

June 10, 1941.

W. M. SMITH

2,245,369

CAM SWITCH

Filed Oct. 19, 1939

2 Sheets-Sheet 1

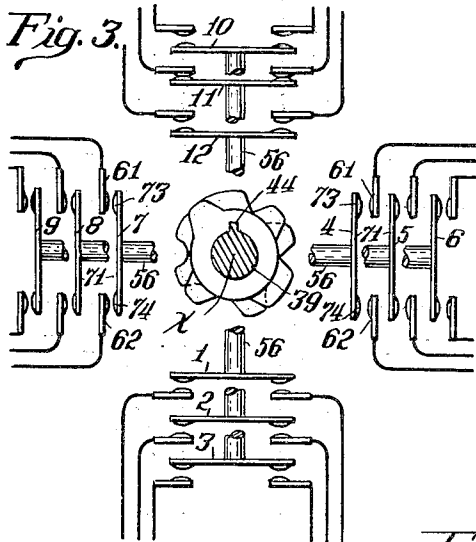


Fig. 4.

Position	1	2	3	4	5	6	7	8	9	10	11	12
Heat			•	•			•	•		•	•	
Off											•	
Vent					•	•	•					
Cool	•	•			•	•	•		•			•

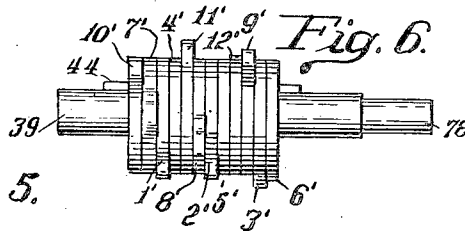
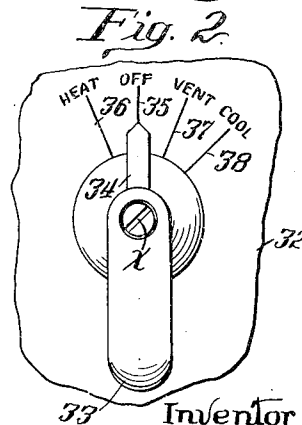
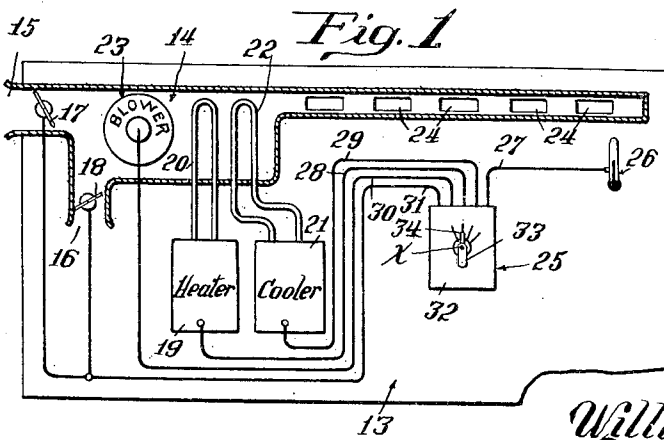
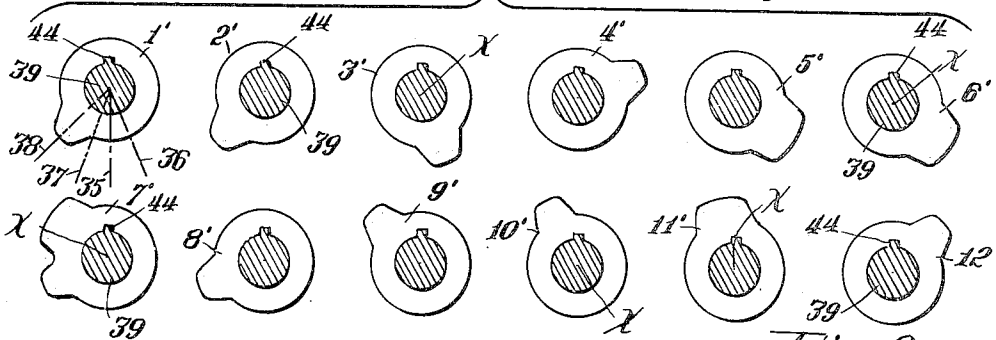


Fig. 6.



