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PRINTING TELEGRAPH.

No. 267,366. Patented Nov. 14, 1882.

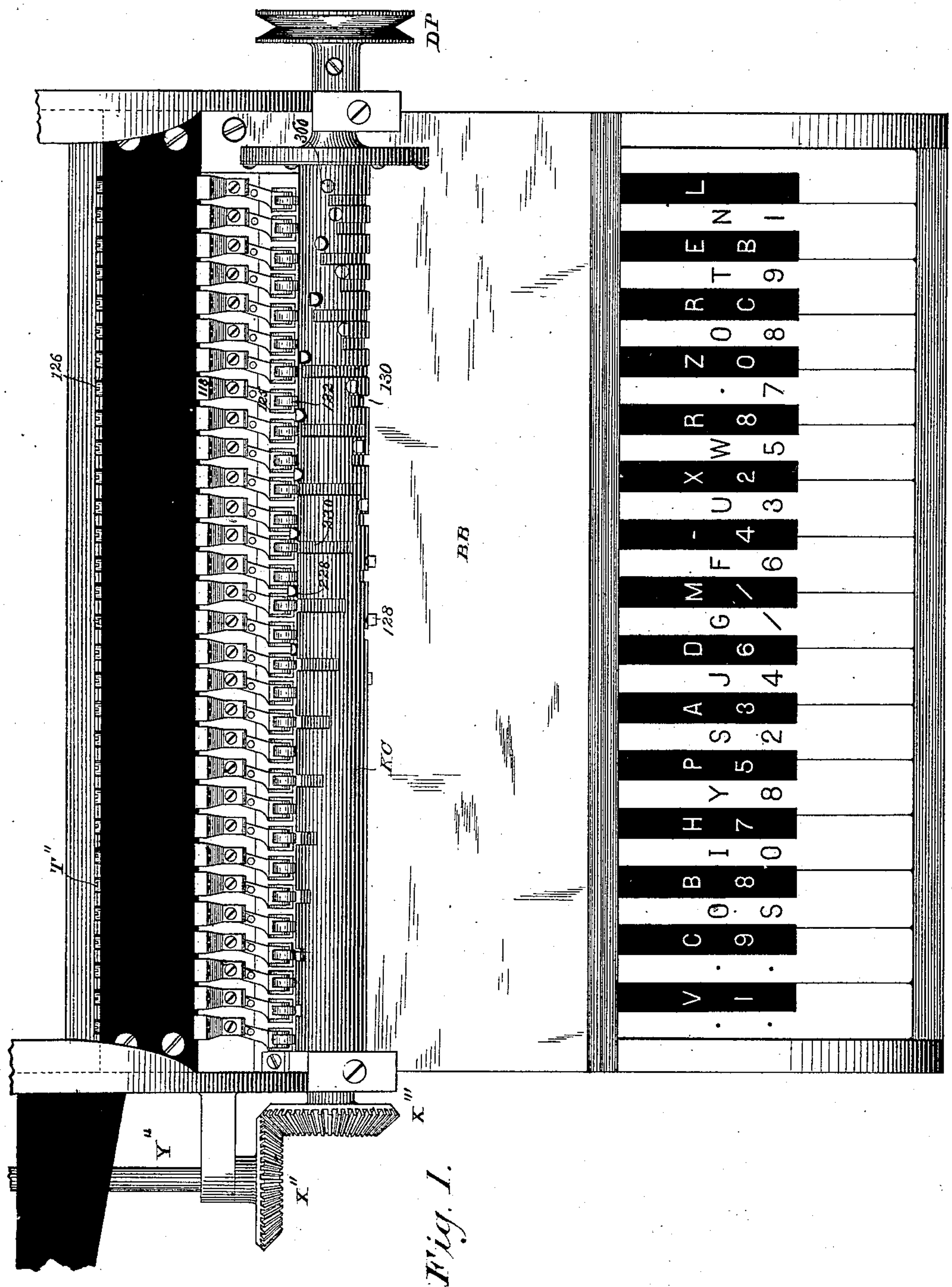

Fig. 1.

WITNESSES
Wm. A. Skinkle.
Geo. W. Breck.

INVENTOR
George M. Phelps.
By his Attorney
C. L. Buckingham

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Fig. 2.

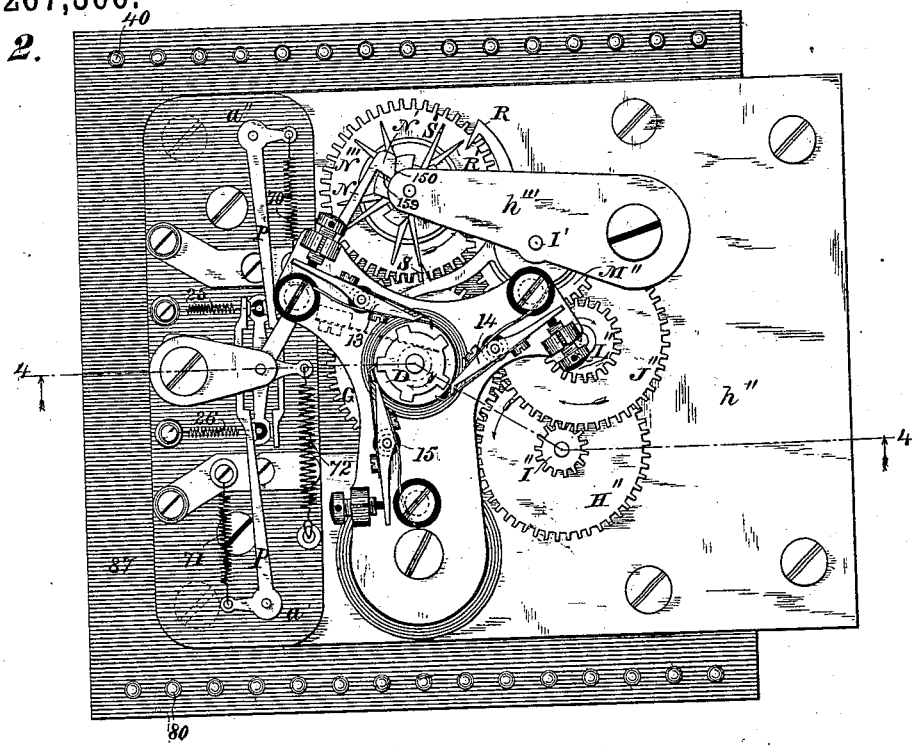
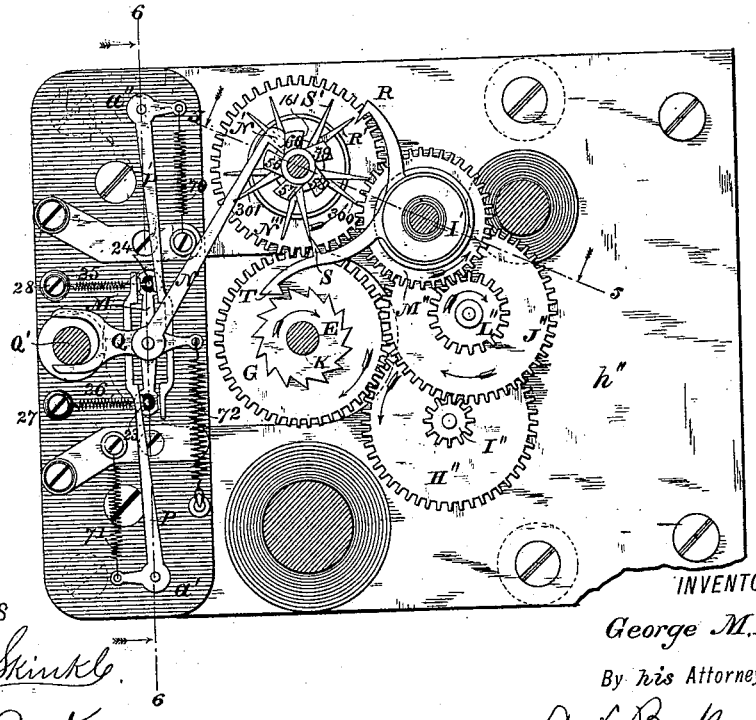


Fig. 3.



WITNESSES

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C. L. Burlingham

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Fig. 4.

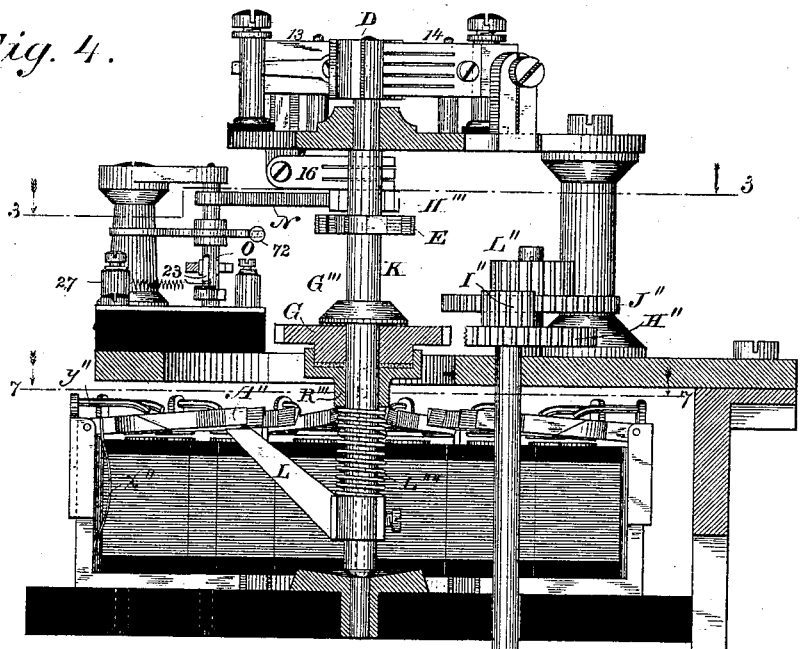


Fig. 5.

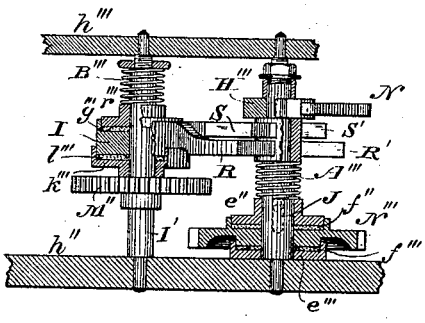
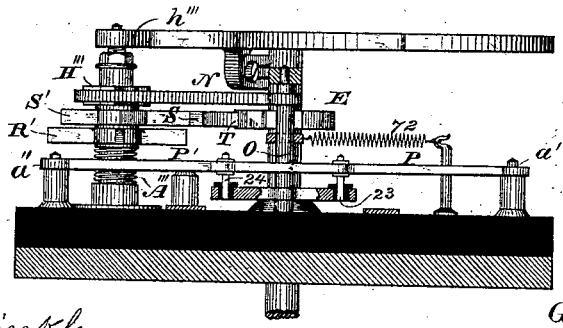


Fig. 6.



WITNESSES

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Fig. 7.

