Sept. 3, 1935. R. C. COUPLAND 2,012,960

FIRE CONTROL APPARATUS FOR GUNS

Filed March 27, 1933 6 Sheets-Sheet 1

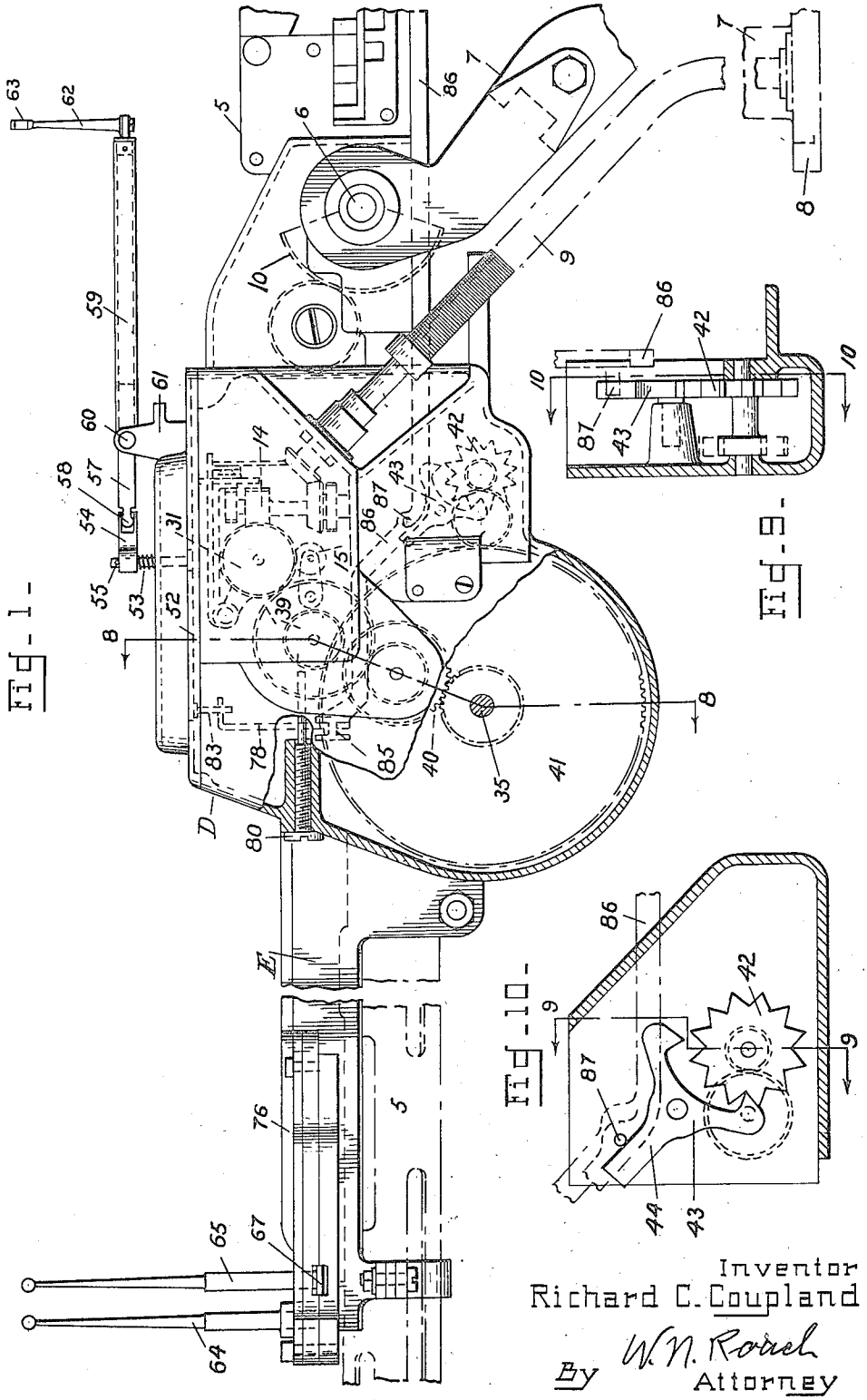

Fig. 1.

Fig. 8.

Fig. 10.

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FIRE CONTROL APPARATUS FOR GUNS

