

April 7, 1936.

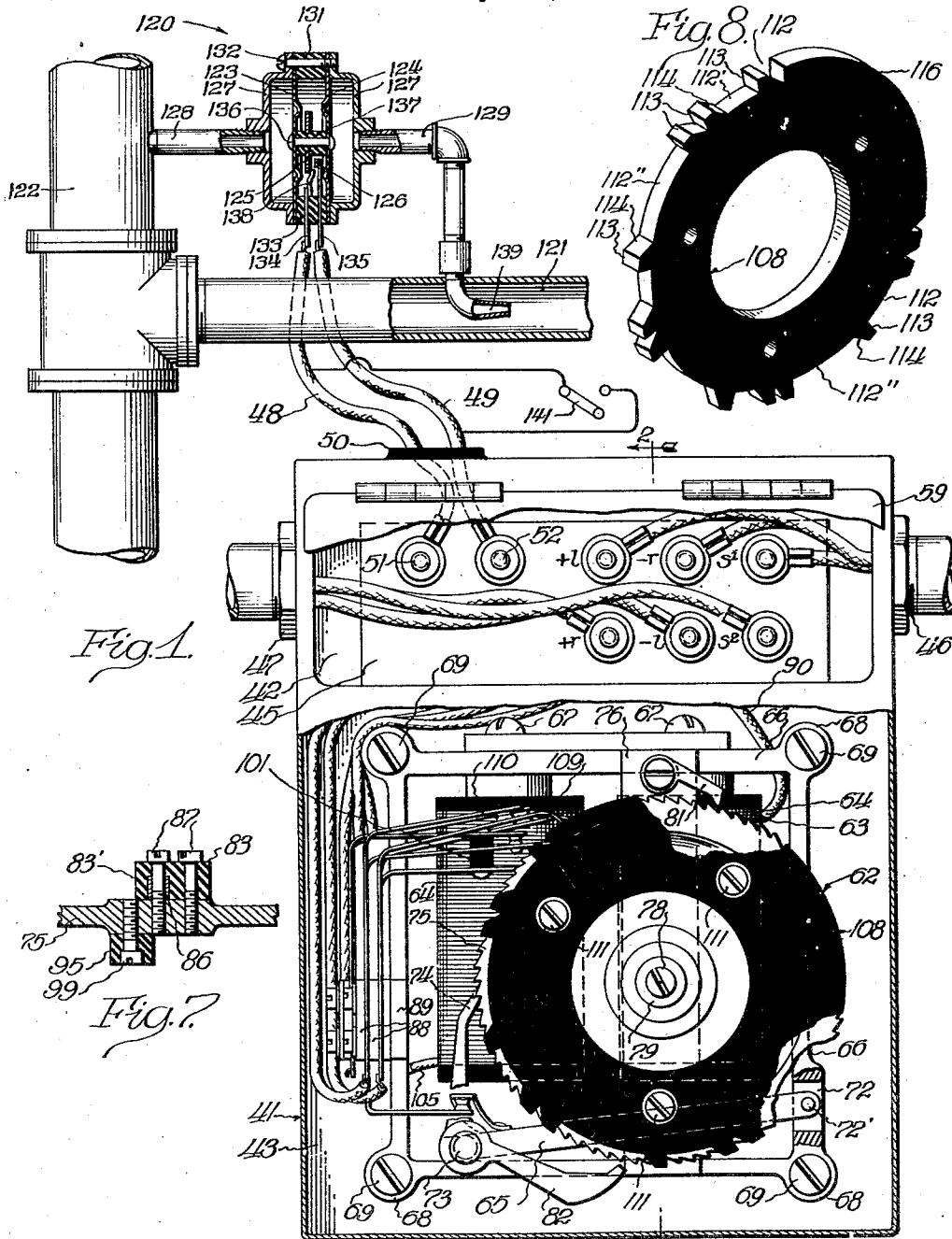
J. R. HARRINGTON

2,036,330

TRANSMITTER FOR SIGNAL SYSTEMS

Filed Sept. 17, 1931

5 Sheets-Sheet 1



Inventor:
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April 7, 1936.

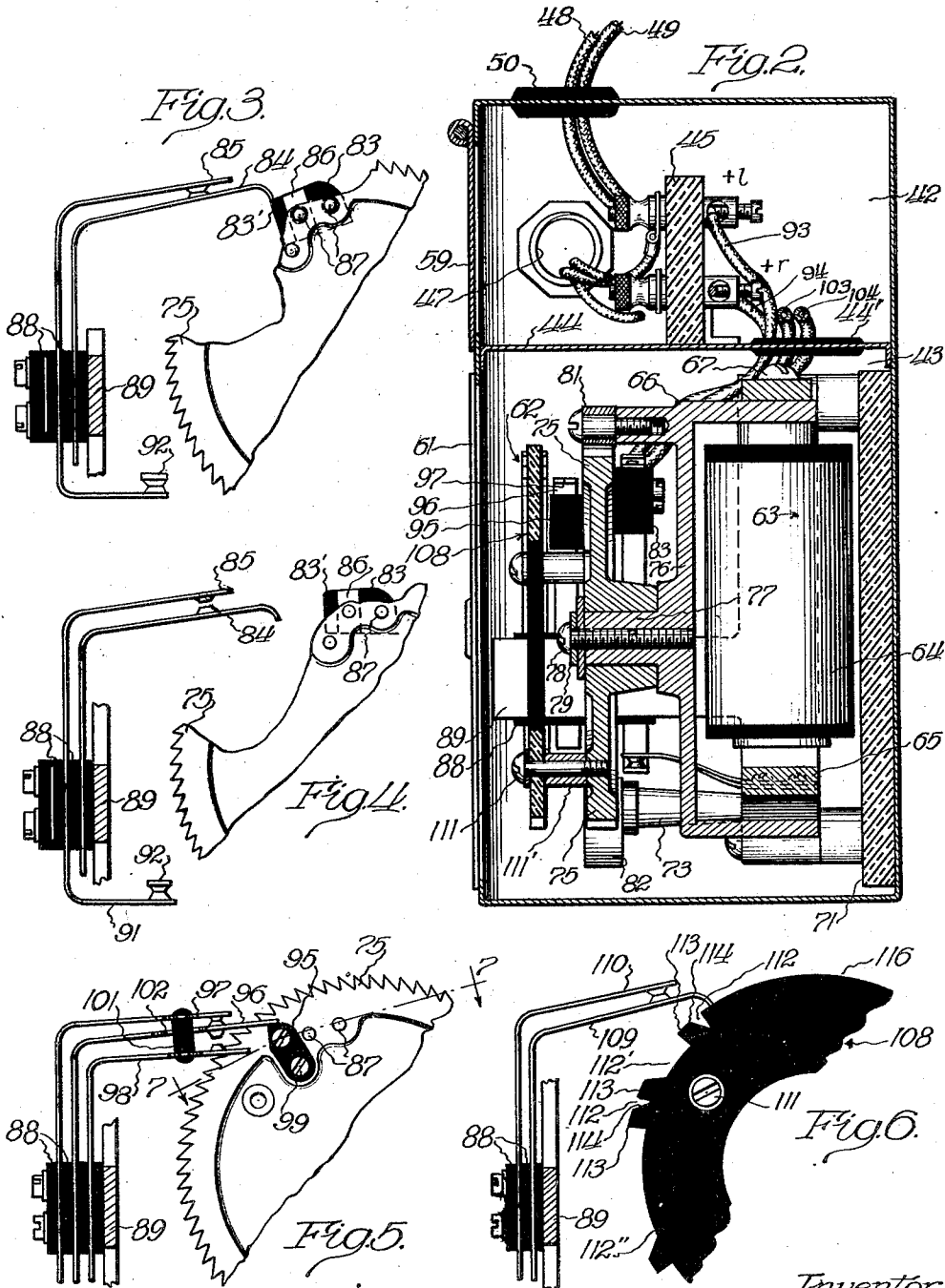
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5 Sheets-Sheet 2



