Jan. 16, 1968 E. HERMLE 3,364,317

SWITCH ACTUATOR ARRANGEMENT

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Fig. 1

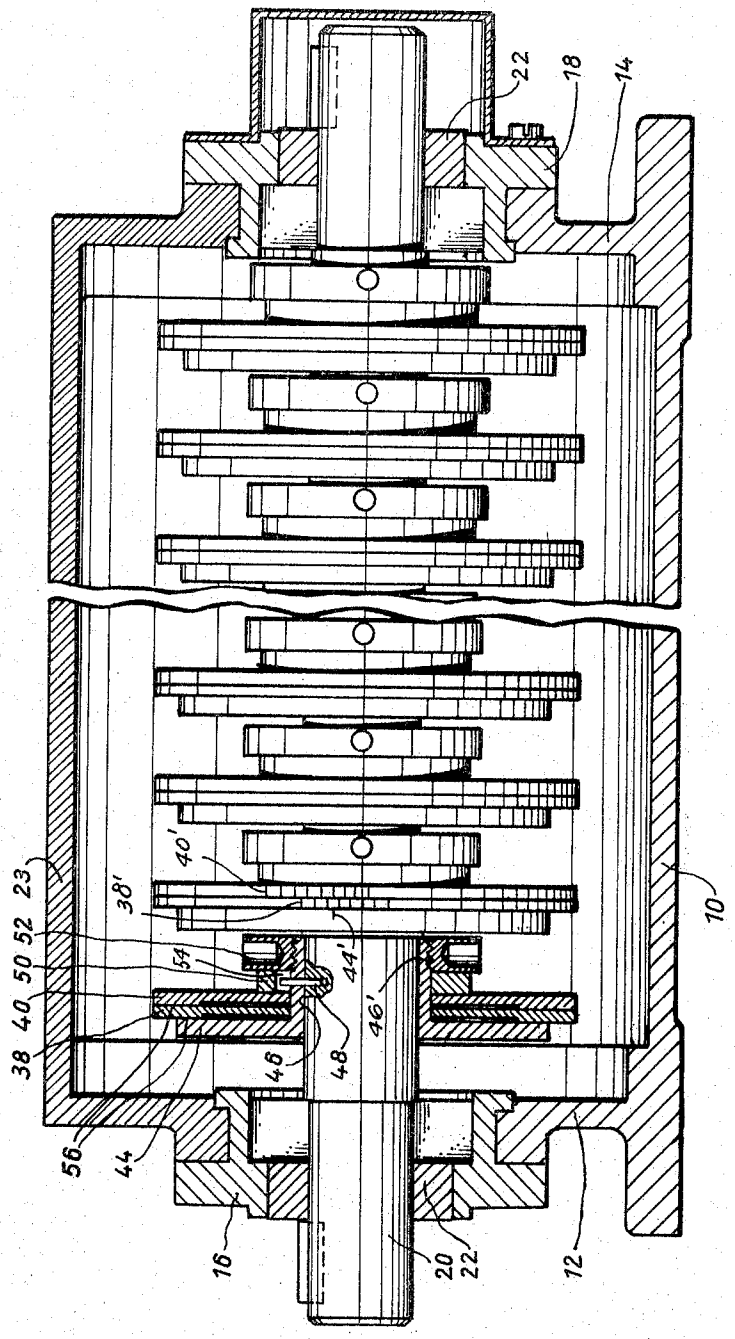

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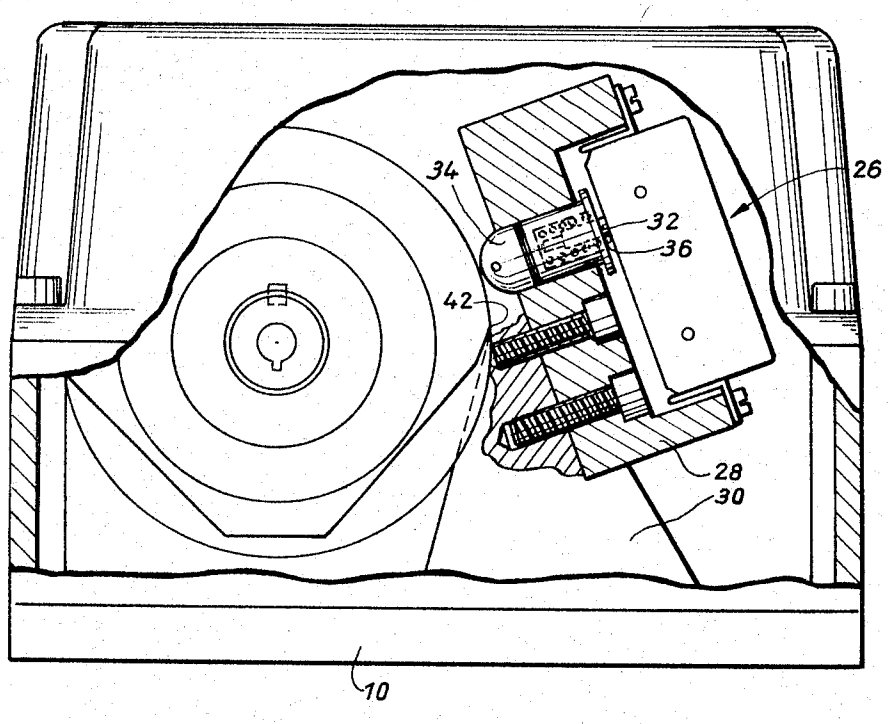
Fig. 2



