Jan. 29, 1952 D. MORRISON 2,583,661

SWITCH FOR USE IN DEFROSTING SYSTEMS

Filed April 20, 1951 2 SHEETS—SHEET 1

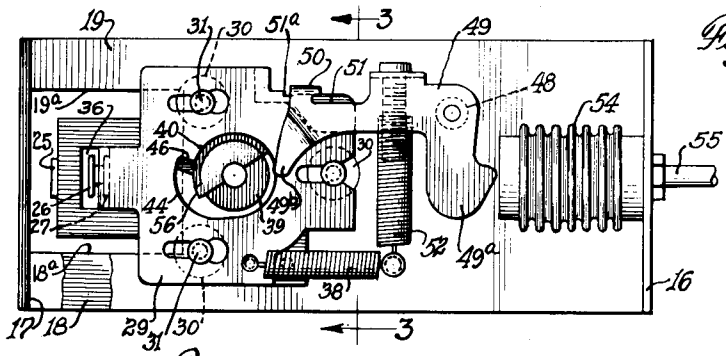


Fig. 1.

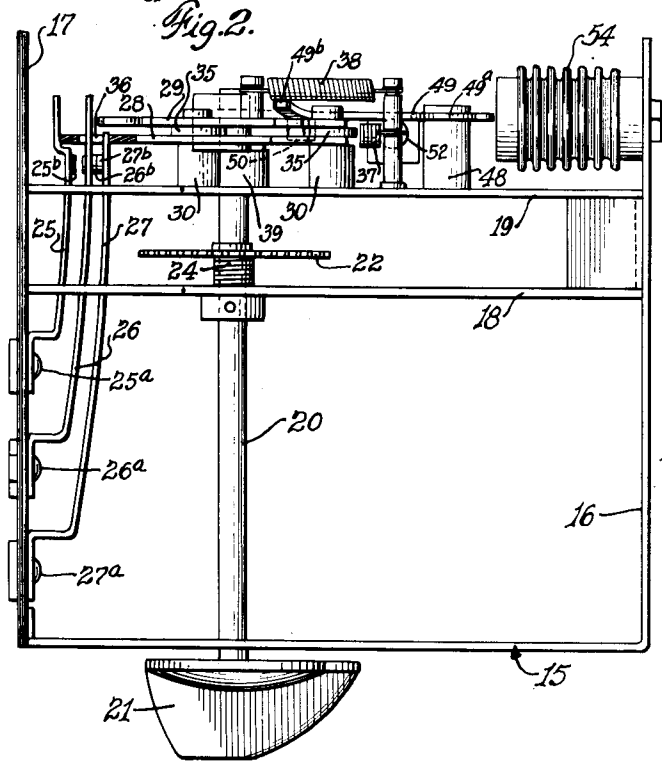


Fig. 2.

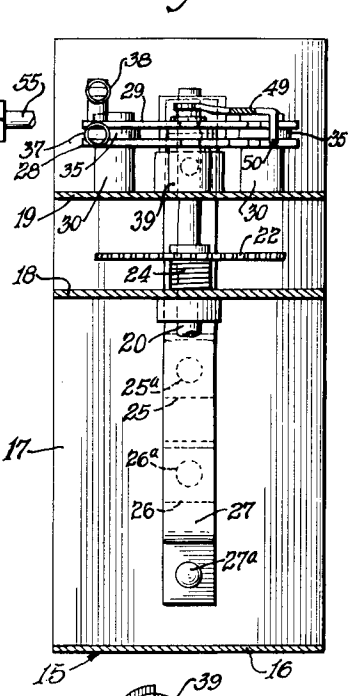


Fig. 3.

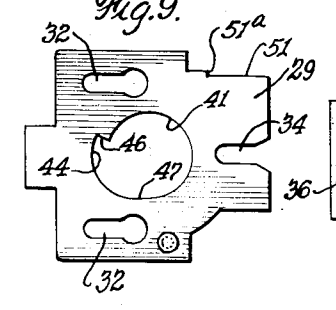


Fig. 9.

