No. 897,662. PATENTED SEPT. 1, 1908.

A. M. ROBERTS.

TELEGRAPHIC SELECTIVE SYSTEM.

APPLICATION FILED DEC. 6, 1906.

7 SHEETS—SHEET 1.

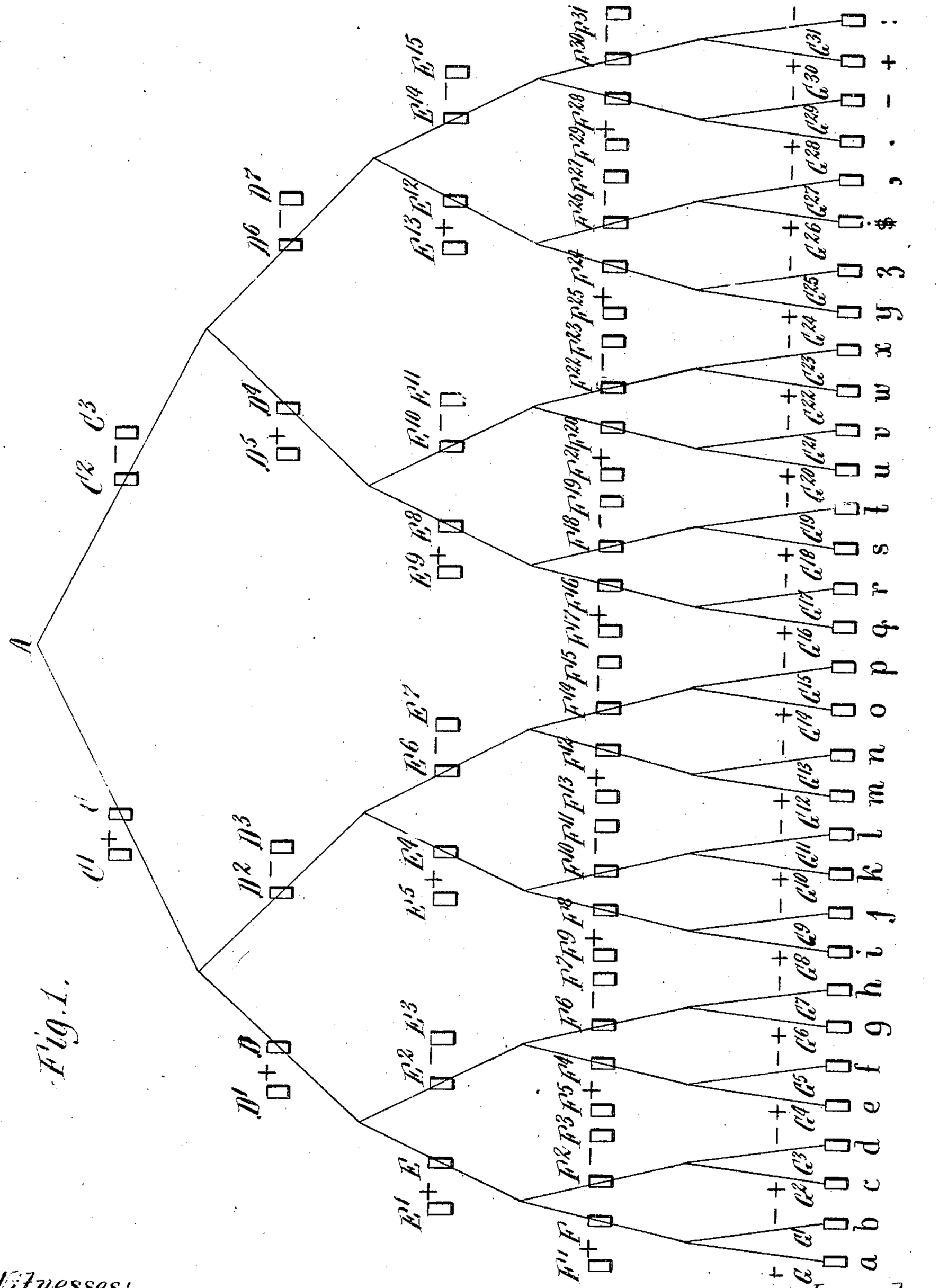

Fig. 1.

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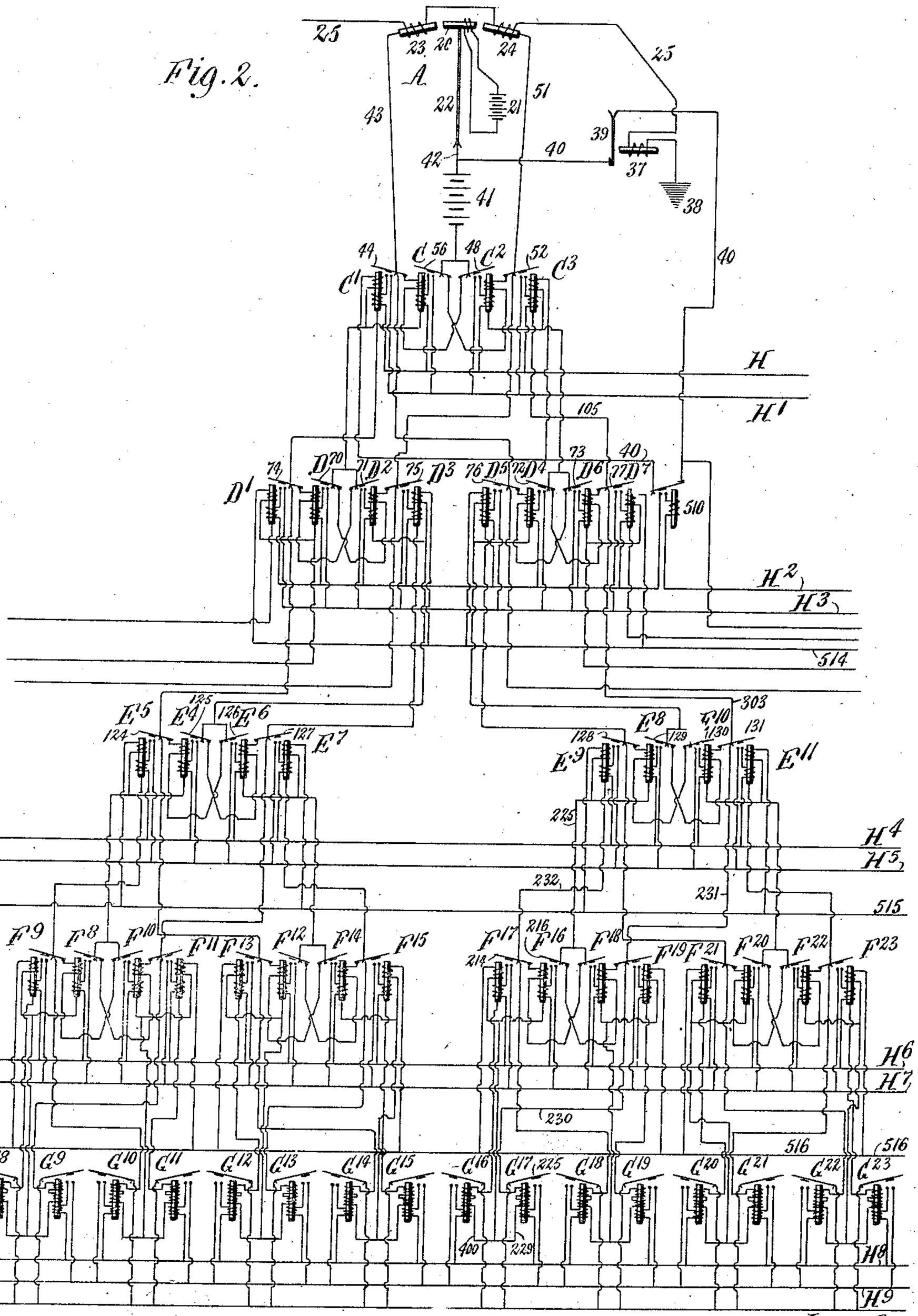
7 SHEETS—SHEET 2.