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SWITCH ACTUATOR ARRANGEMENT

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ABSTRACT OF THE DISCLOSURE

Cam disks on a shaft are clamped against each other and against an abutment flange by nut means having a smaller diameter than the abutting faces of the cam disks and flange so that the cam discs are resiliently deformed and reliably clamped.

The present invention relates to a switch actuator arrangement in which a plurality of electrical switches are arranged in a row adjacent each other and in which the operating members of the electrical switches are respectively operated by a plurality of cam discs mounted on a common shaft for rotation therewith so that the switches are operated in a desired sequence by the plurality of cam discs during roation of the shaft.

Such switch arrangements are known in the art and it is also known in the art to mount the plurality of cam discs on the common shaft adjustable in circumferential direction so that the cam portions on the discs which respectively engage the operating members of the switches to close the same are located at a desired angular position with respect to each other so that the sequence of operation of the various switches may be changed as desired. In such an arrangement, each cam disc has to be mounted on the common shaft turnable with respect to the axis thereof and means have to be provided to fix any of the cam discs properly in a desired angular adjusted position.

To properly fix each of the cam discs in a proper angular adjusted position is difficult since each of the cam discs has to be turned to a desired angular position and fixed in this angular position, and during adjusting one of the cam discs the angular position of the already adjusted cam discs should not be changed.

It is an object of the present invention to provide a switch actuator arrangement in which the angular position of each cam means on the shaft can be easily adjusted and in which each of the cam means may be clamped to the shaft in a very convenient and reliable manner in the adjusted angular position.

It is an additional object of the present invention to provide for a switch actuator arrangement of the aforementioned kind permitting to resiliently fix each of the cam means in an adjusted angular position to the shaft in a convenient manner and in which the whole arrangement is composed of relatively few and simple parts so that the switch arrangement may be constructed at reasonable cost and will stand up trouble free under extended use.

With these objects in view, one embodiment of the present invention mainly comprises support means, shaft means rotatably mounted on the support means and provided with an outer screw thread, a plurality of cam means having each a peripheral cam face and opposite side faces mounted spaced from each other on the shaft means turnably about the axis of the latter, a plurality of abutment means fixed to the shaft means axially spaced from each other and each engaging one side face of a respective one of the plurality of cam means, a ring member for each cam means arranged about the shaft

means axially shiftable with respect thereto and engaging with one end face thereof the other side face of the respective cam means, a nut for each ring member threadingly engaged with the outer screw thread on the shaft means and tightly engaging the other end face of the ring member to press the latter against the respective cam means and the cam means against the respective abutment means so as to hold each of the cam means in an angular adjusted position fixed on the shaft means, and a plurality of switch means mounted on the support means and each having an operating member engaging the peripheral cam face of a respective one of the cam means to be operated thereby during rotation of the shaft means. Preferably, the switch arrangement includes further means connecting each ring member non-rotatable to the shaft means but slidably in axial direction with respect thereto.

In a preferred form, the aforementioned shaft means include an elongated shaft and a plurality of sleeve members, one for each cam means, coaxially fixed spaced from each other on the shaft and in this arrangement the outer screw thread is provided on a portion of each sleeve member and the cam means as well as the ring members are respectively mounted on the sleeve members, whereas the nuts are threadingly engaged with the outer screw threads on the respective sleeves. In this arrangement each of the abutment means is preferably constituted by a flange provided at one end of the respective sleeve member extending transverse to the shaft axis and the outer screw thread on each sleeve is provided at an end portion thereof opposite the one end on which the flange is provided. Each of the sleeve members may be fixed to the shaft by a pin extending through aligned bores in the shaft and the sleeve member and this pin may project with an outer portion thereof beyond the peripheral surface of the sleeve member into an axial groove in the respective ring member, so that the same pin serves also to prevent rotation of the ring member on the respective sleeve member while permitting axial movement of the ring member relative to the sleeve member.

