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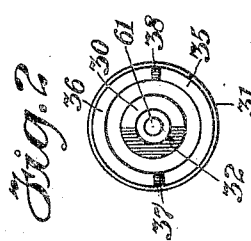
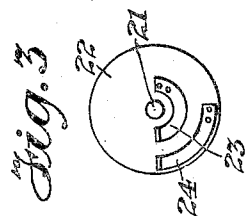
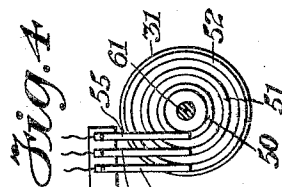
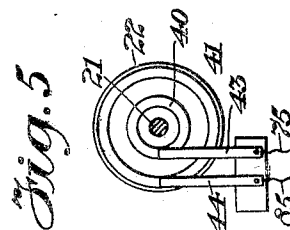
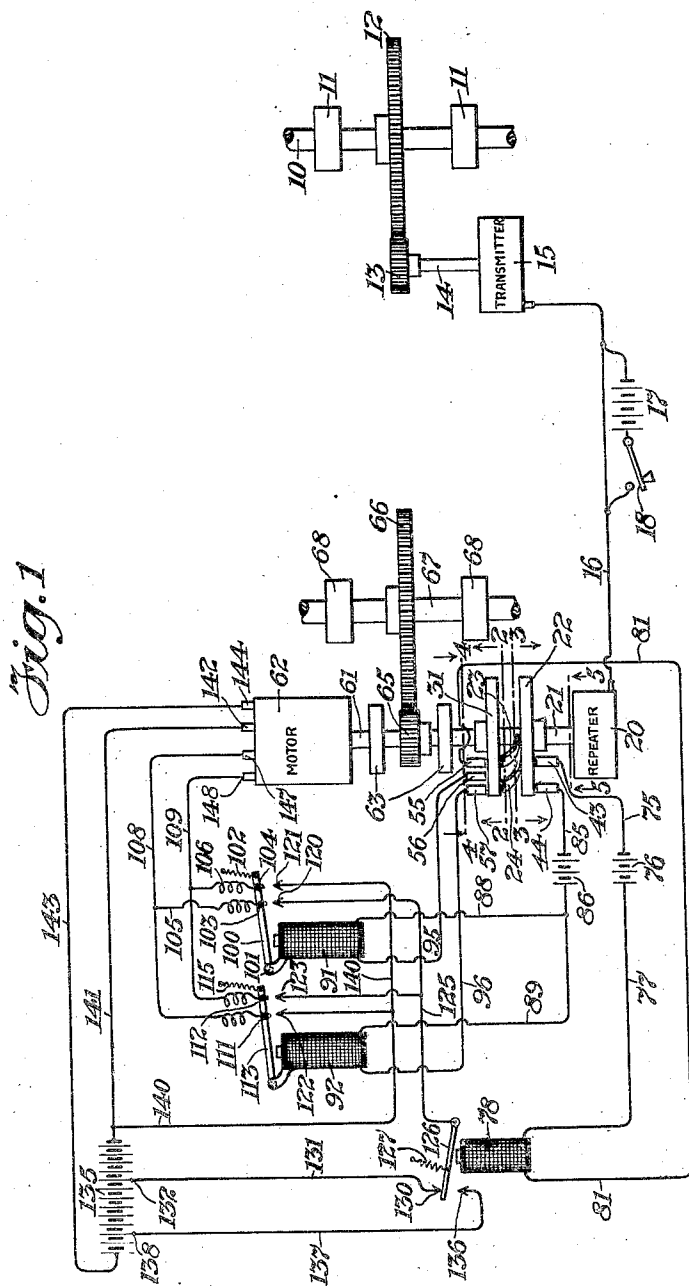
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VARIABLE SPEED REPEATING MECHANISM

