July 30, 1940. H. SENGEBUSCH 2,209,615

TELEPHONE SYSTEM

Filed June 12, 1937 3 Sheets-Sheet 1

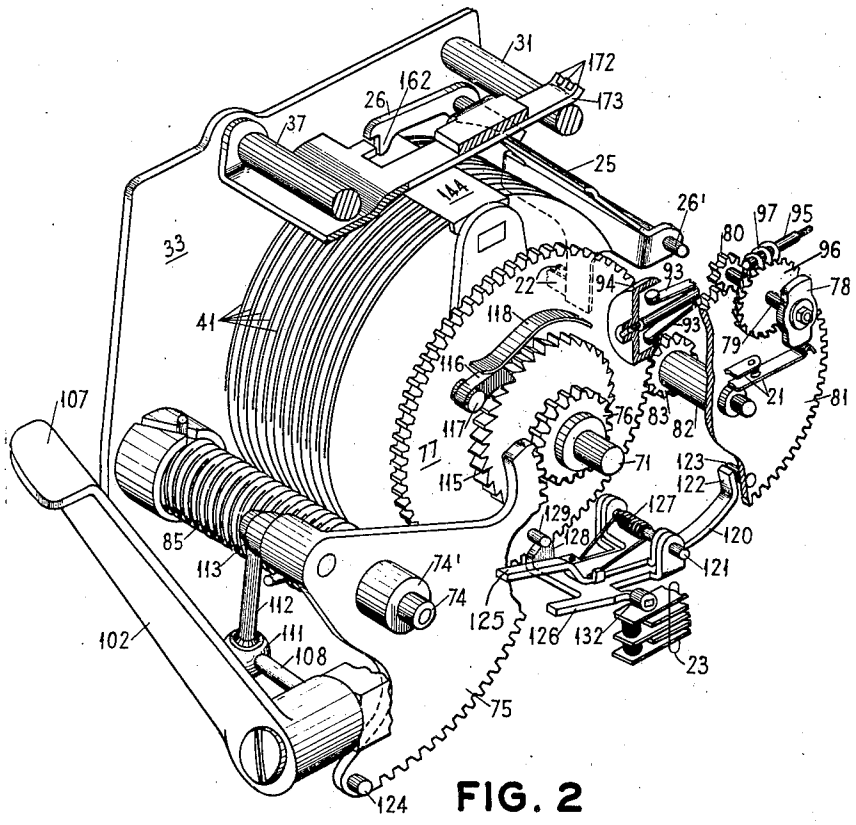


FIG. 2

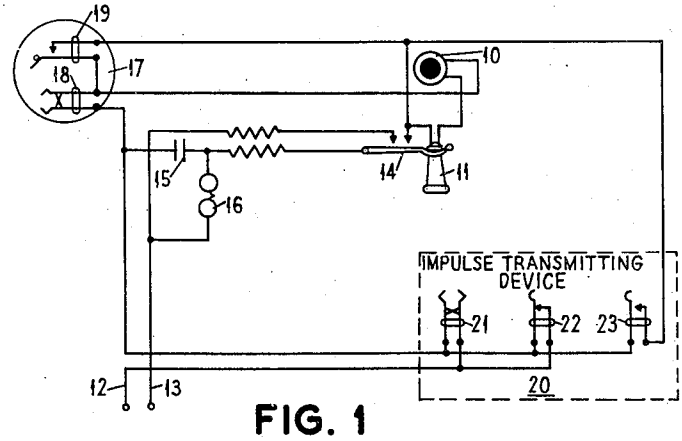


FIG. 1

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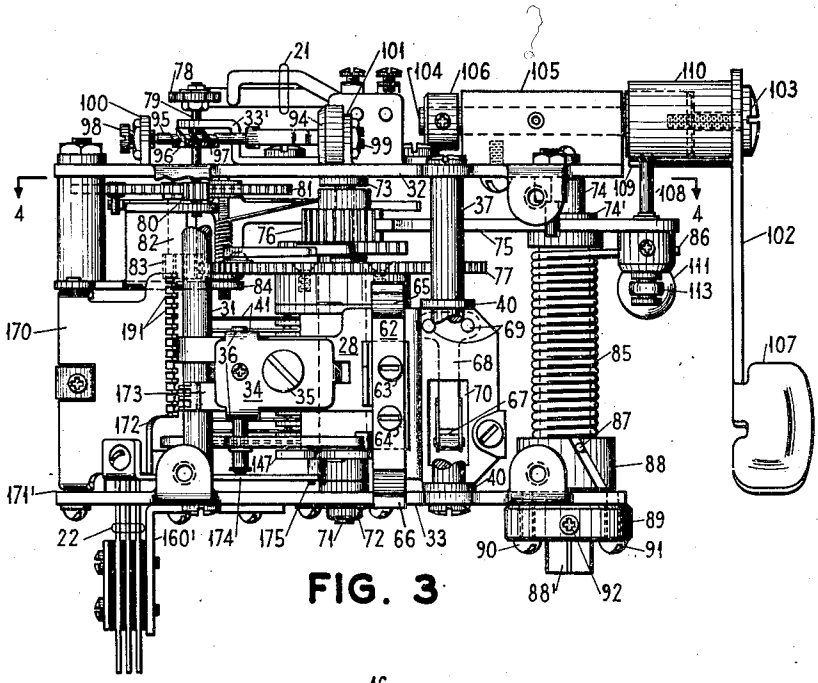


