May 31, 1949. B. J. WILSON ET AL 2,471,806

THERMOSTATIC ELECTRIC SWITCH

Filed May 23, 1947 2 Sheets-Sheet 1

Fig. 1.

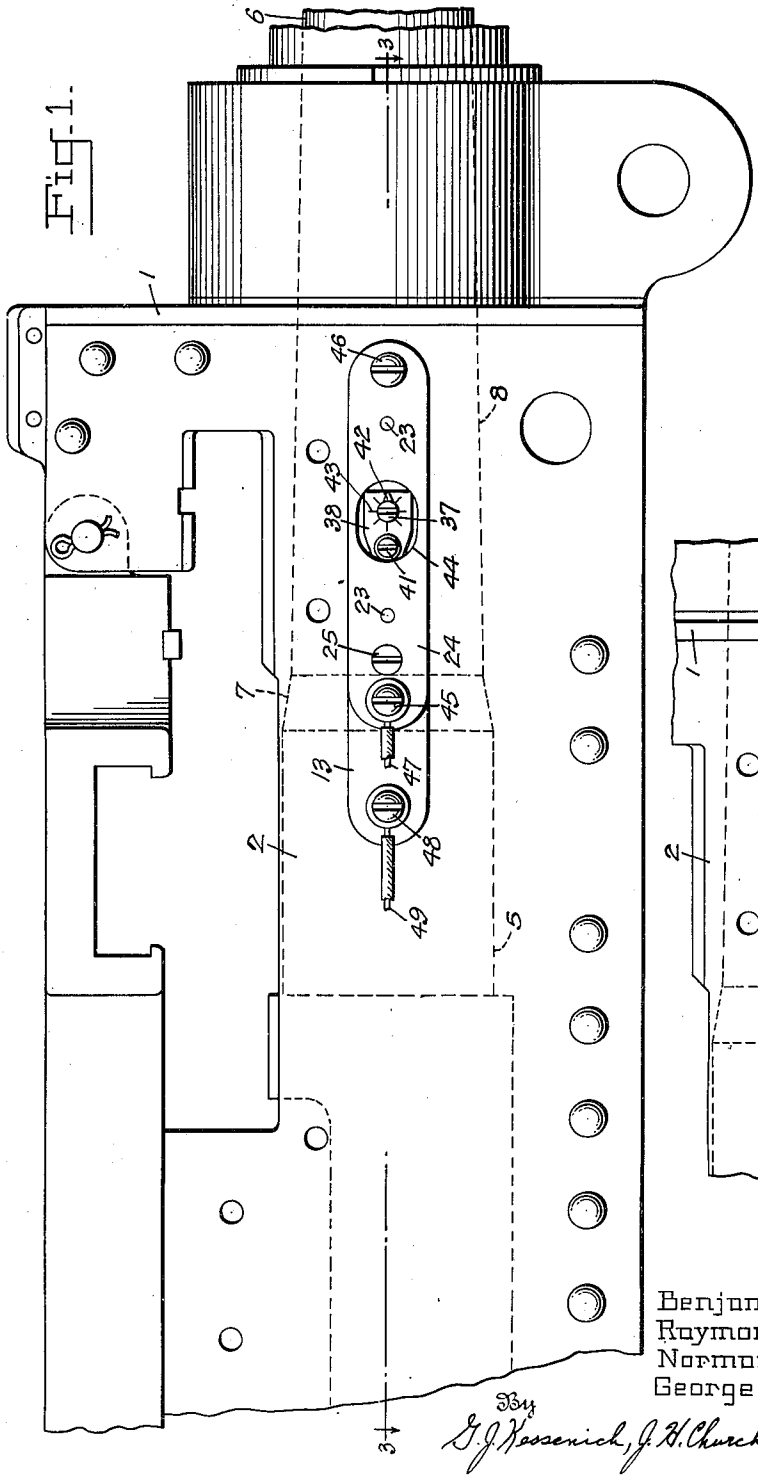
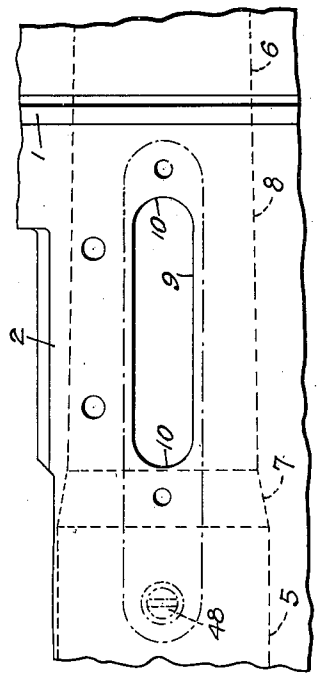


Fig. 2.



