July 29, 1952 M. L. JEFFREY 2,604,792

SNAP ACTION MECHANISM

Original Filed April 19, 1947 3 Sheets-Sheet 1

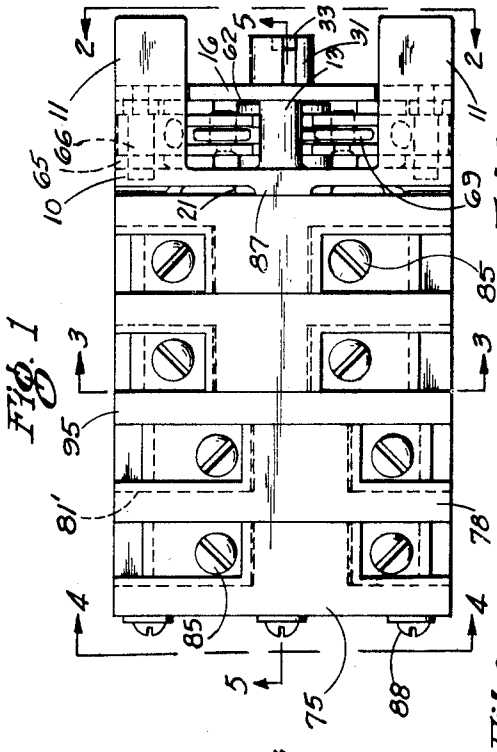

Fig. 1

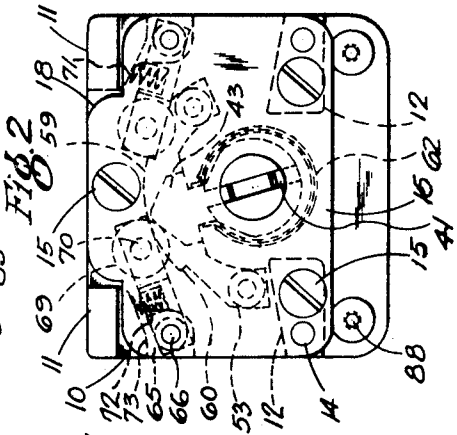

Fig. 2

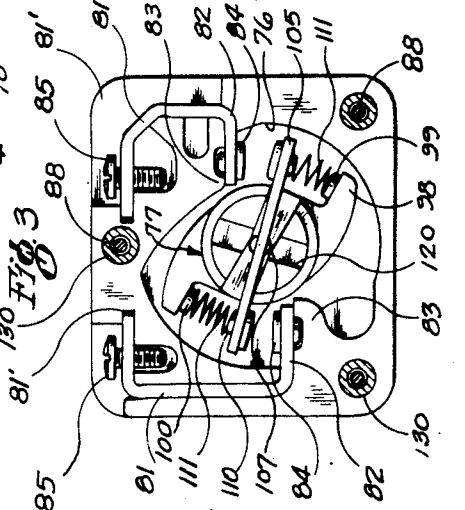

Fig. 3

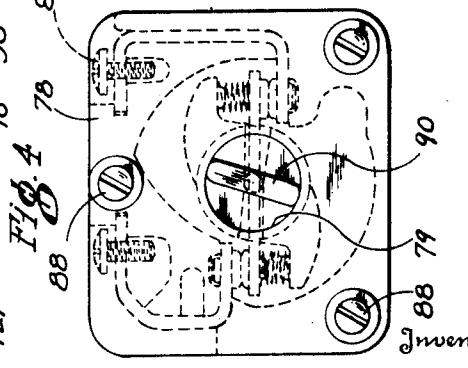

Fig. 4

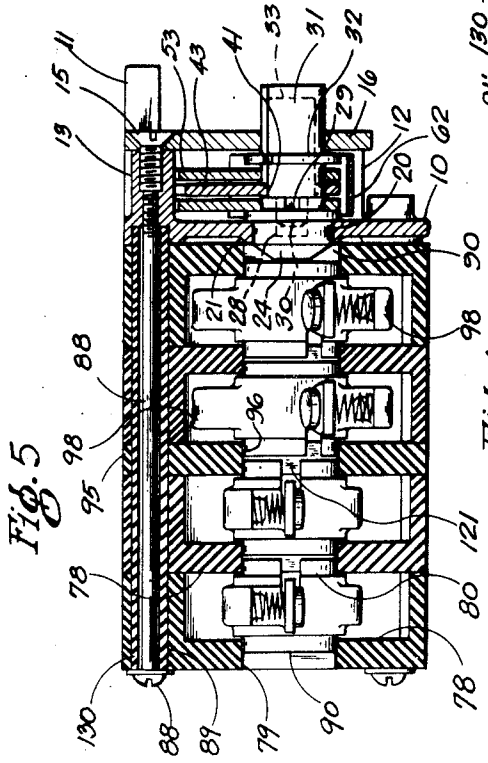

Fig. 5

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SNAP ACTION MECHANISM

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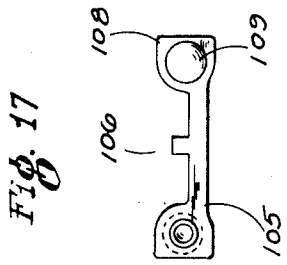


