Aug. 13, 1929. F. LESH 1,724,294

BOMB

Filed July 7, 1928 3 Sheets-Sheet 1

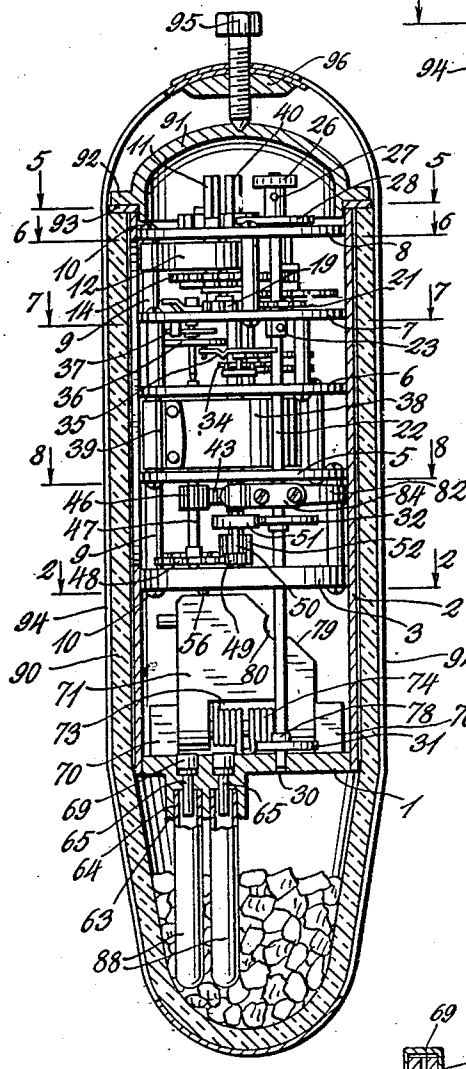


Fig. 1.

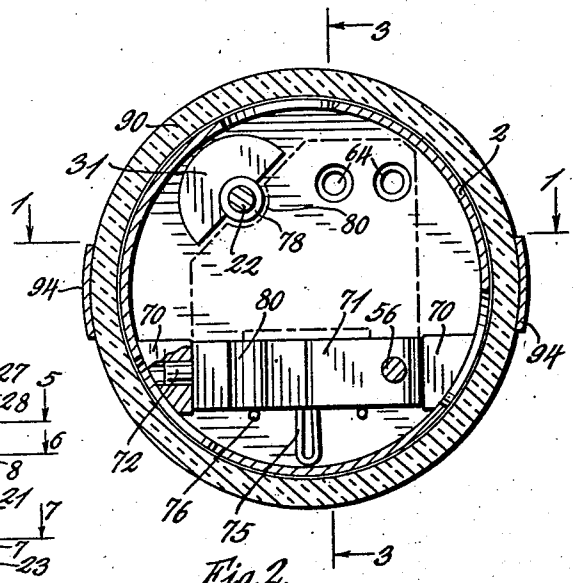


Fig. 2.

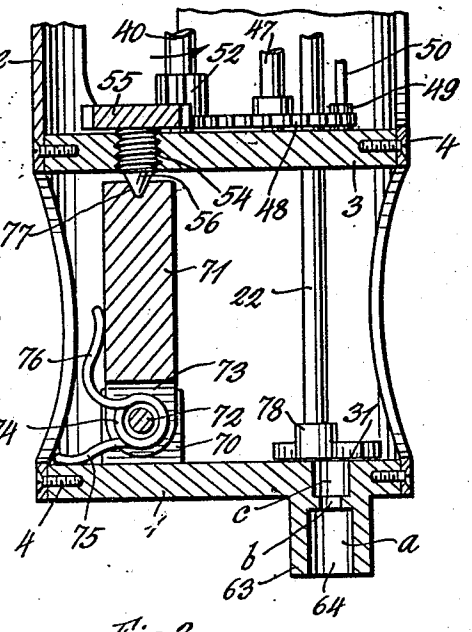


Fig. 3.

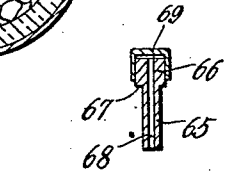


Fig. 4.

Inventor

Frank Lesh.

