

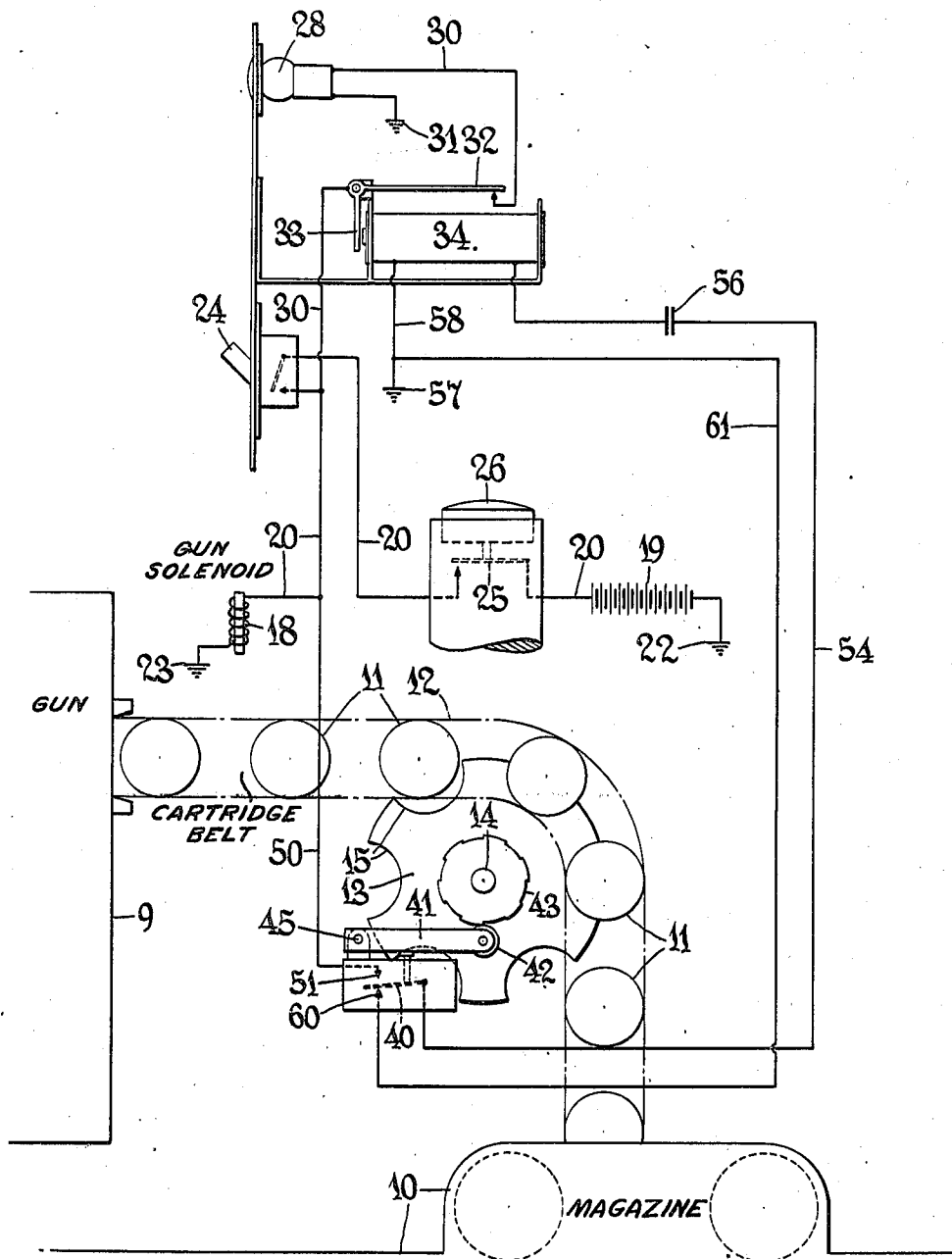
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## GUN OPERATION SIGNAL MECHANISM

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## GUN OPERATION SIGNAL MECHANISM

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This invention relates to automatic guns, and more particularly to operation indicator devices for use in connection with machine guns mounted upon aircraft and the like.