Inventors
Benjamin J. Wilson
Raymond C. Muchler
Norman E. Polster
George E. R. Murray

By G. J. Kossenich, J. H. Church & H. E. Thibodeau
Attorneys

May 31, 1949. B. J. WILSON ET AL 2,471,806

THERMOSTATIC ELECTRIC SWITCH

Filed May 23, 1947 2 Sheets-Sheet 2

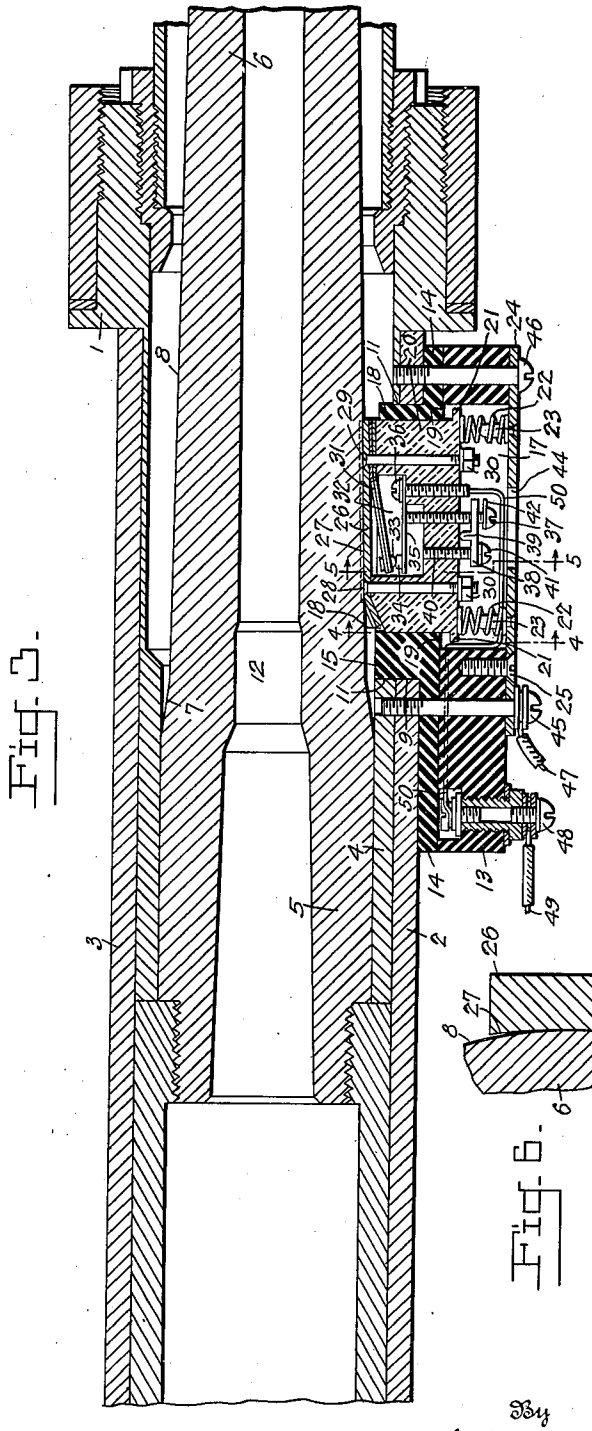


Fig. 3.

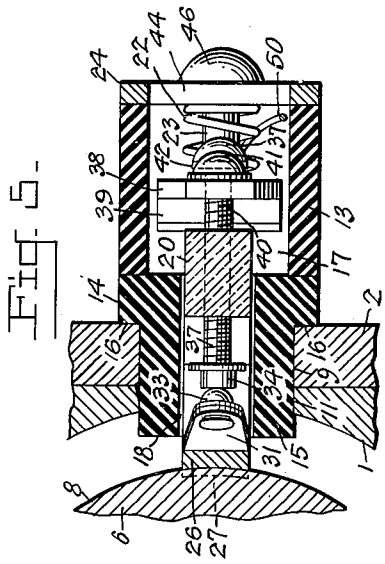


Fig. 5.

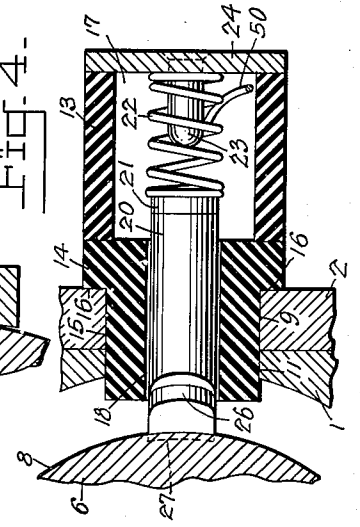


Fig. 4.

