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TRIGGER MOTOR

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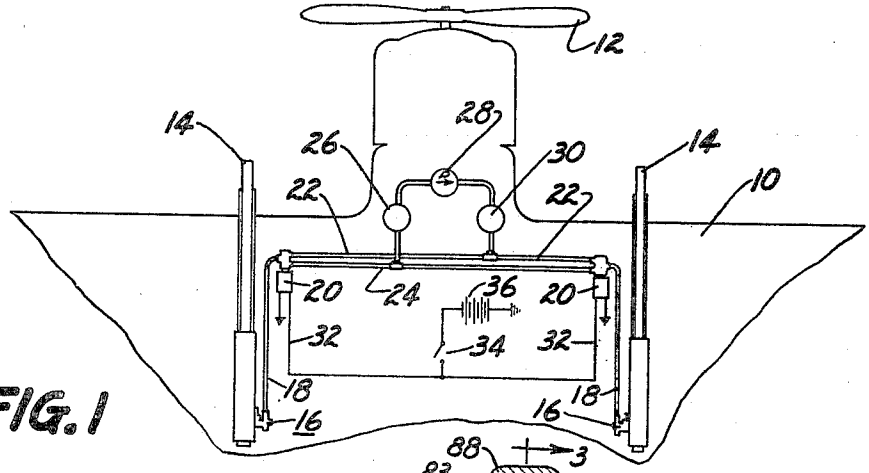


FIG. 1

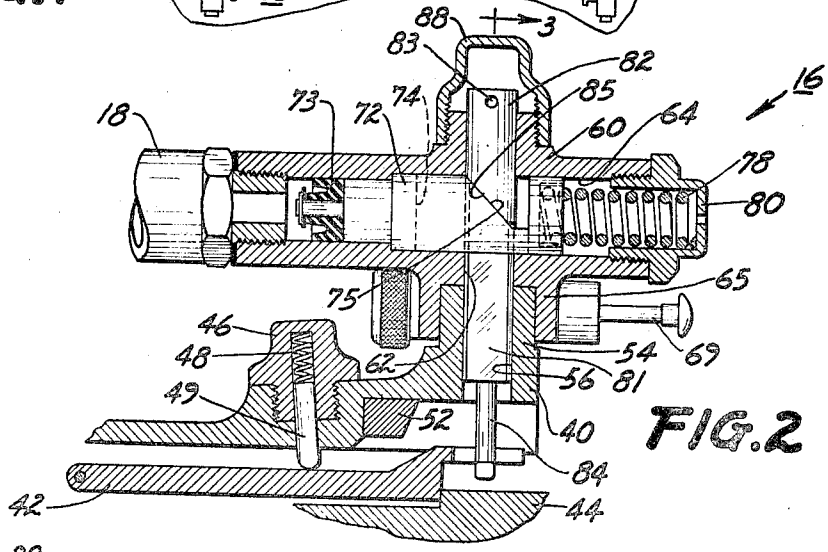


FIG. 2

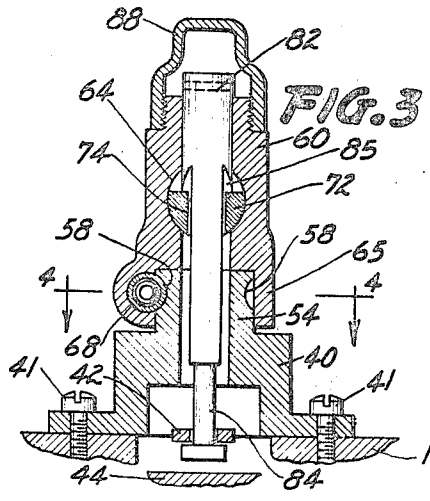


FIG. 3

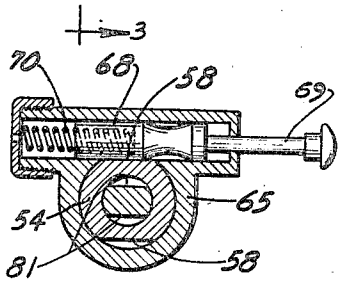


FIG. 4

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TRIGGER MOTOR

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South Bend, Ind.

