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REMOTELY CONTROLLABLE ROTARY SWITCH

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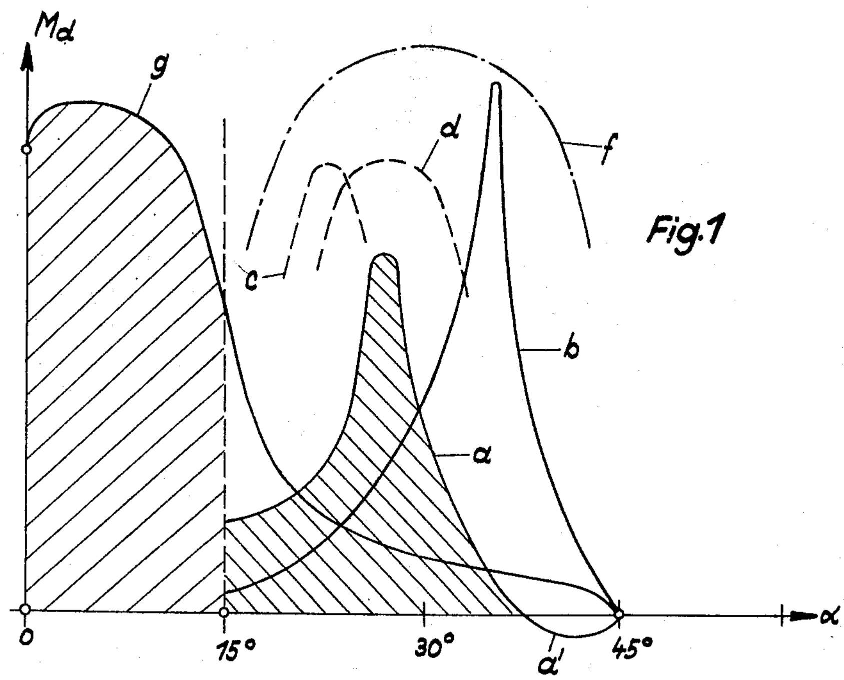

Fig.1

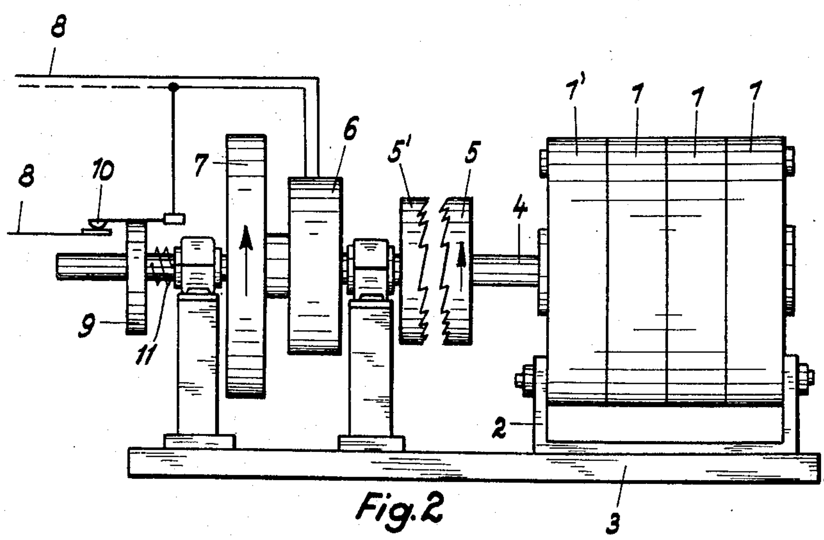

Fig.2

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REMOTELY CONTROLLABLE ROTARY SWITCH

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This invention relates to remotely controllable rotary switches, and is more particularly concerned with a switch drive for actuating movements of a rotary switch.

Rotary switches are convenient for controlling complex or multiple circuits. They have heretofore not been commonly employed for controlling such circuits from a remote operator's station, and remote control of multiple circuits conventionally is achieved by a multiplicity of contactors.

It is the primary object of this invention to provide a switching arrangement which is simpler and less costly than a multiple contactor arrangement, yet fully reliable.

A more specific object is the provision of a remotely controlled rotary switch arrangement which is not sensitive to accidental variations of operating conditions.

Particularly, this invention aims at a remotely controllable drive arrangement for a rotary switch which is reliable enough in its operation to permit replacement of multiple contactors by a single remotely controlled rotary switch.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a chart in which the torque required for operation of a rotary switch, and that supplied by the drive arrangement of the invention are plotted as functions of the angular displacement of the drive and of the switch; and

FIG. 2 is a side-elevational view of a preferred embodiment of a remotely controlled rotary switch of the invention.

Referring now to FIG. 1 in detail, there is plotted on the abscissa angular displacement α of the rotary switch of FIG. 2, and on the ordinate a corresponding torque value M_d. The curve *a* indicates the torque required to angularly displace the switch through a 30° angle which is the indexing angle of the switch between values of α of 15° and 45°. For the particular switch under consideration, the required torque has a sharp peak at approximately 25°. Other switches may have torque requirements which differ from curve *a* as to peak height, peak location, and the like, and the corresponding curves are shown at *b*, *c*, and *d*. The invention provides a drive arrangement which satisfies the torque requirements of a wide variety of switches, while being simple and inexpensive when compared with equivalent contactor arrangements. The torque available from the drive arrangement of the invention as a function of angular switch displacement is represented by the curve *f* which envelopes all torque demand curves *a* to *d*.