Fig. 2.



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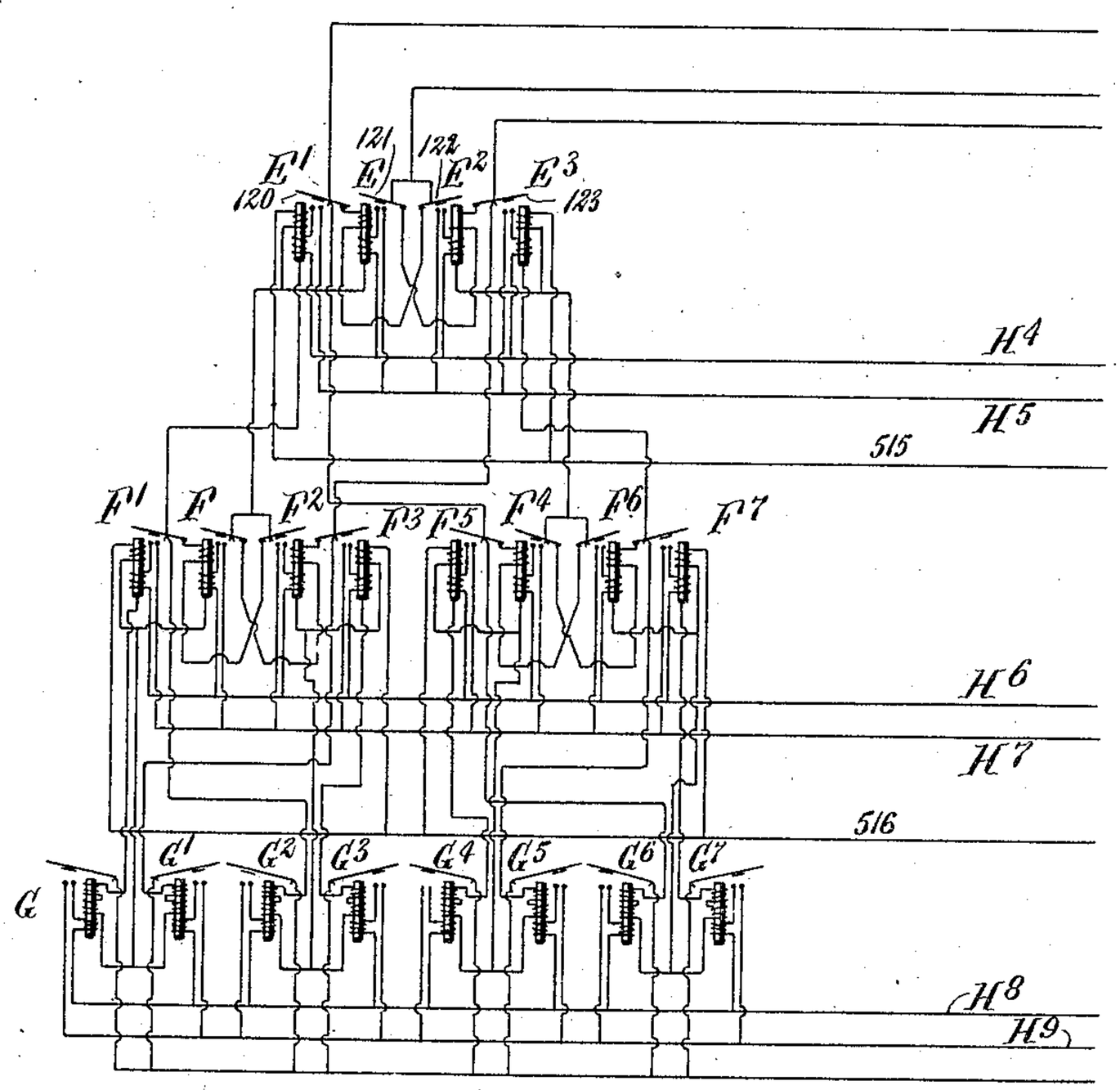
7 SHEETS—SHEET 3.

Fig. 3.



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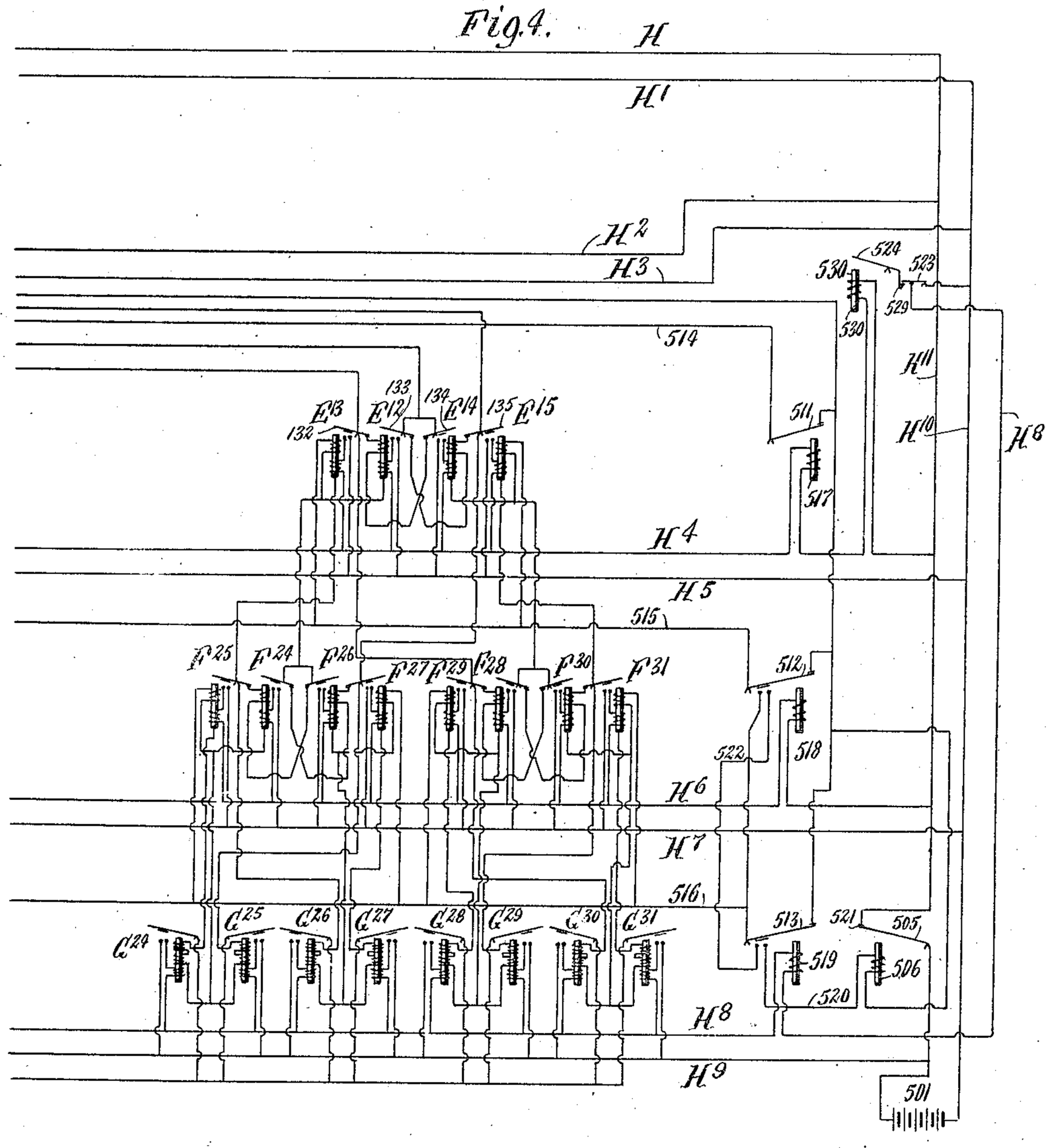
7 SHEETS—SHEET 4.

