Oct. 21, 1924. **1,512,249**

F. D. SPRAGUE ET AL

FIRING MECHANISM

Filed July 24, 1917

Fig. 1.

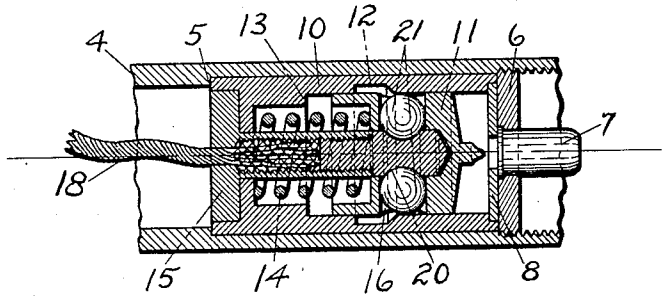


Fig. 3.

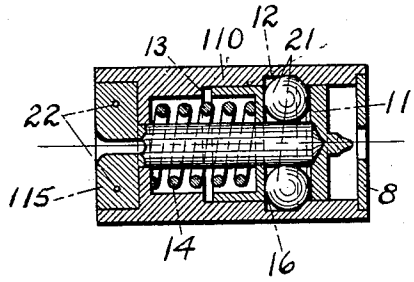
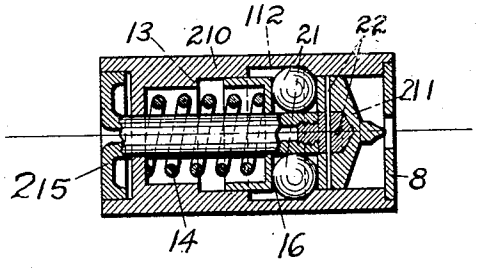


Fig. 4.



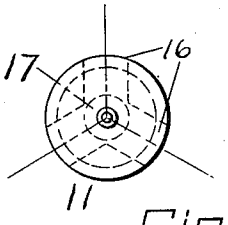


Fig. 2.

INVENTORS
FRANK DESMOND SPRAGUE
PHILIP WHALLEY ALLISON
BY

ATTORNEYS

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UNITED STATES PATENT OFFICE.

FRANK DESMOND SPRAGUE AND PHILIP WHALLEY ALLISON, OF NEW YORK, N. Y.

FIRING MECHANISM.

Application filed July 24, 1917. Serial No. 182,538.

To all whom it may concern:

Be it known that we, FRANK DESMOND SPRAGUE and PHILIP WHALLEY ALLISON, citizens of the United States of America, and residents, respectively, of the city of New York, county of Queens, and State of New York, and of the city of New York, county and State of New York, have invented certain new and useful Improvements in Firing Mechanisms, of which the following is a specification.

This invention relates to firing mechanisms for use in bringing about the explosion or detonation of explosives. The mechanism has a wide range of employment, being capable of use with projectiles of all kinds, (e. g., shells, torpedoes, aerial bombs, depth charges, etc.,) in mines and in the firing mechanisms of ordnance and fire arms, in which a normally locked mechanism is required and in which a movement of a part is necessary to cause a subsequent detonation or explosion. An example of the use of the firing mechanism in projectiles is shown in our companion application, Sr. No. 182,537, Fd. July 24, 1917.

The object of the invention is the production of a firing mechanism as above indicated, which is normally locked by means of a ball-clutch, the positive movement of one of the parts of which must be effected before the hammer is released for firing. The invention aims at the production of a mechanism which is proof against all ordinary accidental discharge.

In the accompanying drawings, we have illustrated three adaptations of our invention in order that it may be readily comprehended, but it is to be understood that the forms shown are merely illustrative and that our invention is by no means confined thereto.

In these drawings, which form a part of this application,

Figure 1 is a longitudinal section of one of the forms of our invention, wherein the movement of the clutch member for releasing the hammer compresses the firing spring;

Fig. 2 is a plan of a portion of the clutch of the firing mechanism illustrated in Fig. 1;

Fig. 3 is a longitudinal section of another form of our invention wherein the firing spring is fully compressed in the normal or at rest position of the mechanism; and

Fig. 4 is a longitudinal section of still another form of our invention having the same above noted characteristics as the form illustrated in Fig. 1.