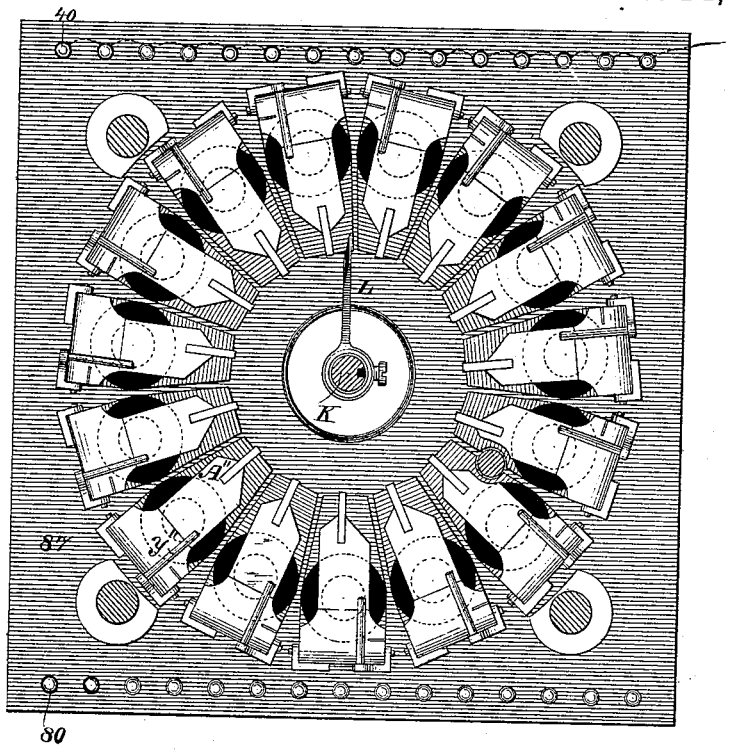


Fig. 9.

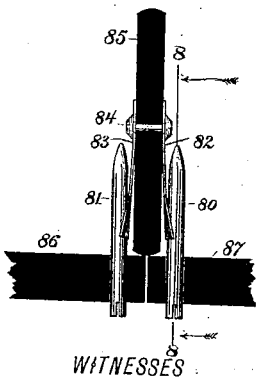
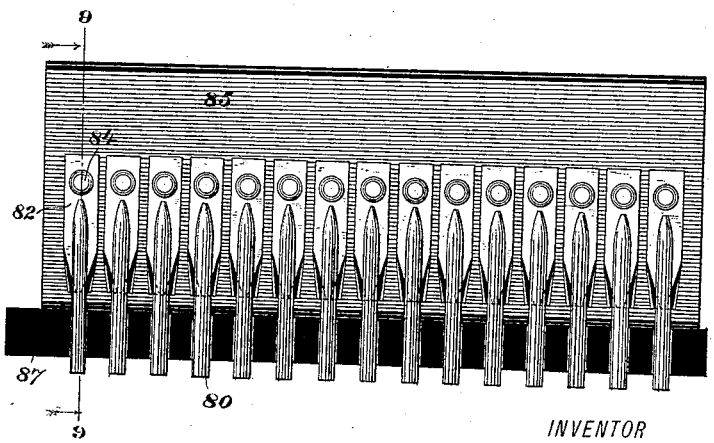


Fig. 8.



WITNESSES

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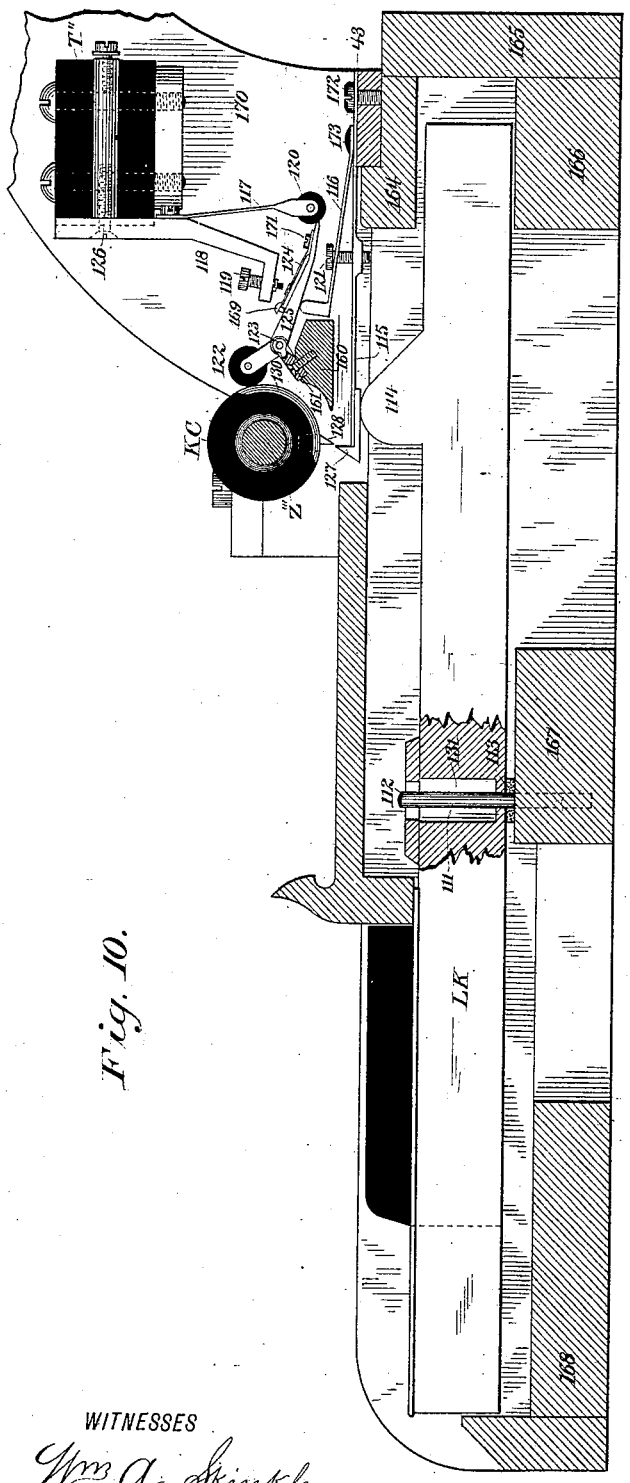

Fig. 10.

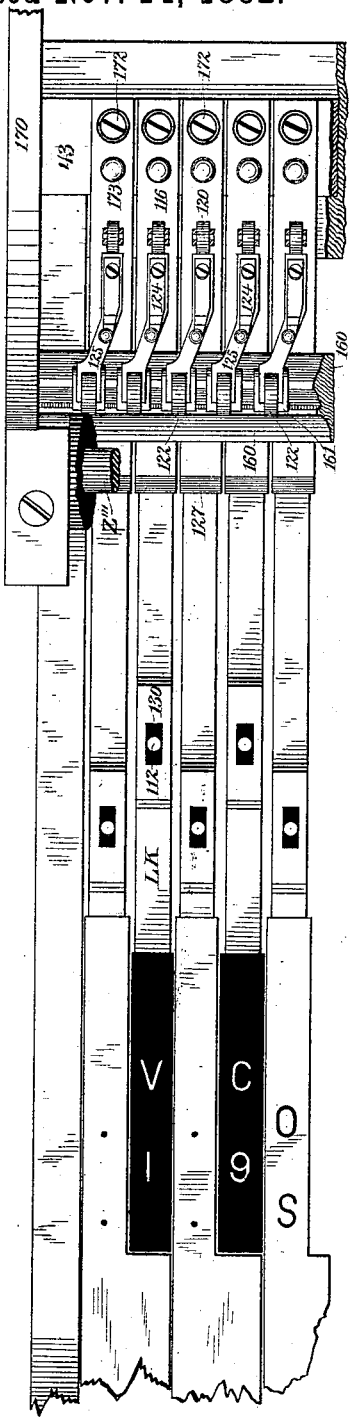

Fig. 11.

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Fig. 13.

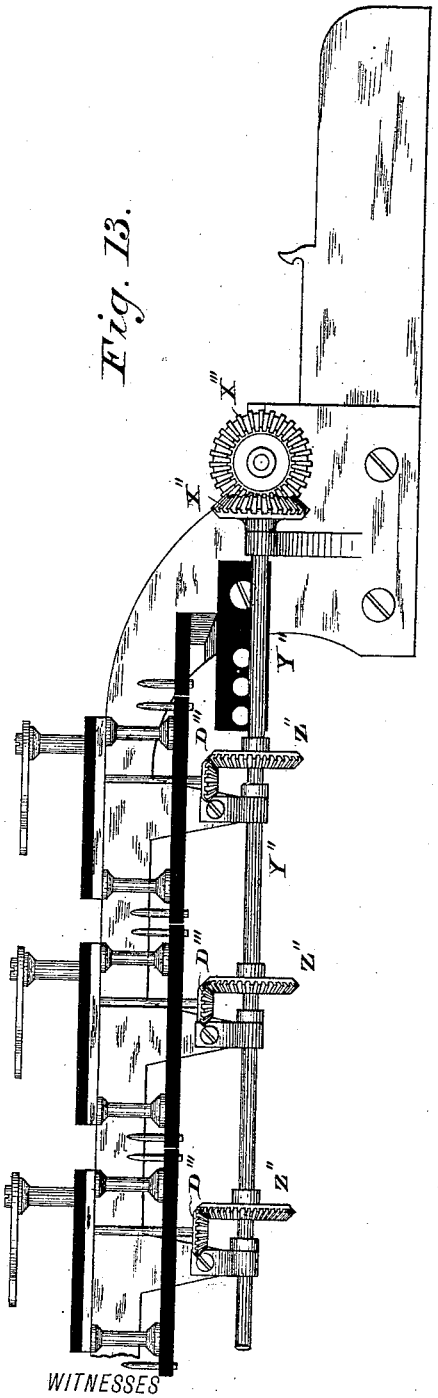
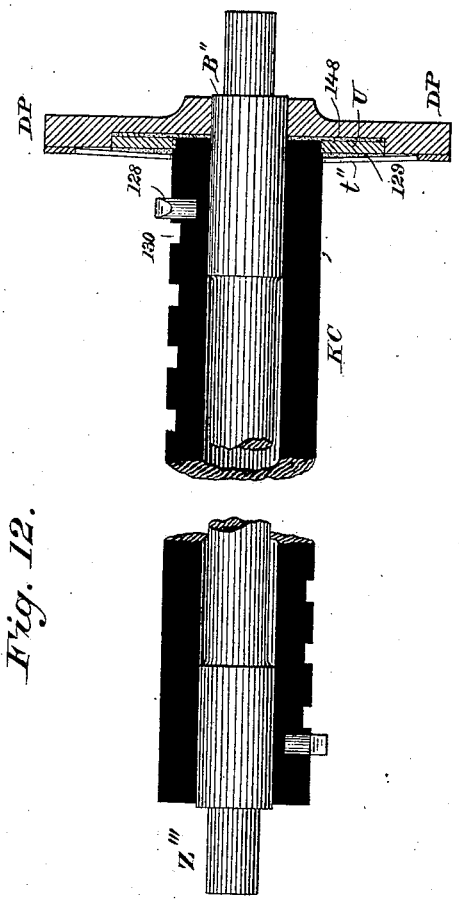


Fig. 12.



