Nov. 16, 1926. 1,606,785

C. H. HODGKINS

SEQUENCE SWITCH

Filed March 8, 1919 2 Sheets-Sheet 1

Fig. 1.

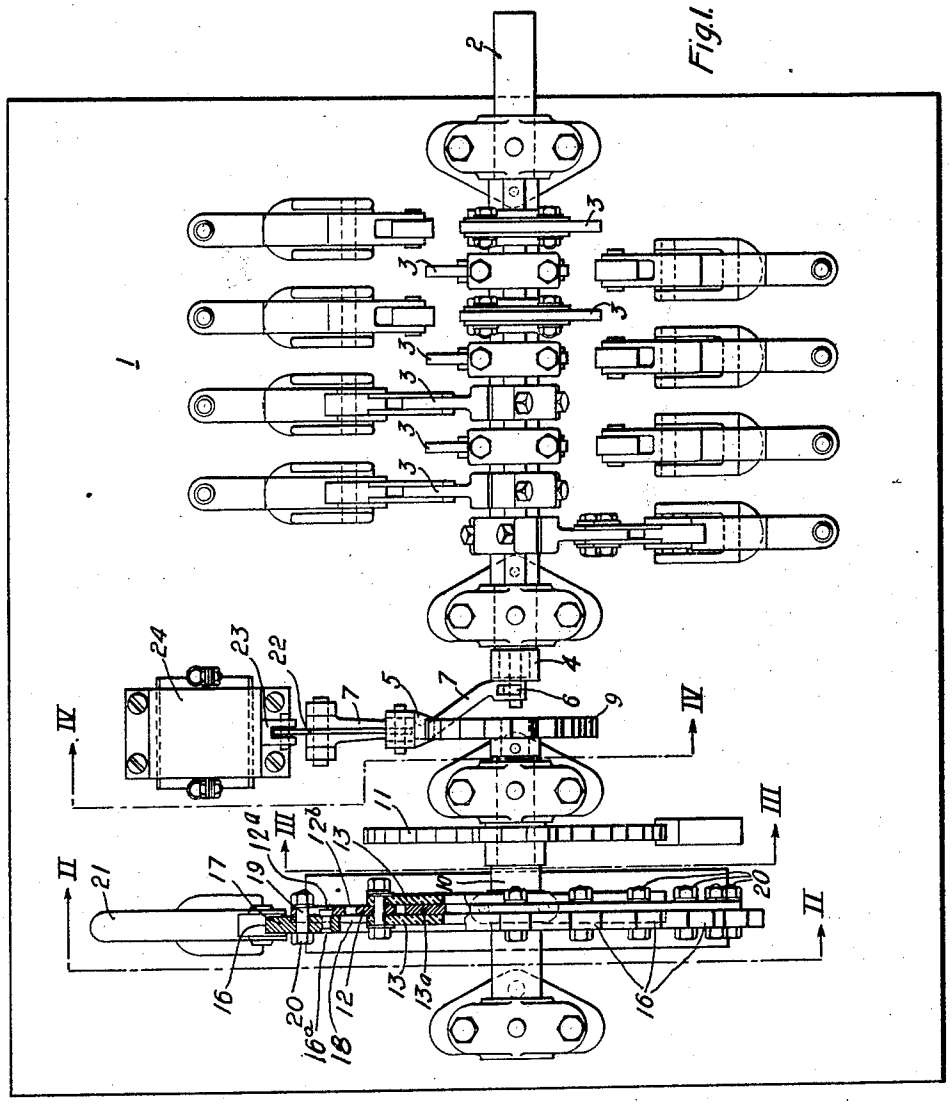

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Fig. 4.

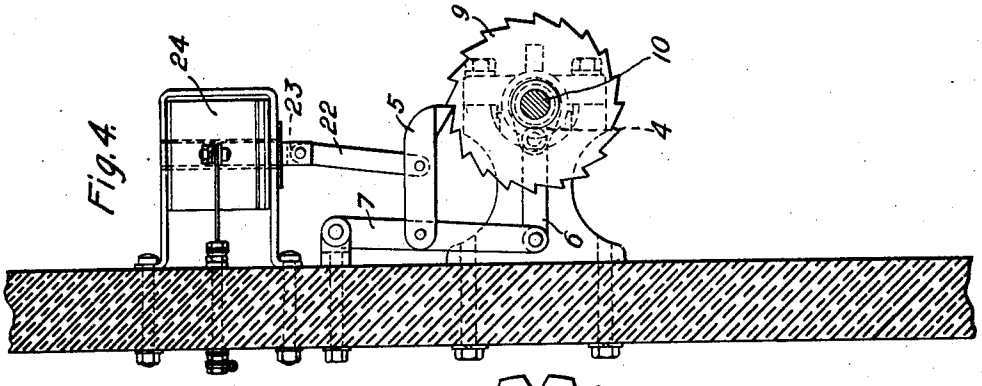


Fig. 3.