Each of the cam means may be formed by at least two cam discs arranged adjacent each other between the flange of the respective sleeve member and the ring member thereon and each of the cam discs forming the respective cam means has preferable a peripheral surface portion forming part of a cylindrical surface coaxial with the shaft axis and arranged so that when engaged by the operating member of the switch, the switch is moved to the closed position thereof so that by angularly adjusting the surface portions of the two cam discs forming each cam means the time during which the respective switch is closed may be adjusted. In such an arrangement, the nut on each sleeve member is also used to hold the peripheral surface portions of the two cam discs on each sleeve member in an adjusted angular position with respect to each other. Each of the cam discs may in such an arrangement be provided with an annular peripheral axially projecting position adjacent the peripheral surface thereof and arranged in such a manner that an annular abutment face on one cam disc engages the flange of the respective sleeve member, whereas the annular abutment face on the other cam means engages a side face of the first mentioned cam disc facing away from the flange. The aforementioned annular abutment faecs on the two cam discs are arranged radially outwardly of the outer periphery of the ring member so that when the ring member is pressed against the side face of the cam disc which is spaced farthest from the flange, the two cam discs will be resiliently pressed against each other and against the abutment flange of the respective sleeve member.

The flanges of the sleeve members and the cam discs may be provided on the peripheral surfaces thereof with cooperating graduations and indicating marks permitting an exact adjustment of the cam discs forming each cam means relative to each other as well as the angular position of the cam means with respect to each other.

The various switch means are preferably arranged on a common support member forming part of the support means and this common support member is preferably of U-shaped cross section forming an elongated channel having a bottom wall facing the axis of the shaft means and the plurality of the switch means are respectively arranged at least in part in the channel. The bottom wall of the common support member is preferably formed with a plurality of spaced bores therethrough in which the operating members of the switch means are respectively guided for movement toward and away from the axis of the shaft means. Spring means are preferably provided for pressing the operating member of each switch means in a direction toward the axis of the shaft means.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a longitudinal cross section through the switch arrangement according to the present invention; and

FIG. 2 is a partially sectioned side view of the arrangement shown in FIG. 1.

Referring now to the drawings, and more specifically to FIG. 1 of the same, it will be seen that the switch arrangement according to the present invention preferably comprises a housing having a lower part **10** in the end walls **12** and **14** of which bearing bushings **16** and **18** are respectively mounted, each carrying a bearing **22** in which an elongated shaft **20** is turnably mounted projecting with end portions thereof beyond the bearings **22**. Means, not shown in the drawing, are coupled with one of the end portions of the shaft **20** for rotating the latter about its axis and the other end portion of the shaft is preferably covered by a cap, as shown at the right side of FIG. 1.

A plurality of sleeve members **46** are coaxially fixed, in a manner as will be described later on, spaced from each other on the shaft **20**, and each of the sleeve members **46** is provided at one end thereof with an annular flange **44** projecting substantially normal to the axis of the shaft **20** from one end of the respective sleeve member, whereas the outer peripheral surface of each sleeve is provided at an end portion thereof spaced from the flange **44** with an outer screw thread **46'**. The shaft **20** and the plurality of sleeves **46** fixed thereto constitute shaft means rotatably mounted on the support means formed by the housing portion **10** and the bearings mounted thereon. A plurality of cam means are mounted on the shaft means turnably about the axis of the latter. Each of the cam means is preferably constituted by at least two cam discs **38** and **40** which are mounted adjacent each other on the peripheral surface of each sleeve **46**. Each of the cam discs is preferably provided adjacent the outer periphery thereof with an axially projecting portion **56** forming an annular shoulder and the annular abutment face of each portion **56** of each cam disc **38** engages a corresponding abutment face of the respective flange **44**, whereas the annular projecting portion **56** of each cam disc **40** engages the side face of the cam disc **38** facing away from the flange **44**. Each of the cam discs **38** and **40** has a peripheral surface portion **42** (FIG. 2) forming part of a cylindrical surface and the cam discs **38** and **40** may be turned with respect to each other that the surface portions **42** thereof form a continuous cylindrical surface extending through a given angle about the axis

of the shaft means for a purpose which will be described later on. By adjusting the angular position of the two cam discs on each sleeve with respect to each other, the length of this cylindrical surface may be adjusted and by adjusting the angular positions of the cam discs on each sleeve relative to the cam discs on the other sleeves the angular positions of the cylindrical surfaces on the respective cam means each formed by a pair of cam discs may be adjusted relative to each other.

