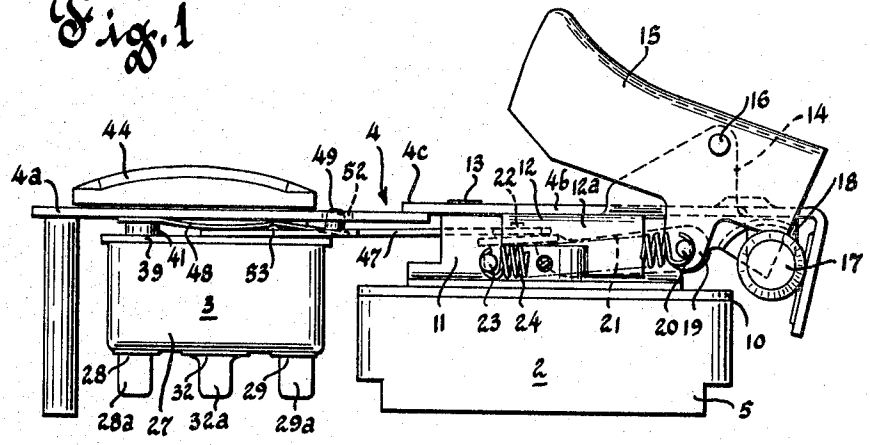
Aug. 16, 1966 R. E. LARKIN 3,267,223

INTERLOCKING MECHANISM FOR ELECTRIC SWITCHES

Filed Aug. 12, 1964 2 Sheets-Sheet 1

Fig. 1



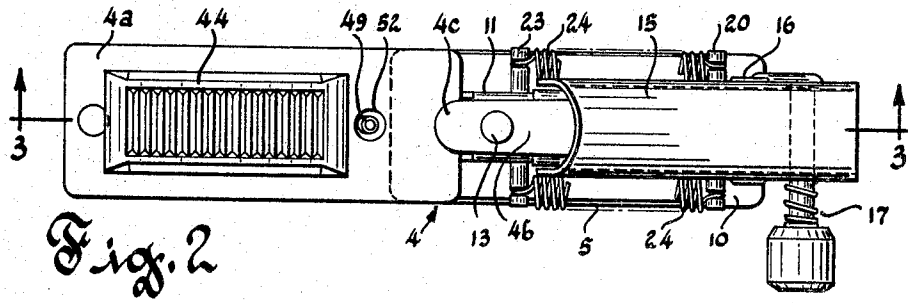
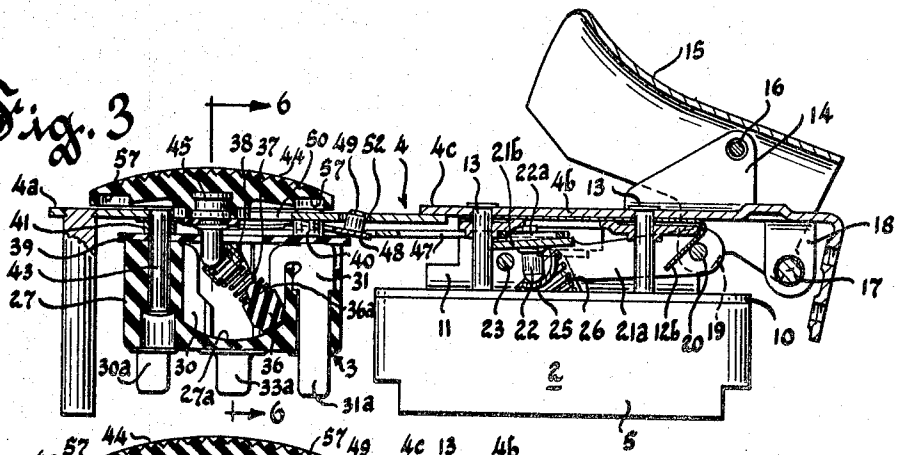


