Feb. 21, 1967 W. J. RUSSELL 3,304,800

SWITCH OPERATING UNIT

Filed Sept. 9, 1963

FIG. 1

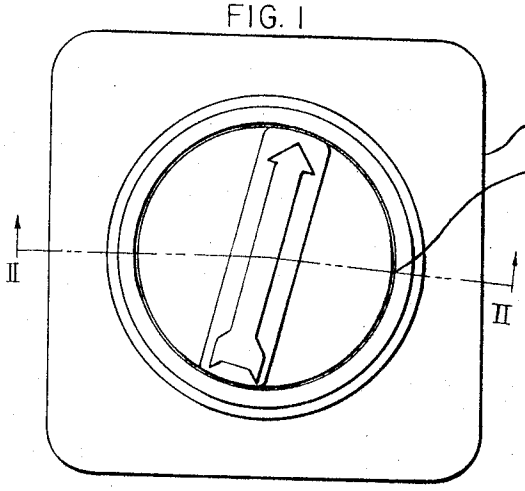
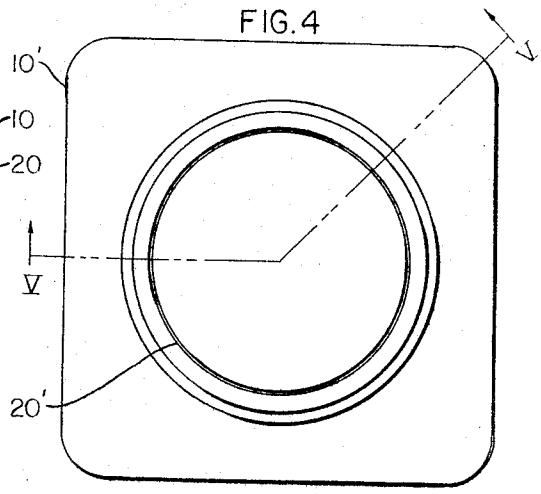


FIG. 4



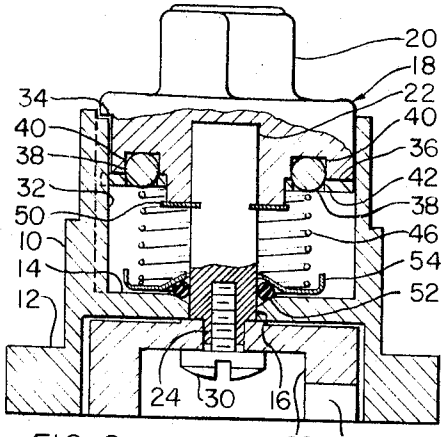


FIG. 2

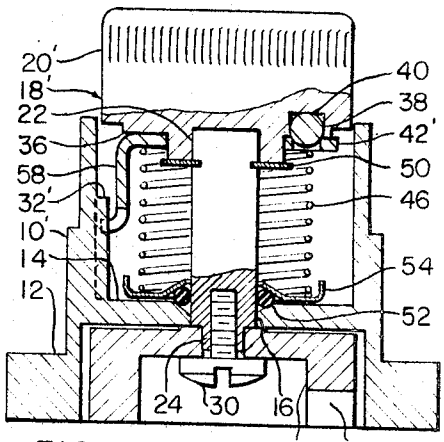


FIG. 5

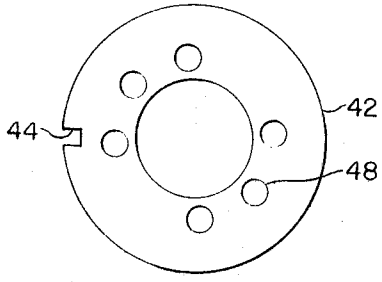


FIG. 3

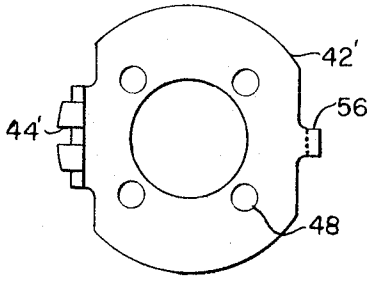


FIG. 6

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SWITCH OPERATING UNIT

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The invention presented herein relates to electric switches of the rotary select or rotary select-push class and more particularly to the operating units for such switches.