Application February 10, 1941, Serial No. 378,148

7 Claims. (Cl. 89—27)

This invention relates to a trigger motor for guns, and more particularly to a trigger motor for automatic guns of the type wherein the breech bolt is held in a retracted position when the gun is not firing.

The invention will be described with reference to aircraft use, although it is not limited to guns for aircraft. The requirements for trigger motors for aircraft guns are several. The firing unit as a whole must give an instantaneous response to the gunner's firing impulse since the sights of a gun are often on the target for a fraction of a second only. The firing unit must be light in weight and have a high power-to-weight ratio, as every ounce of weight is important in aircraft. Also the unit must be such that it can be detached readily from the gun, since guns must be removed frequently from the aircraft for cleaning and inspection, and it is desirable not to remove or disconnect any of the controls to the trigger motor.

In general, trigger motors for automatic guns of the type wherein the breech block is held in a retracted position must be more powerful than for the common type of gun wherein the cartridge is fired after the breech bolt closes on the firing chamber. This is due to the construction of the gun, the trigger in effect being a breech block latch holding the breech bolt against the action of powerful return springs. The release of this latch requires much more power than the release of a firing pin latch as is the case in other guns. Although an electric solenoid is satisfactory for an ordinary gun, a solenoid powerful enough to release a breech bolt would be prohibitively heavy and would require an excessively heavy current for the light aircraft batteries.

It is an object of the invention to provide a trigger motor giving rapid response to a firing impulse from the gunner.

It is also an object to provide a trigger motor having a high power-to-weight ratio.

A further object of the invention is to provide a readily detachable trigger motor.

Still another object is to provide a trigger motor of simple construction having a reliable and positive action, and which utilizes for its actuation hydraulic power derived from the operation of the engine.

Other objects and advantages of the invention will be apparent in the following description and claims which can best be understood when considered in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatic plan view of an airplane carrying a 20 mm. cannon in each wing, and having trigger motors constructed according to our invention;

Figure 2 is a longitudinal sectional view of the trigger motor;

Figure 3 is a view in section along line 3—3 of Figure 2; and

Figure 4 is a section along the line 4—4 of Figure 3 showing the detent for holding the trigger motor to the gun.

The invention is shown applied to an airplane 10 (Figure 1), which is driven by a propeller 12. A 20 mm. cannon 14 is mounted in each wing of the airplane just outside the arc of the propeller 12. The guns are of the automatic type, each having a breech block which is held in the retracted position when the guns are not firing. Each gun is equipped with a trigger motor 16 having a flexible hydraulic connection 18 to a solenoid operated valve 20 which selectively communicates connection 18 to a pressure line 22 for firing, or to an exhaust line 24 for ceasing fire. The airplane 10 has the usual hydraulic pressure system consisting of an exhaust reservoir 26 from which hydraulic fluid is passed to an engine-driven pump 28 which pumps it into an accumulator 30, which maintains the fluid under pressure in the known manner. The reservoir 26 is connected to exhaust line 24 and the accumulator 30 is connected to pressure line 22.

The firing system is operated by energizing the solenoid valve 20. This is done by means of a conductor 32 connected to each valve and energized by a firing switch 34 in the pilot's or gunner's cockpit, which switch is connected to a source of current such as battery 36. When it is desired to fire the gun the pilot or gunner closes switch 34, passing current to solenoid valve 20 which opens to pass high pressure fluid to the trigger motor 16, causing the gun to fire. When it is desired to stop firing, switch 34 is released allowing it to open, and this in turn de-energizes valve 20, which acts to communicate conduit 18 to exhaust line 24 causing the gun to cease firing.

The solenoid valve 20 is of the pilot valve type wherein the solenoid operates a relatively small pilot valve, thus permitting control of a large valve by a small, light-weight solenoid. This valve is fully described in application Serial No. 371,742 filed on behalf of Pontius and Wilson, December 26, 1940, and therefore will not be described here.