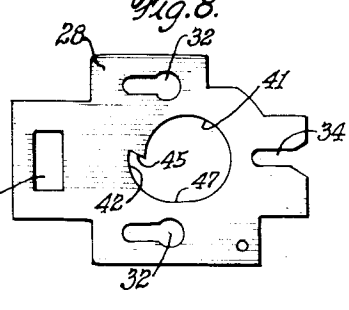


Fig. 8.

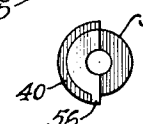


Fig. 10.

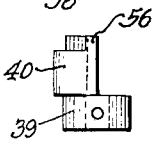


Fig. 11.

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SWITCH FOR USE IN DEFROSTING SYSTEMS

Filed April 20, 1951 2 SHEETS—SHEET 2

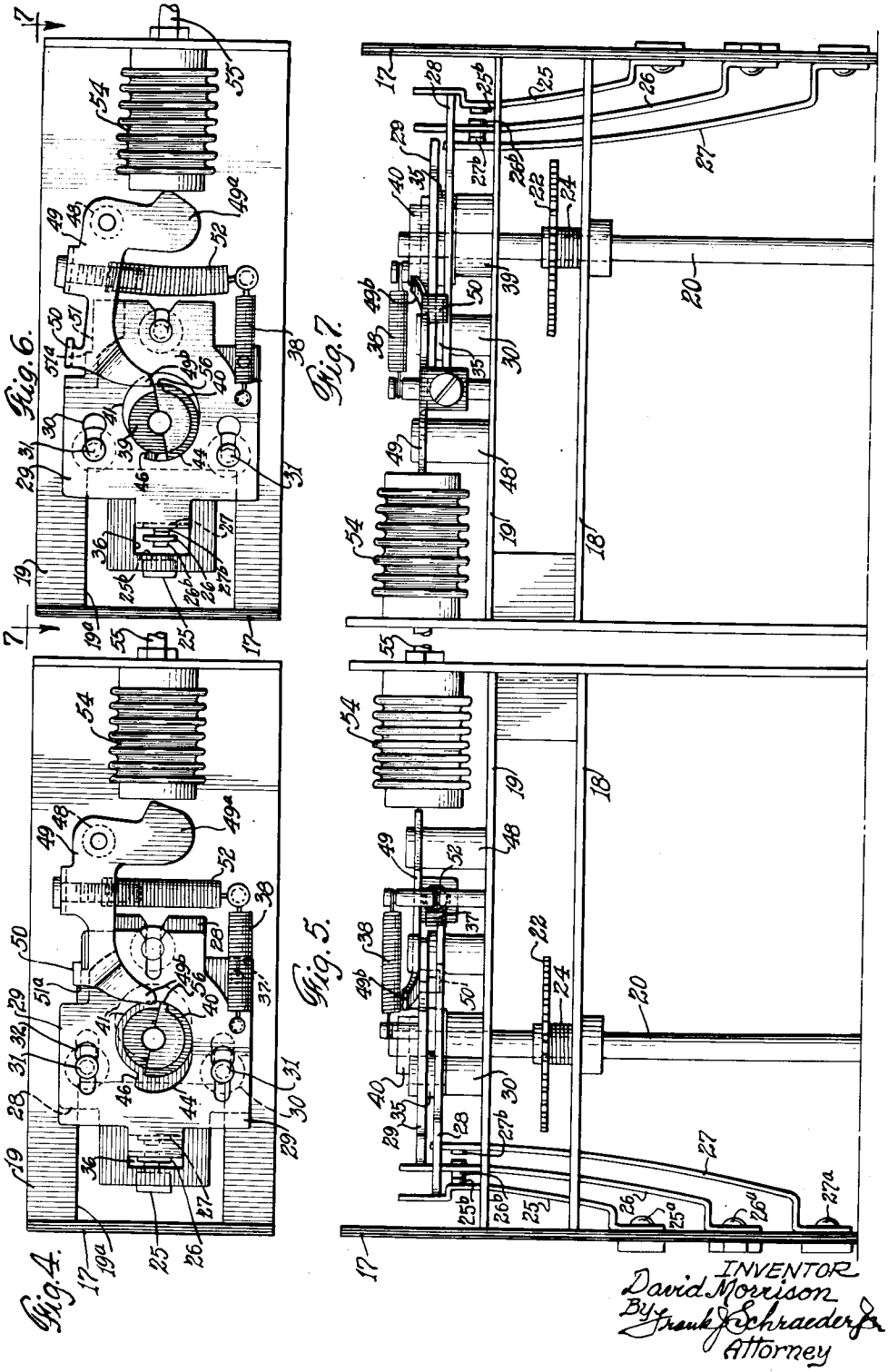


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

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Patented Jan. 29, 1952 2,583,661