Such switches include an operating unit and an associated switch contact unit or units. The operating unit includes a housing in which a manually operable rotor or head of the thumb and finger grip type is positioned. A shaft or operating rod extends axially from the manually operable head through an opening in a transverse web or flange formed as part of the housing. An operating member or contact actuating cam is secured to the end portion of the operating rod extending beyond the web. A detent mechanism which is responsive to the rotation of the operating head and rod is provided to resiliently hold the operating head in any of several predetermined stop positions and thus provide several operating positions for the contact operating cam. In the case of the rotary select type switch, which generally has one or two switch contact units mounted to respond to the head of the operating unit, the rotary motion of the head is reflected in the position of the contact operating cam, the cam surface of which imparts a reciprocatory movement to the contact actuating plungers of the switch contact units. In the case of the rotary select-push type switch, the contact actuating cam is formed so a particular selected position may or may not impart reciprocatory movement to the actuating plungers of the switch contact units. The operating head, however, is positioned in the housing so it may be moved axially to modify the position of the switch contacts according to the rotary position selected for the operating head.

Switches of the type just described are often used where the switches are subjected to liquids such as oil, making it necessary to provide a seal around the operating rod or shaft of the operating unit to prevent the liquids from reaching the switch contact units along the operating rod.

It has heretofore been rather common practice to design the operating units for such switches which use one set of components to provide the sealing action referred to and a separate set of components to provide the required detent action. The operating units disclosed in U.S. Patent 2,669,616, issued February 16, 1954, to S. L. Frank, and U.S. Patent 2,488,982, issued November 22, 1949, to E. F. Mekelburg are examples of this approach in the design of the operating unit for switches of the type described.

It is therefore an object of this invention to provide a novel operating unit in which the detent action and required seal are obtained with a minimum number of parts by the use of parts which are common to the detent action and the sealing action.

Another object is to reduce the number of parts needed without sacrificing simplicity of assembly.

Still another object is to reduce the number of parts needed while providing for the use of a maximum number of parts that are common to a rotary select type operating unit and a rotary select-push type operating unit or are easily modified for use in both types of operating units.

In accordance with one embodiment of the invention, the foregoing object and others are achieved by locating one or more latch or detent balls in the inner face of the operating head positioned at one end of the operating unit housing. The operating head has a shaft or rod portion extending axially from the inner face of the operating head. An indexing or detent plate with recesses for the detent balls is keyed to the housing and is positioned on the shaft adjacent the detent balls so the shaft may rotate relative to the indexing plate and be held in place at the various desired rotary positions of the operating head by engagement of the detent balls in the recesses provided in the indexing plate. Contrary to the usual detent ball arrangement as shown in the prior art, each detent ball does not have a compression spring associated with it. A single coil compression spring is provided which surrounds the shaft and resiliently biases the indexing plate toward the inner face of the operating head. The spring is held in compression between the indexing plate and a retainer element positioned adjacent a transverse web formed as a part of the housing through which the shaft or rod portion passes. A packing gasket or O ring is positioned on the shaft and is held in sealing engagement with the shaft and the web by the retainer element which is biased toward the web by the compression spring. Using this arrangement a single spring provides the necessary biasing force for the detent function and the sealing function. In addition, in the case of a rotary select-push type operating head, the same spring serves as the return spring for the operating head.

The invention, as to organization and operation together with further objects and advantages may be best understood by reference to the following description and the accompanying drawing forming a part of this specification. The specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention presented herein.

In the drawing:

FIG. 1 is a top plan view of an operating unit of the rotary select type for electric switches according to the invention;

FIG. 2 is a partial section view of the operating unit of FIG. 1 looking in the direction indicated by line II—II in FIG. 1;

FIG. 3 is a bottom plan view of the indexing plate used in the operating unit shown in FIG. 2;

FIG. 4 is a top plan view of an operating unit of the rotary select-push type for electric switches according to the invention;

FIG. 5 is a partial section view of the operating unit of FIG. 4 looking in the direction indicated by the line V—V in FIG. 4; and

FIG. 6 is a bottom plan view of the indexing plate forming part of the operating unit shown in FIG. 4.