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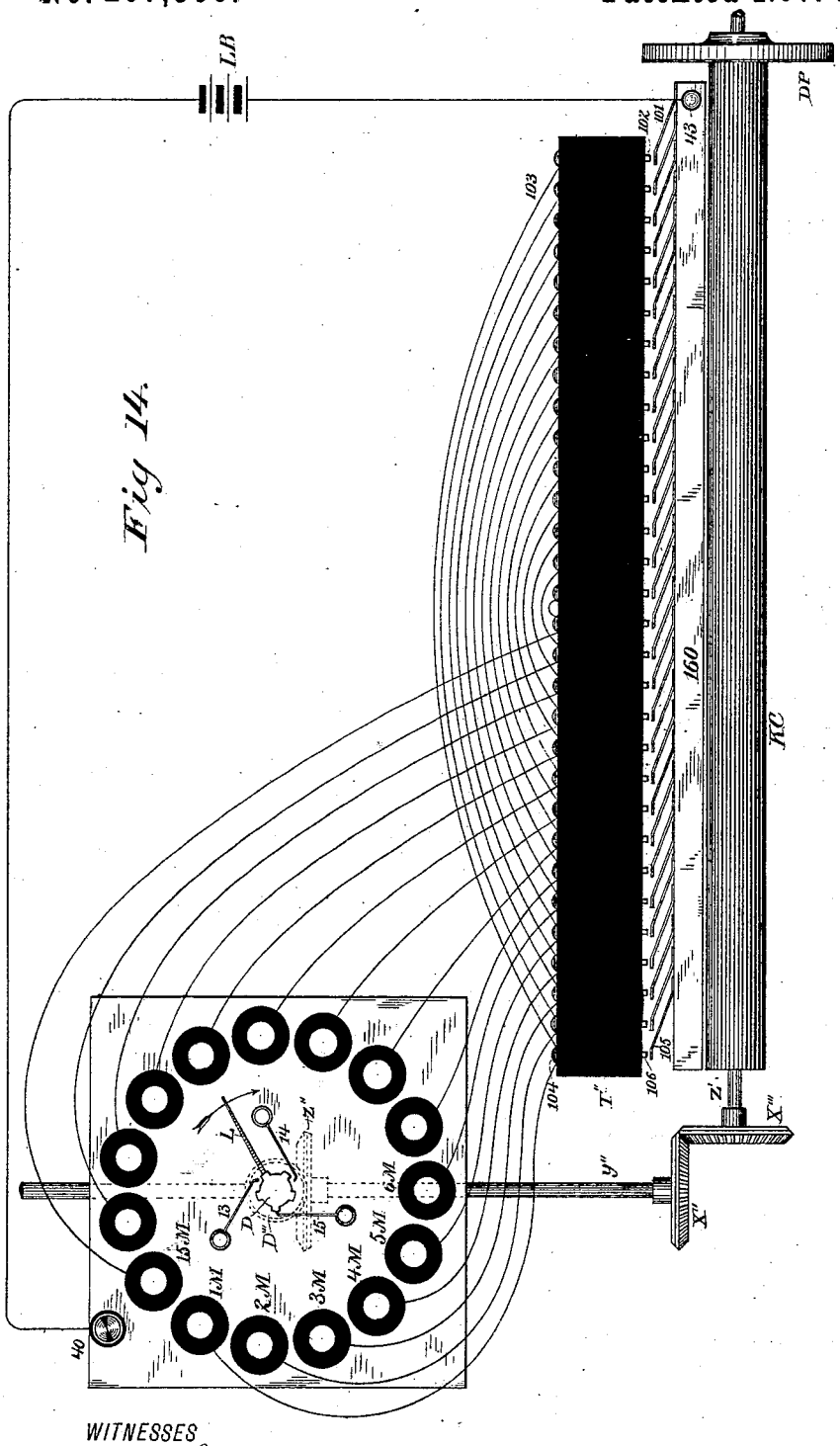

Fig 14.

WITNESSES

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Fig. 15.

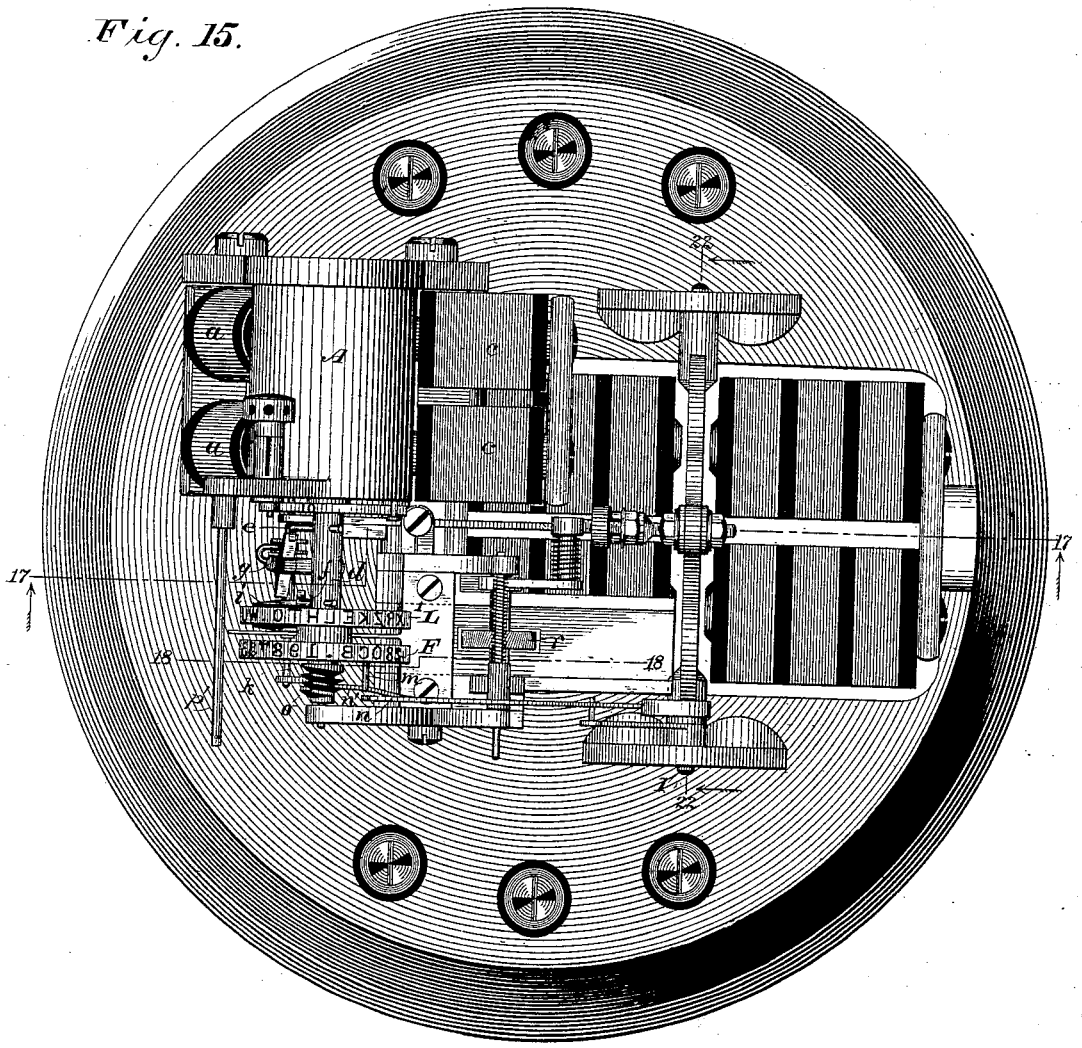
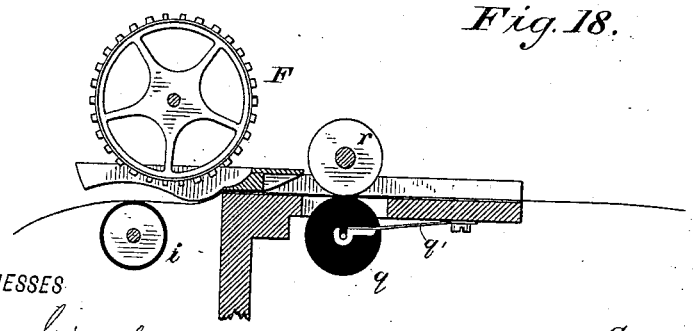


Fig. 18.



WITNESSES

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Fig. 16.

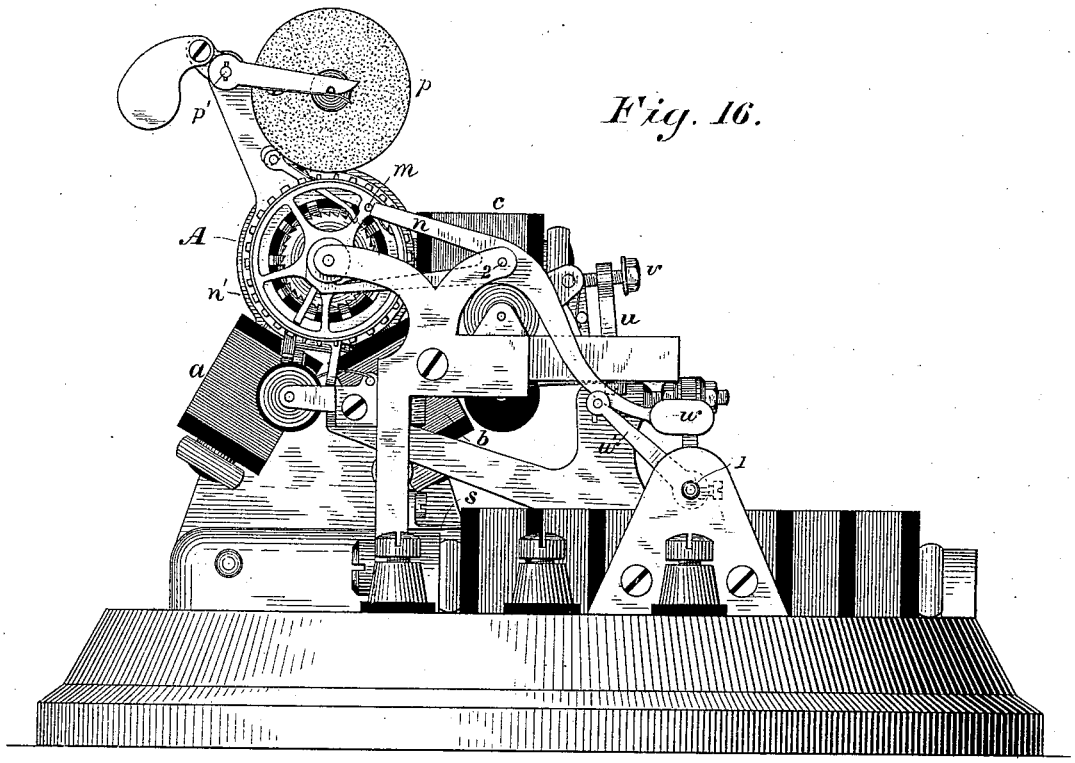

Fig. 17.