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5 Sheets-Sheet 4

Fig. 10

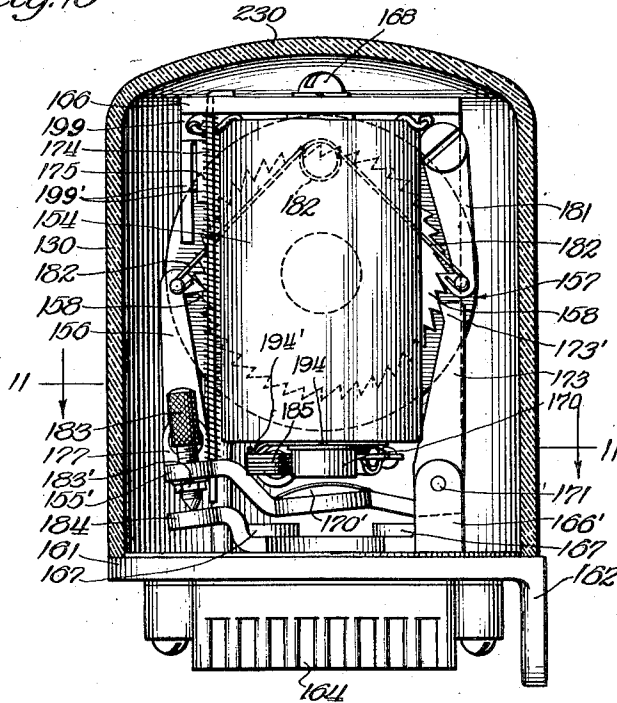
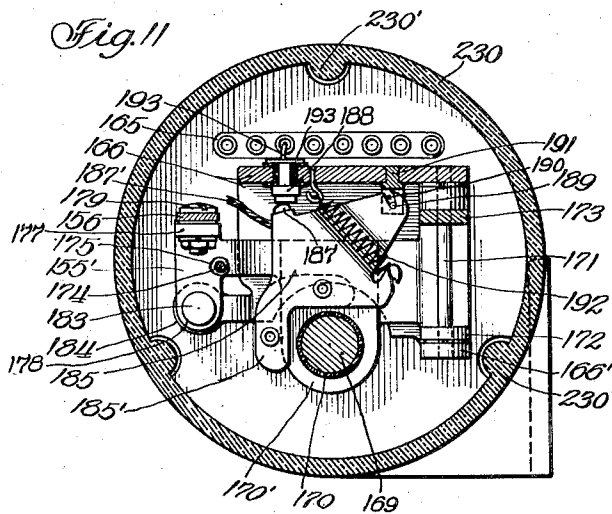


Fig. 11



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5 Sheets-Sheet 5

Fig. 12

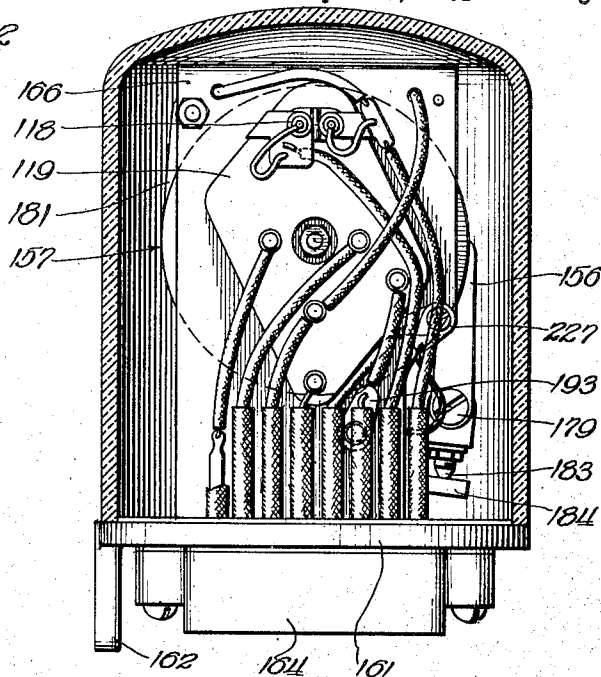


Fig. 14

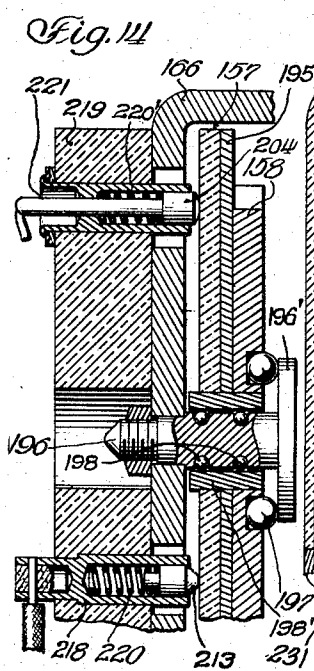
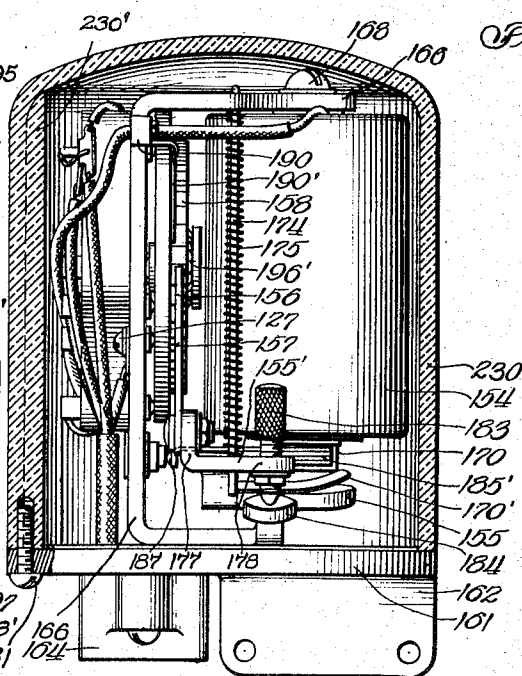


Fig. 13



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UNITED STATES PATENT OFFICE

2,036,330

TRANSMITTER FOR SIGNAL SYSTEMS

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Application September 17, 1931, Serial No. 563,237

11 Claims. (Cl. 177—378)

The present invention relates to transmitters or signal boxes for signal systems, and this application is a continuation in part of my co-pending application, Serial No. 183,478, filed April 13, 1927, on Electric signal systems, which application is issued on March 6, 1934, as Patent No. 1,950,108.

The signal system disclosed in this prior patent may be employed for fire alarm, supervisory or any other type of signal work, and is of the non-interfering, successive repeating type. In this system the signal boxes or transmitters are of the electrically actuated type wherein the signal transmitting mechanism of the box is operated by an electric motor element, which motor element is caused to rotate or advance in a particular timed relation. Such operation of the electric motor element is secured by transmitting a periodically varying current, such as an impulse current, to the motor element, such current impulses being transmitted from a pulsating device at the control panel of the system out over the box operating circuit to the electric motor element of the energized box.

The transmitter constituting the present invention is primarily intended for this general type of signaling system, although it will be understood that some of its features might also be adapted to other systems.

The general objects of the invention are: to provide an improved construction and arrangement of electric motor mechanism for driving the signal transmitting code wheel; to provide an improved construction, arrangement and mode of operation of the contacts which secure the non-interfering, successive repeating characteristics of the transmitter; and to improve upon the construction of these transmitters generally.