Referring to FIGS. 1–3 inclusive of the drawing, there is shown an oil tight rotary select operating unit for use with one or more switch contact units. The operating unit includes a unitary housing or support means **10** which is essentially an open-ended cylinder having an outwardly extending flange **12** used in mounting the operating unit. Details regarding the manner in which the mounting is accomplished are not shown since they are not necessary for an understanding of the invention. An

inwardly extending or transverse flange or web 14 provided with a central opening 16 is formed as an integral part of the housing 10. A manually operable switch actuating means 18 is journalled for rotation within the bore of the cylindrical housing 10 and includes an operating head 20 with a central projection 22 that extends through and beyond the web 14 via the opening 16. The opening 16 in web 14 provides a bearing surface for the projection 22. The manually operable switch actuating means 18 may be formed as a unitary structure or the central projection 22 may be a shaft or operating rod which is secured to the operating head 20 in any suitable manner such as set screw (not shown). The portion 24 of the shaft 22 which extends through the web 14 has a cam means or operating member 26 having a cam surface 28. The operating member 26 may be secured to the shaft 22 in any suitable manner. In the embodiment shown, the portion 24 is necked down and keyed to the operating member 26 to prevent rotation of the member 26 relative to the shaft 22. The operating member 26 is held in place on the shaft 22 by a screw 30. The operating member 26 is thus directly coupled to the operating head 20 and is positioned in accordance with the manual rotation of the operating head 20.

A keying rib or key 32 is provided as an integral part of the housing 10 and extends axially along the inner wall of the housing from the web 14 toward the operating head 20. An arcuate recess 34 is provided in the peripheral portion of the operating head 20 and subtends an arc corresponding to the degree of rotation desired for the operating member 26. The end portion of the key 24 extends into the recess 34. The ends of the recess 34 engage the keying rib 32 to limit the degree of rotation for the switch actuating means 18. The operating unit is used with a switch contact unit or units having a contact actuating plunger which functions as a cam follower and is resiliently biased toward the cam surface 28 of the operating member 26 in a manner similar to that shown in the above mentioned patents. Rotation of the operating member 26 causes the actuating plunger to move in accordance with different portions of the cam surface 28 to vary the position of the actuating plunger and provide the desired switching action.

An indexing mechanism and sealing means for the switch actuating means 18 are positioned in the housing 10 in the space between the web 14 and the inner face 36 of the operating head 20. The indexing mechanism includes one or more detent or latch balls 38 which are located in recesses or holes 40 provided in the inner face 36 of the operating head 20. The depth of the recesses 40 is such that a portion of each detent ball 38 extends above the inner face 36. An indexing plate 42 is positioned adjacent the inner face 36 of the operating head 20 and is keyed to the keying rib 32 via a peripheral notch 44 formed in the plate 42 to allow the operating head 20 to move relative to the indexing plate 42. The indexing plate 42 is resiliently biased toward the inner face 36 by a coil compression spring 46 positioned about the shaft 22. The indexing plate 42 is provided with suitably spaced detents which with the aid of the biasing force supplied by the spring 46 coact with the detent balls 38 to hold the switch actuating mechanism 18 in predetermined positions within the range of rotation of the switch actuating mechanism. In the embodiment shown, the detents 48 are holes formed in the indexing plate 42. The holes 48 have a diameter slightly smaller than the diameter of the detent balls 38. A retaining ring 50 is positioned in a groove provided in the shaft 22 to hold the indexing plate 42 adjacent the inner face 36 of operating head 20 during assembly of the operating unit.

The sealing means for the switch actuating means 18 includes a sealing element 52 positioned about and in engagement with the shaft 22 and in contact with the web 14. In the embodiment shown, the sealing element is an O ring of rubber or other suitable material. The web 14 is tapered adjacent the opening 16 to form a surface for receiving the O ring 52. A force transmitting means 54 is positioned between the end of the spring 46 away from the indexing plate 42 and the O ring 52 and serves to hold the O ring in place by the action of the bias force supplied by the spring 46. The force transmitting means 54 can take on various forms and may be a flat disc or a cup-shaped element positioned about the shaft 22. The embodiment shown in FIG. 2 shows a cup-shaped element as the force transmitting means 54.

