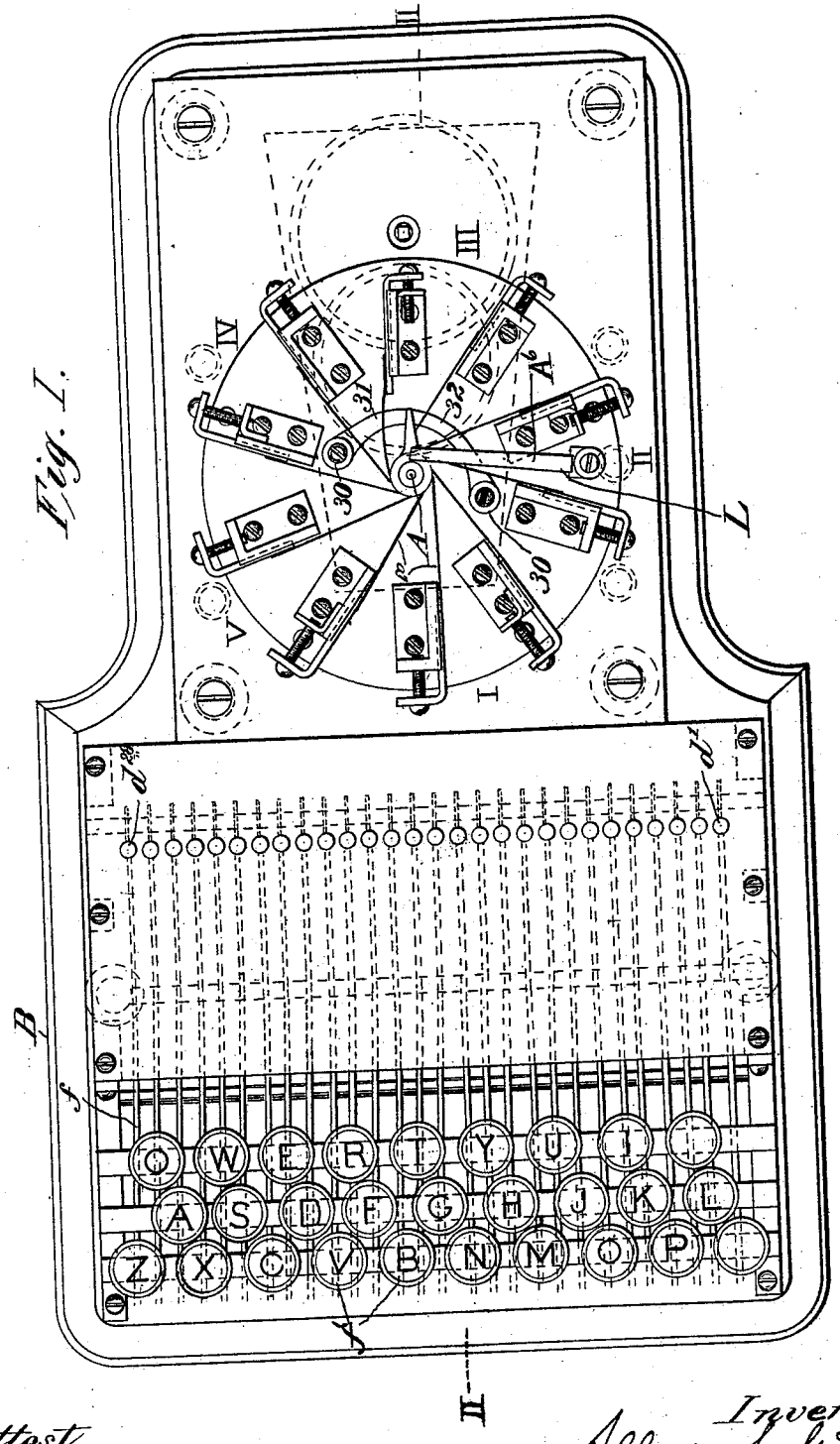
(No Model.) 12 Sheets—Sheet 1.

A. S. McCASKEY.

ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

Fig. 1.



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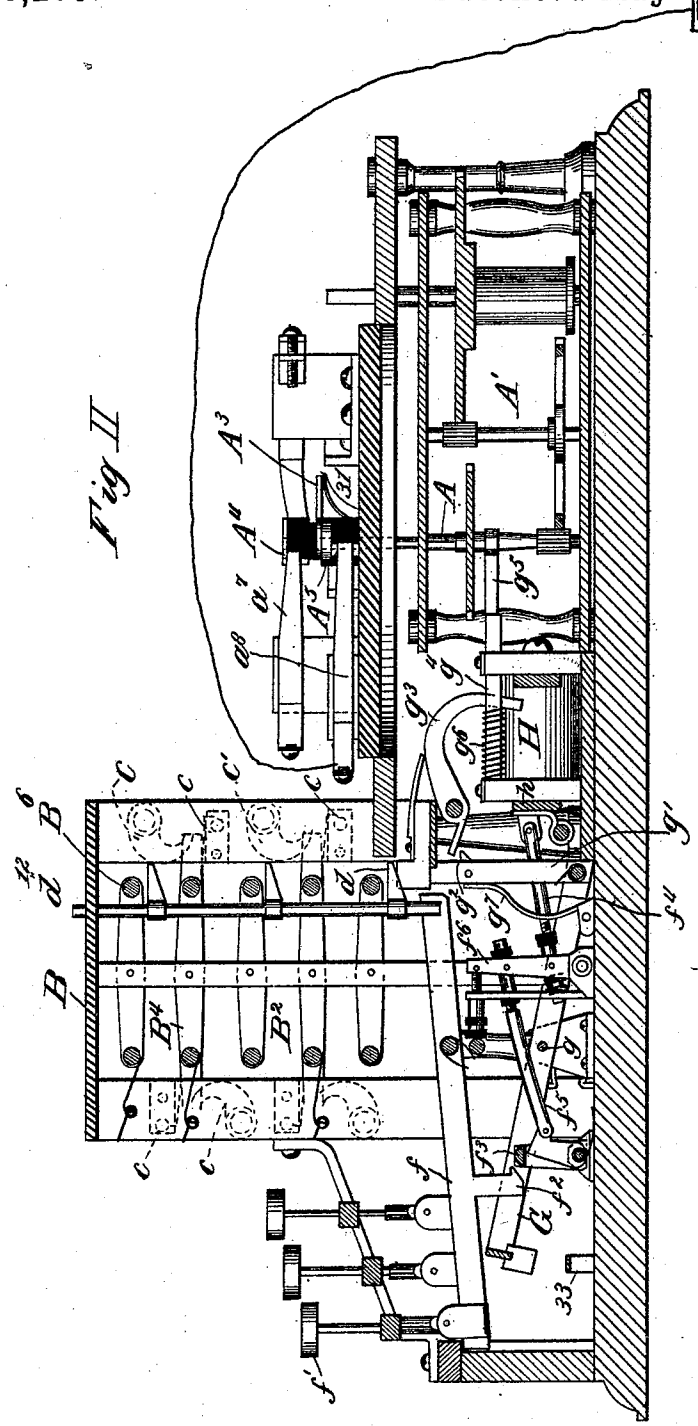
(No Model.) 12 Sheets—Sheet 2.

A. S. McCASKEY.

ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

Fig II



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(No Model.) 12 Sheets—Sheet 3.

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ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

Fig. III.

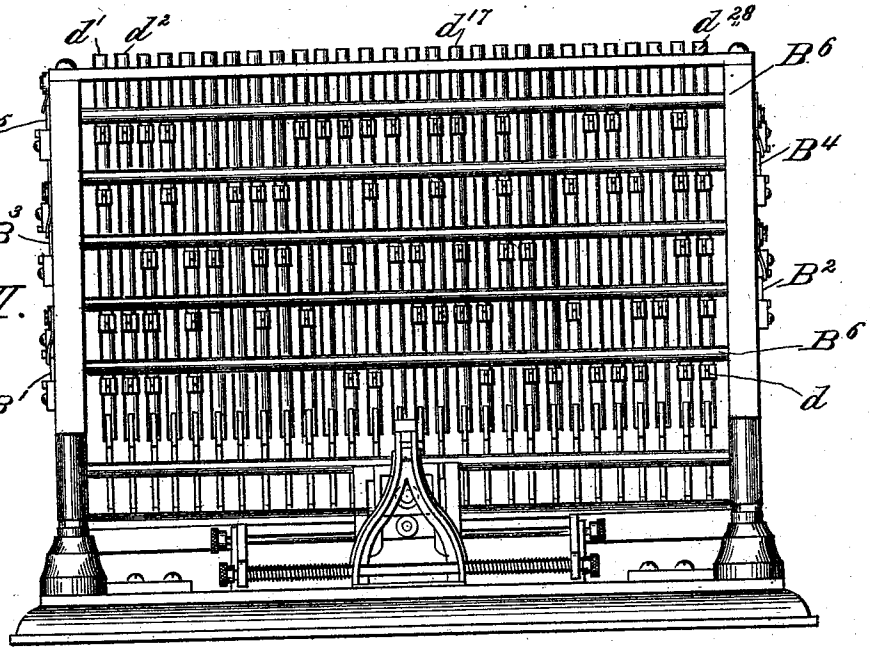


Fig. IV.

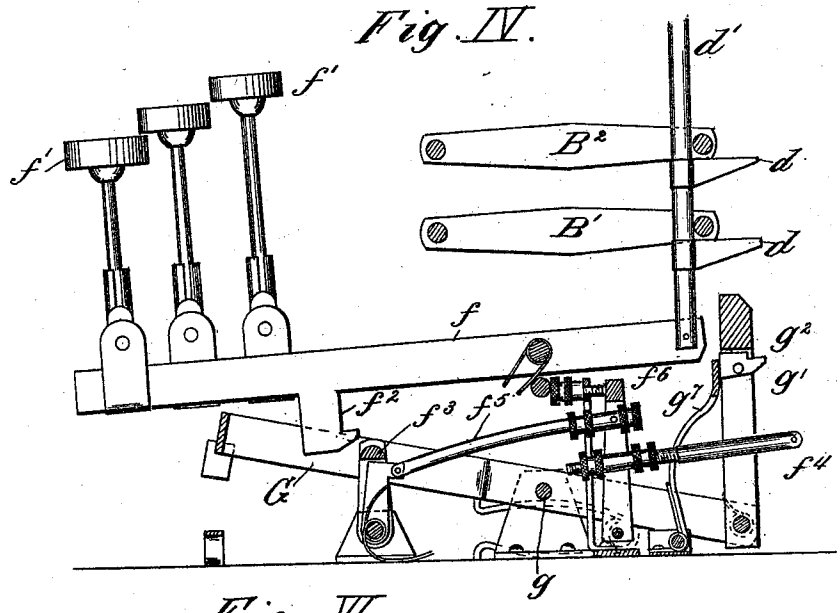
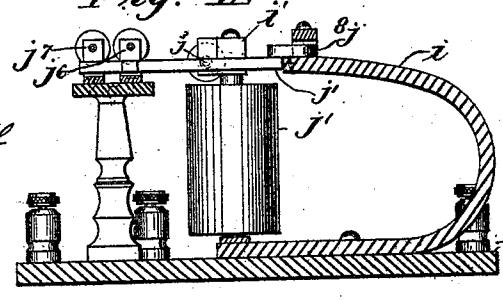


Fig. V.