Inventor
William M. Smith
Barnett & Truman
Attorneys

June 10, 1941.

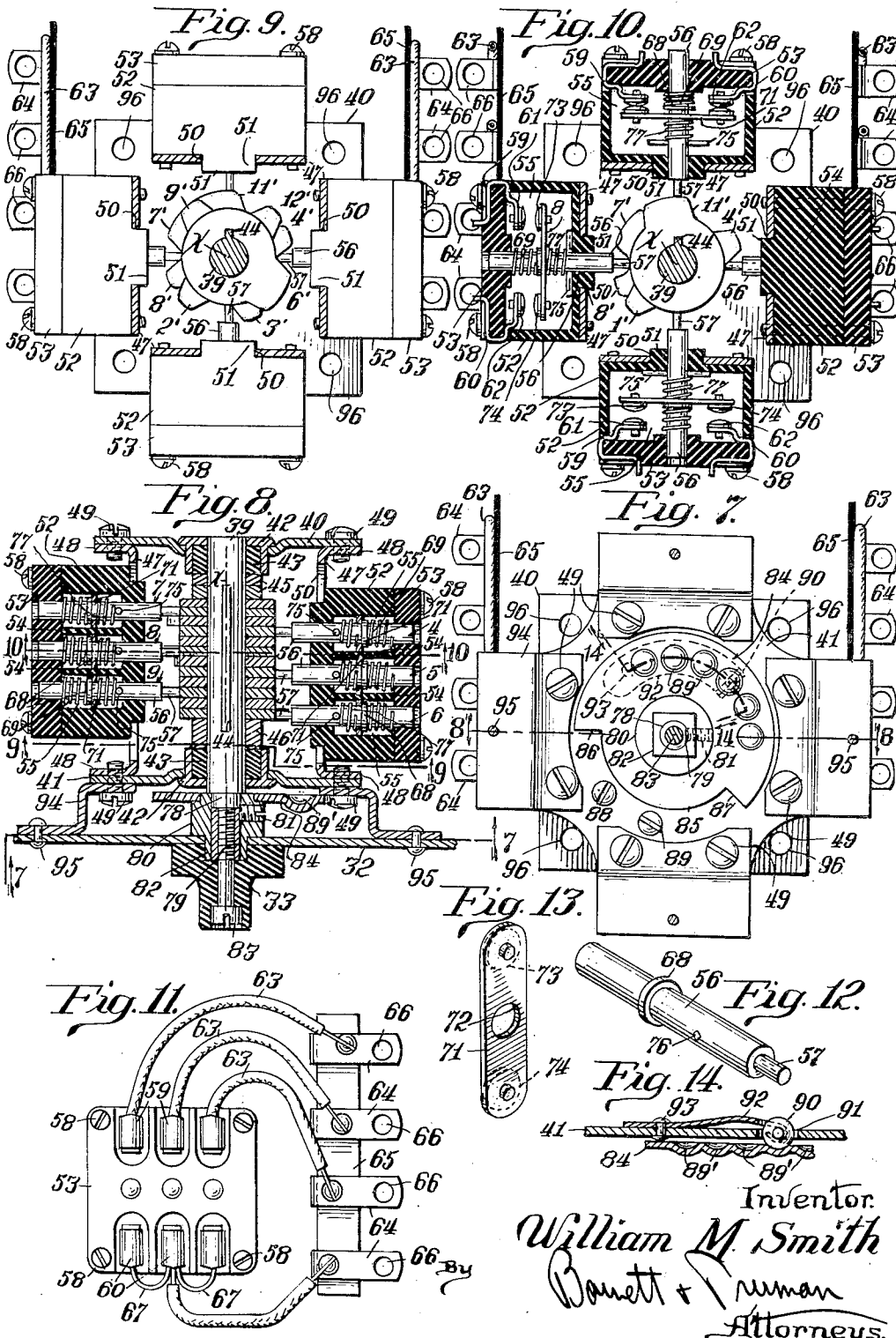
W. M. SMITH

2,245,369

CAM SWITCH

Filed Oct. 19, 1939

2 Sheets-Sheet 2



Inventor.
William M. Smith
Dawett + Ruman
Attorneys.