Each of the three illustrated forms is shown as independent of any permanent mounting, for the mounting is optional and will probably vary with the various forms or types of explosive container to which the invention may be applied. However, in Fig. 1 a tubular mounting 4 for the firing mechanism is indicated for illustrative purposes, and the forms of Fig. 3 and Fig. 4 are, for convenience, presented in proportions and configurations adapted for mounting in a like manner.

For convenience of description we will refer to the left of the figures as the forward end of the mechanism and to the right of the figures as the rear end of the mechanism.

Considering first the construction of Fig. 1, the firing mechanism fits snugly in the mounting tube 4, abutting at the forward end against an annular shoulder 5, and being held in place at the rear end by a plate 6 screwed into the tube. A firing cap or cartridge 7 is centrally mounted in the plate, which is bored and countersunk for the purpose, and is held in position by another plate 8 which is centrally bored to permit the exploding of the cap in a manner later to be described.

The firing mechanism comprises an outer clutch and bearing member 10, which is illustrated in the form of a hollow cylinder and the rear end of the cylinder is shouldered and serves as a support for the aforesaid plate 8 so that the latter is firmly held against the plate 6 and the cap 7.

The cylinder is internally machined and serves as a bearing and support for the piston-like hammer 11. It is provided with an annular groove or recess 12 which is bevelled at the rear, and its bore is reduced toward the front so as to afford a shoulder 13 which serves as a stop to limit the forward motion of the hammer and so as to provide a pocket for the forward portion of a helical firing spring 14 which seats therein and which is normally under slight

compression. The cylinder is centrally apertured at the front and is countersunk and there carries a locking spindle 15.

The hammer is suitably pointed for exploding the cap and is formed with a pocket into which is set the rear portion of the firing spring. It is recessed radially as at 16 16 (see Fig. 2), and is centrally bored as at 17 for the insertion of the spindle 15.

The spindle is made in two parts. The forward part is bored and threaded and serves as a means of attachment for the firing cable 18. For this purpose the cable is ravelled out and its frayed ends secured by filling the spindle cavity with molten lead. The rear part of the spindle screws into the front part and extends into the firing end of the hammer. It is provided with an annular groove 20 which, when the spindle is in place, is in line with the radial apertures 16 16.

Balls 21 21 are located in the pockets formed by the radial recesses in the hammer and the groove in the spindle, and the parts are so proportioned that in the absence of the compressional force of the spring, the balls rest therein without binding and just touch the inner wall of the cylinder 10. The parts are so mounted that the vertical diameters of the balls are normally slightly to the rear of the bevelled groove 12.

Considering the operation of the firing mechanism now under discussion, this operation is initiated by a pull on the firing cable 18. This on becoming taut pulls the hammer 11 forwardly or to the left (as shown) in the cylinder 10 until the balls 21 21 reach a position opposite the recess 12, when the bevelled face on the rear of the groove 20 in the spindle 15 forces the balls outwardly and releases the spindle. The spindle is then pulled out by the cable, and the balls, under the effort exerted by the firing spring, are forced inwardly by the bevelled face of the recess 12 until the hammer is released. It will be observed that the pulling back of the hammer by the spindle has increased the compression of the firing spring. The hammer, now released, plunges rearwardly into the firing cap or cartridge 7, which is exploded, and in turn explodes or detonates any explosive which may be placed around it.

It will be observed that any slight pull on the cable, or any slight forward displacement of spindle 15, due to jar or other cause, will effect no operative derangement of the apparatus, as the hammer 11 is under the initial compression of the spring and will not be pulled to the front far enough to allow balls 21 21 to move outward, and so release spindle 15. As soon as the effect of the jar or the pull on the cable has ceased, the spring 14 will return all parts to their original position. A certain definite tension on cable 18 is necessary to compress the firing spring far enough to allow the ball clutch to be released, and the spindle 15 to be withdrawn. As the initial compression of the spring is, within certain limits, optional, this safety element of the firing mechanism may be made quite effective. Furthermore it is obvious that elements to resist the accidental forward movement of the hammer and spindle are not limited to means acting within the interior construction of the firing mechanism.

