

Jan. 13, 1959

J. E. SORENG

2,868,906

KEY OPERATED SWITCH

Filed June 29, 1956

3 Sheets-Sheet 1

FIG. 1

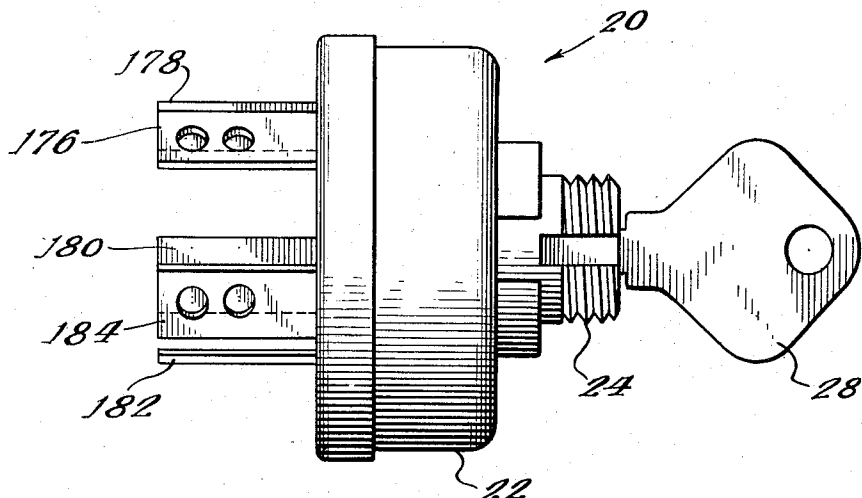


FIG. 2

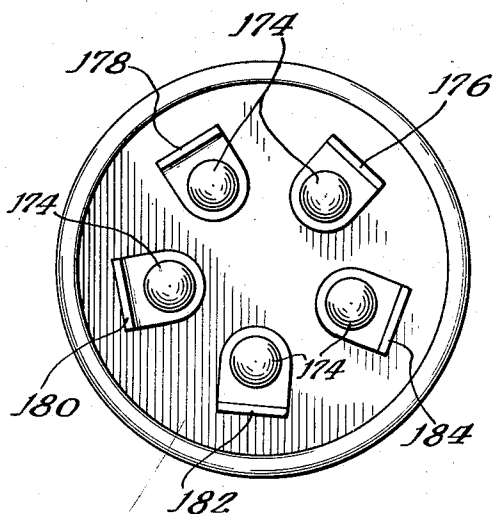
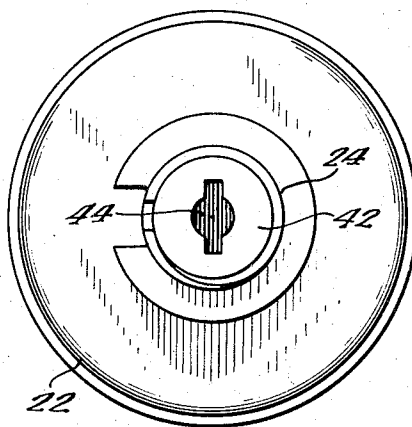


