Nov. 29, 1955 R. H. BENTLEY 2,725,438

ALTERNATING CURRENT SWITCH MECHANISM

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Fig. 1.

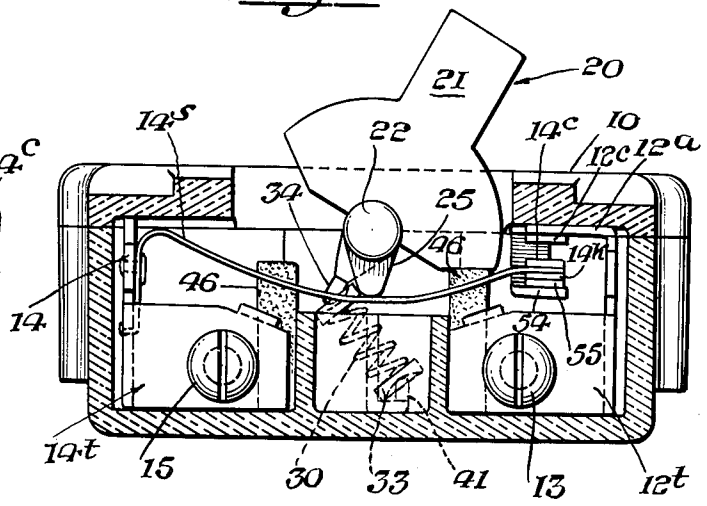


Fig. 3.

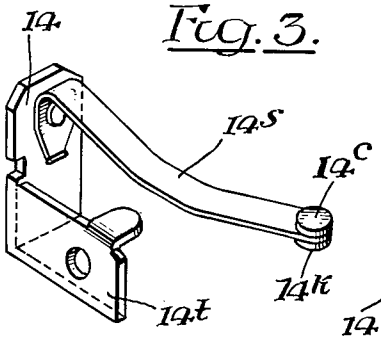


Fig. 4.

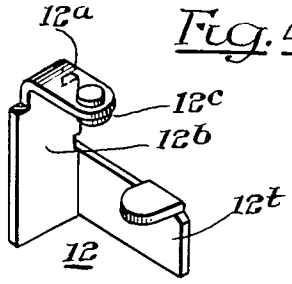


Fig. 2.

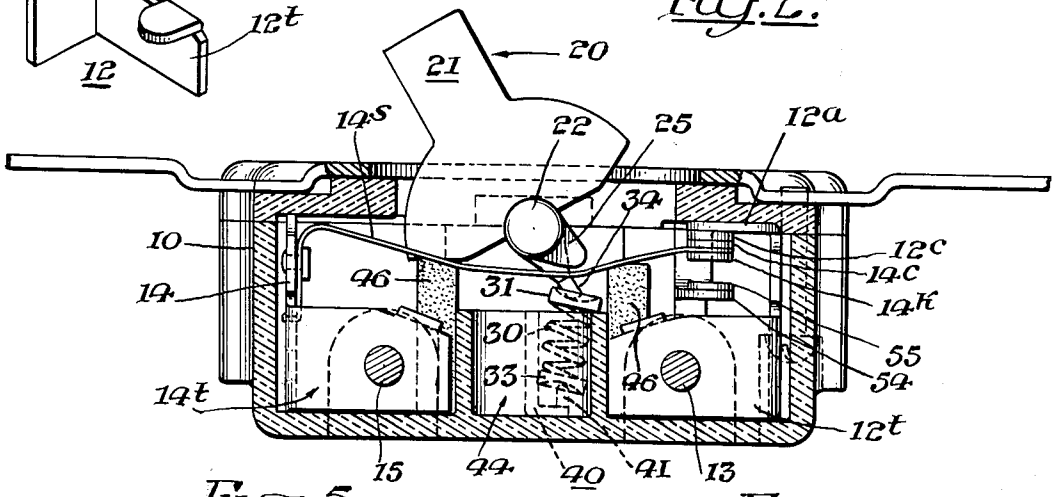


Fig. 5.

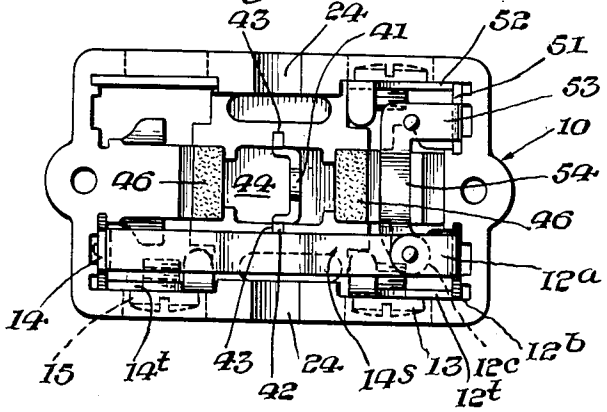
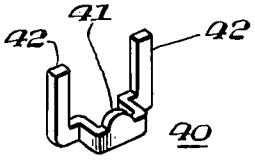


Fig. 6.



Inventor-
Robert H. Bentley
by his Attorneys,
Howson and Howson

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ALTERNATING CURRENT SWITCH MECHANISM

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Fig. 7.