Fig. 17

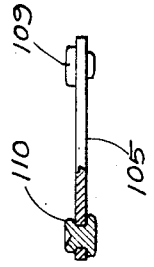


Fig. 18

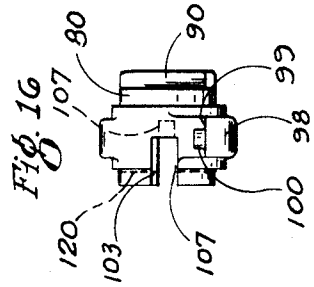


Fig. 16

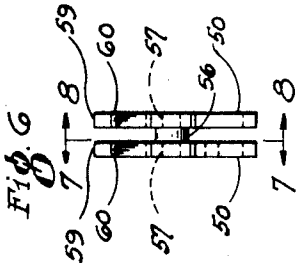
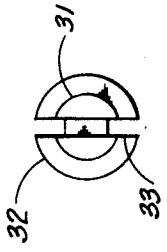


Fig. 6

Fig. 12



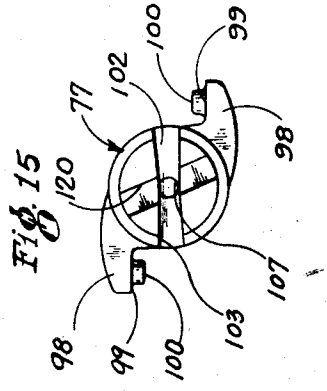


Fig. 15

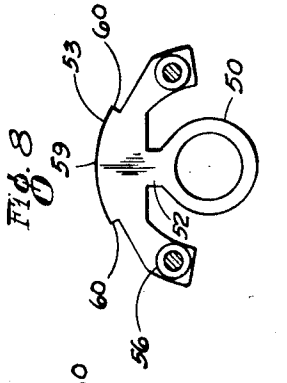


Fig. 8

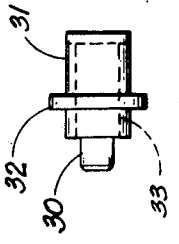


Fig. 11

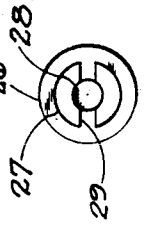


Fig. 14

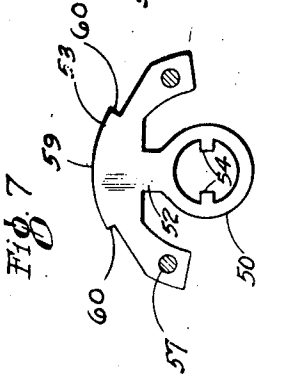


Fig. 7

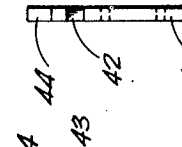


Fig. 10

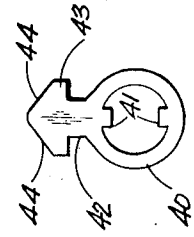


Fig. 9

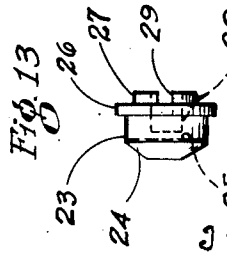


Fig. 13

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SNAP ACTION MECHANISM

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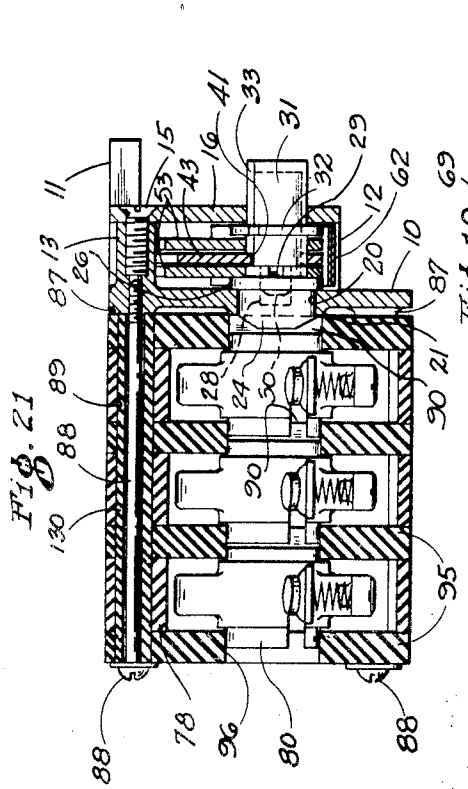