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(No Model.)

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A. S. McCASKEY.

ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

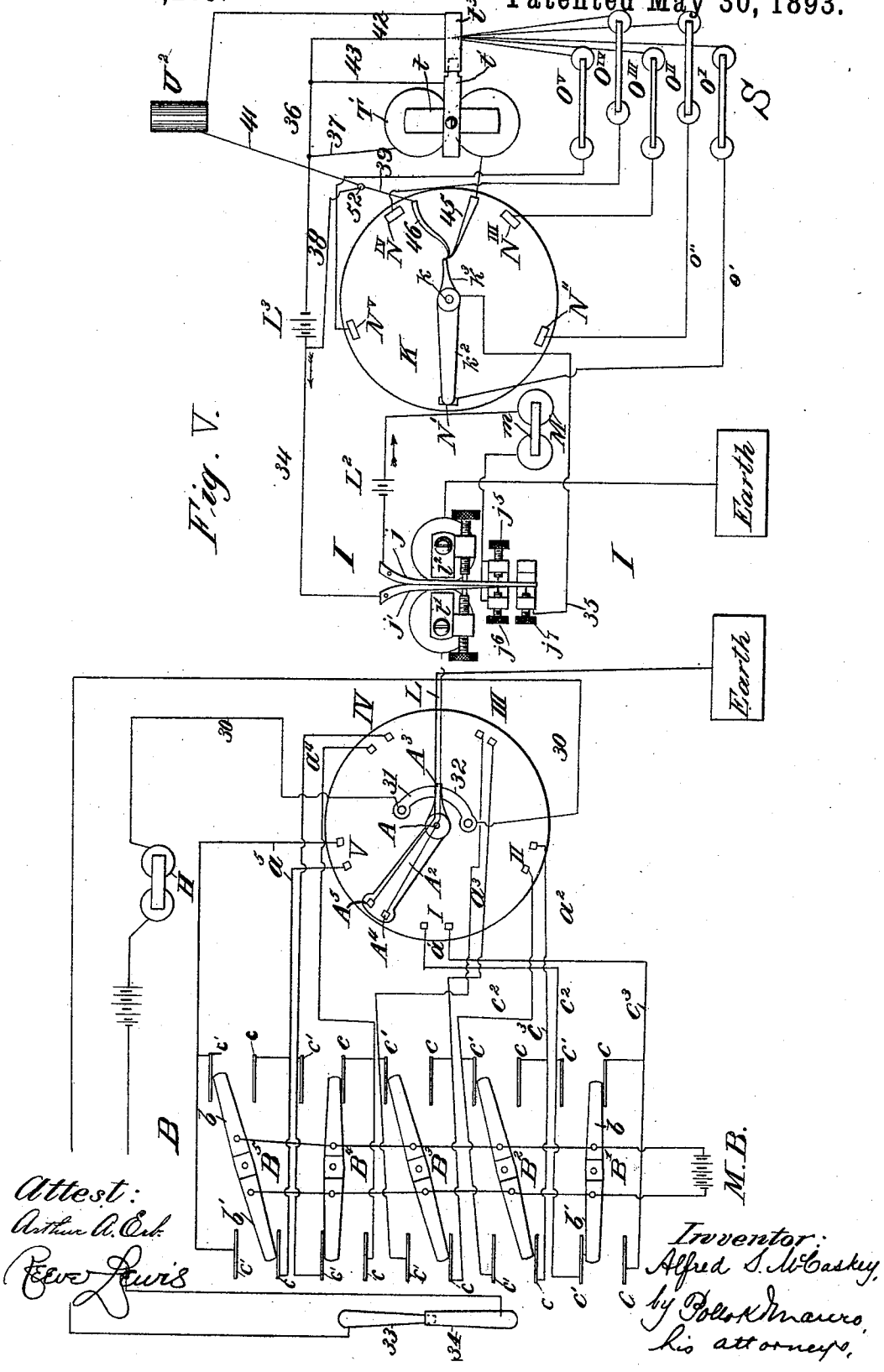

Fig. V.

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A. S. McCASKEY.

ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

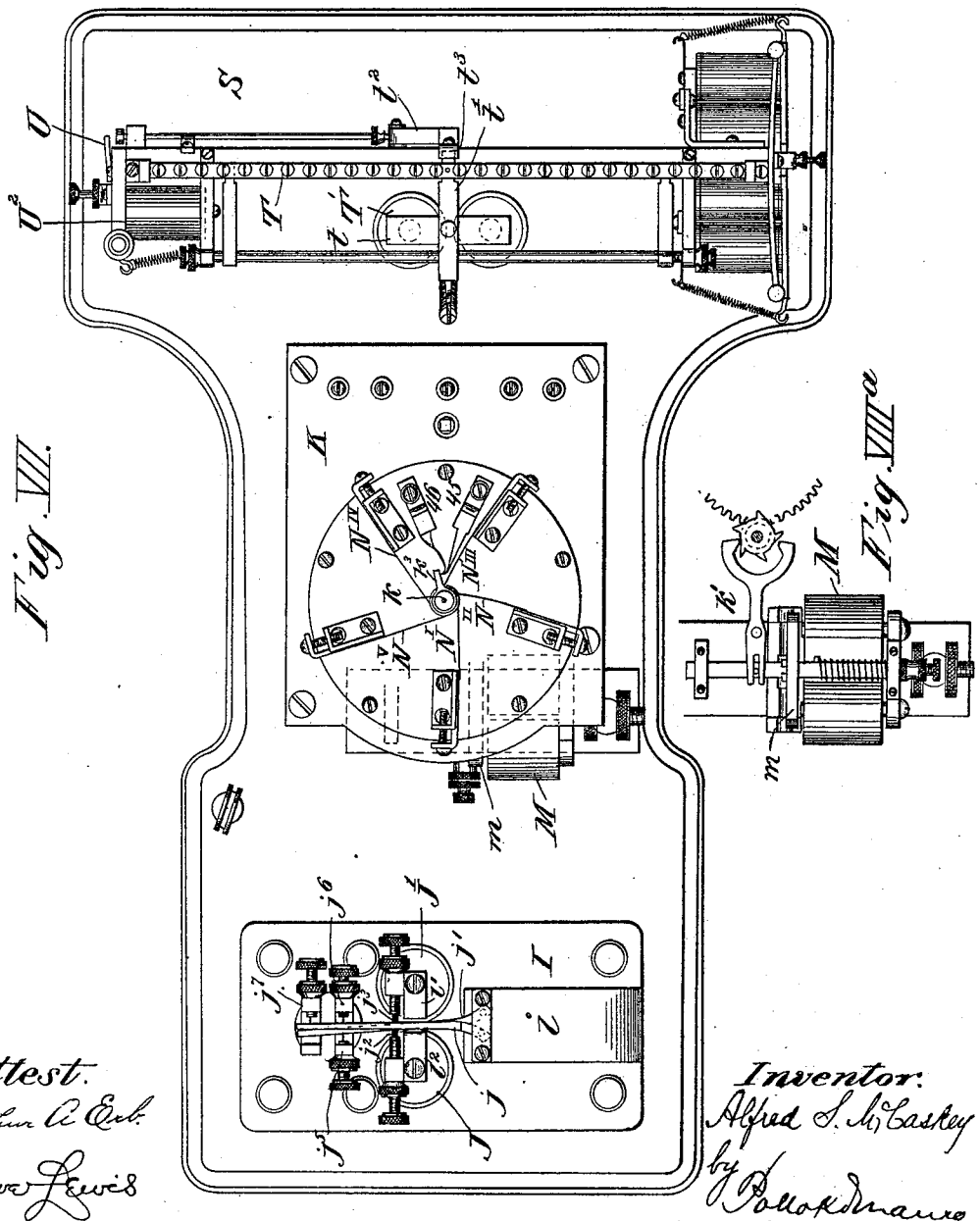

Fig. VII.

Fig. VIII.a

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ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

Fig. IX.

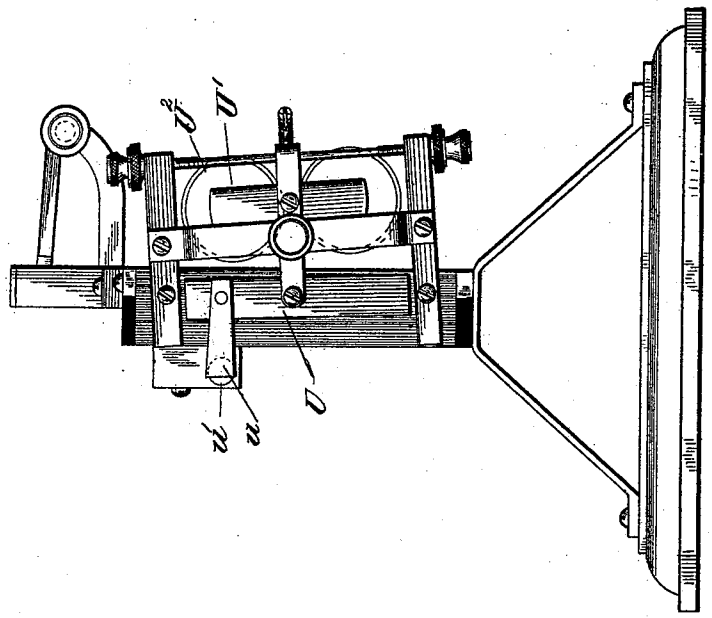
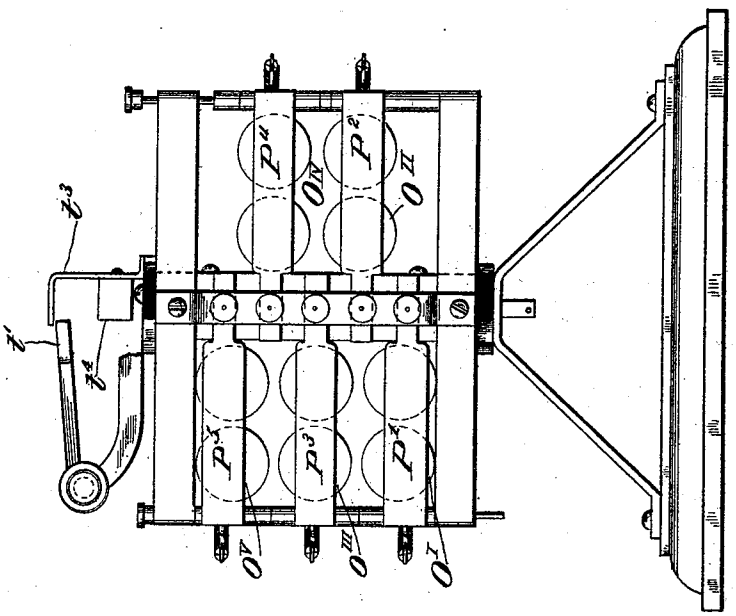


Fig. VIII.