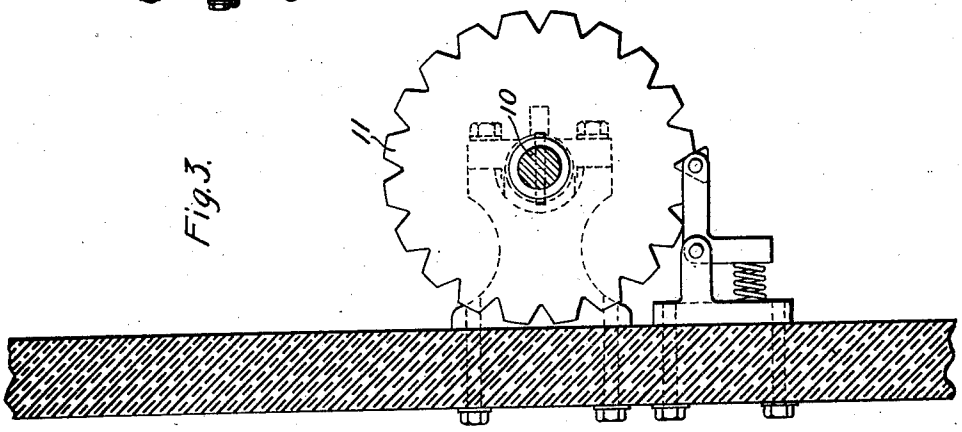
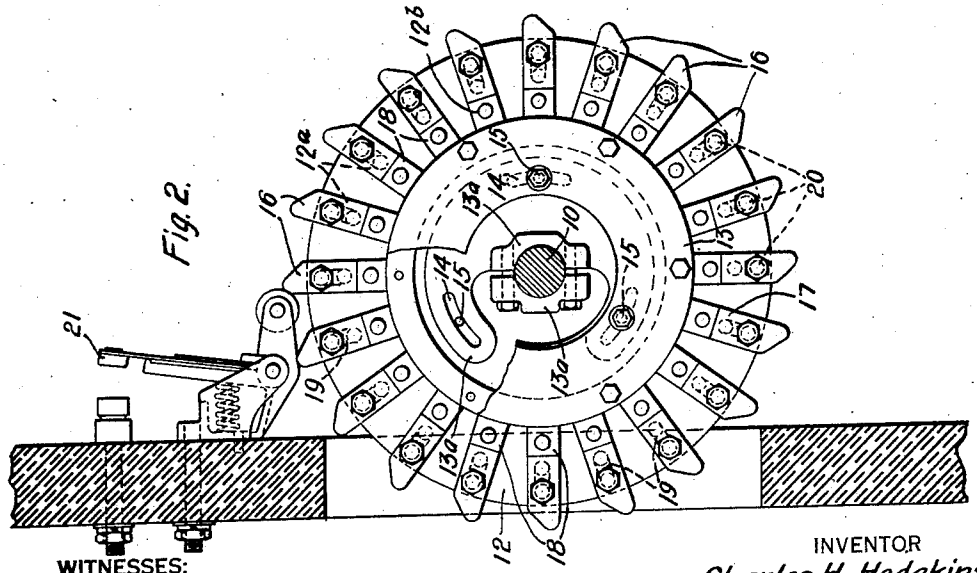


Fig. 2.



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UNITED STATES PATENT OFFICE.

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SEQUENCE SWITCH.

Application filed March 8, 1919. Serial No. 281,505.

My invention relates to switching devices.

An object of my invention is to provide an improved mechanism for the operation of a plurality of switches according to a predetermined sequence.

A further object of my invention is to provide a novel mechanism whereby changes in the said sequence may be easily made at will and whereby one of the switches may be operated without regard to, and yet without disturbing, the predetermined sequence.

Still another object of my invention is to provide a novel adjusting means for a cam-operated switch.

Other objects of my invention will appear hereinafter.

Though by no means limited thereto, my invention is particularly applicable to blast-furnace-control systems. In such systems, it is required that a pair of motors be operated through complete cycles of operation according to a predetermined sequence. It may be desirable, for example, to operate one motor after every four operations of the other. It may be desirable to change the number four to five or six or any other number. At times, too, it is necessary to operate one of the motors through an extra cycle of operation without disturbing the sequence.