Referring to the accompanying drawings illustrating a preferred embodiment of my invention:

Figure 1 is a front elevational view, with portions of the enclosing casing broken away, of one form of my improved signal box or transmitter, this figure also illustrating the manner in which the transmitter may be connected to a flow responsive switch in a fire signaling installation;

Figure 2 is a transverse sectional view through the box or transmitter, taken approximately on the plane of the line 2—2 of Fig. 1;

Figure 3 is a fragmentary sectional view showing the spring contacts and cooperating cam for controlling one side of the box operating circuit in each box;

Figure 4 is a similar view showing another position of the same spring contacts and cooperating cam;

Figure 5 is a fragmentary sectional view showing the other set of spring contacts and cooperating cam for controlling the other side of the box operating circuit in each box;

Figure 6 is a fragmentary sectional view showing the contacts and cooperating signal wheel for controlling the signal or alarm circuit in each box;

Figure 7 is a detail sectional view through the ratchet wheel, taken on the plane of the line 7—7 of Fig. 5, and showing the two cams in section;

Figure 8 is a perspective view of the signal wheel removed from the rotary element of the box;

Figure 9 is a perspective view, partly in section, 15 showing a modified form of transmitter;

Figure 10 is a front elevational view of this same modified transmitter, the casing being shown in section;

Figure 11 is a transverse sectional view taken 20 approximately on the plane of the line 11—11 of Fig. 10;

Figure 12 is a view similar to Fig. 10 but illustrating the rear or opposite side of this modified transmitter;

Figure 13 is a side elevational view of the transmitter, corresponding to a view looking at the right hand edge of Fig. 12, and

Figure 14 is a fragmentary detail sectional view, on an enlarged scale, illustrating the mounting of the rotor in this modified form of transmitter, and the arrangement of the spring contacts.

Referring first to the form of transmitter illustrated in Figs. 1 to 8, inclusive, it will be noted from Figs. 1 and 2 that each transmitter or box comprises a housing 41 divided into upper and lower compartments 42 and 43 by a transverse partition 44. Suitably supported in the upper compartment is an insulating panel 45 on which 40 the several binding posts or terminals of the box are mounted. The circuit wires of the alarm system enter and leave the box through conduit openings 46 and 47 in the side walls of the upper compartment, and two wires 48 and 49 leading 45 from a flow responsive switch, alarm switch or the like also enter this compartment, such as through the opening 50 in the top wall of the compartment. The wires which extend from the connector terminals on the panel down to the contact mechanism in the lower compartment pass through an opening 44' in the transverse partition 44. Mounted on said panel 45 is an upper group of three terminals +I, -r and s', to which are connected three circuit wires which enter the 55

box. Mounted below this upper group is a second group of terminals $+r$, $-l$ and s^2 , to which are connected the three circuit wires which leave the box. Also mounted on the panel 45 is a pair of connector terminals 51 and 52 to which are connected the wires 48 and 49 leading from the flow responsive switch or other box controlling switch, which will be later described. Convenient access is afforded to the upper compartment 42, for making these connections to the terminals through a hinged door 59 which closes the front of the compartment. The lower compartment is closed by a removable plate 61 which is preferably screwed or bolted in place to prevent tampering with the operating parts and contact mechanism disposed in this lower compartment. There is no need of describing in all detail the circuits of the signal system, the same being fully disclosed in my above mentioned patent. It will therefore suffice for the purposes of this description to state that the electric motor elements of the several boxes or transmitters receive their operating current from a box operating circuit comprising two parallel conductors across which the boxes are connected in bridging relation. Positive polarity is applied to one end of one of these conductors so that this positive polarity is fed in one direction through the series of boxes, and negative polarity is applied to the other end of the other of said conductors so that this negative polarity is fed in the opposite direction through the series of boxes. The conductor feeding positive polarity to the boxes enters each box for connection with the terminal $+l$, and leaves each box through terminal $+r$; and the conductor feeding negative polarity through the boxes enters each box for connection with the terminal $-l$ and leaves each box through terminal $-r$. At the main operating station or control panel of the system is a device which functions to transmit current impulses over one of these conductors of the box operating circuit when one of the boxes is energized for transmitting a signal. A third conductor, constituting a signal conductor, also extends through the series of boxes, this signal conductor entering each box for connection with terminal s^1 and leaving each box through terminal s^2 .

Referring now to the operating parts of the transmitter disposed in the lower compartment 43, these operating parts comprise in the main a rotating element 62 and an electrically operated motor device 63 for driving the rotating element. For cheapness and simplicity of construction, the motor device preferably consists of a pair of electromagnets 64 which intermittently attract an armature 65 and through it impart a step-by-step rotary motion to the moving element 62. It will be evident, however, that a rotating armature type of motor might be employed to drive the rotary element 62, in which event suitable speed reduction gearing would be interposed between the armature shaft of the motor and the rotary element. As best shown in Fig. 1, the two electromagnets 64 are supported in an open rectangular frame 66 by screws 67 which pass down through the upper cross bar of the frame and tap into the ends of the magnet cores. Bosses 68 are formed at the corners of the frame to receive screws 69 which fasten to a back panel 71 of insulation, suitably secured to the back wall of the box. This mounting of the frame insulates the same from the box, which is desired, as one of the circuits is continued through this frame. The armature bar 65 is disposed below the lower

ends of the cores and has one end entering a slot 72 in one of the vertical side bars of the frame, where it has pivotal connection on a pivot pin 72'. A stud 73 projects laterally from the free end of the armature, and pivotally mounted on this stud is a pawl 74. The rotary element 62 comprises a ratchet wheel 75, to which the pawl 74 imparts advancing movement in the intermittent operation of the armature. As hereinbefore mentioned, and as fully described in my prior Patent No. 1,950,108, when the system is energized to transmit a signal, the pulsating device at the control panel sends out an intermittent current to the electromagnetic motor device 63 of the operating box, so that this motor device is intermittently energized to advance the ratchet wheel 75 with a step-by-step motion.

Referring to Fig. 2, the motor frame 66 comprises a vertical bar 76 extending between the top and bottom of the frame, intermediate the sides thereof. Projecting forwardly from this bar is a pivot boss 77 on which is journaled the ratchet wheel 75, the latter being held thereon in any suitable manner, such as by a screw 78 and washer 79. A dog 81 is pivotally supported on the upper portion of the intermediate bar 76 to engage in the ratchet wheel and prevent back-throw thereof. Extending from the advancing pawl 74 is another dog 82 which is adapted to move into the teeth of the ratchet wheel on the up stroke of the armature, and thereby prevent overthrow of the wheel.

Secured to the rear side of the ratchet wheel is a cam 83 which is adapted to cooperate with a pair of contact springs 84 and 85 supported at one side of the wheel, see Figs. 3 and 4. This cam consists of a block of insulation, the leading edge of which has a gradual cam slope and the trailing edge of which has a quick drop. In the movement of this cam past the downwardly curved end of the lower spring contact 84 the latter will be forced up against the upper contact 85 (Fig. 3), and then allowed to spring downwardly out of engagement with this upper contact as the cam moves away, (Fig. 4). Recessed in the cam is a metallic contact segment 86, the upper surface of which projects slightly from the outer surface of the cam so as to make contact with the contact spring 84 at one point in the cycle of movement of the ratchet wheel. The parts are so proportioned and arranged that at the termination of one advancement of the ratchet wheel the contact spring 84 will rest on the segment 86, and at the termination of the next advancement the contact spring will rest on the heel portion 83' of the cam. Two screws 87 secure the cam to the side of the ratchet wheel, and one of the screws passes through the contact segment 86 so as to insure the grounding of the latter to the ratchet wheel.

The fixed ends of the contact springs 84 and 85 have mounting between insulating strips 88 which are secured to an arm 89 extending forwardly from one side of the frame 66. The upper contact spring 85 extends down below the arm 89 and has a laterally bent contact portion 91 projecting under a contact spring 92 carried by the armature 65. As shown in Fig. 2, this latter contact spring is suitably secured to the free end of the armature and extends forwardly therefrom over the contact 91, whereby when the armature is in its lower or normal position the contacts 91 and 92 are in engagement.