UNITED STATES PATENT OFFICE

2,583,661

SWITCH FOR USE IN DEFROSTING SYSTEMS

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Application April 20, 1951, Serial No. 222,119

15 Claims. (Cl. 200—83)

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The present invention relates primarily to electric switches adapted for use in defrosting refrigerators, where the energizing circuit for the compressor is automatically opened for a short period, during which a heater within the refrigerator, for melting the frozen moisture, becomes energized.

The invention has for its general purpose to produce a very simple, novel and reliable switch mechanism which shall adequately serve the demands thereon under any condition apt to be encountered in use.

One problem of long standing, and which the present invention has solved, is that of building a switch unit, complete with its timing and operating mechanism, of such size and shape that it may be installed in a refrigerator without taking up otherwise useful space, and yet be readily accessible.

In addition to seeking to create a unit meeting certain requirements as to size and shape, it has been my further purpose to create a novel snap-action switch mechanism for alternately opening or closing one circuit while closing or opening the other.

A further purpose of my invention is to provide automatic regulation of the defrosting period according to the need at any given time, while guarding against excessive heating in the event of failure in the means provided for terminating that period whenever defrosting actually has been completed.

The various features of novelty whereby the present invention is characterized will hereinafter be pointed out with particularity in the claims, but, for a full understanding of the invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a top plan view of a switch unit embodying the present invention, showing part of the housing for the usual motor and the necessary gear train; Fig. 2 is a side view of the parts shown in Fig. 1, without the motor and gear train; Fig. 3 is a section on line 3—3 of Fig. 1; Figs. 4 and 5 are views similar to Figs. 1 and 2, respectively, showing reversed switch positions, however; Fig. 6 is a view similar to Fig. 1 showing the conditions at the end of the defrosting period, just after the circuit connections illustrated in Figs. 1 and 2 have been restored; Fig. 7 is a view related to Fig. 2 as the latter is related to Fig. 1, except that Fig. 7 shows a view from line 7—7 of Fig. 6, showing the side of the unit opposite the side of the device from that appearing in Fig. 2; Fig. 8 is a plan view of the lower sliding actuator for the switch blades; Fig. 9 is a plan view of the upper slide; Fig. 10 is a top view of the cam block; and Fig. 11 is a side view of the block shown in Fig. 10.

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The device shown in the drawings is one for use within a refrigerator as part of a defrosting system and, for the sake of brevity, the detailed description will be confined to this particular embodiment.

In order to permit the unit to be installed in one of the usual narrow spaces in refrigerators that are not used for storage of things to be refrigerated, I have produced a complete timer unit that may be contained in a flat housing less than an inch and a half thick. In the drawings I have shown only the essential core or framing of such a housing. This comprises a U-shaped part 15 composed of a narrow plate 16 bent into L shape to form one arm and the cross piece of the U, together with a thin narrow panel 17 of insulating material to form the other arm of and complete the U. Spanning the space between the arms, not far from their upper ends, are spaced, parallel cross partitions 18 and 19, secured to such arms in any suitable manner. The main shaft 20 of the timer extends up through the bottom of the core and through both partitions, rising well above the upper partition. On the lower end of the shaft is the usual finger piece 21 for setting the timer. The space in the lower part of the housing is adapted to contain the usual motor while the usual gear train occupies the space between the partitions. None of this old driving mechanism is shown, it being sufficient to point out that shaft 20 has thereon the usual gear wheel 22 attached thereto by a conventional one way coiled spring clutch 24; this gear wheel being the last one in the usual train from the motor. The clutch permits the wheel to remain stationary while the shaft is turned manually to set the timer, as is common practice.

