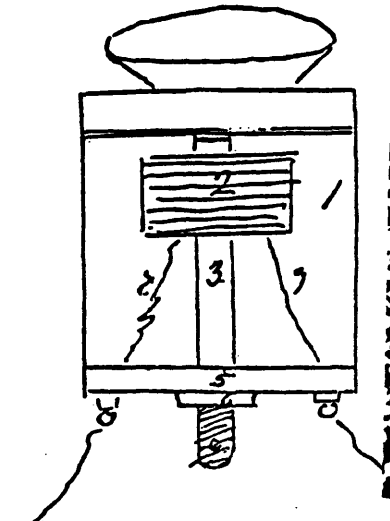
Primo modello con bobina, magnete e diaframma

First model with core and coil, magnet and diaphragm



Modello con magnete a ferro di cavallo, 1854

Model with horseshoe magnet, 1854



Modello perfezionato, 1858-1860

Perfected model, 1858-1860

THE NEXT STEP

About 1852, when he was already in the United States, Meucci expressed the desire "to see and know some factory where were constructed telegraphic instruments, in order to open my mind and be in knowledge of what was in use, either in instruments, and so forth. Said Pader (a Spanish friend mentioned before) being acquainted with my friend Negretti, told me that they knew a manufacturer of telegraphic instruments living in Centre Street, by name of Chester, and that they would take me to said establishment to give me the opportunity to observe the telegraphic instruments, and have me furnished, by paying, with everything I could need. After a few days, we were all together at said Chester's, and he showed me all the things necessary used then in the telegraphic art, and so I was put in knowledge and my memory was opened to build some new instruments to improve the one I had made. Returning home, after some reflection, I constructed a first instrument. . . ." That was instrument No. 4 (No. 3 of the affidavit). Here he used an animal membrane with a hole in the middle and under the hole a metallic tongue for its vibration.

In the next instrument (No. 5 of the deposition and No. 3 of affidavit) made about 1853, Meucci introduced a bobbin or core with coils for the first time, thus getting much closer to the electric telephone. All this instrument needed to be a good electric telephone, as Prof. Cross had to admit, was an iron diaphragm.

In his original description of this instrument Meucci mentioned only an animal membrane with a hole in the center, thereby leading one to suppose, as argued by his lawyer, that under the membrane there was a metallic plate, the whole forming a metallic diaphragm. However, the description Meucci gave in his Answers 21 and 22 is too vague. He was more precise in his Answer 606, when he said: "The description will be the same I gave before. It is a tube of tin, with the mouthpiece, to speak, of the same metal. At the bottom there is an animal membrane saturated with bichromate of potash to render it firmer. In the interior there is a small tongue of platinum soldered to a conductor of copper, to communicate with the battery. The exterior of the tube is covered by insulated copper wire, forming something like a bobbin. One extremity of the wire goes to the interior of the small tongue of platinum; the other to the battery." This instrument was made between 1852 and 1854.

THE PAPERS DISAPPEAR

IN THIS story of mysteries, lies and embroilments, one of the most intriguing of the many unanswered questions is what happened to the papers, drawings and telephone set that had been given to Mr. Grant. It is as if their shadow kept appearing and disappearing during a period of several years, and at times it seems possible to follow the shadow's course, but invariably its traces fade away.

All we can do is recount the known facts. One fact of central importance goes back to 1874. In that year George Durant left his job at American District Telegraph and was replaced by Henry W. Pope. As already noted, American District was part of the Western Union group. Also, Henry Pope had a brother, by the name of Frank, who was chief electrician at Western Union. It seems that at a certain point Frank Pope and his electrician colleague at Western Union, George Prescott, became the custodians of the Meucci material. It is not possible to say whether it was given to them by Pope's brother after he had received it from Grant, or whether the vice president of American District himself gave it to the Western Union electricians to get their opinion on the invention. In any case, the two technicians, Pope and Prescott, were incapable of fully understanding Meucci's invention, and, attaching no importance to it, they merely put the material aside somewhere in the Western Union laboratory.

62. Elisha Gray, l'inventore che richiese un *caveat* per il suo telefono soltanto due ore dopo di Bell.

62. Elisha Gray, the inventor who applied for a caveat on his telephone only two hours later than Bell.

Meanwhile, ever since the summer of 1872, Meucci had continued to knock at Mr. Grant's door. For two years he had returned regularly to the office of American District's vice president, always hopeful that a date would be set for his experiment on the telegraph wires. Sometimes he left comforted and sometimes more disillusioned than ever. But even Meucci's patience had a limit, and one day he decided that he would never cross Mr. Grant's threshold again. He begged Angelo Bertolino to go and demand the restitution of his telephone set and of the rest of the material. But Mr. Grant did not deign to receive Bertolino that day. Instead, he had his secretary tell him quite simply that he no longer knew where the material was, but if it were found he would see that it was returned.

Mr. Grant was a jovial man and welcomed them when he realized that Meucci was saying that he really intended to send spoken words over the wires. Grant fell back in his armchair with an uproarious laugh.

Such was the reigning mentality in the era when the telephone came into being. No one believed it. No one could conceive of the idea. The transmission of the voice over a distance appeared such an absurdity that even after the Bell Company had installed the first telephone lines American newspaper articles continued to treat the idea scoffingly.

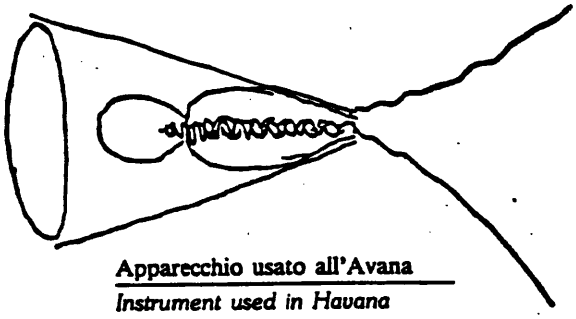
MANY years later, during the legal battle with Bell to prove who had invented the telephone, the days when the candle factory had been in operation were recalled in the testimony of Meucci's lifelong friend, the musician Mariani. "Salvi, Garibaldi and I used to work," said Mariani, "while Meucci spent most of his time on his experiments."

Completely absorbed in his inventions, Antonio paid little attention to his business. The idea of transmitting the human voice by electricity had become a fixation. His one great desire was to construct a real speaking telegraph.

From Meucci's own deposition at the Bell-Meucci trial, we learn that the first attempt to set up a telephone line, albeit rudimentary, goes back to 1852. "In the basement of the house," recounted Meucci, "I placed the battery with several Bunsen cells, and from the battery to the first floor of the house I strung the conductor of electricity. I took the instrument that I brought from Havana and to it I fixed the conductor. Repeating the same operation I made in Havana, speaking with my wife, I obtained the same results; that is to say, I received the transmission of the spoken word — not very distinct — as I had received in Havana in my first experiment."

Some days after this, as Meucci continued to recount in his deposition, an old friend, a Spaniard by the name of Carlos Pader who had known of his experiments in Cuba, came to see Meucci and asked if he had continued experimenting with the speaking telegraph. The inventor told him that he had indeed continued and had obtained the same results, but that he needed new material. He explained to Pader that he wanted to see a place where telegraphic instruments were made, in order to know what was in use.

Pader was acquainted with Meucci's friend Gaetano Negretti. Both men, recounted Meucci, "told me that they knew a manufacturer of telegraphic instruments in Centre Street, by the name of Chester, and that they would take me to his establishment to give me the opportunity to observe the telegraphic instruments and buy everything that I might need. After a few days, we were all together at said Chester's, and he showed me all the things used then in the telegraphic art. And so I gained knowledge and my mind was open to build some new instrument to improve the one I had made."



Apparecchio usato all'Avana

Instrument used in Havana

When Meucci returned home from this expedition, he set to work and began to construct the first of his instruments made in the United States — the first of a long series. It consisted of a tin tube closed at the bottom by a tin cover that allowed the wires to enter; at the upper end there was a funnel-shaped element of tin that served the person speaking as a mouthpiece and the person listening as an earpiece. Inside the tube was a block of wood through which the wires passed. Soldered to the wires just above the block of wood was the metallic tongue, or plate. Just below the block of wood there was a membrane of animal skin with a hole in the center for the wires to pass through. The membrane was a real step forward: Meucci had intuitively conceived the idea of the diaphragm. The animal membrane received the vibrations produced by the voice and amplified them, making their transmission stronger and clearer.

MEUCCI was unaware of the use others were making of his papers and instruments. He continued obsessively to work on improving his invention. He took all the reels of wire he had and strung a line that reached from his house across his property. It was the first real telephone line in history.

Matilde Ciuci, who like Mary Gregory lived with the Meuccis and in exchange for her room and board helped Signora Ester, has left us a precise description of his frenetic activity in this period. "I remember," Ciuci was to testify, "the date when I first went to live with Mr. and Mrs. Meucci. It was the 22nd day of October, 1875.... I saw wires about the thickness of shoelaces going from the basement to the room which was called the Garibaldi room. I remember distinctly there were wires going up to the room on the third floor. Mr. Meucci used to be putting the wires up and down, he sometimes put them up outside of the house and through the window into the room. Sometimes he would have the wires put along the stairs.... He also had wires running from the basement into the yard, the distance was as far as across Broadway. These wires reached the entire width of the lot.... Sometimes he would have me go upstairs to talk, and sometimes he would have me go into the basement.... When he had the wires in the yard, I had to go across the place to the end of the wires.... I remember very positively that often I was called to go across the yard to talk, and this was soon after I went there.... I could plainly hear what he said.... He used to say the words 'good morning,' 'how do you do,' 'hello.' I also remember that I heard him say 'fine weather.' "

In the summer of 1876, after Bell's triumph at the Philadelphia exposition, Meucci suffered deep depression. "Reading a newspaper sent to me by a friend," the inventor was later to recount at the Bell-Meucci hearings, "I saw that the patent for the invention of the telephone had been granted to a certain A. Bell. I recognized immediately that my invention, the fruit of many years of labor, had been stolen, because the description was identical with the one I had made."