FIG. 3

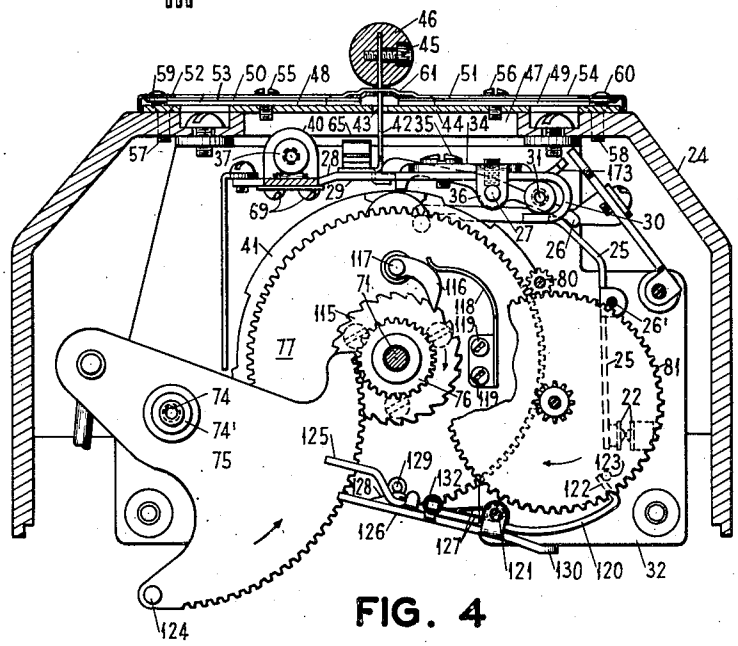


FIG. 4

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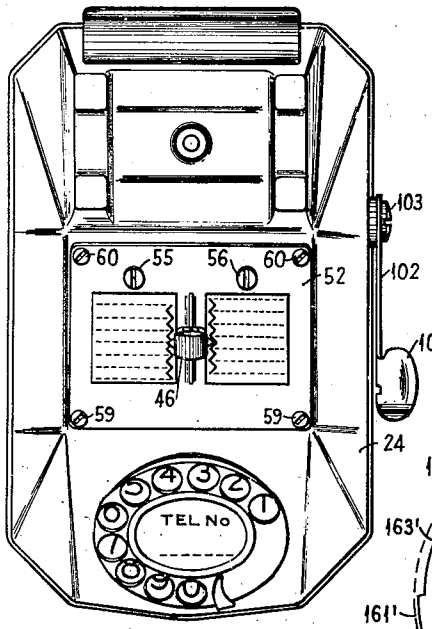


FIG. 5

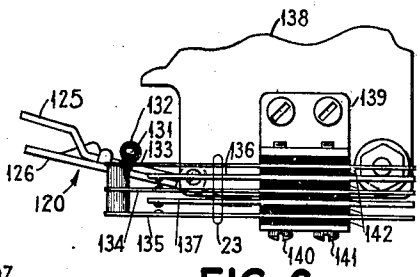


FIG. 6

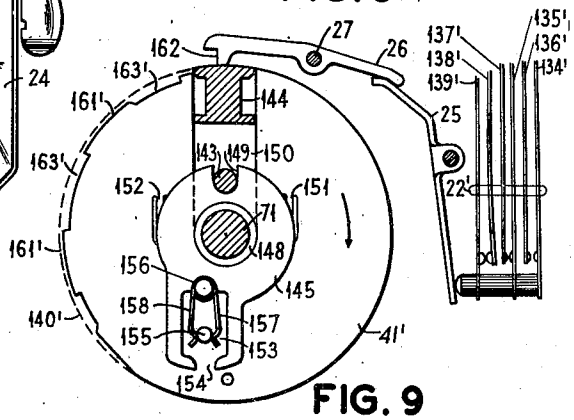


FIG. 9

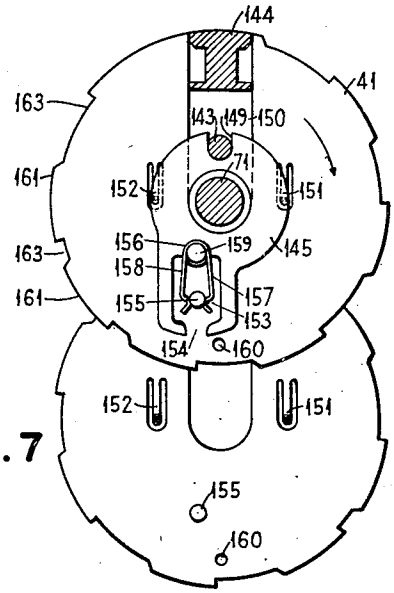


FIG. 7

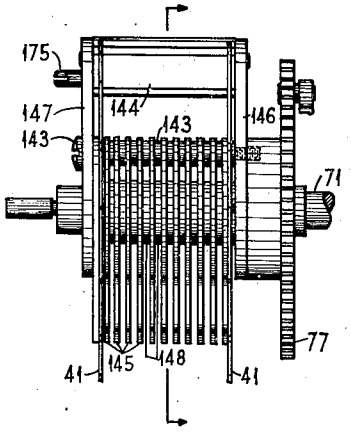


FIG. 8

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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Hans Sengebusch, Villa Park, Ill., assignor to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application June 12, 1937, Serial No. 147,831

16 Claims. (Cl. 179—90)

The present invention relates to signalling apparatus, and more particularly to improvements in impulse transmitting devices of the type adapted to transmit a plurality of series of impulses in response to a single actuation thereof.

Several types of impulse transmitters of the form noted have been developed for use in telephone substations in lieu of the conventional impulsing device requiring repeated operations of a finger dial for the transmission of the plurality of series of impulses corresponding to a subscriber's telephone number. The purpose of using a device of this type is to enable the subscriber to dial predetermined and frequently called substations by a purely mechanical operation and without consulting a directory to determine the telephone number identifying the substation being called. Such devices are of particular utility when installed at the desk of any person who has frequent occasion repeatedly to call certain other subscribers. In the usual impulse transmitter of this character, there is provided, in addition to the impulsing springs of the conventional dial actuated impulsing device, a pair of impulse control springs connected in shunt with the impulsing springs and controlled by the mechanism of the device in a manner such that the impulses produced by a continuous operation of the impulsing springs are effectively transmitted over the line extending to the substation embodying the device only during predetermined intervals. These intervals are so related to the impulsing rate that successive series of impulses, each containing a predetermined number of impulses, are transmitted during each effective time interval. Thus, the device may be constructed so that the plurality of series of impulses making up any subscriber's telephone number may be transmitted therefrom by a single actuation thereof. Shunt springs are also usually provided for short-circuiting, during the periods when the impulse springs are active, the transmitter and receiver embodied in the associated substation. For the purpose of controlling the operation of the impulse control springs, there is usually provided a plurality of disks mounted on a rotatable shaft, each of which corresponds to a particular subscriber's telephone number. Arranged to cooperate with these disks to actuate the impulse control springs is an element which may take the form of a cam rider for following preformed camming depressions and projections formed around the periphery of the disks, these depressions being suitably formed to determine the impulses comprising each series transmitted from the device. In order selectively to associate the cam rider with any particular disk, thereby to select the substation to be called, the cam rider is arranged to be moved over the disks to a position for actuation by a selected disk during rotation of the latter. Normally, the operating shaft upon which the disks are mounted is restrained in a home position by locking means adapted to be moved to its unlocking position through the actuation of a lever which also functions to store energy in a power spring for driving the mechanism. Release of the above-noted locking means is obtained only upon depression of the actuating lever to its extreme off-normal position, thereby to prevent false operation of the device and the transmission of impulses which would result in false routing of a call.