Filed March 29. 1920

2 Sheets-Sheet 1



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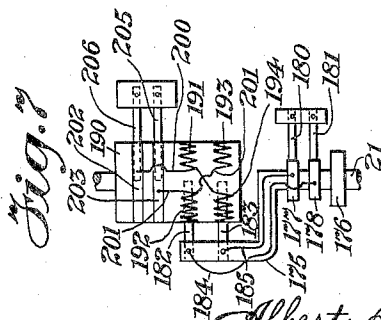
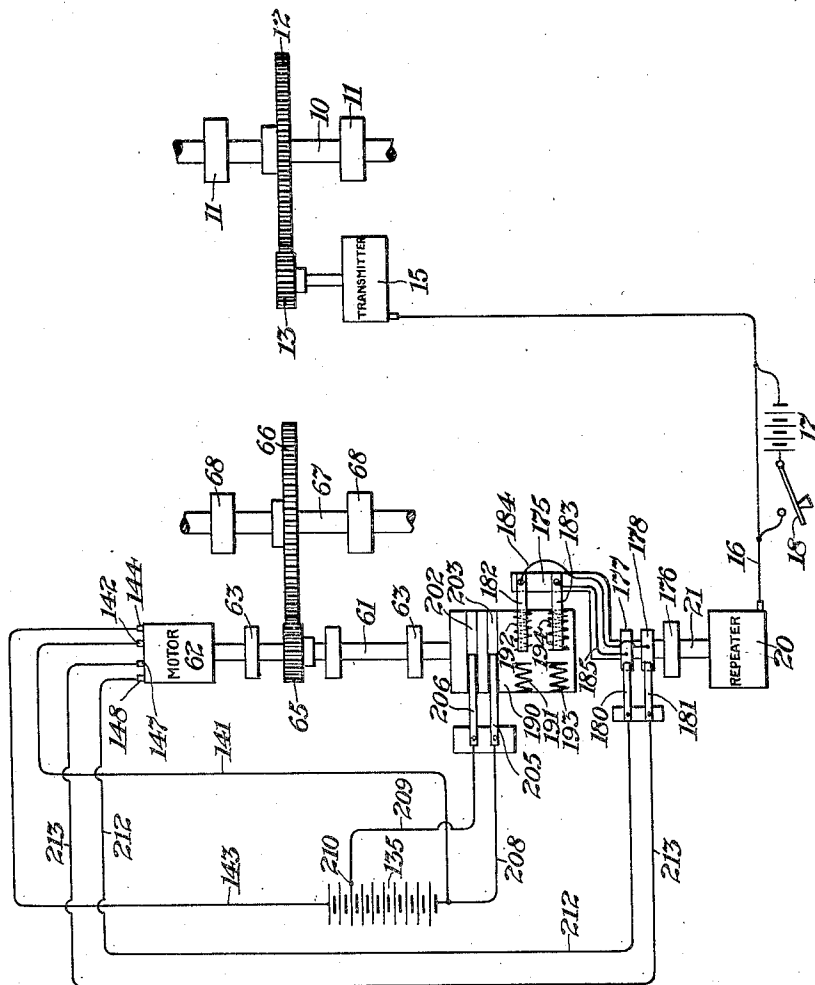
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Fig. 6



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VARIABLE-SPEED REPEATING MECHANISM.

Application filed March 29, 1920. Serial No. 369,782.

Some of the objects of this invention are to provide a motion transmitting device, a motion repeating device controlled by the transmitting device, a motor and means controlled by the repeating device to vary the speed of the motor and to synchronize the motion of the motor with that of the transmitting device; to provide an electric motor, a motion repeating device, and means controlled by the motion repeating device to vary the voltage of the current delivered to the motor; and to provide other improvements as will appear hereinafter.

Fig. 1, represents diagrammatically one form of motion repeating device embodying the present invention.

Fig. 2, represents one face of a contact segment forming a part of the invention.

Fig. 3, represents one face of a disc forming a part of the mechanism which includes the contact segment.

Fig. 4, represents the opposite face of the contact segment shown in Fig. 2.

Fig. 5, represents the opposite face of the disc shown in Fig. 3.

Fig. 6, represents diagrammatically another form of the present invention, and Fig. 7, represents a detail of the commutator mechanism and its connections.