Fig. 4.



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7 SHEETS—SHEET 5.

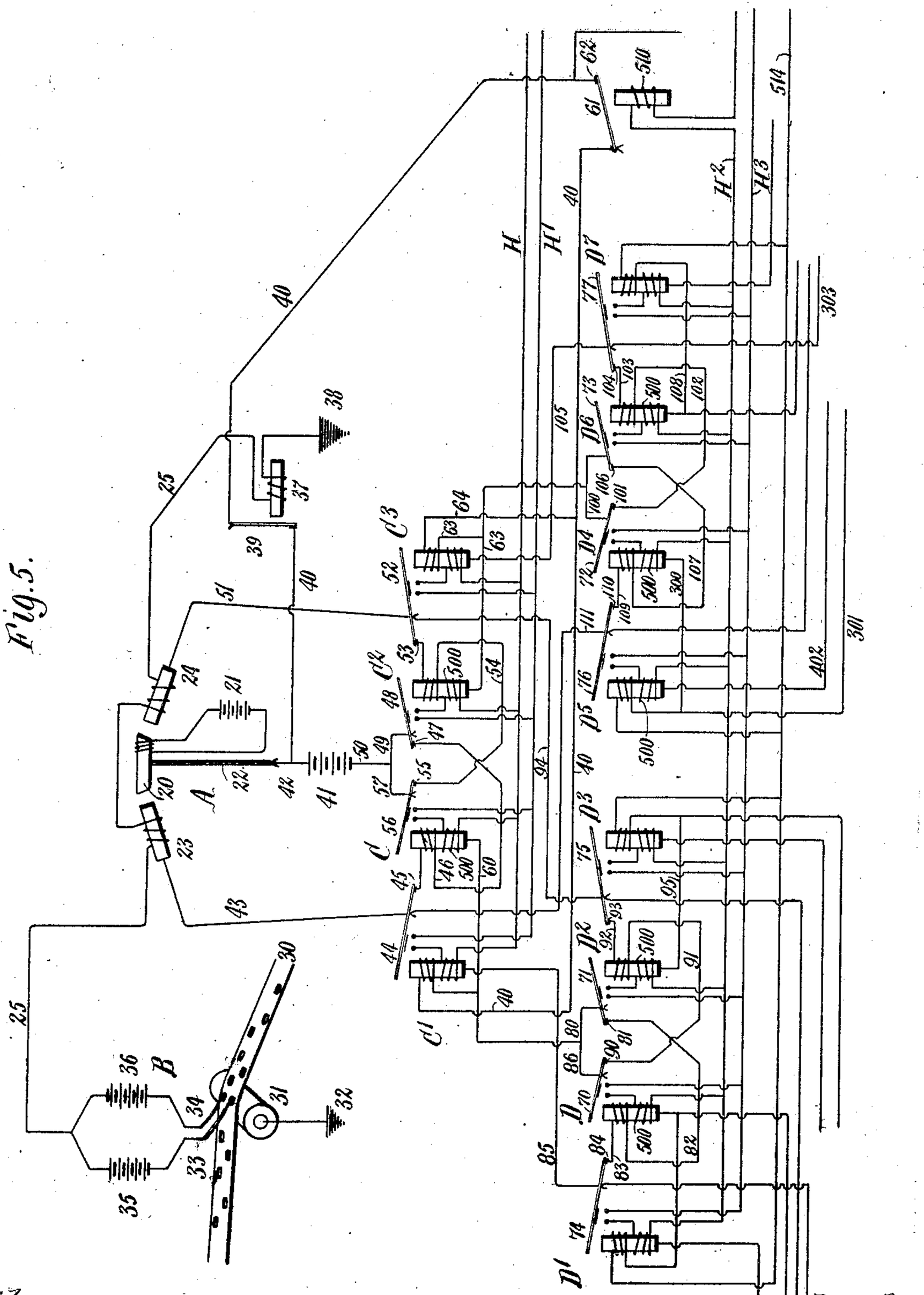

Fig. 5.

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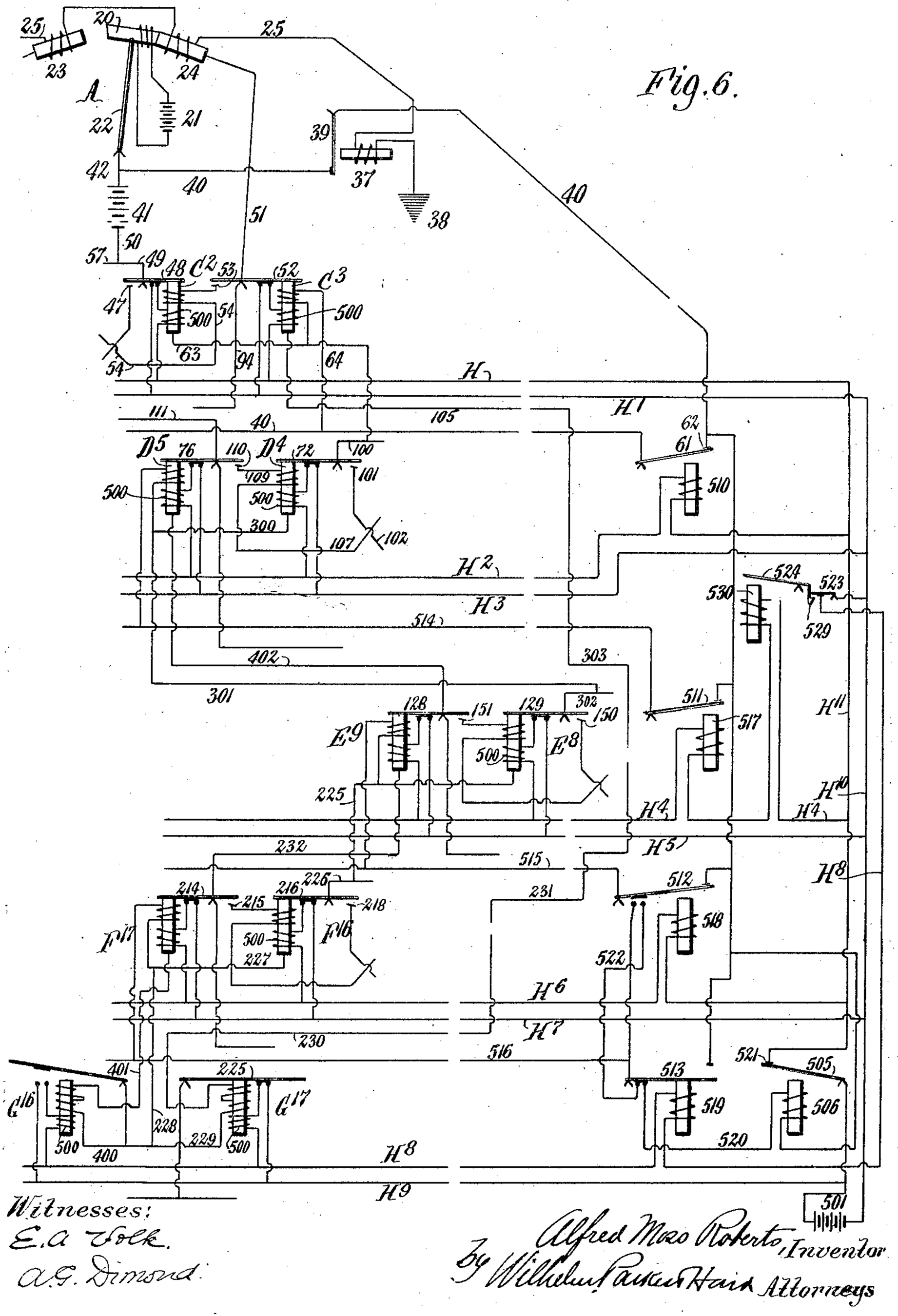
7 SHEETS—SHEET 6.