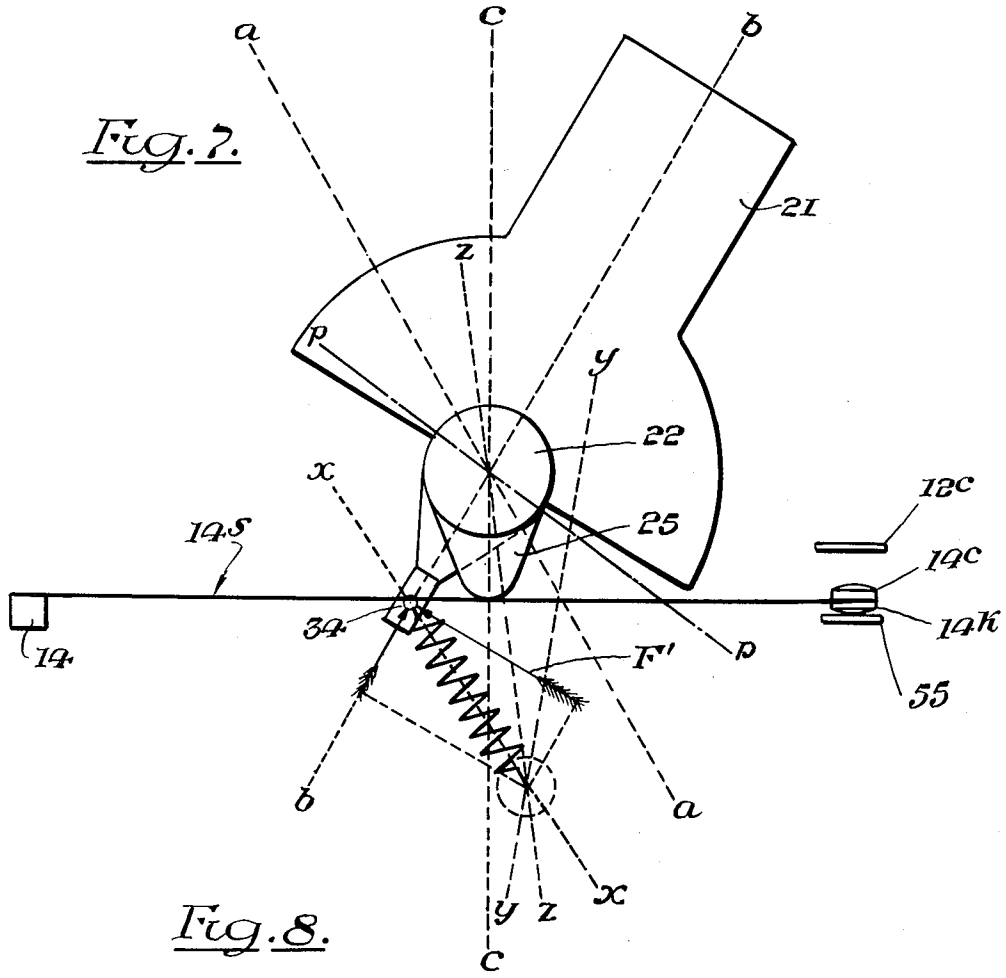
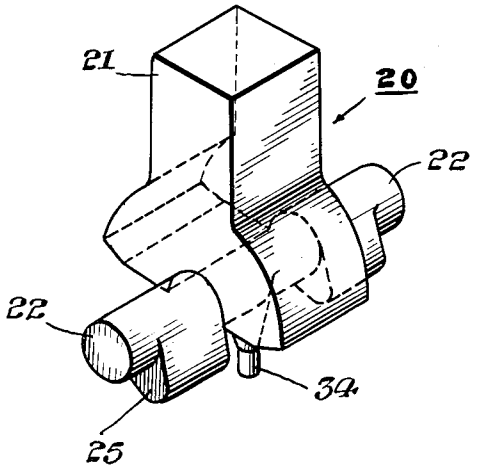


Fig. 8.



Inventor:
Robert H. Bentley
by his Attorneys,
Howson and Howson.

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ALTERNATING CURRENT SWITCH MECHANISM

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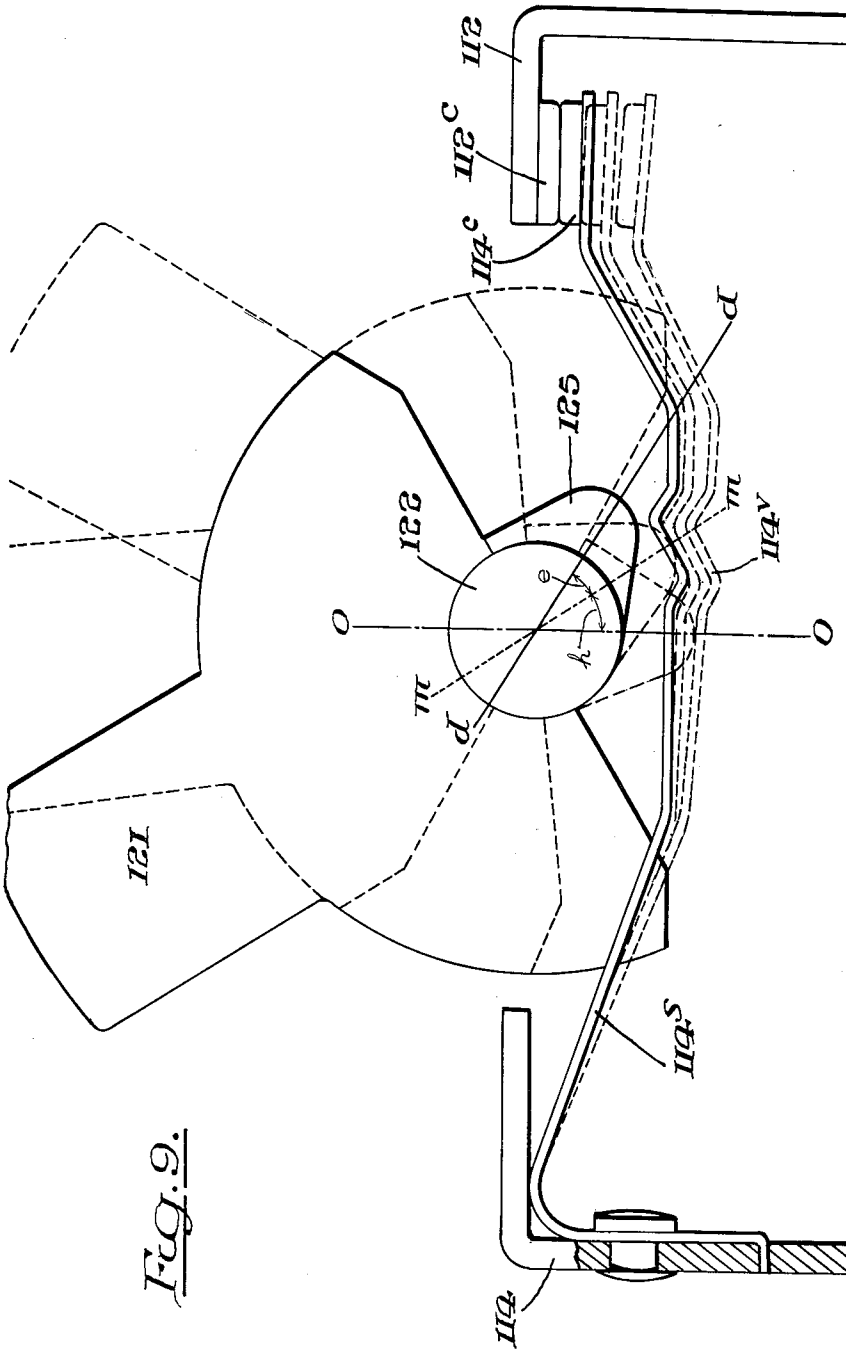

