L. M. POTTS.

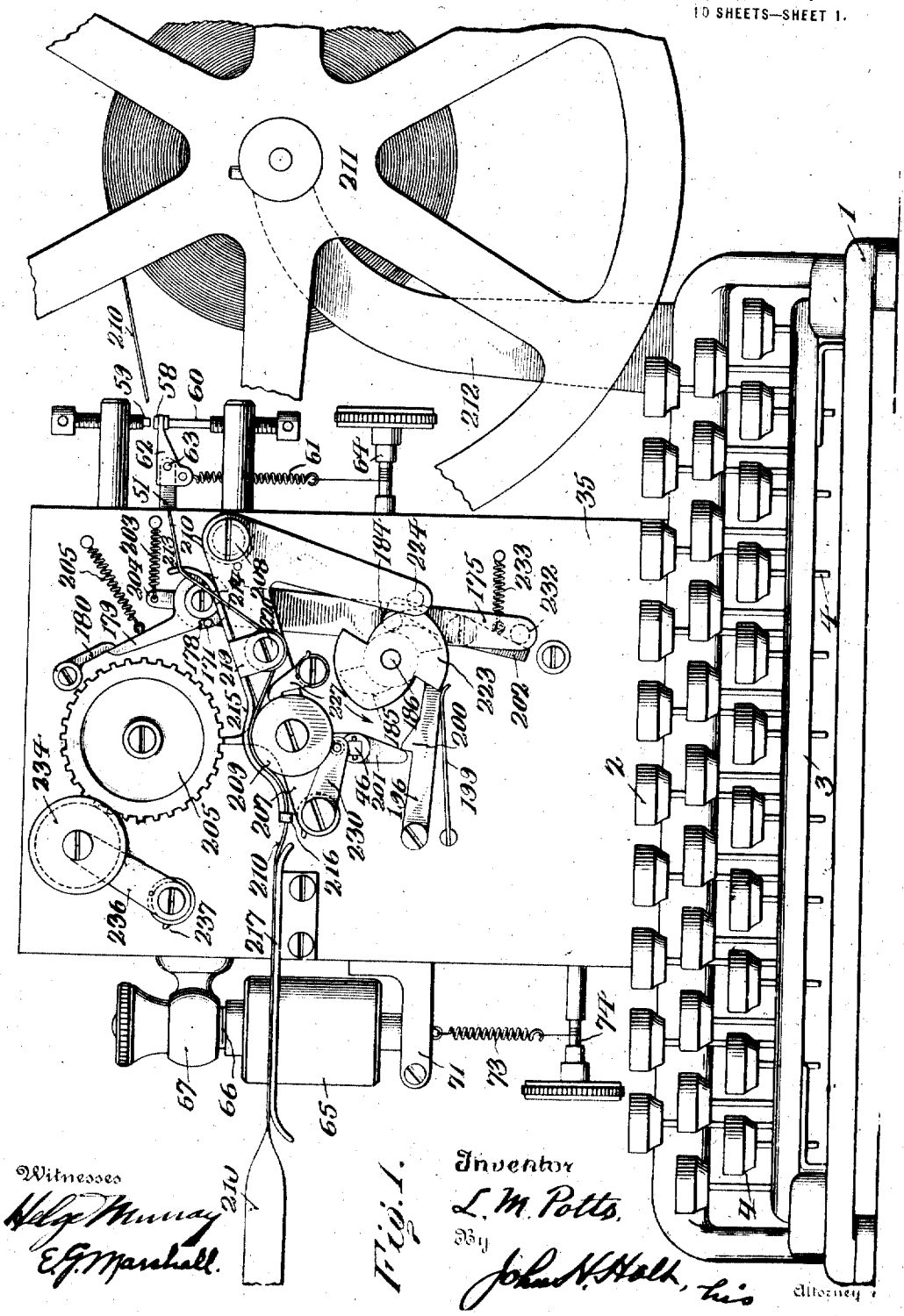
SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

1,229,201.

Patented June 5, 1917.

10 SHEETS—SHEET 1.



Witnesses

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Fig. 1.

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SELECTIVE SIGNALING APPARATUS.

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1,229,201.

Patented June 5, 1917.

10 SHEETS—SHEET 2.

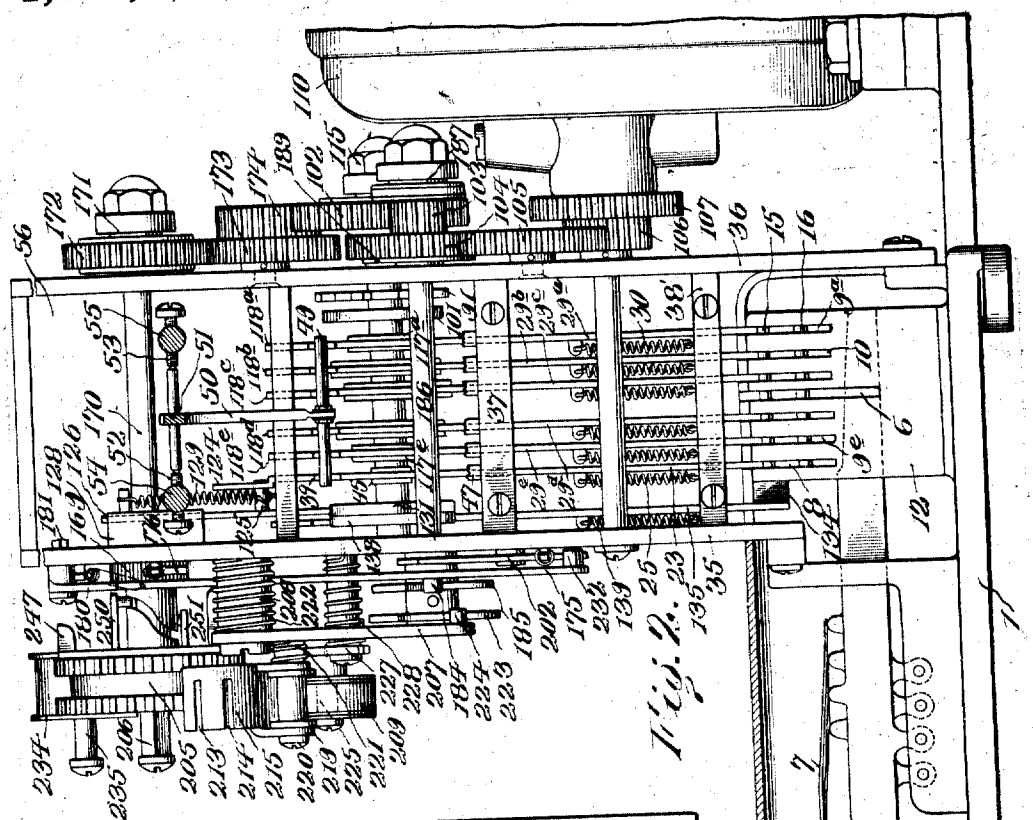


Fig. 2.

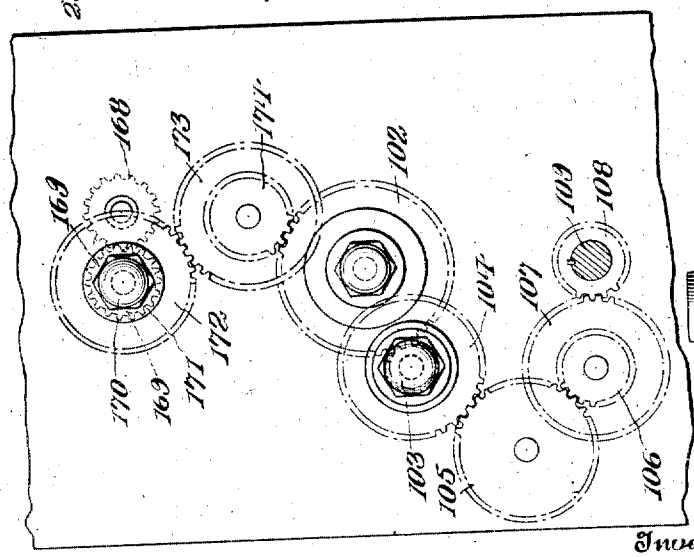


Fig. 3.

Witnesses

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SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

1,229,201.

Patented June 5, 1917.

10 SHEETS—SHEET 3.

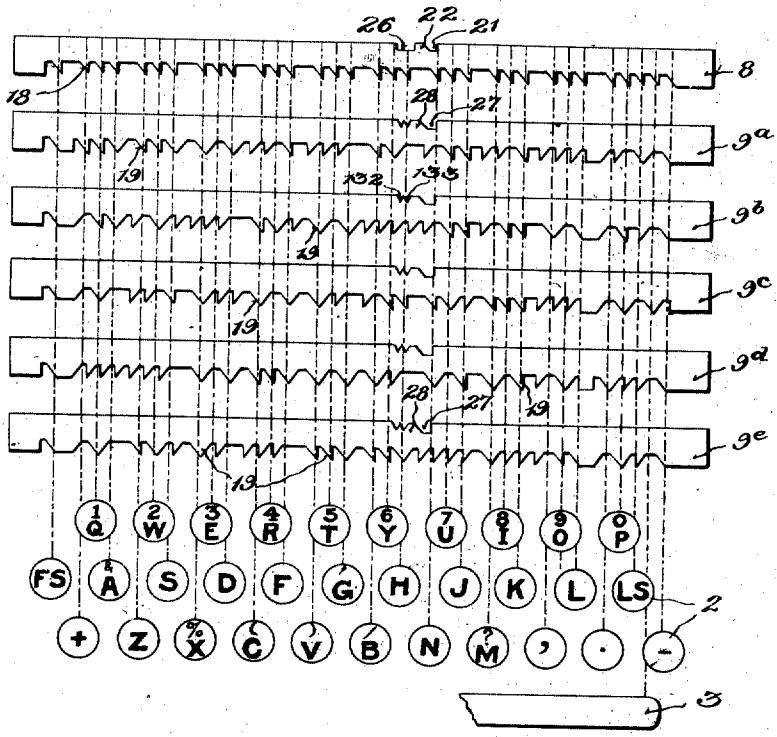


Fig. 4.

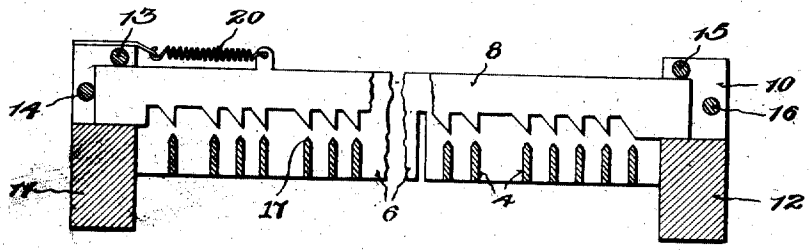


Fig. 5.

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SELECTIVE SIGNALING APPARATUS.

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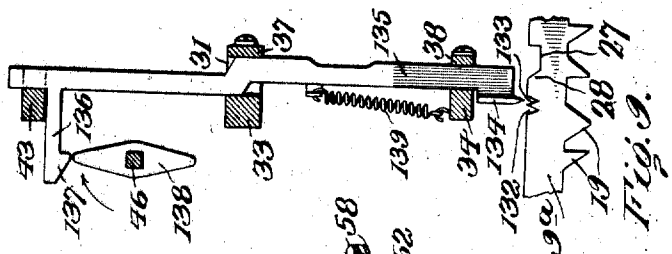


Fig. 9.



Fig. 8.

Fig. 7.

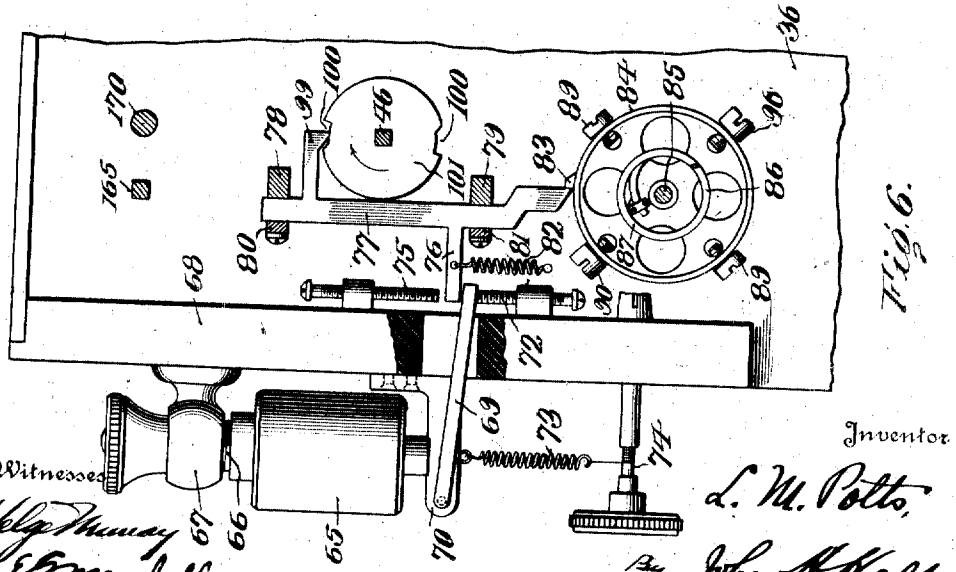


Fig. 6.

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SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

1,229,201.

Patented June 5, 1917

10 SHEETS—SHEET 5

Fig. 10.