Fig. 6.



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APPLICATION FILED DEC. 6, 1906.

7 SHEETS—SHEET 7.

Fig. 7.

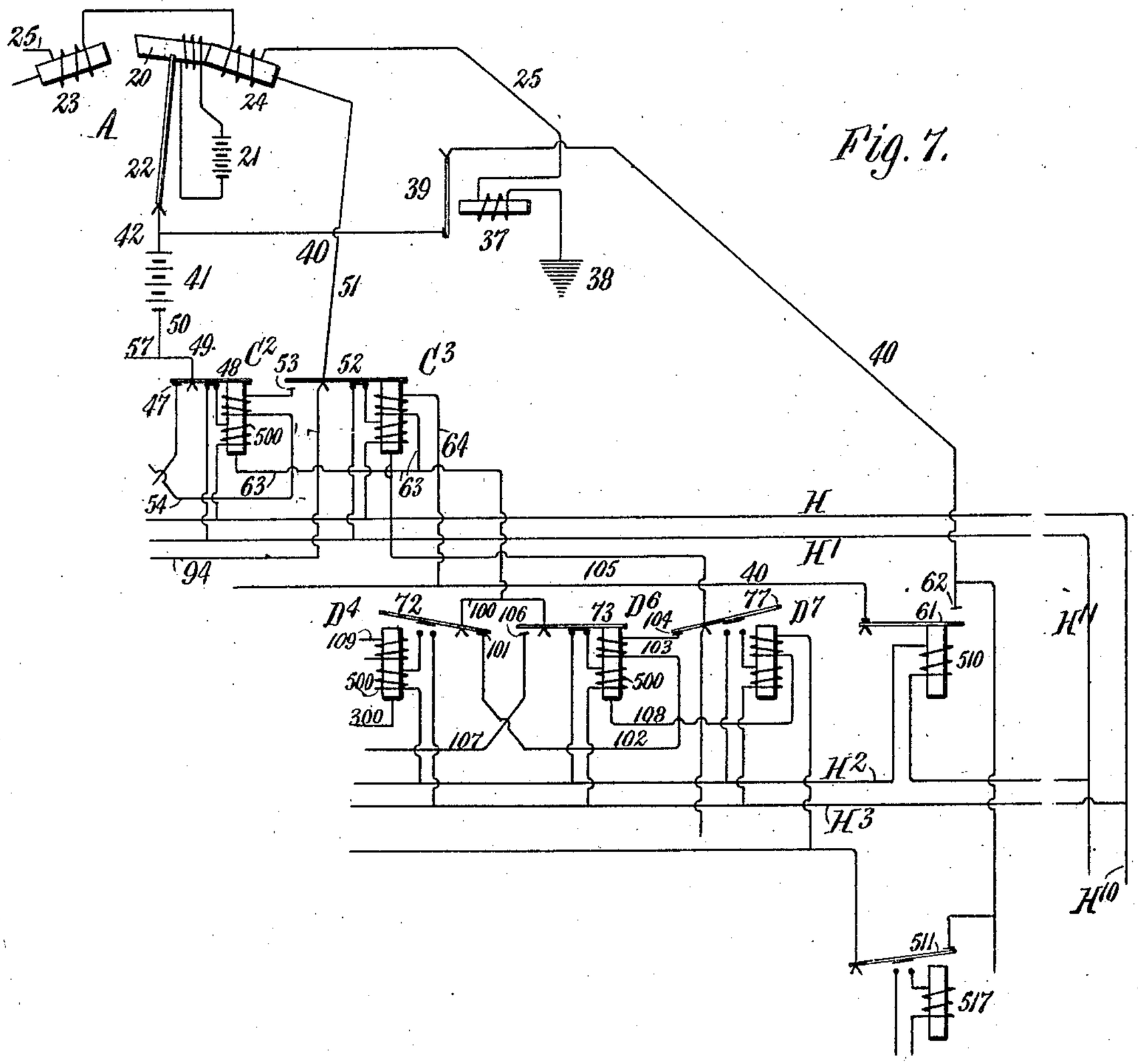
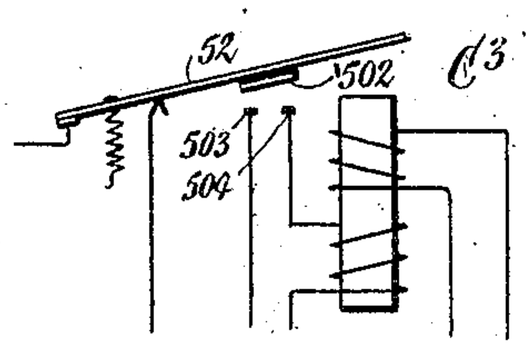


Fig. 8.



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UNITED STATES PATENT OFFICE

ALFRED MOSS ROBERTS, OF BUFFALO, NEW YORK.

TELEGRAPHIC SELECTIVE SYSTEM.

No. 897,662. Specification of Letters Patent. Patented Sept. 1, 1908.

Application filed December 6, 1906. Serial No. 346,641.

To all whom it may concern:

Be it known that I, ALFRED MOSS ROBERTS, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Telegraphic Selective Systems, of which the following is a specification.

This invention relates to that class of telegraph systems in which each letter, character or signal is transmitted by a number of successive electric impulses, which are automatically switched or directed to the individual mechanism or instrumentality which causes the printing, recording or indicating of such particular letter, character or signal.

In the telegraphic system which forms the subject matter of this application each letter, character or signal is transmitted and represented by the same number of successive impulses and both positive and negative impulses are employed, the different letters, characters or signals being identified and differentiated by the order of the successive impulses. These impulses may be of the same length or duration and need not be any longer than necessary to effect the desired movement or action in the receiving instrument. The number of impulses which are employed for each letter, character or signal may be more or less as the number of different letters, characters or signals which are to be transmitted may render necessary. For illustration, if the system requires the transmission of letters, characters or signals not exceeding thirty-two in number, five impulses for each character or signal will suffice. In such a system the letter "a" may be represented and transmitted by five successive plus impulses (+ + + + +), the letter "b" by four plus and a final minus impulse (+ + + + −), the letter "c" by three plus, a minus, and a final plus impulse (+ + + − +), and so on. These impulses actuate a relay which is moved out of its normal or zero position by each impulse and this movement of the relay takes place in one direction if the transmitted impulse is plus and in the opposite direction if it is minus. These movements of the relay cause a current to be sent by successive automatic switching devices to the individual magnet by which the transmitted letter, character or signal is recorded or indicated.