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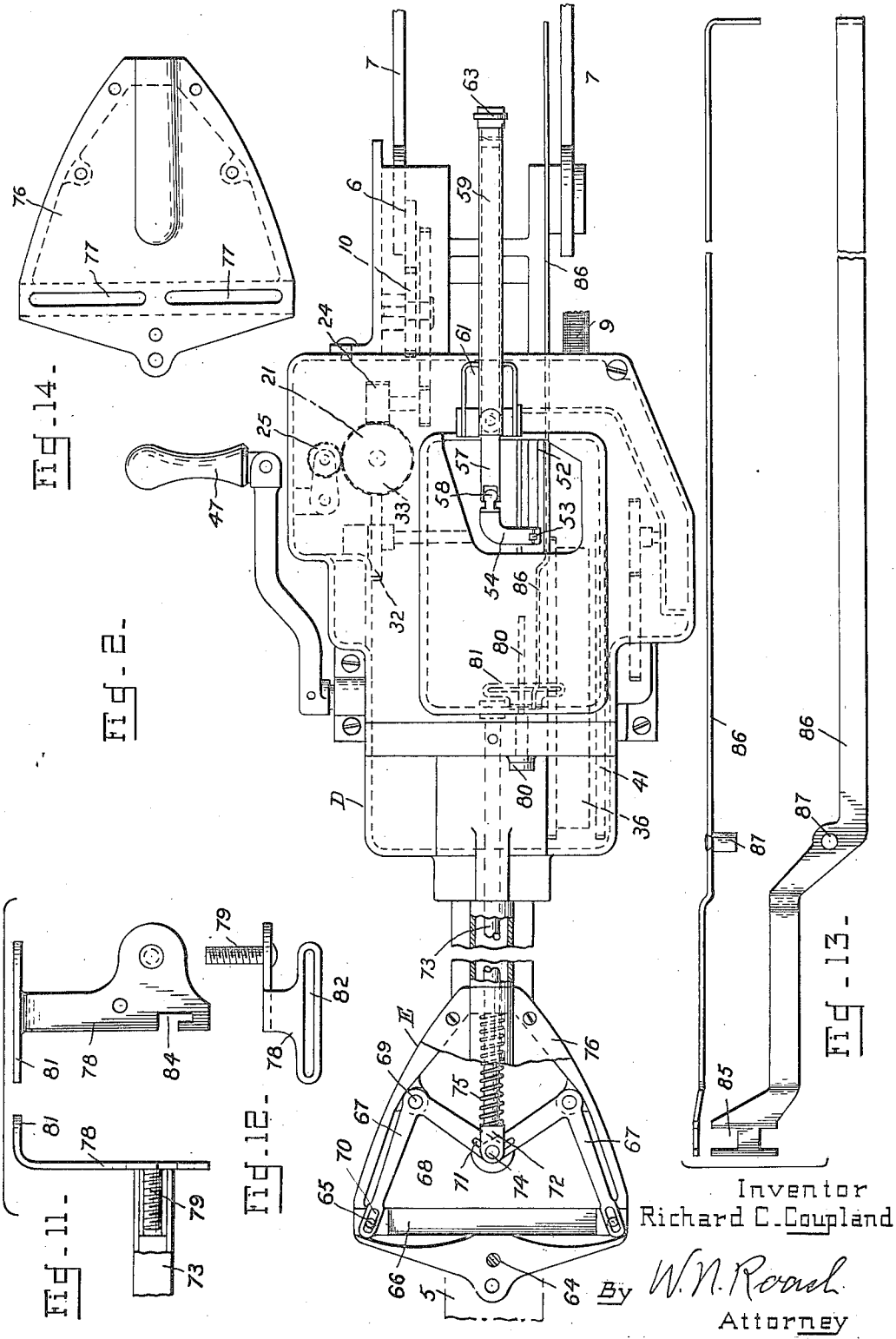

Fig. 14.

Fig. 2.

Fig. 13.

Fig. 11.

Fig. 12.

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FIRE CONTROL APPARATUS FOR GUNS