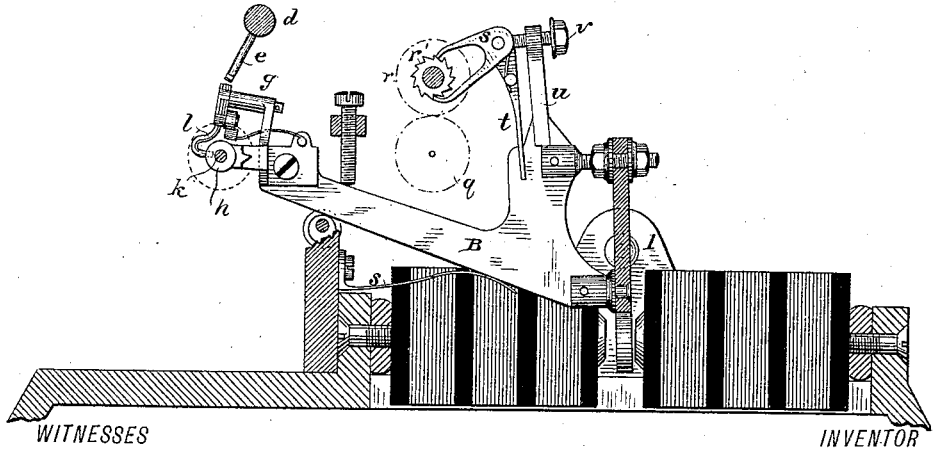

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Fig. 19.

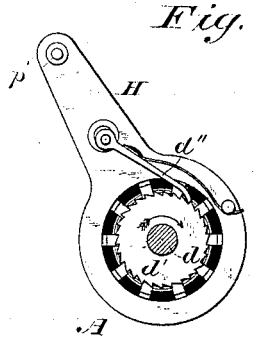


Fig. 20.

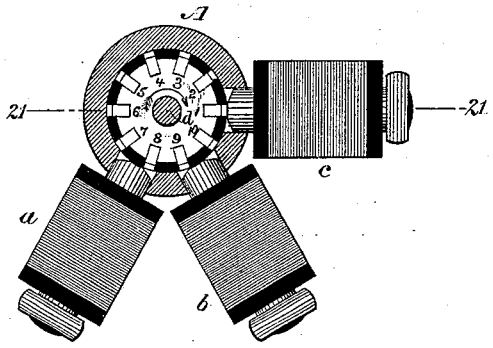


Fig. 22.

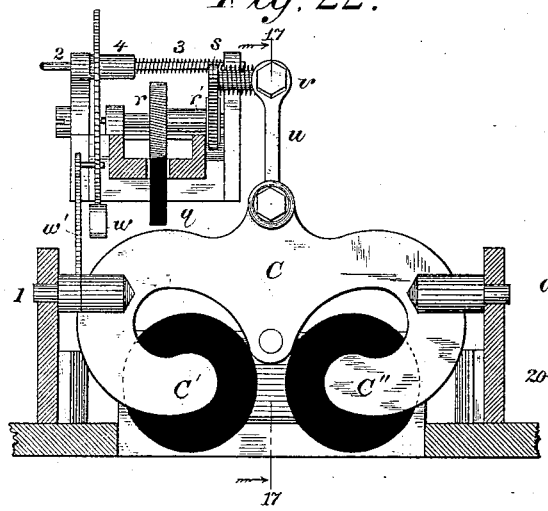


Fig. 21.

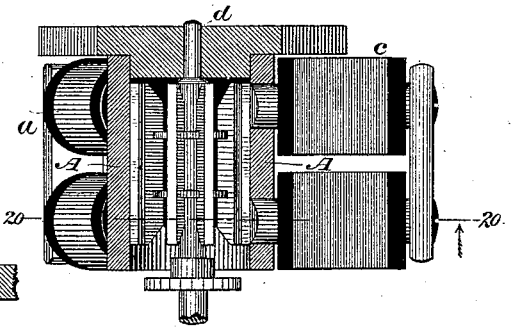
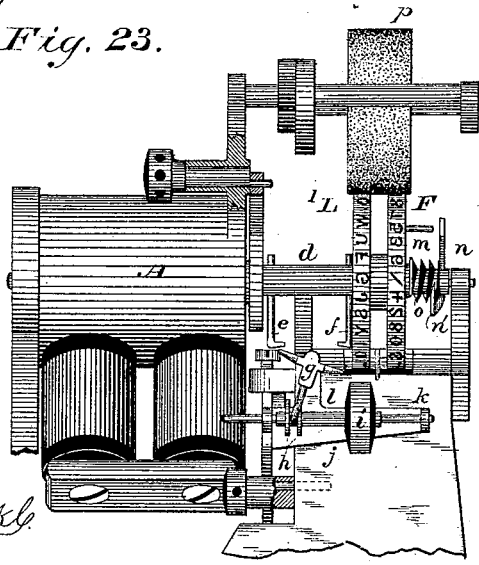


Fig. 23.



WITNESSES

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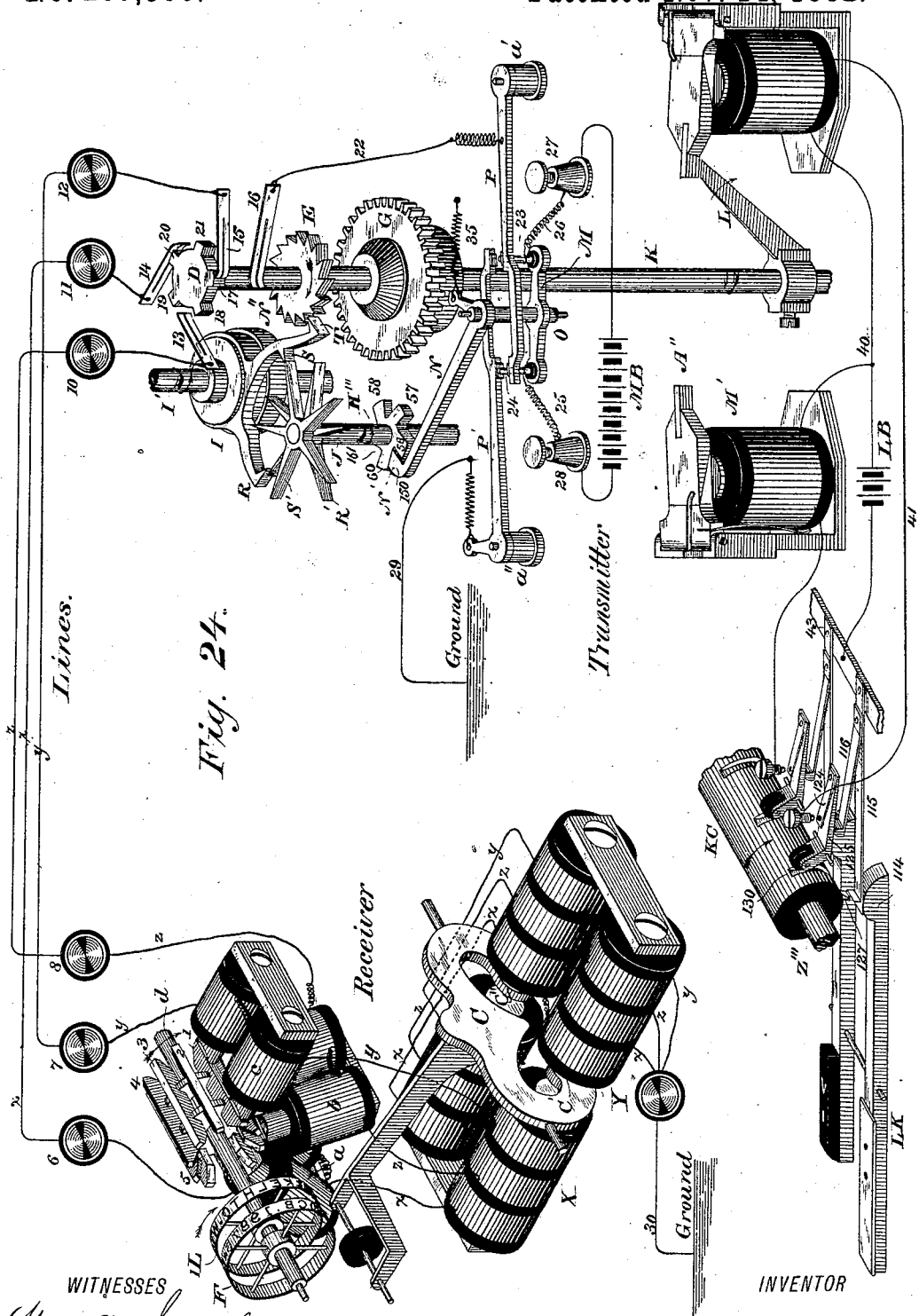

Fig. 24.

WITNESSES

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INVENTOR

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By his Attorney

C. L. Brickingham

UNITED STATES PATENT OFFICE.

GEORGE M. PHELPS, OF BROOKLYN, NEW YORK.

PRINTING-TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 267,366, dated November 14, 1882.

Application filed April 1, 1882. (No model.)

To all whom it may concern:

Be it known that I, GEORGE M. PHELPS, a citizen of the United States, and a resident of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Printing-Telegraphs, of which the following is a specification.

My invention has for its subject-matter a printing-telegraph system in which the type-wheels of the receiving-instrument are connected to and rotated by the revolving armature of an electro-magnetic motor. The armature of the motor is actuated by three stationary electro-magnets whose cores are in different radial planes, and whose respective coils form parts of three independent main lines through which the current of a main-line battery is successively directed. The three main lines—one at a time in regular succession—are connected to the main battery by means of a commutator or pulsator at the transmitting-station, which is geared with a rotating shaft whose movement is derived from any suitable motor, and which is arrested and permitted to start at the pleasure of the transmitting operator by means of a series of transmitting-keys.

The motor-armature of the receiving-instrument consists of a symmetrically-arranged series of magnetic bars, each of which in its proper turn is attracted by one of the stationary electro-magnets through the space represented by one character upon the type-wheels. The armature-bars and the stationary electro-magnets are so arranged with reference to relative numbers and position that when one of the electro-magnets has rotated the armature, and has drawn one of the bars of the armature to its cores, another of the bars, by the same movement of the armature, will be drawn toward another of the three motor electro-magnets, and will be separated therefrom by a space equal to only one-third of the space separating two contiguous bars of the armature. After an armature-bar has been drawn to the cores of one of the motor electro-magnets the main battery-current is removed from that one of the main lines passing through such electro-magnet, and is diverted to a second line, and the motor electro-magnet in the second main line in turn draws an armature-bar through a second space equal to one-third of the distance between two of the armature-bars. When the armature-bar last attracted is drawn opposite the cores of the second electro-magnet the main-line battery is diverted from the second line to the third line, which magnetizes the third electro-magnet and attracts another of the armature-bars through a third space equal to one-third of the distance between two contiguous armature-bars. Thus, upon successively closing the main-line battery through the three main lines the three electro-magnets of the motor successively attract different bars of the armature, and the type-wheel is rotated step by step a space represented by three characters thereon; and to give the type-wheel a complete rotation the battery must be closed through each of the three main lines as many times as there are bars upon the rotating armature; and thus the product of the stationary electro-magnets and the bars upon the rotating armature must equal the number of characters or spaces therefor upon each of the type-wheels. Since a telegraph-line requires a definite time for discharging before it can be recharged, without running succeeding pulsations into one another to form a continuous current, the number of pulsations that may be passed over a line is limited. However, with a three-line motor this difficulty is largely overcome, as while one motor-magnet is discharging the armature is given two succeeding steps of rotation, thus enabling a type-wheel to be driven nearly three times faster than when only one line is used.