His beautiful dream was gone. The great invention of his life now officially bore someone else's name. His old friend Domenico Mariani was to remember having seen him "cry like a baby." For a while Meucci was lifeless, like a man who had turned to stone.

But the inventor's inertia did not last long. He had Angelo Bertolino translate stacks of letters to send to newspapers. Each contained the rage and lament of a man who considered himself "robbed" and raised a condemning voice against the "usurpation" of his rights. He also wrote a letter to the patent lawyer Stetson, requesting him to inform the Patent Office that the invention on which he obtained a caveat in 1871 had been stolen from him.

Just as he had given all his energy in preceding years to the creation of the speaking telegraph, so now he dedicated all his strength to defending his invention.

CAVEAT.

PETITION.

The petition of Antonio Meucci of Clifton in the County of Richmond and State of New York, respectfully represents:

That he has made certain improvements in Sound Telegraphs, and that he is now engaged in making experiments for the purpose of perfecting the same preparatory to applying for Letters Patent therefor. He therefore prays that the subjoined description of his invention may be filed as a Caveat in the Confidential Archives of the Patent Office.

ANTONIO MEUCCI.

OATH.

STATE OF NEW YORK, }
County of Richmond, } ss.:

ANTONIO MEUCCI, the above-named petitioner, being duly sworn, deposes and says that he verily believes himself to be the original and first inventor of the improvement in Sound Telegraphs, described and claimed in the foregoing specification; that he does not know, and does not believe, that the same was ever before known and used; and that I am a citizen of the United States.

ANTONIO MEUCCI.

Subscribed and sworn to before me, }
this 23d day of December, 1871, }

JOSEPH DOYLE,
Justice of the Peace.

The following is a description of the invention sufficiently in detail for the purposes of this Caveat:

I employ the well-known conducting effect of continuous metallic conductors as a medium for sound, and increase the effect by electrically insulating both the conductor and the parties who are communicating. It forms a speaking Telegraph without the necessity for any hollow tube. I claim that a portion or the whole of the effect may also be realized by a corresponding arrangement with a metallic tube.

I believe that some metals will serve better than others, but propose to try all kinds of metals.

Isolating or not. It may be founded necessary for the person communicating the message to be isolated, but* the person receiving to be in electrical connection with the ground

The system on which I propose to operate and calculated, consists* in isolating two persons* separted at considerable distances from each other by placing them upon glass insulators employing glass, for example, at the feet of the chair or bench on which each sits and putting them in communication by means of a telegraphic wire. I believe it preferable to have the wire of larger area than that ordinarily employed in the electric telegraph but will experiment on this. Each of these persons holds to his mouth an instrument analogous to a speaking trumpet in which the word may be easily pronounced and the sound concentrated upon the wire. Another instrument is also applied to the ears in order to receive the voice of the opposite party.

Both the utensils for mouth & ears *must* be metallic conductors of electricity

All these, to wit, the mouth utensil and the ear instruments communicate to the wire at a short distance from the persons. The ear utensils being of a convex form like a clock glass enclose the whole exterior part of the ear and make it easy and comfortable for the operator. The object is to bring distinctly to the hearing the words of the person at the opposite end of the telegraph.

NOTE.—Marginal notes on this Exhibit K are in *red ink*, beginning with the *stars* and the word *isolating*, and ending with the word *electricity*. (See certificate to the caveat.)

COURT BATTLES AND FRUSTRATIONS

HAVE LEFT US A MOST REMARKABLE AFFIDAVIT:

MEUCCI CONCEIVED OF WIRELESS AND TERRESTRIAL

INTERCOMMUNICATIONS NETWORKS IN 1850

To call attention, the party at the other end of the line may be warned by an electric telegraph signal or a series of them. The apparatus for this purpose and the skill in operating it need be much less than for the ordinary telegraphing.

When my sound telegraph is in operation the parties should remain alone in their respective rooms and every practicable precaution should be taken to have the surroundings perfectly quiet. The closed mouth utensil or trumpet and the enclosing the persons also in a room alone both tend to prevent undue publicity to the communication. I think it will be easy by these means to prevent the communication being understood by any but the proper persons.

It may be found practicable to work with the person sending the message insulated and with the person receiving it in free electrical communication with the ground. Or these conditions may possibly be reversed and still operate with some success.

Both the conductors or utensils for mouth and ears should be,—in fact I may say—must be—metallic and be so conditioned as to be good conductors of electricity.

I claim as my invention & desire to have considered as such for all the purposes of this Caveat

The new invention herein set forth in all its details, combinations and sub-combinations.

And more specifically I claim—

FIRST—A continuous sound conductor electrically insulated.

SECOND—The same adapted for telegraphing by sound or for conversation between distant parties electrically insulated.

THIRD—The employment of a sound conductor which is also an electrical conductor as a means of communication by sound between distant points.

FOURTH—The same in combination with provisions for electrically insulating the sending and receiving parties.

FIFTH—The mouth piece or speaking utensil in combination with an electrically insulating conductor.

SIXTH—The ear utensils or receiving vessels adapted to apply upon the ears in combination with an electrically insulating sound conductor.

SEVENTH--The entire system comprising the electrical and sound conductor insulated and furnished with a mouth piece and ear pieces at each end adapted to serve as specified.

In testimony whereof I have hereunto set my name in presence of two subscribing witnesses.

ANTONIO MEUCCI

Witnesses:

SHIRLEY MCANDREW.

FREDK. HARPER.

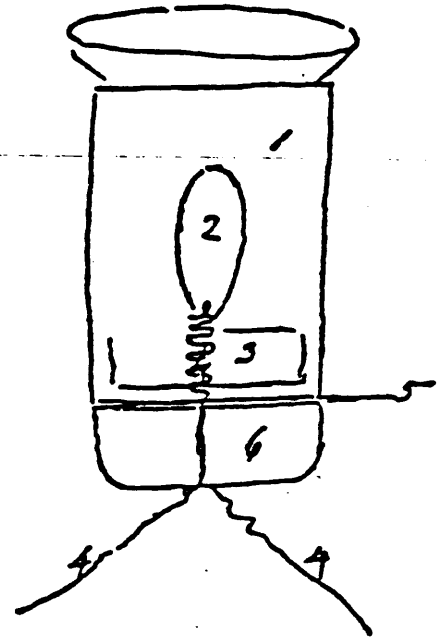
Ans. 17. About the year 1852, I put in place the battery with several cells of Bunsen, in the basement of the house, and I put in place, from the battery to the first floor of the house, the conductor of the electricity. I took the instrument that I brought from Havana (Figs. 1 and 3) as I gave in the diagrams at the last hearing; and I fixed the conductor, repeating the same operation I made at Havana, speaking with my wife, and I obtained the same result that I obtained in Havana; that is to say, receiving the transmission of the word — not very distinct — as I had received in Havana in my first experiment. In this time, after some days, I had a visit from a friend of mine, a Spaniard, who was named C. Pader; he had known of the experiments I had made in Havana regarding the *telegrafo parlante*; he asked me if I had continued the experiments that I had made at Havana, and if I had obtained the transmission of the human voice by means of the wire, conductor of the electricity; and I had obtained the same result as those in Havana, only that I needed to see and know some factory where were constructed telegraphic instruments, in order to open my mind and be in knowledge of what was in use, either in instruments, and so forth. Said Pader being acquainted with my friend Negretti, told me that they knew a manufacturer of telegraphic instruments living in Centre Street, by the name of Chester, and that they would take me to said establishment to give me the opportunity to observe the telegraphic instruments, and have me furnished, by paying, with everything that I could need. After a few days, we were all together at said Chester's, and he showed me all the things necessary used then in the telegraphic art, and so I was put in knowledge, and my memory was opened to build some new instrument to improve the one I had made. Returning home, after some reflection, I constructed a first instrument, as I have made in my affidavit on the first occasion.

Int. 18. Will you please construct or make a drawing of the instrument you first made in Staten Island, as stated in the answer that you have just given?

Ans. 18. Io faccio il seguente disegno. (Fig. 4):

Ans. 18. I make the following drawing:—

Fig 4.



Int. 19. Please letter the several parts of Fig. 4, and describe its construction?

Ans. 19. N. 1, un tubo di latta; al di sopra con una bocca per mettere alla bocca per parlare nell'instrumento. N. 2, una linguetta mettallica come quella adottata nei primi istrumenti sopranominati dell' Avana. N. 3, un blocco di legno ove nel centro passa il conduttore che è saldata detta linguetta N. 2. N. 4, conduttore metallico che passa nel centro del blocco che conduce il filo metallico alla batteria per ricevere l' elettricita.

N. 5, membrana animale con un foro nel centro ove passa il conduttore.

N. 6, coperchio del fondo del tubo N. 1.

Ans. 19. No. 1, A tin tube; at its upper end a mouthpiece to be put to the mouth to speak in the instrument.