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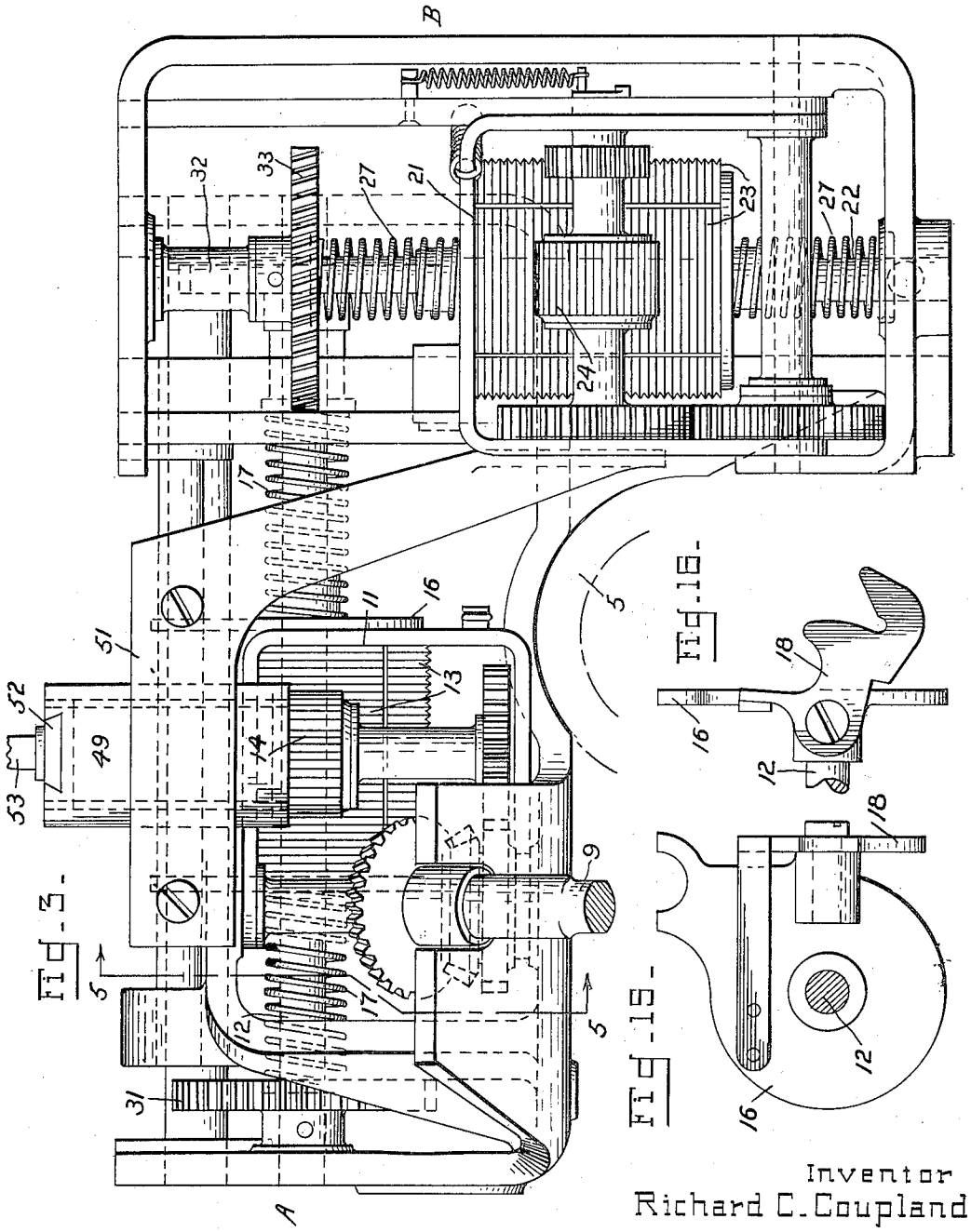

Fig. 3.

Fig. 15.

Fig. 15.

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FIRE CONTROL APPARATUS FOR GUNS

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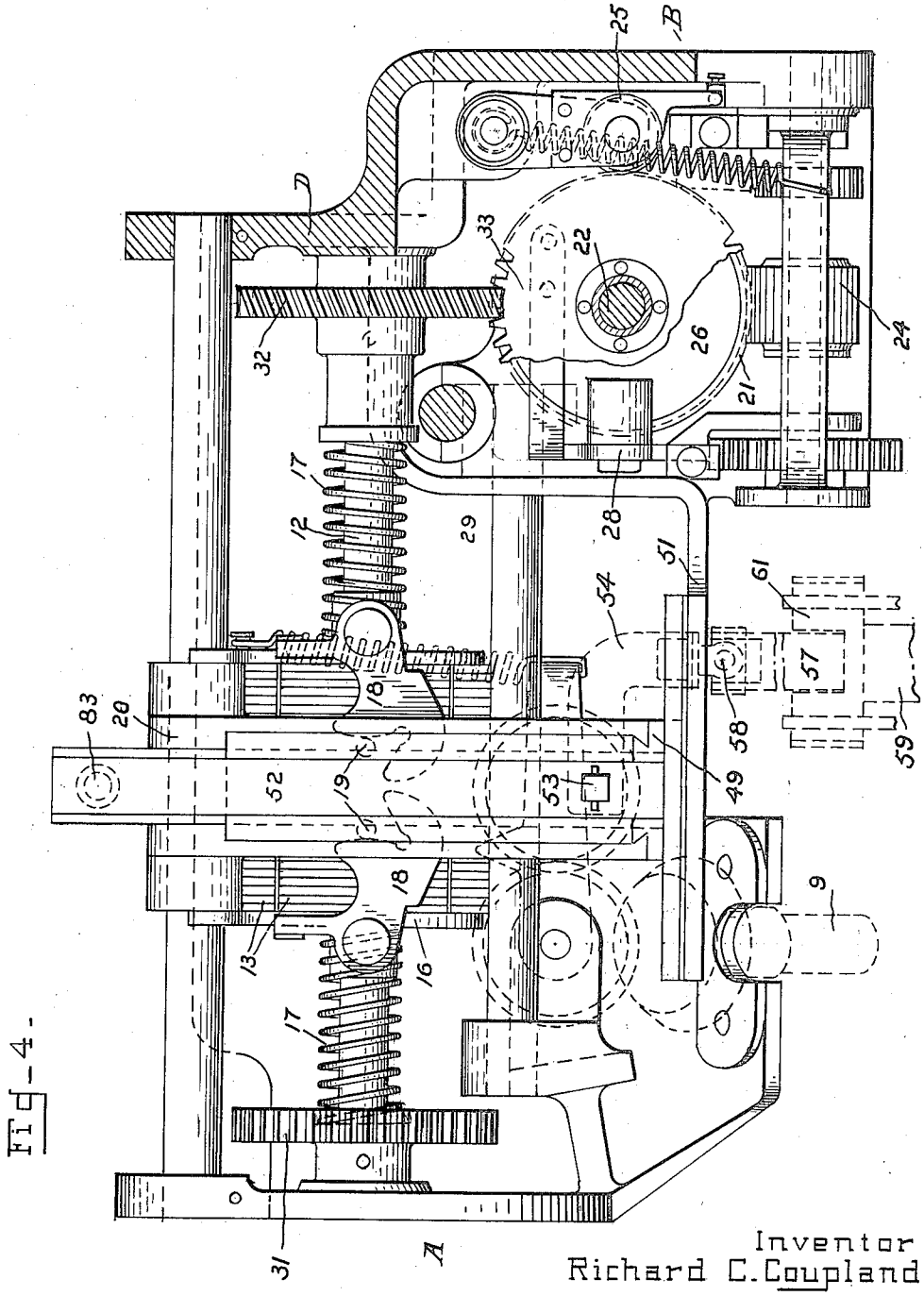