It should be noted that the spring 46 provides the necessary bias or retaining force for the sealing means of the switch actuating means 18 and it also provides the biasing force needed for proper operation of the indexing mechanism. Separate compression springs are not provided with each detent ball 38 as has been the practice in prior art devices thus reducing the number of parts needed in an operating unit of that type.

From the foregoing detailed description it will be apparent that the invention provides an oil tight rotary select operating unit which is extremely simple, compact in construction and wholly dependable and efficient in operation. Few changes are needed to provide an operating unit with any number of possible operating characteristics and such changes can be readily made. Thus, for example, the operating head may be formed with more than one recess 40 in the inner face 36 to vary the degree of rotation of the switch actuating means 18. The indexing or latching positions for the operating head 20 as determined by the detent mechanism can be readily altered by the use of a different indexing plate 42 incorporating the necessary variation in the spacing of the detents 48. Further changes in the operating characteristics of the operating unit can be made by the substitution of operating members 26 having different cam surfaces 28. As will be seen by the following description, few and easily made changes are needed in the parts used for the rotary select operating unit to provide a rotary select-push operating unit and still retain the simplified structure described to carry out the detent or indexing action and necessary sealing for the operating unit to function as an oil tight operating unit.

The following description relates to the rotary select-push type operating unit, shown in FIGS. 4–6 inclusive, which embodies the invention. As indicated above, a number of the parts are the same as those used for the rotary select operating unit shown in FIGS. 1–3 inclusive, and some parts are only modified or differ in form. Accordingly, the same reference numbers are used where the parts are the same and are modified with an identifying mark when used to identify a corresponding part which is a modification or differs slightly. For example, the operating head shown in FIGS. 4 and 5 differs only in form from the operating head 20 shown in FIGS. 1 and 2 and is therefore identified using the reference number 20′.

The modifications incorporated to provide the operating unit shown in FIGS. 4–6 inclusive, permit the switch actuating means 18′ to be rotated to various preselected positions in the same manner as the operating unit shown in FIGS. 1–3 is operated and in addition permit the switch actuating mechanism 18′ to be pushed or depressed to move the cam means 26 axially. Thus, with a switch contact unit or units mounted for operating by the operating unit the rotational position of the switch actuating means 18′ causes the contact actuating plungers of the switch contact units to be moved in accordance with the cam surface 28 of the cam member 26. The position of the contact actuating plungers is further modified when the switch actuating means 18′ is depressed to impart axial movement to the cam member 26 which cooperates with the contact actuating plungers.

The housing 10′ is the same as housing 10 except a portion of the key rib 32 adjacent the operating head 20′ has been removed to allow the switch actuating means 18′ to

be depressed. The operation head **20'** is functionally the same as operating head **20**, but differs as to the form of that portion gripped by the operator. The position and number of recesses **40** for detent balls **38** are, of course, determined by the number of select positions desired and the degree of rotation desired between positions. While it does not appear in the particular view shown in FIG. 5, the operating head **20'** has a recess similar to recess **34** in operating head **20** of FIG. 2 to limit the degree of rotation of the operating head **20'**. This recess cooperates with an axially and upwardly directed tab **56** formed at the periphery of the indexing plate **42'** as shown in FIG. 6. The ends of the recess in operating head **20'** engage the tab **56** to limit the degree of rotation of the operating head **20'**. In the example shown, the recess subtends an arc of 90 degrees as indicated by the recesses **48** in the indexing plate **42'**. The tab **56** thus provides a stop which in the case of the operating unit in FIGS. 1–3 was provided by the key rib **32** cooperating with the recess **34** formed in the inner face of operating head **20**.

The indexing plate **42'** differs from the indexing plate **42** of FIG. 3 in that it has the tab **56** mentioned above and an axially and downwardly extending portion **58** the end portion of which extends radially outward and is formed with a notch **44'** which is keyed with the key rib **32'** to prevent rotation of the indexing plate **42'**.