Fig. 2

Fig. 3



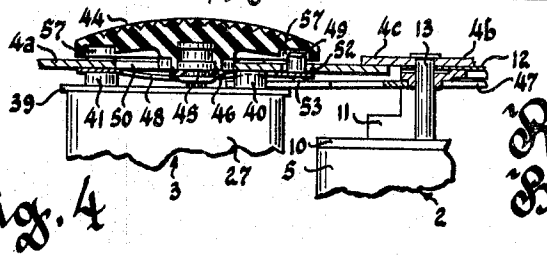


Fig. 4

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INTERLOCKING MECHANISM FOR ELECTRIC SWITCHES

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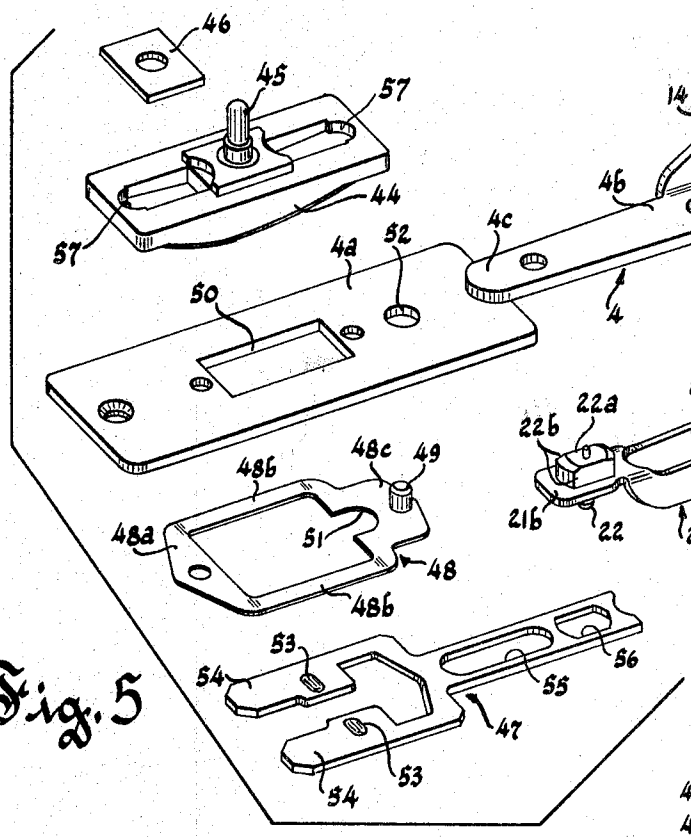

Fig. 5

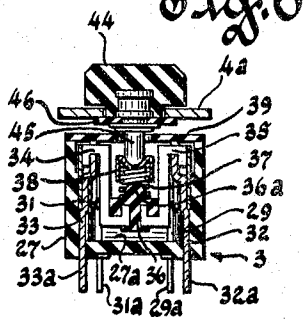

Fig. 6

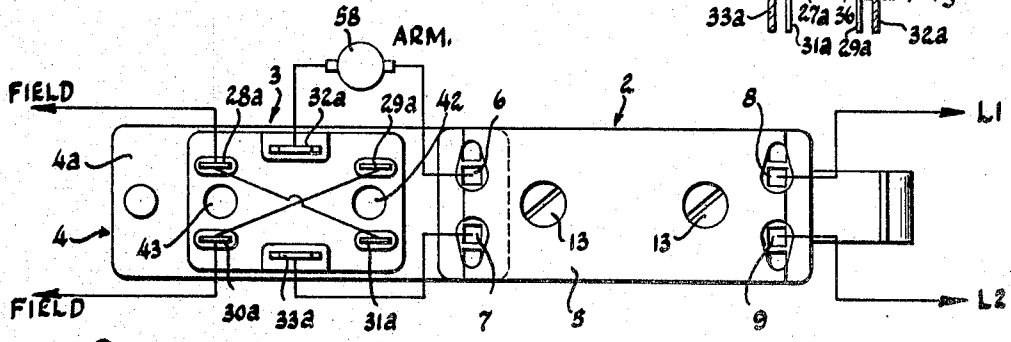

Fig. 7

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3,267,223

INTERLOCKING MECHANISM FOR ELECTRIC SWITCHES

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6 Claims. (Cl. 200—5)

This invention relates to interlocking mechanisms for electric switches and more particularly to switch interlocking mechanisms suitable for portable electric tools having on-off switches together with reversing or two speed switches.

It is an object of this invention to provide an improved interlocking mechanism for a switch assembly including an on-off switch, together with another switch for selection of either motor speed or operating direction, whereby the switch controlling motor speed or direction cannot be operated while the on-off switch is in the "on" position.

It is futher object of this invention to provide an interlocking mechanism of the aforedescribed type which is suitable for interlocking of minimally modified conventional switches of proven reliability.

It is still another object to provide a switch assembly of the aforedescribed type with an interlocking mechanism which occupies a minimum amount of space within the relatively confining interior spaces of portable tool housings and handles.

Various other objects and advantages of the invention will become apparent from the following description.

While the device hereinafter described is effective to fulfill the stated objects it is not intended that the invention be confined to the particular embodiment disclosed since it is susceptible of various modifications without departing from the scope of the appended claims.