Fig. 21

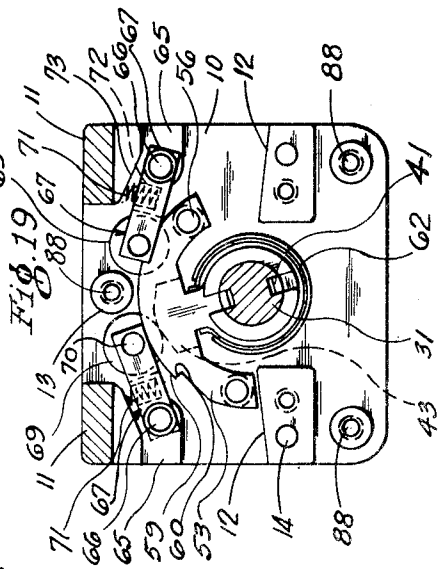

Fig. 19

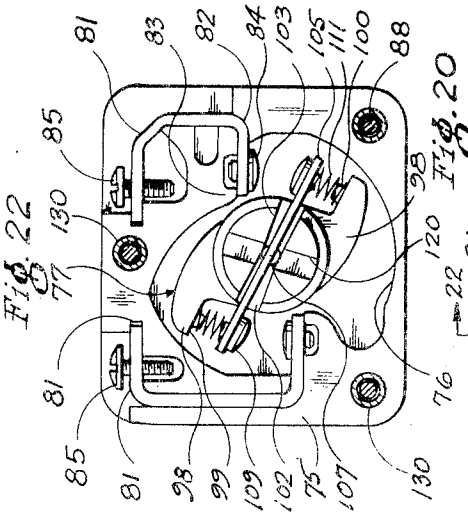

Fig. 22

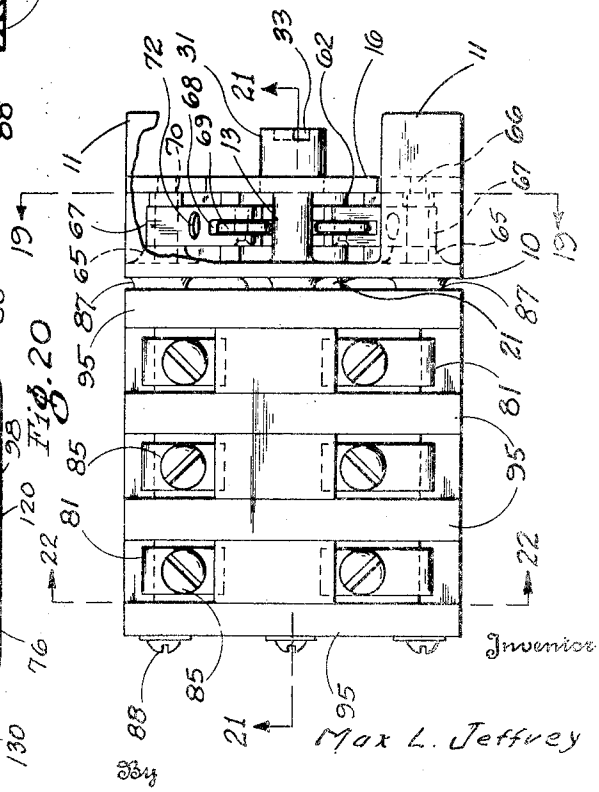

Fig. 20

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Patented July 29, 1952

2,604,792

UNITED STATES PATENT OFFICE

2,604,792

SNAP ACTION MECHANISM

Max L. Jeffrey, Shaker Heights, Ohio

Original application April 19, 1947, Serial No. 742,578, now Patent No. 2,588,632 dated March 11, 1952. Divided and this application December 15, 1948, Serial No. 65,350

5 Claims. (Cl. 74—97)

1

This invention relates to improvements in switches and switch operating mechanisms and more particularly to quick acting switches of the snap action type. This is a division of my copending application, Serial No. 742,578, filed April 19, 1947, now Patent No. 2,588,632.

Although snap action switches have been proposed before and are well known in the art, the snap action, if sufficiently rugged to withstand heavy duty, was cumbersome, complicated and expensive to manufacture.

By the present invention, I have provided an improved snap action switch which is very compact, simple and positive in operation, inexpensive to manufacture and is suitable for the most heavy duty in which such switches may be utilized.