The apparatus contains as many series of magnets and switches as successive impulses are contained in the group which represents a character. The apparatus represented in the accompanying drawings is constructed for a group of five impulses and contains five series of magnets and switches. The first impulse of the group is directed to a magnet in the first series; the second impulse to a magnet in the second series; the third impulse to a magnet in the third series; the fourth impulse to a magnet in the fourth series, and the fifth impulse to a magnet in the fifth or last series, which magnet causes the printing, recording or indicating of the specific letter, character or signal represented by the group of impulses. Each switching operation after the first is controlled by and dependent upon all of the prior switching operations which have already been effected.

In the accompanying drawings, consisting of seven sheets: Figure 1 is a diagram illustrating the general scheme of switching through the different series of magnets. Figs. 2, 3 and 4 are diagrams representing, respectively, the central, the left hand portion and the right hand portion of the apparatus. Fig. 5 is a diagram, on an enlarged scale, showing the first and second series of magnets and connecting parts. Fig. 6 is a fragmentary diagram, showing magnets in all of the five series and the circuit breakers in the binding circuits. Fig. 7 is a fragmentary diagram, showing some of the magnets of the first and second series and connecting parts in different positions. Fig. 8 is an enlarged view of one of the magnets.

Like letters and numerals of reference refer to like parts in the several figures.

A represents the actuating relay which may be of any suitable construction causing the relay to be moved out of its normal or zero position in one direction when a plus impulse is received and in the opposite direction when a minus implus is received. In the construction shown the relay is an electro-magnet 20 which is energized by a battery 21 and mounted on an elastic arm 22 between two impulse receiving magnets 23 and 24. The latter are energized by the impulses received over the main line 25 in which these magnets are arranged. These magnets are so wound that the poles which they present to the poles of the relay magnet 20 are energized in the same sense, both plus or both minus, by the same impulse which passes through the windings of both magnets. One pole of the relay magnet is therefore adjacent to a like pole and the

other adjacent to an unlike pole of the impulse receiving magnets, and one pair of poles act to attract and the other to repel the relay magnet, so that both forces tend to move the relay magnet in the same direction. One of the impulse receiving magnets 23 or 24 may be replaced by an iron abutment and a permanently polarized armature may be substituted for the electro-magnet 20. The relay is held in its normal or zero position, shown in Figs. 2 and 5, by the elastic arm 22 on which it is mounted, or by other suitable means.

The impulses may be produced at the sending station B by any suitable means, for instance, as indicated in Fig. 5, by a perforated ribbon 30 passing over a conducting roller or surface 31, which is grounded at 32, and two brushes 33 34 adapted to make contact with the roller through two rows of perforations in the strip which represent the letters, characters or signals to be transmitted. These brushes are connected with two batteries 35 36 in such manner that one brush produces plus impulses and the other minus impulses. The main line 25 extends through the winding of a circuit breaking magnet 37 and is grounded at 38. This magnet is energized every time an impulse passes through the main line, and opens a circuit breaker 39 in a zero indicating line 40.

The impulses are sent successively through the main line 25 and each impulse causes the relay magnet 20 to move out of its normal or zero position in one or the other direction, according to the nature of the impulse. Upon the cessation of each impulse the relay magnet is returned to its zero or normal position by the reaction of the spring arm to which it is attached, or other suitable means.

For the purposes of this description it will be assumed that the winding of the impulse receiving magnets 23 and 24 is such that a plus impulse will cause the magnets 23 and 24 to present their positive poles to the relay magnet. When a plus impulse is sent through the main line the core of the relay magnet 20 will be moved against the impulse receiving magnet 23, and when a minus impulse is sent the relay magnet will be moved against the magnet 24, as represented in Figs. 6 and 7. A group of five successive impulses will move the relay magnet in this manner five times in succession out of its normal position. This movement of the relay magnet 20 is utilized to send a current through one of two selecting magnets C and C^2. If the relay is actuated by a plus impulse the plus magnet C is energized and if a minus impulse is sent the minus magnet C^2 is energized. The current for energizing the magnets is generated in a battery 41 which is connected with the relay in such manner that the movement of the relay by a plus impulse closes a circuit through the selecting magnet C, while the movement of the relay by a minus impulse closes a circuit through the selecting magnet C^2. The drawings show a simple and convenient way of arranging the necessary conductors for this purpose by utilizing the spring arm 22 of the relay 20, the core of this relay and the cores of the impulse receiving magnets 23 and 24. The battery 41 is connected with the spring arm 22 by a conductor 42 and the spring arm is connected with the core of the relay magnet. The core of the receiving magnet 23 is connected by a conductor 43 with an armature switch 44 making contact, in its normal position, with the contact 45 of a conductor 46 in which the coil of the plus selecting magnet C is arranged and which extends from that coil to a contact 47. An armature switch 48 makes contact with the latter in its normal position and a branch conductor 49 extends from that switch to a conductor 50 which connects with the battery 41. The core of the receiving magnet 24 is similarly connected with the coil of the minus selecting magnet C^2 by a conductor 51, an armature switch 52, contact 53, a conductor 54, in which the coil of this selecting magnet is arranged and which extends from that coil to a contact 55, an armature switch 56 and a conductor 57 which connects with the conductor 50 leading to the battery 41.

When the core of the relay magnet 20 is thrown into contact with the core of the receiving magnet 23 by a plus impulse, the circuit is closed through the coil of the plus selecting magnet C and the current runs from the battery 41 through the conductor 42, spring arm 22, the core of the relay 20, the core of the receiving magnet 23, conductor 43, and described connecting parts and energizes the magnet C. If the relay magnet is thrown into contact with the core of the receiving magnet 24 by a minus impulse, the current is closed through the coil of the minus selecting magnet C^2 and the current runs through the conductor 51 and described connecting parts and energizes this magnet.

When the plus selecting magnet C is energized it attracts the armature switch 56, which in its normal position, shown in Fig. 5, is in contact with the contact 55 of the conductor 54, and this breaks the circuit through the conductor 54, the coil of the minus selecting magnet C^2 and the conductor 51 at the contact 55 and cuts out the minus selecting magnet C^2 and connecting parts.

When the minus selecting magnet C^2 is energized it attracts the armature switch 48, which in its normal position, shown in Figs. 2 and 5, is in contact with the contact 47 of the conductor 46, in which the coil of the plus selecting magnet C is arranged, and breaks the circuit at the contact 47, thereby

cutting out the magnet C and connecting parts.

The plus selecting circuit is closed through the armature switch 48, which is under the influence of the minus selecting magnet C^2, and the minus selecting circuit is closed through the armature switch 56, which is under the influence of the plus selecting magnet C. By energizing one of these selecting magnets the circuit through the other is opened and the parts controlled by such magnet are rendered inactive. In order to make sure that the effect of one impulse is exhausted before the next following impulse takes place, in other words, to avoid conflict between or a running together of successive impulses, a secondary or auxiliary magnet is combined with each selecting magnet in such manner that the secondary circuit, in which the coil of such secondary magnet is arranged, is closed so long as the relay stands in its zero or normal position and is open when the relay is moved out of this position by an impulse.