Fig-4-

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FIRE CONTROL APPARATUS FOR GUNS

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Fig. 5.

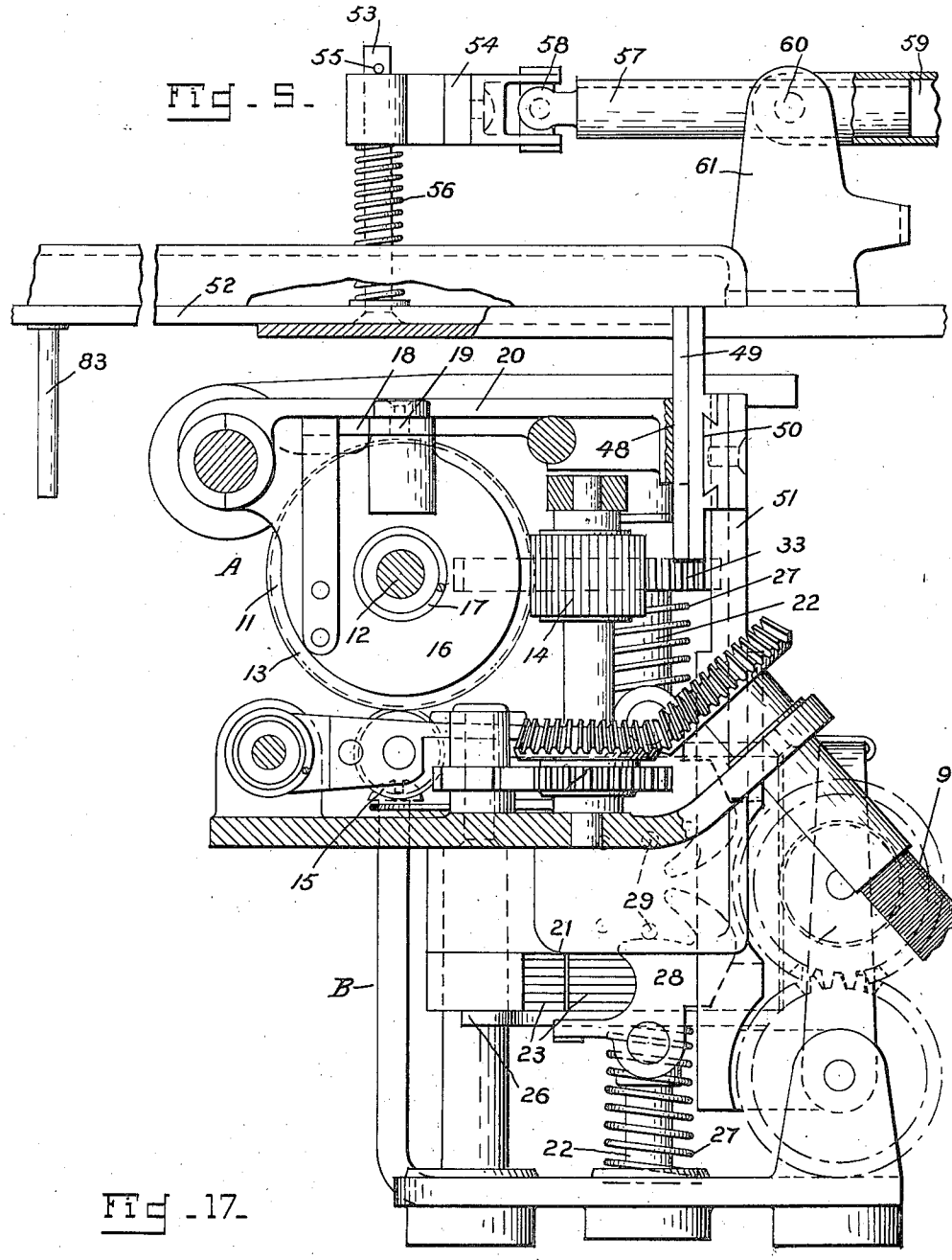

Fig. 17.