FIG. 3



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FIG. 4

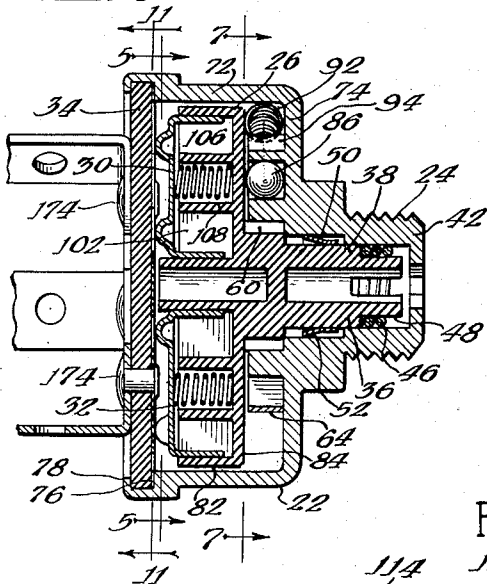


FIG. 5

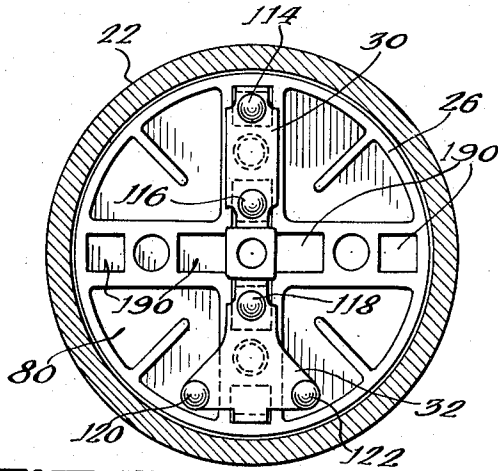


FIG. 10

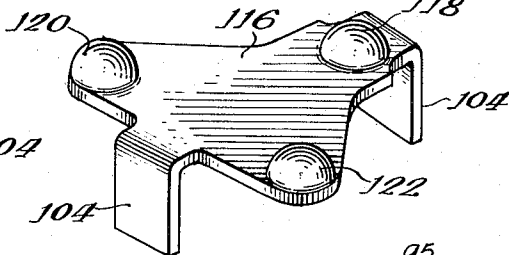


FIG. 9

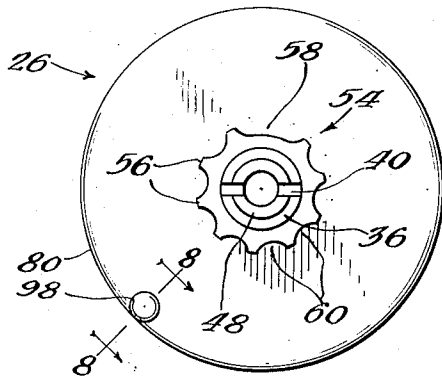
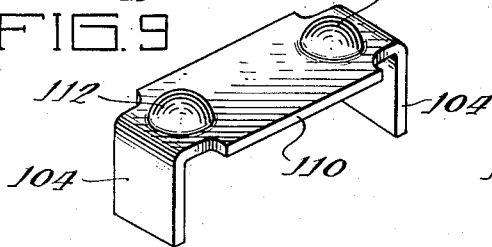


FIG. 6

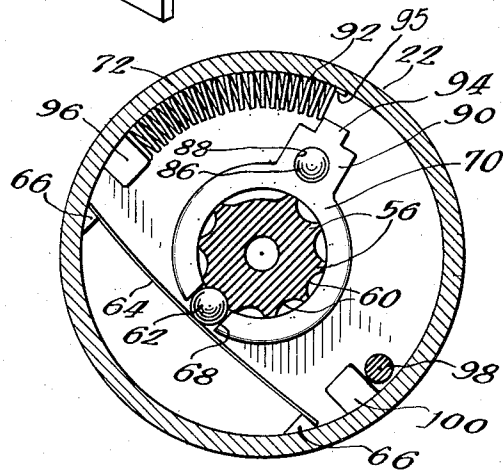
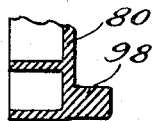