C^1 represents the secondary magnet of the plus selecting magnet C and C^3 the secondary magnet of the minus selecting magnet C^2. In the drawings the selecting magnets are indicated by reference letters with even exponents or without exponents and the secondary magnets by reference letters with odd exponents.

The core of each selecting magnet is connected with the coil of its secondary magnet in such manner that when the selecting magnet is energized a circuit is closed through the coil of the secondary magnet. The core of the plus selecting magnet C is connected by a conductor 60 with the coil of its secondary magnet C^1 and this coil is connected with the conductor 40 of the zero indicating circuit, in which the circuit breaker 39 is arranged. This line also contains an additional circuit breaker 61 which makes contact in its normally closed position with the contact 62.

When the plus selecting magnet C is energized it attracts its armature switch 56 and this closes a circuit through its core. The current now passes from the battery 41 through the conductor 40, the circuit breaker 39, the circuit breaker 61, the coil of the secondary magnet C^1, the conductor 60, the core of the selecting magnet C, the armature switch 56 and the conductors 57 and 50 back to the battery. The core of the minus selecting magnet C^2 is connected by a conductor 63 with the coil of its secondary magnet C^3 and this coil is connected by a conductor 64 with the conductor 40.

When the minus selecting magnet C^2 is energized it attracts its armature switch 48 and this closes a circuit through its core. The current now passes from the battery 41 through the conductor 40, the circuit breaker 39, the circuit breaker 61, the conductor 64, the coil of the secondary magnet C^3, the conductor 63, the core of the selecting magnet C^2, the armature switch 48, and the conductors 49 and 50 back to the battery. These secondary circuits are closed only when the circuit breaker 39 is closed and this circuit breaker is closed only when no current is passing through the main line 25 and the coil of the magnet 37. When an impulse passes through the main line the magnet 37 is energized and this opens the circuit breaker 39 and holds the zero indicating line 40, which forms part of such secondary circuit, open so long as current passes through the main line. The zero indicating line 40 and the secondary circuit are closed when the impulse ceases and the secondary magnet is now energized. The secondary magnet now attracts its armature switch and this establishes a circuit through the core of that magnet, while the circuit through the coil of its selecting magnet is opened, thus compelling a subsequent current through the selecting circuit to pass through the core of the secondary magnet and not through the coil of the selecting magnet. This renders a subsequent current through the selecting circuit of no effect upon the selecting magnet. For illustration, when the plus secondary magnet C^1 is energized it attracts its armature switch 44, whereby the circuit through the coil of the selecting magnet C is opened at the contact 45 and a circuit is established through the core of the secondary magnet C^1.

The first impulse of a transmitted group of impulses, representing a certain letter, character or signal, acts through the relay upon one of the selecting magnets C and C^2 and its armature switch in such manner that it first causes the corresponding selecting magnet to ture switch, and this opens the circuit through be energized. This magnet attracts its armathe other selecting magnet and at the same time establishes a circuit through the core of the selecting magnet and the coil of the corresponding secondary magnet. This last named circuit is, however, not completed until the first impulse has ceased. When this takes place the circuit breaker 39 in the secondary circuit 37 is closed and this completes the circuit through the coil of the secondary magnet. The latter is now energized and attracts its armature switch and this cuts out the coil of the corresponding selecting magnet, rendering that magnet inactive, and establishes a circuit through the core of the secondary magnet. The current from the battery 41 now passes through the coil of the secondary magnet until the next following impulse passes through the main line, when the circuit breaker 39 is opened and the secondary circuit is broken.

The first series of selecting magnets comprises the described plus and minus selecting magnets C C^2 and their secondary magnets C^1

C^3. This first series of selecting magnets is followed by a second series which comprises two groups of magnets, each consisting of a plus and a minus selecting magnet and two corresponding secondary magnets. One of of these groups is controlled by the plus magnet C and the other by the minus magnet C^2 of the first series.

Leaving the secondary magnets out of consideration, the general scheme of automatic switching may be explained by reference to the diagram Fig. 1, as follows: The current from the battery 41 is switched by the action of the relay under the first impulse to the plus selecting magnet C, if a plus impulse is received, or to the minus selecting magnet C^2, if a minus impulse is received. The second impulse causes the current to be switched to one of the selecting magnets of the second series. If the first impulse was plus and the second impulse is also plus, the current is switched to the plus magnet D of the second series. If the first impulse was plus and the second is minus, the current is switched to the minus magnet D^2 of the second series. If the first impulse was minus and the second impulse is plus, the current will be switched to the plus magnet D^4 of the second series, and if the second impulse was also minus the current will be switched to the minus magnet D^6 of the second series. The third impulse causes the current to be switched to a selecting magnet of the third series. For illustration, if the first and second impulses were plus and the third is also plus, the current will be switched to the plus magnet E of the third series, and if the third impulse is minus the current will be switched to the minus magnet E^2.

The described switching of the system, in which each selecting magnet of one series controls a plus and a minus magnet in the next following series, can be extended through as many series of selecting magnets as may be necessary to reach the number of final actuating magnets which the system requires. In the apparatus represented in the drawings the selecting magnets of the fourth series are marked F F^2 F^4 F^6 to F^{30} and their corresponding secondary magnets F^1 F^3 F^5 F^7 to F^{31}, and the final actuating magnets, thirty-two in number, are marked G G^1 G^2 to G^{31}.

D^1 D^3 D^5 D^7 represent the secondary magnets of the selecting magnets D D^2 D^4 D^6, respectively.

70 71 72 and 73 represent the armature switches of the selecting magnets D D^2 D^4 D^6, and 74 75 76 and 77 represent the armature switches of the secondary magnets D^1 D^3 D^5 D^7 of the second series.

The operation of the second series of magnets may be explained as follows: If the first impulse has been plus, the secondary magnet C^1 of the first series has attracted its armature switch 44. If the second impulse is also plus, the circuit through the battery 41 will be closed through the conductors 50 57, armature switch 56, the core of the plus selecting magnet C of the first series, the conductors 60 and 80 leading to the armature switch 71 of the minus selecting magnet D^2 of the second series, the contact 81, the conductor 82 leading to the coil of the plus selecting magnet D of the second series, the conductor 83 leading from that coil to the contact 84, the armature switch 74 of the secondary magnet D^1, the conductor 85 leading to the core of the secondary magnet C^1 of the first series, the core of that magnet, the armature switch 44 thereof, the conductor 43, the core of the receiving magnet 23, the core of the relay 20, the spring arm 22^1 and the conductor 21 to the battery 41. This energizes the plus selecting magnet D of the second series, which magnet attracts its armature switch 70, and this opens the circuit at the contact 90 in the conductor 91 connected with the coil of the minus selecting magnet D^2 of the second series, cutting out that magnet, and closes the circuit through the core of the magnet D and the coil of its secondary magnet D^1. Assuming that the first impulse has been plus and the second minus, the circuit through the battery 41 will be closed through the conductors 50, 57, armature switch 56, the core of the plus selecting magnet C of the first series, the conductors 60 and 86, the armature switch 70 of the plus selecting magnet D of the second series, the contact 90, the conductor 91, the coil of the minus selecting magnet D^2 of the second series, the conductor 92, the contact 93 therein, the armature switch 75 of the secondary magnet D^3 of the second series, the conductor 94 leading from that switch to the armature switch 52 of the secondary magnet C^3 of the first series, the conductor 51, the core of the receiving magnet 24, the core of the relay 20, the spring arm 22 and the conductor 42 to the battery. This energizes the minus selecting magnet D^2 of the second series, which magnet attracts its armature switch 71, breaking at 81 the circuit in which the coil of the plus magnet D is arranged and cutting out that magnet, at the same time establishing a circuit through the core of the minus selecting magnet D^2 and the conductor 95 leading from that core to the coil of the secondary magnet D^3.