The snap action is also particularly useful in conjunction with a multiple contact circuit breaker and as such will be described in conjunction therewith. It will be appreciated that it is useful for communicating a snap action to other types of circuit breakers, however, and therefore is not limited in its use to the particular type shown and described.

In a multiple circuit, it is essential in many instances that the switch be designed to provide some circuits which are closed while other circuits are open. This makes it necessary, in each such circuit, to design or obtain a switch adapted for that particular use. Eventually, in the case of complicated or multiple circuits, it becomes necessary to design special switches for those circuits which are not ordinarily useful except for that particular job. This increases the expense as well as delays the entire installation while the switch is being processed.

By my present invention I have provided a switch where the components are such that they may be added to or subtracted from the assembly to provide a switch for as many circuits as is desired. Furthermore, the components are such that by the mere reversal of certain components thereof, a switch is provided which opens or closes a circuit. Thus, a switch is provided which may open or close simultaneously any desired number of circuits without the necessity of special design.

Another advantage of the construction is that, should the load through one section of the switch be more than through another section causing the contacts in the heavy load section to wear, a new section can be substituted quickly and easily, and it is not necessary to otherwise renew the entire switch. Furthermore, one section which wears, due to arcing, more than the other, may have the points dressed down and substituted for another section, where the wear has

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not been so large because of the reduced load. Thus, as time goes on, the sections may be rotated until eventually they are all worn out simultaneously.

Still other advantages of the invention and the invention itself will become more apparent from the following description of an embodiment thereof, which description is illustrated by the accompanying drawings and forms a part of this specification.

In the drawings:

Fig. 1 is a full size plan view of a switch embodying my invention;

Fig. 2 is a front end elevational view thereof;

Fig. 3 is a section taken on the line 3—3 of Fig. 1;

Fig. 4 is a rear elevational view thereof;

Fig. 5 is a vertical medial section through the switch;

Fig. 6 is a side elevational view of one of the levers which go to make up the snap action mechanism;

Figs. 7 and 8 are sections taken on the lines 7—7 and 8—8 respectively of Fig. 6;

Figs. 9 and 10 are front and side elevational views respectively on another lever which cooperates with the lever shown in Fig. 6 in making up the snap action mechanism;

Figs. 11 and 12 are side and end elevational views of the support for the levers of Figs. 7 and 9;

Figs. 13 and 14 are side and elevational views respectively of a connector coupling for connecting the snap action mechanism and the switch assembly;

Figs. 15 and 16 are front and side elevational views of a switch rotor;

Fig. 17 is a plan view of a contact carrying strip and its contacts;

Fig. 18 is an edge view thereof with part broken away and shown in section;

Fig. 19 is an end elevation of the switch with one of the front plates removed to show the snap action mechanism;

Fig. 20 is a plan view of a switch showing an alternate form of assembly and with certain parts broken away to show a plan view of the snap mechanism;

Fig. 21 is a section taken on the line 21—21 of Fig. 20, with certain of the parts shown in side elevation; and

Fig. 22 is a section taken on the lines 22—22 of Fig. 20.

The mechanism about to be described is illustrated as being without a housing. It will be appreciated, however, that a housing is contemplated, although there may be cases, where the switch is used in conjunction with other ap-

paratus, where the housing for such apparatus will also house the assembly.

Likewise the switch is operated by a rocking or rotating shaft but no particular means is shown connected to the shaft for effecting such rocking or rotation, since this can be effected in many ways as by an electrically operated solenoid, hydraulically or mechanically.

Briefly, the embodiment of my invention shown contemplates a snap action mechanism whereby a turning movement of a shaft causes a certain amount of kinetic energy to be built up in the mechanism which is released at a predetermined time to cause the quick snap rotary action which is communicated to the movable contacts through a coupling.

The circuit breaker portion of the switch includes pairs of fixed contacts and movable contacts which are moved into and out of engagement therewith. Each set of contacts, for controlling a single circuit is housed in a separate housing, and by merely turning one of the housings end for end, that circuit can be normally open or closed. There is no limitation on the number of housings and their elements that can be used. Therefore, a switch can be fabricated for any particular job with the same parts, all as will heretofore more clearly appear.

As can best be seen in Figs. 1 to 3 inclusive, the snap action mechanism includes a rectangular base plate **10** having a pair of outwardly extending bosses **11** at its upper end. A pair of bosses **12** are also provided spaced from the bottom edge of the plate and the upper bosses. Intermediate the two upper bosses **11** is a circular boss **13**. The bosses **12** are provided with outwardly extending pins **14** for engagement in apertures in a front plate **16**, and they are also provided with threaded apertures, which together with the threaded aperture in the boss **13** are adapted to receive screws **15** which hold a front plate **16** in position. The pins **14** enter into holes in the plate and properly locate the same, and the front plate is thus held in spaced parallel relation to the back plate. The front plate is of generally rectangular form being provided with an upwardly extending portion **18** which extends between the bosses **11**.