The trigger motor itself is shown in detail in Figures 2, 3 and 4. A base plate 40 is fastened by bolts 41 to gun 14 adjacent to a pivoted trigger latch 42 which holds the breech bolt 44 of gun 14 in a retracted position. The base plate carries a fitting 46 containing a spring 48 which urges a plunger 49 against trigger latch 42 insuring that it will always engage the breech block 44 upon recoil unless the trigger latch is held in the firing or non-engaging position as hereinafter described. Base plate 40 also retains a hardened steel insert 52 which acts as a buffer block when trigger latch 42 is moved to its firing position. Base plate 40 is formed with an integral collar 54 having a bore 56. Two parallel cylindrical grooves 58 are cut in collar 54 as shown in Figures 3 and 4.

A metal housing 60 has two intersecting passages 62 and 64 of unequal diameters. The housing 60 is provided with a collar 65, coaxial with passage 62, which fits closely over collar 54 on base plate 40. Housing 60 is held to base plate 40 by a detent 68 mounted in collar 65. As shown in Figure 4, detent 68 comprises a cylindrical part and a curved reduced part. By means of a push rod 69, detent 68 may be moved against the force of spring 70 until the reduced portion is in a position opposite collar 54, and housing 60 can then be placed on, or removed from, collar 54. When housing 60 is placed on collar 54 the spring 70 will force the cylindrical part of detent 68 into one or the other of the grooves 58, retaining the housing rigidly in position on collar 54.

A stepped piston 72, provided with any suitable packing 73, fits within the large bore 64 of housing 60. The central part of the piston is provided with a transverse rectangular aperture 74 and is cut away in the region of the aperture to form a cam surface 75. A spring 78 is held against one end of piston 72 by a fitting 80 screwed in one end of passage 64. The spring 78 acts as a return spring for piston 72 after the unit is subjected to hydraulic exhaust pressure, as hereinafter described. The hydraulic conduit 18 is fastened to the other end of passage 64.

The smaller bore 62 of housing 60 retains a cylindrical stem 82 which is provided with diagonal shoulders 85 adapted to coact with cam surface 75 in the operation of the device. From shoulders 85 inwardly, stem 82 is flatted on opposite sides as indicated at 81 and extends through aperture 74 of piston 72. Stem 82 carries at its inner end a T-shaped shank 84, the cross bar of which is set at 90° to the flatted surfaces 81. The T-shaped shank fits in a split tongue of the end of trigger latch 42. A hole 83 is drilled in the other end of stem 82 for a cable fastening in the event that manual firing is desired instead of electro-hydraulic firing. A cover cap 88 closes the outer end of passage 62 and is screwed on housing 60.

If it is desired to remove gun 14 from the airplane 10, detent 68 is pushed inwardly, and when its reduced part lies opposite collar 54, the whole housing 60 can then be rotated 90° so that the cross bar of T-shank 84 is aligned with the split in the tongue of trigger latch 42. The housing 60 can then be pulled from base plate 40, and the two parts separated, T-shank 84 passing through hole 56 in base plate 40. The gun 14 may now be removed from the airplane 10 without the necessity of disconnecting the hydraulic lines. The units are assembled in the same way: detent 68 is depressed; the housing 60 slipped on collar 54 at 90° to insert the T-shank 84 in trigger latch 42; and then housing 60 is rotated 90° until detent 68 snaps into one of the grooves 58 in collar 54.

In operation, the pilot fires the gun by closing switch 34 which causes solenoid valve 20 to open, passing high pressure fluid through flexible conduit 18 into housing 60. The fluid acts on piston 72 moving it against spring 78 and causing the cam surfaces 75, 85 to move stem 82 outwardly from gun 14. A sufficient movement of stem 82 rotates trigger latch 42 releasing breech block 44 allowing its return to a firing position, whereupon the gun is fired by automatic mechanism known in this art, and as a result recoils (to the right in Figure 2) until the breech block 44 again reaches the position shown in Figure 2. If stem 82 is still held outwardly, the breech bolt 44 will again be moved by the recoil mechanism (not shown) to the left, and the cycle will be repeated indefinitely.