Fig. 9.

Inventor:
Robert H. Bentley
by his Attorneys,
Howson and Howson.

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ALTERNATING CURRENT SWITCH MECHANISM

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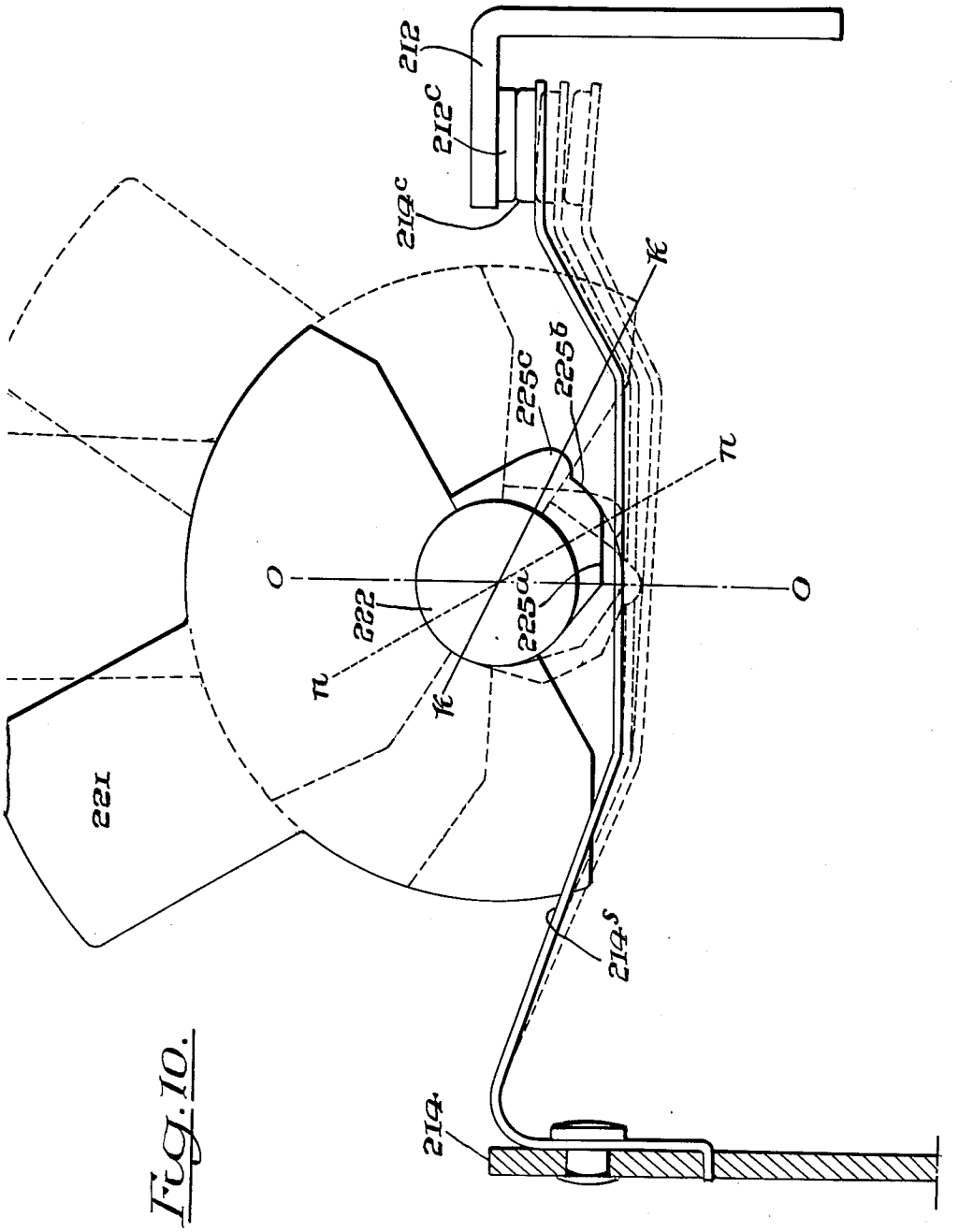

Fig. 10.