Fig. 6.

Inventors
Benjamin J. Wilson
Raymond C. Machler
Norman E. Polster
George E. R. Murray

By
G. J. Kessenich, J. H. Church & H. E. Thibodeau
Attorneys

Patented May 31, 1949

2,471,806

UNITED STATES PATENT OFFICE

2,471,806

THERMOSTATIC ELECTRIC SWITCH

Benjamin J. Wilson, Oreland, Raymond C. Machler, Philadelphia, Norman E. Polster, Willow Grove, and George E. R. Murray, Feasterville, Pa., assignors to the United States of America as represented by the Secretary of War

Application May 23, 1947, Serial No. 750,138

3 Claims. (Cl. 200—138)

1

This invention relates to an improvement in a thermostatic, electric switch having a bi-metallic element, to be operatively connected and thermo-conductively coupled to a relatively moving body, the variations of temperature of which operate the switch. This invention provides a switch to be mounted on an automatic machine gun and suitably connected to its electrical fire control system, to prevent a round of fixed ammunition in the gun barrel from being exploded or "cooked off" should the barrel become unduly heated after a prolounged period of firing.

Remote, electrically operated, control systems are now provided whereby the firing of an automatic gun, such as for instance a machine gun mounted in the wing of an airplane, may be initiated and stopped by the opening and closing of a switch of the fire control circuit. A remote control, electrically operated means has been devised and successfully employed, whereby a round of fixed ammunition is extracted from the barrel of the gun by retracting the bolt to which the round is secured and locking the bolt in the retracted position. Another electrically operated control means which has been previously employed, catches the bolt when it is automatically retracted to load the barrel and secures the bolt in that retracted position in a manner adapted to prevent firing. Neither of these bolt-control safety means, however, are operative when the fire control switch is closed, since in combat the firing of the machine gun is of first importance.

Experience has shown that, after a period of firing, the barrel of an automatic gun may become heated to such a high degree that the round of ammunition which is normally left in the barrel will become ignited and create an obviously dangerous situation which would have been avoided except for the fact that the above mentioned safety control means do not operate automatically when the barrel becomes dangerously heated but function only when the proper switch is manually operated.

It is the purpose of this invention to provide a thermostatic electric switch which functions automatically in an electrical control system in such a manner as to prevent a round of fixed ammunition from being fired by an overheated gun barrel.

Another object is to provide a thermostatic,

2

electric switch which is mounted on a stationary body or frame in such a manner that its thermostatic element will be thermo-conductively coupled to an adjacent movable member and will open or close the switch, as may be desired, when the temperature of the movable member reaches predetermined limits.

A further purpose is the provision of a thermostatic, electric switch of the character described which maintains operative contact with a relatively movable member even though the contacted surface of the movable member lies in a plane oblique to its direction of motion.

Other and further objects of this invention will become apparent from the appended drawings, the following specification and the accompanying claims.

While there has been illustrated in the drawings filed herewith, and hereinafter fully described one specific embodiment of the invention, it is to be distinctly understood that the invention is not considered to be limited to said specific embodiment, and that its scope is defined by the claims appended hereto.

In the drawings:

Figure 1 is a fragmentary side elevation of a machine gun provided with the improved switch.

Figure 2 is a side elevation of a small portion of the gun receiver, the switch being removed and its outline shown in broken lines.

Figure 3 is a horizontal section on the line 3—3 of Figure 1, in the direction of the arrows.

Figure 4 is an enlarged vertical section on the line 4—4 of Figure 3, in the direction of the arrows.

Figure 5 is an enlarged vertical section on the line 5—5 of Figure 3, in the direction of the arrows.

Figure 6 is a greatly enlarged vertical section of the comtact shoe of the switch and a fragment of the gun barrel, the parts being shown as related when the barrel is in full recoil.

As illustrated in the drawings, the improved switch is mounted on a .50 cal. automatic machine gun having a receiver provided with a trunnion block 1 and right and left side plates 2 and 3 riveted to the block 1 which has a portion 4 having a cylindrical bore in which the cylindrical portion 5 of the gun barrel 6 is slidable in recoil and counter-recoil. The barrel 6 has a frusto-

conical portion 7 immediately anterior of portion 5 and a tapered portion 8 anterior of portion 7.