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ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

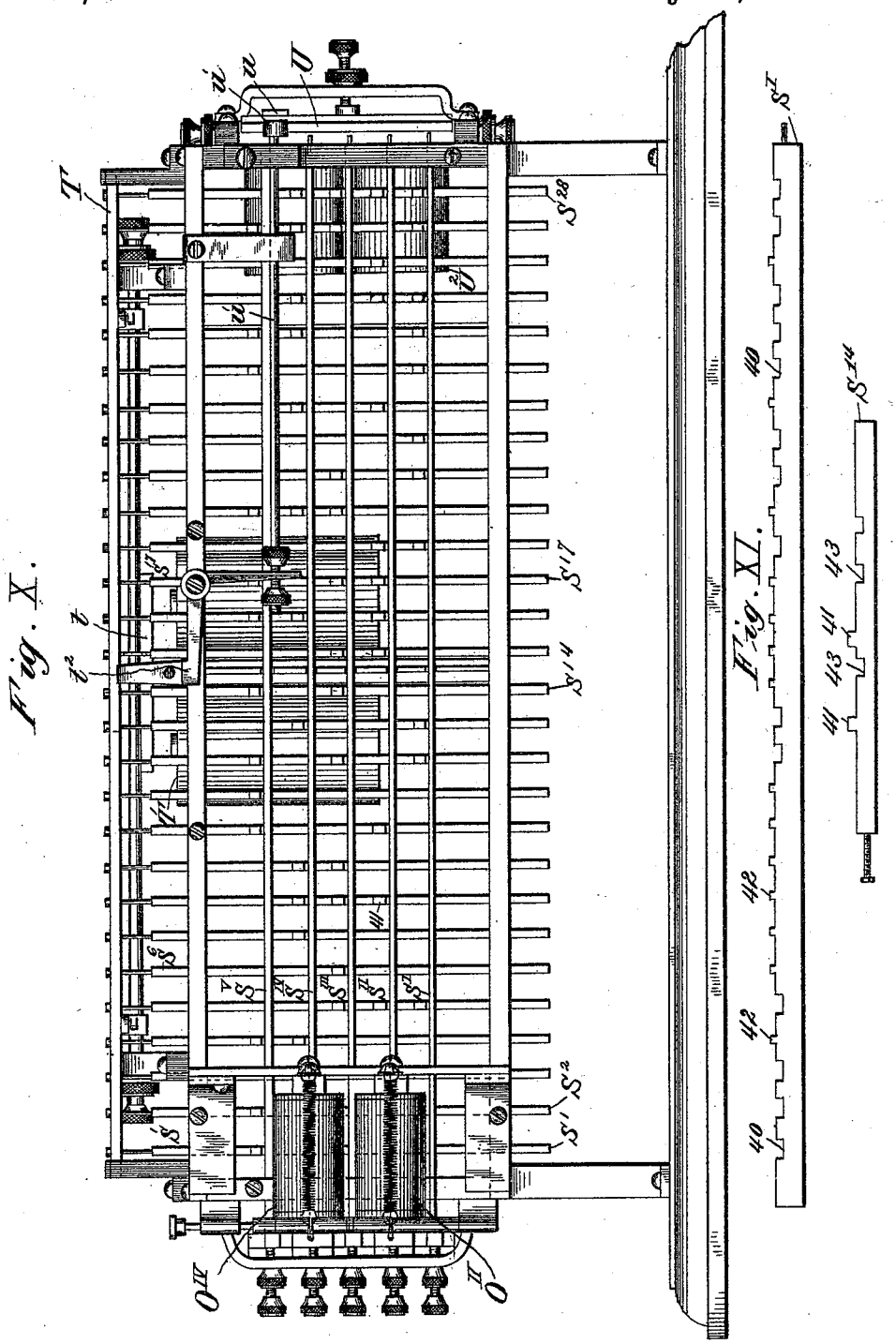

Fig. X.

Fig. XI.

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(No Model.)

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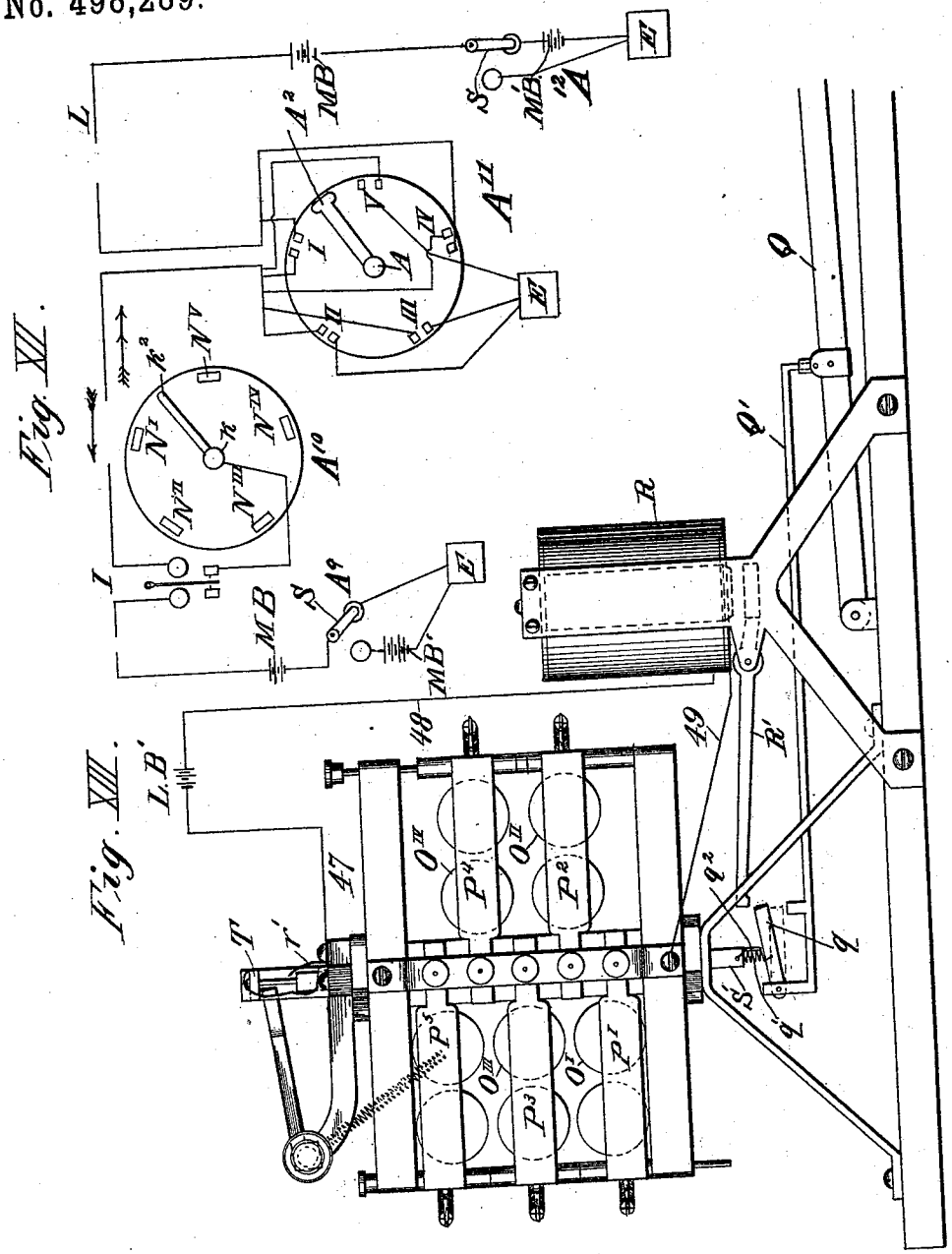
ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.



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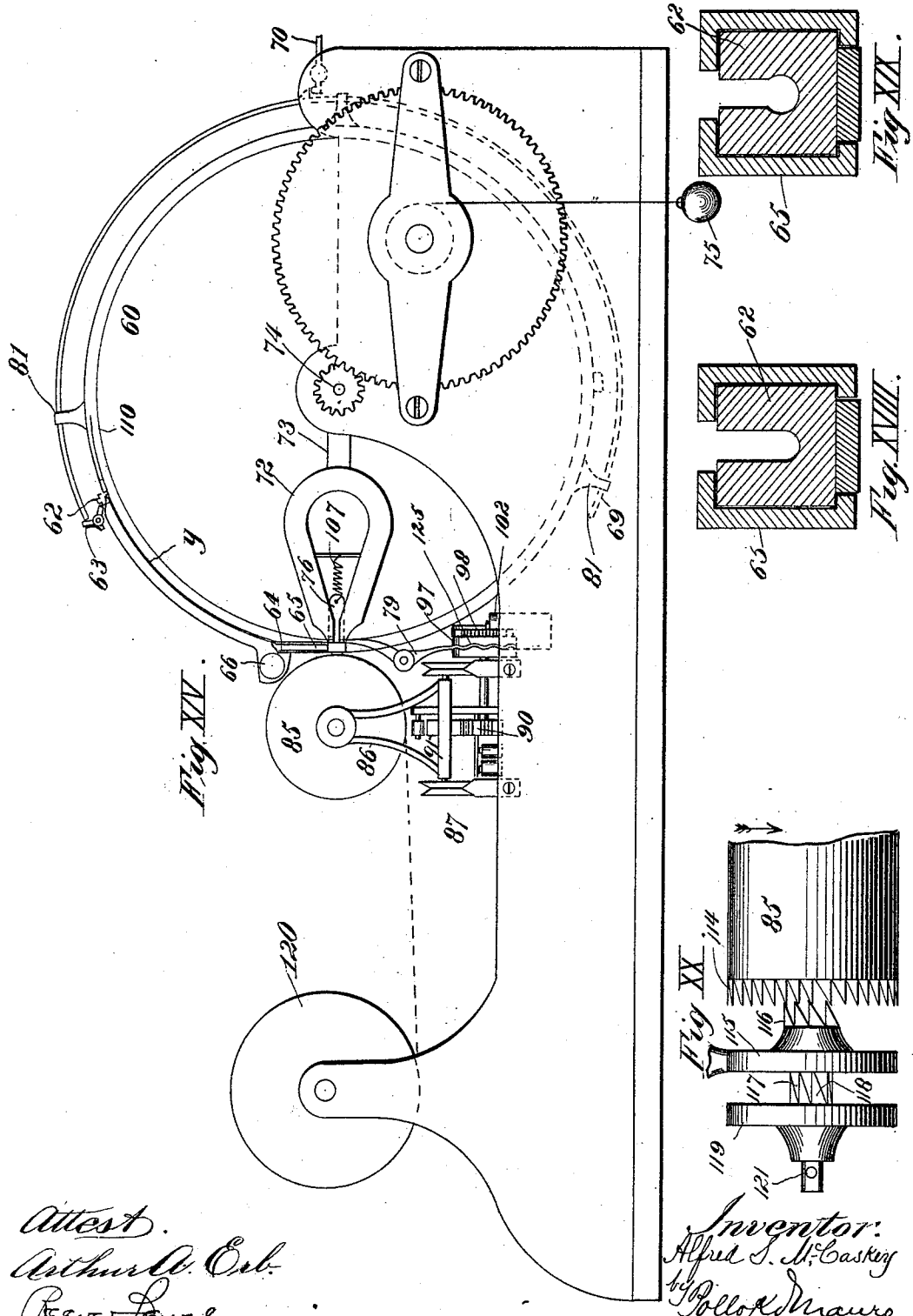
ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.