While prior art impulse transmitters of the general type briefly described in the preceding paragraph are reasonably satisfactory in operation, they are open to several objections with respect to the constructional features thereof, in that they usually embody an extremely intricate operating mechanism comprising a plurality of elements which require frequent adjustments. Moreover, these elements are not positively interlocked to prevent premature operation thereof, resulting in false impulse transmission.

It is an object of the present invention to provide an improved mechanism for locking positively the control disks against movement until the actuating lever of the device is completely depressed, which mechanism functions not only to release the gear train following the release of the actuating lever, but also operates to control the shunt contact springs for short-circuiting the transmitter and receiver of the substation in which the device is incorporated.

It is a further object of the invention to provide an improved and exceedingly simple mechanism for retaining positively the control element for the impulse control springs in a set position immediately the control disks start to rotate.

It is a still further object of the invention to provide an improved device of the character noted, which is of simple, economical, rugged and compact construction and is entirely faithful in operation.

The objects as set forth above are in part attained in accordance with the present invention by providing an impulse transmitting device of the general character briefly described above, wherein the control element for the impulse control springs is mounted on a carriage, adapted to be moved over the disks, thereby operatively to associate the element with any selected one of the disks, and means cooperating with the carriage and responsive to operation of the mechanism actuating member are provided for locking the carriage in a selected position during rotation of the disks. More specifically, this locking means comprises a member included in the carriage having teeth projecting from an edge thereof, a second member having teeth adapted

to engage with the teeth of the carriage member to lock the carriage in any set position, and means responsive to the operation of the actuating lever for moving the second-mentioned member to bring the teeth thereof into engagement with the teeth of the carriage member.

In accordance with a further feature of the invention, a pair of latching elements cooperating, respectively, with studs projecting from different gears of the gear train included in the mechanism are provided; one of which functions as the locking member for restraining the gear train in a position corresponding to the normal position of the operating shaft, and the other of which functions to control the transmitter and receiver shunt springs and to restrain the first arm in its operated position following a slight preliminary movement of the control disks.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification taken in connection with the accompanying drawings, in which Figure 1 illustrates a telephone substation having embodied therein an impulse-transmitting device constructed and arranged in accordance with the present invention; Fig. 2 is a top perspective view, partially in section, illustrating the mechanism of the device embodied in the circuit of Fig. 1; Fig. 3 is a top view of the mechanism shown in Fig. 2; Fig. 4 is a side cross sectional view of the mechanism, taken along the line 4—4 of Fig. 3; Fig. 5 is a top view of the device when fully assembled; Figs. 6, 7, and 8 are views illustrating certain details of the mechanism shown in Figs. 2, 3, and 4; and Fig. 9 illustrates a slightly modified arrangement of certain of the elements included in the mechanism.

Referring now to Fig. 1 of the drawings, there is illustrated the circuit of a subscriber's substation adapted to be incorporated in an automatic telephone system and having embodied therein an impulse transmitting device constructed and arranged in accordance with the present invention. In brief, the circuit comprises a telephone transmitter 10 adapted to be connected in series with a telephone receiver 11 across the line conductors 12 and 13 by means of a hook switch 14 of conventional form. Bridged across the line conductors 12 and 13, in series with a coupling condenser 15, is a bell or signal device 16. For the purpose of transmitting impulses from the substation there is provided a finger dial-impulsing device 17 of conventional form which includes impulsing springs 18, shunt springs 19 for short-circuiting the transmitter 10, and receiver 11 during the impulsing periods, and a finger hole dial, not shown, for controlling the springs 18 and 19. Arranged for alternative use with the impulsing device 17, is a second impulse-transmitting device indicated generally at 20, which includes impulsing springs 21, impulse control springs 22 adapted to shunt the impulsing springs 21, and shunt springs 23 for short-circuiting the transmitter 10 and receiver 11 continuously during the transmission of a plurality of series of impulses comprising the several digits making up a subscriber's telephone number. This device also includes a mechanism for controlling the springs 21, 22 and 23, which mechanism is illustrated in Figs. 2 to 9, inclusive, and described in detail hereinafter.

The apparatus embodied in the substation circuit as illustrated in Fig. 1, is with the exception of the impulse-transmitting device 20, entirely conventional in form and its mode of operation is well understood in the art. A detailed description of the operation of the apparatus is, therefore, deemed to be unnecessary and is omitted in the interests of brevity.

Referring now more particularly to Figs. 2 to 5, inclusive, there are illustrated the details of the impulse transmitting device schematically indicated at 20 in Fig. 1. The mechanism of this device, which is enclosed within a housing 24 comprises a rocker arm 25, pivotally mounted at 26, for actuating the impulse control springs 22 and arranged to be operated by a control element 26, pivotally mounted on a shaft 27 supported on a carriage 28. This carriage comprises a member 29, having a return bent portion 30 slidably engaging a rod 31 fixedly mounted between two frame members 32 and 33, and a member 34 secured to the member 29 by a screw 35 and having downwardly bent arms 36 drilled to provide bearing surfaces for the shaft 27. The other end of the carriage member 29 is slidably supported on a second rod 37, also extending between the frame members 32 and 33, by means of a pair of brackets, indicated at 40, integral with and bent upward from the member 29 at either side thereof. As thus arranged, the carriage 28 is slidably movable along the rods 31 and 37 relatively with respect to a plurality of control disks indicated at 41, thereby selectively to position the control element 26 for actuation by any desired one of these disks. It will be noted that the rocker arm 25 is provided with an upper edge which is substantially coextensive with the disk assembly, thereby to permit the element 26 to be positioned opposite any one of the disks while maintaining an operating connection between the two elements 25 and 26. As pointed out in greater detail hereinafter, each of the disks 41 corresponds to the telephone number of a particular subscriber's substation, and for convenience in moving the carriage 28 thereby operatively to associate the control element 26 with a desired one of these disks, there is provided an arm 42 fixedly mounted on the carriage member 29 and extending through a slot 43 cut in a cover plate 44. This arm has mounted thereon, by means of a screw 45, a finger piece 46. A large opening 47 is formed in the top of the housing 24 to permit ready access to the mechanism enclosed therein, and the cover assembly for this opening includes, in addition to the plate 44, indice bearing plates 48 and 49 suitably marked to identify the telephone stations corresponding to the disks 41, transparent plates 50 and 51 overlying the plates 48 and 49, respectively, and a top cover plate 52 provided with windows 53 and 54 overlying the indice bearing plates 48 and 49. The last-mentioned plates, together with the transparent plates 50 and 51 overlying the same, are secured to the cover plate 44 by screws 55 and 56, and the cover plate 44 is, in turn, secured to the housing 24 by screws 57 and 58. The top cover plate 52, which preferably is chromium plated to provide a pleasing appearance, is secured to the housing 24 by screws 59 and 60. Cooperating with the indice marked on the plates 48 and 49, to indicate the telephone number corresponding to the one of the disks with which the control member 26 is operatively associated, is a double ended pointer 61, provided with a slot, not shown, snugly enclosing the arm 42.