In the drawings:

FIGURE 1 is a side view of an assembly incorporating the principles of the invention comprising two manually operable switches and an interlocking mechanism;

FIG. 2 is a top view of the switch assembly of FIG. 1;

FIG. 3 is a partially sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a fragmentary view in partial section taken on line 3—3 of FIG. 2, but with the switch illustrated in its opposite position;

FIG. 5 is an exploded isometric view of some of the elements of the interlocking mechanism;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 3; and

FIG. 7 is a bottom view of the switch assembly illustrating an exemplary wiring arrangement for use with the switch assembly.

Referring to the drawings, the switch assembly includes a double-pole single-throw trigger operated tool handle switch **2** of a type described in detail in the George J. Meuer Patent No. 1,977,078 and a double-pole, double-throw slide operated switch **3** of a type more completely described in the Alvin W. Krieger Patent No. 2,011,293. A mounting plate **4***a* of slide switch **3** and a mounting bracket **4***b* of trigger switch **2** are welded together at the overlapped portion **4***c* to form a common mounting assembly **4**.

Trigger switch **2** has a molded insulating base **5** for housing stationary and movable contacts (not shown) and associated press-in terminals **6**, **7**, **8** and **9** (FIG. 7) accessible via apertures in the lower surface of base **5**. When in the "on" position the switch mechanism serves to electrically connect terminal **6** to terminal **8** and connect terminal **7** to terminal **9**. An insulating plate **10** covers the top of base **5**. A switch frame **11** having

the shape of an inverted channel rests atop plate **10**. A thin sheet metal dust cover **12** is assembled over frame **11** with depending portions **12***a* and **12***b* for partially covering openings in frame **11** to reduce the entry of dust and other extraneous materials. A pair of rivets **13** pass through base **5**, plate **10**, frame **11**, dust cover **12** and a pair of apertures in bracket **4***b* to fasten the assembly to mounting bracket **4***b*. A pair of upstanding lugs **14** extend from the edges of bracket **4***b* to pivotally support trigger **15** on a pin **16**. A spring biased plunger **17** transversely slidable in the alined apertures of a pair of lugs **18** serves, when depressed against the spring bias, to lock the trigger **15** in its "on" position.

A pair of lugs **19** extend below bracket **4***b* to be pivotally connected by pin **20** to a pair of parallel arms **21***a* of a forked guide link **21** (FIG. 5). A guide pin **22** extends through and is fastened to a tab **21***b* at the other end of guide link **21**. A pin **23** similar to pin **20** extends transversely through apertures in frame **11**. A pair of tension springs **24** between the ends of pin **23** and pin **20** serve to pull pin **20** toward pin **23** and thereby bias the trigger **15** and the associated switch mechanism to the "off" position. The rounded lower end of guide pin **22** engages a generally hemispherical spring guide **25** at the upper end of an overcenter spring **26** of the conventional mechanism of switch **2**. Pin **22** has a flanged upper portion **22***a* overlying the upper surface of tab **21***b* and having flattened parallel sides **22***b*. To operate switch **2**, trigger **15** is depressed from the "off" position illustrated in FIGS. 1 and 3 to pivot about pin **16**. Guide link **21** and guide pin **22** are thereupon pulled to the right to move the upper end of spring **26** over center to cause completion of the circuits within switch **2**. When pressure is removed from trigger **15**, springs **24** reverse the movement, trigger **15** rotates clockwise and guide pin **22** moves toward the left. Spring **26** consequently moves overcenter and the mechanism returns to its "off" position.

Switch **3** is basically a conventional slide operated double-pole, double-throw switch. A base member **27** molded of a suitable insulating material has a substantially rectangular central main recess **27***a*. Four stationary contact members **28**, **29**, **30** and **31** are arranged within base **26** near the respective four corners thereof with contact portions extending into recess **27***a* and with terminal portions **28***a*, **29***a*, **30***a* and **31***a* extending from the lower surface of base **26**. Two terminal and bearing plates **32** and **33** are supported in base **26** between stationary contacts **28**, **29**, **30** and **31** with terminal portions **32***a* and **33***a* extending from the lower surface of base **26**. The upper ends of plates **32** and **33** are formed and recessed to provide bearings for the hooked ends of a U-shaped toggle contactor assembly comprising two generally S-shaped contactors **34** and **35** connected mechanically and insulated electrically at their lower ends by a molded insulating member **36** as best shown in FIG. 6. A rounded nib **36***a* on the upper surface of member **36** serves to retain the lower end of an overcenter compression spring **37**. A spring guide **38** covers the upper end of spring **37**.