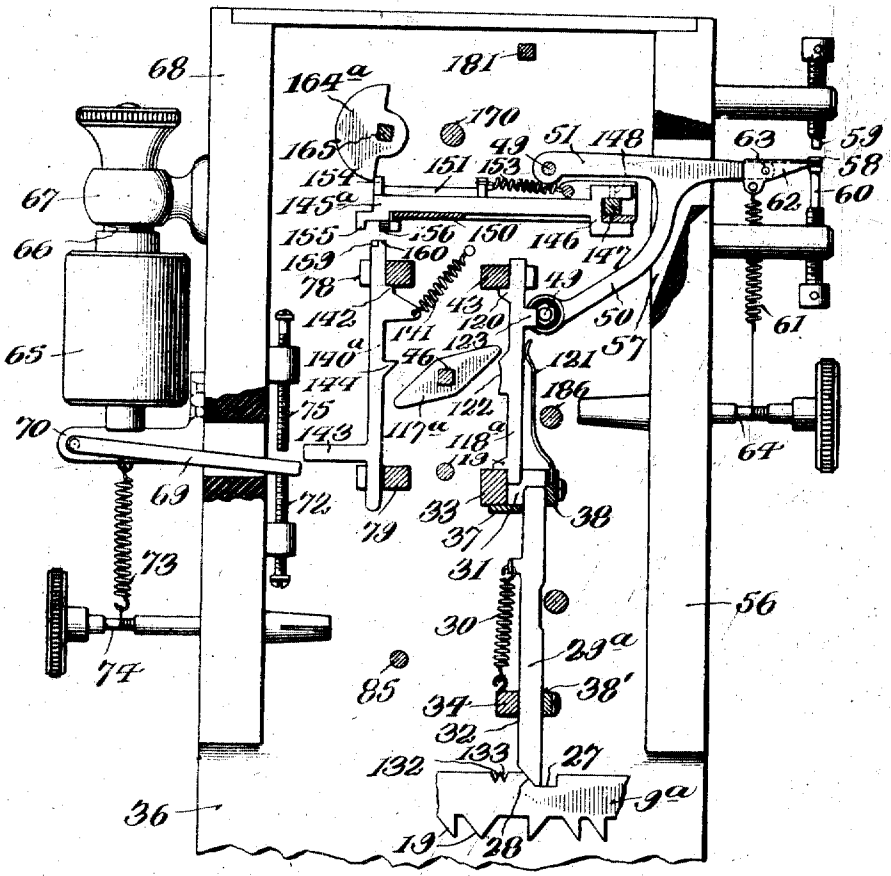


Fig. 11.

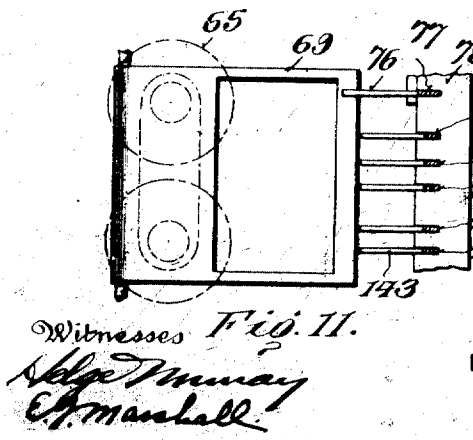
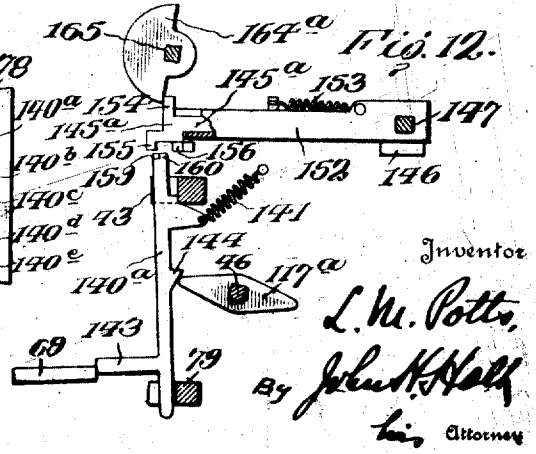


Fig. 12.



Witnesses

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SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

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Patented June 5, 1917.

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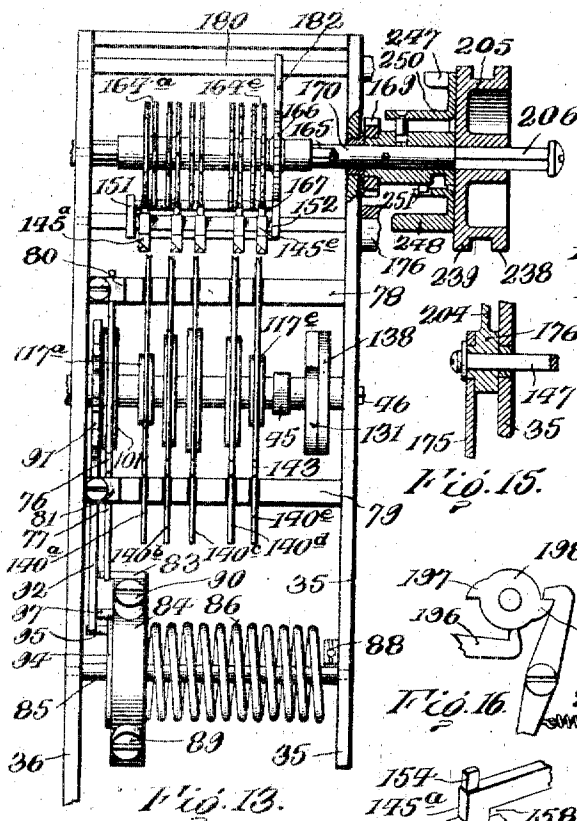


Fig. 13.

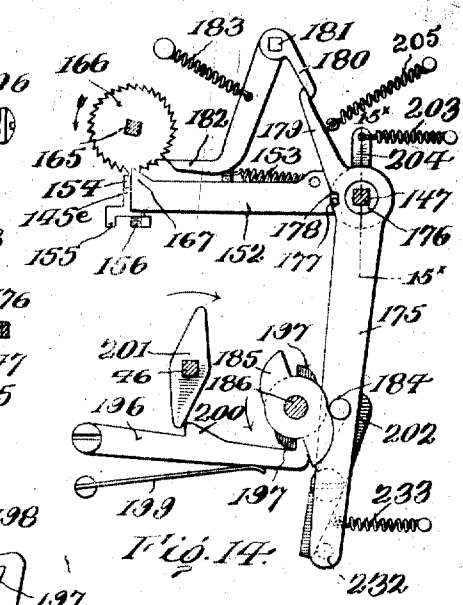


Fig. 14.

Fig. 15.

Fig. 16.

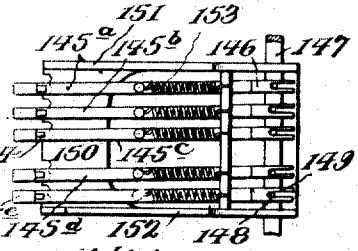


Fig. 17.

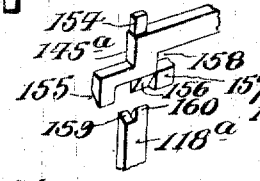


Fig. 20.

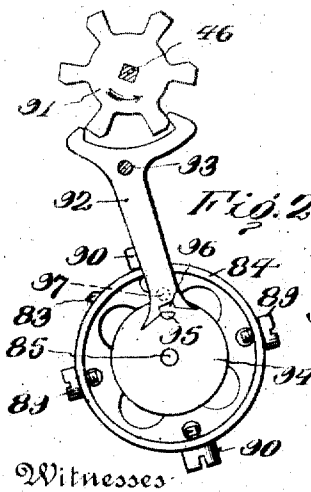


Fig. 22.

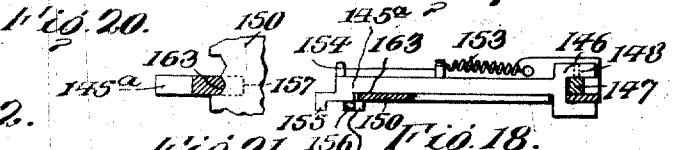


Fig. 18.

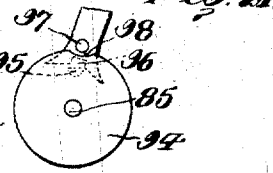


Fig. 21.

L. M. POTTS.

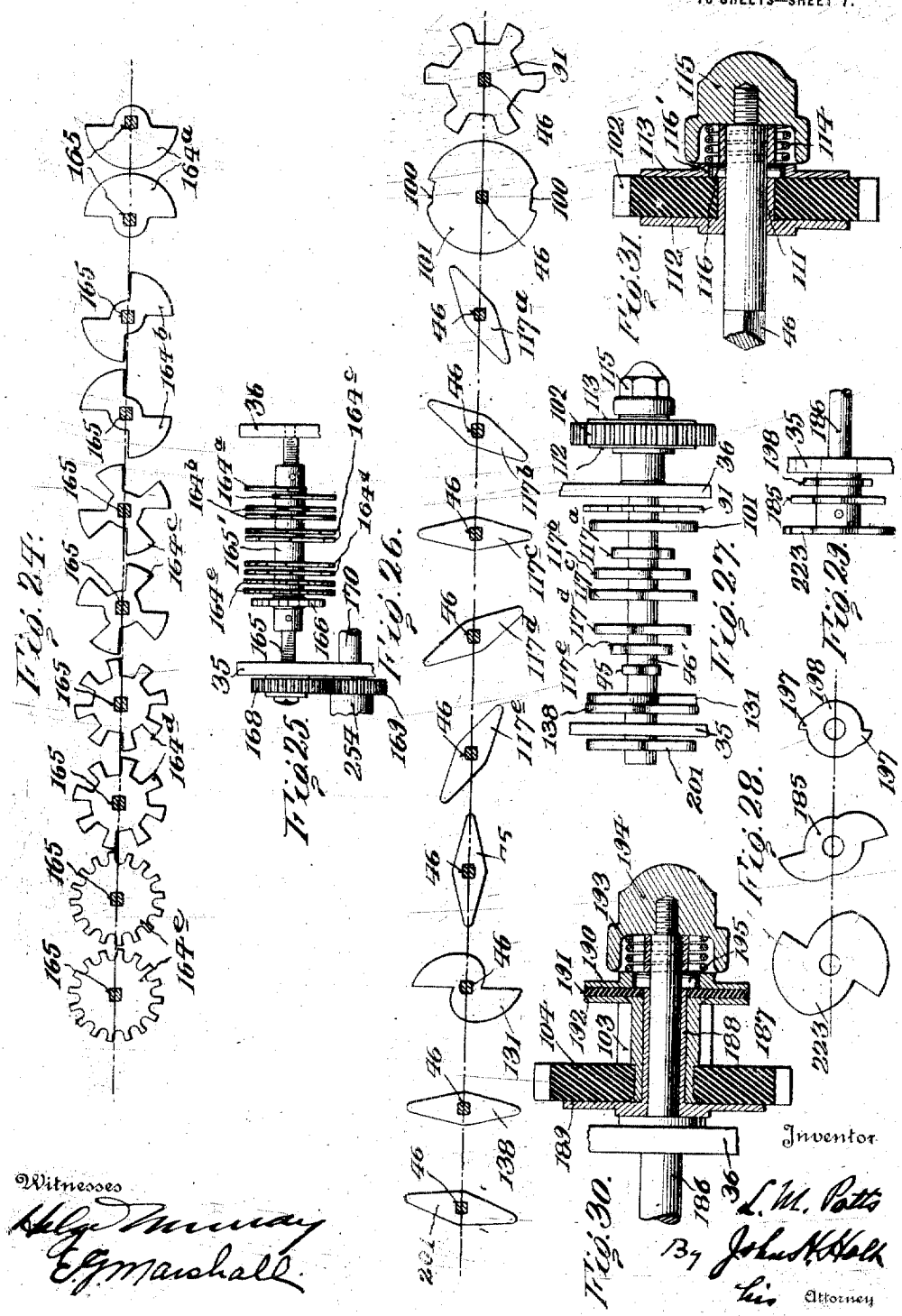
SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

1,229,201.

Patented June 5, 1917.

10 SHEETS—SHEET 7.



Witnesses

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SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

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Patented June 5, 1917.

10 SHEETS—SHEET 8.

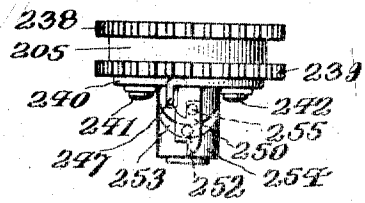


Fig. 32.

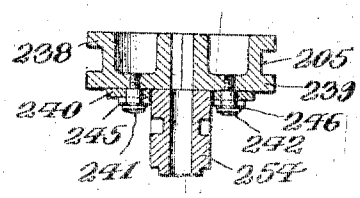


Fig. 33.

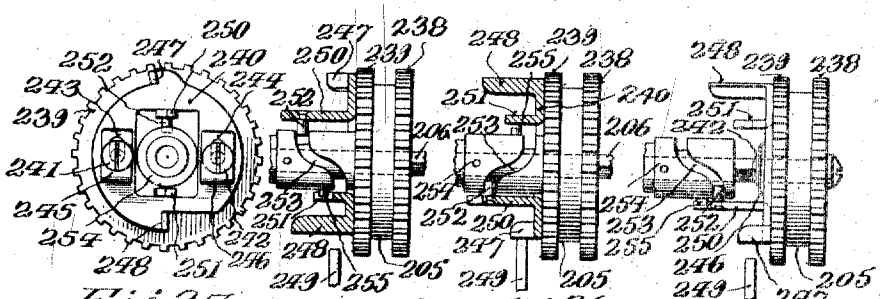


Fig. 34. Fig. 35. Fig. 36. Fig. 37.

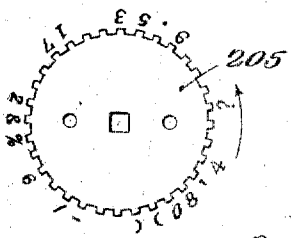


Fig. 39.

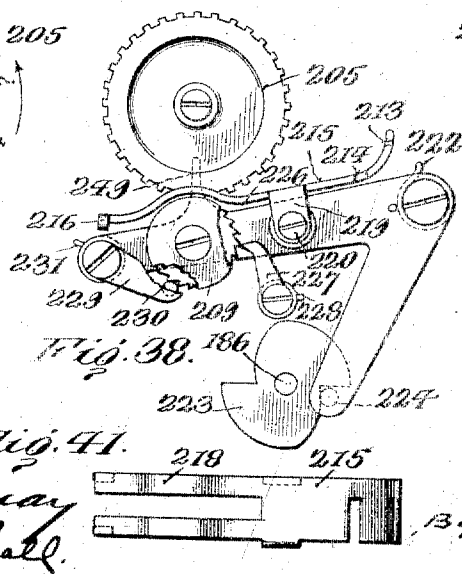


Fig. 38.

Fig. 41.

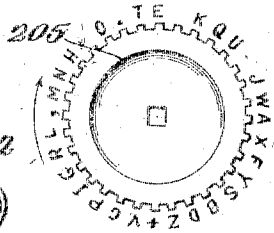


Fig. 40.

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SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

1,229,201.

Patented June 5, 1917.