In order to mount the switch on the gun, the right side plate 2 has a longitudinal slot 9 with semi-circular ends 10 (Figure 2) and the trunnion block 1 has a longitudinal slot 11 of the same configuration and dimensions as slot 9 and registering therewith. It will be noted (Figure 3) that the slots 9 and 11 are so disposed as to extend anteriorly of chamber 12 of the barrel 6 when the barrel 6 is in battery.

The improved switch has a body member 13 of suitable electric insulating, heat-resistant material, which may be transparent to afford observation of the operative structure of the switch, and a cover member 14 of the same material. Cover member 14 has a housing 15 projected therefrom of dimensions and configuration suitable to fill slots 9 and 11 when the switch is mounted on the gun. It will be noted (Figure 4) that members 13 and 14 have corresponding widths and that housing 15 has reduced width to provide lateral shoulders 16 on member 14. It will be noted (Figure 3) that housing 15 extends from member 14 a distance precisely corresponding to the combined thicknesses of plate 2 and portion 4 at the rear end of slot 11.

Member 13 has an elongated chamber 17 formed therein and opening therethrough, and member 14 has an elongated chamber 18 formed therein and opening therethrough. Chambers 17 and 18 register and chamber 18 has a width and a length inferior to chamber 17 providing shoulders 19 on the face of member 14 and adjacent the ends of chamber 17. Slidably disposed in chambers 17 and 18 there is a carriage 20 of suitable mechanically strong, heat-resistant, shock-resistant, electric-insulation material, such as a ceramic body. Carriage 20 is dimensioned and configured to fit loosely in chamber 18 and has projecting lugs 21 on its ends, co-acting with shoulders 19 to prevent passage of carriage 20 through chamber 18. Carriage 20 is biased toward chamber 18 by coil springs 22 guided on pins 23 projecting into chamber 17 from cover plate 24 mounted on member 13 by screw 25. The carriage 20 has mounted on its inner edge a contact shoe 26 of suitable electricity and heat conducting material, such as copper. Shoe 26 has a concave bearing face 27 configured to correspond to tapered portion 8 of barrel 6 on which it bears. Shoe 26 is fixed on carriage 20 by bolts 28 and 29 and nuts 30 thereon. Disposed between one end of shoe 26 and the edge of carriage 20 there is a thermostatic element, consisting of a bi-metallic arm 31 intimately related to the shoe 26, for electricity and heat conducting, by bolt 29. Arm 31 projects into a recess 32 in carriage 20 and has a contact head 33 thereon for co-action with a contact head 34 on a metallic spring arm 35 mounted in recess 32 by a bolt 36 threaded through carriage 20.

Arm 35 is adjustable relative to arm 31 by a bolt 37 bearing on arm 35 and threaded through carriage 20. A rocker plate 38 has a knife-edge lug 39 bearing on the edge of carriage 20 and a set screw 40 passed loosely through plate 38 on one side of lug 39, threaded in carriage 20 and having a head 41 bearing on plate 38. Bolt 37 is threaded through plate 38 on the other side of lug 39 and has an indicating pointer 42 co-acting with a scale 43 on plate 38 circumferential of bolt 37. Pointer 42 and scale 43 are observable through orifice 44 in plate 24 which is dimensioned to afford access to bolt 37 and screw 40 to permit adjustment of arm 35 when the switch is mounted on the gun.

The switch is attached to the gun by bolts 45 and 46 passed through plate 24, and members 13 and 14 and screwed through plate 2 and into trunnion block 1. It will be noted (Figure 3) that bolt 45 is screwed into portion 4 of the trunnion block 1 which is in intimate contact with portion 5 of barrel 6. Therefore, bolt 45 is utilized as a binding post for wire 47 to connect the barrel 6 with the circuit in which the switch functions. A second binding post 48 is mounted in member 13 for connecting the other wire 49 of the circuit with the contact arm 35 by means of the flexible conductor 50 connecting post 48 with bolt 36 holding arm 35.

Before describing the manner in which the switch operates, attention is directed to the fact that, at the present time, two electrically operated safety control devices are used with automatic guns, which function somewhat differently. One of these devices, operated by a relay when its control switch is opened, catches and holds the bolt in retracted position immediately after a round has been fired and its case retracted with the bolt. In the other device, operated by a relay when its control switch is opened, after the round has been rammed into the barrel, it is removed therefrom by the retracted bolt which is then locked in retracted position. Each device, for the reason previously described, functions in such a manner as to permit the gun to commence firing when the fire control switch is closed and each device prevents a round from remaining in the gun barrel, when its control switch is opened. However, both of these control switches are manually operated and neither device provides any means to warn the gunner that the gun barrel is dangerously overheated.