A slotted insulating plate **39** covers the open top of base **26**. A cylindrical spacer **40** and a rectangular spacer **41** are placed between plate **39** and mounting plate **4***a*. A pair of rivets **42** and **43** pass through base **26**, plate **39**, mounting plate **4***a* and the respective spacers **40** and **41** to fasten switch **3** to the assembly. A slide button operator **44** lies atop plate **4***a* and a depending pin **45** passes through plate **4***a* and the slot in insulating plate **39** to pivotally engage the spring guide **38**. An insulating plate **46** is fastened to pin **45** below mounting plate to

retain operator 44 in slidable assembly with mounting plate 4*a*.

In a conventional manner, the reciprocation of button 44 between the position of FIG. 3 and the position of FIG. 4 serves to move the upper end of spring 37 over center. Consequently, contactors 34 and 35 are pivoted to electrically connect terminal 32*a* alternately to terminal 29*a* or terminal 28*a* and terminal 33*a* alternately to terminal 31*a* or 30*a*. By appropriate wiring, switch 3 can therefore be made to function as a two-speed or a reversing switch.

Switches 2 and 3 are interlocked by means comprising a slider plate 47 and a spring member 48 with an attached pin 49. The substantially flat spring 48 comprises three portions 48*a*, 48*b* and 48*c* which are set at small angles to one another. Portion 48*a* is firmly anchored between spacer 41 and mounting plate 4*a* by rivet 43. The intermediate flexible portion comprises two parallel elements 48*b* spaced apart to pass on either side of aperture 50 in plate 4*a* through which pin 45 operates. Spring 48 is closed at its free end by portion 48*c*. A recess 51 is formed therein for clearance of spacer 40. Pin 49 is securely fastened to portion 48*c* adjacent the end thereof to project upwardly into aperture 52 in plate 4*a*. Portions 48*b* and 48*c* are set at such angles to portion 48*a* that portion 48*c* angles downwardly away from portion 48*b* to form an inclined plane. The end of portion 48*c* and the attached pin 49 are thereby spring biased downwardly away from plate 4*a*.

The forked end of slider plate 48 is assembled below spring 48 so that the upwardly facing nibs 53 slidingly contact the lower inclined plane surface of portion 48*c*. The forked arms 54 of slider plate 47 slidingly bear against the upper surface of insulating plate 39 and are spaced apart to clear spacer 40. A slot 55 is formed in slider plate 47 to clear one of the rivets 13. An aperture 56 in the end of plate 47 fits closely over the upper end 22*a* of pin 22 to thereby cause slider plate 47 to reciprocably move in unison with guide link 21 as trigger switch 2 is operated between its "on" and "off" positions.

When trigger 15 is depressed to the "on" position guide link 21 and slider plate 47 move toward the right with reference to FIGS. 3 and 4. As slider plate 47 moves to the right, nibs 53 slide to the right in contact with the lower inclined plane surface of portion 48*c*. Since nibs 53 move in a horizontal direction and portion 48*c* angles downwardly to the right, portion 48*c* and pin 49 are forced upwardly as trigger switch 2 moves to its "on" position. In FIG. 3, trigger switch 2 is shown in the "off" position. Pin 49 extends only slightly above the top surface of plate 48 and slide operator 44 is consequently free to move between its two operating positions without interference with pin 49. When trigger switch 2 is moved from its "off" position toward its "on" position, pin 49 is forced upwardly as previously explained to extend substantially above the upper surface of plate 4*a* as shown in FIG. 4. When pin 49 is in this extended position slide operator 44 is prevented from moving from one position to another. When slide operator 44 is in the leftward position as in FIG. 3, the extended pin 49 prevents rightward movement of operator 44 by interference with the right end surface of operator 44. When slide operator 44 is in its rightward position as shown in FIG. 4, pin 49, when raised, extends into a recess 57 in the lower surface of operator 44 to prevent leftward movement thereof. Upon release of trigger switch 2 to its "off" position, slide plate 47 returns to the left and the spring bias of spring 48 returns pin 49 to its retracted position of FIG. 3.

It can be seen therefore that the aforedescribed interlocking mechanism is effective to prevent operation of slide switch 3 between its two operating positions when trigger switch 2 is moved from its "off" position. It can also be seen that slide switch 3 is free to move between its operation positions when trigger switch 2 is in its "off" position.