The base plate is provided with an opening **20** in its mid-section, the opening being reinforced by an annular boss **21** on the rear thereof which extends around the opening, the opening through the plate and the boss constituting a bearing for the coupling shown in Figs. 13 and 14.

The coupling comprises a barrel **23** rotatably journalled in the opening **20** and is provided with a projection **24** which extends rearward of the plate and is vertically slotted at **25**. The slot provides means for connection with the switch rotors or tumblers later described.

The coupling is provided with a flange **26** adapted for engagement with the front of the base plate **10** and a circular projection **27** which provides a bearing surface for the lever illustrated in Fig. 7. The barrel of the switch is provided with an axial bore **28** to provide a bearing for the operating member (Fig. 11) and is slotted horizontally at **29**.

The operating member includes a pivot pin **30**, adapted to be rotatably journalled in the bore **28** of the coupling, and a cylindrical body **31** rotatably journalled in an opening in the front plate. A flange **32** is provided, which engages with the back of the front plate and is held thereby in position. The body **31** is provided with longitudinally extending slots **33** which extend the length of the body on opposite sides at its diameter and also across the end which projects beyond the front plate, adapted to have an operating member, not shown, secured thereto.

Movement from the operating member is transmitted to the connecting member by a snap mechanism supported in part by the two members and in part by the front and back plate. This mechanism includes the two levers of Figs. 6 to 8 inclusive and Figs. 9 and 10. The lever of Fig. 9 is provided with a ring shaped body **40** having inwardly extending tongues **41** adapted to engage in the side slots **33** of the operating member.

Extending upwardly from the body is a neck **42** which carries on its end a head **43** having two slanting cam faces **44**. This lever is adapted to be swung together with the operating member, the ring **40** being disposed on the body of the operating member, with the tongues **41** extending into the slots **33**.

The second lever, as best shown in Figs. 6 to 8 inclusive includes two spaced apart members adapted to be disposed on opposite sides of the first lever. The one part includes a ring shaped body **50** which is rotatably journalled on the body **31** of the operating member adjacent the rear of the flange **32**. It likewise has a neck **52** extending upward and which carries a head **53** on its end. The other part of the member is of the same conformation, except that the ring **50** is provided with inwardly extending tongues **54** and is adapted to be disposed over the part **27** of the connector member with the tongues **54** engaged in the slot **29**. The two portions of the second lever are held together in spaced relation by pins **56** the ends **57** of which are of reduced cross section and extend through openings in the heads **53** and are headed over to hold the same in place.

The head **53** is of generally T-shape, the extremities extending downward. The mid portion **59** is arcuate and is provided with two steps or notches **60** equally spaced from the center and spaced from the end, for engagement with pawls as will later appear.

It will thus be seen that the first lever **40—44** is fixed on the operating member **30—33** and the second lever **50—60** straddles the first lever, rotates freely on operating member but has a driving connection with the connector **23—29**.

Spring means is provided for transmitting movement from the first lever to the second lever and hence from the operating member to the coupling member and comprises a C-shaped spring **62** of appreciable width, the ends of which engage with all of the necks **42** and **52** of the two levers. It will thus be seen that the movement from one lever to the other is transmitted through the spring and that should either one of the levers meet with any resistance which would tend to hinder its movement the other lever can continue to move, the ends of the spring merely being pushed apart.

It is by virtue of this action that the snap action is obtained. This is effected by holding the second lever against movement until a predetermined relative movement between the two levers is obtained and a predetermined amount of spring pressure is built up at which time the lever is released, and the spring, the ends of which are pressed against the misaligned necks, snaps the two levers into alignment.

The bosses **11** are provided with downwardly extending portions **65** in which are disposed pins

66 extending outward from the plate and on which are journalled pawls 67 which include a body of generally rectangular form, the ends of which are bifurcated at 68 to provide a yoke in which a roller 69 is disposed on a pin 70 extending through the arms of the yoke.

The roller 69 extends between the spaced apart head portions 53 of the lever 50—60 while the body of the pawl 67 is of sufficient width to bridge these portions. Helical springs 71 are provided for urging the pawls toward the surfaces 59 and notches 60, having one end seated in a recess 72 in the pawl and the other end in engagement with the slanting surface 73 on the boss 65.