In order to limit the movement of the car-

riage 28 in its two directions of movement relative to the control disks 41, the brackets 40 are arranged to engage the frame members 32 and 33, respectively. Sudden engagement between either of the two brackets and their associated frame members is prevented by providing a flat spring 62 affixed to the carriage member 29 by screws 63 and 64, and having angularly extending extremities 65 and 66 which are adapted to ride over the top edges of frame members 32 and 33, respectively. For the purpose of exerting a slight restraining force on the carriage, in each position thereof when the control element 26 is operatively associated with one of the control disks 41, there is provided a roller 67 suitably mounted on the free end of a powerful flat spring 68, which spring is affixed to the carriage member 29 by screws 69. This roller is adapted to be forced by the spring 68 into roller slots, not shown, formed at spaced intervals along the length of the rod 37. As indicated, the spring 68 is mounted on the bottom of the carriage member 29, and the roller 67, supported thereon, extends through an aperture 70 cut in the carriage member 29. The roller slots noted are so spaced along the rod 37 that, when the roller 67 is fully projected by the spring into any one thereof, the carriage 28 stands in a position such that the control element 26 is accurately positioned to be actuated by one of the control disks 41. By this arrangement, an indication is given to the operator of the impulse transmitting device that the carriage is accurately located in the desired position each time the carriage 28 is set in a new position.

The control disks 41 are mounted on a shaft 71 in an improved manner described more particularly hereinafter, and the shaft 71 is, in turn, supported in bearings 72 and 73 mounted respectively on the frame members 33 and 32. This shaft is arranged to be driven from a driving element comprising a gear segment 75 fixedly mounted on a sleeve 74' rotatably mounted on a shaft 74. The gear train embodied in the mechanism also includes a pair of gears 76 and 77 mounted on the shaft 71 and gears for driving a cam 78, which cam forms the actuating element for the impulsing springs 21. Thus, the element 78 is fixedly mounted on one end of a shaft 79, journaled in bearing surfaces provided in the frame member 32 and a bracket 33' mounted on this frame member, and a small gear 80 is mounted on the other end of the shaft 79, which latter gear meshes with a large gear 81 carried by a shaft 82. Also mounted on the shaft 82 is a small gear 83 meshing with the gear 77. The shaft 82, upon which the gears 83 and 81 are mounted, is journaled in bearing surfaces provided in the frame member 32 and an intermediate frame member 84.

For the purpose of driving the above-described gear train, there is provided a power spring 85 having its convolutions enclosing the driving shaft 74 and one end 86 thereof fixedly secured to the gear segment 75 in any suitable manner. The other end 87 of the spring 85 is held in an angularly extending slot provided in a member 88, which latter element forms one bearing for the shaft 74 and also a part of means for adjusting the tension in the power spring. The last-mentioned means also includes a second annular ring 89 mounted by screws 90 and 91 on the frame member 33 and provided with an opening through which the shank 88' of the member 88 extends, and a set screw 92 threaded into the ring 89 for holding the member 88 in any set position. The lower end of the shank 88' is squared to accommodate a suitable tension adjusting tool, not shown. As described in detail hereinafter, with the elements of the mechanism inactive, the gear segment 75 is restrained against movement in a clockwise direction, and, consequently, the tension in the spring 85 may be adjusted by the simple expedient of loosening the set screw 92, rotating the member 88 in the proper direction to increase the tension in the spring, and tightening the set screw 92 to hold the member 88 in its adjusted position.

In order to maintain the speed of the gear train constant during its operation to drive the shaft 71 and the cam shaft 79, there is provided a small speed governor, of the well-known centrifugal type, which includes fly balls 93 enclosed within a raceway 94 and mounted on a shaft 95 driven from a gear 96, mounted on the shaft 79 and meshing with a worm 97, formed on the shaft 95. As shown, the shaft 95 is supported by surfaces provided in bearing caps 98 and 99, mounted respectively on the extending brackets 100 and 101. These brackets are integral with and pressed outwardly at right angles from the frame member 32.

Normally, the gear segment 75 is restrained by the power spring 85 in the position shown in Figs. 3 and 4 of the drawings, and in order to tension this spring for the purpose of driving the gear train described above, there is provided an actuating member 102 mounted by a cap screw 103 and a cylindrical member 110 on the end of a stub shaft 104. The stub shaft 104 is journaled in a bearing member 105 mounted on the frame member 32 and is held in its assembled position by a retaining ring 106 mounted on the end thereof. This actuating member is provided at its free end with a finger piece 107 for convenience in depressing the same to transmit power to the spring 85. The power transmitting connection between the member 102 and the spring 85 is of the universal type and includes a rod 108 fixedly mounted on the stub shaft 104 and extending through a slot 109 provided in the left annular portion of the cylindrical member 110. At its free end, the rod 108 is provided with a socket which forms a part of a ball and socket connection 111 between this rod and a second rod 112. The other end of the rod 112 terminates in a loose pin and strap connection 113 the pin of which is mounted on the gear segment 75.