10 SHEETS—SHEET 9.

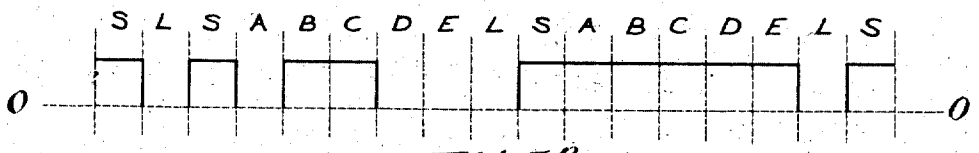


Fig. 42.

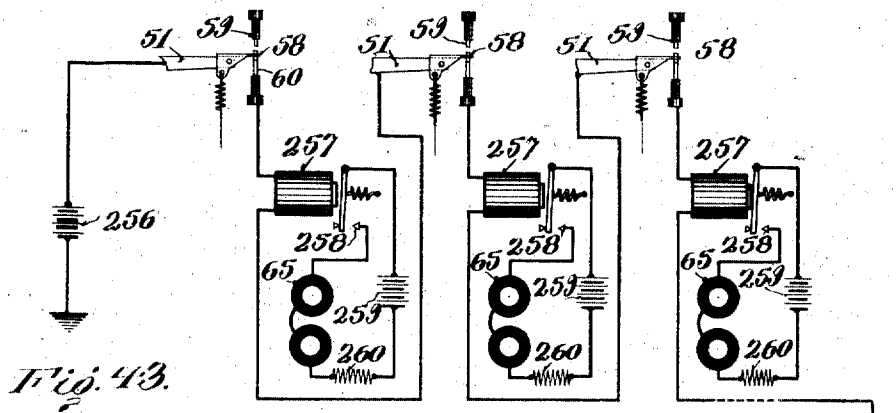


Fig. 43.

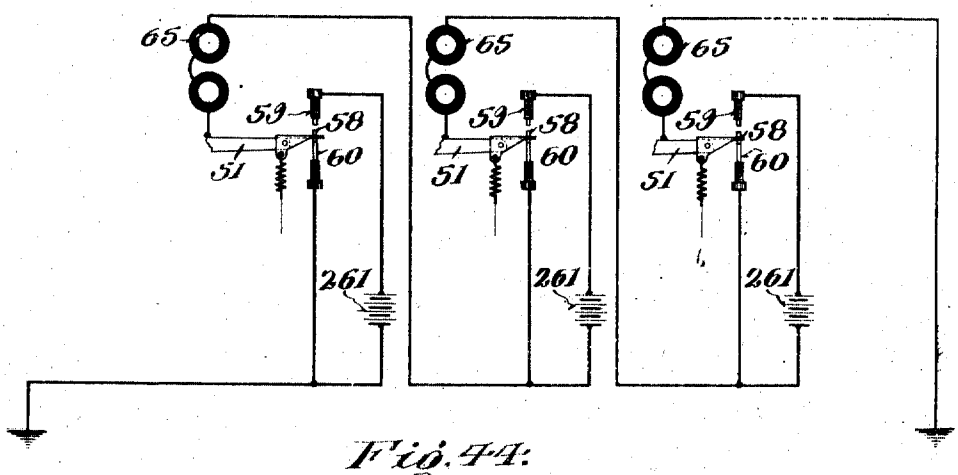


Fig. 44.

Witnesses

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SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED OCT. 11, 1913.

1,229,201.

Patented June 5, 1917.

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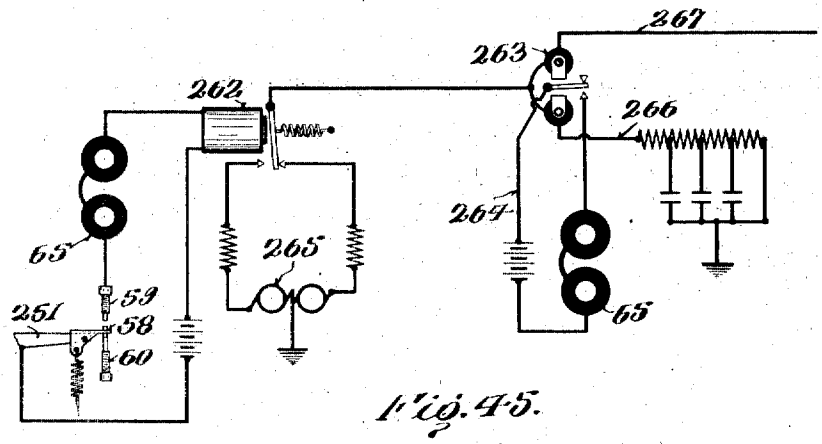


Fig. 45.

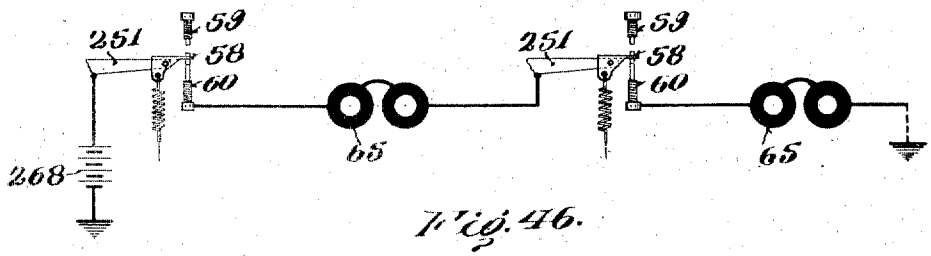


Fig. 46.

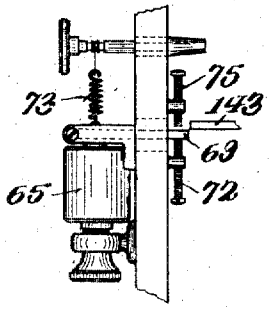


Fig. 47.

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UNITED STATES PATENT OFFICE.

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SELECTIVE SIGNALING APPARATUS.

1,229,201. Specification of Letters Patent. Patented June 5, 1917.

Application filed October 11, 1913. Serial No. 794,633.

To all whom it may concern:

Be it known that I, LOUIS MAXWELL POTTS, a citizen of the United States, residing at the city of Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Selective Signaling Apparatus, of which the following is a specification.

The primary object of this invention is to provide a printing telegraph which shall be applicable to all classes of circuits where the Morse telegraph is used. The electrical operation is such that the transmitting mechanism of one machine, constructed in accordance with this invention, may be substituted for a Morse key, and the receiving mechanism of such machine for a Morse sounder in any type of Morse circuit, without any other change in any part of the line equipment. I do not, however, wish to be understood as limiting my invention to use on a Morse circuit alone.

In order that the machine may be applicable to such wide uses, it is necessary that the adjustments shall be reduced to a minimum, and that the machine shall require the minimum of attention. This has been arrived at by performing all the operations, as far as possible, by mechanical means, and making the construction such that the accuracy of operation depends upon the mechanical construction of the parts, and not upon conditions which may vary.

The transmitting apparatus *per se* herein shown and described constitutes the subject of a division of the present application, filed May 9, 1916, Serial No. 96,323, where the invention as such is claimed.

My invention will be better understood by reference to the accompanying drawings, in which:

Figure 1, is a front elevation of one form of machine embodying my invention;

Fig. 2, a side elevation thereof, partly in section, as viewed from the transmitting side of the machine, much of the receiving mechanism being omitted for clearness in the drawing;

Fig. 3, a semi-diagrammatic front elevation of the train of driving gears, as viewed from the rear of the machine;

Fig. 4, a semi-diagrammatic view showing the arrangement of cams on the starting and combination bars, and their relation to the key levers;

Fig. 5, a fragmentary sectional elevation showing the manner of supporting the starting and combination bars;

Fig. 6, a fragmentary vertical sectional elevation showing the timing balance and its starting and stopping mechanism;

Fig. 7, a fragmentary vertical sectional elevation showing the mechanism for transmitting the starting impulse, and for creating a lag between signals as hereinafter described;

Fig. 8, a detail perspective view of the movable transmitting contact;

Fig. 9, a fragmentary sectional elevation showing the mechanism for locking the keyboard;

Fig. 10, a fragmentary sectional elevation showing portions of the selecting mechanism for transmitting the signals, and for receiving the same;

Fig. 11, a fragmentary top plan view, partly in section, showing the relation of the controlling magnet armature to the parts which it actuates and controls;

Fig. 12, a fragmentary vertical sectional elevation showing one of the receiving selecting levers in its set or operated position relative to one of the tumblers with which it is adapted to co-act;

Fig. 13, a fragmentary side elevation, looking into the receiving side of the machine, and showing the type-wheel and associated parts in vertical section, many parts of the transmitting mechanism being omitted in this view for the sake of clearness;

Fig. 14, a detail sectional elevation of the type-wheel setting mechanism;

Fig. 14^a, a fragmentary detail elevation and modification of parts shown in Fig. 14;

Fig. 15, a fragmentary detail section taken on line 15^x—15^x, Fig. 14;

Fig. 16, a fragmentary front elevation of the stop disk for the control shaft, together with its coacting pawls;

Fig. 17, a detail top plan view of the tumbler mechanism for setting the type-wheel;

Fig. 18, a vertical section thereof;

Fig. 19, a top plan view of the tumbler supporting frame;

Fig. 20, a fragmentary detail perspective view of the cam and of one of the tumblers, together with the upper end of one of the receiving selector levers;

Fig. 21, an enlarged fragmentary sec-

tional elevation to show more clearly the arrangement by which the tumblers are retained in a set position;

Fig. 22, a detail side elevation of the balance and escapement mechanism, showing the balance in the act of oscillating in a counter-clockwise direction;

Fig. 23, a fragmentary detail side elevation to show more clearly the operative relation between the safety-pin and passing hollow of the safety-roller of the escapement mechanism;

Fig. 24, a developed view to show the shapes and relative angular positions in which the various combination cams for stopping the type-wheel are arranged upon their supporting shaft;

Fig. 25, a fragmentary top plan view showing said combination cams and stop ratchet mounted upon their driving shaft, and showing this shaft geared to the shaft of the type-wheel;

Fig. 26, a developed view to show the permanent or relative angular positions in which the various cams are mounted on the timing shaft;

Fig. 27, a fragmentary top plan view showing the lateral spacing or positions of said cams on the timing shaft, and also showing the friction clutch for operating this shaft;

Fig. 28, a developed view showing the shapes and relative angular positions of the cams on the control shaft;

Fig. 29, a fragmentary top plan view showing the lateral arrangement of said cams on the control shaft;

Fig. 30, an enlarged detail vertical section of the friction clutch of the control shaft;

Fig. 31, a similar view of the friction clutch of the type-wheel shaft and the timing shaft;

Figs. 32 to 37, inclusive, detail views of the type-wheel shift mechanism;

Fig. 38, a fragmentary detail front elevation of the type-wheel and its immediately associated printing mechanism;

Figs. 39 and 40, diagrammatic views of opposite faces of the type-wheel to show the arrangement of the characters on said type-wheel;

Fig. 41, a detail top plan view of the presser plate for holding the tape down on the platen and guiding the same;

Fig. 42, a diagram illustrating the current as transmitted for two signals;

Figs. 43, 44 and 45, diagrams illustrating an application of this invention to various types of commercial Morse circuits;

Fig. 46, a diagram illustrating an application of the invention on a short line, as in the case of inter-communication around a plant or building, or other short distances, and,

Fig. 47, a fragmentary detail elevation showing the receiving magnet of my machine reversed from the position shown in Figs. 1, 6, and 10, so as to operate as hereinafter described.

The machine herein shown comprises, among other parts, a main frame which includes a base 1 on which is supported a keyboard and other parts of the machine hereinafter described.

The keyboard comprises a series of keys 2 and a space bar 3, mounted upon the ends of a series of key levers 4 pivotally supported in the machine frame. These levers are held in alinement by two vertically slotted guide combs 5 and 6, and operate against the tension of springs 7 which return them to their normal positions. The arrangement of the keys is preferably that of a standard typewriter.

The function of these key levers is to operate a starting bar 8 and a series of combination bars 9^a, 9^b, 9^c, 9^d, and 9^e, which extend transversely across and above the upper edges of said levers adjacent to their rear ends.

These bars 8 and 9^a—9^e are mounted for longitudinal movement in individual vertical slots 10 in two uprights 11 and 12 on the machine base, and are confined within said slots by horizontal pins 13, 14, and 15, 16. (See Fig. 5.)

The operation of the bars 8 and 9^a—9^e by the key levers is effected by the engagement of beveled edges 17 of these levers with a series of cams 18 on the starting bar, and a series of cams 19 on each combination bar, the said bars being returned to their normal positions by individual springs 20.

The starting bar 8 is shifted on the operation of any of the key levers, and for this reason it is provided with a similar cam lug 18 for each key lever, each such lug having a cam face slanting in such direction as to shift this bar to the right when engaged by the beveled edge 17 of any key lever. (See Figs. 4 and 5.)

The arrangement of cams 19, on the combination bars, however, is different on each such bar as only a certain one or combination of these bars is operated by each key lever.

The arrangement of these cams on the combination bars will vary according to the system of combinations employed. The arrangement of the cams on all of said bars of this particular machine may be had from Fig. 4. Assuming the vertical dotted lines to represent the positions of the key levers, as viewed from above, the relative positions of the various cams with respect to these levers may be readily obtained. In the particular machine herein shown, the five unit system of combinations is employed, and for this reason there are five combination bars.

Only those cam faces which slant upward

from right to left on the lower edges of the combination bars 9^a—9^e act in conjunction with the key levers to shift said bars in the required combinations. The cam faces which slant in the other direction (upward from left to right Fig. 4) are merely for the purpose of preventing the depression, during the transmission of a signal, of some other key than the one operated to send that signal, as hereinafter more particularly described.

The shifting of bars in various combinations by the action of key levers on cams on said bars is old and well known in the art.

The starting bar 8 is provided on its upper edge with a notch 21 and cam 22. Within this notch normally rests the lower end of a vertically movable slide 23, having a beveled edge 24 which rests, under the tension of a spring 25, against the cam 22. (See Fig. 7.) The starting bar is also recessed as at 26 for a purpose which will be stated later.

Each combination bar 9^a—9^e is provided with a notch 27 and cam 28 similar to those of the starting bar, and these cams 28 are in similar coöperative relation respectively with the lower beveled ends of a series of vertical slides 29^a, 29^b, 29^c, 29^d and 29^e, each of which is held against a cam 28 under the tension of an individual coil spring 30. (See Figs. 2 and 10).