While the movement of the type-wheel for the purpose of bringing any desired character to position for printing is effected wholly by short electrical impulses of one polarity, printing is effected by reversing the main-line battery-current upon any one of the three main lines. The press-lever is operated by a polarized electro-magnet having coils thereon in multiple arc, and forming parts, respectively, of the three main lines. The polarized electro-magnet may therefore be operated to print at each step of rotation of the armature, as the main battery-current will then be flowing through some one of the three divisions of the printing electro-magnet. At the transmitting-station the three main lines are connected, one

at a time, through a pulsator, to a single conductor, which is connected to earth. In this single conductor is situated a pole-changing apparatus and a main-line battery, whereby the main-line battery is reversed and again reversed to its normal polarity, and all while the transmitting-key is depressed and before being released. During the entire period that any one of the transmitting-keys is depressed the pulsator will be arrested and the main battery will be continued in connection with one line. Thus the type-wheel will remain locked by virtue of the electro-magnetic attraction between one of the stationary magnets of the motor and one of the bars of the rotating armature of the receiving-instrument.

The means here employed for bringing the type-wheels of a series of receiving-instruments to unison for effecting printing upon either of the two type-wheels at the pleasure of the transmitting operator, and for feeding the paper step by step, are all well known. For effecting unison the free end of an arm rests between spiral threads upon the type-wheel shaft. The type-wheel is provided with a stop-pin, and upon a continued rotation of the type-wheel the free end of the bar resting between the spiral threads will be carried to a position to intercept a further movement of the stop upon the type-wheel. Upon reversing the main-line current the press-lever is actuated, which in turn releases the unison device. For effecting printing upon either of the two type-wheels the type-wheel shaft is provided with two radial pins situated in different radial planes. The press-lever carries a small pivoted T-lever, which is connected with the transversely-movable printing-pad. In one position of the type-wheel shaft, if the press-lever is raised, one arm of the T-lever will be depressed by coming in contact with one of the radial pins upon the type-wheel shaft, and the printing-pad will be thrown laterally from a position to print from one type-wheel into a position to print from the other type-wheel. By a further movement of the type-wheel shaft, and by raising the press-lever a second time, the other arm of the T-lever will be depressed and the press-pad will be shifted to its first position. The paper ribbon upon which the message is printed is drawn the space of one letter at each backward movement of the press-lever by means of a pawl and the ratchet-wheel, which is connected with a driving-roller. Each of the main lines at the transmitting-station terminates in a spring whose free end is in the path of the conducting projections of the rotating pulsator or commutator, which is connected with the main-line battery. The pulsator-contacts and the terminal springs of the main line are relatively so situated that upon the movement of the pulsator through a space equal to that separating the center of two contact projections connection will be made successively between all of the different contacts of the pulsator and all of the main-line terminals, and upon a complete rotation of the pulsator as many pulsations will be sent over each of the main lines as there are arms upon the pulsator.

The main-line pulsator and the key-cylinder of the transmitter are both frictionally geared with a constantly-moving motor. Upon depressing any transmitting-key, not only is the key-cylinder arrested, but the main-line pulsator is also stopped. By arresting the key-cylinder a local circuit is closed, and this local circuit energizes one of a series of electro-magnetic stops, which arrests an arm rigidly fixed upon the shaft of the pulsator. The movement of the driving-motor, however, is not arrested upon depressing a key to effect printing, but is continuous; and upon releasing a transmitting-key which has been depressed the motor instantly imparts its motion to the key-cylinder, which in turn serves to break the local circuit of the electro-magnetic stop, whereupon the shaft of the pulsator is free to move, and motion from the constantly-moving motor is instantly imparted thereto. The shaft of the main-line commutator, being provided with a radial stop-arm, is surrounded by a series of electro-magnets circularly arranged, having armatures, any one of which may be attracted upon arresting the key-cylinder to a position within the path of the rotating arm, and to thereby arrest the pulsator. Each of this series of electro-magnets is in a branch circuit joining the poles of a local battery, and each of these branches of the local battery is closed by either of two of the transmitting-keys. Thus at the transmitter there are half as many stop-magnets, and there are also half as many branches connecting one pole of the local battery and the key-board as there are keys thereon. By depressing a transmitting-key the key-cylinder will be arrested in a certain position, the poles of the local battery will be closed through that local branch and its stop-magnet corresponding with the key depressed, the main-line pulsator will be arrested in a position corresponding with the arrested position of the key-cylinder, and the character represented by the key depressed will be printed upon the receiving-instrument, since upon arresting the main-line pulsator the main-line battery is thereby reversed. As each branch of the local battery may be closed through either of two transmitting-keys, though not simultaneously, the main-line pulsator must be geared to make two rotations during one rotation of the key-cylinder. Thus as many pulsations may be sent over the main line at each rotation of the key-cylinder as there are transmitting-keys. It is by this means that only half as many electro-magnetic stops need be employed for arresting the main-line pulsator as would otherwise be necessary to enable the pulsator to be arrested at any required position.

The pole-changer for effecting printing serves to reverse and re-reverse the main-line battery

automatically upon the mere depression of a transmitting-key, and the double reversal should be effected as slowly as possible to insure a perfect operation of the polarized printing-magnet. To this end I have devised what I term an "unequal-step escapement," consisting of a releasing-pallet which controls a step-by-step rotation of a shaft in such manner that the alternate step movements shall be relatively long and short. The pole-changer reverses and re-reverses the battery wholly during the long step movements of the shaft and after the pallet-yoke has vibrated in one direction, while it is not operated during the short steps of rotation and upon the return vibration of the pallet-yoke.

My invention further embraces a novel construction of a key-cylinder and local-circuit connections which are opened and closed thereby, whereby contacts therein are made and broken independently of the mechanical contact between a key and a stop for arresting the key-cylinder.

In the accompanying drawings, Figure 1 is a plan view of the key-board portion of the transmitting apparatus. Fig. 2 is a plan view of the main-line pulsator and pole-changer portion of the transmitter. Fig. 3 is a similar view of the same portion of the transmitter, with some of the upper parts removed to more fully disclose underlying parts, and particularly the apparatus in section represented by line 3 3 of Fig. 4. Fig. 4 is a vertical transverse section of apparatus on the line 4 4 of Fig. 2. Fig. 5 is a vertical transverse section represented by line 5 5 of Fig. 3. Fig. 6 is a view of a vertical transverse section on line 6 6, Fig. 3. Fig. 7 is a horizontal section on the line 7 7 of Fig. 4. Fig. 8 is a side elevation of a circuit-closing comb. Fig. 9 is a transverse section of the same on line 9 9 of Fig. 8. Fig. 10 is a longitudinal section on an enlarged scale through the key-board of the transmitter. Fig. 11 is a plan view, on the same scale, of like parts. Fig. 12 is a longitudinal central section of the key-cylinder of the transmitter. Fig. 13 is a side elevation, showing means for gearing the key-cylinder of one transmitter with a series of main-line pulsators and respective pole-changers. Fig. 14 is a diagram representing the key-cylinder, the local battery, a series of local branches joining the poles of said battery, and a series of electro-magnetic stops for arresting the movement of the rotating pulsator. Fig. 15 is a plan view of the receiving-instrument. Fig. 16 is a side elevation of the same. Fig. 17 is a detail view, partly in elevation and partly in section on line 17 17 of Figs. 15 and 22. Fig. 18 is a detail section on the line 18 18 of Fig. 15. Fig. 19 is an elevation of the ends of the armature-cylinder. Fig. 20 represents a section through the armature-cylinder on line 20 20 of Fig. 21. Fig. 21 represents a horizontal section of the armature-cylinder on line 21 21, Fig. 20. Fig. 22 represents a transverse section of the receiving apparatus on line 22 22 of Fig. 15. Fig. 23 is an elevation of the electromotor and details of the receiving-instrument. Fig. 24 is a diagrammatic view of the entire system, showing the receiving-instrument, the main-line pulsator and pole-changer, electro-magnetic stops for arresting the pulsator, and the key-cylinder and circuit connections whereby the armatures of the electro-magnetic stops may be brought into position to arrest the movement of the main-line pulsator.

My transmitting apparatus is adapted to close a main-line battery through any one of three main lines to a distant station or stations at which receiving-instruments for recording stock-quotations are located. The transmitter also serves to reverse the main-line battery upon that one of the main lines through which the battery may happen to be connected at any instant when it is desired to print a character. The transmitting apparatus for accomplishing these results consists of several parts, conveniently shown in Fig. 24, to wit: a main-line pulsator, D, rigidly fixed to its shaft K, which is also provided with a rigid radial arm, L, which may be arrested by an armature-stop, A″, of any one of a circularly-arranged series of electro-magnets, 1^{M} 2^{M}. The shaft K is driven by a spur-wheel, G, connected to said shaft by a friction-collar. The shaft Z‴ is driven by a constant and uniform force derived from any suitable motor, and said shaft Z‴ is positively geared through a suitable train of spur-wheels with the frictionally-mounted wheel G. Upon the constantly-rotating shaft Z‴ is also frictionally mounted the hollow gutta-percha key-cylinder K C.

L B is a local battery, having one of its poles connected with a transverse bar or plate, 43, while the opposite pole of the battery is divided into a series of fifteen branches, in each of which is placed one of the electro-magnets 1^{M} 2^{M}. The extremities of the local branches are connected to a series of conducting-contacts at the back of the key-cylinder, and upon depressing any one of the transmitting-keys connection between the two opposite poles of the local battery is made. The depression, therefore, of any one of the transmitting-keys serves to arrest the main-line pulsator D by closing a branch of the local battery corresponding to the key depressed, thereby causing the stop A″ of its electro-magnet to intercept the arm L of shaft K in such a position that before being arrested the pulsator will have sent the required number of pulsations to line to rotate the type-wheel into position for printing the character represented by the key depressed. At the same time, upon arresting the pulsator, as will be more fully hereinafter described, the pole-changer is automatically and mechanically actuated to first reverse the main-line battery and to then again reverse it to its original polarity before the release of the depressed key.

The pole-changer for reversing the main-line battery is automatic, and its operation is dependent wholly upon arresting the pulsator-shaft. The devices employed consist, first, of pallet-yoke I, frictionally pivoted upon a constantly-rotating shaft, I′, having pallets R and S, and a projecting arm, T, whose end is prevented from entering between the cam-teeth of ratchet-wheel E by its rapid rotation. Shaft I′ is positively geared with the constantly-moving motor employed to drive the shaft of the key-cylinder. The shaft I′ rotates constantly in a direction tending to carry the end of arm T between the cam-teeth of wheel E. Therefore when the pulsator and the wheel E, which is rigidly connected therewith, are arrested the end of arm T will fall between two teeth of wheel E, whereupon an escapement-arm of a series, S′, will be released from the pallet S and a second arm of a series, R′, will be arrested by the pallet R; and as the pallet-yoke I is frictionally mounted upon the constantly-rotating shaft I′, the end of arm T, upon the release of an escapement-arm, S′, from S, will not only be suddenly carried between the teeth of E, but it will be firmly held between two of the teeth during the entire time that the pulsator is arrested.