During the operation of the actuating member 102 to tension the power spring 85, the shaft 71 must be restrained in its home position, corresponding to a predetermined angular position thereof, thereby to prevent the disks 41 from rotating. To this end, the gear 76 is not keyed to the shaft 71, but is mounted thereon for free rotation thereabout. This gear is formed integral with a ratchet wheel 115, which cooperates with a pawl 116 pivotally mounted at 117 on the gear 77, to transmit driving power to the last-mentioned gear from the power spring 85 during the return movement of the actuating member 102, and following the actuation thereof to its fully depressed position. This pawl is biased into engagement with the teeth of the wheel 115 by a spring 118, mounted on the gear 77 by means of screws 119. With this arrangement, and when the actuating member 102 is depressed to tension the spring 85, the gear 76 is rotated clockwise from the position shown in Fig. 4, and the pawl

116 rides over the teeth of the ratchet wheel 115. When the actuating member 102 is released following the full depression thereof, the pawl 116 engages an associated tooth of the wheel 115 to transmit power from the spring 85 to the gear train, thereby to cause rotation of the control disks 41.

As pointed out previously, it is necessary for satisfactory operation of the device to restrain the control disks 41 from movement until the member 102 is operated to its fully depressed position. In accordance with one feature of the present invention, this is accomplished by providing the improved mechanism illustrated more particularly in Figs. 4 and 6. This mechanism includes a latch element 120, cooperating with the gear 81 to hold the shaft 71 in its home or predetermined angular position during the operation of the actuating member 102, to tension the power spring 85. The latching element 120 is pivotally mounted on a shaft 121, supported between the frame member 32 and the frame member 84, and has formed at one end thereof a finger 122 for engaging a stud 123 projecting from the side of the gear 81. The latching element 120 is normally biased by a spring 127, to rotate in a counterclockwise direction from the position shown in Fig. 4, thereby to position the finger 122 in the path described by the stud 123 during movement of the gear 81. With the elements of the mechanism occupying their respective normal positions as shown in Fig. 4, such that the finger 122 engages the stud 123 to hold the gear train against movement and when the actuating member 102 is operated to its fully depressed position, the latching element 120 is rotated to disengage the finger 122 from the stud 123 by means comprising a stud 124 mounted on the gear segment 75 and arranged to engage the free extremity 125 of the latching element 120. Movement of the latching element 120 in a counterclockwise direction is limited by a second latching element 126, also pivotally mounted on the shaft 121, and biased by means of the spring 127 in a direction for rotation in a clockwise direction. This second latching element 126 has a cam rider portion 128 formed along an edge thereof which cooperates with a stud 129 projecting from the side of the gear 77 to move the latching element 126 in a counterclockwise direction, thereby to permit the latching element 120 to rotate under the force of the spring 127 to a position wherein the finger 122 is positioned to be engaged by the stud 123. At its right extremity the latching element 126 is provided with an offset portion 130, which is adapted to engage the lower edge of the frame member 32 to act as a stop for limiting the movement of the element.

As shown in greater detail in Fig. 6, the second latching element 126 not only functions to control the operation of the first latching element 120, but also functions to control the position of the switching device comprising the springs 23 for short-circuiting the transmitter and receiver of the substation, as shown in Fig. 1. Thus, the element 126 is provided with a finger 131 having mounted thereon a cap 132 of insulating material, which cap cooperates with springs 133, 134 and 135, included in the spring assembly 23. As will be pointed out with greater particularity hereinafter, the arrangement is such that, when the latching element 126 is rotated in a clockwise direction from the position shown in Fig. 4, the cap 132 is moved from engagement with the spring 133, so that a connection is made between the spring 134 and an associated spring 136, and between the spring 135 and an associated spring 137, thereby to short-circuit the transmitter and receiver, of the substation in the manner described above. Obviously, the number of springs included in the assembly 23 will depend upon the type of substation circuit utilized. In the spring assembly shown, four contact springs are provided, only two of which will be utilized in the substation circuit illustrated in Fig. 1. These springs are supported on an extension 138 of the frame member 32 by means of a bracket 139, a pair of screws 140 and 141, and insulating members 142 interspaced therewith.

Referring now more particularly to Figs. 7 and 8, there are illustrated the details of the improved assembly for retaining the control disks 41 on the shaft 71. This assembly comprises a disk supporting and aligning structure, mounted on the shaft by a screw 143, and including a disk aligning member 144, extending substantially parallel with the shaft 71, and disk spacing members 145 spaced axially along the shaft. The aligning member 144 is supported on a pair of end members 146 and 147, which also have clamped therebetween the disk spacing members 145, interspaced with spacing washers 148 snugly enclosing the shaft 71. As shown in Fig. 7, each of the disk spacing members 145 is provided with a slot 149, the sides of which fit snugly over the shank of the screw 143 to prevent rotation of the spacing members with respect to the shaft 71. The diameter of the spacing washers 148 is made equal to the width of the disk aligning member 144, this width also corresponding to the width of a slot 150 formed in each of the disks 41, so that when any one of the disks is slipped onto the shaft, with the slotted portion thereof snugly straddling the sides of the aligning member 144 and one of the spacing washers 148, it is firmly restrained against relative movement with respect to the shaft 71.

For the purpose of insuring an exact and even spacing of the disks along the shaft 71, each of the disks is provided with a pair of preformed resilient tongues 151 and 152, pressed outwardly from the same side of the disk and positioned on opposite sides of the slot 150. These tongues are adapted to engage the side of one adjacent spacing member 145 as the associated disk is slipped onto the shaft 71.

As pointed out previously, provisions are made for preventing the disks from being improperly assembled on the shaft 71. To this end, each of the disk spacing members 145 is provided with a slot 153 having an opening 154 offset with respect to the plane passing through the axis of the shaft 71 and the axis of the aligning member 144. Each disk has a stud 155 projecting from one side thereof, which is arranged to slip through a slot opening 154 of an adjacent spacing member during the positioning of the disk on the shaft 71, only in the event the disk is properly disposed with respect to the shaft. Thus, if it is attempted to assemble any one of the disks on the shaft with the disk reversed from its proper position, the stud 155 carried thereby will engage one of the projecting fingers formed on either side of the slot 153 of an adjacent spacing member 145 to prevent the disk from assuming its fully assembled position.

In order to retain each disk in its assembled position on the shaft 71, there is mounted on

each of the spacing members 145, a spring 156 having fingers 157 and 158 arranged to grip the stud 155 carried by a disk positioned adjacently thereto. Each of these springs occupies the space between its supporting spacing member and the adjacent control disk formed by the pressure of the tongues 151 and 152 against the spacing member, and is mounted on a small stud 159 projecting from its supporting spacing member. For the purpose of facilitating the removal of the disks, each thereof is provided with a small aperture 160, adapted to accommodate the end of a disk removing tool.