The two sets of contacts 84—85 and 91—92 constitute two switches connected in series, these

two switches being interposed in series relation in one of the aforesaid box operating circuit conductors leading through the box. These two switches are shown as being interposed in the conductor which feeds positive polarity through the boxes; for example, a wire 93 (Fig. 2) extends down from the positive line terminal +l of the box to the spring contact 84, and a wire 94 extends from the frame 66 up to the positive return terminal +r of the box. Under normal conditions the contact 84 is resting on the heel portion 83' of the cam 83 and hence is in engagement with the upper contact 85. The circuit established through terminal +l and wire 93 continues down through the contacts 84 and 85 to the contact 91. Under normal conditions, the armature is down and hence the circuit continues through contact 92, armature 65 to frame 66, and thence by wire 94 to the positive return terminal +r of the box. The positive polarity is fed through each of the successive signal boxes in this same manner. Within each box, a wire 90 extends from one end of the electromagnet windings and connects to the terminal +l, thus placing the electromagnets in permanent connection with the conductor connecting with the two series switches 84—85 and 91—92, but on the "line" side of these switches. The contact segment 86 has electrical connection with the frame 66 through one of the screws 87 and the ratchet wheel 75. It will be obvious that in the energization of the box the contacts 91 and 92 will have a pronounced lead over the contacts 84—85, i. e., with the initial movement of the armature as it starts to actuate the ratchet wheel these contacts 91—92 will be opened. The lead which this switch 91—92 has over the other switch 84—85 provides the non-interfering action which is fully described in my prior patent above mentioned.

Secured to the front side of the ratchet wheel 75 is a cam or pin 95 which is adapted to cooperate with three spring contacts 96, 97 and 98 (Fig. 5), controlling the other conductor of the box operating circuit. This cam is also composed of insulation and is secured to the ratchet wheel in any suitable manner, as by screws 99. The end of the lower contact spring 98 projects into the path of the cam 95 so that as the cam moves under such contacts in its clockwise direction of rotation towards its normal position, it will press this lower contact spring upwardly against the middle contact spring 96. The end of the middle contact spring also projects into the path of the cam so that as the cam moves past the end of the lower contact spring, allowing the latter to snap downwardly, it will engage and press the middle contact spring upwardly against the upper contact spring 97. In the normal position of the parts the ratchet wheel stands with the cam holding the middle contact spring up against the upper contact spring, as shown in Fig. 5. The parts are so proportioned that as the ratchet wheel is approaching the end of its cycle the cam 95 engages and forces the lower contact spring upwardly in a one-step advancement of the wheel; the middle contact spring, which is then engaging the lower spring, being forced upwardly therewith and the upper spring also moving upwardly in spaced relation to both. In the next one-step advancement the cam moves past the end of the lower contact spring, allowing the same to snap downwardly, and moves the middle contact spring up against the upper contact spring. As above remarked, the cam is now

in its normal position. With the next cycle of operation, the cam moves past the middle contact spring, allowing the latter to snap down into engagement with the lower contact spring, at the same time breaking circuit with the upper contact spring. An insulating pin or strut 101 extends between the upper and lower contact springs, passing through an enlarged hole 102 in the intermediate contact spring, so as to maintain the upper and lower springs at a definite spacing for securing the above operation. The three contact springs are mounted between the insulating strips 88 on the supporting arm 89.

The intermediate contact 96 is connected through wire 103 (Fig. 2) with the negative line terminal -l of the box, whereby this negative polarity entering the box at -l is fed to this contact. With the cam 95 normally holding the latter contact up in engagement with the upper contact 97, this polarity is fed up through the upper contact and through wire 104 to the negative return terminal -r communicating with the aforesaid negative conductor leading from the box. A wire 105 (Fig. 1) connects the lower contact 98 to the other end of the windings of the electromagnets 64. The flow responsive switch or other form of box controlling switch, generally indicated at 120, is connected in shunt across the contacts 96 and 98 through wires which extend down from the terminals 51 and 52 to these contacts. The switch 120 is normally open and hence at such time the electromagnets 64 have no connection with the box operating circuit conductor passing through terminals -l and -r.

Mounted on the front side of the ratchet wheel 75 in spaced relation thereto is a signal wheel 108 which cooperates with two spring contacts 109 and 110, shown in Fig. 6. The signal wheel is secured to the ratchet wheel by screws 111 which pass through spacing sleeves 111' interposed between the wheels, whereby the signal wheel is spaced forwardly from the ratchet wheel to accommodate the cam 95 and spring contacts 96, 97 and 98. The screws 111 are set inwardly at a smaller radius than the cam 95 and hence do not engage the contact spring 96. The periphery of the signal wheel is formed with alternating notches 112 and teeth 113, with which engages the downwardly curved end of the contact 109. The two contacts 109 and 110 are mounted between the insulating strips 88 on the arm 89, similarly to the contacts above described. Referring to Fig. 8, it will be seen that the leading edge of each tooth 113 has an inclined slope 114 which serves to cam the contact 109 up on to the top of the tooth, at which time this contact is flexed upwardly into engagement with the upper contact 110. The trailing edge of each tooth has a relatively sharp drop for securing a quick opening of the contacts. The span of the top of each tooth 113 equals a one-step advancement of the ratchet wheel, and similarly the span of the sloping cam surface 114 between closely disposed teeth equals a one-step advancement of the ratchet wheel. Thus, when the contact 109 drops into one of the notches 112 the next succeeding impulse of the ratchet wheel will move the signal wheel the length of the sloping surface 114, causing the contact 109 to be flexed upwardly immediately into circuit closing position.

The teeth and notches on each signal wheel are arranged to close the contacts 109 and 110 in predetermined succession, corresponding to a code individual to that particular signal box. For example, the signal wheel illustrated in Figs. 75

6 and 8 is intended to give a code call of 1:2. That is to say, beginning with the starting point on the signal wheel, a single tooth 113 is followed by a relatively long notch 112', at the end of which are two closely spaced teeth 113 again followed by a still longer notch 112''. This relation of teeth and notches may be repeated several times around the periphery of the wheel. In the rotation of such wheel, it will be evident that each alarm bell in the system or other device responsive to the operation of the system will first be given one stroke, or will be energized for one short period of time, followed by a dwell, and then two strokes or two short periods of operation followed by a longer dwell. It will be understood that each signal box will be provided with a different signal wheel coded to designate the operation of that box. The signal wheels may be readily removed for substitution by simply removing the screws 111. These screws are located unsymmetrically with reference to the wheel so that in the mounting of each wheel it can only be secured to the ratchet wheel in one angular relation. In its normal position the signal wheel stands with the contact 109 engaging on the trailing end of a relatively long raised dwell 116. Thus, the signal circuit is normally completed through the contacts 109 and 110, and at the conclusion of one cycle of rotation of the signal wheel the contact 109 is caused to ride up on this relatively long dwell 116 for again closing the signal circuit. The two signal contacts 109 and 110 are connected through wires (not shown) with the terminals s^1 and s^2 which places these contacts in series in the signal circuit connecting with said terminals.