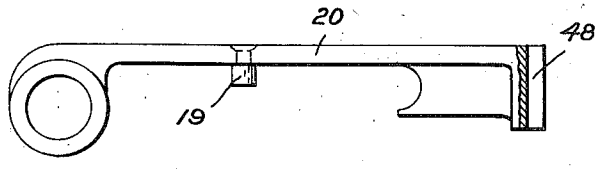

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Fig. 6.

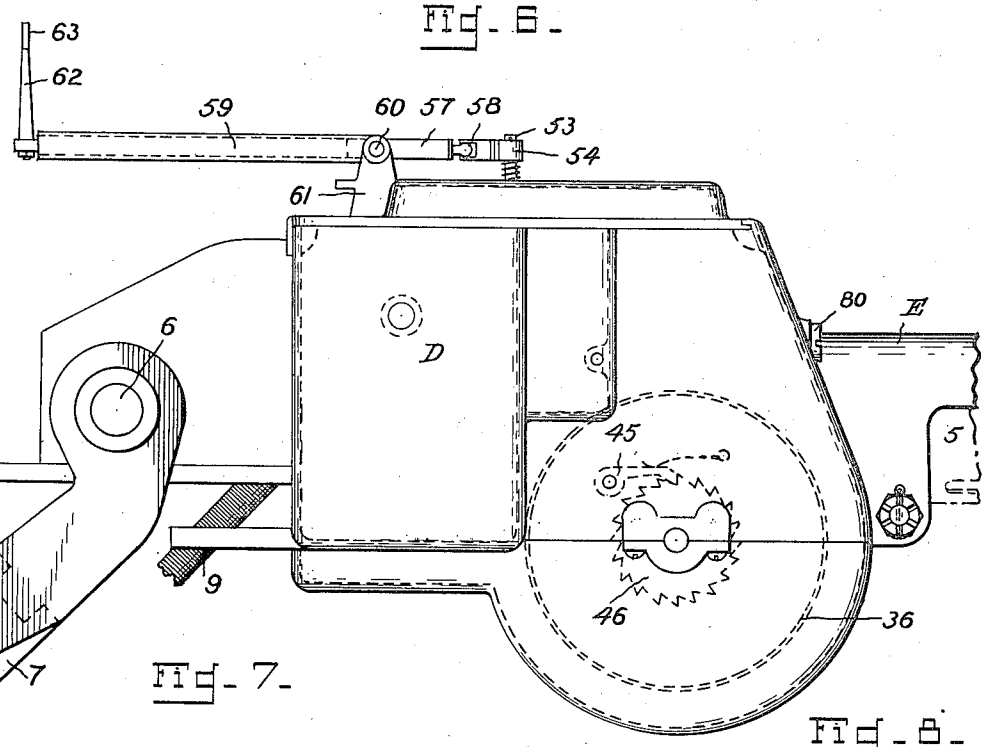
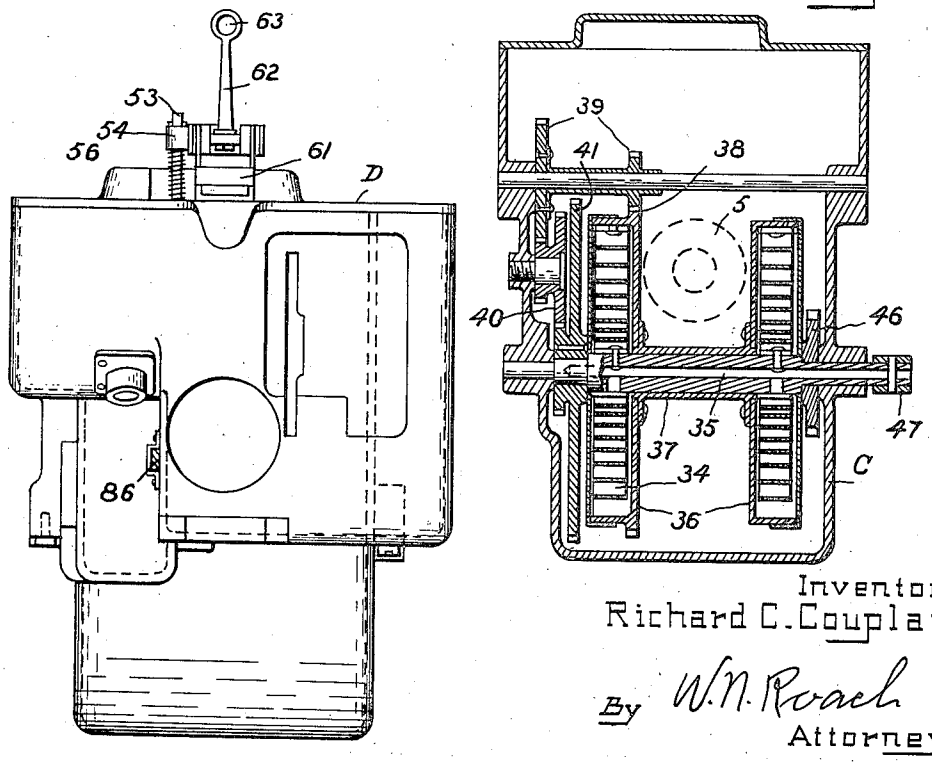