S′ and R′ represent two series of escapement-arms in different horizontal planes, respectively, and rigidly mounted upon the shaft J, which is rotated upon a release and movement of the escapement through the agency of a spur-wheel frictionally connected with said shaft, and which is positively geared with the constantly-revolving motor employed to drive the pulsator. Upon shaft J is also rigidly fixed a notched disk, within the notches of which the arm N′ of lever N may rest. Escapement-teeth S′ rotate in the plane of pallet S and above the plane of pallet R, which is in the plane of the series of escapement-teeth of R′, and, as is best shown in Figs. 2 and 3, teeth S′ in the direction of rotation are slightly in advance of teeth R′, and they are so arranged in respect to pallets R and S that if a tooth S′ is retained by S a tooth R′ will be a very little beyond pallet R. Upon a release of S′ from S a succeeding tooth, 301, of S′ will revolve so far as to come nearly in contact with S; but before the succeeding tooth, 301, of S′ arrives at S a tooth, 300, of R′ is arrested by R. Upon releasing S′, therefore, the escapement moves the distance that tooth 300 is from R before S′ is released, or a space nearly equal to that between adjoining teeth of the escapement. Upon a release of tooth 300 from R it will move only a very slight distance before 301 will be arrested by S. Such distance is shown by the space between the tooth R′ just in advance of R when S′ is retained by S. Thus, when pallet S releases a tooth S′ the escapement moves a long step; when R releases a tooth R′ the escapement moves only a very short step. While pallet S is retaining one of arms S′ a flat end, 150, of arm N′ rests upon the flat surface of the tooth 60 of notched disk H‴. However, upon arresting the pulsator, and thereby permitting the escape of an arm S′ from the pallet S, shaft J will be actuated by pinion N‴, which is frictionally mounted on said shaft, and the flat surface of 60 will slide past the end 150 of arm N′, and said arm will then fall between notches 59 and 60, when the surface 159 of N′ will rest immediately in contact with the surface 161 of tooth 60. Arm N is thus vibrated in one direction as cam-tooth 60 slides past its end N′, and is vibrated in an opposite direction after tooth 60 has passed the end of N′ and when the surface of 159 falls in contact with the surface 161. Arm N is rigidly fixed upon a rock-shaft, O, and is provided with an arm and spring, 35. Rock-shaft O is also rigidly connected with an arm, M, which is provided with insulated pins 23 and 24 at each extremity.

P and P′ are levers, pivoted respectively at a' and a''. Arm P′ is connected by wire 29 to earth, while arm P is connected by wire 22 through the pulsator D, and to any of the three lines, according to the position of the pulsator. When arm S′ is held by pallet S the insulated pin 23 is in contact with arm P and insulated pin 24 is in contact with arm P′, in which case the circuit is made from the distant station, through the pulsator, to contact 16, wire 22, arm P, pin 23, conductor 26, binding-post 27, battery M B, binding-post 28, wire 25, insulating-pin 24, lever P′, and wire 29, to earth. Upon the release of arm S′ from its pallet S, lever N, being given a to-and-fro movement, first moves insulating-pin 23 into contact with lever P′ and pin 24 into contact with lever P, thus reversing the battery upon the line. Upon the return or backward movement, however, of lever N, insulated pin 23 is returned to its contact with lever P and pin 24 to contact with lever P′. Thus for the instant that lever N is given its to-and-fro movement by the movement of tooth 60 the battery is twice reversed. During the entire time that the transmitting-key is depressed the surface 150 of arm N′ will rest in close contact with the surface 161 of tooth 60, owing to the fact that a tooth R′ is retained by its pallet R. However, upon releasing the transmitting-key the main-line pulsator will resume its rotation, tooth T will be raised from between the cam-teeth of wheel E, and escapement-tooth R′ will be released from pallet R. The tooth R′, however, will rotate only for a very short distance, owing to the fact that a second tooth S′ will be almost instantly arrested by its pallet S. The short rotation of shaft J, however, only serves to cause a slight separation between the surfaces 150 and 161, as is more clearly shown in Fig. 3, and does not serve to operate the pole-changer.

The main-line pulsator or commutator D, means for rotating and arresting the same, the pole-changing apparatus, and the unequal-step escapement are shown in detail in Figs. 2, 3, 4, 5, 6, and 7.

In Fig. 4, Z″ is a bevel spur-wheel, rigidly

mounted upon the key-cylinder shaft Z‴, meshing with bevel-wheel D‴ upon the vertical shaft D″, to which is rigidly fixed spur-wheel H″ and I″. Spur-wheel H″ meshes with spur-wheel G, which is frictionally mounted upon shaft K between the rigid flange G‴ and sliding collar R‴, and the collar R‴ is fixed upon shaft K by means of a pin passing through a longitudinal slot of the shaft. Sleeve R‴ therefore revolves with the shaft R, but is capable of longitudinal movement thereon against the tension of spiral spring L‴. The disk-surfaces of G are separated from flange G‴ and collar R‴ by a felt or billiard-cloth washer, for affording proper frictional contact. Spur-wheel G therefore is subject to constant rotation, and it in turn imparts constant rotation to spur-wheel N‴, which is also frictionally mounted upon its shaft J by means of collar *e*″, frictional surfaces *f*″ *f*‴, and spiral spring A‴, in the same manner that wheel G is mounted upon its shaft K, as is best shown in Fig. 5. The pallet-yoke I is supported upon the friction-washer *l*‴ and the rotating flange *k*‴, against which it is pressed by the downward action of the spring B‴ acting against the flange *r*‴. The notched disk H‴ and escapement-teeth S′ and R′ are all rigidly fixed upon shaft J, and the shafts I′ and J are both journaled in the horizontal plates *h*″ and *h*‴.

Figs. 4, 7, and 14 show a series of fifteen electro-magnets, 1^M to 15^M, circularly arranged around shaft K. Each electro-magnet is provided with an armature, A″, which is normally held slightly elevated from its pole against stop *y*″ by a spring, *x*″. Thus when no current is passing through an electro-magnet the end of its armature-lever A″ is retained slightly above the end of the arm L. Upon passing a current of electricity through any one of these electro-magnets its armature-lever is drawn to its core and into the path of the end of arm L, thereby arresting shaft K. Thus the shaft K may be arrested at every fifteenth of its revolution.

The main-line pulsator D consists of a metallic disk having five metallic notches symmetrically arranged upon its periphery, or with their centers seventy-two degrees apart. The three main lines terminate respectively in commutator-springs 13, 14, and 15, so arranged in respect to the projections upon the pulsator that when spring 15 is resting upon projection 17 the pulsator may, upon a further rotation of a distance equal to one-third of the distance between two projections, or eighteen degrees, bring its projection 20 in contact with spring 14, and upon a further rotation to the same extent projection 18 will come in contact with spring 13, and upon a still further equal movement spring 15 will be in contact with projection 21. Thus as the commutator D rotates connection is established from the main battery, first through line *z*, then through line *y*, the circuit through *z* being broken, then through *x*, the circuit through *y* being broken, and again through *z*, the circuit through *x* being broken, and so on.

To secure an electrical contact independent of a rebounding impact due to interposing a stop in the path of a pin fixed in the rotating key-cylinder, I have devised apparatus whereby, upon the depression of a key, the key raises an independent circuit-closing lever to close one of the local branches, while at the same time the key interposes a stop in the path of a cylinder-pin to arrest the cylinder. One end of the circuit-closing lever cannot make contact until its opposite end has fallen into a peripheral cavity. However, the arrangement is such that the end of the circuit-closing lever drops into the peripheral cavity before the pin in the periphery of the cylinder arrives at the stop interposed by depressing the key. A depression of the transmitting-key therefore first imparts a force to the circuit-closing lever without causing it to make contact, which contact will only be possible after the key-cylinder has rotated to a predetermined position. After such a position is reached the circuit-closing lever will operate to make contact, and such contact will have continued for a short period before the key-cylinder will have rotated to a position where it will be arrested. By this means contact through the local branch to its stop-magnet will be made somewhat in advance of the arrival of arm L at its position to be arrested, and a local branch will be closed beyond all danger of being momentarily broken by a rebounding of contacts upon suddenly stopping the key-cylinder. As the circuit-closing lever cannot yield until the cylinder is in proper position, instead of causing the key upon its depression to impinge immediately upon the circuit-closing lever, I interpose between said lever and the key a spring, whereby the key may be depressed without perceptible resistance whatever may be the position of the cylinder, and whereby, when a cavity in the cylinder has arrived opposite the lever, the spring will cause contact to be made without further movement of the key.

Figs. 1, 10, 11, 12, and 14 show a key-board arrangement and local connections for establishing a circuit through the local battery L B and any one of the series of electro-magnets 1^M 2^M.

In Fig. 12, Z‴ represents the constantly-rotating transmitter-shaft, upon which is frictionally mounted the hollow key-cylinder K C, constructed of any suitable insulating material. D P is a driving-pulley, and U is a friction-collar rigidly fixed upon cylinder K C. 148 and 129 respectively represent felt or billiard-cloth packings for giving a frictional connection between D P and U. *t*″ is a series of springs extending from the periphery of D P and pressing packing 129 against collar U.

The key-cylinder is provided with two series of fifteen cavities each. Each cavity—130 of one series and 230 of the other series—extends circumferentially a short distance around the pe-

riphery of the cylinder; and each series of cavities is arranged spirally along its length, and in close proximity to each cavity are placed metallic stops—128 of one series and 228 of the other—by means of which the cylinder may be arrested. The two spiral series of stops and cavities begin at one point at one end of the cylinder and diverge toward the opposite end, where they meet at a point diametrically opposite upon the cylinder. Thus one series of cavities and respective stops are upon a separate semi-cylindrical surface, while the second series are upon the opposite half.

In Fig. 10, 164, 165, 166, 167, and 168 represent the key-board frame, upon which is attached a transverse metallic bar, 43, to which are fixed a series of devices supplemental to each key. Upon depressing key L K, which rests upon and is pivoted over a felt support, 113, and is maintained in position by means of a pin, 112, which passes through an opening in the key 113, projecting portion of the key 114 raises the spring 115, thereby bringing pin 127 into the path of stop 128. Simultaneously as the key-cylinder is arrested the end of spring 116 causes arm 125, which is pivoted at 123, to close an electrical contact between set-screw 119 and spring 124. When arm 125 is thus raised spring 117 will be forced somewhat to the right, and arm 125 will rest above the line joining the pivot of 125 and center of roller 120, and at the same time roller 122 will rest within the peripheral cavity 130 of the key-roller. It is also to be observed that an electrical connection between the spring 124 and the set-screw 119 cannot be effected until the key-cylinder has rotated to such a position as to permit roller 122 to fall within the corresponding cavity upon K C. It is to be seen, however, from Figs. 10 and 24 that the roller 122 will enter the cavity 130 for a considerable time before the lug 128 will arrive at a position to be arrested by stop 127. Spring 116 is employed for the purpose of enabling key L K to be depressed in whatever position the cavity 130 may be in respect to 122. If the key be depressed before the cavity arrives opposite 122, the arm 125 cannot be raised; but owing to spring 116 the depression of the key will not meet any considerable resistance. In fact, only that of the tension of the spring 116 will be encountered, and the spring will, after depression of the key, in turn exert a sufficient pressure upon arm 125 to raise it past the center of roller 120, and to force roller 122 within the cavity of K C when brought opposite thereto. The spring-connections are so arranged that electrical contact between screw 119 and spring 124 cannot be broken unless the pin 128 is permitted to wholly escape from stop 127. A mere vibrating movement of the transmitting-key, which is insufficient to permit an escape or further movement of the cylinder, will not suffice to cause contact to be broken, owing to the agency of the leaf-spring 117 and roller 120. The electrical contact is entirely independent of any movement of the transmitting-key which will not cause the cylinder to be moved. It is a movement of the cylinder which causes contact to be broken, and not the direct movement of the key. The arm 125 being pressed above the line joining the pivot of 125 and the center of 120, the tension of spring 117 will be sufficient to retain the lever in its position of contact unless it is moved therefrom by a positive force. If key L K is so far released as to permit pin 128 to escape from its stop 127, the key-cylinder will then continue its rotation, and as roller 122 will be lifted upon the periphery of the key-cylinder the arm 125 will be depressed and contact with 119 will be broken.