The switch consists of three flat spring blades 25, 26 and 27. The blades are disposed in a row the plane of which is at right angles to wall or panel 17, being anchored at their lower ends to the latter by elements 25a, 26a and 27a, which may also serve as terminals in making circuit connections. The blades extend up, more or less parallel to the supporting panel, through large openings 18a and 19a in the partitions. The outer or forward blade 25 and the middle blade 26 extend farther above partition 19 than does the inner or rear blade 27. On the blades, near their

upper ends, are cooperating contact pieces 25b, 26b and 27b, respectively.

The immediate actuating means for the blades comprises two actuators, composed of insulating material, in the form of flat plates 28 and 29, respectively. These plates are mounted, one above the other, on partition 19 so as to be parallel to the latter and be slidable toward and from panel 17 between forward and retracted positions. In the arrangement shown, plate 28 rests on top of three short posts 30 rising from the partition at some distance from the blades. These posts are at the corners of a triangle at about the center of which is shaft 20. Each post is provided with an upwardly projecting headed stud 31. Plate 28 contains two keyhole slots 32 about midway between its ends and an axial slot 34 opening out through the rear end; these slots being at right angles to panel 17 and being so located that the plate may be set on the posts by registering the large ends of the slots with the studs and lowering the plate. To the extent just described, plate 29 is similar to plate 28, so that it may be slipped onto the studs in a like manner. As it is desirable that the actuators be spaced a little apart, washers 35 are applied to the studs on top of the lower plate before the upper plate is added.

Plate or slide 28 has in the same, near the forward end, a transverse slot 36 through which the upper ends of blades 26 and 27 extend. Blade 27 does not reach to the level of slide 29, whereas blade 26 projects above such level. Slide 29 is shorter than the other one and terminates behind the middle blade, while slide 28 extends to the forward or outer blade 25. A tension spring 37, attached at one end to the lower plate or slide and anchored at its rear end to partition 19, tends constantly to draw that slide back as far as the slots in the latter permit. A similar spring 38 performs the same function with respect to the upper slide.

Each slide has in the center a large hole through which the shaft extends. On the shaft is a cam block 39 the upper part 40 of which is a sector of a cylinder. Part 40 extends through the holes in both of the slides; the main portion 41 of each of these holes being cylindrical to fit the cylindrical surface part 40. Approximately one quarter of each of these holes, at the front and mainly on one side of the longitudinal axes of the slides, is enlarged to provide an interior surface forming part of a cylinder whose axis is displaced a short distance forwardly from the center of portions 41 of the holes. These displaced cylindrical sectors, 42 and 44, respectively, are connected, at their ends near the axes with sections 41, 41 by more or less radial surfaces 45 and 46, respectively; whereas the juncture between the other ends of the relatively displaced parts of a cylindrical surface is effected by flat surfaces 47, 47 tangential to the curved surfaces.

The cam block and the bounding edges of the holes in the slides, in which parts of the block lie, constitute a camming means between the shaft and the slides for operating the latter in cooperation with the springs.

The keyhole slots in the slides are of such length that, after assembly of the slides on the shaft, the slides can never be retracted far enough to bring the studs into the enlarged ends of the slots; thereby avoiding accidental dislodgement of the slides.

Rising from partition 19, rearwardly from the slides, is a post 48. Resting on this post and

rockable about a vertical axis is a latch 49. One end of this latch overlies the upper slide and has a lip 50 that extends down beside one longitudinal edge 51 of that slide. A tension spring 52, attached at one end to the latch and anchored at its other end to the partition, holds the lip against the slide. Edge 51 contains a jog near the front end thereof to provide a shoulder 51a against which the edge of the lip of the latch may bear.

The latch may be tripped by any suitable means, depending on the use to which the device is being put. If it be in a defrosting system, the tripping may be done by the expansion of a bellows 54 mounted on wall 16 behind a transverse arm 49a on the rear end of the latch. The expansion of the bellows may be effected through a rise in temperature of air in a sealed tube that is controlled by the temperature of the evaporator, for example, in a refrigerator; only a fragment 55 of such a tube being shown.