In machine gun installations in aircraft, and the like, each gun is usually provided with an associated cartridge magazine out of which a cartridge belt, comprising a row of axially parallel cartridges with suitable linking elements, moves continuously for feeding the machine gun in response to actuation of the feed pawl mechanism of the gun. The cartridge belt is usually trained about rollers or star wheels for directional changes during the movement from the magazine to the gun; such rollers or star wheels being mounted for idling rotation as a result of their engagement with the moving cartridge belt. According to my present invention I utilize the rotation of such star wheel, or other moving elements of the machine gun installation, to continually make and break an electric circuit, including means adapted to produce in an improved manner an indication of the condition of operation of the machine gun associated therewith.

In setting forth an exemplary embodiment of my invention reference will be had to the accompanying drawing which is a diagrammatic representation of the circuits and electrical and mechanical devices cooperating to provide an aerial machine gun operation indicator mechanism of the invention. In the drawing the numerals 9 and 10 indicate schematically a machine gun and a cartridge magazine therefor, respectively. A series of cartridges 11 are illustrated as being linked together in the form of a cartridge belt 12 arranged to move from the cartridge magazine into the machine gun. A star wheel 13 is arranged upon a supporting shaft 14, and is provided with arcuate peripheral indentations as at 15 for intermeshing engagement with individual cartridges 11 as they move toward the gun in response to the cartridge belt feeding operation of the gun feed pawl mechanism (not shown).

It will be understood that in military aircraft a plurality of machine guns are usually employed, and that in such installations the individual guns are usually each provided with an operating relay or solenoid such as is indicated at 18 in the drawing. For example, a typical solenoid arrangement for this purpose is disclosed at 35, Figs. 2 and 4 of U. S. Patent 2,180,751. An operating circuit for each gun solenoid 18 may comprise a battery 19 and a conductor 20 connecting

one terminal of the battery with one terminal of the gun solenoid. The remaining terminals of the battery and of the gun operating solenoid 18 are grounded to complete the gun operating circuit, as indicated in the drawing at 22 and at 23, respectively.

Thus, as many gun solenoids are provided as there are machine guns, and preferably each gun solenoid circuit has interposed therein a snap selector switch 24. Obviously the portion of the operating circuit which leads from the battery ground 22 through the battery and to one terminal of the selector switch 24 may be common to a number of machine guns. The portion of the operating circuit leading from the selector switch 24 to the gun operating solenoid 18 and therethrough to the ground 23 will, however, be duplicated for each machine gun; there being a selector switch for each gun operating solenoid 18.

Interposed in the portion of the conductor 20 which is common to all of the machine gun operating circuits, is a manually closable switch known as a trigger switch, such as is indicated at 25 in the drawing. Such trigger switch is usually provided with an operating button 26 which is preferably placed in a position of extreme convenience to the gunner, and in the case of a single seater combat airplane it is usually mounted on the upper end of the control stick thereof. Thus, whenever the gunner depresses the button 26 the trigger switch 25 is closed, and as many guns will be caused to fire as have their associated selector switches 24 closed.

In the embodiment now being set forth it is intended to provide an individual indicating or warning device for each machine gun and to this end a warning lamp 28 may be arranged within easy view of the machine gun operator. Disposition of each lamp 28 in close association with its associated selector switch 24 will render identification of the indicating or warning lamps of the several machine guns a simple matter.

In the form of my invention illustrated in the drawing I provide a circuit for each lamp 28 which is provided with a switch adapted to be biased to a closed position for rendering a warning signal, but such switch in normal operation is held open against the biasing tendency by normal movement of cartridges from the magazine to the gun to render the lamp inoperative excepting when the impulse which normally holds the biased switch open fails.