172 and 173 represent bolts for attaching springs 115 and 116 to the transverse conducting-bar 43. 118 represents one of a series of pendent metallic bars attached to an insulating-bar, T″, by a conducting-bolt, 126; and 170 represents a vertical side plate of the transmitter for supporting the transverse insulating-bar T″.

I have arranged my transmitter to send as many impulses over the three main lines as there are transmitting-keys during each revolution of the key-cylinder and during each revolution of the type-wheels of the receiving-instrument. It is obviously a necessary condition of construction and operation that the pulsator be capable of being arrested upon the transmission of every main-line impulse; to the end of reducing the number of parts in the transmitter, and, instead of employing thirty local branches and an equal number of stop-magnets in the circular series, (there being thirty pulsations sent over the main line during each revolution of the key-cylinder,) by gearing the pulsator-shaft so as to make two rotations to one of the key-cylinder, I am enabled to accomplish the same result with fifteen local branches and fifteen stop-magnets. Each of the local branches is connected with two keys of the key-board in such manner as to be capable of being closed by either or both of the two keys.

Fig. 14 represents a key-cylinder, a series of conducting-springs equal the number of keys upon the key-board, a main-line pulsator, D, a circular arrangement of a series of fifteen stop-magnets, a local battery, and fifteen local branches, each of which may be closed by either or both of two transmitting-keys.

160 represents a metallic bar provided with a series of contact-springs equal in number to the number of keys of the key-board. Upon depressing a key one of the springs, as 105, will, after the key-cylinder has rotated to a proper position, be pressed in contact with stop 106, mounted in the insulating-bar T″. By this means electrical connection will be established between one pole of L B through 160, spring 105, stop-pin 106, wire 107, stop-magnet 1^{M}, and binding-post 40. The poles of the battery can also be closed through stop-magnet 1^{M} by depressing the extreme right-hand key of

the series, thereby closing spring 101 with pin 102, and completing the circuit through wire 103 to point 104, thence by wire 107, through stop-magnet 1^M and binding-post 40, to the opposite pole of the battery.

Although the local circuit through 1^M may be closed by depressing either the right-hand or the left-hand key, the stop-arm L could not be arrested at the same time in both cases. As shown in Fig. 1, the cavities and their corresponding stops are in different spiral rows. The arrangement is such that a cavity and stop of one row is one hundred and eighty degrees from a stop and cavity of the other, and each local circuit should be connected with such key-contacts as are each opened and closed by a cavity and stop when the other cavity and stop are one hundred and eighty degrees from a position to open or close the branch. Thus, if the left-hand key were depressed and the stop-arm L were arrested at the first time of connecting the branch of magnet 1^M, L would not be arrested in the event of depressing the right-hand key. The stop-arm would pass by magnet 1^M and return after making a full revolution before the branch of 1^M would be closed and before L would be arrested. The stop-arm L makes a complete revolution to every half-revolution of the key-cylinder. Thus, if the arm L were arrested by 1^M at the first half-rotation of the key-cylinder, by depressing the left-hand key, arm L would only be arrested during the second half-rotation of the key-cylinder on depressing the right-hand key, as the respective cavities and stops upon the cylinder for the two keys are one hundred and eighty degrees apart. Thus, while one key may close the local branch, the cylinder must rotate one hundred and eighty degrees before it can be closed by the other key.

While I have here shown thirty finger-keys and fifteen stop-magnets, I do not wish to limit my invention by such definite numbers, as it is obvious that if I were to employ thirty-six keys, and were to send thirty-six pulsations to line during each rotation of the key-cylinder, I could gear the pulsator-shaft to make three revolutions to one of the key-cylinder. At the same time, however, I would be obliged to employ only twelve stop-magnets, as each of the local branches could be connected with three of the transmitting-keys. However, with such an arrangement the five metallic projections upon the pulsator D should be changed to four.

Figs. 15 to 24, inclusive, show my receiving-instrument, which consists of three stationary electro-magnets, *a b c*, whose cores project through the non-magnetic cylindrical case A surrounding the armature; a rotating armature consisting of magnetic bars numbered from 1 to 10, which are mounted upon non-magnetic disks of shaft *d;* polarized printing-magnet XY, having three coil divisions, which respectively form parts of three main lines, *x y z;* and various other devices, to be hereinafter described, for effecting unison, for shifting the type-wheels to print from letters to figures or figures to letters, and suitable paper-feeding apparatus. The poles of electro-magnets *a*, *b*, and *c*, whose cores are in different radial planes, are so situated that the distances between the poles *a b* and *b c* are equal; and the extremities of their poles are in close proximity to a cylindrical space within which the cylindrical armature rotates. The rotating armature here shown consists of a series of magnetic bars which are mounted upon non-magnetic disks, thereby forming a cylindrical cage; and all of the armature-bars are equally distant from one another.

In order that the type-wheel may stop in a position for printing any desired character, and as there are thirty characters upon the type-wheel, it is necessary that a single rotation of the type-wheel be effected by thirty step movements; and to this end I have employed a motor-armature having ten magnetic bars and three stationary electro-magnets, with their poles so arranged that when one of the armature-bars, as 1, is directly opposite the poles of electro-magnet *c* some one of the other armature-bars, as 8, will be at a distance from the poles of electro-magnet *a* equal to one-third of the space between two adjoining armature-bars. Thus the poles of electro-magnet *a*, when a current is passing through its coil, serves to attract one of the armature-bars a distance equal to one-third of the space between two adjoining bars. Upon breaking the current of the line of magnet *a* and establishing it through the line of magnet *b* the cores of *b* in turn attract the armature-bar 10 an equal distance; and, again, upon removing the current from the line of cores *b* the poles of *c* attract the armature-bar 2 an equal space. Thus upon successively connecting a battery with the lines of electro-magnets *a*, *b*, and *c* the armature is successively rotated three equal steps, which are equal to the distance between two adjoining bars. To give the armature, upon whose shaft *d* the type-wheels are mounted, one complete rotation, it is therefore obvious that the battery must be closed through each of the main lines *x*, *y*, and *z* as many times as there are bars upon the armature.

I am aware that others have employed an electro-magnetic motor for rotating type-wheels having two stationary electro-magnets and an armature consisting of a series of independent magnetic bars. Such an arrangement, however, is incapable of great speed of rotation, while it is also liable to rotate the armature in a direction opposite to that desired. Where three stationary electro-magnets are employed in a motor, as before described, the particular core in each instance which is magnetized is, in the first instance, at one-third of an armature-space from the bar to be attracted and at two-thirds of an armature-space from the receding bar, as is best shown in Fig. 20, where bar 8 is in a position to be attracted upon clos-

ing a current through core *a*, and is one-third of an armature-space therefrom, while the receding bar 7 is at a distance of two-thirds of a space from the core. Thus the approaching bar 8, when the cores of *a* are magnetized, is only one-half as far from the core as receding bar 7, wherefore the attraction upon bar 8 will be four times as great as that upon bar 7 at the first instant the cores of *a* are magnetized. If only two stationary magnets, as *a* and *c*, were employed, the bar 8, at the first instant of magnetizing the cores of *a*, would be nearly as far from the cores as bar 7, in which event the attraction upon bar 8 would be nearly if not the same as that upon bar 7, and no movement of the armature would follow. To avoid this difficulty, however, in a two-magnet motor, the armature-bar last attracted is moved slightly past its core by the inertia of the rotating armature. Thus, if bar 1 were moved slightly past the core of *c*, the bar 8 would be a little nearer the cores of *a* than the bar 7. With such an arrangement, however, as the attractive forces upon 7 and 8 in opposite directions are so nearly balanced, the first part of the movement of the armature is necessarily very slow, and only little speed of rotation can be attained.

A further marked advantage from the employment of three or more main lines and three or more independent motor-magnets arises from the fact that while the main-line current is closed through one magnet, other magnets, having been previously charged, will have time to become electrically discharged; and since an electro-magnet has a definite time of charge and discharge, the velocity of the motor can be greatly increased, since the motor will be subject to the action of an electro-magnet while electro-magnetic discharge is occurring in the others through which the circuits are broken, and which are temporarily not in use.

It is obvious that, instead of employing three main lines and three electro-magnets, *a*, *b*, and *c*, four or even five main lines could be employed by adopting a corresponding number of stationary magnets; also, instead of employing a rotating armature having ten magnetic bars, one having six, eight, ten, or twelve could equally well be used. If five main lines and an armature having twelve magnetic bars were employed, sixty successive step movements would accompany each rotation of the armature. Also, if it were desired to have forty-five characters upon the type-wheel, it would be necessary to accompany each rotation with forty-five step movements, and if, under such circumstances, three lines were employed, it would be necessary that the armature should have fifteen magnetic bars.

My means for effecting printing consists of two polarized electro-magnets, X and Y, each having three independent coils forming parts, respectively, of the main lines *x*, *y*, and *z*. The right-hand coils both of X and Y are connected together and form a part of the main line *x*. The middle coils are connected together and form a part of main line *y*. Between the facing poles of X and Y is mounted the polarized armature *c*, having pole-pieces C′ and C″. When a current is passing through either of the lines *x*, *y*, or *z*, of normal polarity, the poles of armature C are held against the coils of Y, and the press mechanism is in a retracted position in respect to the type-wheels. However, after the pulsator D at the transmitting-station has been rotated to a predetermined position to move the type-wheels to a position for printing any desired character, and is there arrested, the battery is reversed over that one of the lines forming the main-line circuit, and the type-wheels of the receiving-instrument are not only locked in position, but the polarized armature is attracted to the cores of X and the press mechanism is lifted, thereby pressing a ribbon of paper against the type-wheel.

The unison device employed is shown in Figs. 15, 16, 22, and 23, and consists of a worm, *o*, upon the type-wheel shaft, a pivoted lever whose free end, *n′*, rests between the threads of the worm, and a stop, *m*, upon the type-wheel shaft. The pivoted bar is also provided with a stop, *n*. If the type-wheels are continued in operation for several revolutions after printing any character, the worm will cause arm *n* to be carried into a position to arrest movement of *m*. This mechanism is well known and need not be further described.

To hold the type-wheels accurately in position, and to prevent their bounding backward upon their coming to unison and upon the arrest of pin *m* by stop *n*, I place upon shaft *d* of the type-wheels and motor-armature a ratchet-wheel, *d′*, provided with a point, *d″*, whose end engages with the teeth of *d′* and will prevent its backward movement.