FIG. 7

FIG. 8



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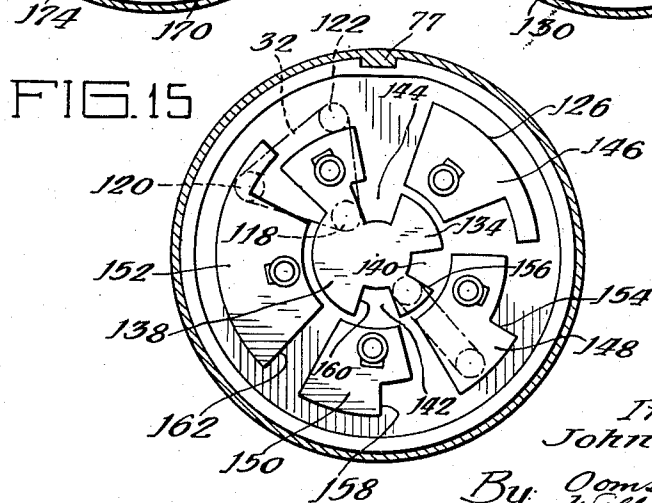
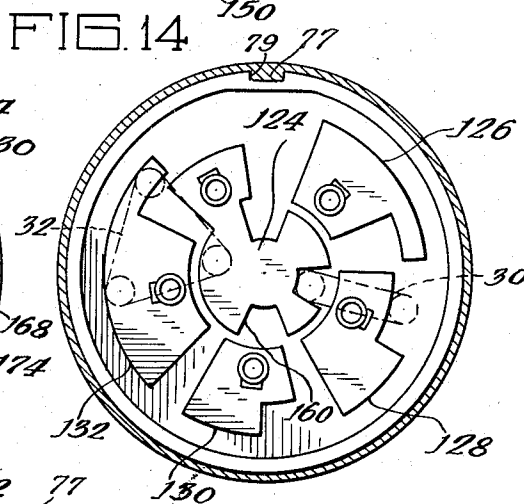
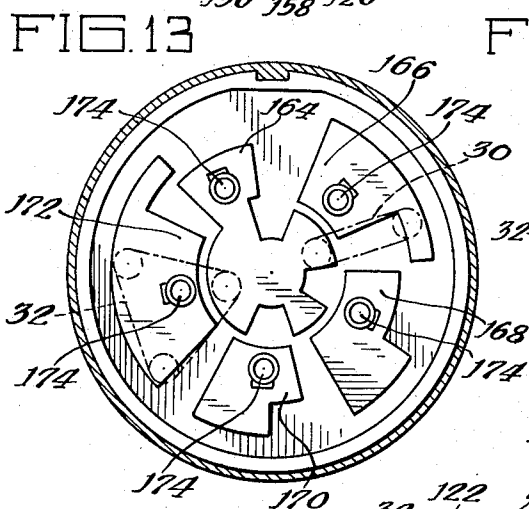
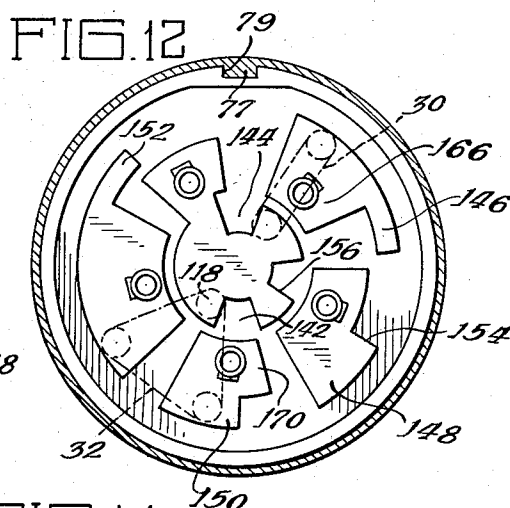
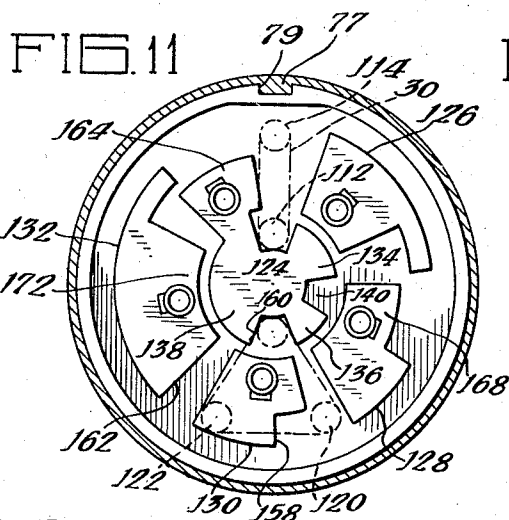
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KEY OPERATED SWITCH

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3 Sheets-Sheet 3



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KEY OPERATED SWITCH

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Application June 29, 1956, Serial No. 594,919

5 Claims. (Cl. 200—44)

This invention relates to electric switches and pertains particularly to key operated switches, such as those frequently employed on automobiles and other automotive vehicles and machines for controlling ignition, lighting, and starting circuits.