Referring to Fig. 1 of the drawings, one embodiment of this invention comprises a system including a rotary shaft 10 supported by bearings 11. This shaft 10 is arranged to be rotated either manually or otherwise in either direction and either at a constant or at a variable rate. Rigidly secured to the shaft 10 is a gear wheel 12 which meshes with a pinion 13 secured to a rotary shaft 14 which actuates an electrical transmitter 15 of any well known form. For repeating the motion of the transmitter shaft 14, the transmitter 15 is connected by a four wire cable 16 including a return wire containing a battery 17 and a switch 18 to an electrical repeater 20 of any well known form.

For increasing the effectiveness of the repeater 20 the shaft 21 of the repeater 20 carries a disk 22 of insulating material upon which are mounted two spring contacts 23 and 24. The contact 23 cooperates with a contact segment 30 carried by a disk 31 of insulating material. The contact segment 30 is shown in the form of a semi-circle but could be made in any other desired shape, as will appear hereinafter. The other part

of the circle is formed by an insulating segment 32 which engages the contact 23 when it is not on the segment 30. The contact 24 cooperates with two segments 35 and 36 mounted upon the insulating disk 31 and separated from each other by two small insulating segments 37 and 38, the former 37 of which is slightly wider than the bearing surface of the brush 24 so that when the brush 24 is upon the segments 37 no current will flow through the brush, and the disk 31 may be rotated through a small arc with the brush in engagement with the segment 37 without having the brush 24 engage either of the conducting segments 35 or 36. The segment 38 may be as wide as the segment 37 or of a different width. The contact 23 is connected to a slip ring 40 on the back of the disk 22 and the contact 24 is connected to a slip ring 41 on the back of the disk 22. These slip rings cooperate with brushes 43 and 44 respectively. The segment 30 is connected to a slip ring 50 upon the back of the disk 31 and the segment 35 and segment 36 are respectively connected to the slip rings 51 and 52 on the back of the disk 31, which is rigidly secured to a shaft 61 which is part of the armature of a motor 62 and which is supported in bearings 63. The slip rings 50, 51 and 52 cooperate with the brushes 55, 56 and 57 respectively. Rigidly secured to the shaft 61 is a pinion 65 which meshes with a gear 66, this gear being rigidly secured to a rotary shaft 67 which is supported in fixed bearings 68. The ratio between the gears 65 and 66 is the same as the ratio between the gears 13 and 12, so that the shaft 67 will be rotated at the same rate and in the same direction as the shaft 10 which actuates the transmitter 15. The shaft 67 may be utilized for any well known suitable purpose, as for instance to rotate a turret of a battle ship, or a searchlight or any other objects.

For controlling the motor 62 the brush 43 is connected by a wire 75 to one pole of a battery 76, the other pole of which is connected by a wire 77 to one end of a coil of a relay 78, the other end of which is connected by a wire 81 to the brush 55. The brush 44 is connected by a wire 85 to one pole of a battery 86, the other pole of which is connected by wires 88 and 89 to corresponding ends of coils of the two relays 91 and 92 respectively, the other ends of which

are connected by two wires 95 and 96 to the two brushes 56 and 57 respectively. The armature 100 of the relay 91 is pivoted at 101 and normally is held in an open position by a spring 102. The armature 100 carries two contactors 103 and 104 which are insulated from the armature but connected by flexible coiled wires 105 and 106 to two wires 108 and 109 respectively. These wires 108 and 109 are connected by flexible coiled wires to two contactors 111 and 112 carried by and insulated from the pivoted armature 113 of the relay 92. This armature 113 is normally held in an open position by a spring 115. Cooperating respectively with the movable contactors 103, 104, 111, 112, are four fixed contacts 120, 121, 122 and 123. The fixed contacts 120 and 123 are connected to a wire 125 which is connected to the pivoted armature 126 of the relay 78. This armature 126 is normally held in an open position by means of a spring 127. When in its open position it makes contact with a fixed contact 130 which is connected by a wire 131 to any suitable point 132 of a battery 135. When in its closed position, the armature 126 engages the fixed contact 136 which is connected by a wire 137 to any other suitable point 138 on the battery 135. The points 132 and 138 are so chosen that when the armature 126 engages the contact 130 a current of predetermined comparatively low voltage will act to rotate the motor 62 at a comparatively slow rate and when the armature 126 engages the contact 136 a current of predetermined comparatively high voltage will act to drive the motor at a correspondingly higher rate. The contact points 121 and 122 are connected by a wire 140 to one side of the battery 135. From this side of the battery a wire 141 goes to a field connection 142 on the motor 62 and from the opposite side of the battery 135 a wire 143 goes to the other field connection 144 of the motor 62. The wire 108 goes to the armature connection 147 on the motor 62 and the wire 109 goes to the other armature connection 148 of the motor 62.