In operation, the improved switch is so adjusted that it will open when its bi-metallic strip 31 reaches a predetermined temperature produced by a temperature of barrel 6 at which it is considered dangerous to permit a round to remain in the barrel 6. Below this temperature, the switch remains closed.

The use and operation of the improved switch will now be described. When the parts have been assembled, as shown in Figure 3, the switch is mounted on the gun by inserting the housing 15 into slots 9 and 11, the lateral shoulders 16 and end portion of cover member 14 being seated against the side plate 2, and the switch is fastened in position by screwing bolts 45 and 46 into place. Wires 47 and 49 are then connected to posts 45 and 48, respectively, and the switch is conditioned to function. It is to be understood that the bolt 37 is adjusted to so relate arm 35 relative to arm 31 that movement of arm 31 will disconnect contact head 33 from contact head 34, to open the circuit, when the temperature of the bi-metallic arm 31 reaches a determined degree. It is obvious, from the foregoing description of the parts, that when the temperature of the barrel 6 is elevated to a degree sufficient to threaten "cooking off" of a round in barrel 6, the temperature of bi-metallic arm 31 is correspondingly elevated by the conductive capacity of shoe 26 which is pressed against barrel 6 by the action of springs 22, and is intimately associated with arm 31 by the bolt 29. It will be understood, therefore, that by the proper adjustment of bolt 37, the switch functions to open the circuit when the temperature of barrel 6 is elevated to a definite degree.

Since the shoe 26 is the means for affecting

arm 31, it is important that surface 27 of arm 26 have its maximum area in contact with barrel 6. The shoe 26 is therefore inclined relative to the axis of barrel 6 to conform to taper of portion 8 and, as above pointed out, the surface 27 is configured to conform precisely with the tapered portion 8 of the barrel 6, against which shoe 26 is pressed by the springs 22. As clearly shown in Figure 3, when the barrel 6 is in battery, the entire area of surface 27 is in contact with barrel 6. When barrel 6 moves rearwardly in recoil, the anterior reduced part of portion 8 is brought into contact with surface 27, and, as clearly shown in Figure 6, the convex surface of the portion 8 remains in constant contact with the concave surface 27 of shoe 26 to insure uninterrupted conductivity during recoil and counter-recoil.

It is obvious that by reason of the relation of slots 9 and 11 and the chamber 12 of barrel 6 when the barrel 6 is in battery, the heat conducting shoe 26 is disposed closely adjacent that portion of barrel 6 in which the temperature is most greatly elevated by the burnt propellant immediately anterior chamber 12 on firing each round.

Having described the invention, what we claim is:

1. In a thermostatic, electric switch responsive to variations in temperature of the barrel of a machine gun slidable in the trunnion block of the gun, on recoil and counter-recoil, the combinations of a housing mounted on the gun and having a portion intruded through the trunnion block and having a passage therethrough; a carriage translatable in said passage toward and from said barrel; an electricity-conducting bearing shoe mounted on said carriage for temperature-conducting contact with the surface of the barrel; resilient means in said housing for biasing said carriage toward the barrel to effect constant contact between said shoe and said barrel; a thermostatic electric contact member attached to said shoe and positioned within said carriage; a second electric contact member mounted in said carriage for adjustment relative to said first contact member and positioned to be engaged by said thermostatic contact member; and a pair of binding posts in said housing for connecting an electric circuit with the barrel through the trunnion block and with the second contact member, respectively.

2. In a heat responsive switch for a machine gun having a receiver and a barrel reciprocably mounted in said receiver, a body member shaped to fit within an opening in said receiver adjacent said barrel, means rigidly securing said member within said opening, a carriage of dielectric material slidably carried by said member for movement toward and from said barrel, spring means interposed between said member and carriage to urge one face of said carriage toward said barrel, there being a recess in said carriage opening through said one face, a metallic shoe secured to said carriage over said recess, said shoe being shaped to fit a portion of said barrel, a bimetallic arm in said recess and having one end rigidly secured to said shoe, a contact on the other end of said arm, a spring arm within said recess and secured at one end to said carriage, the other end of said spring arm being positioned to engage said contact for all temperatures of said bimetallic arm below a predetermined maximum, and electric terminals on said member electrically connected with said arms, respectively.

3. A heat responsive switch as recited in claim 2, and means carried by said carriage for engaging and flexing said spring arm to thereby vary the position of the free end of said arm and correspondingly adjust said maximum temperature.

BENJAMIN J. WILSON.
RAYMOND C. MACHLER.
NORMAN E. POLSTER.
GEORGE E. R. MURRAY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,956,067	Herz	Apr. 24, 1934