The flow responsive switch 120 might be used in situations where the transmitter is intended to transmit a signal when water flow occurs in the pipe 121. For example, in an alarm system associated with sprinkler apparatus the pipe 121 may represent a floor branch main leading from a riser 122 to a series of sprinkler heads located in a particular room or part of the building. The opening of one of these sprinkler heads results in a flow of water through pipe 121 and this is arranged to automatically control the contacts in the flow responsive switch 120. This switch comprises two pressure actuated surfaces 123 and 124 which are connected to be subjected respectively to the pressures in the riser 122 and in the branch main 121. These two surfaces respond to any difference of pressure between the riser and branch main and transmit operating motion to contact mechanism as soon as any such difference of pressure develops. In the particular construction shown, I have illustrated these pressure actuated surfaces as being two spaced diaphragms, but it will be obvious that these surfaces might consist of the opposite sides of a single diaphragm, or the end heads of a movable piston. However, by constructing such surfaces in the form of two spaced diaphragms I am enabled to disposed the two switch contacts 125 and 126 between the diaphragms, thus avoiding any moving joint and avoiding the necessity of disposing any operating parts in the water. The outer sides of the diaphragms are closed by shells or heads 127 forming diaphragm chambers which communicate through pipes 128 and 129 with the riser 122 and branch main 121, respectively. An annulus 131 is interposed between the inner sides of the diaphragms, and bolts or screws 132 pass through the flanges of the end heads and through said annulus. An insulating bushing 133 extends

inwardly through this annulus for supporting the terminals 134 and 135 which extend in to the switch mechanism. The diaphragms are joined centrally by a rivet or bolt 136 on which is mounted an insulating bushing 137. The movable switch contact 125 consists of a disc or finger carried by the insulating bushing 137. This contact is connected through a flexible conductor 138 with the electrode 134 which passes out through the insulating bushing 133. When there is no water flow through branch main 121, equal pressures are effective against both diaphragms, and hence the latter assume a balanced position with the contact 125 separated from the contact 126. A static pressure is normally maintained on the entire piping system from an overhead storage tank or from an air reservoir. As soon as one of the sprinkler heads releases a rapid flow is set up in the associated branch main, which results in a slight difference of pressure being created between the branch main and the riser, with the higher pressure existing in the latter. This difference of pressure, acting on the comparatively large surfaces of the diaphragms, will flex such diaphragms to the right, as viewed in Fig. 1, thereby bringing the movable contact 125 into engagement with the stationary contact 126. The latter contact is a spring finger which can yield slightly with the movement of the contact 125 in its direction. If desired, the end of the pipe 129 entering the stringer 121 may be provided with a nozzle portion 139 facing in the direction of flow through the branch main for giving a Pitot tube action to augment the pressure differential. The two wires 48 and 49 extending down to the transmitter are connected with the terminals 134 and 135. It will be seen from the foregoing that the flow responsive switch 120 functions as a circuit closer for the circuit 48—49 leading to the transmitter. Where the transmitter is embodied in a fire alarm call-box system, a burglar alarm system, or the like, any suitable switch may be substituted for the flow responsive switch 120. As illustrative of the latter, I have shown a manually operated switch 141 connected across the two wires 48—49.

When a circuit is completed between wires 48 and 49, through switch 120 or 141, or some similar circuit closing device, negative polarity is transmitted to the electromagnets 64 through the connections previously described. In the immediate energization of these electromagnets the first action occurring is the opening of the contacts 91 and 92. This occurs with the very first upward movement of the oscillating armature 65, and takes place before any movement has been imparted to the ratchet wheel 75 through the advancing pawl 74. The other two contacts 84—85 do not separate until advancement has been imparted to the ratchet wheel in the initial energization of the electromagnets 64 and hence the armature controlled contacts 91—92 will have a lead of operation in opening the positive side of the box operating circuit through the box over the opening of this circuit through the contacts 84—85. This avoids interference between the boxes, as described in my above mentioned copending application. The completion of this first step of advancement of the ratchet wheel also carries the cam 95 past the end of the contact spring 96 (Fig. 5), resulting in the contact 96 separating from the contact 97 and engaging with the contact 98. The separation of the contacts 96—97 also cooperates in avoiding interfer-

ence between the boxes, as described in my aforementioned patent, and the engagement of the contacts 96 and 98 establishes a shunt between the wires 48 and 49 for compelling the transmitter to operate through a complete cycle once a circuit has been completed between these wires 48 and 49. The transmission of intermittent current impulses over the box operating circuit continues to oscillate the armature 65 and to advance the ratchet wheel 75 with a step-by-step motion until the rotor element approaches the end of its cycle of revolution. At a point one step short of the completion of the cycle the contact segment 86 moves under the contact spring 84 and establishes a shunt across the contacts 91 and 92 for transmitting a testing impulse of positive polarity to other boxes in the series to see if these other boxes are ready to operate, and if no other box is ready to operate the rotor completes its cycle, at which time the contacts are restored to the positions illustrated in Figs. 3 and 5. If the signaling condition continues at that box the transmitter will continue through another cycle. In each cycle of revolution the rotation of the code wheel 138 will transmit code impulses through the opening and closing of the contacts 109, 110, for the purpose of designating that particular box.

In Figs. 9-14, inclusive, I have illustrated a modified form of my improved transmitter, this form being substantially the same as that disclosed in my copending application, Serial No. 550,739, filed July 14, 1931, on Electric signaling, supervising and recording systems. In this modified construction, only a single electromagnetic coil 154 is employed, this being arranged to attract an armature 155 carrying an advancing pawl 156 for imparting a step-by-step advancement to a rotary element 157, the latter having a ratchet wheel 158 with which the advancing pawl 156 engages. These principal elements are generally similar to those in the previously described construction, except that it is the down stroke of the armature in this construction which advances the rotary element, rather than the up stroke i. e., in the first described form it is the energization of the electromagnet which advances the rotary element whereas in this latter form it is the de-energization of the electromagnet which advances the rotary element. The various parts are assembled upon a supporting or base plate 161 having a downturned flange 162 at one side by which the plate can be secured to any suitable support. Secured to the bottom of said plate is an insulating connector block 164 in which are mounted the connector terminals adapted for connection with the box operating and signal circuits and with the circuits or circuits which govern the energization of the box. Wires extending from these terminals pass up through an insulating bushing 165, passing through the base plate, and extend up to their respective contacts and connections associated with the rotary element 157, as I shall hereinafter describe.

The coil and armature assembly is carried by a C-shaped bracket 166, the lower arm of which is secured to the base plate 161 by the insulated bolts or studs 167. The electromagnetic coil 154 is suspended from the upper arm of the C-shaped bracket 166 by a screw 168 passing down through said arm and threading into the core 169 of the coil. A cap 170 composed of copper or like magnetic insulating material is secured over the lower end of the core. A secondary armature, to be later described, is adapted to be magnetically at-

tracted against the side of the core, and the provision of the copper cap 170 assures that this secondary armature will separate from contact with the core, thereby preventing the possibility of slight residual magnetism delaying the return movement of the secondary armature when the coil is deenergized. A thin strip of sheet copper 170' (Figs. 9, 10 and 13) is riveted to the armature 155 in position to engage the lower end of the core 169 when the armature is attracted upwardly. This strip has an upwardly bent spring portion which first engages the copper cap 170 and is then flexed against the armature as the armature is attracted upwardly.

The portion of the armature adjacent its pivot axis is made relatively wide to give considerable width of bearing support, this pivot mounting comprising a pivot pin 171 passing through the back of the bracket 166 and through the extension arm 166' of said bracket. As shown in Fig. 11, this pivot pin passes through a pivot lug 172 bent up from the front edge of the armature 155 and through an arm 173 bent up from the back edge of said armature. Said arm constitutes an overthrow preventing pawl, having a nose 173' at its upper end which is adapted to swing into the teeth of the ratchet wheel 158, in the downward wheel advancing movement of the armature, so as to prevent overthrow of the ratchet wheel.