One object of the present invention is to provide a switch having a new and improved contact arrangement which provides for a multiplicity of contacts in a highly compact arrangement.

A further object is to provide a switch having a new and improved contact arrangement in which the fixed contacts are located on the face of an insulating plate and are arranged so that the circuits between the fixed contacts and the movable contacts may be broken at two points.

Another object is to provide a new and improved switch in which the movable contacts are arranged to bridge over and provide clearance for the rivets, or the like, employed to make connections to the fixed contacts.

It is a further object to provide a key operating switch having a new and improved one-piece rotor construction.

Another object is to provide a switch having a new and improved spring return arrangement whereby the rotor is returned resiliently from at least one position to another position.

A further object is to provide a new and improved spring return arrangement which utilizes a coiled compression spring in an economical and highly advantageous construction.

It is another object to provide a key operated switch having new and improved means for sealing the switch against the entry of moisture or foreign matter around the rotor shaft.

Further objects and advantages of the present invention will appear from the following description, taken with the accompanying drawings, in which:

Fig. 1 is a side elevational view of an illustrative embodiment of the invention in the form of a key operating switch for controlling ignition, lighting, and starting circuits in an automotive vehicle.

Fig. 2 is a rear elevational view of the switch of Fig. 1.

Fig. 3 is a front elevational view of the switch.

Fig. 4 is a central longitudinal sectional view of the switch of Fig. 1.

Fig. 5 is a cross-sectional view, taken generally along a line 5—5 in Fig. 4.

Fig. 6 is an elevational view showing the front of the rotor embodied in the switch of Fig. 1.

Fig. 7 is a cross-sectional view taken generally along a line 7—7 in Fig. 4.

Fig. 8 is a fragmentary sectional view taken generally along a line 8—8 in Fig. 6.

Figs. 9 and 10 are enlarged perspective views of the movable contacts embodied in the switch of Fig. 1.

Figs. 11–15 are cross-sectional views, taken along a line 11—11 in Fig. 4, to show the successive positions of the movable contacts in the five settings of the switch.

As already indicated, the drawings illustrate a key oper-

ated switch 20 which may be employed on a farm tractor, an automobile, some other vehicles, or various machines, to control several circuits, such as the ignition, lighting, and starting circuits. The illustrated switch 20 is provided with a housing 22, preferably made of metal, which has an axially disposed, forwardly projecting threaded bushing 24 adapted to be mounted on the control panel of the vehicle.

Within the housing 22 is a rotor 26 which is adapted to be rotated by a key 28. It will be seen from Figs. 4 and 5 that the rotor 26 carries two movable contacts 30 and 32 which are engageable with the front face of a contact mounting plate 34, preferably made of insulating material. Various fixed contacts, to be described later, are mounted on the plate 34 for engagement with the movable contacts 30 and 32.

The illustrated rotor 26 is preferably made in one piece out of a suitable plastic or other insulating material, such as nylon, for example. In this case, the rotor 26 has a forwardly extending shaft portion 36 which is journaled in a bore 38 formed in the bushing 24 on the housing 22. The shaft portion 36 is formed with a cross-slot 40 adapted to receive the key 28. It will be seen that the bushing 24 on the housing 22 is provided with a front wall 42 formed with a slot 44 through which the key may be inserted. The key is frictionally engaged and retained by a spring 46 coiled around a reduced portion 48 formed at the front end of the shaft 36. The spring 46 is mounted with a snug friction fit on the reduced portion 48 and is adapted to engage the key with a friction fit.

At the rear of the bore 38, the housing 22 is formed with an enlarged counterbore 50. It will be seen from Fig. 4 that a soft resilient sealing ring 52 is interposed between the shaft 36 and the counterbore 50 to prevent the entry of moisture or foreign matter into the housing 22. The sealing ring 52 may advantageously be made out of synthetic rubber, rubber, or suitable plastic. It is preferred to form the ring 52 initially as a simple flat washer, cut or otherwise formed out of sheet material. The washer is then stretched over the shaft 36 so that its inner portion will be in sealing engagement with the shaft. The outer portion of the ring 52 extends outwardly and is in sealing engagement with the bore 50. Sufficient clearance is provided between the bore 50 and the shaft 36 to receive the sealing ring 52.