UNITED STATES PATENT OFFICE

2,245,369

CAM SWITCH

William M. Smith, Chicago, Ill., assignor to Vapor Car Heating Company, Inc., Chicago, Ill., a corporation of New York

Application October 19, 1939, Serial No. 300,207

5 Claims. (Cl. 200—16)

This invention relates to certain new and useful improvements in a cam switch, more particularly a switch assembly such as is sometimes known as a "gang-switch" and comprising a plurality of similar switch units which are opened and closed in a predetermined order by a single rotatable control member.

Briefly described, the assembly comprises a central rotatable operating shaft which is oscillatable to a plurality of arcuately spaced apart operating positions and provided with a suitable locking means for holding the shaft yieldably in each of these positions. There is an operating and indicating member on one outer end of the shaft cooperating with a fixed dial so that the shaft can be selectively moved to any desired position. An inner portion of the shaft carries a multiplicity of cams positioned successively longitudinally of the shaft and secured thereto to rotate therewith. Each switch unit comprises in addition to the contact members, a plunger extending radially of the shaft for moving one of the contact members and engaging one of the cams at its inner end, together with spring means for normally holding the plunger in engagement with the cam. The multiplicity of switches is divided into a plurality of similar groups, and each group is suitably supported in one of a plurality of arcuately spaced apart positions around the shaft so that each switch-operating plunger will be in position to engage its respective cam. The cams are so selectively positioned both longitudinally and circumferentially of the shaft that in each position of the shaft a predetermined selection of the switches will be opened and a predetermined selection will be closed. By properly selecting the number of switches, the number of groups of switches, the number of operative positions of the shaft, and the positioning of the cams on the shaft, nearly any complicated control circuit can be simply operated from a single oscillatable operating member.

The principal object of this invention is to provide an improved cam-switch of the type briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved type of cam-operated switch unit.

Another object is to provide a compact and simple assembly comprising a multiplicity of separably operating switch units.

Another object is to provide improved means for yieldably locking the switch assembly in different selected positions.

Other objects and advantages of this invention will be more apparent from the following detailed description of one approved form of switch mechanism constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a diagrammatic elevation indicating an air conditioning system and an electric-control system therefor embodying this improved switch mechanism.

Fig. 2 is a detail elevation showing, on a larger scale, the switch-operating handle together with the cooperating indicator and dial, all as indicated on a smaller scale in Fig. 1.

Fig. 3 is a diagram illustrating the positioning of the groups of switches about the central operating member, for a sample circuit involving twelve switches and suitable for operating the mechanism indicated in Fig. 1.

Fig. 4 is a chart indicating the positioning of the several switches in the four different operating positions of the cam-shaft.

Fig. 5 is a group of twelve similar vertical sections through the cam-shaft, showing the simultaneous positioning of the various cams when the shaft is in one definite position.

Fig. 6 is a side elevation of the cam assembly as viewed from the left of Fig. 8, 9 or 10, with the shaft in the "off" position here shown.

Fig. 7 is an end elevation of the switch assembly with the front dial panel and operating handle removed, the view being taken substantially on the line 7—7 of Fig. 8.

Fig. 8 is a central horizontal longitudinal section taken substantially on the line 8—8 of Fig. 7.

Fig. 9 is a transverse vertical section taken substantially on the line 9—9 of Fig. 8.

Fig. 10 is a transverse vertical section taken substantially on the line 10—10 of Fig. 8.

Fig. 11 is a detail plan view of one of the switch groups and the connecting circuit wires.

Fig. 12 is a perspective view of one of the switch-operating plungers.

Fig. 13 is a perspective view of one of the movable bridging contact members.

Fig. 14 is a detail section taken substantially on the line 14—14 of Fig. 7, showing the locking device.