The latch may also be tripped in predetermined time relation to the other operations, namely by a part of the camming means between the shaft and the slides. In the arrangement shown, the part 40 of the cam block is made sufficiently long to extend well above the upper slide. This upward extension is reduced in radius to leave only a little lug 56 at one end of the arc. On the latch is a nose 49b that lies in the path of lug 56, so that once during each revolution of the shaft, the lug trips the latch. This feature is primarily a safety device in case of failure of the bellows or other tripping device, energized from outside sources, properly to function; but it is conceivably useful for other purposes, namely, in lieu of the other tripping device.

With the parts in the positions which they occupy in Figs. 1 and 2, all of the switch blades are stressed so that they tend to swing toward the rear, namely toward the right. The slides are in their forward positions, with a little gap between shoulder 51a on slide 29 and lip 50 on the latch. Blades 26 and 27 are held in engagement with each other by one of two shoulders thereon, namely the rear bounding edge of slot 36, on slide 28, and the resiliency of blade 26; whereas a second shoulder, the front edge of this slide, holds blade 25 away from the middle blade. Assuming that blades 26 and 27 are in the compressor circuit of a refrigerator, and that blades 25 and 26 control the heater circuit, the refrigerator is now performing its function of refrigerating while the heater for defrosting remains deenergized.

Shaft 20 may be assumed to be turning in the counterclockwise direction, as viewed in Fig. 1. The camming means are holding both slides in their extreme forward positions. When the shaft has moved on through about one-third of a revolution, from its position in Fig. 1, the trailing vertical edge of the camming element 40 reaches the abrupt shoulder formed by surface 46 in slide 29; whereupon spring 38 starts pulling this slide back. However, the latch allows the slide to move only far enough to close the little gap between the lip on the latch and shoulder 51a, as indicated in Fig. 4. After a further small turning movement of the shaft, the trailing edge of part 40 reaches the shoulder formed by surface 45 in slide 28, whereupon this slide is snapped back into its retracted position by its spring 37; the parts being then in the positions shown in Figs. 4 and 5. Blade 27 has now snapped back, along with slide 28, while the middle blade, 26, has been arrested in its back-

ward movement by the presence in its path of slide 29, which serves as a stop. The outer or forward blade 25 has followed slide 28 and is now in engagement with the middle blade. Thus the compressor circuit has been interrupted and the heater circuit closed.

The conditions last described are maintained until the latch is tripped, allowing slide 29 to snap back into its retracted position. This should occur within fifteen or twenty minutes through expansion of the bellows.

However, should the bellows fail to act in, say, twenty minutes, the camming means will positively trip the latch after an additional few minutes have passed, thereby avoiding overheating of the refrigerator.

After the latch has been tripped, as shown in Figs. 6 and 7, slide 28 remains in its retracted position, holding blades 25 and 27 stationary while middle blade 26, freed by slide 29, snaps back into engagement with the inner or rear blade 27, reestablishing the circuit conditions illustrated in Figs. 1 and 2.

Thereafter the cylindrical surface acts as a cam to force both slides forward; the latch dropping back in place as soon as lug 56 on the camming means has passed. By moving the upper slide forward far enough to leave a gap in front of the lip on the latch, nothing can interfere with the movement of the latch into latching position.

It will thus be seen that by reason of my novel switch construction, I am able to build a complete timer unit that is unusually thin or narrow with terminals at one end and a finger piece at the opposite end; so that the device may be installed in a narrow space with the finger piece within easy reach and the terminals out of the way. At the same time the switch blades may be long and sturdy and the space within which the actuators are located be adequate to permit the use of actuators whose effectiveness is not depreciated by mere space limitations.

It will also be seen that although all parts of my switch mechanism, including the immediate actuating devices for the blades, are simple and rugged, no circuit is made or broken except through the snapping of a switch blade from one position to another.

I claim:

1. In a switch, a group of three spring blades arranged in a row in spaced relation to each other, anchored at corresponding ends with their other ends free, and capable of being flexed from and toward each other; a slide behind and reciprocable lengthwise of said row between forward and retracted positions; a shoulder on the slide behind and, when that slide is in a forward position, engaged with the rear blade while the middle blade stands free and the forward blade is engaged by the forward end of the slide; a second slide that lies beside the first slide, terminates in the vicinity of the middle blade and at all times is clear of the other two blades; springs tending constantly to retract the slides; automatic means to move the slides from their retracted positions to their forward positions and then release them in predetermined time relation to each other; said blades being initially so stressed that the middle blade contacts the rear blade except at times when the second slide is in its forward position and the first slide is in its retracted position, whereas the middle blade and the forward blade engage each other only when the slides are in their last mentioned positions.