In the operation of the form of this invention shown in the drawings, the switch being open and the shafts 10 and 67 having been given respectively suitable initial adjustments rotatively and the disk 22 having been turned manually to bring the contact point 24 on the insulating segment 37, the switch 18 is then closed and then upon the rotating of the shaft 10 in a clockwise direction as viewed from below, and through any given angle at a rate within the limit of speed of the shaft 67 when the motor 62 is energized at the lower voltage, the shaft 14 will be turned accordingly in an opposite direction which will act through the transmitter 15 and repeater 20 to turn the disk 22 through the same angle that the shaft 14

was turned and in the same direction. This movement of the disk 22 will move contact 24 from the insulating segment 37, and into engagement with the contact 35. This closes the circuit through the slip ring 51, brush 56, wire 95, relay 91, wire 88, battery 86, contact 44, and slip ring 41. The relay 91 is therefore energized thus pulling the armature 100 down and closing the circuit through contacts 120 and 121. These allow energy from a part of the battery 135 to pass down the wire 131 through the armature 126, the wire 125, contact 120, contactor 103, wire 105, and wire 108 to the armature terminal 147, returning from the armature terminal 148 through the wire 109, wire 106, contactor 104, contact 121, wire 140 to the battery 135. This will cause the motor 62 to rotate in such a direction that the insulated segment 37 will be moved up to the contact 24 and when the latter is on this segment 37 the circuit through the relay 91 will be broken, thus de-energizing the motor 62 and allowing the armature 100 to assume its initial position, which will break the armature circuit 147-148 of the motor 62, thus stopping the motor. The shaft 67 will therefore have been turned through the same angle and in the same direction as the shaft 10 was turned. Upon continuing the rotation of the shaft 10 in the same direction and at a rate within the lower limit of speed of the shaft 67 determined by the lower voltage of the motor 62, the operation just described will be continued and the rotary movement of the shaft 10 will be repeated by the shaft 67.

If, however, the shaft 10 is rotated at a higher rate than just described the disk 22 will be rotated so far ahead of the disk 31 that the contact 23 will make contact with the segment 30, thus allowing the current from the battery 76 to flow through the wire 75, brush 55 and wire 81 to the relay 78 and wire 77 to the battery 76. This will energize relay 78 and pull down the armature 126, thus closing the circuit through the contact 136. This will allow energy from the point 138 of the battery 135 to pass along the wire 137, contact 136, armature 126, to the wire 125 and thence, as already described, through the armature of the motor 62 back to the other side of the battery 135, thus increasing the voltage of the current actuating the motor and thus accelerating the speed of the motor so that it will drive the shaft 67 at corresponding higher rate. Therefore, while the shaft 10 is being rotated slowly, the low voltage current will cause the motor 62 to rotate at a corresponding slow rate, but as soon as the shaft 10 is rotated at a sufficiently higher rate the armature 126 will be automatically drawn away from the contact 130 and into engagement with the contact 136 and thus the low voltage current

will be replaced by the current of higher voltage to rotate the motor 62 at a correspondingly higher rate. By suitably proportioning the battery 135 and arranging the two points 132 and 138, this motor 62 may be caused to be rotated selectively at any two desired rates. By adding one or more relays corresponding to the relay 78 and by adding suitable switches and contacts to the disks 22 and 31 the motor 62 may be arranged to be rotated successively or selectively at any number of different predetermined rates under the control of the shaft 10.