Reference will first be made briefly to Fig. 1 in order to indicate a typical system in which this improved switch mechanism may be used. At 13 is indicated an enclosure in which the temperature is to be regulated, and 14 is a duct through which tempered air is delivered to the enclosure. Duct 14 is provided with an inlet 15 leading from the outside air, and an inlet 16 for receiving returned air from the enclosure 13. These inlets are controlled by the respective dampers 17 and 18. The heating mechanism 19 is adapted to deliver heat to the radiator or heat-exchanger 20 positioned within duct 14, and in a similar manner the cooling apparatus 21 withdraws heat from duct 14 through the heat-exchanger 22. The blower or fan 23 is adapted to draw in air through one or both of the inlets 15 and 16 and

force this air through duct 14, in contact with either the heater 20 or cooler 22 and deliver the tempered air through the plurality of outlets 24 into the enclosure 13.

At 25 is indicated the main control panel which houses the improved switch mechanism forming the particular subject matter of this invention, as well as the relays, fuses, resistances, etc. also comprised in the operating circuit. At 26 is indicated a thermostatic mechanism (which may consist of a plurality of thermostats positioned at various locations), and connected with the control panel 25 by the circuits here indicated simply by the single line 27. Similarly, the heater 19 and cooler 21 are connected to the panel through circuits 28 and 29 respectively, while the circuits 30 and 31 connect the panel with the blower 23 and damper mechanisms 17 and 18.

The improved switch mechanism is centered within the control panel about the horizontal axis *x*, and on the outside of the face-plate 32 of the panel (see Fig. 2), the pointer 34 moving with the handle 33 indicates on a suitable dial formed on face-plate 32 the selected position to which the switches have been moved. The operating circuit here selected by way of example is not shown in detail, but it is assumed that this circuit comprises 12 separate switches which are opened and closed in a predetermined order, and that the main control handle 33 and the cam shaft moved thereby are shifted between four possible operating positions indicated at 35, 36, 37 and 38 respectively. In all of the figures of the drawings the switch mechanisms are in the "off" or neutral position 35. If handle 33 is moved counter-clockwise to the position 36, the heating system will be operative and the blower will also be operating to force heated air through the duct 14. In a similar manner, if the handle 33 is moved clockwise to the extreme position 38, the cooler and the blower will be operative so as to deliver cooled air into the enclosure 13. However, if the handle 33 is moved clockwise to the intermediate position 37 neither the heater 19 nor cooler 21 will be operative but the blower 23 will be operative to ventilate the enclosure.

The chart shown in Fig. 4 indicates the condition of the various switches 1 to 12 inclusive in the four different operating positions of the switch mechanism. A black dot opposite the switch number indicates that that particular switch is closed while the absence of a dot indicates that the switch is open. It will be noted that when the switch mechanism is in the "off" position shown in the drawings, only switch 11 is closed. In the "ventilating" position switches 5, 6 and 7 will be closed while the other switches will be open, and so on.

Now referring to Fig. 3, it will be noted that the twelve switches are divided into four groups of three switches each, and that the several switch groups are relatively positioned at equal angles of 90° from one another about the central axis *x*. It will be noted that the uppermost group of switches comprises the switches 10, 11 and 12, only the switch 11 being closed while switches 10 and 12 are open. Switches 1, 2 and 3 are included in the lowermost group, while switches 4, 5 and 6 are in the right-hand group and switches 7, 8 and 9 in the left-hand group. It will be apparent hereinafter that the grouping is purely arbitrary, and that the switches may be given any desired grouping and

positioned in any desired order, so long as the cams 1' to 12' inclusive are properly arranged on the cam-shaft 39, all as hereinafter described.

It may be here stated that the several operating cams 1' to 12' (for the switches 1 to 12 respectively) are individually shown in Fig. 5 in the positions which each occupies when the assembly is in the "off" position, while Fig. 6 indicates the relative position which these cams occupy longitudinally of the cam-shaft 39.

A more detailed description of the switch-assembly can now be given, referring more particularly to Figs. 7 to 14 inclusive.

The main supporting frame comprises similar end frame plates 40 and 41, and within central openings in these plates are fitted thimbles 42 holding bearings 43 in which the end portions of shaft 39 are journaled for rotation. One or more keys 44 extend longitudinally of the central portion of shaft 39 so as to lock the cams against rotation on the shaft as indicated in Fig. 5. Annular spacers 45 and 46 properly space the ends of the stack of cams from the journal bearings 43. The end frames 40 and 41 are held together and properly spaced apart by a plurality of bridging frames 47 similarly spaced around the central axis *x*. In the present example there are four of these frames 47 positioned 90° apart. Outwardly extending ears 48 are provided at the respective ends of each bridging frame 47, these ears 48 being secured to the respective frames 40 and 41 by screw bolts 49.