2. In a switch, a group of three spring blades arranged in a row in spaced relation to each other, anchored at corresponding ends with their other ends free, and capable of being flexed from and toward each other; a slide behind and reciprocable lengthwise of said row; a shoulder on the slide behind and, when that slide is in a forward position, engaged with the rear blade while the middle blade stands free and the forward blade is engaged by the forward end of the slide; a second slide that lies beside the first slide, terminates in the vicinity of the middle blade and at all times is clear of the other two blades; springs tending constantly to retract the slides; a rotatable shaft; camming means between the shaft and the slides to move the latter forward and then release them in predetermined time relation to each other as the shaft revolves; a latch for holding the second slide against retraction after being released by the camming means; and means to trip the latch; said blades being initially so stressed that the middle blade contacts the rear blade except at times when the second slide is in its forward position and the first slide is in its retracted position, whereas the middle blade and the forward blade engage each other only when the slides are in their last mentioned positions.

3. A switch as set forth in claim 2, wherein the shaft is in the plane of the blades and at right angles to the direction of movements of the slides.

4. A switch as set forth in claim 2, wherein the latch tripping means includes a device adapted to receive its power from an external source.

5. A switch as set forth in claim 1, wherein the latch tripping means includes a device driven by the shaft and a separate device energized from a separate source of power.

6. In a switch a group of three spring blades arranged in the same plane in spaced relation to each other, anchored at corresponding ends with their other ends free, and capable of being flexed in said plane; two actuators mounted with their axes in said plane and transverse to the blades, and movable back and forth in the axial direction between forward and retracted positions; one of the actuators, while in its forward position and while the other actuator is retracted, serving as a stop to hold the middle blade against the outer blade; the second actuator having a pair of shoulders one of which, when both actuators are in either extreme positions, serves to hold the outer blade away from the middle blade while the other shoulder is holding the inner blade against the middle blade; springs tending constantly to retract the actuators; a rotatable shaft; camming means between the shaft and the actuators to move the actuators forward at predetermined points in the angular movement of the shaft and then to release the actuators at other predetermined points in such movement, a latch restraining the first actuator against retraction by its spring after release by the camming means; and means for tripping the latch.

7. In a switch, a group of three spring blades arranged in the same plane in spaced relation to each other, anchored at corresponding ends with their other ends free, and capable of being flexed in said plane; two flat plates, one overlying the other, mounted with their axes in said plane and transverse to the blades, and movable

in the axial direction between forward and retracted position; the upper plate, while in its forward position and the lower plate is retracted, serving as a stop to prevent the middle blade from moving inwardly; the other plate having a pair of shoulders one of which serves to hold the outer blade away from the middle blade and the second shoulder holds the inner blade against the middle blade in the forward position of that plate; springs tending constantly to retract the plates; a rotatable shaft extending through openings in both plates; camming means between the shaft and the plates, including a part on the shaft and the bounding edges of said openings to move the plates forward at predetermined points in each revolution of the shaft and then to release the plates at other predetermined points in such revolution; a latch restraining the upper plate against retraction by its spring after release by the camming means; and means for tripping the latch.

8. A switch as set forth in claim 7, wherein the upper plate is provided with a latch-engaging shoulder that stands a little ahead of the latch in the forward position, whereby that plate, upon release by the camming means may move back slightly before the latch trips.

9. A switch as set forth in claim 7, wherein the plates rest on a support and contain longitudinal keyhole slots, and wherein headed studs rise from the support through said slots.