The secondary magnet D^1 or D^3 is energized after the second impulse has ceased in the manner which has been described with reference to the secondary magnets C^1 and C^3 of the first series, and this results in the energized secondary magnet attracting its armature, breaking the circuit through the coil of the corresponding selecting magnet and establishing a circuit through the coil of the energized secondary magnet.

The plus and minus selecting magnets D

D^2 and their secondary magnets D^1 D^3 constitute a group on the plus side of the second series, since they are controlled by the plus selecting magnet C of the first series and its secondary magnet C^1, while the plus and minus selecting magnets D^4 D^6 of the second series and their secondary magnets D^5 D^7 constitute a group on the minus side of the second series, since they are controlled by the minus selecting magnet C^2 of the first series and its secondary magnet C^3. The plus selecting magnet D^4 of this last named group is energized if the first impulse has been minus and the second is plus, and the minus selecting magnet D^6 of this group is energized if the first impulse has been minus and the second is also minus. If the first impulse has been minus and the second is also minus, the armature switch 48 of the minus selecting magnet C^2 of the first series has made contact with the core of this magnet and the circuit through the coil of the plus selecting magnet C has been opened at 47, the armature switch 52 of the secondary magnet C^3 has been closed against the core of that magnet, breaking the circuit at 53, as represented in Fig. 7. The circuit through the battery 41 is now closed through the conductor 49, armature switch 48, core of minus selecting magnet C^3, conductor 63, which is connected by conductor 100 with the armature switch 72 of the plus selecting magnet D^4 of the second series, contact 101, conductor 102, the coil of the minus selecting magnet D^6, conductor 103, the contact 104 therein, the armature switch 77 of the secondary magnet D^7, the conductor 105 leading therefrom to the core of the secondary magnet C^3, its armature switch 52, conductor 51, core of receiving magnet 24, and the relay to the battery. The current passing through this circuit causes the minus selecting magnet D^6 to attract its armature 73, breaking the circuit at the contact 106 in the conductor 107 leading to the coil of the plus selecting magnet D^4, and establishing a circuit through the core of the minus selecting magnet D^6 and the conductor 108 leading to the coil of the secondary magnet D^7. The coil of the plus selecting magnet D^4 is connected by a conductor 109 with a contact 110 against which the armature switch 76 of the secondary magnet D^5 rests normally, and this switch is connected by a conductor 111 with the armature switch 44 of the secondary magnet C^1.

The third series of magnets consists of four groups, each controlled by one of the selecting magnets of the second series, as follows: The plus selecting magnet E, the minus selecting magnet E^2 of the third series and their secondary magnets E^1 E^3 are controlled by the plus selecting magnet D of the second series. The plus selecting magnet E^4, the minus selecting magnet E^6 and their secondary magnets E^5 E^7 are controlled by the minus selecting magnet D^2. The plus selecting magnet E^8 and the minus selecting magnet E^{10} and their secondary magnets E^9 E^{11} are controlled by the plus selecting magnet D^4. The plus selecting magnet E^{12} and the minus selecting magnet E^{14} and their secondary magnets E^{13} E^{15} are controlled by the minus selecting magnet D^6. The armature switches 120 to 135 of the third series of magnets are arranged and connected to operate in a manner similar to the armature switches previously described. The fourth series of magnets consists of eight groups, each controlled by one of the selecting magnets of the fourth series, as indicated in the diagram Fig. 1. The plus selecting magnet F and the minus selecting magnet F^2 and their secondary magnets F^1 F^3 are controlled by the plus selecting magnet E of the third series. The plus selecting magnet F^4 and the minus selecting magnet F^6 and their secondary magnets F^5 F^7 are controlled by the minus selecting magnet E^2 of the third series. The armature switches of the fourth series of magnets are arranged and connected to operate like those previously described. The fifth series of magnets G to G^{31} consists of thirty-two actuating magnets arranged in pairs, each pair under the control of one of the selecting magnets of the fourth series. As indicated in Fig. 1, the plus magnet G and the minus magnet G^1 are under the control of the plus selecting magnet F of the fourth series, the plus magnet G^3 and the minus magnet G^3 are under the control of the minus magnet F^2 of the fourth series, and so on.

The operation of these successive series of magnets and switches will be understood from the following illustrations, reference being had to Fig. 6. Assuming that the first impulse was minus, the three next impulses plus and the last impulse minus, the parts which have been actuated will be in the positions represented in Fig. 6. In the first series of magnets the armature switches 48 and 52 of the minus selecting magnet C^2 and its secondary magnet C^3 will rest against the cores of these magnets and the circuits will be broken at the contacts 47 and 53. In the second series of magnets the armature switches 72 and 76 of the plus selecting magnet D^4 and its secondary magnet D^5 will rest against the cores of these magnets and the circuits will be broken at the contacts 101 and 110. In the third series the armature switches 129 and 128 of the plus selecting magnet E^8 and its secondary magnet E^9 are closed against the cores of these magnets and the circuits are broken at the contacts 150 and 151. In the fourth series the armature switches 216 and 214 of the plus selecting magnet F^{16} and its secondary magnet F^{17} are closed against the cores of these magnets and the circuits are broken at the contacts 218

and 215. In the fifth series of magnets the armature switch 225 of the actuating magnet G^{17} is closed. In this position of the parts the circuit through the battery 41 will be closed through the conductors 50, 49, the armature switch 48, the core of the minus selecting magnet C^2, the conductors 63 and 100, the armature switch 72, the core of the plus selecting magnet D^4 of the second series, the conductors 300, 301 and 302, the armature switch 129 of the plus selecting magnet E^8 of the third series, the core of that magnet, the conductors 225, 226, the armature switch 216 of the plus selecting magnet F^{16} of the third series, the core of that magnet, the conductors 227, 228 and 229, the coil of the actuating magnet G^{17}, the conductors 230, 231, 303, 105, the core of the secondary magnet C^3, the armature switch 52, the conductor 51, and so on to the battery. The current from the battery 41 passing through this circuit actuates the final magnet G^{17} and the movement so produced is utilized in any suitable manner to print, record or indicate the letter, character or signal represented by this magnet.

If the fifth impulse had been negative the circuit would have been closed from the conductor 228 through the conductor 400, the coil of the actuating magnet G^{16}, the conductor 401, the core of the secondary magnet F^{17}, the armature switch 214 of that magnet, the conductor 232, the core of the secondary magnet E^9, the armature switch 128, the conductor 402, the core of the secondary magnet D^5, the armature switch 76, and the conductors 111, 43, and so on to the battery. In the last mentioned case the final magnet G^{16} would be actuated. Each magnet is provided with a binding coil 500 which is energized from the battery 501. The binding coils of the several magnets of each series are connected with this battery in parallel. The binding coils of the first series of magnets C C^2 are connected with the conductors H H^1, those of the second series with the conductors H^2 H^3, those of the third series with the conductors H^4 H^5, those of the fourth series with the conductors H^6 H^7, and those of the fifth series with the conductors H^8 H^9. The binding circuit of each magnet is closed when the armature switch of the magnet is closed. This can be done in various ways, for instance, as shown, the armature switch can be provided with an insulated contact piece 502, Fig. 8, which, when the switch is closed against the core, closes the binding circuit by making contact with the contacts 503 and 504.