Each frame member 47 is formed with a longitudinally extending central slot 50 into which fits a tongue or rib 51 projecting from the bottom portion of the housing 52 for a group of switch units, said housing being closed at its upper or outer end by a cover plate 53. The housing and cover plate are preferably formed of a suitable insulating material. The housing is divided interiorly by parallel equally spaced partitions 54 into a plurality of similar chambers 55 each housing one of the switch units. In the present example there are three switches and three chambers 55, but it will be understood that the number of switches in the group can be increased by simply extending the length of the entire assembly in an obvious manner.

Each switch unit comprises (a description of one switch will suffice for all) a longitudinally movable plunger 56 slidable adjacent its inner and outer ends in aligned openings in the bottom of housing 52, and the cover plate 53 respectively. The reduced inner end portion 57 of the plunger is adapted to engage the peripheral surface of one of the cams 1' to 12'. The plungers all extend parallel to one another and radially of the central axis *x*, and are so spaced apart that (in the present example comprising 60 four groups of switches) the plungers of any one group will engage each fourth cam of the stack of cams. Each cover plate 53 is secured on its housing 52, and the complete housing is mounted on and secured to the bridging frame 47 by four screw bolts 58 which project through the cover and housing and are threaded at their inner ends into openings suitably positioned in bridging frame 47. These threaded openings are so located that the housings will be staggered or spaced relative to one another longitudinally of the frame members 47 so that the three switch-operating plungers of any one group will be aligned with the three cams assigned to that group, and each cam will be engaged by one individual plunger and no other. For some cir-

culits it would be possible to have a single cam operate two or more switches, provided these switches are located in different groups circumferentially of the operating shaft, but usually it will be more convenient to provide a separate cam for each switch.

A pair of separate metallic brackets 59 and 60 (for each switch) are clamped about opposite edge portions of the cover plate 53, and the inner end portions of these brackets which project into the chamber 55 are provided with the pair of fixed switch contacts 61 and 62. The wires 63 (see Fig. 11) are secured at one end as by soldering, to the portions of brackets 59 and 60 on the outer side of cover plate 53, these wires extending to and being secured to the respective contact plates 64 carried at spaced locations on a strip of insulating material 65 suitably located adjacent the switch assembly. The circuit wires leading to appropriate parts of the control circuit are connected at 66 with the contact plates 64. In the example shown in Fig. 11, a single wire 63 leads from one side of each of the three switches of the group, the brackets 60 being linked together as indicated at 67. However, there might be separate wires 63 leading from each bracket 60, or any two might be connected. As is obvious, this all depends upon the particular association of the circuit branches that are controlled by this switch assembly.

An outstanding collar 68 is formed intermediately of the length of plunger 56, and a compression spring 69 is confined between this collar 68 and cover plate 53. A contact bar 71 is formed intermediate its ends with an opening 72 to receive the plunger 56. The end portions of bar 71 support contact buttons 73 and 74 adapted to engage respectively with the fixed contacts 61 and 62. A pin 75 (a simple cotter-pin will do) is inserted through an opening 76 in plunger 56, and a second compression spring 77 is confined between pin 75 and the contact bar 71 so as to normally hold the contact bar against collar 68. Normally, that is when the inner end 57 of the plunger is opposite a low portion of the co-operating cam, the spring 69 will expand so as to force the plunger inwardly until pin 75 engages the bottom of chamber 55. The switch contacts will now be out of engagement, and this is the position indicated in the drawings for all of the switches except switch 11.

When the cam shaft 39 is rotated so that the rise of the cam engages and lifts the switch plunger (as shown at 11' in Fig. 10) the plunger will be forced outwardly thus bringing the switch contacts 73 and 74 into engagement with the fixed contacts 61 and 62 respectively. The outward movement of the plunger will be more than is necessary to accomplish this purpose, so that contact bar 71 will be moved away from collar 68 compressing the spring 77 and forcibly holding the switch contacts in engagement.