Slides 23 and 29^a—29^e are mounted for movement in a vertical plane in individual slots 31 and 32 in guides 33 and 34, respectively, secured rigidly between two upright plates 35 and 36 made fast to the frame of the machine as shown most clearly in Fig. 2. These slides must travel vertically without any angular displacement and for this reason are held against such displacement in the slots 31 by plates 37 and 38 and in slots 32 by plate 38′.

Mounted in the same vertical plane with starting slide 23 and extending above it, (see Fig. 7) is a starting lever 39 having a beveled lower end 40 extending into the same slot in guide 33 as the slide 23. This lever has near its lower end a shoulder 41 which rests upon the upper edge of guide 33, while the upper portion of said lever rests in an open end slot 42 in a guide 43. On one of its edges between guides 33 and 43, lever 39 is provided with a cam 44, the function of which is to coöperate, as hereinafter described, with a rotatable cam 45 fast on a square shaft 46, journaled for rotation in plates 35 and 36. A spring 47 bears against lever 39 at a point above the axis of cam 45 and on the opposite side of said lever from said cam so as at all times to exert a pressure on said lever from right to left, Fig. 7. In Fig. 7 the parts are shown in their normal positions, that is, the positions they occupy when no signals are being transmitted. At such a time, cam 45 will engage cam 44 on the starting lever in the central position, as shown, when the lever 39 will occupy a tilting position with its foot kicked outward to the right.

When the starting bar 8 is shifted to the right, (Fig. 7) as it will be when any key is operated, this will cause slide 23 to rise to such an extent that a beveled corner on the upper end thereof engages the beveled portion 40 of lever 39 and forces the lower end of said lever to the left, thus causing the said lever to turn in a vertical plane on cam 45 as a fulcrum, sending its portion above said fulcrum to the right. On the opposite edge of this lever from cam 44 and above it, is an extension 48 which at all times engages a universal bar 49 carried by and insulated from a depending arm 50 of a bell crank lever 51 fulcrumed between two pivot screws 52 and 53 mounted in arms 54 and 55 secured to an insulating block 56 held between plates 35 and 36. The horizontal arm of this bell crank lever extends through an opening 57 in block 56, and carries on its outer end an electrical contact 58 which is adapted to travel between and alternately engage adjustable stationary contacts 59 and 60, contact 58 being normally held in engagement with contact 60 by spring 61 which also acts to hold universal bar 49 against cam extension 48.

Contact 58 is carried on a hinged extension on lever 51, the said extension comprising a bent metal plate 62 fitting over the end of said lever and pivotally secured thereto by pin 63. Spring 61 is attached at one end to extension 62 at a point in the rear of its pivot, and at the other end to a milled thumb screw 64 by which the tension of the spring may be adjusted. Through the action of hinged extension 62, contact 58 is caused to wipe contact 59 on each engament thereof, and thereby make more certain electrical connection. Wiping contacts, however, are old and well known in the art and nothing new is here claimed for this detail which may or may not be employed, as desired.

Engagement of contact 59 by contact 58 results in the completion of a circuit through the coils of an electromagnet 65.

As we are not at this time particularly concerned with any electrical connections, these need not at present be traced. It will simply be assumed that magnet 65 is in series with contacts 58 and 59. The electric circuits will be taken up later on in this description.

Magnet 65 is mounted for vertical adjustment upon a screw 66 carried in a bracket 67 made fast to an insulating block 68 held between plates 35 and 36. This magnet is provided with an armature 69 pivotally supported between two brackets 70 and 71 secured to block 68. This armature, except in the arrangement shown in Fig. 47, is nor-

mally held down against an adjustable stop 72 by a spring 73, the tension of which may be adjusted by thumb screw 74. The upward movement of armature 69 is limited by an adjustable stop 75.

Extending over the forward edge of this armature is an arm 76 on a vertically movable slide 77 (see Fig. 6) mounted in slots in two horizontal guide bars 78 and 79 held rigidly between plates 35 and 36, and retained in said slots by plates 80 and 81.

Slide 77 controls the starting and stopping of the timing mechanism, which will now be described.

When magnet 65 receives the starting impulse, as described, it draws armature 69 upward, and this raises slide 77 against the pull of a spring 82. The lower end of this slide when in the down or normal position, acts as a stop for an arm 83 fast upon the periphery of a balance 84. This balance is fast upon a shaft 85 journaled for rotation in the plates 35 and 36. When the slide 77 is thus sent upward, the balance becomes released and starts oscillating.

This balance oscillates under the control of a helical spring 86 having one end rigidly fastened to the balance at 87, and the other end similarly fastened as at 88 to plate 35, (see Figs. 6 and 13) so that the number of turns in the spring is a whole number, lacking approximately 90° according to the well known practice in chronometer construction. The size of the wire of the spring 86 and the weight of the balance are so chosen that one-half of a complete (forward and back) oscillation of the balance occupies the time necessary for one unit impulse of the signal. This period of oscillation is chosen as being the most convenient, but is not necessarily essential. A unit impulse could correspond to a quarter period of the oscillation of the balance. It is, however, important that the unit impulse correspond to some multiple of the period of the balance.

This balance has on its circumference two mean time screws 89 which are used to bring the balance to the desired standard. This is done by choosing screws of the proper weight. If the balance is too fast, a larger screw is inserted. Two rating screws 90 are inserted in the rim of the balance at about 90° from the screws 89. Screws 90 are used for the purpose of changing the rate of the machine in words per minute to adapt it to different lengths of line and different operating conditions. The balance is so constructed that it has a rate equal to the maximum rate desired, and this rate is brought down to that required in any particular case by different size screws 90.

The power which actually oscillates the balance 84 is transmitted to it through an escapement mechanism comprising an escape wheel 91 fast on timing shaft 46; an anchor 92 fast on rock shaft 93; safety roller 94 fast on shaft 85; an impulse pin 95 fast on said roller, and adapted to engage a notch 96 in the lower end of the anchor, and a safety pin 97 adapted to engage "passing hollow" 98 in the safety roller 94. This escapement mechanism is substantially the same as that commonly known as the "lever escapement," used in the clock and watch making art, so need not here be more fully described.

Escape wheel 91 has six teeth, so that three complete oscillations of the balance will allow the timing shaft 46 to rotate one-half of a revolution, which is the length of time required for the transmission of one complete signal. At the end of this half revolution, the rotation of shaft 46 is stopped by the engagement of stop 83 on the balance with slide 77 which drops into the path of arm 83 on the balance, caused by the dropping of the nose of an arm 99 on said slide (see Fig. 6) into either one of two diametrically opposite notches 100 in the periphery of a cam 101 fast on timing shaft 46. Balance 84 is, therefore, started and stopped at identically the same point each time. Directly after shaft 46 starts to rotate, the nose of arm 99 rides up on the elevated portion of the cam, where it remains until said cam has rotated about one-half of a revolution, thereby positively holding said stop slide out of the path of balance arm 83 for the proper length of time.

The timing shaft 46 is power driven through a train of gearing (see Figs. 2 and 3) comprising a gear 102 mounted on said shaft and adapted to make driving connection therewith through a friction clutch hereinafter described; a pinion 103 meshing with said gear and fast to a gear 104 an idler 105 meshing with gear 104; a pinion 106 meshing with idler 105 and fast to a gear 107, and a pinion 108 meshing with gear 107 and fast on the armature shaft 109 of an electric motor 110.

Any suitable source of power, however, may be substituted for this motor. It is not necessary that the speed of the driving mechanism be constant, but only that it is run sufficiently fast. For a rate of forty words per minute, for example, shaft 46 should rotate about 175 revolutions per minute.

Gear 102, as above pointed out, is not connected directly to timing shaft 46, but drives it through a friction clutch shown in detail in Fig. 31. Gear 102 itself, forms one of the friction members of this clutch, and for this purpose is preferably made of fiber. This gear is mounted to rotate on a metal sleeve 111 fast on a cylindrical extension of shaft 46, and this sleeve is provided with

a friction disk 112 which lies flat against one face of gear 102. Against the other face of this gear is another friction disk 113. Friction is created between gear 102 and disks 112 and 113 by a spring 114 held under compression by a recessed nut 115 upon the end of the shaft 46. A pin 116 passes diametrically through shaft 46, through the sleeve 111, and into radial slots 116′ in the hub of disk 113, thus holding disk 112 fast to shaft 46 both against rotation relative thereto and against sliding laterally thereof, and holding disk 113 against rotation relative to shaft 46, but permitting said disk to move laterally of said shaft. Therefore, as long as the stop 77 is against balance arm 83, shaft 46 will be held against rotation, but as soon as this stop is removed, said shaft is set free and will be driven by the friction between plates 112 and 113 and gear 102. When shaft 46 is held against rotation, gear 102 nevertheless continues to rotate.

Immediately after the timing shaft 46 starts to rotate, cam 45 passes from engagement with slide cam 44. (See Fig. 7). This slide will then be pushed to the left under the action of spring 47 and universal bar 49, whereupon contact 58 breaks connection with contact 59, unless the combination bar 9^a has been operated, thus terminating the starting impulse. If the signal being sent involves the operation of combination bar 9^a, contact 58 will not break connection with contact 59 at the time above stated, but will remain in contact therewith for a time depending upon which other of the combination bars has been operated for that particular signal. This, however, will be more readily understood after the operation of the transmission of the actual signal impulses has been described.

Passing now more particularly to the mechanism which coöperates with the combination bars and vertical slides 29^a—29^e to transmit the impulses which form the actual signals as contra-distinguished from the starting impulse, this comprises, among other parts, five cams 117^a, 117^b, 117^c, 117^d and 117^e fast upon the timing shaft 46, which coöperate respectively with five transmitting levers 118^a, 118^b, 118^c, 118^d and 118^e to operate through the universal bar 49 the movable contact 58.

Cams 117^a—117^e are all of the same shape as cam 45 and are so arranged on the shaft 46 that succeeding ones of said cams (117^a—117^e) are angularly displaced 30° behind the preceding one about the axis of said shaft (see Fig. 26) and are held against lateral movement on said shaft by spacing collars 46′.

The transmitting levers 118^a—118^e are mounted in the same vertical planes respectively with cams 117^a—117^e and to one side thereof as shown most clearly in Figs. 2 and 10. The upper ends of these levers rest in individual open end slots in guide bar 43, while their lower ends extend into the same slots in guide 33 as receive the upper ends of the slides 29^a—29^e, said levers being supported upon the upper edge of guide 33, each by a lug 119, and their upward movement limited by lug 120 engaging the lower side of the guide 43. (See Fig. 10). Each of these levers is normally held in the position shown in Fig. 10 under the tension of an individual spring 121, bearing upon the backs of said levers at a point higher than the axis of shaft 46. The levers 118^a—118^e each have a cam 122 adapted to be engaged each by a different one of cams 117^a—117^e, and each lever is also provided with an extension 123 adapted to engage universal bar 49 of the transmitting contact lever. The operation of these levers 118^a—118^e by the slides 29^a—29^e is substantially the same as that described with relation to the starting lever 39. According to which of the slides 29^a—29^e is or are raised by the operation of any particular key, the lower ends of corresponding levers 118^a—118^e will be held by said slides against movement to the right. Then, as shaft 46 continues its rotation, cams 117^a—117^e will successively engage cams 122 on levers 118^a—118^e. Clearly then, those levers 118^a—118^e, the lower ends of which are restrained from movement to the right by the operated slides 29^a—29^e will move to the right at their upper ends, and in so doing will act through the universal bar 49 and lever 50 to effect engagement of contact 58 with contact 59.

The levers 118^a—118^e are returned to normal by springs 121 and universal bar 49, the latter action under the tension of spring 61.

As to those levers 118^a—118^e whose slides 29^a—29^e have not been operated, the case is different. These levers being less restrained at their lower ends, than at their upper ends, due to the pressure of springs 121 and 61, above the axis of cams 46, will kick out at their bottoms to the right. Therefore, the extensions 123 of these levers have no operative effect on the bar 49, and hence will not operate contact 58. Each of the levers 118^a—118^e is capable of two degrees of motion, but restrained from movement by unequal pressure in two degrees, the cams 117^a—117^e tending to operate said levers in succession, and the slides 29^a—29^e selectively acting to positively lock said levers from motion in the way of least restraint and to compel their motion in a direction of greatest restraint.

Each signal period may be regarded as divided into six equal time intervals corresponding to the six beats or half oscillations of the balance, and represented diagrammatically in Fig. 42 by the spaces in-

dicated S, A, B, C, D and E between the vertical dotted lines. Each of these intervals represents the time that the contact 58 remains against the contact 59 to transmit a unit impulse. The space S indicates the interval of the starting impulses, and the spaces A to E the intervals of the five unit signal impulses which are employed in various combinations to form the signals proper.

In Fig. 42 the solid lines above the line 0—0 of zero current represent the current on the line when two signals are transmitted, one calling for the B C combination, and the other for the A B C D E combination.

In the case of the signal calling for the A B C D E combination, the current is continuously on the line from the commencement to the end of the signal period, as indicated, embracing all the spaces S to E.

Combinations of impulses may therefore be formed ranging from the employment of one impulse for each of the spaces A to E, to the employment of one impulse of a duration equal to all such intervals combined. With the five unit system here employed, thirty-two such combinations may be had.

It will be seen that whenever a combination is transmitted which involves the A impulse position, the starting impulse does not fall to zero, but merges into the A impulse. This is due to the fact that the operation of the combination bar 9^a, which sends the A impulse, operates through slide 29^a, lever 118^a which holds the universal bar 49 out and the contacts 58 and 59 closed notwithstanding cam 45 has passed from the starting lever 39. (See Fig. 7).

The exception, mentioned in a foregoing portion of this description, to the fact that on the passage of cam 45 from cam 44 the contacts 58 and 59 separate, will now be more fully understood.

The spaces indicated L represent the lag which is automatically produced between successive signals, when the machine is operated at maximum speed, as hereinafter more particularly described.

The combination for each signal may be had from Fig. 4 by noting the relation between the dotted lines indicating the key levers, and the cam lugs on the different combination bars 9^a—9^e. These combination bars correspond to the five impulse periods A to E Fig. 42, the impulses being transmitted in combinations depending upon which of said bars are operated. For example, the operation of the 9^a and 9^b bars will send the A B impulse combination, the operation of the 9^c bar the C impulse, etc.

