May 17, 1966 G. PETTERSON 3,251,960

MAGNETICALLY OPERATED MASTER SWITCH CONTACTS

Filed Aug. 26, 1963

FIG. 1.

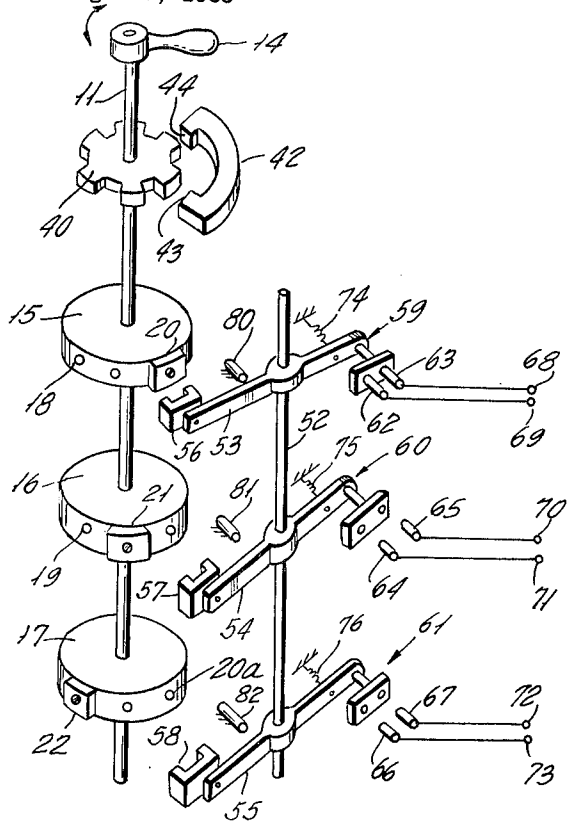


FIG. 2.

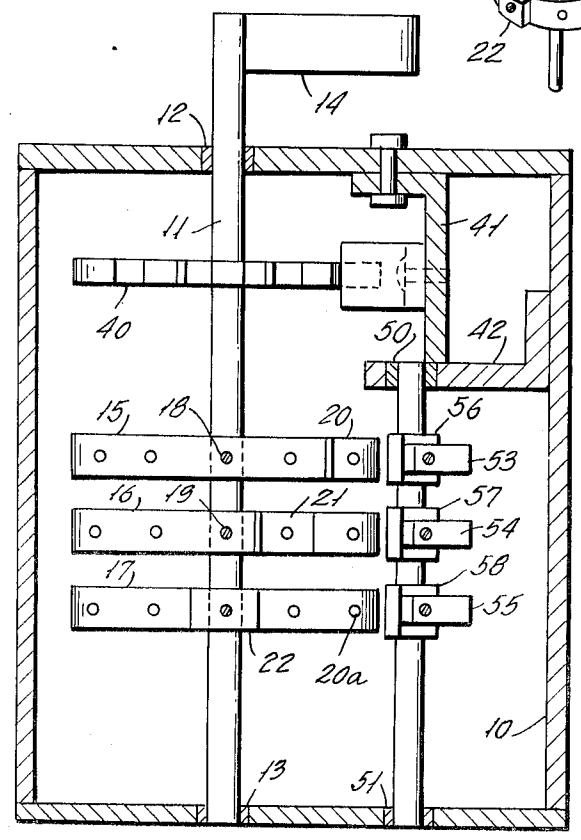


FIG. 3.

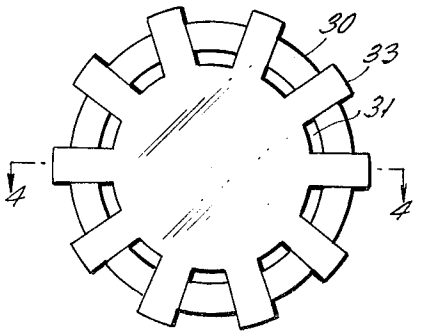
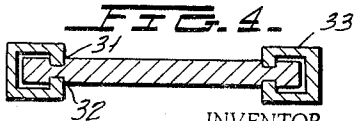


FIG. 4.



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MAGNETICALLY OPERATED MASTER SWITCH CONTACTS

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This invention relates to an improved multi-contact control switch, and more specifically relates to a multi-contact control switch which is particularly adapted for use with magnetic contactor switching arrangements.

In the systems now in use for accomplishing electrical control function, a common fault exists. That is the need of springs to operate the contacts of cams and ratchets for operation of the contacts and indexing arrangement. This use of cams and ratchets necessitates the use of pawls sliding on the cams and ratchets, with accompanying friction and wear.

Another common fault in present systems is the necessity to disassemble the switch and the use of new cams when the operating position of a contact has to be changed.

Still another disadvantage of present systems is the fact that due to the friction between the cams, ratchets and pawls, the movement of the handle is not free and the indication of the switch position is always definite.

The principle of the invention is to employ the use of permanent magnets, instead of springs, pawls and ratchets, for actuating the contacts and for indexing of the switch position.