A detent arrangement is provided to define and establish the various positions of the rotor 26. In this case, the rotor 26 is formed with a toothed gear-like detent receiving portion 54, located at the rear end of the shaft portion 36. It will be seen from Figs. 6 and 7 that the toothed portion 54 has nine teeth 56, which, however, are spaced as if there were ten equally spaced teeth. In other words, there is a blank space 58 where one tooth is missing. Notches 60 are provided between the teeth 56. It will be understood that the number and arrangement of the teeth 56 and the notches 60 may be varied as desired. In this case, a ball 62 serves as the detent and is engageable with the teeth 56 and the notches 60. The engagement between the ball 62 and the notches 60 serves to locate the rotor 26 in its various positions. The ball 62 is resiliently biased against the toothed portion 54 of the rotor 26. More specifically, a leaf spring 64 is arranged with its central portion engaging the ball 62, and with its end portions engaging abutments or lugs 66, formed on the housing 22. The ball 62 is movable inwardly and outwardly in a radial slot 68 which is provided in a sleeve-like formation 70 on the housing 22.

It will be seen from Fig. 4 that the housing 22 is generally cup-shaped and is provided with a generally cylindrical outer wall or flange 72, extending rearwardly from the generally disc-shaped front wall 74. The sleeve-like formation 70 projects rearwardly from the

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front wall 74. The contact mounting plate 34 is seated against a rearwardly facing internal shoulder 76 formed adjacent to the rear edge of the outer wall 72 and is retained by an inwardly turned flange 78. To locate and register the contact mounting plate 34, a key 77 on the housing 22 is arranged to engage a key slot 79 in the edge of the plate 34.

It will be seen from Figs. 4 and 6 that the rotor 26 has a generally disc-like main or body portion 80 which is housed within the outer wall 72 of the housing 22. The body portion 80 has a cylindrical outer surface 82 which is slightly smaller in diameter than the inside diameter of the outer wall 72 so as to provide slight clearance therebetween.

The body portion 80 of the rotor 26 has a flat front surface 84 which is engageable by a thrust bearing 86 carried by the housing 22. In this case, the thrust bearing 86 takes the form of a ball received in a recess or cavity 88 formed in a boss 90 which extends rearwardly from the front wall 74 of the housing 22. The ball 86 is adapted to rotate freely as the rotor 26 is turned.

The arrangement of the switch 20 is such that the rotor 26 is resiliently returned from at least one of its positions. In this case, the rotor 26 is returned from the position at one extreme end of its range of rotation to the adjacent position. This spring return position may advantageously be used to control the starting circuit of the vehicle, since this circuit is energized only momentarily. In this case, the switch 20 is provided with a return spring 92 which advantageously takes the form of a coiled compression spring. In its free state, the spring 92 is preferably straight. However, when the spring 92 is in its normal position in the switch 20, it extends along a curved path immediately adjacent the inside of the cylindrical wall 72. The spring 92 is held in place by a radial projection 94 on the boss 90, and an opposed inwardly extending projection 95 on the housing wall 72. One end of the spring 92 engages a stop or abutment 96 extending inwardly from the housing wall 72. The other end of the spring 92 is initially engaged with the projections 94 and 95. The spring 92 is initially pre-compressed or pre-loaded between the stop 96 and the projections 94 and 95. The pre-compression holds the spring 92 outwardly in bowed position against the curved wall 72. A pin-like lug 98 extends rearwardly from the body portion 80 of the rotor 26 and is movable between the projections 94 and 95, into engagement with the end of the spring 92. It will be seen from Fig. 7 that the lug 98 is also engageable with a stop 100 formed on the housing 22. Thus the stop 100 defines one end of the range of rotation of the rotor 26. As the rotor 26 is rotated, the lug 98 moves from the stop 100 toward the end of the spring 92. In the last position of the rotor 26, the lug 98 compresses the spring 92, with the result that the spring returns the rotor from the last position when the rotor is released. The blank space or missing tooth 58 on the detent member 54 provides for the free return of the rotor 26, without the resistance of detent action. When the spring 92 is compressed by the pin 98, it is held against the inside of the cylindrical wall 72 with increased force.