I provide a pair of switches which may respectively control the two motors. One of the switches is controlled by a cam shaft which also intermittently operates a pawl once during every revolution, the pawl, in turn, engaging a ratchet member which rotates a shaft that is provided with a number, say twenty, of cams for actuating the other switch. By means of a novel form of adjustment, the cams may be rotatably adjusted as a unit, so as to ensure their actuating the last-named switch just at the right moment, and they may be longitudinally, individually adjusted, so as to render them ineffective to actuate the switch. Every fourth cam, for example, may be maintained in operative position and the others moved out of the way, in which event there will be four operations of the first switch to one of the second switch and, of course, if the switches are employed to control the two motors, four operations of the one motor to one of the other. The pawl may be actuated out of engagement with the ratchet member, provision thus being made for rotating the first-named shaft without any effect upon the other. When the pawl is returned to its normal position, obviously, the switches will continue to operate according to the same predetermined sequence.

My invention will be made clear by reference to the accompanying drawings, in which Fig. 1 is a plan view, partly in section, of an embodiment of my invention; Fig. 2 is a section taken substantially upon the line II—II of Fig. 1; Fig. 3 is a section taken upon the line III—III of Fig. 1, and Fig. 4 is a section taken upon the line IV—IV of Fig. 1.

A plurality of switches, indicated as a unit by the numeral 1, are adapted to be operated by a cam shaft 2. Some of the switches 1 may be maintained normally in open and some in closed positions by springs. Others may be normally maintained in open or in closed positions by cams 3 which are rotatable with the shaft 2 and which will be actuated by their springs as soon as the cams 3 are rotated out of operative engagement with the corresponding switches. The switches 1 may be adapted to initiate the operation of a motor and to control its operation throughout any desired cycle.

A crank shaft 4 is rotatable with the shaft 2 to effect the operation of a pawl 5 through a plurality of links 6 and 7. The pawl 5 is adapted to successively engage the teeth of a ratchet member 9. As the crank shaft 4 rotates through a complete revolution, in accordance with the rotation of the shaft 2, the pawl 5 will be actuated first to the right (Fig. 4) and then to the left, first forcing the ratchet member 9 through an angular rotative movement equal to the angular space occupied by one tooth of the ratchet member 9 and then returning to its initial position to engage the next consecutive tooth. In this manner, the ratchet member 9 will be intermittently rotated through a fraction of a revolution upon every complete rotation of the shaft 2.

The ratchet member 9 is rigidly secured to a shaft 10 upon which are also rigidly mounted an accentuating device 11 and a cam-supporting disk 12. The disk 12 is rigidly bolted, or otherwise mounted, between two insulating disks 13, which are

rotatably, adjustably secured to a casting 13[a] that is clamped to the shaft 10. The rotative adjustment of the disks 12 and 13, as a unit, is effected by means of openings 14 in the casting 13[a] and bolts 15 which are adjustably mounted in the openings.

The disk 12 is provided with a number of cams 16, each having a rectangular body portion 17, that is adapted to be slidably mounted in one of a number of rectangular grooves 18 that are radially spaced along the circumference of the disk 12. Each of the grooves 18 is provided with a radially extending opening 19 within which is slidably mounted a bolt 20, that is immovable with respect to the body portion 17. A dowel-pin 16[a] is riveted to each cam 16 and enters a corresponding hole 12[a] or 12[b] in the disk 12. These holes determine the operative and inoperative fixed positions, respectively, of these cams. To shift cams 16, the bolt 20 is loosened enough to disengage the dowel-pin 16[a] from the disk 12. The cam is then shifted radially and locked again by bolt 20. By means of this construction, the cams 16 may be adjusted to positions in which they extend beyond the circumference of the disk 12, as shown in Fig. 2, or they may be mounted within the limits of the circumference. In the former event, they may actuate a switch 21, which switch, for example, may control the operation of the above-referred to second motor. In the latter event they are ineffective to actuate the switch. By mounting every fourth cam 16, for example, in a position in which it extends beyond the circumference of the disk 12, and the remaining cams 16 within the circumference, the switch 21 will be operated once to every four complete operations of the shaft 2. By means of the accentuating device 11, the disk 12 will be maintained in the exact position to which it is actuated by the pawl 5 and the ratchet member 9, without liability of accidental backward or forward movement of the disk 12 to effect an accidental operation of the switch 21.

The pawl 5 is connected, by means of an additional link 22, to the core 23 of a solenoid 24, that is adapted to be energized when it is desired to lift the pawl 5 out of operative relation to the ratchet member 9.