10. A switch mechanism containing a slide movable between a forward position and a retracted position, and having a transverse slot near the forward end; a row of three spaced spring blades anchored at corresponding ends a substantial distance from one side of the slide and standing free at their other ends; the rear blade and the middle blade extending through said slot and the forward blade extending past and near to the forward end of the slide, and the rear blade being shorter than the middle blade; a second slide, also movable between a forward position and a retracted position, overlying the first slide and extending clear of the rear blade and into the vicinity of the middle blade to serve as a stop for the latter when that slide is forward while the first slide is retracted; springs tending constantly to retract the slides; means to hold both slides in their forward positions, then allow the first slide to be retracted by its spring, then allow the second slide to be retracted by its spring, and then force both slides into their forward positions; said blades being initially stressed so as to have a tendency to swing their free ends rearwardly; whereby, when the first slide moves forward the rear blade is pressed against the middle blade, whereas the forward blade is allowed to engage the middle blade when the first slide is retracted while the second slide remains in its forward position, and the middle blade engages the rear blade when both slides are in their retracted positions.

11. A switch mechanism containing a slide movable between a forward position and a retracted position, and having a transverse slot near the forward end; a row of three spaced spring blades anchored at corresponding ends a substantial distance from one side of the slide and standing free at their other ends; the rear blade and the middle blade extending through said slot and the forward blade extending past and near to the forward end of the slide and the rear blade being shorter than the middle blade; a second slide overlying and movable in the same manner as the first slide and extending clear of the rear blade and into the vicinity of the middle blade; springs tending constantly to retract the slides; a rotatable shaft; camming means between the shaft and the slides to move the latter from their retracted positions into their forward positions and leave them free during a considerable portion of each revolution of the shaft; a latch engaged with the second slide to hold it in the forward position after release by the camming means and thus permit it to serve as a stop to arrest rearward movement of the middle blade upon release of the first slide; and means to trip the latch; said blades being initially stressed so as to have a tendency to swing their free ends rearwardly; whereby when the first slide moves forward the rear blade is pressed against the middle blade, whereas the forward blade is allowed to engage the middle blade when the first slide is retracted while the second slide remains latched in its forward position, and the middle blade engages the rear blade when both slides are in their retracted positions.

12. In a switch, a flat housing having a long, narrow edge wall and a narrow transverse partition spaced a short distance from the upper end of said wall, the partition being open adjacent to said wall; a group of three spaced spring blades arranged in a row in a plane at right angles to said wall with their lower ends anchored to said wall below the partition, and the blades rising through said open portion of the partition and having their upper ends free; a slide mounted on the partition over the open portion of the latter and movable from and toward said wall between forward and retracted positions; a second slide overlying the first slide and being similarly movable independently of the lower slide; the forward end of the upper slide being in position to engage the near side of the middle blade whenever that slide is in the forward position and the middle blade is free to move toward it; the lower slide having thereon shoulders to engage those sides of the two endmost blades that face away from said wall when that slide is forward; springs exerting a constant effort to retract the slides; a vertical, rotatable shaft extending up through the bottom of the housing, the partition and through the slides; camming means between the shaft and the slides to move the slides, in definite time relation to each other, into their forward positions and abruptly release them; a latch to hold the upper slide in its forward position after release by the camming means; and means to trip the latch.

13. A switch as set forth in claim 12, wherein the camming means comprises cam edges bounding openings in the slides through which the shaft extends, together with a part on the shaft engaging said edges.

14. In a switch, a group of three spring blades arranged in a row in spaced relation to each other, anchored at corresponding ends and having their other ends free, and capable of being flexed from and toward each other; two actuators arranged one above the other and reciprocable lengthwise of said row between forward and retracted positions; all three blades extending into the path of travel of the lower actuator; the upper actuator serving as a stop for the middle blade when that actuator is in its forward position and the other actuator is retracted; the lower actuator having a pair of shoulders one of which holds one of the endmost blades against the middle blade, in the forward position of that actuator, while the other shoulder is engaged with the second endmost blade and holds it away from the

middle blade; said last mentioned shoulder standing at such a distance from the middle blade, when the latter is being restrained by the upper actuator, that the second endmost blade is permitted to engage the middle blade upon retraction of the lower actuator; a rotatable shaft; camming means between the shaft and the actuators to move each actuator forward at one point in each revolution of the shaft and to release the

actuators again at other predetermined points in such revolution.

15. A switch as set forth in claim 14, wherein the shaft is in the plane of the row of blades and at right angles to the actuators.

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No references cited.