There should always be between successive signals a lag great enough to prevent any signal from blending with the starting impulse of a succeeding signal, and this lag should preferably be equal to the time of a unit impulse in order that at any given speed of transmission the length of the line operable may be a maximum. When the machine is not operated at its maximum speed, a natural lag will be produced between successive signals due to the pauses of the operator. When, however, there are no such pauses by the operator, some means should be provided for automatically producing this lag. This is effected in the present machine by providing means which will automatically retard the action of the contacts 58 and 59 in closing to send the starting impulse of a signal, under the conditions above stated. For this purpose, starting lever 39 (see Fig. 7) is provided at its upper end with an offset or hooked extension 124, and adapted to coöperate, as hereinafter described, with this extension is a pin 125 carried by a slide 126 mounted for vertical movement in fixed guides 127 and 128, said slide being normally pulled down under tension of a spring 129. This slide is provided with a downwardly extending arm 130 having a beveled end adapted to rest upon the periphery of a cam 131 fast on the timing shaft 46. Now, as cam 131 rotates, it raises slide 126, and as this slide nears the extreme end of its upward motion, pin 125 engages the hooked extension 124 of lever 39 and raises this lever so that its lower extremity cannot engage the upper end of slide 23 even when a key is depressed, so that contacts 58 and 60 will remain closed until slide 39 is pushed downward by pin 125. When cam 131 has made a half revolution, which is the end of a signal period, arm 130 will drop from the elevated portion of this cam to the position shown in Fig. 7, thus causing pin 125 to move lever 39 downwardly, and in doing so this lever is rocked about cam 5 as a pivot by the engagement of the lower tip of said lever with the upper tip of slide 23, and this rocking motion of lever 39 causes the engagement of contacts 58 and 59 and the transmission of the starting impulse. Therefore, when the machine is operating at maximum speed, with no pauses by the operator between successive signals, the starting impulse is always sent by the downward movement of slide 126 rather than by the upward motion of slide 23, thereby causing a delayed closing of the contacts 58 and 59 for the starting impulse. The weight of slide 126, the strength of spring 129, and the drop of slide 126 are so chosen that the desired lag is obtained.

Before passing to the reception of the signals the key locking mechanism will be described.

Normally all of the keys of the keyboard are unlocked. The operation of any key, however, not only locks that key and its combination bar or bars, but locks all the

other keys and their combination bars as well, against further operation until the completion of the signal. This is effected by the following mechanism. (See Fig. 9):

Each combination bar 9^a—9^e is provided on its upper edge with two notches 132 and 133. Extending transversely across all of these combination bars and, in the normal or unoperated position of said bars, lying directly above notches 133, is a locking bar 134 having a knife edge adapted to engage with said notches. This locking bar is carried on the lower end of a slide 135 adapted to move vertically in guides 43, 33 and 34. This slide is provided with an offset extension or arm 136 having a cam portion 137 adapted to lie in the path of a rotatable cam 138 made fast on timing shaft 46. Normally this cam occupies the position shown in Fig. 9, at which time it holds slide 135 in the elevated position shown, under the tension of a downwardly pulling spring 139. Immediately after the timing shaft 46 is started into rotation, as described, cam 138 passes from cam 137, thereby allowing slide 135 to be pulled downward. When this happens, the knife edge of bar 134 will be sent into notches 132 of the operated combination bars and into notches 133 of the unoperated combination bars, thus locking both sets of bars against further operation until the signal has been transmitted. When it is attempted to depress any of the keys during the transmission, they will be held from operation by the cams on the combination bars. At the end of a signal period, or when the timing shaft 46 has made a half revolution, cam 138 will again raise slide 135 and unlock the keyboard.

The notch 26 on the starting bar is merely to allow locking bar 134 to descend.

In addition to the transmitting mechanism described, this machine embodies certain novel receiving mechanism which may act either to make a home record of the signals sent out from the machine, or to record signals from a distance or both, said receiving mechanism in each machine being under the initial control of a single magnet 65.

For the purpose of thus recording the signals, the following mechanism is provided in the machine herein shown:

Located on the opposite side of timing shaft from the transmitting levers 118^a—118^e are a series of five receiving levers 140^a, 140^b, 140^c, 140^d and 140^e lying in corresponding vertical planes with the levers 118^a—118^e, and in operative relation and alinement in corresponding vertical planes with cams 117^a—117^e. Levers 140^a—140^e are mounted in individual vertical open end slots in the guides 78 and 79. These levers can move outward to the left in Fig. 10 in said slots at either the top or the bottom, but are normally held back by springs 141, one for each lever, which are placed at an angle, so that as well as holding levers 140^a—140^e to the right, also exert a pull upward thereon. These springs are omitted in Fig. 13, for the sake of clearness in the drawing.

In the normal positions of levers 140^a—140^e, as shown in Fig. 10, a shoulder 142 thereon rests against the lower side of guide bar 78. Each of these levers is provided with a horizontal extension 143, the normal position of which is slightly higher than the free end of the armature 69 when the latter is in its normal or down position. This armature is broad enough to engage all such projections, as shown in Fig. 11.

As shaft 46 rotates, cams 117^a—117^e successively engage cam projections 144 on the receiving levers, and if the armature 69 were in its down position, shown in Fig. 10, the lower end of each of said levers would be kicked to the left by said cams. But, if at the time when cams 117^a—117^e engage levers 140^a—140^e, magnet 65 happens to be energized, armature 69 will then be in alinement with extensions 143, as indicated in Fig. 12, and instead of the levers 140^a—140^e kicking to the left at their lower ends, the upper ends of said levers will move to the left. In other words, each of the levers 140^a—140^e is capable of two degrees of motion, but is restrained from movement by unequal pressure in two degrees, cams 117^a—117^e tending to operate said levers in succession, and armature 69 selectively acting to positively lock said levers from motion in the direction of least restraint and compel motion of these levers in a direction of greatest restraint. Therefore, the upper ends of these levers will be kicked to the left in combinations corresponding to the impulses received by the magnet 65.

The lugs 144 of the receiving levers are so positioned that cams 117^a—117^e engage them slightly after said cams have passed their horizontal position. Cams 117^a—117^e are stopped by the escapement in the horizontal position, which position is the middle of the cams 122 (see Fig. 10) and consequently the middle of the sent impulse, so that cams 117^a—117^e do not apparently engage lugs 144 until somewhat after the middle of the sent impulse. But due to the lag in the operation of magnet 65, this actually occurs at about the middle of the impulse. By a proper location of cams 144 and the slip of the clutch of shaft 46 it may be brought at any desired point of the impulse. The cams 117^a—117^e of course engages lugs 144 only during a small part of the time occupied in the transmission of a unit impulse, and by being timed so that it occurs in approximately the middle of an impulse, the margin allowable for the mutilation of the signal in its transmission on the line is large as it is only necessary that the impulse shall

be good during the interval in which any of the cams 117ª—117ᵉ engages a lug 144.

The function of levers 140ª—140ᵉ, in this machine, is to selectively control the setting of a type wheel, and for this purpose cooperate respectively with a series of five tumblers 145ª, 145ᵇ, 145ᶜ, 145ᵈ and 145ᵉ. (See Figs. 10, 13 and 17 to 21). Each of these tumblers comprises in the case shown, a bar having a bifurcated end 146 supported upon a square rock shaft 147, which carries a series of guide pins 148 which engage slots 149 in the rear end of each tumbler. These tumblers are supported forward by resting on a plate 150 which forms a web between two arms 151 and 152 fast on shaft 147. Each tumbler is pulled in the direction of shaft 147 under the tension of an individual coil spring 153. On the forward end of each tumbler is a head which comprises a vertical lug 154 and two oppositely directed cams 155 and 156, there being a rearward extension 157 adjacent cam 156, between which and the stem of the tumbler there is formed a recess 158 into which extends the forward edge of plate 150. (See Figs. 18 and 20). Each of these tumblers may move in a horizontal plane about guide pins 148 as pivots, and each tumbler has two positions of rest from which it may be thus moved. This movement of the tumblers is effected by the engagement of the upper ends of levers 140ª—140ᵉ with the cams 155, 156 on these tumblers, when said tumblers are brought down on the upper ends of said levers as hereinafter described, and for this purpose the upper end of each lever 140ª—140ᵉ has two oppositely directed cam portions 159 and 160 (see Fig. 20) adapted to engage respectively with tumbler cams 155 and 156.

For the purpose of retaining or locking each tumbler in its shifted position until again operated by one of the levers 140ª—140ᵉ, the forward edge of plate 150 is provided with a series of pairs of indentations 161 and 162 (see Figs. 17, 19 and 21), each pair corresponding to the two positions of rest of a tumbler, the said indentations adapted to engage with a detent cam 163 (see Fig. 21) on each tumbler. The cams 163 are retained in said indentations under the pull of springs 153, which yield to allow the said cams to pass from one indentation to another.

The function of these tumblers is to interlock by means of lugs 154 with a series of pairs of combination cams 164ª, 164ᵇ, 164ᶜ, 164ᵈ and 164ᵉ, and thus to control the stopping of the type wheel in the desired position.

For each of said tumblers there is one pair of such cams, or ten cams in all for a complete machine. The shapes of these cams are shown most clearly in Fig. 24. In all cases the open part of one cam corresponds to the closed part of its mate. Each cam has half of its circumference high and half low, but the arrangement of these parts is different in each set or pair of cams. The cams 164ª, for example, each have 180° high and 180° low in extent; cams 164ᵇ have two 90° sections high and two 90° sections low; the cams 164ᶜ, four 45° sections high, and four low, etc. These cams are then all so spaced angularly about a common horizontal axis comprising a square shaft 165 on which all said cams are made fast, that for any possible combination of said positions of rest of the tumblers, there will be one position and only one where all the lugs 154 on said tumblers will find an opening in all the cams which they engage. The cams 164ª—164ᵉ may assume a variety of shapes different from those shown, so long as they satisfy the above condition.

Mounted fast on the same shaft 165 with cams 164ª—164ᵉ is a ratchet 166 having a tooth for each stopping position of the type-wheel. This ratchet is adapted to be engaged at times by a pawl 167 on arm 152, and when so engaged holds shaft 165 against rotation. This shaft receives its power through a train of gearing which includes gear 168 fast on shaft 165, and meshing with a gear 169 fast on the typewheel shaft 170, a friction clutch 171, including fiber gear 172 (Fig. 1) and gears 173 and 174, the latter two being made fast to each other, and gear 174 intermeshing with gear 102, which latter receives its motion from the electric motor as hereinbefore described. This friction clutch 171 is the same in construction as the friction clutch of the timing shaft shown in detail in Fig. 31, and therefore need not be further described.

Shaft 147 (Fig. 14) is adapted to be rocked on its axis by an arm 175 which is rotatably mounted on a collar 176 (Fig. 15) fast on said shaft. This arm rocks shaft 147 through a pin 177 secured to collar 176 and extending into a slot 178 on the head of said arm, this slot being of such length as to allow a certain amount of lost motion between the rotation of arm 175 and shaft 147, the purpose of which will later appear. The arm 175 is provided with an upward extension 179 adapted to engage a lever 180 fast on a shaft 181, which shaft also carries pawl 182 fast thereon. Pawl 182 is normally pulled to the left, as shown in Fig. 14, by spring 183 secured thereto.

Arm 175 carries a pin 184 which is adapted to rest upon the periphery of a cam 185 mounted fast on the control shaft 186, and normally occupies the position shown in Fig. 14.

Shaft 186 is driven by a friction clutch 187 from power received through gears 103 and 104 from the motor 110. This friction

clutch, shown in detail in Fig. 30, is the same in principle as the clutch, Fig. 31, but differs slightly in construction due to the fact that gear 104 has a pinion 103 adjacent to one of its faces. For this reason the sleeve 188 of friction disk 189 is longer than sleeve 111 (Fig. 31) and the outer friction disk 190 instead of bearing against the outer face of gear 104 bears against a fiber friction disk 191 fast on sleeve 185, and this disk 191 in turn lies flat against a friction disk 192 fast to pinion 103, which latter is made fast to gear 104, and the two are rotatable on sleeve 188. Gear 104, as in the case of the other clutches, is of fiber. The other parts of the clutch including spring 193, nut 194 and holding pin 195 are also the same as in the other clutches. When shaft 186 is held, as hereinafter described, from rotation, gear 104 will rotate without said shaft, but as soon as said shaft is released, it takes up rotation from gear 104 through the friction clutch 187.

Shaft 186 is normally held against rotation by a pawl 196, the head of which engages one of two lugs 197 on a stop disk 198 fast on control shaft 186 (Fig. 14). This lever is forced against said disk under the action of a spring 199, and carries upon its upper edge a lug 200 adapted to be engaged by a cam 201 fast on the timing shaft 46.

Immediately before this timing shaft stops at the end of a signal period, cam 201 sends the head of pawl 196 out of the path of lugs 197. This frees shaft 186, when it takes up its rotation through friction clutch 187 from the train of gearing hereinbefore described. Cam 185 is thereby set in rotation and, acting through pin 184, sends arm 175 to the right, Figs. 1 and 14. This arm acting through extension 179 and lever 180 allows spring 183 to pull pawl 182 into engagement with ratchet 166. The movement of the arm 175 up to this point has taken place without rocking shaft 147, due to the lost motion between pin 177 and slot 178. So at the time that pawl 182 engages ratchet 166, pawl 167 has not disengaged said ratchet. Further motion of the arm 175 to the right, however, takes up this lost motion, when shaft 147 will rotate anti-clockwise (Fig. 14) and withdraw pawl 167 from ratchet 166. Shaft 165, however, is held by pawl 182 against rotation. As arm 175 is moved by cam 185 still farther in the direction stated, shaft 147 is rotated correspondingly and cams 155 and 156 on the tumblers 145^a—145^e are brought down into engagement with the beveled upper ends of levers 140^a—140^e, depending upon whether or not such levers are in their normal or set positions. As to those levers which are set, these will engage cams 155 on corresponding tumblers, and shift said tumblers from their normal to their set positions, provided these particular tumblers have not already been set by the previous signal. A still further motion of arm 175, to the right Fig. 14, will cause the tumblers to push the operated or set levers 140^a—140^e down to their normal positions, ready for the reception of the next signal. If any of the tumblers have been set by a previous signal, and do not enter into the present combination, then tumbler cams 156 will engage the upper ends of these levers 140^a—140^e which will return these tumblers to their normal positions. When a tumbler is thus shifted from its set position, it causes its lug 154 to move from alinement with one cam of its pair of combination cams 164^a—164^e to the other.