The arrangement for mounting the control disks upon the shaft and for preventing improper assembly thereof, described above, is disclosed and claimed in applicant's co-pending application, Serial No. 196,621, filed March 18, 1938, which is a division of the present application.

The impulse control springs 22 are mounted on a bracket 160' extending from the side of the frame member 33 and are suitably insulated from each other in the manner shown. As pointed out previously and shown in Figs. 1 and 4, these springs are arranged to be actuated by the control element 26 through operation of this element to rock the rocker arm 25. Such actuation is accomplished by cutting out portions of the periphery of each of the disks to form cam projections 161 interspaced with cam depressions 163 which cooperate with a cam follower finger 162, formed as an integral portion of the control element 26. With this control element positioned over a disk cut as shown in Fig. 7, and when this disk is rotated in a clockwise direction, the finger 162 alternately drops into the depressions 163 and rides over the projections 161 to rock the arm 25 back and forth against the bias produced by certain of the resilient springs included in the assembly 22. It will be observed that each time the finger 162 drops in one of the depressions 163, the springs of the assembly 22 are in their contact break position, such that the impulse springs 21, as illustrated in Fig. 1, are no longer short-circuited. Thus, by properly relating the length of the depressions 163 and the projections 161 to the rate at which the impulse springs 21 are opened and closed by the camming element 78, any desired number of impulses from 1 to 10 may be caused to be transmitted during each period when the finger 162 is riding in one of the depressions 163. Hence, by suitably forming the depressions 163 and the projections 161 around the periphery of any particular disk, this disk may, during rotation thereof, be caused to control the springs 22 in a manner such that a plurality of series of impulses, corresponding to the telephone number identifying a particular subscriber's substation, are transmitted from the device.

It will be apparent from the description in the immediately preceding paragraph that if the control element 26 is positioned over one of the control disks 41, and this disk is started in operation to cause the transmission of the impulses included in the telephone number corresponding to the disk, the element 26 should be incapable of movement with respect to the disks until the plurality of series of impulses comprising the telephone number have been completely transmitted. In according with a further feature of the invention, this mode of operation is insured by providing, as shown in Fig. 3, a member 170 pivotally mounted on a rod 171', extending between and supported by the frame members 84 and 33, which member is normally restrained from engagement with the carriage 28 and is released during the initial movement of the actuating member 102 from its depressed position to its normal position, lockingly to engage a portion of the carriage 28. More specifically, this member is provided with teeth 191 extending along the upper edge thereof and throughout the axial length of the shaft 71 occupied by the control disks 41. These teeth are adapted to engage with teeth 172 extending along an upwardly projecting portion 173 of the carriage member 29. With the elements of the mechanism occupying the position shown in Figs. 3 and 4, the locking member 170 is restrained in a position such that the teeth thereof are out of engagement with the teeth 172 by means comprising an arm 174, mounted on the member 170, and cooperating with a stud 175, projecting from the side of the end member 147 included in the disk assembly structure as shown in Fig. 8. When, however, the shaft 71 is started in operation to rotate the disks 41, the stud 175 rides from beneath the arm 174, so that the locking member 170 is rotated under the force of gravity to bring the teeth 191 into engagement with the teeth 172. Thus, the carriage 28 and the control element 26 carried thereby are locked against movement relative to the disks 41 until such time as the shaft 71 has been rotated through a complete revolution to again bring the stud 175 into engagement with the arm 174.

In the operation of the device as described above, and with the mechanism thereof fully assembled as shown in Fig. 3, the telephone number of a desired subscriber's substation may be selected by the simple expedient of grasping the finger piece 46 and moving the carriage 28 until the pointer 61 stands opposite a desired subscriber's telephone number, in which position the control element 26 is operatively associated with the control disk corresponding to this telephone number. Following the positioning of the control element 26, the actuating member 102 is operated to its fully depressed position, thereby to tension the power spring 85. During this operation the gear segment 75 is rotated in a counterclockwise direction from the position shown in Fig. 4 to drive the gear 76. This gear rotates about the shaft 71, with the pawl 116 riding over the teeth of the ratchet wheel 115. If the actuating member 102 is released before it is fully depressed, the gear train is held against movement by virtue of the engagement of the finger 122 of the latching element 120 with the stud 123 carried by the gear 81. When, however, the actuating member closely approaches its fully depressed position, the stud 124 engages the extremity 125 of the latching element 120 to rotate this latching element and move the finger 122 from engagement with the stud 123. Thereafter, and when the actuating member 102 is released, the power spring transmits power through the segment 75 to rotate this segment in a clockwise direction from the position shown in Fig. 4. Immediately this occurs, the pawl 116 engages one of the teeth of the ratchet 115 to initiate the movement of the gear train. During the initial movement of this train, and the consequent rotation of the control disks 41 and the camming element 78, the stud 129 rides from beneath the camming portion 128 of the second latching element 126, and the stud 175 rides from beneath the arm 174 carried by the locking member 170. Hence, the last-mentioned member is released

and moves to bring the teeth 191 thereof into engagement with the teeth 172, thereby to lock the carriage 28 against further movement with respect to the control disks 41. Substantially simultaneously, the second latching element 126 is rotated by the spring 127 in a clockwise direction from the position shown in Fig. 4, to restrain the first latching element 120 in its operated position, and to actuate the cap 132 from engagement with the spring 133 of the spring assembly 23. This last-mentioned operation causes the shunt springs included in the assembly 23 to close and complete paths for short-circuiting the transmitter 10 and the receiver 11 as shown in Fig. 1. After a slight continued movement of the segment 75, the stud 124 moves away from the end 125 of the latching element 120, and as a consequence, the last-mentioned element is held in its operated position only by the second latching element 126. The rotation of the disks 41 and the camming element 78 continues, this rotation being at a substantially constant rate of speed determined by the setting of the fly ball governor described previously. Thus, the impulsing springs 21 are operated by the camming element 78 to provide a constant number of circuit interruptions per second. Not all of these interruptions are transmitted over the calling line, however, since the springs included in the assembly 22 are opened and closed in accordance with the depressions 163 and the projections 161 of the particular selected control disk 41 corresponding to the called subscriber's telephone number. Thus, the plurality of series of impulses making up this telephone number are caused to be transmitted over the calling line. It is pointed out that during such transmission the latching element 126 is continuously held in its operated position so that the shunt springs included in the assembly 23 are maintained closed.