No. 2, A metallic tongue, like the one used or adopted in the first instrument above named, at Havana.

spoke into it — myself and my wife, and I obtained the same result as before; that is to say, the sound of the word more distinct.

Int. 25. Please state where the persons experimenting were stationed, and how they were connected, if at all?

Ans. 25. Mia moglie stava nel primo piano ed io nel basamento; io parlavo nell istrumento in connessione col conduttore elettrico, mettendolo alla bocca; mia moglie le metteva all' orechio e cosi riceveva il rumore della parola: e vice versa, quando mia moglie parlava io riceveva.

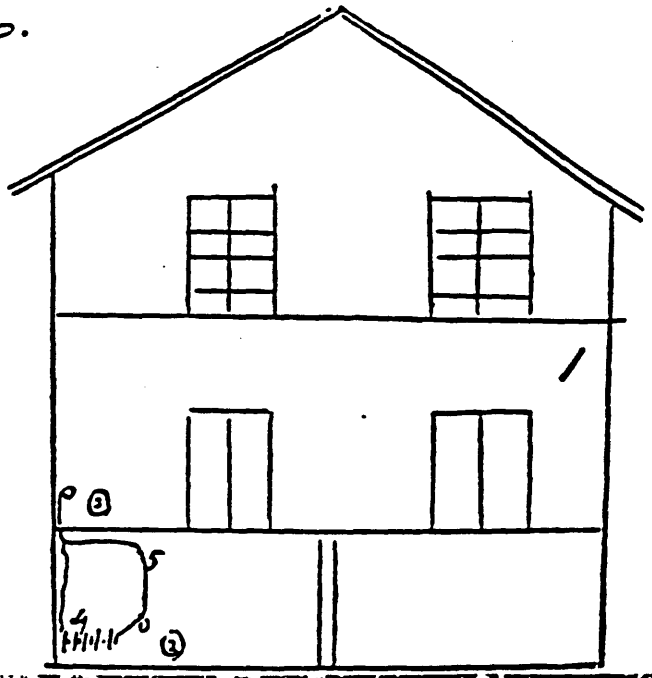
Ans. 25. My wife stood on the first floor, and I in the basement; I spoke in the instrument connected with electrical conductors, putting it to my mouth. My wife put hers to her ear, and so she received the noise of the word; and *vice versa*, when my wife spoke I received.

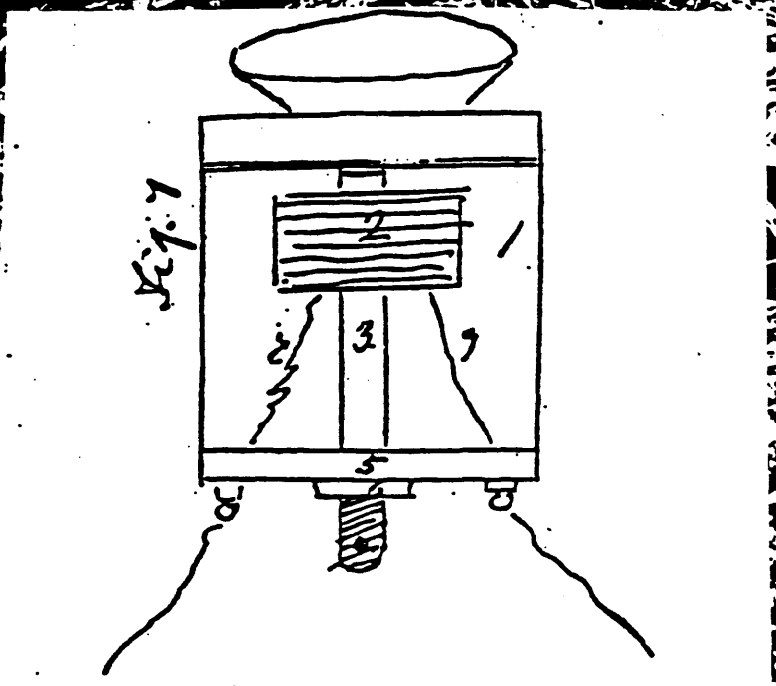
Int. 26. Please make a diagram of the house, showing where you stood, and where Mrs. Meucci stood while talking.

Ans. 26. Ecco; qui è il disegno.

Ans. 26. Here is a diagram. (Fig. 6):—

Fig. 6.





Int. 30. About what year did you construct the instrument of which Figure 7 is a diagram, and will you please go on and state its construction?

Ans. 30. Circa l'anno '59 o '60. Quello é stato il primo strumento che ho fatto colla bobina comprata da Mr. Chester, come pure il centro della bobina di un pezzo d'acciaio temperato e magnetizzato permanentemente messa nell' interno di una cassetta circolare di cartone con fondo di legno e al disopra un diaframma animale col centro forato ed il foro coperto da una linguetta metallica che serve di valvola che apre e serra per l'oscillazione della parola — e nello stesso strumento ho provato diverse altre qualita di diaframmi di varii materiali. Questo strumento mi ha dato eccellente risultata colla trasmissionne della parola quasi esatta. No. 1, cassetta di cartone con fondo di legno; No. 2, bobina; No. 3, sbarra d'acciaio temperato e magnetizzato permanentemente che passa nel centro della bobina, che si puó alzare ed abbassare per mezzo della vite che si trova nel fondo; No. 4, Diaframma animale con un foro nel centro

con una linguetta di ferro disotto, che serve di valvola; No. 5, Fondo del instrumento in legno; No. 6, Dado per alzare ed abbrassare il centro della bobina; No. 7, Filo di rame isolato della bobina, che passa nel fondo dello strumento per connettere colla batteria. Questo apparato mi diede buon risultato, trasmettendo la parola colla stessa facilita senza bisogno di unirlo alla batteria.

Ans. 30. About the year 1859 or 1860. That was the first instrument that I made with the bobbin bought from Mr. Chester, as well as the first with the centre of the bobbin made of a piece of steel, tempered and magnetized permanently, put inside of a circular box of pasteboard, with a wooden bottom, and with above it an animal diaphragm with a hole in the middle and the hole covered by a metallic tongue that served as a valve, opening and closing by the oscillations of the word. And in the same instrument I tried several other qualities of diaphragms of several materials. This instrument has given me excellent results in the transmission of the exact word.

No. 1, pasteboard box, with wooden bottom.

No. 2, bobbin.

No. 3, steel bar, tempered and permanently magnetized, passing through the centre of the bobbin, which can be raised and lowered by means of the screw at the bottom.

No. 4, animal diaphragm, with a hole in the centre, with a metallic tongue of iron under it, serving as a valve.

No. 5, bottom of the instrument in wood.

No. 6, nut to raise and lower the centre of the bobbin.

No. 7, copper wire insulated, coming from bobbin, passing through the bottom of the instrument, to connect with the battery.

This apparatus gave me good results, transmitting the word with the same facility without being necessary to connect it with the battery.

[*Adjourned to to-morrow morning, December* 12, 1885, *at* 10 *o'clock, at the same place,* 15 *Broad Street, New York.*]

NEW YORK, Dec. 12, 1885.

Met pursuant to adjournment; the parties present as before.

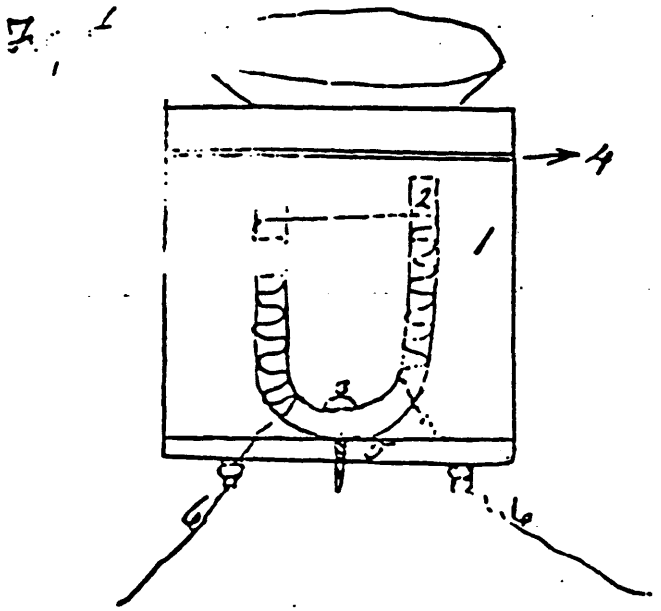
ANTONIO MEUCCI *further examined as follows:* —

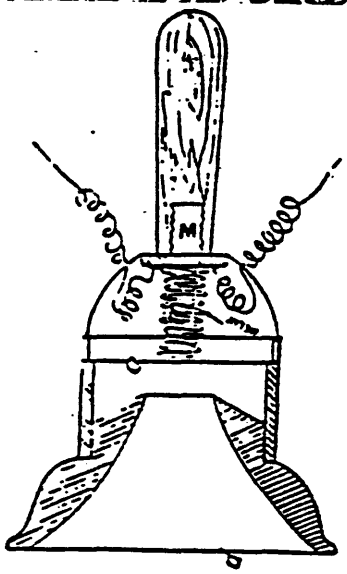
By Mr. HUMPHREYS.

Int. 31. The last instrument that you drew (Fig. 7), you state was made about 1859 or 1860, and those that you drew previously to that were made from 1852 to 1854; state whether you made any other designs, devices or instruments between 1852 and 1860, and if so, state what they were.