The coil compression spring **46** serves the same purpose as in the operating unit of FIGS. 1–3 in that it furnishes the necessary force to resiliently bias the indexing plate **42'** toward the detent balls **38** and bias the retaining element **54** toward the web **14** and O ring **52** to hold the O ring in sealing engagement with the shaft **22** and the web **14**. Since the operating unit is of the rotary select-push type, it is necessary that means be provided to return the operating head **20** to its normal position after being depressed by an operator. The spring **46** is used to accomplish this function also.

Many modifications may be made in this invention without departing from the scope of the invention as exemplified in the described embodiments and defined in the accompanying claims.

What is claimed is:

1. In a rotary select operating unit, the combination including a support having an opening, first and second members, said first member journalled in said support for rotation relative to said support and said second member, said first member having a central projection extending into said opening, said second member being positioned between said first member and said opening, a sealing member engaging said central projection and said support adjacent said opening, a retainer for said sealing member positioned between said sealing member and said second member, a detent ball carried by one of said members with a portion of said ball always extending above the surface of said one member toward said other member, the other of said members having a series of recesses positioned to selectively receive said portion of said detent ball as said first member is rotated and a spring compressed between said second member and said retainer holding said retainer in contact with said sealing member and resiliently biasing second member toward said first member whereby said first member is resiliently held in various angular positions, a different position being established each time said detent ball is received in a different recess of said series of recesses as said first member is rotated.

2. In a rotary select operating unit, the combination including a support having an opening, first and second members, said first member journalled in said support for rotation relative to said support and said second member, said first member having a central projection extending into said opening, said second member positioned between said first member and said opening, sealing means adjacent said central projection and said opening

preventing pasage of liquid between said central projection and said opening, a detent ball carried by one of said members with a portion of said ball always extending above the surface of said one member toward said other member, the other of said members having a series of recesses positioned to selectively receive said portion of said detent ball as said first member is rotated and a spring positioned between said seal means and said second member resiliently biasing said second member toward said first member and holding said seal means in position whereby said first member is resiliently held in various angular positions, a different position being established each time a detent ball is received in a different recess in said series of recesses as said first member is rotated.

3. In a rotary select operating unit, the combination including a housing having a cylindrical opening with a transverse flange within said opening, said flange having a central opening, a manually operable switch actuating means rotatable within said cylindrical opening and including an operating head with a central projection extending through said central opening, said operating head presenting a flat surface adjacent said central projection, an operating member carried by said projection on the side of said flange away from said operating head, sealing means adjacent said central projection and said central opening preventing passage of liquid between said central projection and said central opening, an indexing plate having a series of spaced recesses positioned, adjacent said flat surface of said operating head, means keying said indexing plate to said housing to prevent rotation of said plate relative to said housing, at least one detent ball carried by said operating head at said flat surface with a portion of said ball extending above said surface toward said plate at all times, said ball being positioned to selectively cooperate with said series of spaced recesses as said operating head is rotated, a spring compressed between said sealing means and said plate resiliently biasing said plate toward said flat surface of said operating head and holding said sealing means in position whereby said operating head is resiliently held in various angular positions, a different position being established each time a detent ball is received in a different recess of said series of recesses as said operating head is rotated.

4. In a rotary select operating unit, the combination including a housing having a cylindrical opening with a transverse flange within said opening said flange having a central opening, a manually operable switch actuating means rotatable within said cylindrical opening and including an operating head with a central projection extending through said central opening, said operating head presenting a flat surface adjacent said central projection, an operating member carried by said projection on the side of said flange away from said operating head, an indexing plate having a series of spaced recesses positioned adjacent said flat surface of said operating head, means keying said indexing plate to said housing to prevent rotation of said plate relative to said housing, at least one detent ball carried by said operating head at said flat surface with a portion of said ball extending above said surface toward said plate at all times, said ball being positioned to selectively cooperate with said series of spaced recesses as said operating head is rotated, a sealing member engaging said central projection and said flange adjacent said central opening, a retainer for said sealing means positioned between said sealing member and said indexing plate, a spring compressed between said retainer and said plate resiliently biasing said plate toward said flat surface of said operating head and holding said retainer in position against said sealing member whereby said operating head is resiliently held in various angular positions, a different position being established each time a detent ball is received in a different recess of said series of recesses as said operating head is rotated.

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