Referring now to the form illustrated in Fig. 3, the outer clutch and bearing member 110 is similar to that of Fig. 1 and is closed at its rear end by the centrally apertured plate 8. It differs from the outer clutch member of that figure in the position of the bevelled recess or groove 12 in its relation to the balls 21 21; and the depth of its bore within which a hammer 11 reciprocates is less than in the case of Fig. 1, for here there is no necessity of the forward motion of the hammer to release the clutch. The hammer 11 is similar in construction to that of Fig. 1 but the spindle 115 and the locking method are slightly different.

The spindle here illustrated is cylindrical in form and is without the groove 20. It normally maintains the balls 21 21 in locking engagement with the groove 12, and is prevented from accidental withdrawal by the shearing wires 22 22, which extend through the forward expanded portion of the spindle and the outer clutch member.

The firing spring 14 is here intended to be compressed to the desired extent for firing. The firing cable is, of course, intended to be mounted in the spindle in the same manner as in the case of Fig. 1 and its showing is not repeated.

The operation of this form is effected by a pull of the firing cable which on withdrawing the spindle shears the wires 22 22, and the balls, now free to move inwardly, are so forced by the combined action of the firing spring and the rear bevelled edge of the recess or groove 12, whereupon the hammer is released and plunges to the rear to explode the cap 7 in the same manner as in the case of the construction of Fig. 1.

While in this specific illustration there is no provision for forward movement of the hammer for safety purposes such as in the case of the construction of Fig. 1, it is to be noted that the firing spring is fully compressed in the normal position of the parts; and that this, together with the shearing wires, opposes a release movement of the parts and tends to prevent accidental discharge: further, that as in the case of Fig. 1, the means to resist accidental forward movement of the spindle are not limited to those acting in the interior construction of the firing mechanism.

In the construction of the form illustrated in Fig. 4, the outer clutch member 210 is also similar to that of Fig. 1 and is closed at the rear with the centrally apertured plate 8. Its rearwardly bevelled recess or groove 112 has the same position in respect to the balls 21 21 as the groove 12 of Fig. 3 but it extends forwardly a convenient distance to permit of a limited forward travel of the hammer 211 and balls 21. The bore within which the hammer reciprocates also extends forwardly an equal distance. These differences are for the purpose of permitting a forward movement of the hammer precisely as in the case of Fig. 1 to increase the compression of the firing spring for firing and to permit of its normal compression being comparatively slight.

The spindle 215 is like the spindle illustrated in Fig. 3 but the shearing wires 22 22 are here placed through the rear of the spindle and the head of the hammer, the spindle, for convenience in assembling, being made in two parts. The spindle operates normally to maintain the balls in locking engagement with the groove 112. It is intended to be equipped with a firing cable in the same manner as in the construction of Fig. 1 and a repetition of the showing is accordingly omitted.

When the firing cable is drawn taut the spindle draws the hammer and balls forwardly until the forward part of the hammer seats against the annular shoulder 13 when the shearing wires are shorn and the spindle withdrawn. The shearing of the wires and the withdrawing of the spindle permits the hammer to plunge to the rear and the balls to move inwardly, which they are compelled to do on striking the rear bevelled edge of the recess 112. The rearward movement of the hammer explodes the cap 7 as heretofore described.

From the foregoing description of Figs. 1 and 3 it should be obvious that ample safety means are provided in the construction of the form shown in Fig. 4.