The invention provides an electromagnetic torque producing device which is combined with a flywheel and a clutch in such a manner that the torque of the torque producing device which varies with angular displacement as illustrated by curve *g* in FIG. 1 is stored in the flywheel during rotation through 15° prior to transmittal to the switch, and is transmitted to the switch by the flywheel while the torque producing device itself is practically ineffective, the end of torque output being substantially indicated by the broken line passing through the 15° point on the abscissa.

Regardless of the shape of the torque demand curves *a* to *d*, the drive arrangement briefly outlined above will furnish sufficient energy as long as the area under the curve *g* is greater than the area under a respective curve *a*, *b*, *c* or *d* between the values of α between 15° and 45°.

FIG. 2 illustrates apparatus suitable for operating in the manner above described, the view being in side elevation. A rotary mutliple switch **1** is shown, which may consist of three individual switches **1** and a detent mechanism **1'**.

Each individual switch is cam operated in a known manner and is switched by stepwise 30° movements of the shaft **4**. The detent mechanism is spring loaded to arrest the shaft in the usual manner after each 30° rotation. This switch may be affixed by means of a stirrup member **2** to a baseplate **3**. The switch shaft **4** carries one half of a clutch **5**, the other half **5'** of which is carried by the shaft of the electromagnetic drive device consisting of a stationary electromagnet **6** with a movable rotary armature and a movable flywheel **7**. The drive device may be of that type in which an energized pot-shaped electromagnet causes an armature to move axially toward the magnet, which axial movement is transformed by a cam guide into a rotary movement. The arrangement is such that an energization of the magnet **6** rotates the flywheel **7** in the direction of the arrow and moves it at the same time toward the magnet, i.e. to the right as viewed in the drawing.

The clutch **5**, **5'** is so designed that an energization of the magnet **6** whereby the flywheel is rotated will cause an engagement of the clutch halves **5**, **5'** only after 15°, based on the same assumptions as in FIG. 1. Only when the teeth of the coupling half **5'** interengage with those of the coupling half **5** is the switch rotated, through 30°, as assumed. Thus the flywheel **7** must be capable of rotating through 15°+30°=45°.

The clutch **5**, **5'** may be constantly in resilient engagement and the clutch disc **5'** has no fixed connection with the electromagnet whereas the necessary angle of free rotation required between the coupling parts **5**, **5'** and the electromagnet to enable a storage of energy is provided for by an additional lost-motion coupling.

The magnet device **6** is suitably fed in pulses. The pulse must be long enough to enable the device to store the necessary amount of kinetic energy. As soon as the flywheel **7** has delivered its energy to the switch **1** and as soon as the magnet **6** has become deenergized the flywheel is returned to its initial position by a spring **11**, as is usual in electromagnetic devices of the type under consideration. This will disengage the clutch **5**, **5'** so that the device is re-set for receiving a second pulse.

FIG. 2 shows a possibility of automatically forming such pulses. If the feed circuit **8** for the magnet device **6** is closed and the rotary magnet **6** begins to rotate it entrains a cam **9** which is carried by the shaft of the magnet and which after a sufficient amount of rotation interrupts the contact **10**, whereby the device becomes deenergized and the armature returns to its initial position. This causes also a return movement of the switch cam **9** whereby the contact **10** is again closed and the cycle begins again. The duration of the sequence of pulses is thus unlimited but it requires a limitation. This can be achieved either by interrupting the command as soon as the switch **1** reports through a line provided for this purpose that the ordered switch position has been reached or in that the switch **1** itself interrupts in this position the supply of current to the winding of the rotating device **6**. For this purpose numerous circuits are available, which need not be discussed here in detail.

It is obvious that the turning device may be of various different kinds and constructions and need not necessarily be a rotary magnet.

I claim:

1. A switch drive for driving a rotary switch adapted to perform switching steps by rotating through angles of less than 360°, which comprises in combination: shaft means, first clutch means operatively connected to said shaft means, second clutch means operatively connected to said rotary switch, said first and second clutch means being normally disengaged from each other, a flywheel on said shaft means, said flywheel upon rotation through less than 360° being capable of storing an amount of kinetic energy which is at least equal to the kinetic energy required to perform the switching steps of said rotary switch, and torque producing means for simultaneously rotating said shaft means and said flywheel and to cause engagement of said first and second clutch means after said flywheel has stored said amount of kinetic energy, thereby to rotate said rotary switch.

2. A switch drive as claimed in claim 1, wherein said torque producing means is inactivated before said first and second clutch means have become engaged.

3. A switching arrangement, comprising in combination: rotary switch means adapted to perform switching steps by rotating through angles of less than 360°, shaft means, electrical torque producing means on said shaft means for stepwise rotating said shaft means through angles of less than 360°, first clutch means operatively connected to said shaft means, second clutch means operatively connected to said rotary switch means, said first and second clutch means being normally disengaged from each other, said first and second clutch means becoming engaged with each other after said torque producing means has caused said shaft means to rotate through an angle of less than 360°, and a flywheel on said shaft means for rotation with said shaft means, said torque producing means, said flywheel and the angle through which said shaft means rotates before said first and second clutch means become engaged being dimensioned so that the time period passing between the onset of rotation of said shaft means and engagement of said first and second clutch means is sufficient to allow for storage of an amount of kinetic energy in said flywheel and said shaft means which suffices to rotate said rotary switch means to perform its switching steps upon engagement of said first and second clutch means.

4. A switching arrangement as claimed in claim 3, electrical circuit connections leading to said electrical torque producing means, cam means on said shaft means, and said cam means after rotation of said shaft means through a predetermined angle interrupting said circuit connections to inactivate said torque producing means.

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