Inventor:
Robert H. Bentley
by his Attorneys,
Howson and Howson

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ALTERNATING CURRENT SWITCH MECHANISM

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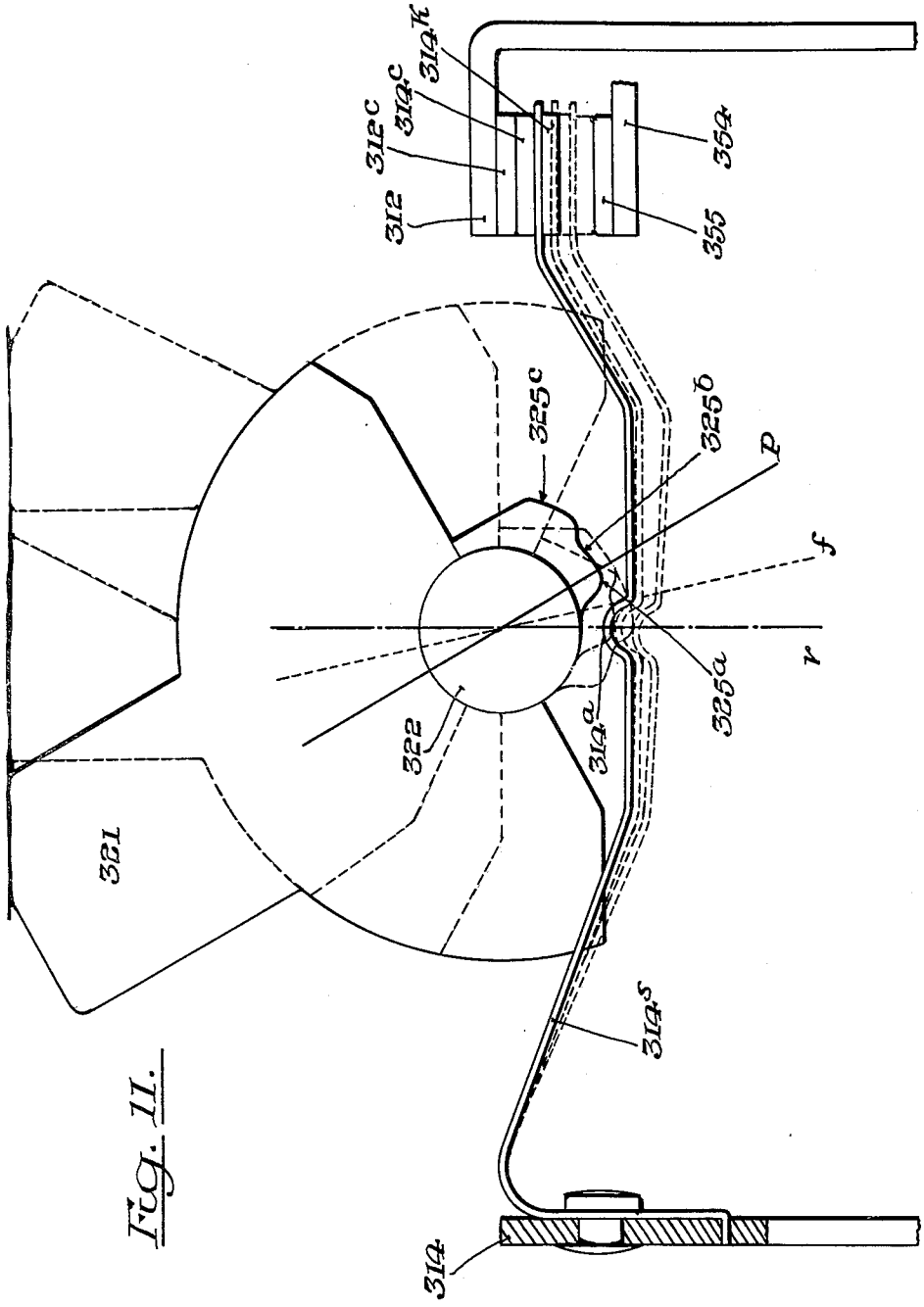

Fig. 11.

Inventor:
Robert H. Bentley
by his Attorneys,
Howson and Howson

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2,725,438

ALTERNATING CURRENT SWITCH MECHANISM

Robert H. Bentley, Hartford, Conn., assignor to The Arrow-Hart & Hegeman Electric Company, Hartford, Conn., a corporation of Connecticut

Application September 15, 1952, Serial No. 309,689

23 Claims. (Cl. 200—67)

This invention relates to electric switches for use in alternating current circuits. More particularly it relates to a mechanism which will quietly open and close the switch contacts especially of the butt type. Additionally, it relates to such a mechanism which separates the contacts slowly for a short distance in initial stages of switch operation.

With the growth of the electrical industry there have been less and less uses of direct current for domestic purposes such as for house wiring. Likewise, the use of direct current in cities has almost disappeared. Hence the original need for switches which open the contacts and close them with a snap action has now largely disappeared. It has long been known that for ordinary house wiring voltage and current requirements, slow-opening contacts were satisfactory and that expensive, complicated and noisy snap switch mechanisms were not essential to satisfactory circuit-breaking action. Also, butt type contacts were satisfactory and often preferable in alternating current work.

The vogue for housing wiring switches of the type which are mounted in the wall to be operated when a person comes into or leaves a room and for other related uses has long been for the lever-type; and there has been a demand for such switches which would operate quietly. The snap switch mechanism commonly used heretofore in lever-operated switches caused considerable noise when the switch lever reached the end of its travel. Efforts to overcome this objectionable click or snap have resulted in conventional snap mechanisms provided with rubber bumpers and in devices embodying mercury contact arrangements. Generally speaking, they have not been satisfactory or, in the case of mercury switches, the use of fragile and expensive glass elements has increased greatly the cost of the switch and liimted its field of use.

Therefore, it is an object of my invention to provide a novel lever-operated electric switch mechanism which may be economically manufactured and will be reliable and quiet in operation.

Another object of the invention is to provide a quietly-acting switch of the above mentioned type wherein the lever will positively move from one position to the other when released by the hand of the operator thus to give to the operator the feeling of satisfaction and confidence that the switch has operated properly.

Another object of my invention is to provide a butt-type lever operated switch for alternating current house wiring and related uses which will at the same time satisfy the aforesaid objectives.

Another object is to provide a quietly-acting butt-type switch achieving the above objectives which will also pass the underwriters' tests and be acceptable for general usage in houses and elsewhere.

Another object is to provide a butt contact type of switch possessing one or more, or all, of the foregoing features and also having superior arc-interrupting capacities. A related object is to provide for slow initial separation of the contacts to a predetermined distance for

optimum arc-extinguishing characteristics followed by a further separation for adequate final separation. Another related object is to provide in such a switch for slow initial opening of the switch contacts followed by rapid final switch opening movement.