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ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

Fig. XV.

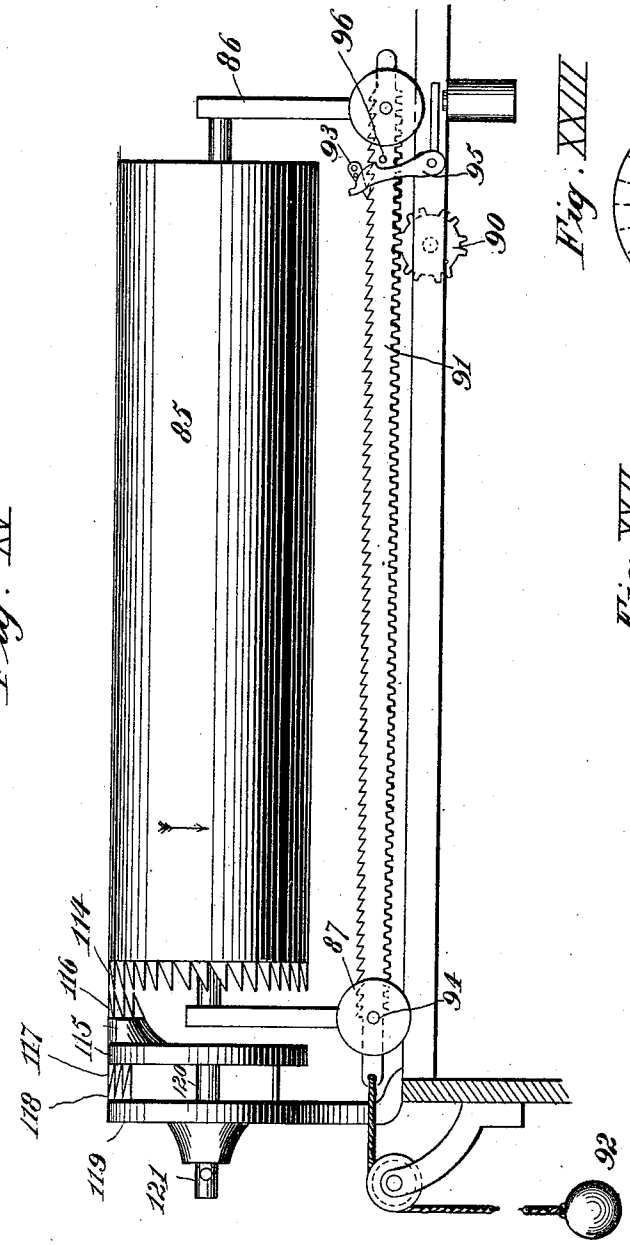


Fig. XXIII.

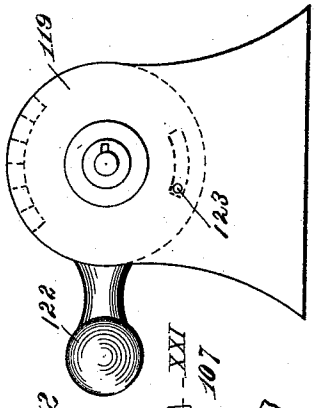


Fig. XXII.

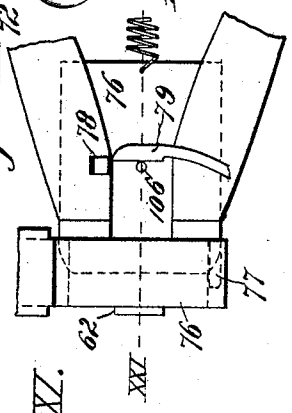
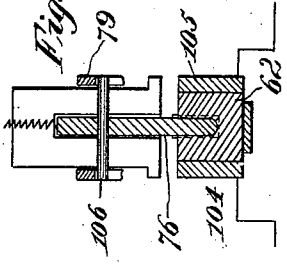


Fig. XXI.



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ELECTRICAL SIGNALING SYSTEM.

No. 498,289. Patented May 30, 1893.

Fig. XXI.

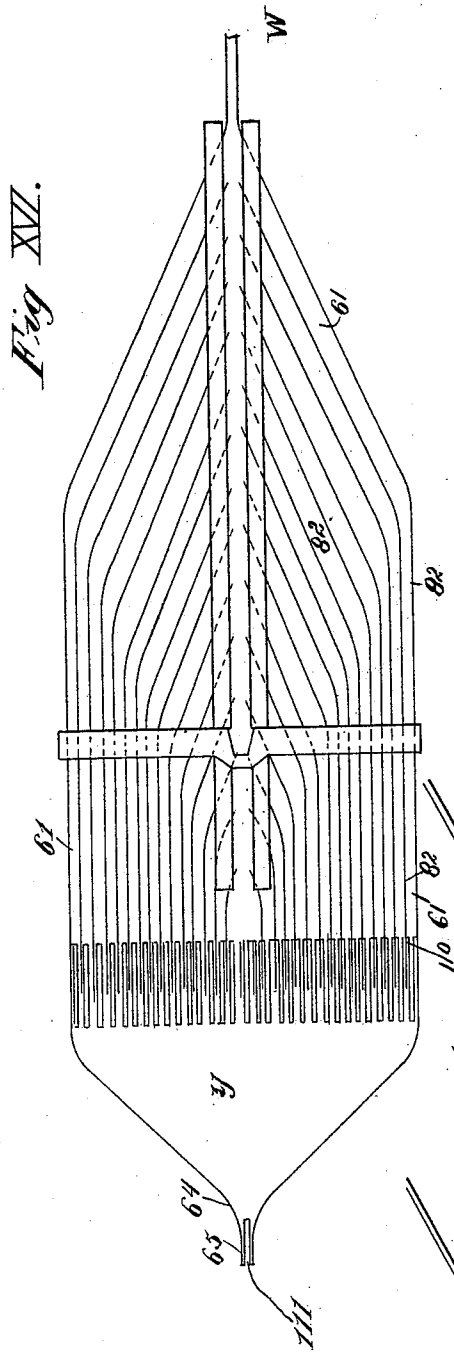


Fig. XXII.

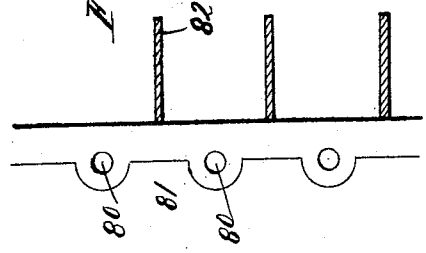
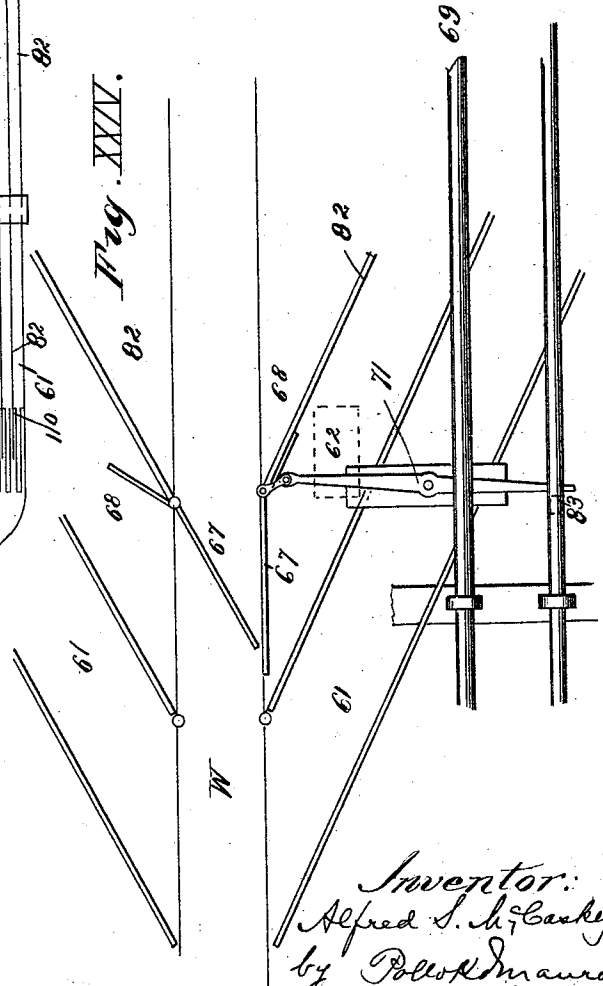


Fig. XXIII.



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ELECTRICAL SIGNALING SYSTEM.

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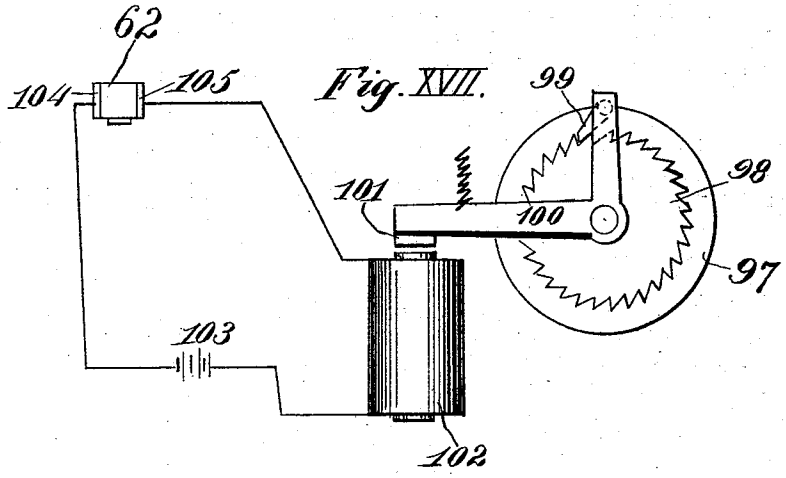

Fig. XVII.