The lamp circuit for each gun installation comprises a conductor 30 which taps the gun circuit

conductor 20 between the selector switch 24 and its associated gun solenoid 18 and leads to one terminal of the lamp 28, the other terminal thereof being grounded as at 31. The lamp circuit 30 has interposed therein a switch 32 which may be biased to a closed position by the force of gravity, or by spring means, or by other suitable means. The switch 32, however, is provided with an armature 33 adapted to be attracted by an electromagnet 34 when the latter is electrically energized. Attraction of the armature 33 by the electromagnet 34 opens the switch 32 against its biasing means.

It will presently appear that the electromagnet 34 is arranged in the electrical circuit in such fashion as to be energized during continued proper movement of cartridges 11 from the cartridge magazine 10 to the machine gun 9 when the trigger switch 26 and any one or more selector switches 24 associated with particular lamps 28 are closed. However, stoppage of cartridge passage from the associated cartridge magazine to a particular machine gun will result in cessation of rotation of the associated star wheel 13, and, in a manner which will presently appear, such stoppage of the star wheel 13 results in deenergization of the electromagnet 34 despite continued closure of the gun operating circuit.

A two-way switch 40 is arranged to be automatically alternated between its two circuit closing positions by means of an oscillating arm 41 which is adapted to be oscillated by contact between a roller 42 carried at one of its ends with a cam wheel 43 which is fixed for rotation with the star wheel 13. The other end of the oscillating arm 41 is pivotally supported as at 45. It is to be understood that the normal speed of operation of the associated machine gun and the plurality of notches appearing in the cam wheel 43 are such that a rapid alternation of the switch 40 between its two circuit closing positions will take place as long as the cartridge belt moves over the star wheel 13 toward the cartridge feedway of the gun.

When the switch 40 is in a position opposite to that shown in the drawing a circuit is closed which includes a conductor 50 which taps the main gun circuit 20 between the selector switch 24 and the ground 23 and leads to the upper contact 51 of the switch 40, and then through the switch bar and over a conductor 54 to one terminal of the electromagnet 34. The conductor 54 includes a condenser 56. The opposite terminal of the electromagnet 34 is grounded as at 57 via a conductor 58.

It will be seen that in its upper position the switch 40 establishes a circuit which loads the condenser 56. If we consider the grounded side of the battery as negative, then the right-hand plate of the condenser 56 will be positively charged and the left-hand plate, as viewed in the drawing, negatively charged.

Upon reversal of the switch 40 to the position shown in the drawing, the circuit 20, 50, 54, 53 is broken between conductors 50 and 54 and substantially concurrently therewith the switch arm 40 engages the lower contact 60 of the two-way switch, the lower contact 60 being connected directly to ground as by means of a conductor 61. With the switch arm 40 in this position, that is as shown in the drawing, the conductor 54, including the condenser 56 and the electromagnet 34, is connected directly to ground at both ends; at one end permanently by the conductor 58 and at its other end through the switch arm 40, the

contact 60, and the conductor 61. When the arm of the switch 40 is in engagement with the contact 60 as here set forth the conductor 61 short circuits the electromagnet 34 and the condenser 56 which is in series therewith and the condenser releases its charge, causing reverse current flow in the circuit until the condenser is unloaded.

Thus, normal operation of the star wheel provides successive and alternate charging and discharging of the condenser 56 at a rapid rate, resulting in a substantially continuous alternating current excitation of the electromagnet 34 with consequent attraction of the armature 33 with the result that switch 32 is held in open position while the arm of the switch 40 is alternating between the contacts 51 and 60.

Cessation of rotation of the star wheel 13 results in de-energization of the electromagnet 34 regardless of the particular position of the switch arm 40 at the time of discontinuance of operation of the star wheel 13 and its associated instrumentalities and despite continued closure of the gun solenoid operating circuit.