All of these levers 140^a—140^e are now in their normal positions, and the signal has been transferred to the tumblers.

Cam 185, however, continues to rotate until either of the lugs 197 on stop disk 198 has rotated 90° from its initial starting position, when it will engage with a pawl 202 and stop the rotation of the control shaft and cam 185.

Before cam 185 is thus stopped, pin 184 clears the elevated portion of said cam, and when this takes place shaft 147 is rotated clockwise (Fig. 14) under the pull of a spring 203 acting on an arm 204 forming an extension on collar 176 fast to said shaft. (See Fig. 15). Such rotation of shaft 147 sends tumbler lugs 154 into engagement with the peripheries of those cams 164^a—164^e with which they are in alinement, said lugs being held against said cams under the tension of spring 203.

A spring 205 acting through arm 179 takes up the lost motion between arm 175 and pin 177, and, pulling arm 179 to the right (Fig. 14) releases pawl 182 from ratchet 166, and as the pawl 167 is at this time also out of engagement with ratchet 166, shaft 165 is now free to rotate. This shaft now starts into rotation under power received through its friction clutch. This causes cams 164^a—164^e to rotate, and by so doing to bring their peripheral openings into register with the lugs 154 of the tumblers. The cams 164^a—164^e will thus rotate until they reach that position where all the tumbler lugs 154 find cam openings in which they may simultaneously enter. When these tumbler lugs pass into the openings in said cams, shaft 147 continues its clockwise rotation (Fig. 14) sending pawl 167 into engagement with ratchet 166, thus stopping the rotation of shaft 165, which in turn stops a type wheel 205 in the printing position.

It should be noted here that the type wheel passes to its printing position by a continuous motion from its last printing position, and this is a great advantage over a step-by-step movement of the type wheel from one printing position to another, since

it saves considerable time and permits the operation of the machine at many more words per minute without undue strain on any of the parts.

This type wheel is carried on and rotates with a square extension 206 of the type wheel shaft 170 and for the purpose of effecting a shift from one set of characters to another, as hereinafter more fully described, is slidable longitudinally of said extension.

The printing mechanism which coöperates with this type wheel is shown most clearly in Figs. 1, 3, and 38, and comprises, among other parts, a print lever 207 fulcrumed on a shoulder screw 208 secured to the outer face of plate 35, said print lever carrying rotatably mounted thereon, a circular platen 209 which also serves as a paper feed roller.

Over this platen is adapted to pass a tape 210 of paper or other desired material upon which the printing is to be effected. This tape in the machine shown is carried upon a reel 211 mounted on a bracket 212 secured to the base of the machine.

This tape passes from reel 211 first through two open end slots 213 and 214 in a presser plate 215, then over the platen, and then between guides 216 at one end of said plate, to a receiving plate 217.

The presser plate 215 is bifurcated, as shown most clearly in Fig. 41, to permit of the passage of the type between its arms 218 (Fig. 41). This presser plate is pivotally secured through two side arms 219 and screw support 220 to the print lever 207, and holds the tape down on the platen under the tension of coil spring 221 (Fig. 2).

The platen is under tension of a spring 222, the effect of which is to constantly tend to send said platen toward the type wheel, but the platen is normally held away from the type wheel in the position shown in Fig. 1 by a cam 223 fast on the control shaft, said cam acting through a pin 224 on an arm of the print lever.

Mounted on the same stud 225 with the platen, and fast to said platen for imparting rotation thereto, is a ratchet 226 (Fig. 38) which is adapted to engage with a pawl 227 which is under tension of a spring 228.

Also engaging this ratchet is a holding pawl 229 pivotally mounted on the print lever near its forward end, an ' having a roller 230 adapted to be held in engagement with the teeth of said ratchets 226 under tension of spring 231.

Arm 175 carries near its lower end a pin 232 which, immediately upon the stopping of the type wheel, engages pawl 202 and releases the control shaft 186, allowing it to make a quarter revolution. This rotation of shaft 186 rotates cam 223 and after this cam has rotated in the direction of the arrow, Fig. 1, something less than 90°, pin 224 will drop from the elevated portion of said cam to the lower, under the action of spring 222. This causes print lever 207 to send the platen upward and consequently the tape 210 against the type on the periphery of the type wheel.

In the upward movement of the print lever, pawl 227 passes from one tooth to the next of ratchet 226. Then, as cam 223 continues its rotation, pin 224 rises on the elevated portion of said cam, causing the platen to recede from the type wheel and rotate under the action of ratchet 226 and pawl 227, consequently advancing the tape one space.

When cam 223 has completed a quarter revolution, one of the lugs 197 on stop disk 198 engages pawl 202 and stops the control shaft 186 in position for the next type wheel setting operation. Pawl 202 is at all times pulled toward stop disk 198 under the tension of a spring 233.

The type wheel is inked from a felt roller 234 adapted to rotate and slide longitudinally of a spindle 235 carried by an arm 236 pivoted to the outer face of plate 35, said roller being pressed against the periphery of the type wheel under tension of spring 237.

With a five unit code it is possible to get only thirty-two combinations, which is not enough usually for a printing telegraph. In using such code it is therefore desirable to have a double type wheel and shift, thus increasing the number of available signals to sixty-four.

The type wheel shift mechanism in the present machine is shown in detail in Figs. 32 to 40, to which reference will now be had in connection with Fig. 13.

The type wheel, as will be seen, is provided with parallel type flanges 238 and 239, on one of which is formed the type for the alphabet and certain other characters as shown in Fig. 40, while on the other is formed the type for the numerals and other characters as indicated in Fig. 39.

This type wheel carries on its inner face a plate 240 slidable friction tight thereagainst, said plate being secured to the type wheel by two screws 241 and 242 which pass through slots 243 and 244, respectively, in said plate. Inserted between the heads of said screws and the plate 240 are two small spring plates 245 and 246.

Plate 240 carries two projections or arms 247 and 248 $\frac{15}{32}$ of a circumference apart, as hereinafter described, which are adapted to be engaged by a projection 249 on the print lever. Arms 247 and 248 are so arranged that they come into the printing position when their corresponding signals are received.

Plate 240 is provided also with two other arms 250 and 251. Arm 250 carries a pin 252 fast thereto, and this pin extends into a

cam groove 253 in a sleeve 254 fast to the type wheel shaft. Fast to this sleeve is a pin 255, the function of which is to engage, as hereinafter described, with arm 251.

Let it be assumed that the type wheel as shown in Fig. 35 is in position to print the alphabet, and that it is desired to shift to numerals.

When the type wheel occupies the position shown in Fig. 35, it will be seen that pin 255 engages arm 251. Therefore, the type wheel will rotate under power from its shaft transmitted through this pin and arm, without sliding laterally on the shaft.

Then, if a signal combination is received corresponding to the shift to numerals, arm 247 stops directly in line with the projection 249 on the printing lever, which projection will then rise, and engaging arm 247 (Fig. 36) will push plate 240 upward. This sends arm 251 clear of pin 255 and leaves the connection between the type wheel and sleeve 254 solely through pin 252 in the cam groove 253. Then as the said sleeve takes up its rotation, pin 252 will travel forward in the cam groove, sending the type wheel along with it to the position shown in Fig. 37, when it will be in position to print numerals. In this position arm 250 engages pin 255 and therewith forms a positive driving connection for the type wheel.

When a signal is received for the shift back to the alphabet, the type wheel will stop so that arm 248 is in alinement with print lever projection 249, which latter will then rise and engage arm 248, pushing it, together with the plate 240, upward. This disconnects arm 250 from pin 255 and allows the cam groove 253 to come into action on pin 252, thereby shifting the type wheel back to its original position.

The projection 249 on the print lever, and the length of the slots 243 and 244 in the plate 240 are of such a length that when the print lever moves upward, it is stopped before pawl 227 falls into the next tooth, thus preventing the spacing of the tape when shift signals are received.

It should be noted, in connection with this shift mechanism, that the same power which sets the type wheel shifts it.

The sequence of operations, as they take place in the machine above described, is briefly as follows:

When the operator depresses a key to transmit a signal, starting bar 8 is pushed to the right, as is also a certain one or combination of the combination slide bars 9^a—9^e, the latter depending on the signal to be transmitted. Starting slide 23 rises, rocks starting lever 39 about the tip of cam 45 (Fig. 7), and this lever, acting through bell crank 51, opens contacts 58—60, and closes contacts 58—59. This completes a circuit through the coils of magnet 65, which, becoming energized, draws armature 69 upward. This movement of the armature raises escapement slide 77, releases stop 83, and allows balance 84 to move counterclockwise, as viewed in Fig. 6, which in turn releases escapement wheel 91 and allows timing shaft 46 to rotate one step. On this step of the timing shaft, cam 45 releases lever 39, and allows contacts 58, 59 to open and contacts 58, 60 to close, unless combination bar 9^a has been operated, in which event contacts 58, 59 will not, at the end of the first step of shaft 46, open but will remain closed until a time arrives when one of the levers 118^a—118^e is not operated directly after its preceding lever in the series, as fully explained in a preceding portion of this specification.

Timing shaft 46 will continue its rotation step-by-step under the action of escapement 91, the balance 84 oscillating back and forth under the control of spring 86, and as the timing shaft thus continues its rotation after the first step, cams 117^a—117^e successively engage transmitting levers 118^a—118^e, and, depending upon which of the slides 29^a—29^e have been raised by the particular key operated, levers 118^a—118^e will kick out at their upper ends, and, operating through bell crank 51, will close contacts 58, 59 at times corresponding to the times of operation of levers 118^a—118^e, the length of the time of closure of said contacts being the same in each case, and corresponding to a half oscillation of the balance, that is, to one forward or backward swing thereof.

Slightly after cams 117^a—117^e pass the center points of the cams 122, on the transmitting levers (Fig. 10), the opposite ends of these cams operate corresponding receiving levers 140^a—140^e, and depending upon whether magnet 65 receives an impulse at the time of engagement of said receiving levers with cams 117^a—117^e, these levers will be restrained from movement at their bottoms by magnet armature 69, and will kick to the left (Fig. 10) at their upper ends.

Just before the balance has made three complete oscillations, three swings forward and three backward, cam 99 (see Fig. 6) drops into one of the openings 100 of cam 101, and allows slide 77 to descend into the path of stop lug 83 on the balance, arresting the oscillation of the balance positively at the end of its third complete oscillation, and thereby stopping the rotation of the timing shaft 46, which marks the end of a signal period.

Just before timing shaft 46 comes to rest at the end of a signal period, cam 201 on said shaft (see Fig. 14) engages a cam 200 on pawl 196, and throws said pawl out of engagement with lug 107 on stop disk 198, allowing control shaft 186, normally held from rotation, to rotate under the action of

its friction clutch 90°, when said shaft will be stopped by the engagement of lug 197 (formerly engaged by pawl 196) with a pawl 202. Shaft 186 in making this quarter revolution and acting through cam 185 and arm 175, swings the tumbler frame and its tumblers 145ª—145ᵉ downward, allows pawl 182 to engage ratchet 166, and brings tumblers into engagement with cams 155 and 156 of the transmitting levers, depending upon which of these levers have been set, thereby setting the tumblers corresponding to the receiving levers 140ª—140ᵉ which enter into this combination and returning to their normal positions those corresponding to the receiving levers 140ª—140ᵉ which do not enter into the present combination, but which were set for the preceding signal, and releasing the receiving levers 140ª—140ᵉ which were set for the signal. Pin 184 (Fig. 14) then drops from the elevated portion of cam 185, whereupon the tumblers are sent upward under action of spring 203 until their lugs 154 engage the peripheries of combination cams 164ª—164ᵉ, and pawl 182 under pull of spring 179′ releases ratchet 166. This permits shaft 165 and the type wheel shaft 170 geared to it, to rotate, and this they do until the lugs 154 of the tumblers all find openings in the cams 164ª—164ᵉ, into which all of said lugs may pass simultaneously. When the tumbler lugs pass into these openings, this allows pawl 182, under pull of spring 183, to engage ratchet 166, thus stopping the type wheel in the printing position.

Just as the type wheel stops, pin 232 on arm 175 causes pawl 202 to release stop disk 198, allowing control shaft 186 to again take up its rotation, which it will continue for a quarter revolution.

Just before shaft 186 reaches the end of this quarter revolution, pin 224 of the print lever 207 drops from the elevated portion of cam 223, when the platen 209 is sent upward under action of spring 210, sending the paper against the type wheel, and thereby printing the character.

When the control shaft again takes up its rotation for the next signal, cam 223, acting through pin 224 causes the platen carrying arm of lever 207 to descend, whereupon the tape will be spaced up to the next printing position by the action of pawl 227 on ratchet 226 (Fig. 38).

When the control shaft 186 reaches the end of its quarter revolution to effect the operation of the platen, it is stopped by one of the lugs 197 on stop disk 198 energizing pawl 96.

Further description of the operation of the type wheel shift is not necessary.

The holding pawl 182, lever 180, arm 177, and the lost motion connection between shaft 147 and lever 175 (see Fig. 14) may be dispensed with, and the type wheel stopped only at such times as pawl 187 engages ratchet 166, thus allowing the type wheel to rotate while the tumblers are being set. In such a case arm 204 may be replaced by an arm 204′ (Fig. 14ª) integral with lever 175′, the latter being the same in all other respects as lever 175 except that the pin and slot connection 177—178 is dispensed with and the lever 175′ is fast directly on shaft 147. This is but one of many modifications which may be made in the constructional details of this machine without departing from the spirit of the invention.

It will be seen from the detail description of this machine that its operation is almost wholly mechanical, the electrical transmission taking place through a single contact, and the reception through a single magnet, the working out of the various combinations to transmit and record the signals, as well as the timing thereof, being effected in a purely mechanical way.

The timing being purely mechanical, may be made extremely accurate, and being based upon the well developed art of horology, it has the great advantage of having the experience of that art behind it to guide in its design. The machine here shown employing the essential time keeping element—the balance—of a chronometer, is at least commensurate with a chronometer in accuracy, with the added advantage that while in the ordinary time keeping chronometer the variation is integral, since such instruments usually run continuously or for long periods, in my machine the integrating effect of any variation is negligible, owing to the short periods of the operation of the balance before it is stopped and started afresh.