The C-shaped supporting bracket 166 is preferably of a magnetic material to complete the magnetic circuit from the top of the coil 154 down to the magnetic armature 155. The swinging end of said armature has an arm portion which slopes upwardly and thence outwardly as indicated at 155'. A light rod 174 is extended down through a hole in the top horizontal leg of the C-shaped supporting bracket 166 and has its lower end passing loosely through a hole in the extension arm portion 155' of the armature, see Figs. 10, 11 and 13. A light compression spring 175 is confined on this rod to bear at its upper end against the top leg of the bracket 166 and at its lower end against the armature arm 155'. The considerable length of this spring avoids any tendency for the pressure to increase objectionably as the armature swings upwardly. A detent pawl 181 is pivotally mounted on the supporting frame 166 and is arranged to engage the ratchet wheel 158 to prevent reverse movement thereof. The two pawls 156 and 181 are yieldingly held in operative engagement with the ratchet wheel 158 through the action of a light wire spring 182, the latter having an intermediate coiled portion and having its ends extending down and fastened to pins carried in the swinging ends of the two pawls 156 and 181. The extension arm 155' of the armature carries a vertically extending apertured lug 177 and a laterally extending threaded lug 178. The threaded lug 178 on the armature carries a stop screw 183 which threads down through said lug and is adapted to have its lower end abut a fixed stop 184 projecting from the mounting bracket 166. Adjustment of the screw 183 adjusts the downward limit of movement of the armature 155, said screw being held in adjusted position by a suitable lock nut 183'. The upward limit of movement of the armature may also be defined by an adjustable stop screw, although I preferably have the armature engage the copper cap 170 on the end of the magnet core.

Referring to Fig. 11, at the instant that a magnetic flux starts to build up in the energization of the electromagnet 154, a secondary armature 75

185 is magnetically actuated to separate two contacts 187 and 188. This secondary armature may be mounted in different relations to respond to the flux created by the electromagnet, but in the preferred arrangement shown it is mounted at the lower end of the vertical back wall of the bracket 166, at the lower end of the coil. Said armature or switch is pivoted on a pin 189 carried by a suitable stud or mounting projection 191 fixedly mounted in said back wall. Said mounting stud 191 is slotted horizontally, with the end of the armature extending into said slot and embracing the pin 189, this portion of the armature having an inclined slot 190 which permits the armature to be readily assembled in pivotal engagement with the pin 189. Said secondary armature comprises a yoke shaped portion 185' of magnetic metal which is adapted to be attracted into contact with the side of the copper cap 170. A tension spring 192 suitably connected between a lug on the secondary armature and a fixed point of attachment on the bracket 166 tends to normally hold the armature in the position illustrated with the contacts 187 and 188 in engagement. The movable contact 187 is grounded to the bracket 166 through the armature pivot support, and also through a flexible pigtail 187' which is soldered to the contact 187 at one end and has its other end grounded to the bracket 166. The stationary contact 188 is mounted in an insulated bushing 193 in the bracket 166. A ring 194 (Fig. 10) secured to the base end of the coil 154 has an outwardly and downwardly bent guide finger 194' which is adapted to bear against the top surface of the secondary armature 185 so that when the coil is energized this secondary armature is properly attracted inwardly against the copper cap 170 and is prevented from being pulled or attracted upwardly by the flux against the end of the coil 154.

This secondary armature is of relatively light inertia and it responds instantly to the energization of the electromagnet. The two contacts 187 and 188 are open by the time the main armature 155 has started to move upwardly, and since it is the down stroke of this main armature rather than the up stroke that advances the rotary element it naturally follows that the opening of the two contacts 187 and 188 has a lead of operation over any contact change or contact operation effected by the rotary element. The manner in which this lead of operation is advantageously utilized in the control of my signal systems has been briefly mentioned in the description of the preceding form of transmitter, and is fully set forth in my prior Patent No. 1,950,108 and in my prior application Serial No. 550,739.

The rotary element 157 comprises a disc of insulating material to the back side of which the ratchet wheel 158 is rigidly pinned. Also secured to the back side of this insulating disc, and disposed between said disc and the ratchet wheel, is a thin metal plate 195 (see Fig. 14) which serves as a common connecting element for connecting together certain of the contacts disposed on the front face of the insulating disc. This rotor assembly is revolvably mounted on the enlarged hub portion of a bearing screw 196 which has a reduced end non-rotatably mounted in the upright portion of the bracket plate 166. Ball bearings 197 track in an annular groove in the face of the ratchet wheel 158 and bear against the outer head 196' of the pivot screw 196, thereby providing an anti-friction thrust bearing for carrying the end thrust which is imposed on the

rotor by the spring pressed contacts bearing against the front face of the insulating disc 157. The radial load of the rotor is carried by two longitudinally spaced sets of ball bearings 198 which track in grooves in the pivot stud 196 and engage the inner surface of a central bearing hub or ring 198' in the rotor. The ratchet wheel 158 and the metallic connector disc 195 are electrically connected to the frame support 166 through the pivot mounting 196, and also through a connector brush 199 (Fig. 10) which is fastened to the frame support 166 in electrical connection therewith and which has spring fingers 199' bearing against the metallic disc 195. The frame support 166 preferably has no connection with "ground" in the systems described in my above mentioned applications.

Referring to the diagrammatic illustration of Fig. 9, the front face of the insulating rotor disc 157 carries a series of signalling or selecting contacts 201 adjacent to the outer periphery of the disc. These contacts preferably consist of a series of spaced pins extending back through the body of the insulating disc and all riveted over or otherwise connected with the metallic connector disc 195 on the back side of the rotor. Said pins are arranged in a code combination designating the particular transmitter; for example, in Fig. 9 the first three groups of contact pins transmit signalling or selecting impulses corresponding to 1-3-4 for designating that particular box. I prefer to have each box or transmitter so arranged that a half revolution of the rotor disc 157 gives one complete signalling cycle and the other half revolution gives another complete signalling cycle. By this arrangement one box may be utilized to signal two distinct supervisory conditions, i. e., one of the half revolutions can be used to signal that a certain valve is closed and the other half revolution can be used to signal that this same valve is open. In such arrangement there are two of these series of signal contacts 201 disposed on diametrically opposite halves of the code wheel. In an alarm box the two series are preferably identical, but in a supervisory box there is a different arrangement of the contacts on one side than on the other to signal the two different conditions. While I prefer this construction wherein a half revolution constitutes a complete signalling cycle, it will be understood that if desired the construction may be such that a whole revolution of the rotor will be required for a complete signalling cycle. Coacting with these rotating signal contacts 201 is a stationary signal contact 202, such comprising a spring pressed contact supported in an insulating bushing which is mounted in the vertical portion of the bracket 166 (the details of which I shall hereinafter described), this spring pressed contact preferably bearing against the lower portion of the insulating disc, and being engaged successively by the pins 201 in the rotation of the disc.

Spaced inwardly at a smaller radius than the aforesaid pins are two diametrically opposite shunting or bridging contacts 203 and 203'. These contacts do not have electrical connection with the connector disc 195 on the back side of the rotor, but merely consist of inserts anchored in depressions in the front face of the insulating disc 157. Such shunting contacts are adapted to make and break a bridging connection between two spring pressed contacts 204 and 205 which are supported by the bracket 166 preferably in a position to engage the upper portion of the

rotary element. In the normal position of the rotary element the two contacts 204, 205 are bridged by the shunt 203. A one-step advancement of the rotor from its normal position breaks this shunt, but thereafter, upon the completion of 180° of movement of the rotor, the shunt is again reestablished by the other bridging contact 203'.

Spaced inwardly from the arc of the two shunting contacts 203, 203' are two diametrically opposite pin contacts 208 and 208' which extend back through the insulating disc and are electrically connected to disc 195 and ratchet wheel 158. Coacting therewith is a stationarily mounted spring pressed contact 209 which is preferably arranged substantially in the angular relation shown in Fig. 9 with respect to the rotating contacts 208 and 208'. In the normal position of the rotor shown, one or the other of the rotating contacts 208 or 208' lies in a position one step in advance of the stationary contact 209, in the direction of rotation of the rotor. That is to say, in any one cycle operation or half revolution of the rotor from the normal position shown, one or the other of the moving contacts 208 or 208' will engage the stationary contact 209 one step in advance of the rotor completing its cycle or half revolution. The engagement of said contacts establishes a temporary shunt across the secondary armature contacts 187, 188 for transmitting positive polarity toward the other boxes in one direction through the series of boxes to test if another box in this direction has been energized and is ready to take the line. This function corresponds generally to the function of the contacts 84 and 86 of the first described embodiment, and is fully explained in my aforementioned patent and copending application.