Thus, one important object of the present invention is to provide a novel control switch on which the operating handle is easy to move and still will give the operator a definite indication of the several contact positions by feel.

Another object of the inevntion is to provide a novel control switch wherein friction between parts is eliminated, thereby eliminating wear.

A further object of the invention is to eliminate as many springs as possible in a novel control switch, and thereby make the apparatus more reliable and less subject to breakdown.

A still further object of the invention is to provide a novel control switch which can be operated at high speed as well as low speed without contact bounce.

A still further object of the invention is to provide a novel control switch which lends itself to rugged construction so that maintenance costs will be kept low and need for adjustment from time to time will be obviated.

A still further object of the invention is to provide a control switch on which the operating position of the contacts relative to the control handle position can readily be changed without disassembling the apparatus.

These and other objects of this invention will become apparent from the following description when taken in connection with the accompanying drawings, in which:

FIGURE 1 shows an exploded perspective view of the novel control switch.

FIGURE 2 is a cross-sectional view of the switch of FIGURE 1 when assembled in a housing.

FIGURE 3 is a side view of an alternate structure for securing the armatures to the operating disks.

FIGURE 4 is a cross-sectional view of FIGURE 3 taken across lines 4—4 in FIGURE 3.

Referring first to FIGURES 1 and 2, I have illustrated therein a control switch contained within a suitable housing **10** (FIGURE 2) which has a rotating operating shaft **11** carried in bearings **12** and **13** (FIGURE 2) in housing **10**. The shaft has a suitable operating handle **14** secured thereto.

A plurality of contact operating disks **15**, **16** and **17** or any desired number are then rigidly connected to shaft **11**, and have a plurality of drilled and tapped openings such as openings **18**, **19** and **20***a* in disks **15**, **16** and **17** respectively which receive screw means for securing magnetic armature **20**, **21** and **22** to disks **15**, **16** and **17** in any desired position on the periphery of the disks.

The securement of armatures **20**, **21** and **22** to the disks can be achieved in any manner. For example, in FIGURES 3 and 4, I have shown a disk **30** which has circular notches **31** and **32** in the opposing surfaces thereof. One or more armatures such as armature **33**, which has a U-shaped configuration may then be snapped onto the disk at any desired location as shown by the plurality of armatures in FIGURE 3.

Returning to FIGURES 1 and 2, shaft 11 further receives an indexing wheel **40** of magnetic material and which has a plurality of spaced teeth extending therefrom.

The housing **10** is then provided with support platforms **41** and **42** (FIGURE 2) which are secured to the housing in any desired manner. Platform **41** then carries a permanent magnet **42** as by bolting. Permanent magnet **42** has pole faces **43** and **44** positioned in the plane of indexing wheel **40** and spaced from one another to span the distance between teeth on the index wheel **40**. Thus, a magnetic latching system is provided where index wheel **40** will be held in a position such that the air gap between the teeth of the wheel and the pole faces **43** and **44** assumes its smallest value. Therefore, the indexing wheel will have a plurality of predetermined, preferred rest positions.

The platform **42** carries a shaft receiving means **50** which, with shaft receiving means **51** in housing **10**, rigidly carry a fixed shaft **52**. Fixed shaft **52** rotatably carries a plurality of insulation contact operating arms **53**, **54**, and **55** which are in alignment with disks **15**, **16** and **17** respectively. One end of arms **53**, **54** and **55** then carry U-shaped permanent magnets **56**, **57** and **58** respectively which are movable into engagement with the periphery of disks **15**, **16** and **17** respectively.

Movable bridging contacts **59**, **60** and **61** are then secured to the other end of arms **53**, **54** and **55** respectively (FIGURE 1) and move into and out of engagement with stationary contacts **62–63**, **64–65** and **66–67** respectively which are in turn connected to suitable electrical circuit terminals **68** through **73**. The contact arms **53**, **54** and **55** are then secured to biasing springs **74**, **75** and **76** respectively (FIGURE 1) which have their other end fixed to housing **10** (not shown) whereby contact arms **53**, **54** and **55** are normally biased counterclockwise in FIGURE 1 and to a contact disengaged position. Note that by a simple mechanical rearrangement the contacts could be normally biased closed; or some contacts could be biased close and others biased open.

The operation of the switch of FIGURES 1 and 2 is as follows:

When the operating handle **14** is turned in either direction, the indexing wheel **40**, and the contact operating disks **15**, **16** and **17** rotate with the shaft **11**. When two of the teeth on the indexing wheel **10** line up with the two pole faces **43** and **44** of the stationary mounted permanent magnet **42**, a magnetic circuit is established through the permanent magnet **42**, the teeth on the indexing wheel **40** and the body of the indexing wheel **40**.

As the indexing wheel **40** is made of soft iron, the reluctance of the magnetic circuit is very low. It should be noted that the permanent magnet **42** is mounted very close to the indexing wheel so that the air gap between the face of the indexing wheel teeth and the pole faces

of the permanent magnet is very small, in the order of a few thousandths of an inch.