In my machine the balance is stopped at the end of each interval allotted a signal, and always in identically the same position, and therefore starts into operation each time from the same position. If we consider the case, for example, of duplicate machines located at different stations on a transmitting line, the balance on these machines will always start into operation in a fixed phase relation to each other, and as the oscillations of the balance of the sending machine times the transmission of the impulses to form the signals, the balance of the receiving machine will always start into operation in a fixed phase relation with the first impulse of a signal, and as these balances are so soon brought to rest, the effect of any variation between the beats of the two balances is negligible, so that the phase relation between the oscillations of the receiving balance and the received impulses is corrected, thus maintaining the proper phase relation between the operation of mag-

net 65, and the movement of selector levers 140^a—140^e.

Moreover, as the escapement shafts 46 on the two machines are prevented by disks 101 from locking, except in certain fixed positions of said shafts, and as these shafts are unlocked by the same start impulse, said shafts which operate the selecting levers always start into operation in corresponding positions, thereby rendering unnecessary the adjustment of the receiving to the transmisting mechanism commonly known as "finding the letter."

This operation of "finding the letter" corresponds to the operation of causing the receiving sunflower trailer or brush to arrive simultaneously with the trailer of the transmitting sunflower upon corresponding segments of the two sunflowers, in systems such as the Rowland and others employing sunflower distributers.

The two machines are therefore always in phase, and have the letter found.

It should be noted, in connection with the type wheel, that it passes from one printing position to the next by one continuous motion, as distinguished from the step-by-step motion of a stock ticker, thereby greatly saving time; and it should also be noted that this type wheel is shifted by the same power which rotates it.

It should be noted also that the magnet 65 can control the reception of signals by moving its armature a very short distance, and also that it acts to control the operation of the selecting elements rather than actually move or operate them.

Attention is further called to the fact that in the machine here shown the receiving elements are in an operating position only during a small fraction of the time occupied by the transmission of the corresponding impulses, insuring good operation with comparatively poor impulses, and thereby rendering the machine capable of operating well over long circuits where the character of the signal impulses is likely to change in transmission.

This machine has also the advantage of being able to operate with a very short code. In order to adapt it to Morse circuits, it should be capable of operating with a code at least as short as the Morse code. In the present machine, I preferably employ a five unit code which, together with the starting impulse and the lag between signals, is actually shorter than the Morse code. Counting the five code impulse periods, the starting impulse period and the period of lag between impulses, each signal in my case, may be considered in comparison with the Morse code as being seven units long, whereas the Morse code is 8.5 units long. The average signal being shorter than the Morse, the delicacy of adjustment will be less and the distance of operation greater than a Morse telegraph for the same rate of transmission in words per minute.

It will also be seen that I have shown and described my invention here, so far as its receiving features are concerned, in the form of a tape printer. It should be understood, however, that my invention is not limited to tape printers alone. It may be applied also to page printers, but since I do not herein claim specifically a page printing machine, further description along this line is unnecessary. In a generic sense, I wish to be understood, however, as including within the scope of my claims all types of machine to which my invention as here claimed is applicable.

Some specific examples of the adaptation of this machine to ordinary commercial Morse methods of operation and others are shown in Figs. 43 to 47, inclusive, to which reference will now be had.

In Fig. 43 is shown the connections for three stations on a way-wire according to the well known American Morse closed circuit method. In this case, a line battery 256 is required at one station only, and contacts 58 and 60 are connected directly in the main line in series. At each station a main line relay 257 is connected in series with contact 60. Magnet 65 on my machine, at each station, is connected in series with a contact of the main line relay, just as is connected the sounder in the ordinary Morse circuit, except that in the present case the magnet 65 is connected in series with the back contact 258 of the main line relay instead of the front contact thereof. If, however, magnet 65 is reversed on a machine, as shown in Fig. 47, so that its armature is normally pulled down by the magnet, the coils of this magnet would then be connected to the front contact of relay 257 in the same manner as a Morse sounder. The magnet 65 of each machine is in series in its local relay circuit with a battery 259 and suitable resistance 260.

Fig. 44 shows the connections for three stations on a way-wire operated according to the British open circuit method. In this case the line is normally closed, but at this time there is no battery on the line. This method requires a battery 261 at each station, which is thrown on to line in series with magnet 65 and contact 58, each time the latter contact engages contact 59. In this case the magnet 65 and contact 58 are connected directly in series at each station.

In both cases, Figs. 43 and 44, each magnet 65 causes its machine to make a home record of the message transmitted from that machine, and these magnets also act to cause their respective machines to record the mes-

sages when transmission is from another station, so that but one machine is required for both sending and receiving.

In Fig. 45 is shown the connections for a duplex terminal. In this case, transmitting contacts 58 and 59, and magnet 65 of the transmitting machine, are connected in a local circuit with the coils of a main line transmitter 262, the magnet 65 of this machine acting to produce a home record. The signals from a distance are received on main line relay 263, which controls a local relay circuit 264, in which is connected magnet 65 of another one of my machines. In this case one machine transmits the signals to a distant point, while the other machine receives them. In this diagram, 265 indicates the source of signal current at the terminal shown, and 266 the artificial line, while 267 represents the main line supposed to pass to a terminal which is a duplicate of that shown.

In Fig. 46 is shown connections for a method of operation particularly adapted to short distances, such as the distribution of orders, etc., around a plant, factory, railroad yard, and the like. In this case contacts 58 and 60 are normally closed, and these contacts, as well as magnets 65, are all in series with a single source of current 268 at one end of the line. In this case, any machine is ready to transmit at any time, and it is not necessary to operate a switch to change from sending to receiving.

My invention as herein shown and described is susceptible to considerable variation or modification without exceeding the scope of what I claim, and in this connection it should be understood that I do not limit my invention to telegraphic signaling alone, in the commonly accepted sense of the word "telegraphic," since in a generic sense, it embodies the selective transmission and reception of electric impulses or signals for any purpose to which it may be applied.

Likewise, the type wheel setting and shifting mechanism herein shown and described is not necessarily limited to telegraphs.

Also, while I have herein shown a specific embodiment of my invention in the form of a combined transmitter and receiver it is not limited to such combined machine. My invention embraces also the transmitting and receiving mechanisms considered individually, since one machine may embody transmitting mechanism alone, and another, receiving mechanism alone.

The mechanism, in so far as it is limited to transmitting alone, forms the subject of a division of the present application, filed May 9, 1916, and serially numbered 96,323.

What I claim is:

1. Apparatus for electrical signaling, comprising a body having a natural period of motion, mechanical means to impart motion to said body, a series of movable mechanical selecting elements, and mechanical means controlled by said body to time the movement of said elements, said movement of said elements and the periodic motion of said body having a fixed phase relation.

2. Apparatus for electrical signaling, comprising a body having a natural period of motion and making a plurality of oscillations for each signal, electrical signaling means the timing of which is controlled by said body, and mechanical means acting directly on said body to control the phase thereof with respect to the signaling current.

3. Apparatus for electrical signaling, comprising a spring controlled balance, and mechanical means to drive the same, in combination with means electrically operated to start said balance into motion at the commencement of a signal, and means automatically operating to positively stop said balance invariably in the same position at the end of a signal.

4. Apparatus for electrical signaling, comprising a spring controlled balance, and mechanical means to drive the same, in combination with mechanical means electrically operated to start said balance into motion at the commencement of a signal, and mechanical means automatically operating to positively stop said balance invariably in the same position at the end of a signal.

5. Apparatus for electrical signaling in which equal time intervals are allotted to each signal, comprising a balance and power operated escapement for imparting impulses thereto, mechanism to start said balance and stop it at the commencement and end respectively of each signal period, and each time at the same point in its travel, electrical means to operate the mechanism for starting said balance, and automatically acting mechanical means to operate the mechanism for stopping said balance.

6. Apparatus for electrical signaling, comprising a series of selecting elements, means to move said elements in succession, and means coöperating with said element moving means to selectively modify the motion of said elements.

7. Apparatus for electrical signaling, comprising a balance and a power driven escapement for imparting motion thereto, a timing shaft controlled by said balance, a series of members movable with said shaft, a series of selecting elements adapted to be operated in succession by said members, mechanical means to select certain of said elements and in combination with said members selectively control said elements.

8. A telegraphic receiver, comprising a type wheel, a constantly rotating power shaft, a cam shaft normally at rest, type wheel setting means, printing means, means

to couple said constantly rotating shaft to said cam shaft to operate said type wheel setting means, and means to subsequently couple said constantly rotating shaft to said cam shaft to operate said printing means.

9. Apparatus for electrical signaling, comprising in combination apparatus for transmitting electrical impulses, a series of selecting elements, mechanical means to operate said elements, mechanism to time the operation of said mechanical means, a magnet selectively controlling said elements according to the impulses received, and means operated by said magnet to start said timing mechanism into operation.

10. Apparatus for electrical signaling, comprising means to transmit electrical impulses in combinations, an electro-magnet operated by said impulses, a series of receiving elements selectively controlled by said magnet in combinations according to the signal received, means to operate said elements, means to time said operating means and means operated by said magnet at the commencement of each signal to start said timing means into motion.

11. A telegraphic receiver, comprising a type wheel, a magnet, a series of receiving elements, mechanical means controlled by said magnet to operate said elements in combinations according to the signal received, and means controlled by said receiving elements to set said type-wheel.

12. Signal receiving apparatus, comprising a magnet, a series of receiving elements and mechanism to operate all of the elements of said series in succession for each signal, in combination with means operated by said magnet to start the said element operating mechanism into operation at the commencement of each signal, and means controlled by said magnet to set said receiving elements in combinations according to the signal received.

13. Selective signaling apparatus, comprising a magnet, a series of selecting elements, means to operate all of said elements in succession for each signal, operative mechanical connection between said magnet and said element operating means whereby said element operating means is started into action under the control of said magnet, means for operating said magnet invariably at the beginning of each signal interval to thus start said element operating means, and means to operate said magnet thereafter variably according to the signal selected.

14. Signal receiving apparatus, comprising a series of receiving selecting elements, power operated means to move said elements into selected positions, a magnet, and means operated by said magnet and acting as regards said elements solely to control their operation according to the signal received.

15. Selective signaling apparatus, comprising a series of movable elements, means acting on said elements in successive order, means adapted to act on two or more of said elements simultaneously and coöperating with said first mentioned means to operate said elements in combinations according to the signal selected.

16. Signal receiving apparatus, comprising a series of elements having two degrees of motion but normally restrained from motion by unequal pressure in two degrees, means operating to move said elements in successive order, and means to positively restrain said movement of said elements in the degree of least normal restraint and to compel movement of said elements in the degree of greater normal restraint, in combinations according to the signal received.

17. Signal receiving apparatus, comprising a series of selector elements having two degrees of motion, means to normally restrain said elements from motion by unequal pressure in two degrees, a series of rotating cams arranged to move said elements in succession, a movable body common to all said elements and comprising a stop to positively restrain the movement of said elements by said cams in the degree of least normal restraint and compel said movement in the degree of greater normal restraint in combinations according to the signal received, and a magnet to operate said stop.

18. Signal receiving apparatus, comprising a type wheel, a series of movable receiving elements, electrical means to control the operation of said elements in combinations according to the signal received, a second series of elements corresponding in number to the first mentioned series, means co-acting with the first of said series of elements to operate the second series in combinations corresponding to those of the first series, and means controlled by said second series to stop said type wheel in a printing position corresponding to the signal received.

19. Signal receiving apparatus, comprising two sets of movable selector elements, electrically controlled means to operate the first set in combinations according to the signal received and in successive order, mechanical means coöperating with said first set to operate said second set in combinations according to the signal received, said mechanical means acting subsequently to return the operated elements of the second set to normal.

20. Signal receiving apparatus, comprising two sets of movable selector elements, electrically controlled means to operate the first set in combinations according to the signal received and in successive order, mechanical means coöperating with said first set to operate said second set in combinations according to the signal received, said mechanical means acting subsequently in

combination with said first set to return the operated elements of the second set to normal.

21. Signal receiving apparatus, comprising a combination device having a series of permutation locking members, a flexible key mechanism comprising a series of movable members adapted to interlock with said locking members, and electrically controlled signal receiving means to set said movable members in combinations.

22. Signal receiving apparatus, comprising a combination locking device having a series of permutation members in fixed relation to each other, a series of relatively movable members adapted to interlock with said permutation members, mechanical means electrically controlled to move said relatively movable members in combinations corresponding to the signals received to cause the same to interlock with said permutation members.

23. Signal receiving apparatus, comprising a type wheel, means to rotate said type wheel, a shaft connected to said type wheel to control its rotation, a series of permutation disks mounted on said shaft, a set of tumblers adapted to interlock with said disks, mechanical means to set said tumblers in combinations to interlock with said disks, electrical means to control said mechanical tumbler setting means, and mechanism controlled by the interlocking of said disks and tumblers to stop the rotation of said type wheel in a printing position.

24. Signal receiving apparatus, comprising a combination device having a series of permutation members in fixed relation to each other, a series of relatively movable members adapted to engage with said permutation members, a single magnet common to all said relatively movable members, mechanical means controlled by said magnet to move said relatively movable members in combinations corresponding to the signals received to cause the same to operatively engage with said permutation members, and signal recording means controlled by said operative engagement.

25. Signal receiving apparatus, comprising a type wheel, means to rotate said type wheel, a shaft geared to said type wheel to control its rotation, permutation disks mounted on said shaft, a set of tumblers adapted to engage with said disks, mechanical means to set said tumblers in combinations to coöperatively engage with said disks according to the signal received, a single magnet common to all said tumblers, and means operated by said magnet to selectively control said mechanical tumbler setting means, and mechanism controlled by the interlocking of said disks and tumblers to stop the rotation of said type wheel in a printing position.

26. Signal receiving apparatus, comprising a type wheel, means to rotate said type wheel, a shaft connected to said type wheel to control its rotation, a series of permutation disks mounted on said shaft, a set of tumblers adapted to interlock with said disks in various combinations, mechanical means to set said tumblers in operative relation to interlock with said disks in combinations according to the signal received, electrical means to control said mechanical tumbler setting means, mechanism to set said type wheel in motion at the end of a signal, and to stop said type wheel in a printing position, said stopping being controlled by the interlocking of said tumblers and disks, and mechanism coöperating with said type wheel to print the characters.

27. Apparatus for electrical signaling, comprising a transmitting switch, mechanical means to directly operate a single contact of said switch to form differing signals, a printing telegraphic receiver having a single magnet, means to record the signals, and operative connections, entirely mechanical, between said magnet and recording means, and operative electrical connection between said magnet and said contact.