In operation the two levers are normally held in alignment by the spring 62 which, as stated, engages with the necks. The lever 40—44 is swung when the coupling 30—33 is rotated but the lever 51—53 is held against movement by one of the pawls 67, the end of which engages in one of the notches 66 on the periphery of the T shaped head. The result is that although the center lever is moved, the outside lever stands still and the necks on the two levers which are then swung out of alignment force the ends of the spring 62 apart. The further out of alignment the two levers move, the greater the tension built up in the spring.

As the lever 40—44 is swung farther, one of the cam faces 44 eventually engages the roller 69 on the pawl forcing the pawl upward against the pressure of the spring 71. The pawl is thus eventually forced out of engagement with the notch 60 and releases the outside lever 50—53. At this time the spring which has had the ends pushed apart and is exerting considerable pressure against the misaligned necks of the two levers, snaps the two levers quickly into alignment. The outside lever then swings to the opposite position to that shown in Fig. 2 and the other pawl is engaged in the other notch 60.

The spring 62 can be a single C shaped spring, or it can consist of several springs placed on top of each other. Springs may be added or removed or stiffer springs may be substituted to provide substantially any tension desired.

The tongues 54 on the outside lever being engaged in the notches 29 of the coupling 23—28 which is journalled in the base plate, the coupling is quickly rotated, which movement is communicated to the switch rotor or rotors.

As previously stated, the snap action mechanism is adapted to move the switch rotors to quickly open or close the contacts. Preferably, each rotor is disposed in a separate housing, and the housings may be secured together with the rotor in one housing in interlocking engagement with the other to thus enable all of the rotors to be operated in unison.

Each of the housings may be comprised of a suitable insulating material, preferably such as can be readily molded and is not subject to distortion or deformation in the presence of heat.

As best shown in Figs. 3 and 4, each housing has a body or side wall 75 in which a recess 76 is formed, the recess being of suitable conformation to house the rotor 77 which is capable of limited movement therein. The one end of the recess is closed by a wall 78 which is apertured at 79 to provide a bearing surface for the hub 80 of the rotor.

The terminal strips 81 are provided having one end disposed in recesses 81', opening to the exterior of the housing, and extending through the wall to the interior as indicated at 82. The interiorly extending part of the strip is backed by a boss 83 on the housing, and carries a fixed contact 84, the strip being so arranged that the contact is in the path of travel of the movable contact carried by the rotor. If desired, the terminal strips 81 may be secured in the housing during the molding operation.

The end of the strip in the recess may be provided with one or more terminal screws 85. The base plate 10 is provided with rearwardly extending bosses 87, one of which is opposite to the post 13, and the other two are disposed at the lower end of the plate adjacent opposite corners. The bosses are provided with threaded openings for the reception of screws 88 which extend through fiber tubes 130 disposed in openings 89 in the housings. Thus a series of housings may be secured to the base plate 10.

The rotors which carry the movable contacts each comprise a hub 80 of cylindrical form, which, as stated, is journalled in the wall of the housing and is provided with a tongue 90 on one end adapted to extend into and engage the walls of the slot 25 of the couplings 23—29 to provide an operating connection therebetween or, as will later appear, the tongue may engage in the slot of another rotor.

It should be noted, as can best be seen in Fig. 5, that the bearing surface does not extend entirely through the wall but terminates substantially half way through the wall.

The other end of the hub extends outward and is likewise provided with a surface which engages with the wall of the aperture of the adjacent section so that each rotor has a bearing in two adjacent sections.

It will thus be seen that each of the discrete housings cooperates with the other housing and that one housing acts as a closing wall for the other housing. It will also appear that in a case where all the housings face in the same direction, the last housing would be open and its rotor unsupported if it were not for the fact that the housing can also be closed by a single plate 95 which has an opening 96 in which the hub of the rotor is journalled. This is shown clearly in Fig. 5 where the plate 95 is utilized to provide a wall between the second and third sections, or in Figs. 20 and 21 where the plates are used to separate the housings.

At this point it should be noted that in some instances it may be desirable to make each of the housings in two parts, in which event the wall portion 78 of the housing 75 would be open on both sides and only comprise the parts extending from the wall. This is shown clearly in Figs. 20 and 21.

Each rotor is also provided with a pair of curved arms 98 which extend outwardly from diametrically opposite sides of the hub and are provided with flat faces 99, Figs. 15 and 16 having circular bosses 100 which extend in opposite directions and toward a horizontal line through the diameter of the hub but spaced therefrom. The hub is formed with a slot 102 which extends transversely of the hub along the horizontal diameter thereof and the walls 103 which diverge slightly from the center of the hub toward the periphery.