The operation may be briefly summarized as follows: Assuming that the shaft 2 has been rotated throughout a complete rotation to effect the operation of the switches 1 (and the consequent operation, throughout a complete cycle, of one of the motors), the ratchet member 9 will be rotated through an angular space equal to the space occupied by one of its teeth, which space is also equal to the angular space between two of the cam members 16. During this operation, a cam member 16 will be momentarily actuated into operative relation to the switch 21. If this particular cam member 16 happens to be adjusted within the limits of the circumference of the disk 12, the switch 21 will remain in its open position. The shaft 2 may be operated through an additional complete rotation or through additional complete rotations, and, so long as the corresponding cam members 16 are adjusted to inoperative positions, the switch 21 will remain open. Upon a cam member 16 that is adjusted to an operative position (in Fig. 2, they are all shown in operative positions) being momentarily actuated into operative relation to the switch 21, the switch will be momentarily closed, the cam continuing in its movement until it is no longer effective to operate the switch 21. The momentary closing of the switch 21, however, will be sufficient to effect the operation of the second motor, assuming that the switch is used for such purpose. The sequence of operation of the switches 1 and 21 may, therefore, obviously be controlled by simple adjustment of the cam members 16. Twenty such cam members are illustrated, because it is usually desirable to operate two motors according to a sequence which is numerically a factor of twenty.

At times, it is desirable to operate the motor, which is controlled by the switches 1, through an extra cycle of operation. This may be effected by energizing the solenoid 24, whereupon the pawl 5 will be lifted out of engagement with the ratchet member 9, so that the shaft 2 may be rotated to effect the operation of the switches 1 without in any way disturbing the position of the disk 12 and the cams 16, so that, upon return of the pawl 5 into operative relation to the ratchet member 9, the switches controlled by the shafts 2 and 10 will be operated according to the same sequence as before the extra operation of the shaft 2.

Although I have described my invention in connection with the control of a pair of motors, it will be obvious that the invention is not limited to such application and I desire, therefore, that the annexed claims be construed broadly except in so far as limitations may therein be specifically imposed.

I claim as my invention:

1. The combination with a switch and a plurality of rotatable cams for operating said switch, of an intermittently operable mechanism for actuating said cams and means providing for the radial adjustment of said cams to such positions as to selectively render them effective or ineffective.

2. In a sequence switch mechanism, the combination with a switch member, a rotatable actuating member therefor and a pawl-and-ratchet mechanism normally mechanically connected thereto for operation at a definite speed ratio, of a second switch

member actuated by said mechanism whereby said switch members operate in a definite sequence, said second switch member having adjustable actuating means whereby the number of operations effected thereby may be varied to correspondingly vary the sequence of operation of said switch members, and means whereby said pawl-and-ratchet mechanism may be temporarily rendered ineffective to permit independent operation of the first mentioned switch member.

3. In a sequence switch mechanism, the combination with a switch and a rotatable cam shaft for operating said switch, of a second switch, a plurality of revoluble cams for operating said second switch, means for selectively rendering said cams effective or ineffective, a rotatable ratchet member operatively connected to said cams, a pawl for normally intermittently rotating said ratchet member, linkage mechanism for transmitting movement from said first-named shaft to said pawl, and means for temporarily moving said pawl out of operative relation to said ratchet member to permit independent operation of one of said switches.

4. In a sequence switch mechanism, the combination with a switching device and a rotatable device for controlling the same, of a switch, a rotatable member, a plurality of mechanisms carried by said rotatable member for controlling said switch, means for successively rotating said rotatable member through a fraction of a complete movement of rotation to successively actuate said mechanisms into operative relation to said switch upon every complete rotative movement of said rotatable device, and means for selectively rendering said mechanism ineffective to correspondingly vary the sequence of operation and the ratio of the numbers of operations of said switching device and said switch.

5. In a sequence switch mechanism, the combination with a switch member, a rotatable actuating member therefor, and a pawl-and-ratchet mechanism actuated by said actuating member, of a second switch member normally operatively connected to said mechanism for operation in a definite sequence, said second switch member having adjustable operating means for varying said sequence, and means for selectively rendering the said mechanism effective or ineffective to actuate the second switch member.

6. The combination with a switch, of an actuating cam therefor having a rectangular body portion, a supporting member for said cam having a rectangular groove to receive said body portion and an extended opening in the wall of said groove, and fastening means rigidly mounted with respect to said rectangular body portion and slidably mounted in said opening.

In testimony whereof, I have hereunto subscribed my name this 26th day of Feb., 1919.

CHARLES H. HODGKINS.