Spaced inwardly from the two latter contacts 208, 208' are two arcuate contacting segments 212, 212'. Both of these segments are secured to the signalling rotor by connectors which extend through the rotor and connect both segments to the back connector disc 195. Coacting with both of these segments is a stationary spring pressed contact 213 which, when the rotor is in its normal position, presses against one of the two diametrically opposite insulating gaps which occur between the opposite ends of the contact segments 212, 212'. The contacts 212 and 212' have impressed thereon the polarity of one side of the circuit which supplies current to the signal box or transmitter, which side will be assumed to be the positive side of said circuit. In such arrangement, the contact 213 has connection with the positive terminal of the electromagnet 154. Hence, as soon as the rotor makes a one step advancement, the engagement of one or the other of the segments 212 or 212' with the contact 213 maintains positive polarity impressed on the electromagnet 154 through a half revolution of the rotor, thereby insuring that the rotor will complete a signaling cycle, once it has started operation.

Spaced inwardly from the radius of these contact segments is an inner contact 214 which also extends through the insulating rotor for connection with the ratchet wheel and connector disc 195. Coacting with this innermost rotating contact are two diametrically opposite spring pressed contacts 215 and 215', mounted on the bracket plate substantially in the angular relation shown in Fig. 9. In the normal position of the rotor, as the same is illustrated in this figure,

the moving contact 214 is in engagement with the stationary contact 215', being adapted to make a later engagement with the other contact 215 when the rotor has revolved through approximately 180°. The moving contact 214 has the same polarity of the box operating circuit impressed thereon as the arcuate segments 212, 212', which has been assumed to be the positive side of the circuit. The cooperating stationary contacts 215, 215' are adapted to have connection with the outside contacts of any three point switch which is to control the operation of the transmitter, the intermediate contact of said switch being connected to the positive terminal of the electromagnet 154. Thus the contacts 214, 215 and 215' supply positive polarity alternatively to the two positions of said control switch, whereby the control switch determines the starting of the transmitter for operation through either of its two signaling cycles.

Fig. 14 illustrates two of the stationary spring pressed contacts in cross section, and the lower one of these contacts, designated 213, typically represents the construction of each of the spring pressed contacts 202, 209, 213, 215 and 215'. Each of these contact devices comprises a guide sleeve or bushing 218 suitably anchored in a hole in an insulating mounting block 219 secured to the vertical portion of the bracket 166. The contact plunger, or ball, moves in this metallic guide sleeve, being urged against the face of the rotor disc 157 by a compression spring 220 confined between the contact and an internal shoulder formed in the outer portion of the metallic guide sleeve. The wire connecting with this contact is extended into a diametrical hole or slot in the outer end of said guide sleeve and is soldered thereto. The upper spring pressed contact shown in section in this Fig. 14, which upper contact is designated 204, is also mounted in a metallic guide sleeve 218, with a compression spring 220' confined between the contact plunger and an internal shoulder in the guide sleeve. However, in this construction, the same also being true of the companion contact 205, the contact carries a rod extension 221 projecting back through the outer end of the guide sleeve and moving directly with the contact. The wire connecting with this contact is soldered directly to the rod 221. This avoids the necessity of carrying the current through a movable joint and reduces the resistance of the circuit through the contacts 203, 204 and 205.

A housing or cover 230, preferably composed of insulation, is secured over the operating parts of the transmitter. The open lower end of this casing is secured to the base plate 161 by screws 231. At spaced points around the inside of this casing are formed longitudinally extending ribs 230' which strengthen the casing, and the screws tap into threaded holes in the lower ends of these ribs.

One of the conductors of the box operating circuit, preferably the conductor which feeds positive polarity to the box, is electrically connected through the wire and connector terminal 227 (Fig. 12) to the supporting frame 166. Hence, positive polarity is normally continuously fed to the secondary armature contact 187 and the rotor contacts 201, 206, 208', segments 212, 212', and contact 214, all of which have electrical connection with the supporting frame 166. In the normal, non-operating condition of the box this positive polarity is fed on through the box down to the next box in the series through a circuit estab-

lished from secondary armature contact 187 to its cooperating contact 188 and thence through a wire to the positive conductor leading to the next box. As previously described, these secondary armature contacts 187, 188 have a lead of operation over any of the contacts controlled by the rotation of the rotor. The contacts 208 and 208' cooperate with the contact 209 in establishing a shunt across the secondary armature contacts 187, 188 at a point one step short of the completion of each cycle of operation of the box, for transmitting positive polarity down to the next box in the series to see if this box has been energized and is ready for operation. The other conductor of the box operating circuit, which preferably feeds negative polarity to the box, connects with spring pressed contact 204, and the continuation of this negative conductor leading up to the next box extends from the cooperating spring pressed contact 205. In the normal condition of the box these two contacts 204, 205 are bridged by one of the shunting segments 203 or 203'. The electromagnet 154 is permanently connected to the line side of this conductor so that the electromagnet normally has negative polarity impressed thereon.

The control circuit for the box comprises a connection or connections leading from the spring pressed contacts 215, 215' to the flow responsive switch, valve, pressure gauge, or whatever other device is intended to cause operation of the transmitter. Leading back from that device is a connection to the other end of the winding of the electromagnet 154, whereby when that flow responsive switch, valve or other device is placed in condition to cause the transmission of a signal positive polarity will be supplied to the electromagnet 154 for starting its operation. The spring pressed contact 213 cooperates with the contact segments 212, 212' for compelling the transmitter to complete its half revolution of operation, corresponding to one cycle of signalling, once the transmitter has been energized by the flow responsive switch, valve, or other device to which the transmitter is to respond.

The signalling conductor extending through the series of boxes has connection at each box with the spring pressed contact 202. In the rotation of the rotor the movement of the signalling contacts 201 under this spring pressed contact 202 successively transmits positive polarity from the supporting frame 166 through the contacts 201 and 202 to the signalling conductor for causing the recording or signalling operation.

While I have illustrated an embodiment of my invention which I consider to be a preferred embodiment, it will be understood that such is merely exemplary of the essence of my invention and that numerous modifications and rearrangements may be made therein without departing from the essence of the invention.

I claim:

1. In a signalling transmitter for signal systems, the combination of an electromagnet, an armature responsive thereto, a rotor comprising a ratchet wheel, an insulating disc and a metallic connector disc secured together with said metallic connector disc interposed between said ratchet wheel and said insulating disc, a pawl actuated by said armature and adapted to engage said ratchet wheel, contacts recessed in the face of said insulating disc and electrically insulated from said connector disc and said ratchet wheel, contacts mounted in said insulating disc and electrically connected to said connector disc, and spring contacts bearing

against said rotor and adapted to engage with the aforesaid contacts.

2. In a signalling transmitter for signal systems, the combination of a supporting plate, an electromagnet mounted at one side of said supporting plate, a rotor mounted between said electromagnet and said supporting plate, an armature responsive to said electromagnet, means actuated by said armature for advancing said rotor, signal transmitting contacts carried by said rotor, an insulating block mounted on the opposite side of said supporting plate, and spring pressed contacts mounted in said insulating block and adapted to engage with the contacts on said rotor.