A contact carrying strip is provided for the hub and includes a flat bar 105, adapted to rotate freely in the slot 102 and capable of relative movement between the walls thereof. The mid section of the bar is provided with a tongue 106 adapted to extend into and having a bearing in a circular recess 107 in the axis of the rotor hub and opening in the bottom of the slot 102.

The ends of the contact strip are enlarged at

108 and have secured therein in any suitable manner, as by riveting, the contacts 109, Figs. 17 and 18. Preferably, the shanks of the contacts extend through the portions 108 and are headed over at 110 to provide a boss for retaining a helical spring 111 in place, the other end of the spring being disposed on the boss 100. Thus, the springs tend to hold the contact strip rotated in a counter clockwise position as shown in Fig. 3 with the sides of the strip in engagement with the walls 103 on opposite sides of the axis of the rotor.

When the contacts are closed, as shown in Fig. 4 upon the rotary contact meeting the fixed contact, further rotary movement of the contact strip is prevented, but the rotor may continue its rotation relative to the strip which pivots about the tongue 106, the springs 11 compressing and the sides of the strips moving away from the walls 103. Thus, in the "contact" closed position the contacts are held in spring pressed engagement with the fixed contacts.

It will be noted from Figs. 1 and 3 that the snap action mechanism is in its left hand position, and that to operate it the operating member 30—33 must be moved in a clockwise direction. This movement is communicated to the rotor which is also moved clockwise as viewed from the right and of Fig. 1 or counter clockwise as viewed in Fig. 3 to cause the closing of the contacts.

This is true of the first and second sections of the switch as viewed in Fig. 1, but it will also be noted that the third and fourth sections are turned around; that is, turned end for end so that they face in the opposite directions to those of sections one and two. In this case, the plate 95 is disposed between the two sections, and as can be seen in Fig. 5, since the hubs of the rotors, which have slots 120, which align with the tongues 90 on the opposite end and are normally disposed for engagement with the tongues on the adjacent rotor (Fig. 5) are toward each other, a coupling member 121 in the form of a flat rectangular bar, which may also be insulating material, is disposed in both slots 120 of the adjacent rotors connecting them together.

The remaining or end section is also turned around. Therefore, the tongue and groove connection therebetween is provided.

It will be seen therefore that sections one and two have the contacts open, and that sections three and four (Fig. 4) have the contacts closed. Therefore, when the snap action mechanism is operated, the open contacts close, and the closed contacts open.

It will be appreciated that by this arrangement any number of sections can be built up to provide a single contact for the desired circuit, and wherein simultaneous opening and closing of circuits is attained.

I have described the sections as being held together with a screw 88 which extends through aligned openings in the discrete sections. There is also shown a fiber tube 130 which is first inserted in the openings and subsequently the screw extends through the tube. This construction increases the dielectric path and prevents arcing to the bolt.

In Figs. 20 and 21 I have shown a three-section switch wherein the side wall sections are separated from the end walls.

In this case the contact carrying strips 81 are somewhat narrower than in the other design and are secured in place during the molding. In all other respects, however, it is the same as that of Figs. 1 to 5 inclusive.

As can best be seen in Fig. 19, the ends of the lever 50—60, at the limit of their movement are closely spaced to the top surface of the lower bosses 12.

This spacing is maintained by the springs 111 on the contacts which in the closed position are under compression. The end of the lever may contact with the bosses 12 limiting the movement and removing strain from the rotors in event that the operating member has a tendency to over travel, causing a further relative movement of the snap action levers. It will be apparent that considerable over travel is allowable because of this construction without undesirably affecting the operation.

It will therefore be clear that the snap action is small, rugged, simple and economical to manufacture, and that it takes up a minimum of space allowing a compact assembly to be made. It is also apparent how the switch assembly per se is versatile, enabling a few standard parts to be used and allow the fabrication of a switch which can control a great variety of circuits.

Having thus described my invention, I am aware that numerous and extensive departures may be made therefrom without departing from the spirit or scope of my invention.

I claim:

1. A snap mechanism comprising first and second coaxially aligned rotatable shaft sections movable relative to each other, a driver member carried by the first section and a driven member carried by the second section and spring means connecting the driving and driven members, means for holding the driven member against movement including pawls for engagement with the driven member, said driven member being formed with a slot extending longitudinally thereof and a curved surface concentric to the shaft axis having spaced apart notches for alternate engagement with said pawls, said pawls having portions resting on said curved surface and other portions extending alongside said driven member into said slot and in the path of travel of the driver member, said driver member being arranged to engage said last mentioned parts of the pawls and raise them alternately in said slots to disengage said pawls from said notches.