Type-wheels 1^L and F are rigidly connected together, and are mounted upon the type-wheel shaft *d*.

B is a press-lever attached to the polar armature C. Upon the press-lever B is mounted a shaft, *k*, provided with a printing-roller, which can slide laterally in a direction transverse to the plane of printing-lever B. Upon the shaft *k* is a sleeve, *j*, and a collar, *h*. A T-lever, *l*, whose end rests within the collar *h*, is pivoted at *g*, and *e* and *f* are radial arms in different radial planes passing through shaft *d*. In the position shown in Fig. 23, if the press-lever is raised, the left arm of the T-lever will come in contact with the radial arm *e*, and the hanging arm of lever *l* will press the printing-pad and its shaft to the right, thereby leaving the pad in position to print from the right-hand type-wheel. Again, if the type-wheel be so moved that radial arm *f* is over the left-hand arm of T and lever *l*, and the press mechanism be raised, the pendent arm of *l* will be driven to the left and the printing-pad will be moved to a position to print from the left-hand or letter type-wheel.

This mechanism is old, and is here specifically disclaimed.

The press-lever B is normally in its lowest position, and the polarized armature is in close proximity to the right-hand electro-magnet Y. Lever B is partially sustained by a small leaf-spring, *s*, which, though inadequate to raise it, is of sufficient strength to render its operation comparatively quick.

The paper-feeding device is of an ordinary character, and is shown in Figs. 17 and 18. *q* is a press-roller mounted upon a spring, *q'*. *r* is a roller connected with the driving-ratchet *r'*, and is actuated a step at a time upon each backward movement of the polarized armature, after the operation of printing. *u* is a rigid bar fixed into the upper part of press-lever B. *t* is a flexible bar, also fixed into the upper part of press-lever B, upon which the driving-pawl *s* is mounted. To effect proper adjustment of the pawl *s*, a set-screw, *v*, passing through the upper end of lever *u*, is provided, whereby the position of *t* in respect to *u* may be varied.

In Fig. 7, 80 represents a series of metallic pins, each of which is electrically connected with one of the circular series of stop-magnets. Corresponding with the series of pins 80 is another series of pins, 81, (shown in Fig. 9,) forming terminals for the local branches from the key-board of the transmitter. By means of the comb circuit-closer, as shown in Figs. 8 and 9, connection is made from the key-board through each local branch to its stop-magnet, through the pin 80, leaf-spring 82, metallic plate 84, leaf-spring 83, pin 81, thence to its stop-magnet, and from there to a series of metallic pins, 40, which are all electrically connected by one conductor to one pole of the local battery.

In Figs. 8 and 9, 85 represents a flat bar of insulating material. 87 is the supporting-plate of a series of stop-magnets, and 86 is a plate to which the local branches from the key-board are connected. I find such a means of simultaneously connecting all of the local branches of importance, as it is necessary to make the pulsator and pole-changer part of the transmitter detachable from the key-board portion for convenience of repairs.

For convenience of description I have heretofore described one transmitting apparatus and one receiving-instrument only. It will be obvious, however, from an inspection of Fig. 24 that, instead of connecting the lines *x y z* immediately to earth, they may extend through a series of receiving-instruments, and that all of the instruments in line may act in unison to record the same messages; also, in addition to employing with one transmitter a series of receiving-instruments upon one set of lines, which I will call "one circuit," I may gear with the motor driving the key-cylinder shaft, as shown in Fig. 13, a series of main-line pulsators and respective pole-changers. The bevel-wheel X''' upon the key-cylinder shaft drives the shaft Y'', upon which are mounted a series of spur-wheels, each one of which serves to drive a pulsating and pole-changing arrangement for operating a three-line circuit. In such an arrangement, however, it will be necessary to connect the corresponding stop-magnets of the transmitters of separate circuits all in one local branch and to the same key of the transmitter. By this means not only may the message be transmitted to any one of many instruments upon the same circuit, but it may be transmitted to every instrument upon a great number of branch circuits. The depression of one transmitting-key, which will arrest the key-cylinder, will serve to arrest simultaneously in the same relative position the stop-arms of all the different pulsators, and will at the same time effect the operation of each of the respective pole-changers.

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

1. The combination of a series of three or more main lines, a main-line battery, a rotating pulsator for connecting the battery and main lines successively, and a pole-changer for reversing the main-line battery.

2. The combination of a rotating main-line pulsator for connecting a battery successively with a series of three or more main lines and an automatic pole-changer, which automatically operates to reverse the battery upon arresting the action of the pulsator.

3. The combination of a series of transmitting-keys, a local battery and a series of local branches, a series of stop-magnets, and a rotating pulsator-shaft having a rotating arm, whereby upon depressing any one of the transmitting-keys the poles of the local battery are closed through that one of the stop-magnets which will arrest the pulsator in a position of rotation corresponding with the key depressed.

4. The combination of a constantly-moving motor, a rotating main-line pulsator and a key-cylinder, both of which are separately and frictionally connected with said motor, a series of transmitting-keys, and a series of stops for arresting the pulsator, whereby upon depressing any transmitting-key the key-cylinder and pulsator may both be arrested at positions corresponding with the key depressed, while the motor continues in motion.

5. The combination of a main-line battery, a main-line pulsator, a key-cylinder, a motor for rotating the key-cylinder and pulsator in unison, a series of transmitting-keys and branch conductors of a local battery, and a series of electro-magnetic stops placed in said local branch conductors, the whole being so arranged that when a key is depressed the circuit of that magnetic stop corresponding with the key depressed will be closed and the pulsator will be arrested at the same instant that the depressed finger-key arrests the key-cylinder.

6. A key-cylinder having both a peripheral cavity and a stop-pin corresponding with each key of the key-board.

7. The combination of a key-cylinder having

a series of peripheral cavities and corresponding stop-pins, a series of circuit-closing levers and electrical connections, and a series of transmitting-keys, whereby, when a cavity in the key-cylinder is opposite a circuit-closing lever, a circuit may be closed upon a depression of a corresponding transmitting-key, and is broken upon a release of the transmitting-key and a continued rotation of the key-cylinder.

8. The combination of a key-cylinder having a series of peripheral cavities, a series of circuit-closing levers and electrical connections, and a series of transmitting-keys, each of which is provided with a spring which impinges upon its corresponding circuit-closing lever when depressed, whereby a key may be easily depressed whatever the position of rotation of the key-cylinder, and whereby the circuit-closing lever may be subsequently actuated to make an electrical contact when the key-cylinder has rotated to a proper position.

9. The combination of a series of circuit-closing levers, each having an electrical contact, and spring-supports for retaining them in a position of contact after connection is once made, and a key-cylinder provided with a series of cavities or cam-surfaces corresponding with and serving to cause the respective circuit-closers to break their contacts upon the rotation of the key-cylinder.

10. The combination of key-cylinder K C, provided with cavities, a circuit-closing lever, 125, electrical contact 119, and a frictional spring-support, 117, substantially as described.

11. The combination of key-cylinder K C, provided both with stop-pin 128 and cavity 130, key 114, stop device 127, circuit-closing lever 125, and interposed spring 116, for the purpose specified.

12. A series of stop-magnets arranged in a circle around the pulsator-shaft, a local battery, and a series of local branches, each of which branches is connected with a stop-magnet and a key-contact.

13. A series of stop-magnets arranged about the pulsator-shaft, a local battery, and a series of local branches, each of which is connected with a stop-magnet and the contact of two or more keys, whereby each stop-magnet may be made to arrest the pulsator by depressing either of two transmitting-keys.

14. The combination of a key-board, a local battery, and a series of local branch conductors joining the opposite poles of said local battery, which may be opened and closed by the transmitting-keys, and each of which is connected with the contacts of two or more of the transmitting-keys, whereby each local branch may be closed by either of two or more transmitting-keys.

15. The combination of a main-line battery, a rotating motor-driven pulsator for successively connecting the main-line battery upon a series of three or more main lines, a main-line pole-changer for reversing and successively reversing the battery upon any one of said main lines, and automatic mechanical means for operating said pole-changer by arresting the rotating pulsator to effect a reversal and re-reversal of the main-line battery.

16. The combination of a main-line pole-changer, an unequal-step escapement, which is released for a long step upon arresting the pulsator, and which is released for a short step upon starting the pulsator in motion, and means for causing the pole-changer to reverse and re-reverse the battery during the long step of the escapement.

17. A pallet-yoke which is frictionally connected with a constantly-rotating motor, in combination with an escapement-wheel mounted upon a shaft which is frictionally geared with the same motor.

18. The combination of an escapement-wheel mounted upon a shaft which is frictionally geared with a driving-motor, and a pallet-yoke which is frictionally mounted upon a constantly-rotating shaft driven by the same motor, having a projecting arm which is held in one position by the rapid rotation of a series of cam-teeth, while said arm and the yoke are carried to an opposite position by the agency of the friction-gearing of the motor, after the cam-wheel is arrested and the end of the arm upon the pallet-yoke falls between said cam-teeth.

19. The combination of the cam-tooth wheel E, mounted upon the pulsator-shaft, pallet-yoke I, having pallets R and S, and an arm, T, which is frictionally mounted with a motor-train, an unequal-step escapement having teeth R′ and S′, frictionally geared with a moving motor, and a disk, H‴, having cam-teeth, which is geared with the escapement-shaft, and which serves to actuate the arm N of the main-line pole-changer.

20. The combination of the constantly-rotating shaft I′, pallet-yoke I, provided with pallets and arm T, and normally-rotating toothed wheel E.

21. The shaft J and a constantly-rotating wheel, N‴, frictionally geared together, said shaft having rigidly fixed thereon escapement devices, and a toothed disk, H‴, all in combination with pole-changer arm N and escapement pallets, substantially as specified.

22. The combination of escapement-teeth R′ and S′, arranged substantially as specified, cam-tooth wheel H‴, and a pole-changing lever, N, having an arm, N′.

23. A pole-changing lever, N, having an arm, N′, whose surface 150 rests upon the surface of tooth 60 of H‴ at the end of a long step, while at the end of the succeeding short step face 160 will be in contact with tooth 59 and face 150 will be separated from tooth 60.

24. In a receiving-instrument, the combination of an electro-magnetic motor having three or more stationary electro-magnets, each of whose magnetizing-coils is placed in an independent main telegraph-line, a rotating arma-

ture provided with a series of magnetic bars, and a type-wheel.

25. The combination, substantially as specified, of an electromotor having three stationary electro-magnets, a type-wheel, a printing-magnet having three sectional coils, and three independent telegraph-lines, in each of which lines are placed the magnetizing-coils of one of the stationary electro-magnets and one section of the magnetizing-coils of the printing electro-magnet.

26. The combination of an electromotor having three stationary electro-magnets whose separate coils respectively form parts of independent telegraph-lines, a type-wheel shaft which is rotated thereby, and a polarized printing-magnet having three sectional coils, each of which respectively forms a part of one of the three independent main lines.

27. The combination of three main telegraph-lines, a motor having three stationary electro-magnets whose magnetizing-coils respectively form parts of said telegraph-lines, a printing electro-magnet having three sectional coils, forming parts, respectively, of said telegraph-lines, a pulsator or commutator for connecting the main lines separately and successively with a battery, and a pole-changer for reversing the battery upon any one of the main lines for the purpose of printing.

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Witnesses:
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