16 Preferably the low voltage for the current supplying the motor 62 is so selected that while sufficient to rotate the motor slowly it will not be sufficient to cause the motor to carry either of the insulating segments 37 or 38 across the brush 24 to such an extent as to reverse the motor, while the shaft 10 is being rotated slowly and within a predetermined rate in a direction opposite to the direction of rotation of the motor; and 25 the high voltage is preferably so selected that while sufficient to rotate the motor at a rate corresponding to a predetermined relatively high rate of rotation of the shaft 10, it will not be sufficient to cause a reversal of the motor while the shaft 10 is being rotated continuously in either direction approximately at the predetermined relatively high rate.

35 If, however, the shaft 10 is rotated as hereinbefore described but in the opposite direction, the shaft 21 will also be turned accordingly and the spring contact 24 will then make contact with the segment 36, energizing the relay 92 which closes the circuit through the armature of the motor 62 so that 40 the current flows through the armature in a direction opposite to that through which it flowed when the relay 91 was operating, thus reversing the motor 62 and rotating the shaft 67 accordingly. In this case the speed of the motor 62 will also be controlled in a manner similar to that just described.

A modified form of this invention is shown in Figs. 6 and 7, and includes a shaft 50 10, gear 12, pinion 13, transmitter 15 and repeater 20, shaft 61, motor 62, bearings 63, pinion 65, gear 66, shaft 67 and bearings 68, constructed and arranged as hereinbefore described. Rigidly secured to the shaft 21 55 of the repeater 20 is an arm 175 rotatably supported in a fixed bearing 176. This arm carries two slip rings 177 and 178 which cooperate with two brushes 180 and 181 respectively. The arm 175 also carries two 60 brushes 182 and 183 which are connected by wires 184 and 185 to the slip rings 178 and 177 respectively. The brushes 182 and 183 cooperate with a commutator 190 made of insulating material and carried by the 65 end of the shaft 61. The brushes 182 and

183 cooperate with resistances 191, 192 and 193, 194 respectively. The resistances 191 and 194 are electrically connected together on the under side of the commutator 190 (see Fig. 7) and are connected by a wire 200 70 to slip ring 202 fixed upon the commutator 190. The resistances 192 and 193 are connected together on the under side of the commutator 190 and by a wire 201 to the slip ring 203 fixed upon the commutator. Two 75 brushes 205 and 206 cooperate with the slip rings 202 and 203 respectively. The brush 205 is connected by a wire 208 to one side of the battery 135 and the brush 206 is connected by a wire 209 to a suitable point 210 80 of the battery 135. The brush 180 is connected by a wire 212 to the armature terminal 148 and the brush 181 is connected by a wire 213 to the armature terminal 147. The field terminals 142 and 144 are connected 85 to opposite sides of the battery 135 by the wires 141 and 143.

In the operation of the modified form of this invention shown in Figs. 6 and 7 with the switch 18 open the shafts 10 and 67 are 90 initially adjusted as described in connection with Fig. 1 and the arm 175 is so positioned as to bring the brushes between and out of engagement with the free ends of the resistances 191, 192 and 193, 194 respectively. 95 The switch 18 is then closed and the shaft 10 is then rotated. If now the shaft 10 is rotated through a definite angle in a clockwise direction as viewed from below it will, as previously described, rotate the shaft 21 a 100 corresponding amount but in an opposite direction. This rotates the arm 175 and moves the brushes 182 and 183 so that they make contact with the resistances 191 and 193, 105 respectively, which causes the current to flow from the point 210 of battery 135 through the wire 209 to the brush 206, slip ring 202, wire 200, resistance 191, brush 182, wire 184, slip ring 178, brush 181, and wire 213 110 through the armature of the motor 62, through the wire 212, brush 180, wire 185, brush 183, resistance 193, wire 201, slip ring 203, brush 205, wire 208 to the battery 135. This causes the motor 62 to rotate in such 115 a direction that the commutator 190 is forced to follow the brushes 182 and 183. When the shaft 60 has thus been rotated through the same angle as the shaft 21 the brushes 182 and 183 will be again between and out of engagement with the free ends of the 120 resistances 191, 192, and 193, 194, and the circuit through the armature of the motor 62 will be broken, thus bringing the motor to rest.