28. Signal receiving apparatus, comprising a type wheel, mechanism to stop said type wheel in a selected position, electrical means acting to mechanically control said stopping mechanism, a power shaft normally at rest, means operated by said shaft to print the selected character, and means controlled by the said type wheel stopping mechanism to start said power shaft in motion.

29. In apparatus for electrical signaling, the combination with a source of signaling current, a telegraphic receiver, means to transmit from said source an electrical impulse to start said receiver into operation, and subsequently to transmit from said source code impulses to be recorded by said receiver, and means to automatically delay the transmission of said starting impulse after the completion of the preceding signal period.

30. Signal receiving apparatus, comprising a type wheel having two rows of characters, a printing platen, a body to receive impressions from said type wheel, mechanism to shift said type wheel transversely of said body to bring one row of said characters into alinement with said platen, and the other row out of alinement therewith, and electrical signaling means to control the said shifting mechanism.

31. Signal receiving apparatus, comprising a double type wheel, printing means, and power means independent of said printing means adapted to shift said type wheel and controlled by the stopping position thereof.

32. Signal receiving apparatus, compris-

ing a double type wheel, a member slidably mounted on said type wheel, a platen, a lever to operate said platen, means operated by said lever to shift said slide, means controlled by said slide to shift said type wheel longitudinally of its axis of rotation from one printing position to another, and electrical means to control the shifting of said type wheel.

33. Signal receiving apparatus, comprising a type wheel having two rows of characters, power operated means to rotate said type wheel from one printing position to the other, mechanism operated by the same power which rotates said type wheel and acting to shift said type wheel longitudinally of its axis of rotation, and electrical means to control both of said operations of said type wheel.

34. In combination a type wheel having two rows of characters, power operated means to rotate said type wheel from one printing position to the other, mechanism operated by the same power which rotates said type wheel and acting to shift said type wheel longitudinally of its axis of rotation, and means to control both of said operations of said type wheel.

35. Apparatus for electrical signaling, comprising a body having a natural period of motion, mechanical means to impart motion to said body, electrical signal receiving means, and means controlled by said body to time in a series of steps for each signal the operation of said signal receiving means to cause said signal receiving means to operate in phase with the received impulses.

36. Apparatus for electrical signaling, comprising a body having a natural period of motion and a fixed phase relation to the signals received, a power driven escapement for imparting motion to said body, electrical signal recording means, and means controlled by said body to time the operation of said signal recording means.

37. Apparatus for electrical signaling, comprising a transmitting switch, mechanism to operate said switch variably in combinations for each signal, a signal receiving magnet, time keeping mechanism, mechanical operative connection between said time keeping mechanism, said switch operating mechanism and magnet, and electrical connection between said switch and said magnet, the timing of the operation of said switch and the operation of said magnet being both under the control of said time keeping mechanism.

38. Apparatus for electrical signaling, comprising a transmitting switch, mechanism to operate said switch variably in combinations for each signal, a signal receiving magnet, time-keeping mechanism, mechanical operative connection between said time-keeping mechanism, said switch operating mechanism and magnet, and an electric circuit including said switch and magnet.

39. Apparatus for electrical signaling, comprising signal transmitting means, signal receiving means, and mechanism comprising a body having a natural period of motion and making a plurality of oscillations for each signal and mechanical operative connection between said body and both said signal transmitting and receiving means to time their operation.

40. Signal receiving apparatus, comprising signal timing mechanism, a type wheel and power operated means to rotate the same, a printing platen and means to operate the same, electrically operated means to start said timing mechanism at the beginning of a signal period, means to start said type wheel into rotation at the end of a signal period, means to stop said type wheel to print, and means controlled by the said type wheel stopping means to start said platen operating means into operation.

41. Signal receiving apparatus, comprising signal timing mechanism and a rotatable shaft controlled thereby, a type wheel and a shaft to rotate the same, a printing platen and a shaft to operate the same, all of said shafts being normally at rest, electrically operated means to start said timing mechanism into operation at the beginning of a signal period, means to start said type wheel shaft into operation after the completion of a signal period, means to stop said type wheel, and means controlled by the said type wheel stopping means to start said platen-operating shaft into rotation.

42. The combination with an electric circuit, of a series of transmitting contacts therein, mechanical permutation means individual to each of said contacts and adapted to operate each to transmit signal impulses in combinations corresponding to the respective signals, a magnet individual to each of said contacts, printing means individual to each of said magnets, and operative connection wholly mechanical between each of said magnets and its respective printing means.

43. In combination, a plurality of transmitting contacts, a plurality of electromagnets, an electric circuit normally closed and including in series all of said contacts and the coils of said magnets, permutation means individual to each of said contacts to cause the same to interrupt said circuit variably according to the signal transmitted, separate printing means individual to each of said magnets, and means individual to each of said magnets and mechanically controlled thereby to select the character to be printed.

44. Selective signaling apparatus comprising a plurality of movable mechanical selecting elements, step-by-step moving mechanical means adapted to operate said se-

lecting elements, a mechanical timing element having a natural period of motion and mechanically connected to said step-by-step moving mechanism to control its motion, electrical means controlling the starting of said timing element at the commencement of a signal, and means to stop the operation of said timing element at the end of a signal, the control of said timing element after starting and until stopped at the end of a signal being independent of the operation of said electrical means.

45. Selective signaling apparatus comprising a plurality of selecting levers, mechanical means including a step-by-step moving shaft adapted to operate said levers, timing mechanism comprising a spring controlled balance adapted to control the movement of said shaft, power means to drive said shaft, electrical means controlling the starting of said balance and shaft at the commencement of a signal, and automatic means to stop the motion of said balance and shaft at the end of a signal, the control of said shaft and balance after starting and until stopped at the end of a signal being independent of the operation of said electrical means.

46. Selective signaling apparatus comprising in combination with means to produce a series of electrical impulses, a series of elements to be operated selectively and corresponding to certain of said impulses, local means comprising a balance and escapement controlled by the first impulse of said series and independent of succeeding impulses of said series, to control step-by-step the action of said elements selectively.

47. Selective signaling apparatus comprising in combination with means to produce a series of electrical impulses, a series of elements selectively controlled by certain of the impulses of said series, local means comprising a balance and escapement controlled by the first impulse of said series and independent of the succeeding impulses thereof, to control step-by-step the selective action of said impulses on said elements.

48. Apparatus for electrical signaling, comprising a body capable of natural periodic motion, mechanical means to impart motion to said body, a series of mechanical selecting elements, mechanical means controlled by said body to time the operation of said elements, and means to cause said body to make an integral number of half periods of motion for each signal period.

49. Apparatus for electrical signaling, comprising in combination apparatus for transmitting electrical impulses, a series of selecting elements, a magnet, means comprising a series of elements acting individually on corresponding ones of said selecting elements and co-acting with said magnet to successively control said elements according to the impulses received, and means controlled by said magnet to start into operative motion said second mentioned series of elements.

50. Selective signaling apparatus comprising a series of movable elements, means acting on said elements in successive order, and means adapted to act on two or more of said elements simultaneously and co-acting with the first mentioned means to operate said selected elements in signal combinations.

51. Apparatus for electrical signaling, comprising signal transmitting means, signal recording means including permutation mechanism and a magnet selectively controlling the same in combinations, and means controlled by said magnet to start said signal transmitting means into operation.

52. Apparatus for electrical signaling, comprising a spring controlled balance, electrical controlled means to release said balance at the beginning of a signal period, and automatically acting means to lock said balance at the end of a signal period, a series of signal selecting elements, and means controlled by said balance to time step-by-step the operation of said elements.

53. A telegraph receiver comprising character selecting mechanism, recording mechanism, a control shaft rotating in steps, mechanism operated by said shaft in making one of said steps for operating said character selecting mechanism, and mechanism operated by said shaft in making another of said steps for operating said recording mechanism.

54. A telegraph receiver comprising a type wheel and a shaft for operating the same, a timing shaft and a control shaft, electrically operated means for starting the timing shaft, means controlled by the timing shaft for rotating the control shaft, means operated by the control shaft to operate the type wheel shaft, means controlled by the stopping of the type wheel shaft to again start the control shaft, and means operated by the control shaft on its second rotation to print a character.

55. A telegraph receiver comprising a type wheel and a shaft for operating the same, character selecting mechanism, a printing platen, a timing shaft, and controlling mechanism operating in two steps, first to control said character selector and then to control said printing platen, means operated by the timing shaft to start said control mechanism on its first stage of operation, and means controlled by said character selecting mechanism to stop said control mechanism and subsequently start the same on its second stage of operation, and means under the control of the timing shaft to stop said control mechanism at the end of the second stage of its operation.

56. Signal receiving apparatus comprising a plurality of elements to be selectively operated according to the signal received,

a rotary shaft and means operated thereby to move said elements one by one in succession for each signal received, a magnet, and means operated thereby arranged to cooperate with said shaft-operated means to operate said elements selectively according to the signal receiver, and means comprising a spring controlled balance timed to oscillate in phase with said impulses to time step-by-step the operation of said shaft.

57. Selective signaling apparatus in which equal time intervals are allotted to all the signals, comprising a spring controlled balance timed to make the same number of oscillations for each signal and to oscillate in phase with electrical impulses comprising said signals, a movable stop normally acting upon said balance to hold it against oscillating, an electro-magnet operative upon said stop to release said balance at the commencement of a signal, and mechanical means timed in its movement by said balance, and acting to hold said stop from operative engagement with said balance from the time that it is released at the commencement of a signal until the end of a signal interval and to then permit said stop to be brought into position to stop said balance, each time at the same point.

58. In a telegraph receiver the combination with signal recording mechanism, of selecting mechanism to control the same, said selecting mechanism comprising a rotary shaft, interlocking mechanical permutation mechanism arranged to stop said shaft in a different angular position for each signal received, a plurality of movable mechanical elements to be operated selectively in combinations according to the signal received and determining by their positions the operation of said permutation mechanism, a power driven shaft and a series of members mounted thereon and adapted to operate said selecting elements in step-by-step successive order for each signal received, a spring controlled balance controlling the movement of said shaft step-by-step, and timed to oscillate in phase with impulses which go to make up the signals, a magnet adapted to be energized by said impulses, an armature for said magnet co-acting with said series of members to selectively operate said selecting elements, means operated by said armature to control the starting of said balance at the commencement of each signal, and mechanism controlled by said timing shaft to automatically stop said balance at the end of each signal, the said balance oscillating the same number of times for each signal.

59. Selective signaling apparatus comprising means to transmit electrical impulses to form the signals, signal receiving means controlled by said impulses, a balance and escapement for timing the operation of said receiving means, and impulse-controlled means acting recurrently on said balance to adjust or correct its phase with respect to that of the received impulses and maintain a fixed phase relation between the beats or oscillations of said balance and said impulses.

60. Signal receiving apparatus, comprising a plurality of elements to be selectively operated according to the signal received, means comprising a body capable of periodic motion to time the operation of said elements, mechanical means to maintain the motion of said body, and independent means controlled by the signals to correct the phase of said body.

61. Selective signaling apparatus, comprising means acting to transmit a starting electrical impulse and combinations of code impulses for the respective signals, a balance and escapement, means operative by the start impulse of each signal to set said balance in motion, and means to automatically stop said balance invariably in the same position at the end of each signal interval, the said balance always starting into operation at the commencement of each signal in a definite or fixed phase relation to the code impulse or impulses under the control of said start impulse and operating independently thereafter, and signal receiving mechanism timed by said balance and escapement, substantially as described.

62. Selective signaling apparatus including a telegraph receiver comprising a plurality of selector elements electrically controlled to be set in various combinations according to the signals received, a second series of selector elements, means acting subsequently to the setting of said first series to cause the same to mechanically set the second series in corresponding combinations, and recording means controlled by the setting of the said second series of elements.

63. A transmission line including a transmitting contact and two magnets in series, mechanism to move said contact variably according to the signal transmitted, a recorder controlled by one of said magnets, and means under the control of the other of said magnets to start said contact moving mechanism into operation.

64. A telegraphic transmission line connecting two or more stations, a movable transmitting contact and a magnet in series in said line at one of said stations and a magnet in series with said line at another of said stations, means at one of said stations to move said contact variably according to the signals to be transmitted, said contact moving means being dependent for its operation upon the operation of the said magnet at that station, and recording means controlled by the other of said magnets.

65. A transmission line including signal transmitting means and two magnets in series, mechanism to operate said transmitting

means to transmit combinations of electrical impulses over said line, means under the control of one of said magnets to start said transmitting means into operation to transmit combinations of impulses, and signal recording mechanism controlled by the other of said magnets.

66. Selective signaling apparatus, comprising selecting mechanism including an element having two degrees of motion and normally less restrained from motion in one of said degrees than in the other, electrically operated selective means, and means operative by said selective means to oppose the movement of said element in the degree of least normal restraint to cause the same to move in the degree of its greater normal restraint.

67. A telegraphic receiver, comprising signal receiving means, character selecting means, printing means, a power drive to operate each of said means, and a clutch individual to each of said means controlling their connection to said power drive.

68. In a telegraphic receiver, a double typewheel, a shaft on which said typewheel is mounted, means to shift said typewheel longitudinally of said shaft, a magnet, and operative connection entirely mechanical between the said shifting mechanism and said magnet to cause said shift to operate according to impulses received by said magnet.

69. A telegraphic receiver, comprising a magnet, an armature operated thereby, timing mechanism, a movable stop acting to hold said timing mechanism against operation when no signal is received and to release said mechanism at the commencement of the respective signals, a member connected to said stop and lying in the path of the movement of said armature for engagement thereby to release said timing mechanism, and means to render said member further inoperative by said magnet until the completion of the reception of the signal by said magnet.

70. A telegraphic receiver, comprising signal receiving means, character selecting means, recording means, a power drive to operate each of said means, and a clutch individual to each of said means controlling their connection to said power drive.

71. In a telegraphic receiver, a timing mechanism, means to start said timing mechanism at the beginning of each signal period, and means acting on said starting means to prevent the operation thereof again until after the completion of a signal period.

72. In a telegraphic receiver, a timing mechanism, means to start said timing mechanism at the beginning of each signal period, a magnet to control said starting means, and means acting on said starting means to prevent the operation of said starting means again until the armature of said magnet has returned to its normal position after the preceding signal.

In testimony whereof I affix my signature in presence of two witnesses.

LOUIS MAXWELL POTTS.

Witnesses:
JOHN R. HOOPER,
CHARLES J. AYD.