2. A snap action mechanism including a driven member and a driving member, means to connect said members whereby a slow rotary movement is converted to a fast rotary movement including a driven lever connected to said driven member and comprising a pair of spaced apart members rigidly connected to each other, a driving lever connected to said driving member and disposed between the spaced members of the driven member, spring means for holding said driving and driven members in predetermined position relative to each other adapted to have its tension increased upon relative movement between the levers, said driven member having a portion formed with spaced apart seats, separate pawl means disposed for engagement with said seats, and means carried by each pawl extending between the spaced apart elements, and means on said driving lever for alternate engagement with the means carried by each pawl to move said pawl out of engagement with said seat upon a predetermined movement of the driving member, said spring adapted to move the driven member upon relays of the pawl.

3. An apparatus of the class described including an operating member comprising a

slotted barrel, a reduced extension on said barrel, a driving lever having a ring disposed on the barrel and provided with tongues extending from the inside of the ring into the slots, a neck extending from the ring and a head on the end of the neck formed with cam faces on the end of the head, an operated member journalled on the reduced extension at one end and supported in a bearing on the other end, a driven lever having a ring portion rotatably journalled on said barrel and disposed on one side of the driving lever and a second ring portion disposed beyond the end of the slotted barrel and the other side of the driven lever, tongues extending inwardly from the ring in the second portion and engaging in grooves of said operated member, said driven lever having necks extending therefrom in spaced axial relation to each other on opposite sides of the neck on the first lever, cam members carried by said necks on the ends thereof and swingable on opposite sides of the driving lever, means rigidly connecting said cam members together at their ends, spring means for drivingly connecting said levers together disposed around said rings and engaging said necks on opposite sides, latch means for said second lever, said cam members on the driven lever having a curved intermediate portion and formed with latch engaging shoulders at the end of the intermediate portion, said latches being pivotally journalled and swingable into and out of engagement with said shoulders, and means on said latch comprising a roller extending between said cam members adapted for engagement by said cam faces on the head of the driving lever, spring means for holding said latches against said cam faces and for urging said latches alternately into said notches, said first cam upon being swung being alternately engageable with the rollers on said latches and said driven lever being movable by said spring upon release of one latch and engageable upon said movement by the second latch to hold the same in alternate locked positions.

4. An apparatus of the class described including an operating member comprising a slotted barrel, a reduced extension on said barrel, a driving lever having a ring disposed on the barrel and provided with tongues extending from the inside of the ring into the slots, a neck extending from the ring and a head on the end of the neck formed with cam faces on the end of the head, an operated member journalled on the reduced extension at one end and supported in a bearing on the other end, a driven lever having a ring portion rotatably journalled on said barrel and disposed on one side of the driving lever and a second ring portion disposed beyond the end of the slotted barrel and the other side of the driven lever, tongues extending inwardly from the ring in the second portion and engaging in grooves of said operated member, said driven lever having necks extending therefrom in spaced axial relation to each other on opposite sides of the neck on the first lever, cam members carried by said necks on the ends thereof and swingable on opposite sides of the driving lever, means rigidly connecting said cam members together at their ends, spring means for drivingly connecting said levers together disposed around said rings and engaging said necks on opposite sides, latch means for said second lever, said cam members on the driven lever having a curved intermediate portion and formed with latch engaging shoulders at the end of the intermediate portion, said latches being pivotally journalled and swingable into and out of engagement with said shoulders, and means on said latch comprising a roller extending between said cam members adapted for engagement by said cam faces on the head of the driving lever, spring means for holding said latches against said cam faces and for urging said latches alternately into said notches, said first cam upon being swung being alternately engageable with the rollers on said latches and said driven lever being movable by said spring upon release of one latch and engageable upon said movement by the second latch to hold the same in alternate locked positions, abutments disposed for engagement with the ends of the driven member for limiting the movement thereof.

5. A snap action mechanism comprising first and second rotary members in axial alignment, driving members connected to one of said rotary members and a driven member connected to the other, said driven member comprising a pair of rigidly connected spaced apart portions one of which is rotatably journalled on the first rotary member and the other of which is rigidly connected to one other member, said driving member being drivingly connected to said first rotary member and disposed between the spaced apart portions of the driven member, said members being provided with radially extending portions the lateral edges of which coincide, spring means engaging with said lateral edges under tension for holding said radially extending portions in alignment with each other adapted to increase in tension upon relative movement of said members, said driven members extending beyond the end of the driving member and provided with the ends extending laterally from said radially extending portions in the directions of travel of said member, said laterally extending portions being provided with spaced apart notches, separate pawl means each disposed for alternate engagement in said spaced apart notches upon said driven member being moved to predetermined position, rollers carried by said pawls and extending between said spaced apart portions, said driving lever having a portion movable into alternate engagement with each of said rollers to force said pawls out of said notches.

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