When the shaft 10 is rotated at a constant 125 speed, the shaft 67 will be rotated in the same direction, but if at any time the motor 62 does not rotate quite fast enough to keep the shaft 67 in synchronism with the shaft 10, then the brushes 182 and 183 will be 130

moved relative to the resistances 191 and 193 so as to decrease the effective lengths of these resistances, thus increasing the voltage on the armature of the motor 62 proportionally, and consequently causing the armature to rotate at a proportionally higher speed and thus keep the shaft 67 in synchronism with the shaft 10. The brushes 182 and 183 will therefore take up positions relative to the resistances 191 and 193 which will cause the motor 62 to rotate the shaft 67 at approximately the same speed as the shaft 10 is being rotated, and when the speed of rotation of the actuating shaft 10 is varied the speed of the motor 62 will be accordingly varied to rotate the driven shaft 68 approximately in synchronism with the actuating shaft 10.

If the shaft 10 should be rotated in a counter clockwise direction as viewed from below, the brushes 182 and 183 will make contact with the resistances 192 and 194, thus reversing the direction of the current in the armature of the motor 62 and causing the shaft 67 to be rotated at approximately the same speed as the shaft 10 and in the same direction.

Having thus fully described my invention what I claim is:—

1. A variable repeating mechanism comprising in combination a motion transmitting mechanism, a driven mechanism controlled thereby, a repeating device interposed between said mechanisms, said repeating device and said driven mechanism having rotary motions, a circular element movable with said repeating device, a second circular element movable with said driven mechanism, a contact affixed to each of said circular elements, said contacts being arranged to engage when the relative angular position of said circular elements exceeds a predetermined amount, and a relay controlled by said contacts to modify the speed of said driven mechanism.

2. A variable speed repeating mechanism comprising in combination a motion transmitting mechanism, a driven mechanism controlled thereby, a repeating device interposed between said transmitting mechanism and said driven mechanism, a substantially flat circular element operatively connected to said repeating mechanism, a second substantially flat circular member operatively connected to said driven mechanism and posi-

tioned substantially parallel to said first named flat member, a contact affixed to each of said flat members and arranged to close a circuit when the relative angular positions of said flat members exceeds a predetermined amount, and a relay included in said circuit and controlled by said contacts for modifying the speed of said driven mechanism.

3. A variable repeating mechanism comprising in combination a motion transmitting mechanism, a driven mechanism controlled thereby, a repeating device interposed between said mechanisms, said repeating device and said driven mechanism having rotary motions, an element affixed to said repeating device, a second element affixed to said driven mechanism, a contact fixed to each of said elements, said contacts being arranged to engage when the relative angular position of said elements exceeds a predetermined amount, and a relay controlled by said contacts to modify the speed of said driven mechanism.

4. In combination, a repeating mechanism including a transmitter, a motor adapted to be controlled by the transmitter, a repeater device interposed between the transmitter and the motor, means including a pair of relays for controlling the energization and direction of operation of said motor, means including a third relay for controlling the speed of the motor, and means controlled by relative movement of the motor and repeater device for selectively controlling the energization of each of the relays.

5. In combination, a transmitter, a motor adapted to be controlled by the transmitter, a repeater interposed between the transmitter and the motor, a circuit for said motor including a source of current and reverse switching means, means including a relay operable by a predetermined relative movement of the motor and repeater for controlling said switching means to operate the motor at a substantially constant speed, and means including a second relay operable upon further relative movement of the motor and repeater for varying the speed of the motor.

Signed at New York, in the county of New York and State of New York, this 26th day of March, A. D. 1920.

ALBERT D. TRENOR.