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE

2,012,960

FIRE-CONTROL APPARATUS FOR GUNS

Richard C. Coupland, Norfolk, Va.

Application March 27, 1933, Serial No. 662,994

10 Claims. (Cl. 33—49)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a fire-control apparatus for guns employed under conditions where either or both the gun or bomb platform and target are moving at high speeds.

In Patent No. 1,935,615 of November 21, 1933, there is shown an apparatus in which members interpreting the rate of the relative angular travel of a target in both the horizontal and vertical planes are associated with a constant speed device to produce a variable speed mechanism displacing the line of sight of an aiming device to correct for the future position of the target or otherwise to indicate the lead.

The present invention relates to an improvement in this type of fire control apparatus and includes the particular rate mechanisms described and claimed in Patent No. 1,946,485 of February 13, 1934.

The improvements in this invention are directed to a novel arrangement of the rate mechanisms relative to the gun, and an arrangement of a motor relative to the rate mechanisms and gun. There is also provided a front sight unit that is operated to afford a measure of range or time of flight of projectile, and a novel manner of introducing this factor into the product of the rate mechanisms whereby a correction may be incorporated in the displacement of the rear sight to allow for the influence of range. The operation of the front sight unit controls the running of the motor.

With the foregoing and other objects in view, the invention resides in the novel arrangement and combination of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

A practical embodiment of the invention is illustrated in the accompanying drawings, wherein:

Fig. 1 is a view in left side elevation, with parts broken away, of the improved fire control apparatus applied to a machine gun.

Fig. 2 is a plan view of Fig. 1 with parts broken away.

Fig. 3 is a view in rear elevation of the rate mechanisms.

Fig. 4 is a plan view, partly in section of the rate mechanisms.

Fig. 5 is a sectional view on the line 5—5 of Fig. 3.

Fig. 6 is a view in right side elevation of the rear sight unit.

Fig. 7 is a view in rear elevation of the casing for the rear sight unit.

Fig. 8 is a sectional view on the line 8—8 of Fig. 1.

Fig. 9 is a sectional view on the line 9—9 of Fig. 10.

Fig. 10 is a sectional view on the line 10—10 of Fig. 9.

Fig. 11 are detail views in elevation of the plate connecting the front sight unit with its operating mechanism and with the rear sight unit.

Fig. 12 is a plan view of the plate shown in Fig. 11.

Fig. 13 are detail views of the operating link for the plate.

Fig. 14 is a plan view of the cover for the front sight unit.

Figs. 15 and 16 are respectively views in side elevation and plan of the pressure plate and lever of the rate mechanisms.

Fig. 17 is a view in side elevation of the carriage of the rate mechanisms.

The invention is illustrated as directly applied to a machine gun 5 (Fig. 1) mounted by means of trunnions 6 in a standard 7 which is rotatably supported on a base 8.

The fire control apparatus includes two similar rate mechanisms which have been described and claimed in Patent No. 1,946,485. Only such essential features of these rate mechanisms are to be shown and described as will lead to a clear understanding of their relation to the features forming the subject matter of the present application.

Referring to Figs. 1, 2 and 3, a horizontally positioned rate mechanism A is actuated by means of a flexible shaft 9 driven by the rotatable standard 7 and a vertically positioned rate mechanism B is actuated by means of a train of gearing 10 driven by one of the trunnions 6. Accordingly the mechanism A deals with the relative angular travel or position of the target in azimuth and the mechanism B functions in a similar capacity with regard to elevation.

The rate mechanism A includes a drum 11 fast on a shaft 12. A plurality of slides or racks 13 are arranged about the periphery of the drum and are mounted for longitudinal movement parallel to the axis thereof. The slides 13 are displaced by a pinion 14 driven by the flexible shaft 9 and they

are individually held in position of displacement by a roller 15 while the pinion is acting on a succeeding slide. A pressure plate 16 (Figs. 5 and 15) is slidably mounted on the shaft 12 at each end of the drum and receives the axial displacement of the slides 13. A spring 17 embracing the shaft 12 acts on the outer face of the pressure plate and restores it to neutral position. Each pressure plate carries a hooked lever 18 adapted to be rotated upon displacement of the pressure plate by cam plates clearly shown and described in Patent No. 1,946,485 to pick up a pin 19 on a carriage 20 mounted for movement on an axis parallel to the axis of the drum. The levers 18 on the opposite pressure plates serve as clutches to selectively engage and release the pins 19 (Figs. 4, 5 and 17) of the carriage.