The foregoing detailed description has been given for clearness of understanding and no undue limitation should be deduced therefrom but the appended claims should be construed as broadly as permissible in view of the prior art.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In a firing mechanism, the combination of a hammer provided with recesses, a firing spring to project the hammer, a clutch for restraining the release of the hammer comprising the combination of a plurality of balls, carried in and cooperating with the recesses of the hammer and moving therewith on firing movement thereof, and a part whereby the balls are normally maintained in locking engagement and means for compressing the firing spring and for releasing the clutch, substantially as described.

2. In a firing mechanism, the combination of a firing member provided with recesses, resilient means for propelling the firing member for firing, a clutch for restraining the movement of the firing member comprising a plurality of balls carried in and cooperating with the recesses of the firing member and moving therewith on firing movement thereof, and means for releasing said clutch on an increase of pressure on said resilient means.

3. In a firing mechanism, the combination of a firing member, resilient means for effecting a firing movement thereof, a ball clutch normally restraining said firing member and comprising an inner member and an outer member, the inner member being movable to release the said clutch, means for compressing said resilient means on releasing movement of the said element.

4. In a firing mechanism, the combination of a firing member, a firing spring, and a ball clutch normally restraining said firing member and comprising a plurality of elements, one of said elements being centrally positioned in the fuse mechanism and movable to release the said clutch, the firing spring opposing the release movement of said element.

5. In a firing mechanism, the combination of a firing member provided with recesses, resilient means for propelling the firing member for firing, a ball clutch for restraining the movement of the firing member comprising a plurality of balls, carried in and cooperating with the recesses of the firing member and moving therewith on firing movement thereof, an inner clutch member and outer clutch member, one of said clutch members being normally locked with the firing member, means for effecting relative movement of the said last named parts in respect to the other clutch member whereby the clutch is released and the resilient means are compressed for firing.

6. In a firing mechanism. a clutch comprising the combination of a plurality of balls, a carrying member provided with recesses for the balls, an annularly grooved spindle centrally positioned in respect to the balls, and movable relatively to the carrying member to release the clutch and a recessed enclosing member in which the carrying member has reciprocating movement, the enclosing member being so formed and positioned as normally to maintain the balls in locking engagement with the spindle and the recessed portion of the enclosing member permitting an outward movement of the balls to release the spindle when the balls are brought opposite thereto, substantially as described.

7. In a firing mechanism, the combination

of a clutch comprising a ball, a ball carrying firing member, a central member, and an outer member, the ball carrying firing member, central member and outer member each containing a recess for the said ball, a spring for propelling the firing member, and means for compressing the spring and for bringing the recesses into release alignment.

8. In a firing mechanism, the combination of a plurality of balls, a ball carrying firing member, a central member, and an outer member, the ball carrying firing member, central member and outer member being relatively movable in respect to each other, and each containing recesses for the said balls, the recesses in two of said members being normally out of alignment, a spring for propelling the firing member, means for compressing the said spring and means whereby after said spring is compressed and said alignment is established between the said recesses the last named member is released for firing movement.

9. In a firing mechanism, the combination with a firing member, of a clutch comprising a plurality of balls carried in the recesses of the said firing member, movable therewith on firing movement thereof, operating to restrain said firing movement, and released by an arming movement of the firing member, and a resilient element placed under tension by the arming movement of the firing member to cause a firing movement thereof when released.

10. In a firing mechanism, the combination with a firing member provided with recesses and a supporting member therefor, of a clutch normally restraining the firing movement of the firing member in respect to the supporting member, and comprising a plurality of balls carried in and cooperating with the recesses of the firing member and moving therewith on firing movement thereof, a resilient element for effecting a firing movement of the firing member, and means for moving one of the said members to disengage the clutch and place the resilient member under compression to effect the firing.

11. In a firing mechanism the combination of a firing member, a clutch normally restraining said firing member, a firing spring and a member arranged axially with respect to the firing mechanism under impulse of which the firing spring is compressed, and the clutch is released.

Signed at Washington, D. C., this 23rd day of July, 1917.

FRANK DESMOND SPRAGUE.
PHILIP WHALLEY ALLISON.

Witnesses:
HAROLD COUVECHIE,
STACY H. BRIANT.