If the switch arm 40 happens to be in the position illustrated in the drawing when the star wheel stops, the electromagnet 34 will be de-energized as soon as the condenser 56 unloads by virtue of the open circuit at 51. If the switch arm 40 happens to be in an opposite position at the time of stoppage, current will flow in the circuit 54, 56, 34, 58, only instantaneously, until the condenser 56 is fully charged, and the continued application of direct current to the circuit will be ineffective due to the presence of the condenser 56.

From the foregoing it will be seen that continued rapid alternation of the position of the switch 40 by rotation of the star wheel 13 provides a holding impulse by way of the electromagnet 34 which keeps the lamp circuit 30 open through the medium of the switch 32. As soon as the star wheel 13 discontinues rotation, the electromagnet 34 becomes de-energized and the switch 32 closes under the force of gravity or whatever other biasing means, in the form of a spring or the like, is employed. Closure of the lamp circuit 30 illuminates the lamp 28 and apprises the operator of the machine gun of the stoppage of the star wheel 13. Consequently, if the associated machine gun jams, or if the cartridge belt runs out, or if the operation of feeding the machine gun stops for any reason whatsoever, the consequent stoppage of rotation of the star wheel 13 automatically results in illumination of the signal lamp 28; provided the corresponding selector switch 24 and the trigger switch 25 are also closed. Hence, the operator of the multiple gun unit is immediately apprised of unintended stoppage of the firing operation of any one or more of the guns of the unit so that he may be directed to the cause of reduced fire, in an improved manner.

While a single complete embodiment of the principles of my invention is disclosed herein by way of example, it is to be understood that my invention is not to be considered as limited thereto or otherwise than as defined in the appended claims.

What is claimed is:

1. Cessation indicating means for a normally movable member having a direct current operating circuit and motive means therein for moving said member, said indicating means comprising a lamp in said circuit in parallel with said motive

means, a normally closed switch in said lamp circuit and an electromagnet for opening said switch, said electromagnet being connected in parallel with said motive means and said lamp, a switch and a condenser connected in series with said electromagnet, a ground connection engageable by said switch when the latter is open, and means operated by said movable member for continuously opening and closing said switch during movement of said movable member whereby the condenser is successively loaded and discharged to provide alternating current energization of said electromagnet while said movable member is operating, whereby said lamp is illuminated only when said direct current operating circuit is closed and said movable member is not moving.

2. Cessation indicating means for a normally movable member having a direct current operating circuit and motive means therein for moving said member, said indicating means comprising a lamp in said circuit in parallel with said motive means, a normally closed switch in said lamp circuit and an electromagnet for opening said switch, said electromagnet being connected in parallel with said motive means and said lamp, a switch and a condenser connected in series with said electromagnet, and means operated by said movable member for continuously opening and closing said switch during movement of said movable member to provide continuous alternating current energization of said electromagnet while said movable member is operating, whereby said lamp is illuminated only when said direct current operating circuit is closed and said movable member is not moving.

3. Cessation indicating means for a rotatable member having a direct current operating circuit

and motive means therein for rotating said member, said indicating means comprising a lamp in said circuit in parallel with said motive means, a normally closed switch in said lamp circuit and an electromagnet for opening said switch, said electromagnet being connected in parallel with said motive means and said lamp, a switch and a condenser connected in series with said electromagnet, and means operated by said rotatable member for continuously opening and closing said switch during movement of said rotatable member to provide continuous alternating current energization of said electromagnet while said rotatable member is operating, whereby said lamp is illuminated only when said direct current operating circuit is closed and said rotatable member is not moving.

4. Cessation indicating means for a normally movable member having a direct current operating circuit and motive means therein for moving said member, said indicating means comprising a lamp in said circuit in parallel with said motive means, a normally closed switch in said lamp circuit and an electromagnet for opening said switch, said electromagnet being connected in parallel with said motive means and said lamp, a reversing switch and a condenser connected in series with said electromagnet, and means operated by said movable member for continuously reversing said switch during movement of said movable member to provide continuous alternating current energization of said electromagnet while said movable member is operating, whereby said lamp is illuminated only when said direct current operating circuit is closed and said movable member is not moving.

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