The foregoing elements numbered from 11 to 20 have corresponding parts in the vertical rate mechanism B which are numbered from 21 to 30.

The drive for the drum of the horizontal mechanism A is received from a constant speed spring motor C (Fig. 8) driving a gear 31 (Figs. 3 and 4) on the left end of the shaft 12. A gear 32 on the right end of the shaft 12 meshes with a gear 33 on the shaft 22 of the vertical rate mechanism B. As seen clearly in Fig. 3 the mechanism A is positioned above the gun 5 and the mechanism B is positioned at one side of the gun. Both of the mechanisms are housed in a casing D which embraces the gun and also contains the motor C. The motor C comprises a pair of spaced coiled springs 34—34 and as seen in Fig. 8 the gun 5 is positioned between the springs and above their common shaft 35.

One end of each spring is secured to the shaft 35 while the other end is secured to a rotatable casing 36 enclosing the spring. The casings 36 for the pair of springs are connected by a sleeve 37 on the shaft 35 so that they are driven as a unit by the springs. One of the casings 36 includes a gear wheel 38 which drives a twin gear 39 which in turn drives the gear wheel 31 (Fig. 1) of the rate mechanism A. Referring back to Fig. 8 the gear wheel 39 also drives a train of gearing 40 including a large gear wheel 41 mounted on the shaft 35. The gear wheel 41 is associated with and controlled by an escapement 42 (Fig. 1) whose pallet 43 includes an arm 44 the purpose of which will appear hereinafter. The customary pawl 45 and ratchet 46 (Figs. 6, 8 and 9) are provided for holding the shaft 35 stationary against the action of the springs 34. A crank handle 47 on a projecting end of the shaft 35 is provided for winding the springs.

Referring to Figs. 3, 4 and 5 the carriage 20 is provided with a vertical groove 48 for receiving a slide holder 49. The holder in turn is provided with a horizontal groove 50 for receiving an arm 51 on the carriage 30 of the vertical rate mechanism B. By this arrangement the slide holder is capable of being displaced horizontally and vertically.

A slide 52 carried by the holder 49 has a squared post 53 (Fig. 5) on its rear end on which is mounted an arm 54. The arm 54 is held against a stop pin 55 by means of a spring 56 embracing the post. The outer end of the arm is connected to a tube 57 through a universal ball joint 58. The tube 57 telescopically fits into a larger tube 59 whose forward end is mounted by means of trunnion pins 60—60 in a yoke 61 that is secured to the top of the casing D (see Fig. 11). The rear end of the tube 59 carries a post 62 on whose upper extremity is a ring 63 constituting the rear element of a sighting system.

The casing D (Figs. 1 and 2) has a forward extension E for the purpose of carrying the front sight elements. The front sight includes a central laterally immovable post 64 threadedly mounted in the casing E and a pair of laterally movable posts 65—65 slidably mounted in a groove 66 in the casing. A pair of bell-crank levers 67—67 disposed in a recess 68 in the casing are mounted on pivot pins 69.

The long arms of the levers are each provided with a slot 70 for receiving one of the posts 65. The short arms of the levers also provided with a slot 71, are arranged in overlapping relation in a yoke 72 of the front end of a control rod 73. A pin 74 secured to the yoke passes through the slots 71 of the overlapping ends. A spring 75 embracing the control rod is confined between the casing E and the yoke and normally tends to hold the levers 67 in extended position, arrested by the side walls of the recess 68 in the casing. A cover 76 is provided with a pair of slots 77 for the posts 65.

The control rod 73 (Figs. 1 and 2) extends rearwardly and terminates within the main casing D. A plate 78 (Fig. 11) secured to the rod by means of a screw 79 rides on a guide pin 80 threaded into the front wall of the casing D. The upper portion of the plate is turned into a flange 81 having a slot 82 for receiving a pin 83 (Figs. 1 and 5) depending from the slide 52.

The lower portion of the plate is provided with an angled slot 84 opening at one side of the plate to permit the intersection of the H-shaped end 85 of an operating link 86. There is a limited play in the engagement between the end 85 and the plate 78 so that the link 86 may have a slight movement in retraction before picking up the plate. This provision is made so that a pin 87, fixed to the link and normally engaging the arm 44 of the pallet 43 to hold the pallet immovable, may release the pallet upon initial retraction of the link 86. Further retraction of the link results in moving the plate 78 which through the control rod 73 causes the spaced posts 65 of the front sight to be drawn towards each other. The link 86 extends rearwardly to a position from which it may be conveniently actuated by the operator of the machine gun.

In employing the device the first operation of the gunner is to direct the gun on the target by lining up the rear sight 63 and the front sight 64 in the customary manner. The operating link 86 is then retracted until the front sight posts 65—65 subtend the target and tachymetrically afford an indication of range to the target or time of flight of a bullet corresponding to such range. Since the movement of the link 86 is transmitted to the slide 52 through the plate 78 the slide will be moved proportional to range or time of flight.