Ans. 31. - Sicuro che ne ho fatti. Ne ho fatti tanti chi non ricordo bene. Farò quello che avrò in memoria. Dal '54 al '60 mi ricordo d'aver ne fatti diversi; questo fu quando cominciai a costrurre l' esteriore dello strumento di cantone o di latta, di forma circolare, di circa tre pollici di diametro e da 3 a 4 d' altezza, di cui farò un disegno come segue (Fig. 8).

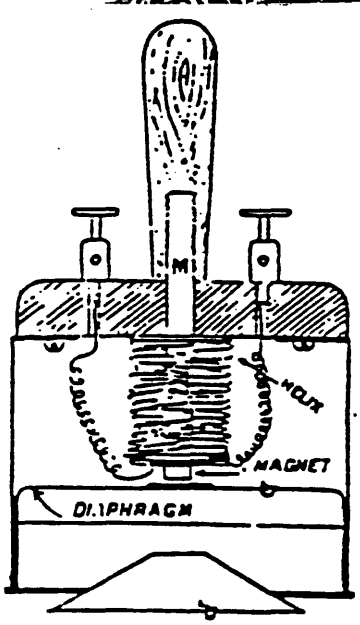
Ans. 31. Certainly, I have made some. I have made so many that I don't remember well; I will tell what I can remember. From 1854 to 1860 I remember to have made several of them; this was when I began to construct the interior of the instrument in pasteboard or tin, of circular form, about three inches in diameter and from three to four inches high. Of that I will make a drawing, as follows: —





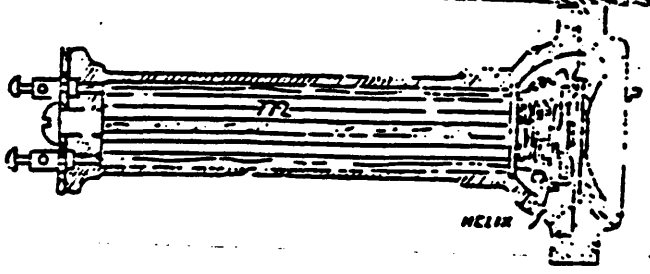
Meucci's Telephone. — 1857.

M — Magnet.
D — Diaphragm.
P — Mouth or Ear Piece.



Meucci's Telephone. — 1867.

M — Magnet.
D — Diaphragm.
P — Mouth or Ear Piece.



Bell Telephone.

M — Magnet.
D — Diaphragm.
P — Mouthpiece.

Let any one read the claims of Antonio Meucci of 1871, compare the description of the instrument where he speaks of its shape and application to the mouth and ear, and his description generally, as to how it is to be used, with those of the Bell claims (remembering that Meucci's description was written five years prior to the application of Bell), and with it consider Meucci's inability to speak the language of the country, his destitute condition, his persistent and earnest efforts, with all these difficulties before him, in his endeavor to bring his invention before the world; and having done so, it is respectfully submitted that it is one of the most remarkable instances on record that inventions of so important a character and so entirely similar could have been made by two persons who never had met or held communication with each other.

Other parties have laid claim to priority of invention of the telephone, and have presented evidence in substantiation of their claims, but they have failed in the one important particular: they did not, as was done by Meucci, file their claims in the Patent Office years before those of Bell; and in none of the claims they presented did they set them forth in the clear and distinct language to be found in the caveat of Antonio Meucci.

As we have before suggested, the coincidence is one of the most remarkable on record. Is it not reasonable to at least infer, that by some means the ideas of Antonio Meucci may have been *Telephoned* to others and *their* ideas been moulded into form that he set out, and he thereby been deprived of the rights justly due him?

INSISTENCE ON ACOUSTIC SUPERIORITY

MEUCCI DISCOVERED MORE THAN ACOUSTIC TELEPHONY: HE DISCOVERED VISCERAL RESPONSE AND VRILLIC TELEPHONY

By speaking or singing in the practical experiments made thus far it was possible to transmit with astonishing faithfulness chords, airs, &c.; while reading, speaking, &c., single words were less distinctly heard.

Philip Schmidt, a paymaster in the German navy, says—

He [Reis] succeeded finally in reproducing at a distance words and whole sentences.

In volume 2, p. 404, of Das Neue Buch der Erfindungen, speaking of the Reis discovery, is found—

It sounds more than fantastic if it is stated that it is possible to converse through the electric telegraph wire to hundreds of miles with a distant person . . . yet this possibility has already become an actuality.

This, with much other contemporaneous testimony, given at a time when the facts were yet fresh and perpetuated with unerring certainty, is very cogent evidence that Reis invented a speaking-telephone, and also illustrates its gradual development towards perfection.

The affidavits and letters of like scientific men, many of whom are devoting their lives to the study and teaching of the science of electricity, who are entirely disinterested here, after examination and study of the description of the instrument, as shown by the publications of Professor Reis, have borne witness that in all its substantial features the Reis instrument anticipates the alleged discovery by Bell. Many others testify that instruments constructed carefully in strict accordance with the description given by Reis have in their own personal presence actually transmitted words and sentences in conversation long distances. It is scarcely credible that all this testimony from disinterested sources is untrue.

There is also evidence that as early as 1849 Antonio Meucci began experiments with electricity, with reference to the invention of a speaking telephone, he being then a resident of the island of Cuba. In 1851 he came to New York, where, from time to time, he continued his experiments. Between that and 1854 considerable progress had been made. Between 1858 and 1860, it seems, he published in an Italian paper in New York the statement that he had invented a speaking telegraph. Being an Italian, he made, in 1861, arrangements to patent it in Italy—but they miscarried. Up to 1871 his experiments were continued, during which interval, although much of the time very poor, he constructed several different instruments, with which, in his own house, he conversed with his wife and others in different parts of the house. Models of several of these instruments made during this interval were exhibited, and seem in principle to combine most, if not all, of the elements that enter into the Bell instruments. His testimony is corroborated by his wife, and by affidavits of a very large number of witnesses. He claims that in 1872 he went to Mr. Grant, vice-president of the New York District Telegraph

Company, explained his invention, and tried repeatedly to have it tried on the wires of the company. This, it is claimed, was used by the telegraph company, and was the basis of the contract between the Western Union Telegraph Company and the Bell Telephone Company, dated November 10th, 1879. There is evidence that Prof. A. E. Eaton, an electrician, began prior to 1875, experiments upon the Reis telephone with reference to its improvement. He had frequently referred to the Reis invention in lectures, and claims it was well known to scientists, from different publications, since 1861 and 1862; that, from the description of the instrument in the summer of 1875, he constructed a speaking telephone, which (including the Blake transmitter now used in the Bell telephone) is substantially the same in all its essential principles as the Bell instrument; that during that year he used it successfully. He is corroborated in this statement as to the use of the instrument and its transmission of words by S. S. Pratt, of the New York World. It was Professor Eaton who sold to Spencer the telephones with which Spencer alleged he wished to establish a line between Boston and Providence.

Action was brought by the Bell Telephone Company against Mr. Spencer in Boston for the use of the instruments procured by him of Professor Eaton, and on the 27th of June, 1881, Lowell, justice, sustained the Bell patent; but in this case Professor Eaton was not called as a witness, and this is made the ground for a charge by the petitioners that Spencer was in the interest of the Bell Company and the suit collusive. There is no reason to believe that the attorneys or counsel for defendant in the Spencer case conducted the defense therein otherwise than with diligence, ability, and integrity; but all the evidence now presented before us was not then presented to that court. It is said by Professor Eaton that he began to make speaking telephones from the Reis description in the summer of 1875, and much other testimony is now before us. That testimony, if believed, would most likely have changed the result of the Spencer case. This was the first suit brought and test made upon the Bell patent. After this five other suits were brought in different courts by the Bell Company, and the defendants in the different cases were enjoined.

These suits are a principal feature in the evidence of the respondents in the applications. It is not claimed they are a bar to the action asked, but that they are a high degree of persuasive evidence that the claim of the applicants is not well founded. Their weight as persuasive evidence would largely depend upon the evidence which was offered by the defendants in each case, and the skill and integrity with which that evidence was presented.

If the evidence was identical with that before us, they might be sufficient to warrant a refusal of the application. But this is disputed. It is certain that in the Spencer case the same evidence was not before the court that has been here submitted. This last difference occurs in possession of the proper parties to demonstrate the truthfulness of the foregoing statements.

By way of illustrating the similarity of the claims, we call attention to two cuts of models of Antonio Meucci's invention, one certified to as of 1857, and the other of 1867, and also a cut of the Bell telephone. It will be seen that a diaphragm and a magnet are properly placed in a case with wires running from the same for attachment to the transmitting wires. Upon reference to the Bell telephone, while differing somewhat in shape and proportions, it will be found that the essentials of the Meucci device are the same.

MEUCCI REVEALS SUCH EXPERIENCE WITH ALL FORMS OF TELEPHONY THAT THE JURY BECOMES ASHAMED

Int. 79. Please state the way you used this instrument you have just described, if at all?

Ans. 79. It was connected with the battery, and the connecting wire passed from the basement into the room on the third story called of Garibaldi; with this instrument many people spoke as they did with other and similar ones made of pasteboard. With this instrument spoke my wife, Mariani, and others of whom I can't remember the names.

Int. 80. Please state who made this soap-box instrument, that you have just described, and the other pasteboard box instruments, that you have also just described?

made by me with the bobbin having the central bar of tempered and magnetized steel that I bought from Mr. Chester. But this bar being of tempered and magnetized steel surrounded by a metallic wire many feet long, it produced a resistance much greater than the one of the preceding apparatus, Fig. 5, because the center of the bobbin producing the electro-magnetic current was of a larger size.