The forwardly extending end portion of cam-shaft 39 is reduced at 78 and has one flat side 79, and a collar or head 80 is mounted on this reduced portion and held in place by a set screw 81 engaging the flat side of the shaft. A non-circular end portion 82 of collar 80 projects forwardly through a suitable opening in the dial plate 32 and receives the operating handle 33 which is held in place by a screw bolt 83 threaded into the end 78 of the shaft.

A locking plate 84 is non-rotatably mounted on collar 80, adjacent the end frame 41, and a portion of this plate is cut away as indicated at 85

(Fig. 7) so as to form stop shoulders 86 and 87 adapted to engage stop screws 88 and 89 respectively mounted in frame plate 41 so as to limit the rotation of the cam shaft in each direction. The other side of locking plate 84 is formed with an arcuate series of spaced apart depressions 89' positioned to be alternatively engaged by a locking wheel or roller 90 (see Fig. 14) projecting through a slot 91 in frame member 41 and rotatably carried by the free end of the leaf-spring 92, the other end of which is fixedly secured at 93 to frame member 41. The switch assembly is thus yieldingly held in each of its four operative positions. At the same time stop screws 88 and 89 positively limit the movement of the cam assembly in either direction.

The entire switch assembly can be secured to the closure or cover plate 32 by bracket arms 94 attached at one end to end frame member 41 by the same screw bolts 49 which engage the bridging frames 47, and attached at their other ends by suitable means 95 to the cover plate 32. The other end portion of the switch assembly may be supported from any suitable member by bolts extending through suitable openings 96 in the other end frame member 40.

In order to design one of these switch assemblies for any particular purpose or circuit, it is only necessary to first determine the number of necessary operating positions of the main control handle 33, and total number of switches that must be operated in the particular circuit. These switches are then divided into a convenient number of groups (conveniently four as in the present example) and the switches assigned arbitrarily to certain groups as indicated in Fig. 3. A chart similar to Fig. 4 is then made indicating the position of each switch at each operative position of the main control handle 33. Some one operative position of the cam-assembly can then be assumed (conveniently the "off" or neutral position as in the present case) and the cams are laid out as indicated in Fig. 5. The other possible positions of the cams are indicated by the arcuately spaced lines extending at the proper angles from opposite sides of the main positioning line which is determined by the angular position of the group to which this switch is assigned (see Fig. 3). In the present example we notice that switch 1 is closed only in the cooling position, so a high point is established on the "cooling" line which is two angular spaces clockwise from the "off" line which projects downwardly since switch 1 is in the lowermost group of switches. This establishes the single high point on cam 1'. In a similar manner, since switch 11 is closed when the assembly is in the "off" position, a high point is established on the upwardly extending line of cam 11'. Also, since this switch 11 is closed when the control member is moved to the "heating" position, this high point will be extended to the angular line spaced counter-clockwise from the upwardly extending center line. This establishes a "rise" on cam 11' that is of double width as compared with the single width rise of cam 1'. The location of the rises on the other cams will be obvious from the examples given above. The cams are then positioned on the shaft 39 in an order determined by the staggered positions of the several switch groups longitudinally of shaft 39.

It should now be apparent that many alternatives are possible. A greater or less number of operative positions of the cam-shaft are pos-

sible without necessarily changing any of the other structure except to make appropriate changes in the spacing of the stop screws, 88 and 89, and perhaps to provide additional depressions 89' for the locking roller. If an increased number of switches are to be handled, more switches may be assigned to each group, or the number of groups can be increased by suitably spacing these groups at angles of less than 90° around the central axis x . In any event, the assembly will be quite small and compact. While a preferred form of switch unit has here been disclosed, it will be apparent that a different types of switch could be used, or even more than one type of switch could be used in the same assembly, without departing from the general principles of the invention as set forth hereinabove and in the claims which follow.