The retraction of the operating link 86 has also released the pallet 43 of the spring motor C and the drums 11 and 21 of the two rate mechanisms A and B are rotated at a constant speed. As the gun is moved in azimuth in following the target the pinion 14 displaces the successively presented slides or racks 13 which through the pressure plates 16 move the carriage 20 proportional to the relative angular travel of the target in the horizontal plane. By properly porportioning the gearing this measure of angular movement in a given period of time is made to automatically set in the horizontal lead angle made necessary by reason of the speed of the target.

If the gun is also moved in elevation the pinion 24 displaces the slides 23 which through the pressure plates 26 move the carriage 30 proportional to the relative angular travel of the target in the vertical plane, thereby affording a measure of the vertical lead angle.

The displacements of the carriage 20 and 30 are combined in the holder 49 which transmits the combined movement to the rear sight 63. The displacement of the rear sight 63 gives a deviation in the line of sight with respect to the axis of direction of the gun.

Since the range to the target is a factor influencing the vertical lead to be allowed for by the sighting system, the position of the rear sight must be further modified. As previously discussed the subtending of the target by the front sight posts 65—65 affords a measure of range which is introduced into the system by displacing the slide 52 longitudinally of the gun. The tube 57 carried by the slide 52 is thereby moved in or out of the tube 59 carrying the rear sight 63. The lever arm of the combined tubes 57 and 59 is thereby varied with respect to the trunnions 60. From an inspection of Fig. 1 it will be obvious that a shortening of the lever arm will give a greater movement of the sight 63 when the lever is moved by vertical movement of the holder 49.

I claim:

1. In a combination with a member mounted for movement in azimuth and elevation, a vertical rate mechanism operable upon movement of the member in elevation, a horizontal rate mechanism operable upon movement of the member in azimuth, a holder displaceable by said rate mechanisms, a slide carried by the holder, means for displacing the slide an amount proportional to a range factor, a tube universally connected to the slide, a pivotally mounted tube in which the first tube is telescopically fitted, and a sighting element on the pivotally mounted tube.

2. In a fire control apparatus, a holder, means for displacing the holder proportional to horizontal and vertical lead factors, a slide carried by the holder, means for displacing the slide on said holder an amount proportional to a range factor, a lever one arm of which is axially adjustable said arm being universally connected to the slide, and a sighting element on the opposite arm of said lever.

3. In a fire control apparatus, a holder, means for displacing the holder proportional to horizontal and vertical lead factors, a slide carried by the holder, means for displacing the slide on said holder an amount proportional to a range factor, a lever one arm of which is axially adjustable, said arm being connected to the slide, and a sighting element on the opposite arm of said lever.

4. In a fire control apparatus, a lever, one arm of which is adjustable in length, means for adjusting the length of said arm an amount proportional to a range factor, means for moving the arm an amount proportional to horizontal and vertical lead factors, and a rear sighting member mounted on the opposite arm of said lever.

5. In a fire control apparatus, a lever, one arm of which is adjustable as to length, means for adjusting the length of said arm an amount proportional to a range factor, and a rear sighting member mounted on the opposite arm of said lever.

6. In the fire control apparatus, a front sight unit including spaced posts, bell crank levers each connected to one of the posts, a control rod connected to the levers, a spring acting on the control rod to normally separate the posts, and means for retracting the control rod to move the posts towards one another.

7. In a fire control apparatus, sighting members mounted for movement towards and away from each other, actuating means for simultaneously moving the sighting members, and means acting through said actuating means for normally separating the sighting members.

8. In a fire control apparatus, front sighting members movable to subtend a target, actuating means for moving the sighting members toward and from each other, a lever having an arm axially adjustable to vary the effective length thereof, said arm being coupled to the actuating means, and a rear sighting member mounted on the opposite arm of said lever.

9. In combination with a gun mounted for movement in azimuth and elevation, a vertical rate mechanism positioned at one side of the gun and operable upon movement of the gun in elevation, a horizontal rate mechanism overlying the gun and operable upon movement of the gun in azimuth, a motor for driving the rate mechanisms and including spaced springs positioned on opposite sides of the gun, a lever displaceable by the rate mechanisms, an adjustable arm on the lever adapted to change the throw of the lever, a rear sighting member on the lever, front sighting members movable toward and away from each other, and means connecting said front sighting members to the adjustable arm of the lever.

10. In combination with a gun mounted for movement in azimuth and elevation, a vertical rate mechanism positioned at one side of the gun and operable upon movement of the gun in elevation, a horizontal rate mechanism overlying the gun and operable upon movement of the gun in azimuth, a lever displaceable by the rate mechanisms, an adjustable arm on the lever adapted to change the throw of the lever, a rear sighting member on the lever, front sighting members movable toward and away from each other, and means connecting said front sighting members to the adjustable arm of the lever.

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