In order to hold the two cam discs **38** and **40** on each sleeve **46** in an adjusted angular position relative to each other as well as in an adjusted angular position to the shaft, a nut **52** is provided for each sleeve **46** and having an inner screw thread threadingly engaging with the outer screw thread **46'** at one end of each sleeve. Each nut **52** is preferably provided with a plurality, for instance four, blind bores extending in radial direction uniformly spaced from each other into the nut so that the end of a pin may be engaged into a respective one of the bores to thus conveniently turn the nut **52** in one or the other direction. A ring member **50** is preferably sandwiched between each cam disc **40** and the respective nut **52** so that by turning the nut in tightening direction, an inner portion of ring **50** will be pressed against the cam disc **40** and the axially projecting portion **56** thereof will be pressed against the cam disc **38**, whereas the projecting portion **56** on the cam disc **38** will be pressed against the flange **44** on the respective sleeve **46** to hold thereby the two cam discs **38** and **40** on each sleeve in proper adjusted angular position with respect to each other as well as in proper angular position with respect to the cam discs on the other sleeves. The flanges **44** of the sleeves **46** constitute therefore abutment means each engaging one abutment face of a respective one of the plurality of cam means, the latter being constituted by the pair of cam discs **38** and **40** on each sleeve **46**.

To prevent during tightening of the nut **52** transmission of a torsional moment onto the cam discs **38** and **40**, which would change the angular position to which these cam discs have been manually adjusted, means are preferably provided for connecting each ring member **50** to the respective sleeve member **46** nonrotatable with respect thereto, but slidable in axial direction. These means for each ring are preferably constituted by a pin **48** tightly fitted in a transverse bore in the shaft **20** and extending in radial direction through a correspondingly aligned bore through the sleeve member to project with an end portion thereof beyond the peripheral surface of the sleeve member. This end portion is slidably guided in an axial slot **54** formed at the inner surface of each ring member **50**. Each of the pins **48** serves therefore to fix the respective sleeve member **46** to the shaft **20** and to prevent rotation of each ring member **50** relative to the sleeve **46** on which it is mounted while permitting the ring to slide on the sleeve member in axial direction. The radius of ring member **50** is smaller than the radial distance of the rims **56** from the shaft so that holding means **50, 52** acts on an inner portion of cam disc **40** radially spaced from the abutting portions **56**. Consequently, the pressure of nut **52** resiliently deforms cam disc **28, 40** to assure a reliable clamping.

The peripheral surface of each flange **44** is preferably provided with a graduation line **44'** and the peripheral cam faces of the cam discs **38** and **40** are also preferably provided with a plurality of graduations **38'** and **40'**, respectively, to facilitate adjustment of the angular position of each cam disc relative to the cam disc adjacent thereto and relative to the flange of the respective sleeve **46** on which the two cam discs are mounted. Such graduations are shown only on the second cam means from the left, as shown in FIG. 1, but it is to be understood that all cam means are provided with such graduations and that the graduation lines **44'** on the flanges are all aligned along a line parallel to the shaft axis.

A plurality of switch means 26, one of which is shown in FIG. 2, is provided adjacent each other and the switch means 26 are preferably mounted on a common support member 28 which, as shown in FIG. 2, has a U-shaped cross section forming an elongated channel having a bottom wall facing the axis of the shaft 20 and the plurality of switch means 26 are arranged at least in part in this channel fastened to the common support member 28 in any convenient manner, for instance by being engaged at opposite end faces thereof by angular spring clips fixed by screws to the side walls of the U-shaped support member 28. Each switch 26 has operating means comprising an operating member 32 projecting toward the axis of shaft 20 and slide member 34 extending about each operating member 32 and guided movable toward and away from the axis of the shaft 20 in a respective bore formed through the bottom wall of the support member 28. The end of each member 34 projecting beyond the outer face of the bottom wall of the member 28 is preferably rounded and adapted to engage the cam faces 42 of the pair of cam discs 38 and 40 forming the cam means cooperating with the respective switch 26. A coil spring 36 located in a bore of the member 34 and engaging with opposite ends thereof the inner end of this bore and a side wall of the switch 26 is preferably wound about the operating member 32 so as to press the member 34 into engagement with the cam faces 42 of the cam means cooperating with the respective switch. An annular shoulder provided on the inner end of each member 34 permits limited movement of each member 34 toward the shaft axis. The arrangement is made in such a manner that when the acting cam faces 42 of the respective cam means engage the end of the member 34 the latter is pressed toward the switch 26 against the action of the coil spring 36 to press thereby the operating member 32 into the switch 26 to close the latter, whereas when the acting cam faces 42 of the respective cam discs have moved past the end of the member 34 the latter is pressed by the spring 36 toward the axis of the shaft 20 until the annular shoulder on the member 34 engages the end wall of the support member 28 so that the respective switch 26 will open.