Another object is to provide a double-throw switch having one or more of the foregoing features which will operate with equal arc-quenching effect and/or silently in both directions.

Other objects and advantages of the invention will become apparent as it is described in connection with the accompanying drawings.

This application is a continuation-in-part of my co-pending application Ser. No. 267,052, filed January 18, 1952, entitled "Alternating Current Switch Mechanism," abandoned October 17, 1952.

In the drawings:

Figs. 1 and 2 are longitudinal section views of the switch embodying the invention, in two different positions of the mechanism,

Figs. 3 and 4 are detail perspective views of the wire terminals with movable and fixed contacts attached respectively,

Fig. 5 is a plan view of the interior of the switch base with the contacts and terminal members in place,

Fig. 6 is a detail perspective view of the overcenter spring support shown in Figs. 1 and 2,

Fig. 7 is a diagrammatic view showing the force actions in various switch positions,

Fig. 8 is a perspective view of the operating lever,

Figs. 9, 10 and 11 are diagrammatic views of three other different forms of the invention.

Referring to the drawings, the parts are mounted upon a base **10** made from any suitable insulating material, which is hollowed out for the reception of the fixed and movable switch parts. At one end of the base is mounted a combined wire terminal and contact member which may be stamped conveniently from sheet metal into the form illustrated in Fig. 4. A flat body portion **12***b* extends from front to back into the base **10** at one end and has a terminal plate **12***t* bent laterally therefrom to be alongside the interior wall lengthwise of the base near one end. The base is cut away adjacent a portion of the terminal plate to accommodate a terminal screw **13** and for affixing wires when desired. A supporting finger **12***a* is bent at right angles to the body portion **12***b* and a contact button **12***c* of silver is mounted on the underside of the finger **12***a*.

Adapted to engage and disengage the fixed contact button **12***c* is a movable contact button **14***c* mounted upon the end of a movable contact supporting member **14***s* which may be conveniently formed from a strip of resilient thin sheet metal. This movable contact supporting member is mounted at its opposite end upon a wire terminal and supporting member which may also be stamped from sheet metal as illustrated in Fig. 3. It has a flat body portion **14** extending from front to rear of the base at the end opposite terminal **12**. A terminal plate **14***t* bent at right angles to the body portion **14** lies alongside of the inner wall of the base which is recessed adjacent the plate for a terminal screw **15**. The movable contact member thus extends from one end of the switch base to the other. Above it and pivotally mounted on the base is a contact operating lever **20** which is preferably molded from insulating material into the form illustrated, as will now be described.

The contact operating lever may have an extending handle portion **21** of conventional shape adapted to fit within the usual rectangular aperture of the conventional switch or wall plate. Trunnions **22** extend laterally from the lever and are seated in bearing recesses **24** in the side walls of the switch base. Extending into the base

from the lever **20** preferably at one side of the center plane thereof is a cam member **25** of V-shape with its end rounded and adapted to engage the movable contact and supporting member **14***s* to operate it. This operating cam has its center line located in a plane perpendicular to the base of the switch (and to the wall plate which is usually used over the base) when the cam is in position to cause separation of the contacts **12***c* and **14***c*, as may be seen in Fig. 1. In this position, the handle **21** will be at an angle approximately 30° to the right of the center line or center plane. When the handle is moved to the opposite position or in other words, to a position about 30° on the left side of said center line, the operating cam **25** moves counterclockwise and disengages the movable contact supporting member. The resilience of the movable contact supporting member then causes that member to move into position wherein its button **14***c* engages the button **12***c* of the fixed contact.

In order to positively move the lever member **20** and to hold it in its two opposite positions, I provide an overcenter spring device comprising a coiled compression spring **30** having circular, cup-shaped, bearing caps **31** and **33** on its upper and lower ends. The bearing cap **31** on the upper or outer end of this spring engages with an operating finger **34** extending inwardly from the operating lever along the center line thereof and tapering towards its end to a rounded point for engagement with said bearing cap **31**. The inner or lower end of the spring has its bearing cap **33** resting upon a fulcrum or pivot point **41** formed upon a U-shaped fulcrum member **40** which conveniently may be stamped from sheet metal into the form illustrated in Fig. 6. The location of this point is of importance and as will be explained, the point is offset from the transverse median plane through the pivotal axis of the switch operating lever **20**, differing from prior practice when overcenter springs were used. The parallel side arms of the fulcrum member may conveniently be slid in opposite parallel grooves **43** formed in the side walls of a well **44** in the center of the base **10** wherein the spring pivots to and fro.

To halt the movement of the operating lever quietly at the proper positions and also to deaden the sound of the movement of the operating lever moving into one or the other of its positions, bumpers **46** made of rectangular blocks of sponge rubber or other soft resilient material are provided at either end of the well **44**. The ends of the operating lever are flattened to abut the flat top surface of the bumpers in the two positions of the lever; and any overtravel of the spring in the position of Fig. 2 will be taken up by abutting against the opposing faces of the bumpers until the several forces of the moving parts are in equilibrium. The mechanism is designed and proportioned, however, to avoid abutment of the spring with the rubber bumpers. Since the operating lever comes to rest against and is stopped by the top of the rubber bumpers, it limits the movement of the spring so that the spring need not abut the bumper; but if the spring should overtravel, its motion has been so retarded, at that time and position, that no considerable click can result from that cause. The only moving part other than the contacts, which is designed to have its motion stopped by engagement with a stationary part is the operating lever **20**; and since it engages quietly with the bumpers **46**, the switch operates silently.