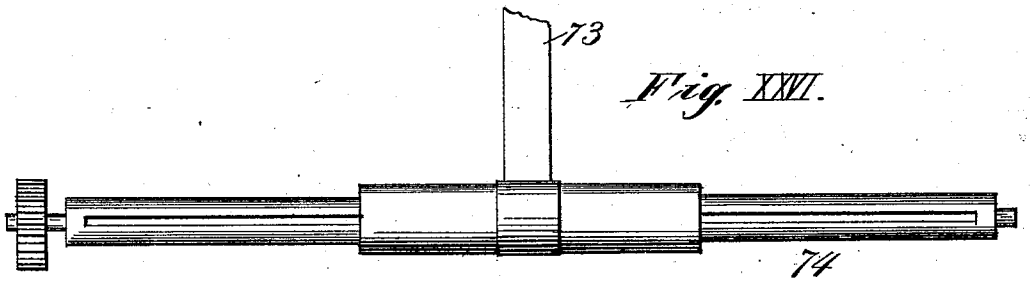

Fig. XXVI.

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UNITED STATES PATENT OFFICE.

ALFRED S. McCASKEY, OF CHICAGO, ILLINOIS.

ELECTRICAL SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 498,289, dated May 30, 1893.

Application filed July 29, 1892. Serial No. 441,589. (No model.)

To all whom it may concern:

Be it known that I, ALFRED SAMUEL McCASKEY, of Chicago, Illinois, have invented a new and useful Improvement in Electrical Signaling Systems, which is fully set forth in the following specification.

This invention has general reference to electrical signaling or communication, and relates more particularly to printing telegraph systems.

Primarily the object of the invention is to produce, with the minimum number of working parts, the maximum number of electric signals, represented by combinations of electric impulses, in which each individual signal differs from all the others, in the number of operating impulses which compose it, or in the intervals separating these impulses. Thus with the maximum number of five impulses to each signal it is possible to produce thirty different signals. If each signal is composed of six impulses, sixty two different signals or characters can be produced at the receiving station, and so on.

The principle of the invention and much of the apparatus hereinafter described, are applicable to many different industrial uses, and may be employed wherever it is desired to produce, by electrical impulses, distinct mechanical effects. Thus I contemplate employing certain features of the invention in railway block signaling systems, in an automatic telephone exchange apparatus, and in various other ways.

Such parts of the invention as are susceptible of various uses are designed to be covered broadly herein, and not to be limited specifically to a printing telegraph system.

In applying the principle of my invention, it is first necessary to provide a transmitting apparatus, or device whereby a distinct combination of electric impulses for each character or signal is produced and sent to line. These impulses are sent to line through the operation of a rotary-circuit-maker, (actuated by clock-work, or by any suitable mechanism) which, in performing a single revolution, operates say five contact points or springs, if that be the maximum number of impulses necessary to form any signal or character. The number of operating impulses sent to line at a revolution of the circuit-changer, and the interval between them will be determined by a combination forming device, having a key for each character to be formed. In a printing telegraph system, it is of course necessary that the transmitter at each station should have the capacity to produce all the signals comprised in the code; but in other systems (such as telephone signaling, block signaling, &c.) a different signal or group of signals is assigned to each local station, all being connected with a common receiving apparatus capable of responding by a distinct mechanical action to each of the entire code of signals. The depression of a key at the key-board, or other equivalent operation, releases the circuit-maker from an arresting pin, permitting it to make a single revolution, and it also connects certain of the contact points through the main battery with the line, in such manner that the pre-determined group and arrangement of impulses, representing the character assigned to that particular key, will be thrown upon the line. The currents used may be all of one polarity; but in that case it will be necessary to depend upon the synchronous movement of the receiving apparatus or distributer. It is preferred, therefore, to use reversals of current in connection with a polarized relay of special construction, as hereinafter explained. In this case the circuit-maker will, at each contact point, send an impulse to line, those which I have termed "operating impulses" being all of the same polarity the others being of the opposite polarity, and being designed merely to operate the circuit-maker or distributer of the receiving apparatus, so that the proper circuit at the receiving station will be closed when one of the operating impulses is thrown upon the line. The circuit-connections of the branch circuits terminating at the contact points of the circuit-maker, are controlled by a series of pole-changers, one for each branch. In the printing telegraph system herein described there are five pole-changers. Each normally connects its branch to line through say the positive pole of the battery, so that the circuit-maker in passing each contact point would send a positive impulse to line. The depression of a key on the key-board actuates one or more of these pole-changers, so that at one or more of the contact-points the

circuit-maker will send a negative, instead of a positive impulse to line. The details of this part of the apparatus may be varied in many ways, and while I will hereinafter explain that construction which I have found to be most simple and effective, I do not wish to be understood as limiting myself thereto. Having obtained, by the making and breaking of five branch circuits, twenty-eight distinct signals, any one of which may be produced at a single rotation of the circuit-changer, it is necessary to provide apparatus at the receiving station, so constructed that each distinct signal may produce a distinct effect. This effect may be the operation of one lever of a type-writer or printing machine, or the bringing into printing position of a particular type, or the operation of any audible or visual indicating device, which can be recognized as representing the particular signal which set such device in operation. In the simplest form in which I have embodied it, the receiver consists of a series of rods, one corresponding to each character embraced within the adopted code of signals, and specially devised selecting mechanism, whereby each signal is caused to select and actuate its appropriate rod. The selecting mechanism comprises a series of controlling bars crossing the rods at right angles, and an actuating magnet for each bar. In the system herein described for purposes of illustration, there will be five of these controlling bars, one for each of the contact points on the transmitting circuit-maker, and twenty eight signal actuating rods. Each group of impulses, representing a letter or character, actuates one or more of the controlling bars, which in turn operates that particular rod which corresponds with the bar or group of bars so actuated, all other rods being simultaneously held out of action. The actual mechanical details of the bars and rods will be hereinafter explained. Each bar-operating magnet is in a branch separate from the other magnets, and each of these local branches terminates at one of the five contact points of the receiving circuit-maker or distributer. This distributer is similar to that at the sending station, but preferably has a step-by-step movement, resting for an instant at each of the contact points. If while resting at point No. 1 an operating (negative) impulse comes from the sending station, this impulse causes (through the action of a relay) a current to pass over the branch of bar-magnet No. 1, and operates selecting bar No. 1 and so on. The distributer is preferably driven at a greater speed than that at the sending station, so that it is sure to arrive at each of its resting points when the transmitting circuit-maker passes over its corresponding contact point. In so passing the latter sends to line either a positive or a negative impulse. In the former case, the only consequence is to release the distributer which immediately passes to the next resting point. If the impulse here is of opposite polarity to that at first supposed, the distributer is released as before, and in addition, through the operation of the polarized relay magnet, the circuit of the bar-operating magnets is closed through that bar-magnet which is connected with this contact point. The polarized relay magnet has two armatures controlling parallel local circuits, one of which includes only the escapement or release magnet of the distributer, and the other includes this magnet, and also the bar operating magnets. One armature is operated to close its circuit by currents of positive polarity, and the other by currents of negative polarity. The armatures are so disposed with reference to the poles of the magnet that when the main circuit is broken each armature is attracted to and normally remains in its resting position. The particular construction of this relay magnet, which will be hereinafter fully described, constitutes a special feature of the invention.

The main object of the present invention is to produce a simple and efficient printing telegraph system, whereby messages may be transmitted and reproduced at a high rate of speed, namely at a speed approximating that of an expert type-writer. All printing telegraphs, so far as I am aware, which have gone into industrial use heretofore, include a printing wheel at the receiving station, the operation of which is necessarily slow. In my system the proper keys or rods of the receiver respond instantly to the signals with which they correspond. Moreover, the combination-forming mechanism, is believed to be simpler in construction and more rapid in action than any heretofore devised.

In order that the invention may be fully understood I will now describe in detail a printing telegraph system embodying the same, reference being had to the accompanying drawings which form part of this specification.

Figure I, is a plan view of the transmitting or combination forming device. Fig. II, is a longitudinal section of line II. Fig. III, is a rear elevation. Fig. IV, is a partial side view on a larger scale, certain parts being broken away or omitted. Fig. V, is a diagram illustrating the circuit connections of the system. Fig. VI, is a sectional elevation of the polarized relay magnet. Fig. VII, is a plan view of the apparatus at the receiving station (not including any printing or recording mechanism). Fig. VIII[a], is a detail view showing the escapement. Figs. VIII and IX are elevations from opposite sides of the selecting mechanism. Fig. X, is a rear elevation of the same. Fig. XI, shows in detail one of the selecting bars and one of the individual signal rods. Fig. XII, is a diagram showing a line having terminal and intermediate stations. Fig. XIII, is a side elevation showing the selecting mechanism connected with one form of recording mechanism. Fig. XIV, is a side view of the printing mechanism; Fig. XV, an eleva-

tion from the rear of the platen or printing cylinder; Fig. XVI, a view of the type-holding cylinder developed into a plane. Fig. XVII, is a detail of the feed-magnet; Figs. XVIII and XIX cross-sections on a much enlarged scale showing the type when at the printing point; Fig. XX, a detail in plan of one end of the platen; Figs. XXI and XXII details on a large scale of the mechanism for giving a printing stroke; Fig. XXIII, a detail in elevation looking at the left end of Fig. XVI; Fig. XXIV, a detail, greatly enlarged, of some of the type distributing guides; Fig. XXV a sectional detail of some of the type receiving channels, and Fig. XXVI, is a detail view of the shaft of the type-carrying magnet.

The apparatus illustrated in the drawings is designed to produce twenty eight distinct signals or characters by a combination of five impulses. These impulses are sent to line from a main battery M. B, (Fig. V) through the action of a revolving arbor A, which constitutes or carries a circuit-maker, and which is actuated by a clock-train A′ or other suitable motor. At equal distances around the arbor A are disposed five pairs of contact springs at the points I, II, III, IV, V. These contact points are the terminals of the five battery branches a', a^2, &c. As arbor A makes one rotation it will (if the circuits of all the branches are complete) send to line five short impulses at equal intervals apart, and the polarity of these impulses will depend upon which terminal of each pair of contact points of the branches a', a^2, &c., is at the time connected with the positive pole of the main battery M. B.

As shown in Figs. I and II the pairs of contact points are represented by springs a^7 and the arbor A has two contact plates A^4 A^5 so placed as to make contact, simultaneously with the two springs of each pair. One plate A^4 is permanently connected with the main line L by line spring A^6 (Fig. II) and the other with the earth by spring A^8. In the diagram (Fig. V) I have for convenience shown the contact plates A^4 A^5 on the end of an arm A^2 carried by arbor A, and the contact points of the battery branches are shown arranged in such position that the plates A^4 A^5 will respectively make contact at the same moment with one of the pair of contacts, and so close a circuit to line L. Arbor A carries also a trailing arm A^3, whose function will be presently explained. It will be assumed, in this instance, that the combinations which are to form the code of signals, are composed of negative impulses; that is, that it is only the negative impulses sent to line at the contact points I to V which are to actuate the selecting magnets of the receiver. As an illustration, let it be assumed that the letter F is represented by the combination 2, 3, 5. To transmit that character the circuit maker A^2 should send to line negative impulses at the points II, III and V, and positive impulses at the points I and IV. Therefore the apparatus must be so constructed that, when the operator desires to transmit the letter F, the branches a^2, a^3 and a^5 will all connect the negative pole of the battery M. B with line contact A^4 and the branches a' a^4 will connect the positive pole with the line contact. These connections will vary for each letter according to the combination by which it is arbitrarily represented.