The common support member 28 is mounted on a pair of brackets 30, respectively formed on the end portions 12 and 14 of the housing member 10, by means of screws as shown in FIG. 2. The housing is closed by an upper housing member 23 removably connected to the lower housing member 10 in any convenient manner.

The operation of the switch arrangement above described will be obvious from the above description. The various nut members 52 are first loosened and the cam discs 38 and 40 on each sleeve member 46 are angularly adjusted with respect to each other so that the acting cam faces 42 thereof will be arranged on a continuous cylindrical surface portion extending through a preselected angle about the axis of the shaft 20. After the two cams 38 and 40 on each sleeve 46 are thus adjusted, whereby the graduations 44', 38' and 40' respectively provided on the peripheral surfaces of the cam discs and the flange 44 will facilitate proper adjustment, the nut 52 is tightened so as to hold the cam disks 38 and 40 in properly adjusted position on each sleeve 46. The non-rotatable ring 50 sandwiched between each nut 52 and the corresponding cam disc 40 will prevent that during tightening of the respective nut 52 any torsional moment is imparted to the respective cam discs, preventing thereby change of the adjusted position of the cam discs during tightening of the nut. This operation is repeated for the cam discs on each sleeve, whereby the cam discs on each sleeve are not only adjusted relative to each other but also with respect to the cam discs on the other sleeves. The shaft 20 is then rotated by any convenient means so that the plurality of switches 26 will be opened and closed in a desired sequence.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of switch arrangements differing from the types described above.

While the invention has been illustrated and described as embodied in a switch arrangement with a plurality of adjustable cam discs, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. Switch actuator arrangement, comprising, in combination, shaft means having an outer thread, and at least one abutment means having a circumferential portion with a first abutment face radially spaced from said shaft means; at least one cam disk means for operating a switch and mounted on said shaft means for axial and turning movement and having a circumferential portion with a second abutment face located opposite said first abutment face and being radially spaced from said shaft means, at least one of said portions projecting in axial direction toward the other of said portions and forming a shoulder; and at least one holding means including nut means mounted on said shaft means in threaded engagement with said outer thread on the side of said cam disk means remote from said abutment means, said holding means having a radius smaller than the radial distance of said first and second abutment faces and of said shoulder from said shaft means, said holding means exerting pressure in axial direction on an inner portion of said cam disk means to move the same into a position in which said second abutment face abuts said first abutment face while said abutment means and cam disk means are axially spaced in the region of said inner portion so that said cam disk means is resiliently clamped to said abutment means and shaft means and is angularly adjustable upon loosening of said nut means.

2. Switch actuator arrangement as claimed in claim 1 wherein said cam disk means has said projecting circumferential portion.

3. Switch actuator means as claimed in claim 1 wherein said cam disk means includes two cam disks mounted adjacent each other on said shaft means for axial movement and for turning movement relative to each other, the one of said cam disks adjacent said abutment means having said axially projecting circumferential portion, and the other of said cam disks having a circumferential portion axially projecting toward said one cam disk and having a third abutment face abutting said one cam disk so that the inner portions of said cam disks are axially spaced from each other and from said abutment means; and wherein said holding means acts on an inner portion of said other cam disk to resiliently clamp said other cam disk against said one cam disk, and said one cam disk against said abutment means whereby said cam disks are connected with said shaft means for rotation.

4. Switch actuator as claimed in claim 1 wherein said circumferential portion of said abutment means has a graduated scale; and wherein said circumferential portions of said cam disks have indicating marks cooperating with said scale for indicating angular positions of said cam disks in relation to each other and to said shaft means, and to a switch operated by said cam disks.

5. Switch actuator as claimed in claim 1 wherein said holding means include a ring member having a radius smaller than the radius of said nut means and located between said nut means and said inner portion of said cam disk means; and wherein said shaft means includes a member for guiding said ring member in axial direction and blocking turning movement of the same so that pressure of said nut means against said ring member is transmitted by the same in axial direction to said inner portion without transmission of a torque to said cam disk means.

6. Switch actuator arrangement as claimed in claim 5 wherein said ring member has an inner surface surrounding said shaft means and formed with an axially extending groove; and wherein said guiding member is a pin

radially projecting from said shaft means into said groove for guiding said ring member in axial direction.

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