If the indexing wheel 40 should be moved from this position, the area of the tooth faces and the pole faces facing each other is reduced. Therefore, the reluctance of the magnetic circuit is increased. This results in a force being set up between the permanent magnet pole faces 43 and 44 and the indexing wheel tooth faces in such a direction as to reduce the reluctance of the magnetic circuit. In the case at hand, this would mean that the interaction between the permanent magnet 42 and the teeth of the indexing wheel 40 would tend to hold the indexing wheel 40 and thereby the rotating shaft 11 with its contact operating disks 15, 16 and 17 in a certain position. This results in position indexing of the rotation of the rotating assembly.

As the position of the rotating assembly is then changed by turning it with the handle 14, the movement will first be resisted by the magnetic force between the permanent magnet 42 and the indexing wheel 40. As the rotation continues until the area of the air gap between the pole faces 43 and 44 and the indexing teeth 40 facing each other in the original position is reduced, a position will be reached where the indexing teeth corresponding to the next switch position will present a larger area of their faces to the pole faces 43 and 44. This will result in a force tending to move the rotating assembly into the next position. This procedure will, of course, be repeated for each indexing position.

From the above it can be understood that a very positive indexing "feel" on the handle 14 is realized without having any parts of the indexing assembly in physical contact with any other parts. This results in a frictionless, non-wearing arrangement.

As the rotating control switch shaft 11 is moved, the contact operating disks 15, 16 and 17 are also moved. When one of the soft iron armature plates 20, 21 or 22, mounted on the several contact operating disks, is in a position opposite one of the permanent magnets 56, 57 or 58 mounted on the contact arms 53, 54 or 55 respectively, the permanent magnet will be attracted to the soft iron armature plate. This results in the respective contact arm 53, 54 or 55 being rotated around the stationary shaft 52, and closing its respective contacts. As the rotating control switch shaft 11 is again moved to another position, the attractive force between the permanent magnet on the control arm and the soft iron armature is reduced, and the contacts are returned to their open position by the biasing spring.

Thus, in FIGURE 1, shaft 11 positions armature 20 adjacent magnet 56. This causes arm 53 to rotate against the force of spring 74 to close contacts 59, 62 and 63. Note that armatures 21 and 22 are removed from magnets 57 and 58 so that contact arms 54 and 55 are in their normally open position.

The travel of the contact arms 53, 54 and 55 is limited by suitable control stops 80, 81 and 82 respectively (FIGURE 1) so that the permanent magnet mounted on the respective contact arm will not actually touch the soft iron armatures on disks 15, 16 and 17. This eliminates friction and wear.

It should be noted that the position of the armatures 20, 21 and 22 can be changed without dissassembling the switch assembly, thereby adjusting the indexing.

Although this invention has been described with respect to preferred embodiments thereof, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred therefore that the scope of this invention be limited not by the specific disclosure herein but only by the appended claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. A magnetically operated control switch comprising a rotatable contact operating disk mounted on a shaft having a first magnetic member thereon, a rotatable contact arm positioned adjacent said disk and having a second magnetic member thereon at one end thereof; said rotatable contact arm being rotatable between a first position wherein said first magnetic member is spaced from the periphery of said disk and a second position wherein said first magnetic member is adjacent said periphery of said disk; at least one of said first and second magnetic members being a permanent magnet; a pair of cooperating contacts; said rotatable contact arm having one of said pair of cooperating contacts thereon; the other of said pair of cooperating contacts being relatively stationarily mounted with respect to said one of said pair of cooperating contacts; said one of said pair of cooperating contacts being movable into and out of engagement with said other of said pair of cooperating contacts responsive to rotation of said rotatable contact arm between said first and second positions; and stop means for preventing engagement of said first and second magnetic members; and a toothed indexing wheel; said toothed indexing wheel secured to said shaft and rotating with said shaft; and a permanent magnet located adjacent said indexing wheel and having a pair of pole faces spaced from one another by the spacing of adjacent teeth on said indexing wheel and being spaced from the periphery of said teeth; said permanent magnet defining a plurality of stop positions for said shaft defined by the positions where respective teeth of said pairs of teeth are located adjacent said pole faces.

2. A control switch comprising a movable operating shaft movable to a plurality of operating positions and having a plurality of first magnetic members thereon, a plurality of movable contact members, and a plurality of second magnetic members connected to respective movable contact members of said plurality of movable contact members; said plurality of second magnetic members being movable toward and away from respective magnetic members of said plurality of first magnetic members responsive to movement of said operating shaft from one to another of its said plurality of operating positions; stop means for preventing engagement between respective first and second contact members when moved toward one another, and a plurality of stationary contacts for cooperating with respective movable contacts of said plurality of movable contacts; each of said plurality of movable contacts being movable between an engaged and disengaged position with respect to its said respective stationary contact responsive to movement of its said respective second magnetic members into its said stop means; an indexing means including an indexing magnetic member having a plurality of spaced extending portions and a permanent magnet member; one of said members being secured to said operating shaft; said permanent magnet member having extending pole faces adapted to span across adjacent pairs of spaced extending portions thereby to bias said magnetic member into any one of a plurality of positions determined by said extending portions.

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