FIG. 7 illustrates exemplary connections which may be used to adapt switch 3 to function as a motor reversing switch while switch 2 serves as an "on-off" switch. Terminals 8 and 9 of switch 2 are connected to power lines L1 and L2, respectively. At the opposite sides of switch 2 terminal 7 is connected to a center terminal 33*a* of switch 3. Terminal 6 is connected to one side of the armature 58 of the motor which is typically of the universal type. The other side of armature 58 is connected to the other center terminal 32*a* of switch 3. Terminals 29*a* and 31*a* are cross-connected to terminals 30*a* and 28*a*, respectively. Terminals 28*a* and 30*a* are connected to opposite sides of the motor field winding (not shown). Switch 2 is therefore effective to energize both the armature and field when moved to its "on" position, and operation of switch 3 between its opposite operating positions as heretofore described is effective to reverse the polarity of the field winding with respect to the motor armature and thereby cause reversal in the direction of rotation of the motor.

While the combination switch assembly hereinbefore described is effective to function as a motor reversing switch, it may easily be adapted by one skilled in the art to other uses such as two speed control of a two speed motor.

I claim:

1. In an electrical switch assembly;
a first switch having first and second operating positions;
a second switch having a base member and a movable operating member exterior thereto;
mounting means to which said second switch is fastened, the operating member of said second switch being on one side of said mounting means and said base member being mounted in the opposite side of said mounting means;
and interlocking means effective to prevent operation of said second switch when said first switch is moved from its first position but to allow operation of said second switch when said first switch is in its first operating position comprising:
locking means mounted between said base member and said mounting means communicating to said one side of said mounting means via an aperture in said mounting means and having extended and retracted positions with respect to said one side of said mounting means;
reciprocatory means mechanically linked to said first switch for movement between first and second positions as said first switch is operated between its corresponding first and second position;
and means engaging said locking means and operated by said reciprocatory means for moving, when said reciprocatory means moves to its second position, said locking means from its retracted position to its extended position to interfere with the movement of the operating member of said second switch by engagement therewith to thereby prevent operation of said second switch when said first switch is moved from its first position.

2. In an electrical switch assembly:
a first switch having first and second operating positions;
a second switch having a base member and an operating member exterior thereto operable between two operating positions;
mounting means to which said second switch is fastened, the operating member of said second switch being one side of said mounting means and said base member being mounted on the opposite side of said mounting means;
and interlocking means effective to prevent operation of said second switch when said first switch is in its second operating position but to allow oper-

ation of said second switch when said first switch is in its first operating position comprising:

a spring member mounted between said base member and said mounting means;

a locking member extending from said spring member for movement through an aperture in said mounting means and having extended and retracted positions with respect to said one side of said mounting means;

a slide member mechanically linked to said first switch for movement between first and second positions as said first switch is operated between its corresponding first and second positions;

and means movable with said slide member engaging said spring member for moving, when said slide member moves to its second position, said locking member from its retracted position to its extended position to interfere with the movement of the operating member of said second switch by engagement to thereby prevent operation of said second switch when said first switch is moved from its first position.

3. In an electrical switch assembly:

a first switch having first and second operating positions;

a second switch having a base member and a sliding operator exterior thereto reciprocably operable between two operating positions;

a mounting plate to which said first and second switches are fastened, said sliding operator being on one side of said mounting plate and in close proximity thereto, and said base member being mounted on the opposite side of said mounting plate;

and interlocking means effective to prevent operation of said second switch when said first switch is in its second operating position but to allow operation of said second switch when said first switch is in its first operating position comprising:

a substantially flat spring member mounted between said base member and said mounting plate, anchored securely at one end and having an inclined plane surface toward the free end thereof biased away from said mounting plate, locking means extending from said spring adjacent the free end thereof for movement through an aperture in said mounting plate and having extended and retracted positions with respect to said one side of said mounting plate;

a flat elongated slide member slidable between said spring and said base and mechanically linked to said first switch for movement between first and second positions as said first switch is operated between its corresponding first and second positions;

and means movable with said slide plate engaging the inclined plane surface of said spring member for moving when said slide plate moves to its second position, said locking means from its retracted position to its extended position to interfere with the movement of said sliding operator by engagement therewith to thereby prevent operation of said second switch when said first switch is moved from its first position.

4. The invention as defined in claim 3 in which said locking means comprises a pin fastened to and extending substantially perpendicular to said spring member.

5. The invention as defined in claim 3 in which said first switch is of the trigger operated type biased to said first operating position and is manually movable against its bias to said second operating position.

6. The invention as defined in claim 3 together with:

a contact making mechanism within the base member of said second switch;

a projection extending from the sliding operator of said second switch through an aperture in said mounting plate and mechanically connected to said contact making mechanism;

means fastening said spring member adjacent one end of said second switch, the free end of said spring member extending toward the opposite end of said second switch;

and an aperture located substantially centrally in said spring member, said projection passing freely therethrough for reciprocatory movement.

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