While the body portion 80 of the rotor 26 is generally disc-like in form, it is hollowed out to reduce its weight and the amount of material therein. Moreover, the rear face of the rotor disc 80 is formed with cavities or recesses 102 to receive and retain the movable contacts 30 and 32. In this case, each of the movable contacts 30 and 32 has a pair of rearwardly projecting lugs or prongs 104 which are movable forwardly and rearwardly in the recesses 102. Springs 106 are employed to bias the movable contacts 30 and 32 rearwardly against the contact plate 34. From Figs. 4 and 5, it will be seen that the illustrated springs 106 are in the form of coiled compression springs seated in rearwardly opening bores or cavities 108 formed in the rotor disc 80. One of the

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springs 106 acts between the rotor 26 and each of the movable contacts 30 and 32. From Figs. 4, 5 and 9 it will be seen that the movable contact 30 has a bar-like main or body portion 110 formed with inner and outer rearwardly extending projections 112 and 114. In this case, the projections 112 and 114 are in the form of generally semispherical pimple-like members pressed rearwardly from the body portion 110. The projections 112 and 114 are spaced apart radially.

The movable contact 32 also has a body portion 116, which, however, is generally triangular in shape. One inner projection 118 and two outer projections 120 and 122 are provided on the contact member 32. Individually, the projections 118, 120 and 122 are similar to the projections 112 and 114. Moreover, the radial spacing between the inner projection 118 and the outer projections 120 and 122 is substantially the same as between the projections 112 and 114. The outer projections 120 and 122 are spaced apart to provide two distinct outer points of engagement between the contact 32 and the plate 34.

Various arrangements of fixed contact may be provided on the mounting plate 34. In this case, a single inner contact 124 is provided, along with four outer contacts 126, 128, 130 and 132. All of the fixed contacts 124—132 are in the form of thin plate-like members mounted on the front face of the insulating plate 34. The fixed contacts 124—132 may advantageously be formed by known or suitable circuit printing techniques.

The inner fixed contact 124 has one or more projections extending along segments of a circular path corresponding in radius to the radial position of the inner contact projections 112 and 118 on the movable contacts 30 and 32. In this case, the inner fixed contact 124 has three such portions 134, 136 and 138, separated by breaks or spaces 140, 142 and 144. It will be understood that a plurality of inner fixed contacts might be provided instead of the single inner contact employed in this present switch.

Each of the outer fixed contacts 126, 128, 130 and 132 has one or more portions extending along a circular path corresponding in radius to the radial position of the outer contact projections 114, 120 and 122 on the movable contacts 30 and 32. In this case, each of the outer contacts 126—132 has one such portion. These portions have been designated 146, 148, 150 and 152.

In some cases, the radial edges of the contact portions 146—152 are aligned radially with the edges of the contact portions 134—138 on the inner fixed contact 124. With this arrangement the circuits established by the movable contact 30 will be broken at two points when the contact is moved over the aligned edges. It will be seen from Figs. 11—15 that the radial edges of the outer contact portion 146 are aligned radially with the radial edges on the inner contact portion 134. Likewise, one radial edge 154 on the contact portion 148 is aligned radially with one radial edge 156 on the contact portion 128.

To provide for double breaks between the triple contact 32 and the fixed contacts, certain of the arcuately extending portions on the outer fixed contacts are arranged with their radial edges displaced from radial edges on the inner contact portions by an angle corresponding to the angle between the inner contact projections 118 and the outer contact projections 120 and 122. Thus the outer contact portion 130 has a radial edge 158 which is displaced from one radial edge 160 on the inner contact portion 138 by an amount corresponding to the angle between the inner and outer projections 118 and 120. Likewise, one radial edge 162 of the outer contact portion 152 is displaced from the edge 160 by an angle corresponding to the angle between the projections 118 and 122.