The combinations are formed at the apparatus B which consists of an upright frame to which is connected a key-board similar to that of a type-writer. Any mechanical device, which an operator can manipulate to designate different characters may be employed in this part of the system, but a key-board has certain well known advantages, and is therefore preferred.

The connections of the local branches are reversed at will by a series of five circuit-changers or pole changers B', B^2, &c., one in each branch. These consist, as shown, of pivoted levers arranged for sake of compactness, three on one side and two on the other of the frame. Each lever has two contact plates b, b'. The former on each lever is permanently connected with the positive pole of the battery M. B., the latter with the negative pole (see Fig. V). Near each end of each lever are two contact springs c, c' the latter being connected with what may be called the earth wire c^2, of one of the local branches, and the former with the line wire c^3 of the same branch. In the normal position of each circuit changer what may be termed its positive end b is in contact with line spring c, and its other end with earth spring c'. It is obvious that when tilted slightly (as shown in the case of the levers B^2, B^3 and B^5 Fig. V) these connections will be reversed, and that to make up any combination it is only necessary to reverse the proper circuit-changers. This is the function of the vertical rods d' d^2., &c, of which there are one for each character, and mechanical connections are provided such that on lifting a rod, its movement will shift those circuit changers which produce the combination corresponding to the character represented by that rod. Each pole changer has a long operating bar B^6 extending across the entire series of vertical rods, the operating bar of each rod being at a different elevation from any of the others. Each vertical rod has one or more projecting arms d so placed as to engage and move one of the operating bars upon the elevation of the rod to which it (the arm) is attached. Each rod d', d^2, &c., differs from every other, either as to the number or position of its projecting arms, so that each rod will operate a distinct combination of pole-changers. Thus the rod d'^7, which corresponds with the letter F has its arms so placed that it will actuate pole-changers B^2, B^3, B^5 and no other rod will actuate this particular combination of pole changers. Each vertical rod is con-

nected by a lever f, with a finger key f' of the key-board, and by these means any combination may be formed by depressing the appropriate key.

Two other functions are necessary to make the transmitting apparatus complete; first the depression of any key must initiate a revolution of circuit-maker A, and second, the parts must all be returned to their normal position in the brief interval between the striking of successive keys.

Under the key levers f is a rocking frame G, pivoted at g, its forward end being in such position that it will be depressed each time a key is struck. Its rear end carries bracket g' in which is pivoted a tooth g^2, which on its ascent strikes and oscillates a tripping lever g^3. The forward end of the latter enters a slot in the stop-bar g^4, and when this curved end moves downward, it withdraws said bar from the path of the stop arm g^5 carried by arbor A of the clock-train, and permits this arbor to make one revolution. As soon as tooth g^2 passes the tail of lever g^3, the spring g^6 at once returns stop-bar g^4, so that even if the operator should keep his finger on the key, the arbor A will be arrested at the completion of its revolution. Tooth g^2, which is held rigidly in its ascent by spring g^7, can tilt in descending, and so pass the tail of trip lever g^3.

I will now explain how each key is held down during the entire revolution of the circuit-maker, and restored to its normal position as soon as the revolution is completed. Each key-lever f has on its under side a hook f^2, and when a key is depressed its hook will be caught by a spring-actuated rock-bar f^3. So long as this key is depressed the circuit connections of the branches a' a^2, &c., made by it will remain established. The bar or catch f^3 is connected by the rods f^4 f^5 (both of which are pivoted to the oscillatory arm f^6) to the armature h of the restoring magnet H. The circuit 30 of this magnet includes springs 31, 32 whose resiliency tends to keep them apart. When, however, the circuit-maker is at rest its arm A^3, heretofore referred to, presses upon and closes the circuit at this point. As soon as arbor A begins its revolution arm A^3 releases the springs and opens the circuit of the restoring magnet H which remains open until the revolution is completed, whereupon the circuit is closed, magnet H energized, and bar f^3 withdrawn. This circuit 30 also includes contact springs 33, 34, arranged under the rocking frame G, at which point the circuit is normally open, so that no current flows in the circuit when the instrument is out of use. When frame G is tilted by the depression of a key it closes the circuit at 33, 34, at the same time that it is opened at 31, 32, so that when arm A^3 reaches the latter point the circuit will be completely closed.

I will now describe the apparatus at the receiving station. This comprises (see Fig. VII) the polarized relay I, the distributer K, and the selecting mechanism S whereby the combinations are resolved into the different characters which they represent. The polarized relay consists of a curved permanent magnet i, to the lower end of which are attached the cores terminating in pole pieces i', i^2. These pole pieces are consequently of like sign, say south poles. To the upper end of the permanent magnet are pivoted the two tongues or armatures j j', which constitute the north poles of the magnet. These armatures are arranged one above the other. The armature j', is set nearer to the pole i', and the armature j nearer to the pole i^2. Consequently when the coils of the magnet are not in circuit with a battery, the permanent magnetism attracts the armatures in opposite directions, each resting against an insulated point j^2 or j^3. The coils J J' are wound in opposite directions. Consequently a positive current will neutralize or completely reverse the polarity of pole i' and reinforce that of pole i^2. The armatures therefore will both be attracted toward the latter, but j alone will move, j' being held by its insulated stop. A current of opposite direction will produce the contrary effect, causing tongue j' to move toward pole i'. Thus with this relay I obtain the sensitive action (due to the absence of springs) which characterizes the Siemens relay, and also am enabled to control one circuit with positive impulses and another with negative impulses. Armature j, responding to a positive impulse, closes circuit of the escapement magnet of the distributer by contact with the point j^5. Armature j' touches two contact points j^6, j^7, the former being in the circuit of the escapement magnet and the latter in the circuit of the circuit-making arm k^3 of the distributer.

The distributer K comprises an arbor k rotated by a suitable spring-motor at a speed somewhat greater than that of the circuit-making arbor A of the transmitter. The movements of this arbor are controlled by an escapement lever k' actuated by the armature m of an escapement magnet M whose circuit is closed by the relay at every impulse coming from the transmitting station. Arbor k therefore moves step by step, and completes its revolution in five movements, one for each of the five impulses which make up a signal. In its revolution the circuit-closer k^2, carried by arbor k, touches each of the five contact springs marked N', N'', N''', N^{iv}, N^{v}, which are the contact springs of the five bar-operating magnets or as they may be conveniently termed "selecting magnets," and correspond in position with the five contact points of the transmitting circuit-maker.

In the diagram Fig. V the circuit closer k^2 is shown as an arm, and the branch contacts N', &c., as plates or points instead of springs.

It will be convenient here to trace the circuits of the distributing device and the es-

capement magnet. When armature j moves toward pole i^2 in response to a positive impulse, it touches point j^5, and closes a circuit from the positive pole of the local battery L^3 to the escapement magnet M, thence to contact point j^5, to armature j, and back to the battery. When a negative impulse shifts armature j' it also closes the circuit of the escapement magnet by touching point j^6 which is electrically connected with point j^5. It also touches point j^7 closing a circuit which may be traced from local battery L^3 by wire 34, to armature j', point j^7 and thence by wire 35 to arbor k and arm k^2. As the latter will at this moment be resting on one of the points N', N'', the circuit will continue by one of the branches, marked o' to o^v, to the corresponding selecting magnet O', O'', &c., and thence by the common return wire 36 to the battery.

The selecting mechanism S involves a principle of construction similar to that of the combination-forming mechanism of the transmitter. It comprises a series of upright rods S' S^2, &c., corresponding to the rods d' d^2 of the transmitter, and each representing a distinct character or signal, and a series of transverse bars S' S'' S''', &c., capable of a slight longitudinal movement. In Fig. XI is shown a top view of bar S' and also a side view of rod S^{14}. The former has at certain points notches 40, and the latter has corresponding lugs 41, these lugs being just above the bar and a little to one side of the notches 40 when the parts are in their normal position. When a bar is shifted its notches will all be brought into register with those lugs which are just above it, and consequently the rods to which such lugs are attached are free to descend so far as that bar is concerned.

The displacement of one or more bars is necessary to release any rod, and each rod is controlled by a distinct combination of bars. For example the letter F, represented by the combination 2, 3, 5 and to which rod S^{17} corresponds, is controlled by bars S'' S''' S^v. These bars therefore will have each a releasing notch adjacent to a lug of rod S^{17}. Some rods are held only by a single bar. Thus the rod representing letter E is held only by bar S'. Since this bar enters into many combinations, it is evident that at the formation of any such combination the letter E would be indicated by the dropping of its rod, unless provision to prevent this were made. It will be observed that all the rods are upheld by a stop-bar T extending across the top of the frame, this stop-bar being controlled by a magnet T' (herein called the release magnet) whose circuit is closed as hereinafter explained, after the selecting bars have been operated. Hence when bar S' is shifted, letter E does not immediately drop, for the signal when arriving may be a combination of No. 1 with other numbers. In this case I utilize the movement of the other bar or bars making up the combination to lock the rod corresponding to letter E, and this principle of interlocking is applied to all the bars and rods. Thus bar S' (Fig. XI) has at each point of intersection with a rod where there is no releasing notch 40, a locking lug 42, and the rods adjacent thereto have corresponding notches 43, and it will be evident upon calculation that where twenty-eight characters are to be formed by a combination of five elements three of the selecting bars will have fourteen and the other two will have thirteen releasing notches 40, there being locking lugs 41 at each of the other intersections.

The shifting of any bar occurs when the armature (P', P^2, &c.,) of its selecting magnet is attracted, the armature striking the end of the bar and giving it the required movement. The circuits of the bar magnets have already been traced, and it will be understood how each signal selects and operates the combination of bars which control the corresponding rod.

The operation of the release magnet T' is necessary to drop the rod. This magnet is in a branch circuit of local battery L^3, which branch is normally open at the springs 45, 46 on the distributer. The circuit is as follows (Fig. V): from spring 45 to magnet T', thence by wire 37 to wire 36, to battery L^3 and by wires 38, 39 to spring 46. Just before the arbor k completes its revolution, the arm k^3 presses together springs 45, 46 and immediately releases them, thus momentarily closing the circuit of magnet T', depressing stop-bar T and permitting the selected rod to drop. The selecting bars are all returned to their normal positions by the action of the restoring plate U, carried by the armature U' of the restoring magnet U^2. This magnet is in a circuit which branches from the circuit of the release magnet T' at the point 52; thence it proceeds to magnet U^2 by wire 41, by wire 42 to finger t^3, to tongue t' of the armature when said tongue momentarily touches the armature, as presently explained and by wire 43 to wire 36, and thence through battery L^3 and by wire 38 back to the point 52. When armature t descends, its tongue t' depresses an insulating block t^4 (Fig. VII) carried by the bent lever t^2, and brings the metallic finger t^3 of this lever into such position that electrical connection is made with it by the tongue t' when the latter again rises, which it does immediately. This contact closes the circuit of restoring magnet U^2, which becomes energized, attracts its armature and operates the restoring plate U, returning all the selecting-bars to their normal positions. Plate U has a projection u which in this movement of the armature strikes the end of rod u' connected with lever t^2, and returns said lever to its normal position. Thus the movement of the armature of the restoring magnet U^2 breaks the circuit of that magnet.