The binding conductors H H^1 of the first series, H^2 H^3 of the second series, H^3 H^4 of the third series and H^4 H^5 of the fourth series are connected in parallel with the main conductors H^{10} H^{11} of the binding battery 501. A circuit breaker 505 is arranged in the conductor H^{11} so that when the circuit is broken the binding circuits of the first four series of magnets are broken and the closed armature switches of these magnets are released and returned to their normal positions. This circuit breaker is actuated by a magnet 506. The dead point or zero circuit of which the conductor 40 forms part is provided with a circuit breaker 61 which is opened by a magnet 510, the coil of which is arranged in the binding circuit of the second series, for instance, in the conductor H^2, so that when a current passes through this circuit, that is to say, when one of the armature switches of the second circuit is closed, the dead point or zero circuit of the first series of magnets is opened. Similar circuit breakers 511, 512 and 513 are arranged in the zero circuits 514, 515 and 516 of the second, third and fourth series of magnets, which circuit breakers are opened by magnets 517, 518 and 519 in the binding circuits of the third, fourth and fifth series, so that as one binding circuit is closed after another each preceding zero circuit is opened, thereby preventing short circuiting through the secondary magnet of the preceding series.

The coil of the circuit breaker magnet 506 is arranged in a branch 520 of the zero circuit 516. The circuit through this coil is closed only when the circuit breaker 512 has been closed by the operation of the binding circuit of the fourth series under the fourth impulse, and when also the circuit breaker 513 has been closed by the operation of the binding circuit of the fifth series under the fifth impulse, and when finally the circuit breaker 39 of the zero circuit 40 has been closed after the fifth impulse has ceased. This energizes the magnet 506 and breaks the binding circuits of the first four series at the contact 521, releasing all of the closed armature switches of these series without disturbing the closed armature switches of the fifth series. The circuit breaker 512 being operated by the magnet 518 of the fourth series, that circuit breaker is also released and this breaks the circuit through the conductor 522. This breaks the circuit through the coil of the magnet 506, releases the circuit breaker 505 and closes the circuit through the conductor H^{11} and restores the apparatus to the initial position, with the exception of the fifth series, in which the closed armatures are still undisturbed.

The apparatus is now ready to receive the next group of impulses, representing the next letter, character or signal, and the impulses of this next group are received and operate the apparatus in the same manner. When the binding circuit of the third series is closed by the action of the third impulse the binding circuit of the fifth series is broken. This releases the closed armatures of the fifth series and restores this series to

the initial position. The period of time during which the closed armatures of the fifth series are held closed is utilized in effecting the operation which the magnet of the fifth series is required to perform in printing, recording or indicating the transmitted letter, character or signal, whether by operating the key of a typewriter, a chemical printing apparatus, or other means.

The binding circuit of the fifth series is broken by any suitable switch. That which is shown consists of a circuit breaker 523 arranged in the binding conductor H^8 of the fifth series. This breaker is actuated quickly by a switch lever 524 having a spring catch 529 which opens the breaker 523 and allows it to close again. The lever 524 is attracted by a magnet 530, the coil of which is arranged in the binding conductor H^4 of the third series. If preferred, this circuit breaker may be arranged in the second or fourth binding circuit.

I claim as my invention:

1. In a telegraph, the combination of successive series of selecting magnets, the first series comprising a selecting magnet which responds to a transmitted plus impulse and a selecting magnet which responds to a transmitted minus impulse, and each following series comprising a pair of magnets for each selecting magnet of the preceding series, one magnet of the pair responding to a transmitted plus impulse and the other to a transmitted minus impulse, substantially as set forth.

2. In a telegraph, the combination of successive series of selecting magnets, the first series comprising a selecting magnet which responds to a transmitted plus impulse and a selecting magnet which responds to a transmitted minus impulse, and each following series comprising a pair of magnets for each selecting magnet of the preceding series, one magnet of the pair responding to a transmitted plus impulse and the other to a transmitted minus impulse, and automatic switches whereby circuits are closed through different magnets of successive series according to the direction of the transmitted impulses, substantially as set forth.

3. In a telegraph, the combination of a relay which is moved out of the zero position in one or the other direction according to the direction of the transmitted impulse, successive series of selecting magnets, the first series comprising a magnet which responds to a transmitted plus impulse and a magnet which responds to a transmitted minus impulse, and each following series comprising a pair of plus and minus magnets for each selecting magnet of the preceding series, and automatic switches whereby circuits are closed through different magnets of successive series according to the direction of the transmitted impulse, substantially as set forth.

4. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, a plus and a minus selecting magnet which respond respectively to plus and minus impulses acting on the relay, and secondary magnets which are controlled by said selecting magnets and are energized after said selecting magnets have been energized, substantially as set forth.

5. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, plus and minus selecting magnets which respond respectively to plus and minus impulses acting on the relay, secondary magnets which are controlled by said selecting magnets, a circuit in which said secondary magnets are arranged, and an automatic circuit breaker which breaks said circuit when an impulse actuates said relay and closes said circuit after such impulse has ceased, substantially as set forth.

6. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, plus and minus selecting magnets which respond respectively to plus and minus impulses acting on the relay, armature switches for said selecting magnets, corresponding secondary magnets, and circuits in which the cores of said secondary magnets and the armature switches of said selecting magnets are arranged, substantially as set forth.

7. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, plus and minus selecting magnets which respond respectively to plus and minus impulses acting on the relay, corresponding secondary magnets, armature switches for said selecting and secondary magnets, and circuits connecting the coil of each selecting magnet with the armature switch of its secondary magnet, substantially as set forth.

8. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, plus and minus selecting magnets which respond respectively to plus and minus impulses acting on the relay, corresponding secondary magnets, armature switches for said selecting and secondary magnets, and circuits connecting the coil of each selecting magnet with the armature switch of its secondary magnet and with the armature switch of its opposite selecting magnet, substantially as set forth.

9. The combination of a relay which is moved out of its zero position in one or the

other direction according to the direction of the transmitted impulse, selecting magnets which respond respectively to plus and minus impulses acting on the relay, a binding circuit for said magnets, and means for closing and breaking said binding circuit automatically, substantially as set forth.

10. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, selecting magnets which respond respectively to plus and minus impulses acting on the relay, a binding circuit for said magnets, means for closing said binding circuit automatically when said magnets are energized, and means for breaking said binding circuit automatically after the transmitted impulse has ceased, substantially as set forth.

11. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, successive series of selecting magnets, each series comprising magnets which respond respectively to plus and minus impulses acting on the relay, binding circuits for said magnets, means for automatically closing said binding circuits, and means for breaking the binding circuits of successive series of magnets simultaneously, substantially as set forth.

12. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, successive series of selecting magnets, each series comprising magnets which respond respectively to plus and minus impulses acting on the relay, binding circuits for said magnets, means for automatically closing said binding circuits, and means for holding the binding circuit of the last series closed, while the binding circuits or preceding series are broken, substantially as set forth.

13. The combination of a relay which is moved out of its zero position in one or the other direction according to the direction of the transmitted impulse, successive series of selecting magnets, each series comprising magnets which respond respectively to plus and minus impulses acting on the relay, binding circuits for said magnets, means for automatically closing said binding circuits, and means for breaking the binding circuit of the last series upon closing the binding circuit of a preceding series by a subsequent impulse, substantially as set forth.

Witness my hand this 30th day of November, 1906.

ALFRED MOSS ROBERTS.

Witnesses:

EDWARD WILHELM,

C. B. HORNBECK.