Both the inner and the outer fixed contacts 124—132 have respective portions which are located along a circle disposed between the paths of the inner contact projections 112 and 118 and the outer contact projections 114, 120 and 122. These portions are employed for making connections to the fixed contacts 124—132. In Figs. 11—

15, these intermediate portions are designated 164, 166, 168, 170 and 172. Rivets 174, or the like, extend through the mounting plate 34 and the contact portions 164—172 to make connections to the contacts 124—132. Connection lugs 176, 178, 180, 182 and 184 are secured to the insulating plate 34 by the rear ends of the rivets 174.

It will be seen from Fig. 14 that the body portions 110 and 116 of the movable contacts 30 and 32 bridge over the heads of the rivets 174. In other words, contact projections 112—122 space the contact members 110 and 116 forwardly from the plate 34 so as to provide ample clearance for the rivets 174.

Figs. 11—15 illustrate the sequence of operation of the switch 20. In considering the operation of the switch, it will be assumed that the inner fixed contact 124 is connected to a battery or some other source of power. The outer fixed contact 126 may be connected to headlights and taillights on the vehicle. The starting motor circuit may be connected to the outer contact 128. The contact 130 may be connected to a flood lamp or some other accessory. The ignition circuit may be connected to the contact 132.

Fig. 11 represents the "off" position in which the inner contact projections 112 and 118 are aligned with breaks or spaces 144 and 142 in the inner contact 124. In Fig. 12, the contacts 30 and 32 have been moved to the second position, in which the contact 30 establishes a connection between the battery contact 124 and the headlight contact 126, while the triple contact 32 establishes connections between the battery contact 124, on one hand, and the flood lamp and ignition contacts 130 and 132, on the other.

In the third position of the switch, shown in Fig. 13, the connection between the battery and headlight contacts 124 and 126 is maintained. The connection between the battery and flood lamp contacts 124 and 130 is broken, while the connection between the battery and ignition contacts 124 and 132 is maintained.

When the switch is moved to its fourth position, as shown in Fig. 14, the connection between the battery and headlight contacts 124 and 126 is broken. Because of the alignment between the radial edges of the contact portions 134 and 146, the break in this circuit is double, along both edges. In this position, the triple contact 32 maintains the connection between the battery and ignition contacts 124 and 132.

In the fifth and final position of the switch, as shown in Fig. 15, the ignition connection is maintained by the triple contact 32. The double contact 30 establishes a connection between the battery contact 124 and the starting contact 128.

It will be recalled that the compression spring 92 returns the rotor 26 from the starting position of Fig. 15 to the ignition position of Fig. 14 when the rotor is released. The break in the starting circuit occurs at two points, along the aligned edges 154 and 156 of the contact portions 148 and 136.

When the rotor 26 is moved from the second position of Fig. 12 to the first position of Fig. 11, the headlight circuit is broken at two points by the double contact 30, along the aligned radial edges of the contact portions 134 and 146. Likewise, the ignition and flood lamp circuits are broken at two points by the triple contact 32 because of the fact that the edges 158 and 162 are displaced from the edge 160 by an amount corresponding to the angular displacement between the inner contact projection 118 and the outer projections 120 and 122.

It will be understood that the spring pressed detent ball 62 and the toothed detent member 54 locate the rotor 26 in its various positions. As the rotor 26 is turned, each of the teeth 56 in turn pushes the ball 62 outwardly against the force of the spring 64. The ball 62 snaps into the next notch 60 and thereby locates the rotor 26 in its new position. However, the blank space 58 permits the free return of the rotor 26 from its final

position, by the action of the coiled compression spring 92.

It will be seen from Fig. 5 that the movable contacts 30 and 32 are disposed in diametrically opposite positions on the back of the rotor 26, in the present construction. However, the positions of the movable contacts may be varied to adapt the switch for various applications. Thus, it will be seen that the contacts 30 and 32 may be repositioned in cavities 190, which correspond generally to the cavities 102, but are displaced ninety degrees therefrom on the back of the rotor 26. Likewise, the shape and position of the various fixed contacts may be changed in adapting the switch for various applications. Changes may also be made in the length and position of the return spring 92, the number and position of the detent notches 60, the position of the stop 98 on the rotor 26, and the location of the fixed stops 96 and 100.