To summarize the operations that occur during one rotation of the distributer, the circuits of one or more of the selecting magnets are closed at the contact points of the

distributer, the corresponding selecting bars are shifted, the circuit of release magnet T′ is closed depressing the stop-bar T and permitting the selected rod to drop, the last named circuit is instantly broken (when arm K^3, Fig. V, has passed springs 45, 46) and armature t is retracted by its spring, lifting the said rod. The tongue t' on its return closes the circuit of restoring magnet U^2 by making contact with finger t^3 of lever t^2, the restoring plate U shifts the selecting bars back to their normal positions and breaks the circuit of the restoring magnet by oscillating lever t^2 of said lever out of contact with tongue t', and all is again in readiness for the next signal.

From the foregoing description it will be seen how two stations, properly equipped with line batteries, may communicate with each other; but it is desirable that provision should be made whereby a line having a number of intermediate stations may be operative for communication between such intermediate stations in either direction, with line batteries only at the terminal stations. The difficulty to be overcome in making this provision is to give each station complete control of the direction of impulses on the line. The manner in which this object is attained will be understood from the following explanation taken in connection with Fig. XII, in which A^9, A^{10}, A^{11}, A^{12} represent stations connected by a single line. The main batteries at the terminal stations are divided into two groups M B and M B′, the same pole in each being connected to line. Between each group of batteries at each station is a switch s by which one group may be switched out. As shown in the diagram both groups of batteries at terminus A^{12} are in circuit, and but one group at the other station, this being the condition when station A^{11} desires to communicate with station A^{10}, or any station to the left of it. In the condition here represented, in which the transmitter at station A^{11} is supposed to be communicating with the receiver at A^{10}, it is evident that when the circuit is completed through the entire line from earth at A^{12} to earth at A^9, a current will flow in the direction of the single headed arrow, and the strength of the current will be proportional to the difference of energy between the two groups of batteries at the former station, and the single group at the latter station, the batteries being connected in opposition, that is, with like poles to line. On the other hand when, by the action of the rotating arm A^2 of the transmitter at A^{11}, the circuit is grounded at that station, the batteries at A^{12} will be cut out, and the current will flow through the receiving station A^{10}, from the batteries at station A^9. The direction of this current will, of course, be that indicated by the double-headed arrow. Thus we have a means whereby the operator at station A^{11} can produce impulses of either direction in the receiving instrument at A^{10}. The contact points I to V at the transmitter at A^{11} are, as shown, so connected that an impulse from the batteries at station A^{12}, will be thrown upon the line at points I and IV and an impulse from the batteries at A^9 at points II, III and V. Thus when arm A^2 closes the contact points I the circuit is made through contacts I from the stronger batteries at A^{12} through the weaker batteries at A^9. But when arm A^2 rests on the contacts II it will be seen that the batteries at A^{12} are entirely disconnected and an impulse in the opposite direction passes from batteries at A^9 through points II to the earth. Thus station A^{11} has complete control of the direction of the impulses on the line. To communicate in the opposite direction it is only necessary by an agreed signal to switch in all the batteries at A^9 and cut out one group at A^{12}. In other words the preponderance of electric pressure must be behind the transmitting station.

For sake of simplification and clearness the pole-changing devices are omitted, it being obvious that their operation is precisely as before described.

As already stated, the dropping of the rods S′, S^3, &c., may be utilized in various ways. For example each rod may control the type-bar of a type-writing machine. This plan is illustrated in Fig. XIII. In this figure R represents a printing magnet, which gives a printing stroke through a lever or striker R′. Each type-bar Q has an arm Q′ to receive the impact of the striker R′, and each arm has at its free end a pivoted finger q flexibly connected by a spring q' with one of the rods S′. Finger q is normally in such position as to be clear of striker R′; but when rod S′ drops, the end of the finger q is pushed by projection q^2 into the path of the striker R′. The latter now makes its stroke depressing arm Q′ and operating the type-bar connected therewith. This farther descent of finger q is permitted by the spring q'. The circuit of printing magnet R is closed when the head bar T drops and makes contact with a spring r' from which a wire 47 runs to local battery L B′. The circuit continues from this battery by a wire 48 to the magnet R, and from the magnet by a wire 49 to the frame of the selecting mechanism, which is in metallic contact with the head bar T.

Another and preferred form of recording mechanism is illustrated in Figs. XIV to XXVI, whereby the dropping of one of the bars S′, S^2, &c., is caused to release a movable type, bring the same to the printing point, take an impression therefrom, and return the type to its original position, the object being to reproduce the message upon a printed page, as in a type-writer.

The type-holder is in the form of a cylinder 60 having a series of type-channels 61, one for each type 62, the latter being in the form of a block of iron or steel with a raised letter on the face. The type normally stand at the end of their channels near the top of the cylinder, each type being held by a piv-

oted stop 63. From this point downward the sides of the type holder *y* converge forming a chute leading to the point 64 forming from that point down to the printing point a vertical type-channel 65 whose shape is shown in Figs. XVIII and XIX. Just before reaching this channel the type brushes against an inking roller 66. After passing the printing point the common type channel *y* communicates with a series of individual type channels, the entrance to each of the latter being guarded by a pivoted gate having two arms 67, 68. When the gate is open the arm 67 stands across the common type channel and deflects the type into its individual channel. The releasing stop 63 and the corresponding gate 67 are actuated by a sliding wire 69 having an operating lever 70, and working in guides 80, formed in a strip 81 crossing under partitions 82 of the type-channels. (See Figs. XXIV, XXV.) When lever 70 is struck, as by one of the character rods S, wire 69 trips stop 63, and a lug 83 (Fig. XXIV) on the lower side thereof, tilts a horizontal lever 71, opening the gate corresponding to the stop 63. Consequently a type will fall to the printing point, and the guiding gate of the channel to which the type belongs will be opened ready to guide it back to its normal position. As the type re-enters its channel it brushes against wing 68, closing the gate behind it.

The return of the type after printing is effected by a rotatory type-carrier, shown as a permanent magnet 72 carried by an arm 73 which is feathered on the shaft 74, so that it can move lengthwise thereof while rotating therewith, (Fig. XXVI) this lateral motion taking place when the arm leaves the common type channel W for that to which the type individually belongs. Shaft 74 is turned by a weight 75 through gearing as shown in Fig. XIV. Magnet 72 has a tongue 76 which can slide in slots in the end of the poles of said magnet 72 and projects into the path of the type-channel 65 (Figs. XXI and XXII). The type-block has a groove in its under side, which receives tongue 76, and the latter carries a little shelf 77 upon which the type is caught as it falls to the printing point. The magnet is held in the position shown in Figs. XIV and XXII by stops 78 which are caught by the ends of the forked printing lever 79. (Fig. XXII.) This is the normal position of these parts. The groove in the type may be enlarged at its bottom as shown in Fig. XIX.

The platen or printing roller 85 is supported in bearings in a carriage 86 having wheels 87 upon which the carriage can move lengthwise of the platen. A step-by-step movement is given to the carriage by the mutilated gear wheel 90 which engages a rack bar 91 on the carriage, moving the latter and lifting a weight 92 (Fig. XV). A stop pawl 93 prevents the weight from pulling back the carriage until the end of the line is reached. When the pin 94 on bar 91 strikes the pivoted cam arm 95, the latter lifts pawl 93, releasing the bar, and weight 92 returns the carriage and roller to the starting point. At the end of this return movement a pin 96 throws cam 95 in the other direction, releasing pawl 93.

On the same shaft with the mutilated gear 90 is a disk 97, having on its outer face a toothed ring 98, with which engages a pawl 99. The latter is carried by a lever 100 to one arm of which is attached the armature 101 of the feed-magnet 102. The latter is connected in circuit with a local battery 103 (Fig. XXVII) the wires of which run to the insulated plates 104, 105, which form the extremities of the type-chute or channel. Consequently, when a type falls to the printing point it closes the circuit of the feed magnet, causing the shaft of disk 97 and wheel 90 to turn one step. Disk 97 has a cam groove 125 into which projects the end of printing lever 79. The latter is thereupon actuated, striking pins 106 on sliding tongue 76, and impressing the type upon the paper carried by platen 85. The retractile spring 107 withdraws the tongue, and the cam groove moves the lever back far enough to release the stops 78 on the magnet 72, leaving the latter free to rotate under the force of weight 75. The movement of the armature of the feed-magnet also feeds the carriage forward one step, the feed taking place after the printing stroke has been made. As the magnet 72 carries the type around the cylinder 60, it enters that channel 61 whose gate stands open, and so brings the type around to the upper side of the cylinder. The type chute *y*, on which the type descend to the printing point, is a plate with upturned edges, and its upper end (see Fig. XVI) terminates in a series of teeth 110 with intervening slots, their teeth being under the point where the stops 63 are located. When the carrying magnet 72 brings the type to the end of plate *y*, the tongue 76 passes between two adjacent teeth 110, the type pass ing above these teeth, and the poles of magnet 72 being beneath them. As shown in Fig. XIV the arc of plate *y* is eccentric to the shaft 74, diverging outwardly from the center of that shaft, so that the tongue 76 can pass under the plate, while the type being above it is stripped from the magnet 72, and comes to rest at the stop 63, which is replaced by a small spring shown in Fig. XIV. From the point 64 down to the printing point the type-channel is vertical, so that the magnet comes to rest after completing its revolution, with its tongue 76 protruding through the slot 111 (Fig. XVI) in the type channel, ready to receive the next type that may be released. When the carriage 86 is returned after printing a line to the starting point, it is necessary that platen 85 should turn the space of a line. The line spacing mechanism (which may be of various kinds) is shown in Figs. XV, XX and XXIII. The end of platen 85 is provided with a ring of teeth 114 having one side inclined, and adjacent to this end of the platen is a ring 115 hav-

ing a row of corresponding teeth 116, and on its opposite face another set of teeth 117 which engage teeth 118 on the fixed support 119. Ring 115 is carried by a pin 120 capable of rotating and also of sliding in a bearing of support 119, the latter movement being limited by a pin 121. A weight 122 tends to turn the disk in a direction opposite to that in which the platen is to be rotated, and a pin 123 (Fig. XXIII) entering a slot in the disk limits the movement of the disk in this direction. When platen 85 returns to the left (Fig. XV) its teeth engage teeth 116 of disk 115 tending to turn the platen in the direction of the arrow. The disk is engaged on the other side by the teeth of the fixed support 119, and consequently it turns a certain distance with the platen, lifting weight 122. When platen 85 has moved as far as it can to the left, it will have turned a distance equal to the distance between the teeth, which can be made as great as desired. When the platen is fed away from disk 115, the latter is returned by weight 122 to its first position ready for another feed, and at the same time owing to the inclination of the teeth 117 and 118, moves slightly away from support 119, but not far enough to disengage these teeth, this movement being limited by pin 121. By these means platen 85 is rotated one step each time it is pulled back to the starting point by weight 92. A roll 120 supplies paper to the platen 85.