Int. 543. On cross-examination (Int. 513) you were asked by Mr. Storrow: "Look at Fig. 7 referred to in your twenty-ninth answer, and state to me as fully as you can, why you put in the magnet 3 and the bobbin 2, in that instrument?" Your answer is in part, "I have more resistance." Please explain what you mean by "more resistance."

Ans. 543. To have more resistance; the word I can't change; "more" and "greater" are the same. If he asks me the effect made by the magnetic center, it is another thing.

Int. 544. Please answer the question you have just asked.

Ans. 544. Putting it higher or lower in the bobbin, or nearer or further from the diaphragm, it produces the oscillations of the membrane on top and corresponding to the hammer in the telegraphic apparatus. The oscillations are what formed the voice. In those cases when I used the animal or vegetable membrane, it being more elastic than the iron one, the central bar must be put at a greater distance. When the membrane is metallic, the bar must be somewhat nearer. It is for this reason that the screw is put at the bottom, to be used as a regulator. I think that this is what was asked.

[*Recess from* 12.30 *to* 1 *o'clock.*]

Int. 545. While you are on Fig. 7: You stated in your answer 70, in chief, "This telephone gave me good results, transmitting the word with the same facility without being necessary to connect it with the battery." Please state what you meant.

Ans. 545. What I said is certain, that it is possible to transmit the word in any telephone containing a bar of tempered and magnetized steel without the aid of the battery; only it will not be possible to obtain it at a long distance. In some experiments made by me I found that using a larger conducting wire or a rope of copper wire I obtained great advantage; and so in the explanation I gave to Mr. Stetson for the application for the caveat, and in the one I gave to Mr. Grant, I said that using a cable of copper wires the exact transmission of the word was obtained more easily. Moreover, in 1880, I gave to Mr. Bennett some samples of a cable of copper wire made by me in order to have it adopted in the transmission of the human word, and for which I wished an application for a patent to be made, as well for the ordinary telephone as for the marine telephone.

Of the instruments described above, the first four, made before 1852, were primarily of an experimental nature. The fourth was more or less like the others, but, as we have said, it marked another step in the right direction, for it employed an animal membrane which was missing in the first three.

Instruments No. 5, 10, 11, and 8, all made after 1852 and before 1857, mark further progress in the right direction. In No. 5, we find for the first time the use of a bobbin or core and coil, with a small tongue of platinum; in No. 10 we have a metallic diaphragm "sometimes of iron." No. 11 also may have had an iron membrane, although Meucci is not very clear about it. No. 8 also used metallic membranes.

Thus, since Meucci kept on experimenting and changing membranes, it is quite possible that he may have made a good electric telephone between 1852 and 1857. As he said in his Answer 29, "At the same time I tried several qualities of membranes; some of iron, some of different qualities of fabrics and metals, and animal substances, etc."

Meucci's description of instrument No. 7 (also No. 7 in the affidavit), made about 1859 or 1860, is more precise. Because of its importance we quote it in full:

"Answer 30. About the year 1859 or 1860. That was the first instrument that I made with the bobbin bought from Mr. Chester, as well as the first with the centre of the bobbin made of a piece of steel, tempered and magnetized permanently, put inside of a circular box of pasteboard, with a wooden bottom, and with above it an animal diaphragm with a hole in the middle and the whole covered by a metallic tongue that served as a valve, opening and closing by the oscillations of the word. And in the same instrument I tried several other qualities of diaphragms of several materials. This instrument has given me excellent results in the transmission of the exact word.

"No. 1, pasteboard box, with wooden bottom.

"No. 2, bobbin.

"No. 3, steel bar, tempered and permanently magnetized, passing through the centre of the bobbin, which can be raised and lowered by means of the screw at the bottom.

"No. 4, animal diaphragm, with a hole in the center, with *a metallic tongue of iron* under it, serving as a valve (italics ours).

"No. 5, bottom of the instrument in wood.

"No. 6, nut to raise and lower the centre of the bobbin.

"No. 7, copper wire insulated, coming from the bobbin, passing through the bottom of the instrument, to connect with the battery.

"This apparatus gave me good results, transmitting the word with the same facility without being necessary to connect it with the battery." Obviously, THIS IS AN EXCELLENT ELECTRIC TELEPHONE.

Confronted with the above evidence, the Bell counsel, Mr. Storrow, and the Bell expert, Prof. Cross, tried to discredit it to the best of their abilities but, being unable to deny that some of the later instruments contained all the elements of

the electric telephone, (the others, as we have seen, were introduced in order to show the different stages of the invention) they stated without hesitation that Meucci must have copied them.

We shall take up this charge in the following chapter. Before doing that, however, we submit for the consideration of the impartial reader some of the arguments to which Prof. Cross and Mr. Storrow resorted in order to further confuse the issue. We quote verbatim from Mr. Storrow's direct interrogation of his witness, Prof. Cross, as it appears in Prof. Cross' deposition:

"Int. 69. Will you state whether you have used an apparatus composed of two instruments constructed exactly alike, and of substantially the same size as Fig. 7 of Mr. Meucci's deposition, as explained in his 29th and 30th Answers,—substituting, however, a sheet iron diaphragm for the membrane diaphragm; and if you have tried it with such substitution state the results."

Now notice how precise, however repetitious, was Prof. Cross' answer. Meucci would have replied "Yes" and done with it:

"Ans. 69. I have used an apparatus composed of two instruments constructed exactly like Fig. 7 of Mr. Meucci's deposition, and his description of the same in his thirtieth answer, except that a sheet-iron diaphragm was added at the upper end, a short distance from and in front of the upper end of the steel magnetized core 3. With that addition it became an excellent electric speaking telephone, transmitting and receiving speech without the aid of a battery, and without any trouble whatever. I am very sure that an instrument made according to that drawing, with the addition of a diaphragm of soft, thin shee-iron, would give such results as would leave no one in doubt as to its practicability and utility."

That answer should have been sufficient, but not for Mr. Storrow, who then asked the following question:

"Int. 70. If you employ an animal membrane diaphragm in Fig. 7, instead of the iron diaphragm which you did employ, will an apparatus composed of two such instruments connected together, be an electric speaking telephone, and transmit speech by means of electricity?

"Ans. 70. Such an apparatus would not be an electric speaking telephone, nor would it be possible by such an apparatus to transmit speech electrically.

"Int. 71. Will you examine the statements Mr. Meucci makes about what he calls a valve in Fig. 7, as described in his answer thirty, and in his cross answers 253 to 256 inclusive, and tell me whether that valve can perform any function in the electrical transmission of speech?

"Ans. 71. I do not see how the valve which he describes can possibly perform any function in the transmission of speech.

REDUNDANT CROSS-EXAMINATIONS

INTENDED TO CONSISTENTLY DENY THE TRUTH

"Int. 72. Please look again at that description of the valve and state whether a metal valve attached so delicately that it would open and shut the hole in the animal membrane, under the influence of the sound waves due to the voice of the speaker, would serve as an inductive armature, or convert animal membrane into a diaphragm amounting to an inductive armature, acting like the instruments of Fig. 7 of the Bell patent?

"Ans. 72. In my opinion it is not possible that a metal valve as described, so delicate as to open and close the aperture in the membrane in the manner indicated, could possibly serve so as to operate in the manner of the transmitter shown in Fig. 7 of the Bell patent."

In his affidavit Prof. Cross stated:

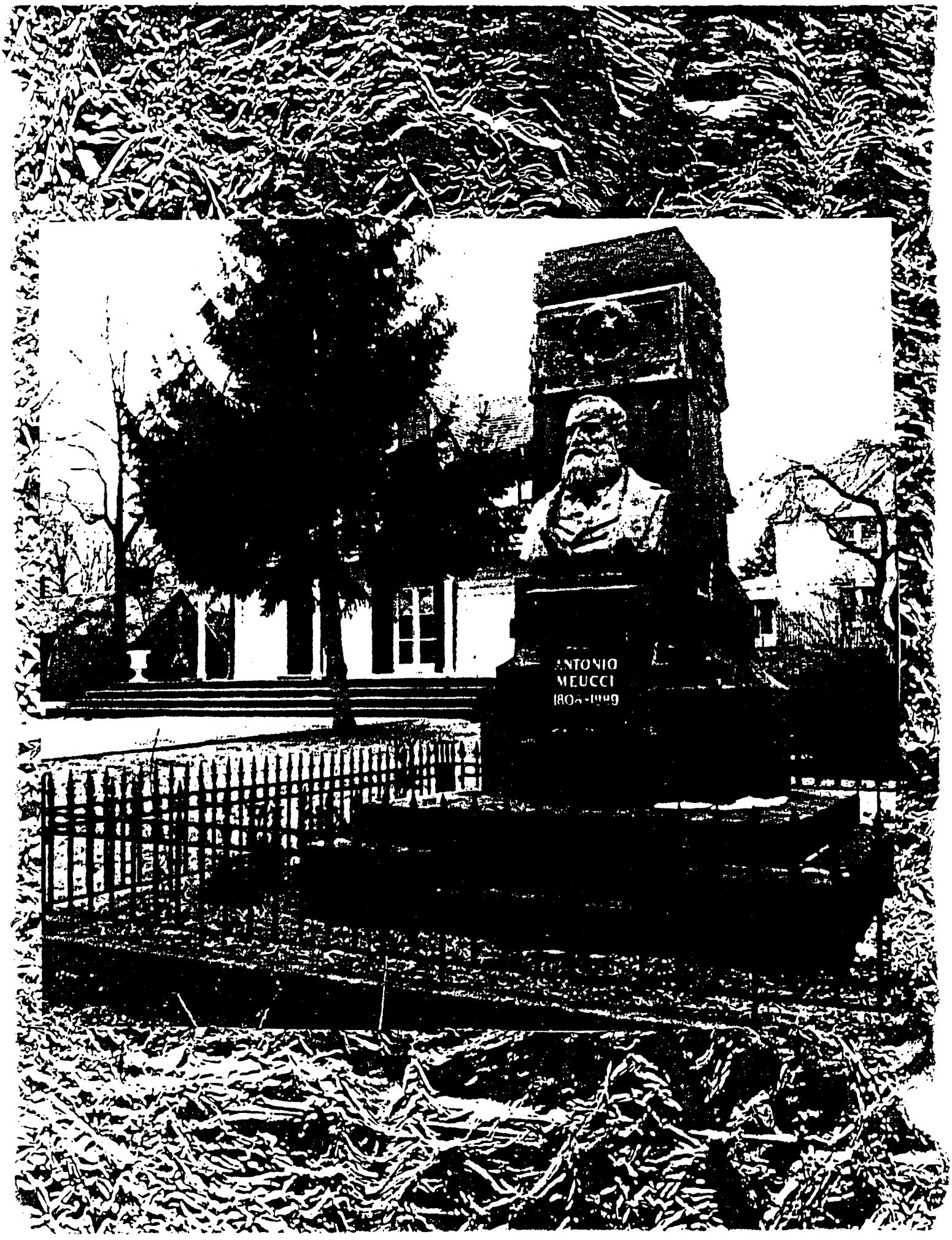
"I have used an apparatus composed of two instruments constructed exactly like Fig. 7 of Mr. Meucci's deposition, and his description of the same in his thirtieth answer, except that a sheet-iron diaphragm was added at the upper end, a short distance from and in front of the upper end of the steel magnetized core 3. With that addition it became an excellent speaking telephone, transmitting and receiving speech without the aid of a battery, and without any trouble whatever. I am very sure that an instrument made according to that drawing with the addition of a diaphragm of soft, thin sheet-iron, would give such results as would leave no one in doubt as to its practicability and utility."

Mr. Storrow's interrogations and Prof. Cross' replies, as well as Prof. Cross' statement in his affidavit in which he says "except a sheet-iron was added at the upper end" might lead one to believe that Meucci's telephone did not include an iron diaphragm. But, as we have seen, Meucci in his answer No. 30 did clearly specify a *metallic tongue of iron.*

Prof. Cross' replies to the cross-interrogations of Mr. Humphreys, Meucci's lawyer, are nothing short of extraordinary. Referring to Meucci's Answer No. 30, Prof. Cross says that Meucci "does not in his principal description mention that there is any iron used in connection with the diaphragm" (referring to the first part of the answer) conveniently disregarding that a few seconds later, in the same Answer No. 30 Meucci was more specific and said "metallic tongue of iron."

Furthermore, according to Prof. Cross, whether Meucci said "metallic tongue" or "metallic tongue of iron," was irrelevant, adding "I should judge from his description that he did not consider it in any way material whether the metallic valve were of iron or of any other material." But how can one make such a statement when Meucci, for once, was very precise? The inductive action of the diaphragm is clearly indicated by his description "opening and closing by the oscillations of the word."

VRILLIC RELAY SWITCH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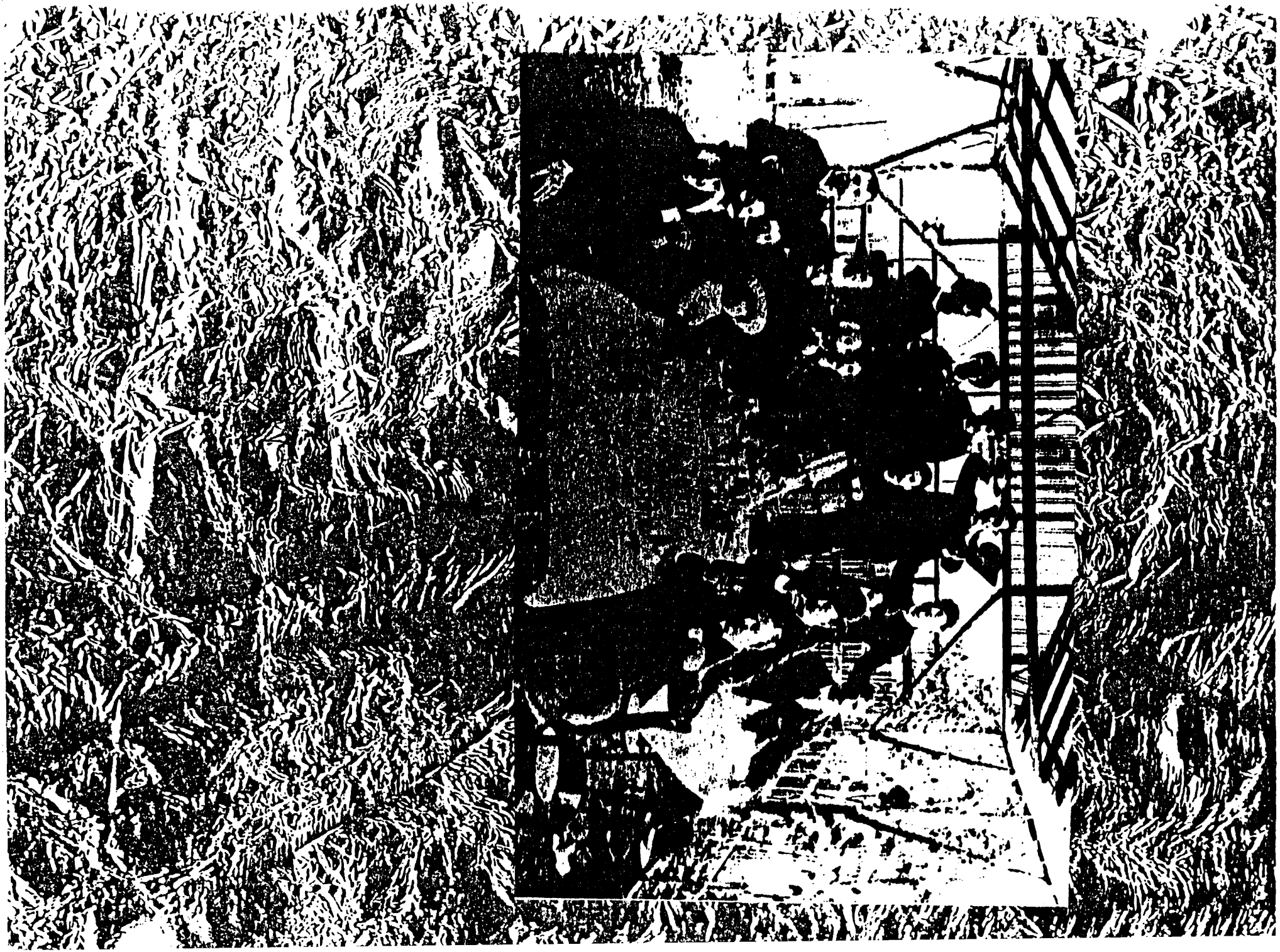


Patents Granted to and Applications and Caveats Filed by Antonio Meucci.

22,789. January 25, 1859. Appl. Nov. 15, 1858. Candle Mold. Ass'd to Domenico B. Lorini, Nov. 29, 1859. Recorded Feb'y 24, 1859, Z5, p. 29. E. S. Renwick, att'y. W. E. Rider, witness.

Caveat. April 9, 1859. Galvanic Battery.

Caveat. June 8, 1860. Candle Apparatus. E. S. Renwick, att'y.

Application. June 8, 1860. Dry Galvanic Battery. Rejected. E. S. Renwick, att'y.

30,180. Sept. 25, 1860. Appl. Apparatus for moulding candles. Ass'd to N. Y. Paraffine Candle Co., May 28, 1860, U5, p. 60; W. E. Rider, witness to ass't. E. S. Renwick, att'y. [Possibly the ass't relates to caveat of June 8, 1860.]

36,192. Aug. 12, 1862. Appl. May 7, 1862. Lamp burner. W. E. Rider, witness. Ass'd to Antonio Jand, May 12, 1862, N6, p. 600. E. S. Renwick, att'y.

36,619. Sept. 9, 1862. Appl. June 16, 1862. Imp't in treating mineral oils for paint. Ass'd to Antonio Jand, June 12, 1862, O6, p. 207. Munn, att'y.

36,714. May 26, 1862. Appl. April 8, 1862. Preparing hydrocarbons for paint. Ass'd to Mrs. Esterre Meucci (wife of A. M.), March 18, 1862, B6, p. 618. Munn & Co., att'ys.

44,788. October 18, 1864. Appl. Sept. 12, 1864. Removing gum, &c., from vegetable material for paper pulp. Ass'd to Wm. E. Rider, Nov. 26, 1864, S7, p. 17. E. S. Renwick, att'y.

46,007. Feb. 28, 1865. Appl. Jan'y 17, 1865. Making wicks out of vegetable fibre. Ass'd to W. E. Rider, Jan'y 18, 1865, S7, p. 844. E. S. Renwick, att'y.