3. In a signal transmitter for signal systems, the combination of a primary armature, a secondary armature, electromagnetic means for simultaneously actuating both of said armatures, each of said armatures having an attractive movement in one direction when attracted by the energization of said electromagnetic means and having a retractive movement in the opposite direction upon the deenergization of said electromagnetic means, an advancing pawl actuated by said primary armature, a code wheel, a ratchet wheel connected to said code wheel and adapted to advance the latter, said advancing pawl engaging successive teeth of said ratchet wheel upon the attractive movements of said primary armature, and advancing said ratchet wheel upon the retractive movements of said primary armature, and circuit controlling means responsive to said secondary armature and adapted to be placed in open circuit condition by the attractive movement of said secondary armature, said armatures having a time differential in their operations whereby said secondary armature in its attractive movement will place said circuit controlling means in open circuit condition before said primary armature in its attractive movement will have actuated said advancing pawl sufficiently far to engage the next succeeding ratchet tooth on said ratchet wheel.

4. In a signal transmitter for signal systems of the class wherein the speed of operation of the transmitter is governed by the frequency of unidirectional current impulses transmitted thereto, the combination of a non-polarized primary armature, a non-polarized secondary armature, stationary electromagnetic means for simultaneously actuating both of said armatures, each of said armatures having an attractive movement in one direction when attracted by the energization of said electromagnetic means and having a retractive movement in the opposite direction upon the deenergization of said electromagnetic means, an advancing pawl actuated by said primary armature, a code wheel, a ratchet wheel connected to said code wheel and adapted to advance the latter, said ratchet wheel being limited solely to unidirectional rotation, said advancing pawl engaging successive teeth of said ratchet wheel upon the attractive movements of said primary armature and advancing said ratchet wheel upon the retractive movements of said primary armature, and circuit controlling means responsive to said secondary armature and adapted to be placed in open circuit condition by the attractive movement of said secondary armature, said armatures having a time differential in their operations whereby said secondary armature in its attractive movement will place said circuit controlling means in open circuit condition before said primary armature in its attractive movement will have actuated said advancing pawl sufficiently far to engage

the next succeeding ratchet tooth on said ratchet wheel.

5. In a signal transmitter for signal systems of the class wherein the speed of operation of the transmitter is governed by the frequency of current variations transmitted thereto, the combination of a primary armature, a secondary armature, electromagnetic means for simultaneously actuating both of said armatures, each of said armatures having an attractive movement in one direction when attracted by the energization of said electromagnetic means and having a retractive movement in the opposite direction upon the deenergization of said electromagnetic means, an advancing pawl actuated by said primary armature, cooperating stationary and movable code signaling contacts, a ratchet wheel limited to uni-directional rotation and arranged to cause relative movement between said signaling contacts, said advancing pawl engaging successive teeth of said ratchet wheel upon the attractive movements of said primary armature and advancing said ratchet wheel upon the retractive movements of said primary armature, and circuit controlling means responsive to said secondary armature and adapted to be placed in open circuit condition by the attractive movement of said secondary armature, said armatures having a time differential in the operations whereby said secondary armature, in its attractive movement, will place said circuit controlling means in open circuit condition before said primary armature, in its attractive movement, will have actuated said advancing pawl sufficiently far to engage the next succeeding ratchet tooth on said ratchet wheel.

6. In a signal transmitter for signal systems, the combination of a primary armature, a secondary armature, electromagnetic means for simultaneously actuating both of said armatures, each of said armatures having an attractive movement in one direction when attracted by the energization of said electromagnetic means and having a retractive movement in the opposite direction upon the deenergization of said electromagnetic means, an advancing pawl actuated by said primary armature, a code wheel, a ratchet wheel connected to said code wheel and adapted to advance the latter, said advancing pawl imparting advancing movement to said ratchet wheel, and circuit controlling means responsive to movement of said secondary armature and adapted to be placed in open circuit condition by the attractive movement of said secondary armature, said armatures having a time differential in their operations whereby said secondary armature in its attractive movement will place said circuit controlling means in open circuit condition before said primary armature completes the next advancement of said code wheel.

7. In a signal transmitter for signal systems of the class wherein the speed of operation of the transmitter is governed by the frequency of current variations transmitted thereto, the combination of electromagnetic means intermittently energized by said current variations, actuating mechanism moving in response to each energization and to each deenergization of said electromagnetic means, a code wheel limited solely to uni-directional rotation, a ratchet wheel connected to said code wheel and adapted to advance the latter, an advancing pawl actuated by said actuating mechanism for advancing said ratchet wheel, and circuit controlling means comprising a relatively stationary contact and a cooperating relatively movable contact both independent of

said code wheel and actuated by said actuating mechanism, said actuating mechanism moving said relatively movable contact to open circuit position with each energization of said electromagnetic means, said relatively movable contact moving back to closed circuit position with each deenergization of said electromagnetic means independently of the angular position of said code wheel, said actuating mechanism having a time differential between the time when it actuates said ratchet wheel for advancing said code wheel and when it actuates said relatively movable contact into open circuit position, whereby said relatively movable contact is moved to open circuit position before said code wheel is completely advanced.

8. In a signal transmitter for signal systems, the combination of electromagnetic means, actuating mechanism responsive thereto, said electromagnetic means responding to current variations of a frequency determined independently of said actuating mechanism, a code wheel, ratchet mechanism actuated by said actuating mechanism for advancing said code wheel, and circuit controlling means comprising a relatively stationary contact and a cooperating relatively movable contact independent of said code wheel and actuated by said actuating mechanism, said actuating mechanism moving said relatively movable contact to open circuit position with each energization of said electromagnetic means, said relatively movable contact moving back to closed circuit position with each deenergization of said electromagnetic means independently of the angular position of said code wheel, said actuating mechanism moving said relatively movable contact to open circuit position before actuating said code wheel through an advancing step.

9. In a signal transmitter for signal systems of the class wherein the speed of operation of the transmitter is governed by the frequency of current variations transmitted thereto, the combination of a code wheel, circuit controlling means independent of said code wheel, electromagnetic means, and actuating mechanism responsive to said electromagnetic means for actuating said code wheel and for actuating said circuit controlling means, said actuating mechanism actuating said circuit controlling means to open circuit position with each energization of said electromagnetic means, said circuit controlling means restoring to closed circuit position with each deenergization of said electromagnetic means independently of the angular position of said code wheel, said actuating mechanism having a time differential in the actuation of said circuit controlling means and said code wheel, whereby in each energization of said electromagnetic means said circuit controlling means will be moved to open circuit position before effective advancing motion has been imparted to said code wheel.

10. In a signal transmitter for signal systems, the combination of a supporting frame, an electromagnet supported on said frame, an armature pivotally mounted on said frame and responsive to said electromagnet, a code wheel rotatably mounted on said frame, a pawl actuated by said armature and operative to advance said code wheel with a step-by-step motion, a plurality of contacts mounted in the end face of said code wheel at different radii thereof, a plurality of guide members carried by said frame arranged at different radii relatively to the axial line of said code wheel and extending substan-

tially normal to said end face of the code wheel, contacts reciprocally mounted in said guide members, and springs thrusting said latter contacts against said end face of the code wheel for engagement with the contacts carried by said wheel.

11. In a signal transmitter for signal systems, the combination of a stationary electromagnet, an armature responsive thereto, a code wheel, a ratchet wheel connected to said code wheel and adapted to advance the latter, said code wheel and ratchet wheel being limited solely to uni-directional rotation, an advancing pawl actuated by said armature, said advancing pawl engaging successive teeth of said ratchet wheel

upon the attractive movements of said armature and advancing said ratchet wheel upon the retractive movements of said armature, a plurality of contacts mounted in the end face of said code wheel at different radii thereof, a support adjacent to said end face, a plurality of guide members carried by said support arranged at different radii relatively to the axial line of said code wheel and extending substantially normal to the end face of said code wheel, contacts reciprocally mounted in said guide members, and springs thrusting said latter contacts against said end face of the code wheel for engagement with the contacts carried by said wheel.

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