Various other modifications, alternative constructions, and equivalents may be employed without departing from the true spirit and scope of the invention, as exemplified in the foregoing description and defined in the following claims.

I claim:

1. In a switch, the combination comprising a rotor, an insulating plate spaced rearwardly from said rotor, inner and outer thin plate-like fixed contacts mounted on the front of said plate and having respective portions extending along concentric spaced inner and outer circular paths, said contacts having additional portions disposed between said circular paths, terminal elements extending through said plate and engaging said additional portions, a movable contact carried by said rotor and having inner and outer rearwardly extending projections engageable with said fixed contacts and movable along said inner and outer paths, and a bridge portion on said movable contact extending between said projections and spaced from said fixed contacts to afford clearance for said terminal elements.

2. In a switch, the combination comprising a rotor, an insulating plate spaced rearwardly from said rotor, inner and outer thin plate-like fixed contacts mounted on the front of said plate and having respective portions extending along concentric spaced inner and outer circular paths, said contacts having additional portions disposed between said circular paths, terminal elements extending through said plate and engaging said additional portions, a movable contact mounted on said rotor for rearward and forward movement and having inner and outer rearwardly extending projections engageable with said fixed contacts and movable arcuately along said inner and outer paths, means resiliently biasing said movable contact rearwardly against said plate and said fixed contacts, and a bridge portion on said movable contact extending between said projections and spaced from said fixed contacts to afford clearance for said terminal elements.

3. In a switch, the combination comprising a rotor, an insulating plate spaced rearwardly from said rotor, at least one inner thin plate-like fixed contact mounted on the front of said plate and having a portion extending along an inner circular path, a plurality of outer thin plate-like fixed contacts mounted on the front of said plate and having respective angularly distributed portions extending along an outer circular path concentric with and spaced outwardly from said inner circular path, said inner and outer contacts having additional portions disposed between said inner and outer circular paths, terminal elements extending through said plate and engaging said additional portions, a movable contact carried by said rotor and having inner and outer rearwardly extending projections engageable with said inner and outer fixed contacts and movable along said inner and outer paths, and a bridge portion on said movable contact extending between said projections and spaced from said

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inner and outer fixed contacts to afford clearance for said terminal elements.

4. In a switch, the combination comprising a rotor, an insulating plate spaced rearwardly from said rotor, inner and outer thin plate-like fixed contacts mounted on the front of said plate and having respective portions extending along concentric spaced inner and outer circular paths, said contacts having additional portions disposed between said circular paths, terminal elements extending through said plate and engaging said additional portions, a plurality of angularly spaced movable contacts carried by said rotor, each of said movable contacts having inner and outer rearwardly extending projections engageable with said fixed contacts and movable along said inner and outer paths, and a bridge portion on each of said movable contacts extending between said projections and spaced from said fixed contacts to afford clearance for said terminal elements.

5. In a switch, the combination comprising a generally cup-shaped housing having a front wall with a generally cylindrical outer wall extending rearwardly therefrom, an axial bushing portion extending forwardly from said front wall, a rotor having a generally disc-shaped body portion received in said housing and an integral shaft portion extending forwardly from said body portion and journaled in said bushing portion, said housing having a bore therein concentric with and spaced outwardly from said shaft portion, a thin flat washer made of soft elastic material and stretched over said shaft portion, said washer engaging said bore to form a seal between said bore and said shaft portion, an insulating plate closing the

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rear of said housing and spaced rearwardly from said rotor, inner and outer thin plate-like fixed contacts mounted on the front of said plate and having respective portions extending along concentric spaced inner and outer circular paths, said contacts having additional portions disposed between said circular paths, terminal elements extending through said plate and engaging said additional portions, at least one movable contact carried by said rotor and having inner and outer rearwardly extending projections engageable with said fixed contacts and movable along said inner and outer paths, a bridge portion on said movable contact extending between said projections and spaced from said fixed contacts to afford clearance for said terminal elements, a coiled linear compression spring flexed into curved position along the inside of said outer wall of said housing, means in said housing for retaining said spring in said curved position, a stop on said housing engaging one end of said spring, and an abutment on said rotor movable into engagement with the other end of said spring for compressing said spring.

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