If the pilot wishes to cease fire he opens switch 34, causing valve 20 to communicate trigger motor 16 to exhaust. Spring 78 then forces piston 72 back to its starting point, relieving the pressure on stem 82. Stem 82 can then move inwardly toward the gun to release trigger latch 42. Spring 48 then forces trigger latch 42 into the path of reciprocating breech bolt 44, and upon the next recoil of the bolt 44, latch 42 will hold it in its retracted position, preventing further firing of the gun.

Although this invention has been described with reference to a particular embodiment thereof, it is not limited by the drawing or description or otherwise, except by the following claims.

We claim:

1. A hydraulic trigger motor comprising a housing with intersecting passages, a piston in one passage having a transverse rectangular hole therethrough and a relieved portion cut on a diagonal in the region of the hole, a spring on the end of the piston opposite the diagonal cut of the relieved portion, a T-shaped stem fitting in said housing transversely to the piston, and passing through the hole in the piston and having a part engaging the diagonal cut of the piston, a collar on the housing adjacent to the T-shaped stem, and a locking detent in said collar.

2. A trigger motor for a gun having a sear, comprising a hydraulic cylinder adapted to be connected to a source of hydraulic pressure, a piston in said cylinder having a cam surface associated therewith, a cam member extending through an aperture in the piston and cooperating with the cam surface, and an operative connection between the cam member and the sear to actuate the sear.

3. A trigger motor for a gun having a sear, comprising a hydraulic cylinder adapted to be connected to a source of hydraulic pressure, a piston in said cylinder designed to be operated by said hydraulic pressure, yielding means for retracting said piston, a cam surface associated with said piston, a cam member extending through an aperture in said piston and cooperating with the cam surface to be operated thereby when the piston is operated, and connecting means between the cam member and the sear to move the sear to inoperative position.

4. A trigger motor for a gun having a sear and a breech block, comprising an hydraulic cylinder adapted to be connected to a source of hydraulic

pressure, a piston in said cylinder designed to be operated by said hydraulic pressure, yielding means for urging the piston to its starting position, a cam surface associated with said piston, a cam member cooperating with the cam surface of the piston and extending through an aperture in the piston, connecting means between the cam member and the sear to move the sear from engagement with the breech block, and yielding means to return the sear to engagement with the breech block.

5. A trigger motor for a gun having a sear and a breech block, comprising an hydraulic cylinder adapted to be connected to a source of hydraulic pressure, a piston in said cylinder designed to be operated by said hydraulic pressure, yielding means for urging the piston to its starting position, a cam surface associated with said piston, a cam member cooperating with the cam surface of the piston and extending through an aperture in the piston, connecting means between the cam member and the sear to move the sear from engagement with the breech block, yielding means to return the sear to engagement with the breech block, a collar on the motor for enclosing the connecting means, and a detent in said collar for securing the motor to the gun.

6. In combination with a gun having a sear, a hydraulic trigger motor including a cylinder and a piston having a cam portion, a cylindrical extension on the cylinder, connecting means including a cam member extending through said extension and through an aperture in said piston for connecting the piston with the sear, a cylindrical extension on the gun in telescoping relation to the first mentioned extension, and a detent associated with said extensions and operative in one position to prevent relative movement therebetween, said detent being manually movable to a position permitting separation of said extensions from each other.

7. In combination with a gun having a sear and a breech block, an hydraulic trigger motor including a cylinder and a piston having a cam portion, a cylindrical extension on the cylinder, connecting means including a cam member extending through said extension and through an aperture in said piston for connecting the piston with the sear, a cylindrical extension on the gun in telescoping relation to the first mentioned extension, and a detent associated with said extensions and operative in one position to prevent relative movement therebetween, said detent being manually movable to a position permitting separation of said extensions from each other, and yielding means to return the sear to engagement with the breech block.

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