47,066. March 28, 1865. Appl. Feby 21, 1865. Imp't on 44,788. Ass'd to W. E. Rider, Feby 11, 1865, S7, p. 869. E. S. Renwick, att'y.

British 788 of 1865. Reissue nos 44,788 and 47,066.

Italian. Nov. 8, 1865. Ditto.

53,185. March 13, 1866. Appl. Aug. 8, 1866. Treating vegetable fibre for paper pulp. Ass'd to David Whiting, Mch. 16, 1866, A6, p. 307; W. E Rider and Jas. C. McAndrew, witnesses. E. S. Renwick, att'y.

Caveat. Dec. 28, 1871. Sound Telegraph. T. D. Stetson, att'y. Witnesses, Shirley McAndrew and Fred. Harjes.

122,470. Jan'y 21, 1872. Appl. Nov. 20, 1871. Effervescent drinks. Shirley McAndrew, witness. Ass'd to Alex. McAndrew, Dec. 17, 1871, U18, p. 103. Ass'd to Mrs. Esterre Meucci (wife of A. Meucci), March 4, 1872, V18, p. 431; B. Bertolino, witness. T. D. Stetson, att'y. Final fee paid Dec. 20, 1871.

Caveat. Dec. 9, 1872. *Caveat* for Sound Telegraph renewed. Stetson, att'y.

Caveat. July 7, 1873. Screw steamer for canals. T. D. Stetson, att'y.

142,071. Aug. 26, 1873. Appl. July 9, 1873. Angiolo P. Agresta and Antonio Meucci, inventors. Sauce for food. T. D. Stetson, att'y.

1,503. Oct. 21, 1873. Appl July 9, 1873. Trade mark for sauce. Stetson, att'y.

Caveat. Dec. 15, 1873. *Caveat* for Sound Telegraph renewed. Stetson, att'y.

Caveat. April 22, 1874. Refining, &c., mineral oil. T. D. Stetson, att'y.

Caveat. July 2, 1874. *Caveat* for canal steamer renewed. Stetson, att'y.

168,373. Sept. 28, 1875. Appl. July 23, 1875. Lactometer. Ass'd to Giuseppe Tagliabue, July 17, 1875, O18, p. 481. Van Santvoord and Hauff, attorneys.

183,069. Oct. 10, 1876. Appl. Dec. 1, 1875. Hygrometer. L. D. Cunningham, witness. Ass'd to Esterre Meucci, his wife, Nov 29, 1875, R19, p. 477; witness Luigi Tartarini. Esterre Meucci appoints Antonio Meucci "my husband," her att'y, about this

Articles supporting Meucci's claim appeared in numerous American newspapers during the last quarter of the 19th century. Reading these articles prompted us to reopen the Meucci case and press for his fair recognition. Among the periodicals are the following:

Scientific American	Nov. 22, 1884
Electrical World	Nov. 28, 1885
Chicago Tribune	Sept. 16 and Nov. 9, 1885
New York World	Oct. 8, 1885 and Oct. 19, 1889
Brooklyn Daily Eagle	Oct. 10, and Oct. 19, 1885
Evening Post	Nov. 10, 1885
New York Times	Sept. 25, 26, Oct. 19, Nov. 80, 8885
Staten Islander	Jan. 6, 1926
Baltimore Sun	Oct. 21, 1885
Chicago Evening Journal	Jan. 31, 1887

The caveat which Meucci filed contained the drawing made by Nestori, and as shown in the cut, which is a facsimile, represents two persons with telephones connected by wires and batteries in circuit. The caveat, however, does not describe the invention very clearly; it describes the two persons as being insulated, but Meucci claims that he never made any mention of insulating persons, but only of insulating the wires. To explain this seeming incongruity, it must be stated that Meucci communicated with his attorney through an interpreter, as he was not master of the English language; and even at the present time he understands and speaks the language very poorly, so much so, that we found it necessary to communicate with him in French during the conversation in which these facts were elicited.

In the summer of 1872, after obtaining his caveat, Meucci, accompanied by Mr. Bertolino, went to see Mr. Grant, at that time the Vice-President of the New York District Telegraph Company, and he told the latter that he had an invention of sound telegraphs. He explained his inventions and submitted drawings and plans to Mr. Grant, and requested the privilege of making a test on the wires of the company, which test if successful would enable him to raise money. Mr. Grant promised to let him know when he could make the test, but after nearly two years of waiting and disappointment, Mr. Grant said that he had lost the drawings; and although Meucci then made an instrument like the one shown in Fig. 9 for the purpose of a test, Mr. Grant never tried it. Meucci claims that he made no secret of his invention, and as instance cites the fact that in 1873, a diver by the name of William Carroll, having heard of it, came to him and asked him if he could not construct a telephone so that communication could be maintained between a diver and the ship above. Meucci set about to construct a marine telephone, and he showed us the sketch of the instrument in his memorandum book, which dates from that time and contains a number of other inventions and experiments made by him.

When Professor Bell exhibited his invention at the Centennial, Meucci heard of it, but his poverty, he claims, prevented him from making his protestations of priority effective, and it was not until comparatively recently that they have been brought out with any prominence.

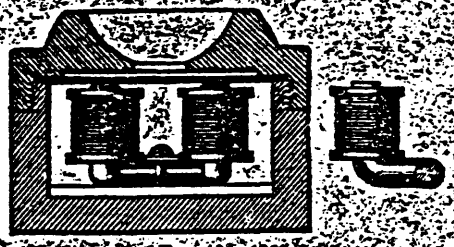


FIG. 10.—1861.

From a pioneer to a pauper

"As early as 1856 Meucci made a telephone which extended from his wife's sick room to the kitchen and his room was connected with the brewery by the same method. This telephone was composed of an imperfect magnet with a coil and a diaphragm and was enclosed in a box of wood and paper. In 1860, according to his testimony before the United States Circuit Court, he had perfected his invention. His discovery of the telephone's principle is somewhat interesting. While in Havana he treated patients with electricity in his own house. Once he thought he heard voices across the wires, and upon investigation he found that the sound came from the lips of a patient who was eight feet away. By using a paper cone he discovered that the sound could be increased in volume. This was as early as 1841. He called the invention the teletrofono, and attempted to introduce it in Italy but failed. He continued work upon it until 1864, when he believed it was perfect. But then he almost lost his life in the explosion of the boiler of the ferryboat Westfield, and for five months he was unable to help himself. His wife pawned everything she had in the world, and he sold his telephone to a junk dealer for $6. Instead of dying, however, Meucci recovered, and in 1871 organized the Teletrofono Company, but could raise only $20 capital. He filed caveats in 1869 and 1871 announcing his intention of taking out patents, and sought a financial backer. But he met with final disappointment, and while exceedingly poor in 1876 he read that Bell had secured patents for the instruments which he claimed to have invented. He was subsequently taken into the Globe Telephone Company. When the Bell Company sued the Globe, Meucci sold his patents to the latter for a few thousand dollars, of which his share was taken by creditors."

Thus, the Times has told us the story of the telephone's invention by Antonio Meucci. The Times' report was confirmed that same day by the New York World, with interesting particulars as to how Meucci happened to be the first to conceive the idea of the telephone. The World refers to the Italian inventor as "one of the most remarkable figures of the age."

We quote from a World editorial under date of October 29, 1889:

"The invention of the telephone dates back to Meucci's residence in Cuba in 1849. He was then Director of Mechanism of the Tacon Opera House and employed much of his leisure in electrical experiments. While pursuing a theory of the cure of disease by electricity he arranged a wire and battery to form a complete circuit. Each wire was connected with a copper plate. Two men were in different rooms, Meucci and his friend. Each man put the plate to his mouth. The shock caused the other man to exclaim. Meucci at the other end of the line had the copper-plate between his teeth and heard the sound. He continued to experiment on this discovery. In May 1851, he perfected a paper cone and conversed faintly with people across the street. When Meucci came to New York there was a great struggle between his poverty and his consuming desire to further his invention. For a year or two he was paid a royalty of $150 per month by the Globe Telephone Company of Philadelphia.

What did Bell mean when he said, 'I cannot claim to be the inventor of the modern telephone.'

Esther Meucci recalls the events

Meucci's wife, Esther, in an affidavit published by the Globe Telephone Company of New York, clears these facts. Let us quote from the *Scientific American*:

"The affidavit of Esther Meucci, the wife of the inventor, states that in Havana, Meucci, while engaged as director of the mechanism of the Town Opera House, sometimes devoted his attention to making various articles of galvano-plastic, and made experiments endeavoring to speak to another person at some distance through the use of the wire attached to his electric battery. That the persons with whom he made experiments, as well as myself, heard words through a wire, but not satisfactory plain to my husband. (She) mentions the burden she has been on account of incurable rheumatism to him and she corroborates Mr. Bendelari's statement about his being asked in 1860 by interest capitalists in Europe. (Esther Meucci's affidavit) then touches on the subject of the explosion, and states the amount of their indebtedness for the necessities of life and for the expenses of sickness. It goes on to relate that when Meucci had somewhat recovered from his injuries he recommenced his experiments and borrowed money for drawing the necessary papers in the English language (he being not familiar therewith), and that he filed his caveat. (She) mentions the Grant matter, and then deposes that she sold some of Meucci's devices to a second-hand dealer of Clifton (one John Fleming) to get money to support temselves.

Upon recovering from his illness, Meucci attempted to have Fleming return him the models of his invention but Fleming had sold them to an unknown who could not be found. What interest had that unknown in the invention that came into his hands? Who was he?