When it is desired to provide contact arrangements for a three-way or double-throw switch, a contact and terminal member may be provided comprising a sheet metal stamping having a flat body portion **51** at the same end of the switch base **10** as the member **12***b* but at the other side of the base. The body **51** extends from front to rear of the base in slots as do the body portions of the other terminal and contact members. From the outside edge of the body a flat terminal plate **52** is bent at right angles to lie along the inside wall of the base; and the side wall of the base is open alongside the terminal plate to accommodate a terminal screw. From the top edge of the body **51**, a flat extension **53** is bent at right angles toward the middle of the base from the end of which an arm **54** extends laterally and downwardly toward the opposite side of the base to a point beneath the end of the movable contact carrier **14***s*. On the bottom side of the end of the carrier **14***s* is a contact button **14***k* which is adapted to engage a similar fixed contact button **55** on the top side of the end of the arm **54** when the switch handle **21** is in the right hand position. The pressure of the cam **25** on the resilient contact carrier **14***s* will provide the necessary pressure to hold contacts **14***k* and **55** firmly engaged. After movement of the handle **21** through a small angle from right to left, contact carrier **14***s* will gradually be released and its resilience will cause disengagement of contacts **14***k* from fixed contact **55**.

In prior switches employing an over-center spring which acted to cause the movable contact to operate with a snap motion and which also acted upon the handle, the forces which acted upon the handle were equal in each direction of travel. Users have become accustomed over the years to expect such a feel of the handle as indicative of normal and proper switch functioning.

According to my invention, the parts are arranged and the forces are designed to interact so as to develop substantially equal forces on the handle in each direction of its travel, despite the disrupting effect introduced by the spring force of the contact supporting member **14**.

For better understanding of the novel interaction of forces as employed in this invention, reference is made now to Fig. 7. As the handle moves from the right to the left position, its center line moves from the line *b*—*b* to the line *a*—*a*. In so doing, it moves through the line *c*—*c* wherein the handle is perpendicular to the switch base. In prior switches (but not in this switch) this was commonly the overcenter point or dead center position.

As the handle moves from right to left, the overcenter spring has its line of action moved from the line *x*—*x* to the line *y*—*y*. In so doing, it passes through the pivotal axis of the handle at the line *z*—*z* which is angularly spaced from the perpendicular, *c*—*c*.

When the handle is at the right, the movable contact operating cam **25** acts in a plane perpendicular to the movable contact carrier **14***s*. This is the plane of line *c*—*c* as shown in Fig. 7.

In the left position the contact-operating cam **25** has moved to the line *p*—*p* where it exerts no force and is disengaged from the movable-contact carrier **14***s*. This disengagement is designed to take place (on moving the handle from right to left) before the overcenter spring reaches the dead center position. This disengagement eliminates the spring force of the contact carrier from action on the cam **25** and operating member **20**. Since the spring force of the movable contact carrier **14***s* at all other times acts on the cam **25**, its inherent spring force aids the handle movement to the left initially but opposes its movement to the right as soon as the cam **25** engages the spring carrier **14***s* and starts to separate the contacts **12***c* and **14***c*.

In order to substantially equalize the pressure or force needed to move the handle in each direction for operating the switch and also to equalize the pressure exerted by the mechanism on the handle at the end of its travel in each direction, it is necessary to balance the combined effects of the spring forces of the contact carrier **14***s* and of the overcenter spring **30**. It is for that reason that the mounting of the lower or inner end of the overcenter spring is offset from the center line *c*—*c*. By that offsetting, the component F′ of force of the overcenter spring acting tangentially to the radius of the spring operating finger **34** at the point of application of the spring force in the right position of the handle is greater than the corresponding component (not illustrated) in the left position. But in moving the handle from right to left position such greater component of

force opposing such operation is in part neutralized by the aid that the force of the contact-carrying spring starts to exert as soon as the movement of the handle toward the left starts.

Such aid however ceases as or before the overcenter spring reaches the dead-center or z—z position (because the cam **25** disengages the contact spring **14***s* before that event) so that thereafter only the overcenter spring force acts to complete the movement of the handle to the left.

As stated, on movement of the handle from left to right position, a lesser component of the overcenter spring force has to be overcome than the component which acted when the switch handle was being moved the other way. This lesser component is approximately equal to the greater component minus the force of the carrier spring **14***s* which is encountered in moving in the other direction. The overcoming of this lesser component continues until the dead-center or z—z position of the spring is reached. Thereafter the component of the overcenter spring and the handle carrying them on past dead-center builds up in opposition to the counter-force of the movable-contact-carrying spring **14***s* until the parts come to rest with the handle in the right hand position.

Comparing the composite of forces acting on the operating lever **20** as the handle moves past dead-center position (z—z), it will be noted that in movement after dead-center from left to right by the handle, the overcenter spring is opposed by the contact carrier **14***s*. The resultant is substantially equivalent to the lesser force component of the overcenter spring which alone acts after dead-center in movement of the handle from right to left.

From the foregoing, it will be observed that I have provided an arrangement of switch contacts and operating mechanisms in which the forces acting upon the switch handle in both open and closed positions are equal in a butt contact type of switch wherein the contacts are normally biased into one position and wherein the switch operates quietly. Moreover, the equalization of forces as above described avoids the excessive force in one direction or another as would result if the pressure of the contact-carrying spring were merely aggregated to the handle biasing spring.

It is now well known that if contacts are separated slowly in alternating current circuits, preferably to an optimum distance, the current has an opportunity to pass through zero while the contacts are separating. Hence the tendency of the arc to draw out and prolong is retarded and counteracted. After the contacts have separated slowly, a small distance, so as to give the arc suppressing tendency an opportunity to function, it is desirable to move the contacts apart, further and more rapidly, to a predetermined and desired distance.

To provide for the slow initial separation and more rapid final movement, the structure illustrated in Figs. 9 and 10 may be incorporated in the invention previously described.

In Fig. 9 the operating member **120** is mounted on trunnions **122** and has a handle **121**. A wire terminal **114** carries a flexible contact supporting member **114***s* and is operated by a cam member **125** on the operating member **120**. The contact button **114***c* on the end of the contact support **114***s* is adapted to engage and disengage the fixed contact button **112***c* on wire terminal **112**.