I claim:

1. In an electric control mechanism, a plurality of similar switches each comprising an operating plunger, a rotary shaft, a plurality of closely assembled cams fixedly mounted on the shaft, the switches being divided into a plurality of similar groups, means for housing each group of switches with the plungers arranged parallel to one another and projecting in the same direction in equally spaced relation from one another, means for supporting the shaft and the housings in different selected arcuate positions around the shaft, the housings being staggered with relation to one another longitudinally of the shaft so that each plunger will extend radially inward in a selected plane transverse to the shaft into engagement with a selected cam, the cams being equally spaced longitudinally of the shaft and so arranged circumferentially of the shaft that in each arcuate position of the shaft a selection of switches will be moved to closed position and a selection to open position.

2. In an electric control mechanism, a plurality of similar switches each comprising an operating plunger, a rotary shaft, a plurality of closely assembled cams fixedly mounted on the shaft, the switches being divided into a plurality of similar groups, means for housing each group of switches with the plungers arranged parallel to one another and projecting in the same direction in equally spaced relation from one another, means for supporting the shaft and the housings in different selected arcuate positions around the shaft, the housings being staggered with relation to one another longitudinally of the shaft so that each plunger will extend radially inward in a selected plane transverse to the shaft into engagement with a selected cam, means for locking the shaft in a plurality of different arcuate positions, the cams being equally spaced longitudinally of the shaft and so arranged circumferentially of the shaft that in each arcuate position of the shaft a selection of switches will be moved to closed position and a selection to open position.

3. In an electric control mechanism, a supporting frame comprising a pair of spaced apart frame plates, an operating shaft journaled adjacent its ends in said plates, a plurality of cams of similar thickness closely assembled on said shaft between the plates, a plurality of bridging frame members connecting the plates at positions spaced apart arcuately around the shaft, a plurality of similar switches each comprising an operating plunger, said switches being divided into similar groups, a housing supporting each group, the switches being similarly spaced apart

in each group, each housing being mounted on one of the bridging frame members and the housings being differently spaced longitudinally of the respective frame members so that the radially inwardly projecting plungers will each be aligned with a selected cam on the shaft, the cams for operating adjacent plungers of a group being spaced apart in the cam assembly by a group of cams formed by one cam for each additional group of switches, and locking means for holding the shaft in a plurality of different selected arcuately spaced positions.

4. In an electric control mechanism, a supporting frame comprising a pair of spaced apart frame plates, an operating shaft journaled adjacent its ends in said plates, a plurality of cams of similar thickness closely assembled on said shaft between the plates, a plurality of bridging frame members connecting the plates at positions spaced apart arcuately around the shaft, a plurality of similar switches each comprising an operating plunger, said switches being divided into similar groups, a housing supporting each group, the switches being similarly spaced apart in each group, each housing being mounted on one of the bridging frame members and the housings being differently spaced longitudinally of the respective frame members so that the radially inwardly projecting plungers will each be aligned with a selected cam on the shaft, the cams for operating adjacent plungers of a group being spaced apart in the cam assembly by a group of cams formed by one cam for each additional group of switches, and locking means for holding the shaft in a plurality of different selected arcuately spaced positions, the locking means comprising a plate fixed on the shaft adjacent one of the end frame plates, and a yieldable detent carried by one plate and selectively engaging a circumferentially spaced series of depressions in the other plate.

5. In an electric control mechanism, a supporting frame comprising a pair of spaced apart frame plates, an operating shaft journaled adjacent its ends in said plates, a plurality of cams of similar thickness closely assembled on said shaft between the plates, a plurality of bridging frame members connecting the plates at positions spaced apart arcuately around the shaft, a plurality of similar switches each comprising an operating plunger, said switches being divided into similar groups, a housing supporting each group, the switches being similarly spaced apart in each group, each housing being mounted on one of the bridging frame members and the housings being differently spaced longitudinally of the respective frame members so that the radially inwardly projecting plungers will each be aligned with a selected cam on the shaft, the cams for operating adjacent plungers of a group being spaced apart in the cam assembly by a group of cams formed by one cam for each additional group of switches, locking means for holding the shaft in a plurality of different selected arcuately spaced positions, the locking means comprising a plate fixed on the shaft adjacent one of the end frame plates, a yieldable detent carried by one plate and selectively engaging a circumferentially spaced series of depressions in the other plate, and mutually engaging stop members on the respective adjacent plates for limiting the arcuate rotation of the shaft.

WILLIAM M. SMITH.