In 1849 Meucci accidentally discovered that the human voice could be transmitted over a copper wire charged with electricity.

In 1857 Nestori Corrado, an artist, prepared a sketch showing the Meucci's telephone in operation.

In 1859 Secche de Casali, editor of the Eco D'Italia, published an article on Meucci's telephone and made an appeal for capital to develop his invention. He failed.

In 1860 Enrico Bendelari went to Italy with drawings and a description of the invention in an attempt to raise capital. He failed.

On December 28, 1871 Meucci filed with the U.S. Patent Office his Telephone Caveat.

For two successive years — in 1872 and 1873 — Meucci filed and renewed the Caveat. He failed to renew it on the third year, due to lack of money.

In 1874 Meucci submitted the plans of his invention to the President of the District Telegraph Company, who promised to assist him to make the necessary tests and models. After numerous visits to the Telegraph Office he was told that the papers had been lost and that nothing could be done.

Twenty days before Bell applied for his patent, he was told about the loss of the papers.

In 1876 Bell announced the invention of the telephone.

The press rediscovers Meucci

The name of Meucci begins to appear in the columns of the press at the time of the fierce attacks on the Attorney General. On October 2, 1885, the New York World carried this information:

"Five years before Gray and Bell made their applications for patents Antonio Meucci, of Staten Island, filed a caveat for a telephone now in use, but, strange to say, his drawings have been lost from the archives of the Patent Office. Over fifty persons however, have made affidavits that it was in use and was a good speaking telephone before and after 1871."

A few days after, the Baltimore Sun (October 21, 1885) received a report of Meucci's invention from New York, and wrote: "The Meucci case is such as to appeal strongly to the sympathies of everybody. The Sun reported the origin of the invention, defined Meucci's instrument as a most excellent telephone, and recalled the efforts made by Meucci to interest the New York Telegraph Company in his invention.

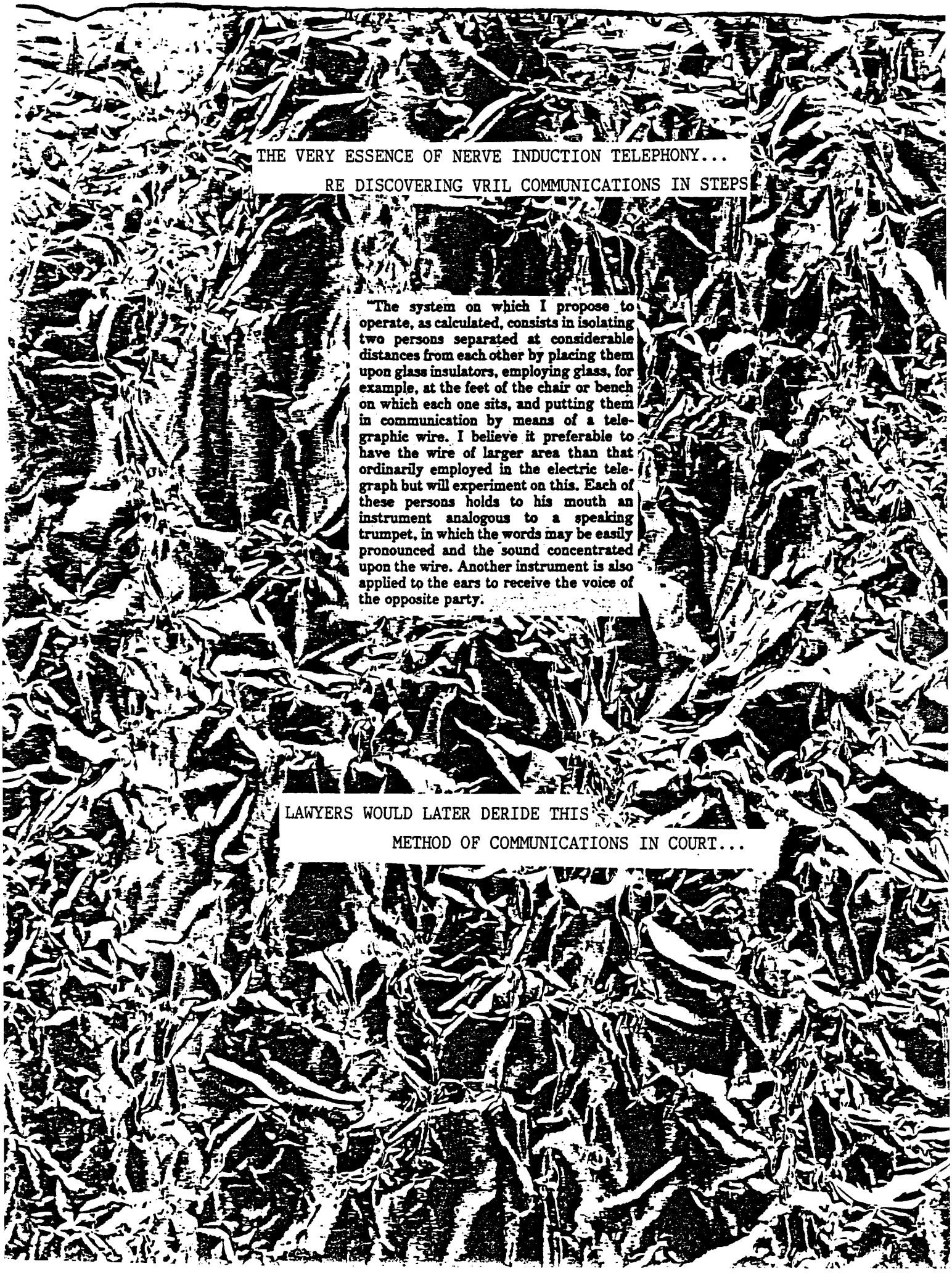
We have already published the affidavits that recall Meucci's attempts to interest the President of the New York District Telegraph Company, Mr. Grant, in his invention. The importance of these attempts which were fruitless for Meucci, is set forth later in a publication of the Chicago Tribune. On November 9, 1885, amply describing Meucci's invention, that newspaper said:

"After he had filed his caveat, he laid a copy of it before a man connected with a telegraph company in New York, with drawings and explanations, and this man promised to furnish means for making tests of the invention. The story goes on to say that this electrician kept putting Meucci off with various excuses for two years and finally, when Meucci demanded that the papers be given back to him, he was informed that they had been lost. The theory of the Globe people is that Meucci's plans were shown to Bell and that he appropriated the ideas."

As we have already said, if the personality and the discovery of Meucci were not known to the public at large, they were certainly known to the Bell Company. In fact, two years before the storm of lawsuits broke out, in 1883, the news that a syndicate was being formed at Philadelphia to buy Meucci's rights had already reached the ears of theBell Company, and it immediately sought to prevent it. Let the Chicago Evening Journal, which reported these events in a long article four years later (January 31, 1887), tell the story. And let us bear in mind that whatever the Journal says is based on recorded documents, accompanied by regular affidavits.

"The sworn statement of Mr. William W. Goodwin, of Philadelphia, deposes 'That on or about the 2nd day of August, a gentleman named Mr. E. B. Welch, an official of the Bell Telephone Company, 95 Milk Street, Boston, Mass., and President of the Mexican Bell Telephone Company, wrote a confidential letter to Antonio Meucci, who was at Staten Island, asking for a statement of the details of his invention and requesting an early answer.

'That it was Meucci who invented the telephone was corroborated by all the leading publications of the day. Yet Meucci died poor and robbed of the honor of his invention, while Graham Bell died 30 years later amidst glory and wealth.'


THE VERY ESSENCE OF NERVE INDUCTION TELEPHONY...
RE DISCOVERING VRIL COMMUNICATIONS IN STEPS
"The system on which I propose to operate, as calculated, consists in isolating two persons separated at considerable distances from each other by placing them upon glass insulators, employing glass, for example, at the feet of the chair or bench on which each one sits, and putting them in communication by means of a telegraphic wire. I believe it preferable to have the wire of larger area than that ordinarily employed in the electric telegraph but will experiment on this. Each of these persons holds to his mouth an instrument analogous to a speaking trumpet, in which the words may be easily pronounced and the sound concentrated upon the wire. Another instrument is also applied to the ears to receive the voice of the opposite party.
LAWYERS WOULD LATER DERIDE THIS
METHOD OF COMMUNICATIONS IN COURT...

TRIBUTE TO TWO EXTRAORDINARY ITALIANS:

SR.JOHN LA CORTE...

TIRELESS PIONEER OF THE MEUCCI BIOGRAPHY

TELEPHONE CENTENNIAL — noted where it began, on Staten Island. Contrary to what Ma Bell has told us, the real telephone centennial was celebrated in 1971 not 1976 (Meucci received his caveat in 1871; Bell's patent application came five years later). Prior to a centennial tribute to Meucci in December 1971 (the first annual Meucci Day) Staten Island Borough President Robert T. Connor (seated at left) discusses the event with LaCorte, Peter Galasso (also seated) and (standing l. to r.) Ralph Lamberto, Ferdinand Marchi and S.I. Chamber of Commerce President Adam Antonucci.

SR.ANTONIO MEUCCI

DISCOVERER OF NERVE INDUCTION TELEPHONY

WIRELESS (MARINE) TRANSCOMMUNICATIONS

SUBMARINE WIRELESS

MARINE RANGING THROUGH CONDUCTION

MARINE DETECTION THROUGH CONDUCTION