However, to cause rapid opening after initial separation, a concave V-shaped deformation **114***v* is formed in the portion of the contact support **114***s* which is engaged by the cam **125**. This V-portion is so formed that as the cam **125** engages and moves down one side of the concavity, the contact support will be caused to move slightly and will separate the contact button **114***c* from button **112***c*, slowly, a predetermined distance as shown in dotted lines in Fig. 9.

When the cam has moved from line *d*—*d* through angle *e* to line *m*—*m*, the advancing cam face will abut the ascending opposite face of the V-shaped concavity. From that position onward as the rotation of the cam and operating member is continued, the camming action is effective at a steeper angle thus causing a greater movement of the contact supporting strip **114***s* and more rapid movement from the contact **112***c*. Thus, more rapid movement continues while the operating member and cam move through the final angle *h* to the dot-dash line position *o*—*o*, at which position the full degree of contact separation is achieved.

Although for clarity the spring **30** and associated parts are not shown in Fig. 9 or in Fig. 10 about to be described, it will be understood that they are or may be employed for the same reasons and functions as have already been described.

In Fig. 10 is illustrated another form similar in function to Fig. 9, but differing in details of construction. In this form the operating member **220** has a handle **221** and is pivotally supported by trunnions **222**. The terminal **214** has flexible contact supporting strip **214***s* mounted at one end thereon. Movable contact button **214***c* on the other end of the strip engages and disengages fixed contact button **212***c* on terminal **212**.

The cam **225**, in this instance, is adapted to engage a flat portion of the contact support **214***s*. The cam has a flat portion **225***a* spaced from the flat portion of the contact supporting strip **214***s*. The flat portion **225***a* merges into an arcuate portion **225***b* concentric with trunnions **222** and joining a round hump or high point **225***c*.

As the handle **221** is moved clockwise from the position of Fig. 10, cam **225** rotates. During the first small angle of rotation, i. e. until the beginning of surface **225***b* comes into engagement with the flat portion, the contact supporting strip, there is no motion of the contacts. Thereafter, the surface **225***b* exerts a camming action on the strip, slowly separating contact button **214***c* from button **212***c*. This slow separation continues until the cam hump **225***c* reaches the dotted line position *n*—*n* of Fig. 10. Thereafter, the increased camming angle and action of surface **225***c* will cause more rapid contact separation as the contacts continue to move apart until they reach the position shown in dot-dash lines *o*—*o* in Fig. 10. At that position the contacts have reached their maximum separation.

From the foregoing it will be understood that both the forms, Fig. 9 and Fig. 10 provide slow limited initial contact separation followed by more rapid final movement of the contacts apart. Actual tests show these functions added by the novel structure of Figs. 9 and 10 to give superior operation and to possess arc suppressing characteristics of high order.

In Fig. 11 is shown another form generally similar to Figs. 9 and 10 but wherein a dwell or hesitation is provided in the movement of the contacts between the original separation and the final position.

The operating handle **321** pivotally mounted on trunnions **322** has its cam engaging the flexible contact-supporting strip **314***s* mounted on the terminal **314** at one end and carrying the moving contact button **314***c* on top of the other end. This button engages and disengages fixed button **312***c* on terminal **312**. On the other (or bottom) surface of the strip opposite the top button **314***c* may be a bottom button **314***k* for engagement with a lower stationary contact button **355** on a different terminal **356**, in case a double throw or three-way switch is desired.

In Fig. 11 the contact strip has a half-round cylindrical or arcuate portion **314***a* in its mid-portion for engagement with the cam surfaces on the operating lever. These cam surfaces are most conveniently flat in lateral extent but merge one into the other peripherally. From about the level or a diameter equal to that of the trunnions **322**, cam surface **325***a* curves convexly upward merging

into another arcuate cam surface 326*b* which is concentric with the axis of trunnions. Surface 326*b* continuing for a short distance of say 15° more or less depending on the conditions of use and requirements of design, merges into another convex arcuate cam surface which rises sharply. The curvatures of cam surfaces 325*a* and 325*c* determine the speed of movement of the contact during engagement and disengagement; and the amount of their rises to and above the surface 325*b* respectively determines the degree of initial and final separation of contact button 314*c* from 312*c*. The reverse applies as to contact button 314*k* and fixed contact button 355 since in the fully open position of contacts 312*c* and 314*c* the contact 314 is engaged with contact 355.

As the operating lever is moved clockwise from the full line position (position P) of Fig. 11, cam 325*a* moves into engagement (position *f*) with the half-round 314*a* on the movable contact supporting strip causing that strip to move away from fixed contact 312 into the dotted line position as the cam 325*a* rides over the half round 314*a*.

As surface 325*b* rides over the half-round 314*a* during continuance of the movement of the operating lever, the contacts remain substantially stationary.

When finally during the end of the movement of the operating lever the surface 325*c* engages (position *r*) and rides over the half-round 314*a* the contact 314*c* is forced further from the fixed contact 312*c*. Simultaneously contact 314*k* is pressed into engagement with contact 355.

Thus the contacts 312*c*, 314*c* will separate initially with a slow motion to a predetermined distance which will be the optimum distance for arc suppression and extinguishment and thereafter will hesitate or halt and then continue on its path to fully separated position.

The reverse will occur on reverse movement of the operating lever.

Besides the added functions of arc suppression on reverse operation in double-throw switches the form of Fig. 11 has manufacturing advantages due to the form of the movable contact supports.

Many other modifications embodying the principles of the invention will occur to those skilled in the art. Therefore, I do not limit it to the precise forms illustrated and described.

What I claim is:

1. An electric switch comprising a housing a manually operable lever movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, over-center spring means engaging a portion of said lever member and biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member.

2. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, said carrier exerting a force on said lever member as it moves into and from one position, spring means biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member.

3. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, said carrier exerting a force tending to move said lever member in the direction of its motion when it is moving toward one position and exerting a force opposing movement of said lever when it is moving in the other direction, spring means biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member.

4. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, said carrier exerting a force tending to move said lever member in the direction of its motion during the first part of its travel when it is moving toward one position and exerting a force opposing movement of said lever when it is moving in the other direction, spring means biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member.

5. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, said carrier exerting a force tending to move said lever member in the direction of its motion during the first part of its travel when it is moving toward one position, and exerting a force opposing movement of said lever during the last part of its travel when it is moving in the other direction, spring means biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member.

6. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member mov-

able with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, said carrier exerting a force tending to move said lever member in the direction of its motion when it is moving toward one position and exerting a force opposing movement of said lever during the last part of its travel when it is moving in the other direction, spring means biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member.

7. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, spring means biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member, said carrier exerting a force on said lever member when said lever member and spring means are on one side but not when they are on the other side of mid-point of their combined actions.

8. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, spring means biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means spring in said two positions of said lever member causat its other end from said housing, the position of said ing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member, said movable contact engaging said fixed contact before said spring means exerts its biasing action toward switch-closed position and thus eliminating the action of the carrier on the lever member during further movement in switch-closing direction.

9. An electric switch comprising a housing a manually operable lever member movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, spring means biasing said lever member into one or the other of its two positions, and said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing its bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member, said movable contact remaining engaged until said spring means starts to exert its biasing action in switch-opening direction.

10. A switch as claimed in claim 2 having resilient noise absorbent means engageable by said lever member quietly to limit the movement of said lever member.

11. An electric switch comprising a housing, a manually operable lever member movable about a pivotal axis between two positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, over-center spring means engaging a portion of said lever member and biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing the bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member, and means associated with said actuating member and contact carrier to cause separation of said contacts slowly and after predetermined separation to continue separating movement more rapidly.

12. A switch as claimed in claim 11 wherein the means associated with the actuating member and contact carrier comprise mutually cooperating cam surfaces of different extent and inclination.

13. An electric switch comprising a housing, a manually operable lever member movable about a pivotal axis between two positions, an actuating member movable with said lever member, fixed and movable contacts, a movable contact carrier biased toward said actuating member, said actuating member engaging said contact carrier to operate the movable contact from one position to another against said bias, over-center spring means engaging a portion of said lever member and biasing said lever member into one or the other of its two positions, said spring means being supported at one end by said lever member, and means supporting said spring means at its other end from said housing, the position of said spring in said two positions of said lever member causing the bias of said lever into said two positions to be different in amount and opposite in direction to compensate for the biasing action exerted by the contact carrier on said lever member, and interengaging cam surfaces on said actuating member and contact carrier, the relative inclination of certain portions of the surfaces causing slow initial contact separation, the relative inclination of other adjacent surfaces causing more rapid continued contact separating movement as said actuating member is moved further without substantial variation in rate.

14. An electric switch comprising an insulating casing, a fixed contact mounted therein, a movable contact engaging and disengaging said fixed contact, a molded insulation operating handle having molded trunnions seated in bearings in the wall of said casing, a cover for said casing engaging said trunnions and holding them in their bearings, a flexible contact carrier biased toward said handle, an operating cam molded integrally with said handle and engaging said carrier to operate said movable contact, a finger on said handle, over-center spring means engaging said finger, a seat for said spring means located in the bottom of said casing, said seat being offset to provide a larger component of force in one at-rest position of said switch than in the other, said larger component compensating for the force exerted by the bias of said carrier on said handle in said other position.

15. A switch as claimed in claim 14 wherein the spring

seat in the casing bottom comprises a U-shaped metal member.

16. A switch as claimed in claim 14 wherein the spring seat in the casing bottom comprises a U-shaped metal member, and slots in the casing into which the arms of said U-member fit to enable the stamping to be dropped into place in the casing.

17. A switch as claimed in claim 14 wherein the spring seat in the casing bottom comprises a U-shaped metal member, and slots in the casing into which the arms of said U-member fit to enable the stamping to be dropped into place in the casing, the transverse portion of the U-member being offset from the plane of said arms.

18. A switch as claimed in claim 14 wherein the spring seat in the casing bottom comprises a U-shaped metal member, said U-member having parallel arms and a transverse portion offset from the plane of said arms.

19. An electric switch as claimed in claim 2 having oppositely facing contacts on said contact carrier, two fixed contacts alternately engageable by the contacts of said contact carrier when said switch is alternately in its two positions.

20. An electric switch as claimed in claim 1 having oppositely facing contacts on said contact carrier, two fixed contacts alternately engageable by the contacts of said contact carrier when said switch is alternately in its two positions.

21. An electric switch as claimed in claim 5 having oppositely facing contacts on said contact carrier, two fixed contacts alternately engageable by the contacts of said contact carrier when said switch is alternately in its two positions.

22. In an electric switch, a manually operable lever movable about a pivotal axis between two at-rest positions, an actuating member movable with said lever member, two fixed contacts, a movable contact carrier, movable contacts on said carrier alternately engageable by said movable contacts when the switch is alternately in its two positions, and interengaging cam surfaces on said

actuating member and contact carrier, the relative inclination of certain portions of the surfaces causing slow initial contact separation, the relative inclination of other adjacent surfaces causing more rapid continued contact separating movement as said actuating member is moved further without substantial variation in rate and regardless which of said fixed contacts is being disengaged.

23. An electric switch comprising a manually operable lever movable about a pivotal axis between two at rest positions, an actuating member movable with said lever member, fixed contacts, a contact carrier movable between said fixed contacts, movable contacts on said carrier alternately engageable with said fixed contacts when the switch is alternately in its two positions, and interengaging cam surfaces on said actuating member and contact carrier, the relative inclination of certain portions of the surfaces causing slow initial contact separation, the relative inclination of other adjacent surfaces causing more rapid continued contact separating movement as said actuating member is moved further without substantial variation in rate, said cam surfaces being operable in both directions of movement of said actuating member and regardless which fixed contact is being disengaged.

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