From the foregoing explanation it will be obvious to persons skilled in the art to which this invention relates that parts or elements of the system could be omitted or modified, or other mechanisms having similar functions substituted therefor, without departing from the spirit of the invention, and that certain portions of the system could be used for purposes other than those herein mentioned. It is therefore to be understood that the invention is not limited to the details of construction described and shown.

What I claim is—

1. In a printing telegraph system, the combination of a transmitting circuit-maker in the main-line, a series of battery branch terminals in the path of said circuit-maker, a circuit-changer in each of said battery-branches, and a series of keys each operating a distinct combination of circuit changers, whereby signals, composed each of a distinct arrangement of impulses may be sent to line, as set forth.

2. An electric signal transmitting device, comprising in combination a rotary main-line circuit-maker, a series of branches leading from a battery to terminals in the path of said circuit-maker, a series of circuit-changers, one in each branch, a series of keys each representing a different character, and connections between said keys and circuit-changers, whereby each key operates a distinct combination of circuit-changers and sends to line a signal made up of an impulse or group of impulses differing in number of impulses or the intervals that separate them, substantially as described.

3. In an electrical signaling transmitting apparatus, the combination of a rotary main line circuit-maker, a series of battery branches connected to terminals in the path of said circuit-maker, a pole-changer or current reverser in each branch, and a series of keys each operating a distinct combination of pole-changers, whereby the normal connections of any one or more of the battery branches at the points of contact with the circuit-maker may be reversed by striking the proper key, substantially as described.

4. In an electrical signaling transmitting instrument, the combination of a main line circuit-maker, a series of battery branches adapted to be connected to line by said circuit-maker, a series of circuit-changers one in each branch, a series of keys exceeding the number of circuit-changers, a series of rods one connected with each key, actuating bars for said circuit-changers, and projecting arms on said rods for operating said bars, each rod having a distinct number or arrangement of arms, so that it actuates a distinct combination of circuit-changers, substantially as described.

5. The described combination-forming mechanism, comprising the combination of finger-keys, a series of rods, one for each key, each rod having one or more projecting arms, and a series of transverse bars, arranged relatively to said rods and arms as set forth, so that each rod actuates a distinct bar or combination of bars, substantially as described.

6. The combination with the main line circuit-maker, the finger-keys, pole-changers and key-levers and connections whereby the said pole-changers are actuated from the said key-levers, of a catch or holder for engaging a key when depressed, a releasing magnet for withdrawing said catch, a circuit including said magnet, and contacts controlled by said circuit-maker for closing the circuit of said magnet at the proper time, substantially as described.

7. In an electrical signaling system, the combination with a transmitting apparatus adapted to send to line impulses of either polarity, of a polarized relay magnet having its coils wound in opposite directions and provided with two vibrating tongues each set nearer to one of the poles than to the other so that one is normally attracted in one direction and the other in the opposite direction, and local circuits having contacts controlled by said tongues, as set forth.

8. The combination in a polarized relay, of a permanent magnet having at one end two reversely wound coils with their cores at one end, and at the other end two pivoted tongues free to vibrate between the extremities of the cores, one being normally attracted by the permanent magnetism toward one of the cores, and the other toward the opposite core, where-

by the tongues will respectively respond to currents of opposite polarity, as set forth.

9. The combination with a transmitting apparatus including a rotary circuit-maker and a series of battery branches connected to terminals arranged at suitable distances apart in the path of said circuit-maker, of a distributer comprising a circuit-maker and terminal contact points corresponding with those of the transmitting apparatus, escapement mechanism for arresting the arm of the distributer at each contact, an escapement magnet for releasing the distributing arm at each impulse traversing the line from the transmitting station, and a motor for driving said arm at a greater speed than the circuit-maker of the transmitting station, substantially as described.

10. The combination with a transmitting apparatus including a rotary circuit-maker, a series of battery branches connected to terminals in the path of said circuit-maker, pole changers, one in each branch whereby a current of either polarity can be sent to line at each contact point, a polarized relay at the receiving station controlling two local circuits, a distributer in one of said circuits controlling contacts in branches corresponding with battery branches of the sending station, driving mechanism for said distributer, an escapement therefor, and an escapement magnet in both of the said local circuits, substantially as described.

11. The combination of a series of parallel selecting bars, a magnet for moving each bar independently of the others, and a series of transverse rods intersecting said bars and normally upheld by lugs, said bars having release notches adapted to register with said lugs when the bar is moved by its magnet, substantially as described.

12. The combination of a series of selecting bars, electro-magnetic operating mechanism therefor, a series of rods each controlled by a bar or combination of bars, a head bar normally upholding all the rods, and means for depressing said head bar when the desired selecting bar or combination of bars has been operated, substantially as described.

13. The combination of a series of parallel selecting bars having release notches and locking lugs, a series of transverse rods each controlled by a distinct bar or combination of bars, and each having notches and lugs adapted to register with certain of those on the selecting bars, and means for moving any bar or combination of bars longitudinally, thereby releasing one of the rods and locking all the others, substantially as described.

14. The combination of a transmitting apparatus comprising a rotating circuit-maker, a series of contact points in the path thereof, pole-changers one in the circuit of each contact point circuits and connections whereby a series of impulses of negative or positive polarity may be thrown to line during the rotating of the circuit-maker, a distributer at the receiving station comprising a rotating arm adapted to move in unison with the transmitting circuit-maker, a series of contacts in the path of said arm corresponding in number and location with the contact points at the transmitting station, a polarized relay in the main line controlling the circuits through the contact points of the distributer selecting magnets in separate branches terminating each at one of said contacts, selecting bars actuated each by one of said magnets, and a series of rods each controlled by one of said bars, or by a combination of bars, substantially as described.

15. The combination with the selecting bars and the rods controlled thereby, of a magnet for each selecting bar, and a restoring magnet and its circuit and connections as set forth for restoring the selecting bars to their normal positions, substantially as described.

16. In an electrical signaling system comprising terminal and intermediate stations connected by a line conductor, the combination of a transmitting apparatus at the several stations adapted to send signals composed of groups of impulses of positive and negative polarity, main batteries at the two terminal stations of the line, switches whereby a portion of the batteries at one or the other may be cut out, and circuit connections between the line and the local transmitters, whereby to send currents in one direction both the terminal batteries are included in circuit, and to send reverse currents the stronger group of batteries are cut out and the line completed to earth at the transmitting station, thereby giving each station while transmitting complete control of the polarity of the line, substantially as described.

17. The combination with the selecting mechanism comprising a series of selecting bars, electro-magnetic actuating mechanism therefor, and character rods each actuated by a distinct bar or combination of bars, of recording mechanism, whereby the movement of each rod is recorded, said recording mechanism comprising a series of movable-types, means for displacing each type from its normal position when the corresponding rod is actuated, a printing lever, and a single printing magnet common to all the type substantially as described.

18. In an electric printing telegraph system, the combination with the receiving apparatus having a series of movable rods, one for each character or signal, of a series of movable type, controlling devices for each type actuated respectively by the movement of one of said rods, a printing lever or striker and its actuating magnet common to all the type for giving a printing stroke to the type when brought to the printing point, and restoring devices for returning the type to their normal positions, substantially as described.

19. The combination of a type-holder having a series of independent type-channels converging to a common printing point, and re-

turn channels diverging therefrom, a series of stops normally holding the type in position above the printing point, a series of gates separating the return channels from the common type-channel, means for actuating each stop and its corresponding gate, a type-carrier and its actuating mechanism for carrying the type from the printing point to its normal position, a movable platen or printing roller, and a printing lever and its actuating mechanism, substantially as described.

20. The combination of a type-holder having a series of independent type-channels converging to a common printing point, the path of the type being inclined downward to said point so that the type can fall thereto by gravity, a type-carrier adapted to arrest the falling type at the printing point, a printing lever and its actuating mechanism, and means for actuating said carrier to return the type to its normal position, substantially as described.

21. The combination of the type-holder, the series of independently movable type supported normally above a type-chute leading to a common printing point, means for releasing at will any type, a printing platen mounted on a movable carriage, a feed-magnet controlling the movements of said carriage, and an electric circuit including said magnet and having normally open terminals in the path of said type and adapted to be closed thereby, substantially as described.

22. The combination of the type-holder, the series of independently movable type supported normally above a type-chute leading to a printing point, means for releasing at will any type, a printing platen mounted on a movable carriage, a printing lever, a feed-magnet, an electric circuit including said magnet and having terminals adapted to be closed when the type falls to the printing point, a shaft adapted to be rotated by the armature of said feed magnet, and mechanical connections for actuating said carriage and printing lever from said shaft, substantially as described.

23. The combination of the type-holder, the independently movable type made of magnetic material, means for bringing any desired type to the printing point, the platen and its movable carriage, the printing lever, the type-carrier in the form of a magnet, and means for actuating said carrier to return the type to its normal position in the holder after the printing lever has operated, substantially as described.

24. A printing telegraph system comprising in combination the following elements: a series of key-levers representing the several signals comprised in the code, a series of circuit changers, each lever controlling a distinct circuit-changer or combination of circuit-changers, a series of battery-branches, each including one circuit-changer, a series of normally open terminals for said branches, a rotating circuit-maker adapted to make contact with said terminals successively, a polarized relay at the receiving station adapted to close a local circuit on receiving a positive impulse and another circuit on receiving a negative impulse, a rotatory distributer, escapement mechanism therefor controlled by a magnet in both of said local circuits, so as to move in unison wth the transmitting circuit-maker, contacts in the path of said distributer corresponding in number and position with the battery terminals of the transmitter, a series of branch circuits leading from said contact points and each including a selecting magnet, a series of selecting bars one for each magnet, a series of character rods each operated by a distinct bar or combination of bars, and each corresponding with a particular key-lever at the transmitting station, a type-holder having a series of type-channels converging to a common printing point, an arresting stop in each channel, means for releasing each type on the movement of the corresponding character rod, a type-carrier adapted to convey the type from the printing point to its normal position, a printing platen, a carriage therefor, a printing lever, a feed magnet in a circuit whose terminals are normally open in the path of the type and adapted to be closed thereby, connections actuated by the armature of said feed magnet for operating said printing lever, and for feeding said carriage forward one step, a weight for returning said carriage to the starting point, and means for turning the platen the space of a line at each return movement of said carriage, substantially as described.

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

ALFRED S. McCASKEY.

Witnesses:
PHILIP MAURO,
REEVE LEWIS.