When the last impulse of the last series of impulses has been transmitted, the gear segment 75 approaches its normal position, and the stud 129 rides into engagement with the camming projection 128. There results the rotation of the latching element 126 in a counterclockwise direction to permit the latching element 120 to be restored to its normal position wherein the finger 122 intersects the path of rotation of the stud 123. Almost immediately thereafter, the stud 123 engages the finger 122 to stop the movement of the gear train. When this occurs, the camming finger 162 of the control element 26 rests in engagement with the top of the disk aligning member 144, so that the springs included in the assembly 22 are in their make positions. During the final movement of the gear train the stud 175 rides into engagement with the arm 174 to actuate the locking member 170 thereby to disengage the teeth 191 from the teeth 172 and unlock the carriage 28. Thus, the elements of the mechanism are restored to their respective normal positions, and the device is in readiness for further use.

Referring now more particularly to Fig. 9 of the drawings, there is illustrated a modified arrangement for controlling the operation of the springs shunting the transmitter and receiver of the substation during the transmission of impulses over the line outgoing from the substation. In this arrangement, the shunt springs, indicated at 134', 135', 136' and 137', are included in the spring assembly 22' comprising the impulse control springs 138' and 139' for shunting the impulsing springs 21. The active portion of the periphery of each control disk 41' has a radius slightly less than the radius of the disk aligning member 144 as indicated by the dotted line arc 140'.

In the operation of the modified arrangement shown in Fig. 9 and when the disk illustrated is rotated in a clockwise direction from its home position, the cam finger 162 of the control element 26 first drops off the left edge of the disk aligning member 144. This permits the rocker arm 25 to rotate slightly in a clockwise direction and there results the engagement of the springs 134' and 135' with the springs 136' and 137', respectively, thereby to short-circuit the transmitter and receiver of the associated substation in the manner described previously. This first movement of the arm 25 does not open circuit the impulse control springs 138' and 139' and, hence, the impulse springs 21 are held short-circuited. Shortly thereafter and when the finger 162 drops into the first depression 163', arm 25 is caused further to rotate in a clockwise direction by the force exerted thereon by the springs 134', 135' and 139' and, as a consequence, the spring 139' is moved from engagement with the spring 138'. As a result, the short circuit is removed from the impulse springs 21 and impulses are transmitted from the device over the calling subscriber's line. When the finger 162 rides onto the next projection 161' the arm 25 is rocked in a counterclockwise direction only the required amount to again close the springs 138' and 139' without opening the springs 134', 136' and 135', 137'. The impulse control springs 138' and 139' are thus opened and closed in accordance with the depressions 163' and the projections 161'. The enumerated shunt springs 134' to 137' are, however, maintained in their contact make positions continuously during impulsing and until the finger 162 again rides onto the non-active portion of the disk having a radius equal to the radius of the outer surface of the disk aligning member 144. This occurs only when the complete series of impulses has been transmitted and results in the sustained closure of the impulse control springs 138' and 139', and the movement of the springs 134' to 137', inclusive, to their open circuit positions.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made in the structure thereof and it is contemplated in the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element in one direction, an actuating member operable from one position to a second position to rotate said driving element in the opposite direction, without rotating said shaft, thereby to store energy in said spring, a latching element adapted to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said shaft only when said actuating member is fully operated to said second position and released, whereby said shaft is

driven by said spring through said driving element and said gear train, said last named means being operative to hold said latching element in its operated position only during the preliminary movement of said shaft, and additional means for holding said latching element in its operated position until said shaft is returned to its predetermined angular position.

2. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with one of the gears of said train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is operated to said second position and released, whereby said shaft is driven by said spring through said driving element and said gear train, a second latching element cooperating with a second of the gears included in said gear train, and means including said second latching element for restraining said first named latching element in its operated position.

3. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with one of the gears of said train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is operated to said second position and released, whereby said shaft is driven by said spring through said driving element and said gear train, a second latching element cooperating with a second of the gears included in said gear train, means including said second latching element for restraining said first named latching element in its operated position, and means including said second gear and said second latching element for returning said first named latching element to its latching position when said shaft returns to its predetermined angular position.

4. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with one of the gears of said train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is operated to said second position and released, whereby said shaft is driven by said spring through said driving element and said gear train, and a second latching element cooperating with a second of the gears included in said gear train, said second element normally being restrained by said second gear to one position and being released during the initial movement of said gear train to restrain said first named latching element in its operated position.

5. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with one of the gears of said train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is operated to said second position and released, whereby said shaft is driven by said spring through said driving element and said gear train, a second latching element cooperating with a second of the gears included in said gear train, said second latching element normally being restrained by said second gear to one position and being released during the initial movement of said gear train to restrain said first-named latching element in its operated position, and means including said second gear and said second latching element for returning said first named latching element to its normal position when said driven shaft returns to its predetermined angular position.

6. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with one of the gears of said train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is fully operated to said second position and released, whereby said shaft is driven by said spring through said driving element and said gear train, said last named means being operative to hold said latching element in its operated position only during the preliminary movement of said driven shaft, additional means for holding said latching element in its operated position until said driven shaft is returned to its predetermined angular position, a switching device operable between two positions, and means including said last named means for operating said switching device from one of its two positions to the other.

7. A mechanism for use in an impulse transmitting device comprising, in combination, a

shaft, a plurality of control disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with one of the gears of said train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is operated to said second position and released, whereby said shaft is driven by said spring through said driving element and said gear train, a second latching element cooperating with a second of the gears included in said gear train, means including said second latching element for restraining said first named latching element in its operated position, a switching device, and means including said second latching element for operating said switching device from one of its two positions to the other.

8. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of disks mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with one of the gears of said train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is operated to said second position, whereby said shaft is driven by said spring through said driving element and said gear train, a second latching element cooperating with a second of the gears included in said gear train, means including said second latching element for restraining said first named latching element in its operated position, a switching device operable between two positions, means including said second latching element for operating said switching device from one of its two positions to the other, a carriage relatively movable with respect to said disks and including a first member having teeth along an edge thereof, a control element carried by said carriage and adapted to be selectively associated with said control disks for actuation thereby, a second member associated with said first member and having teeth along an edge thereof, means for normally maintaining the teeth of said second member disengaged from the teeth of said first member and for releasing said second member to permit engagement between the teeth of said first and second members during the initial movement of said actuating member from its said second position to its first position, and means including said second member for locking said carriage against movement during rotation of said driven shaft.

9. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, means including an actuating member operable between two positions for imparting rotary movement to said shaft, a carriage relatively movable with respect to said disks and including a first member having teeth along a projecting edge thereof, a control element carried by said carriage and adapted to be selectively associated with said control disks for actuation thereby, a second member associated with said first member and having teeth along an edge thereof, said second member normally being restrained to a position such that the teeth thereof are disengaged from the teeth of said first member and being released during the initial movement of said actuating member from one of its two positions to the other to engage the teeth of said first and second members, and means including said second member for locking said carriage against movement during rotation of said shaft.

10. A mechanism for use in an impulse transmitting device comprising, in combination, a rotatable shaft, a plurality of control disks mounted on said shaft for rotation therewith, a plurality of circuit controlling elements, and means including a control member arranged to cooperate with any selected one of said disks for operating said circuit controlling elements, each of said disks having an active portion and a non-active portion and being so constructed and arranged relative to said circuit controlling elements that when the disk is rotated to bring the non-active portion thereof effectively into cooperation with said control member a first and a second of said circuit controlling elements are moved to their normal positions, when the disk is rotated to bring the active portion thereof effectively into cooperation with said control member said first circuit controlling element is moved from its normal position to its off-normal position, and when the disk is further rotated with its active portion in continued cooperation with said control member said second circuit controlling element is moved from its normal position to its off-normal position without returning said first circuit controlling element to its normal position.

11. A mechanism for use in an impulse transmitting device comprising, in combination, a rotatable shaft, a plurality of control disks mounted on said shaft for rotation therewith, a plurality of circuit controlling elements, and means including a control member arranged to cooperate with any selected one of said disks for operating said circuit controlling elements, each of said disks having an active portion of one radius and a non-active portion of a greater radius and being provided with camming depressions along its active portion arranged to cooperate with said control member to operate said circuit controlling elements, the radius of the active portion of each disk being so related to the radius of its non-active portion and to said circuit controlling elements that when the disk is rotated to bring the non-active portion thereof effectively into cooperation with said control member a first and a second of said second controlling elements are moved to their normal positions, when the disk is rotated to bring the active portion thereof effectively into cooperation with said control member said first circuit controlling element is moved from its normal position to its off-normal position, and when the disk is further rotated with its active portion in continued cooperation with said control member said second circuit controlling element is moved from its normal position to its off-normal position without returning said first circuit controlling element to its normal position.

12. A mechanism for use in an impulse transmitting device comprising, in combination, a rotatable shaft, a plurality of control discs mounted on said shaft, means including a driving element for rotating said shaft, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element adapted to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said shaft only when said actuating member is fully operated to said second position and released, whereby said shaft is driven by said spring through said driving element, said last-named means being operative to hold said latching element in its operated position only during the preliminary movement of said shaft, additional means for holding said latching element in its operating position until said shaft is returned to its predetermined angular position, a switching device operable between two positions, and means including said last named means for operating said switching device from one of its two positions to the other.

13. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control discs mounted on said shaft, a driving element, a gear train including gears for driving said shaft from said driving element, a power spring for rotating said driving element, an actuating member operable from one position to a second position to rotate said driving element, without rotating said shaft, thereby to store energy in said spring, a latching element cooperating with said gear train to restrain said shaft in a predetermined angular position during such rotation of said driving element, means comprising said actuating member for operating said latching element to release said gear train only when said actuating member is operated to said second position and released, whereby said shaft is driven by said spring through said driving element and said gear train, a second latching element cooperating with said gear train, and means including said second latching element for restraining said first-named latching element in its operated position.

14. A mechanism for use in an impulse transmitting device comprising, in combination, a shaft, a plurality of control disks mounted on said shaft, means including an actuating member operable between two positions for imparting rotary movement to said shaft, a carriage relatively movable with respect to said disks and including a first member having teeth along a projecting edge thereof, a control element carried by said carriage and adapted to be selectively associated with said control disks for actuation thereby, a second member having teeth along an edge thereof, said second member normally being restrained in a predetermined position such that the teeth thereof are disengaged from the teeth of said first member and being released during the initial movement of said actuating member from one of its two positions to the other for movement to engage the teeth of said first and second members, means including said second member for locking said carriage against movement during rotation of said shaft, and means controlled when rotation of said shaft is arrested for returning said second member to its predetermined position, thereby to unlock said carriage for movement.

15. A mechanism for use in an impulse transmitting device comprising, in combination, a rotatable shaft, a plurality of control disks mounted on said shaft for rotation therewith, a plurality of circuit controlling elements, and means including a control member arranged to cooperate with any selected one of said disks for operating said circuit controlling elements, each of said disks having an active portion and a non-active portion and being so constructed and arranged relative to said circuit controlling elements that when the disk is rotated to bring the non-active portion thereof effectively into cooperation with said control member a first and a second of said circuit controlling elements are moved to their normal positions, when the disk is rotated to bring the active portion thereof effectively into cooperation with said control member said first circuit controlling element is moved from its normal position to its off-normal position, and when the disk is further rotated with its active portion in continued cooperation with said control member said second circuit controlling element is successively moved between its normal position and its off-normal position without returning said first circuit controlling element to its normal position.

16. In a mechanism for use in an impulse transmitting device comprising, in combination, a rotatable shaft, a plurality of control disks mounted on said shaft for rotation therewith, a plurality of circuit controlling elements, and means including a control member arranged to cooperate with any selected one of said disks for operating said circuit controlling elements, each of said disks having a non-active portion and an active portion including a number of projections spaced apart by intervening depressions, the radius of the projections on the active portion of said disk being intermediate the radius of the non-active portion of said disk and the radius of the depressions in the active portion of said disk, the non-active and active portions of said disk being arranged to cooperate with said control member to operate said circuit controlling elements, each of said disks and said circuit controlling elements being so constructed and arranged that when any one of said disks is rotated to bring the non-active portion thereof effectively into cooperation with said control member a first and a second of said circuit controlling elements are moved to their normal positions, when the disk is rotated to bring one of the projections on the active portion thereof effectively into cooperation with said control member said first circuit controlling element is moved from its normal position to its off-normal position while said second circuit controlling element is retained in its normal position, and when the disk is rotated to bring one of the depressions in the active portion thereof effectively into cooperation with said control member said second circuit controlling element is moved from its normal position to its off-normal position while said first circuit controlling element is retained in its off-normal position.

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