By A. O'Brian

Attorney

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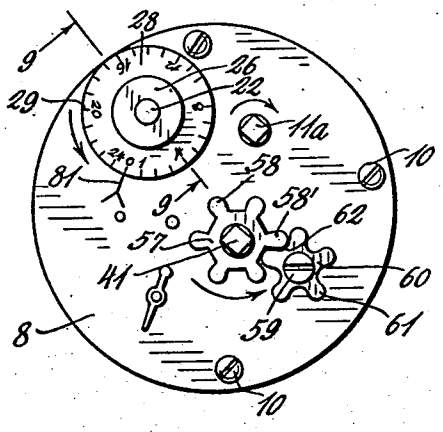


Fig.5.

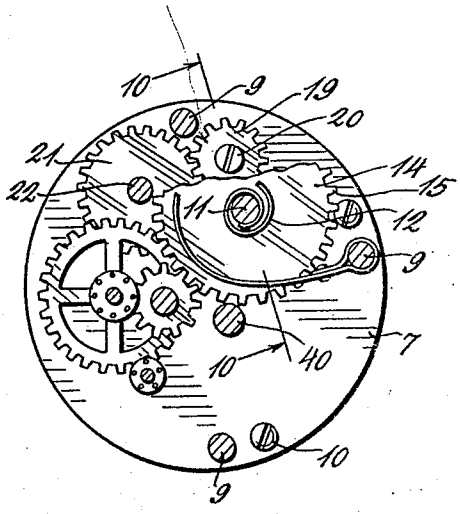


Fig.6.

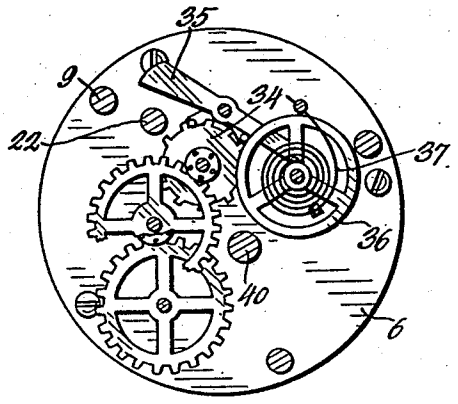


Fig.7.

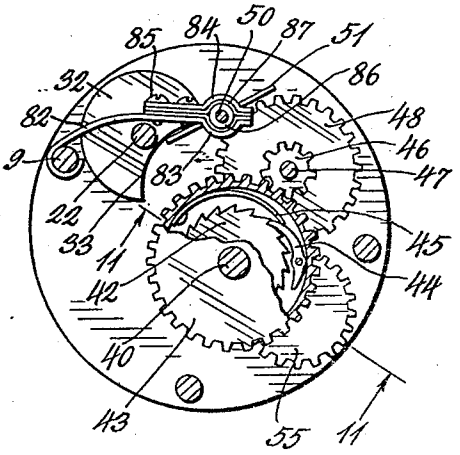


Fig.8.

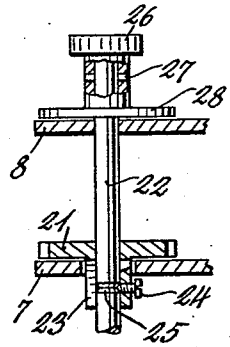


Fig.9.

Inventor

Frank Lesh.

By A. J. O'Brien

Attorney

Aug. 13, 1929. F. LESH 1,724,294

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Filed July 7, 1928 3 Sheets-Sheet 3

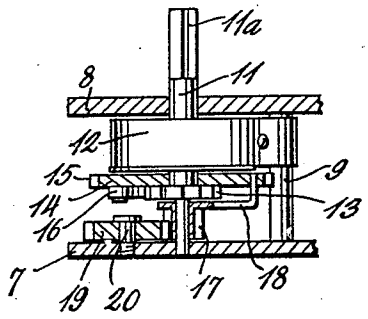


Fig.10.

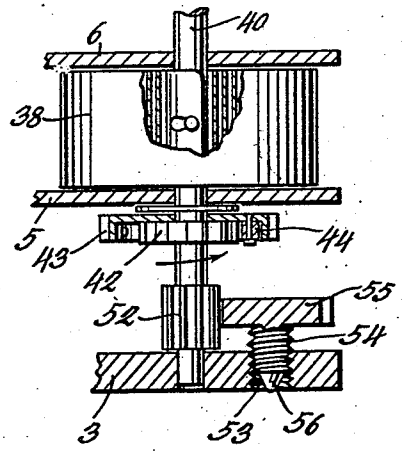


Fig.11.

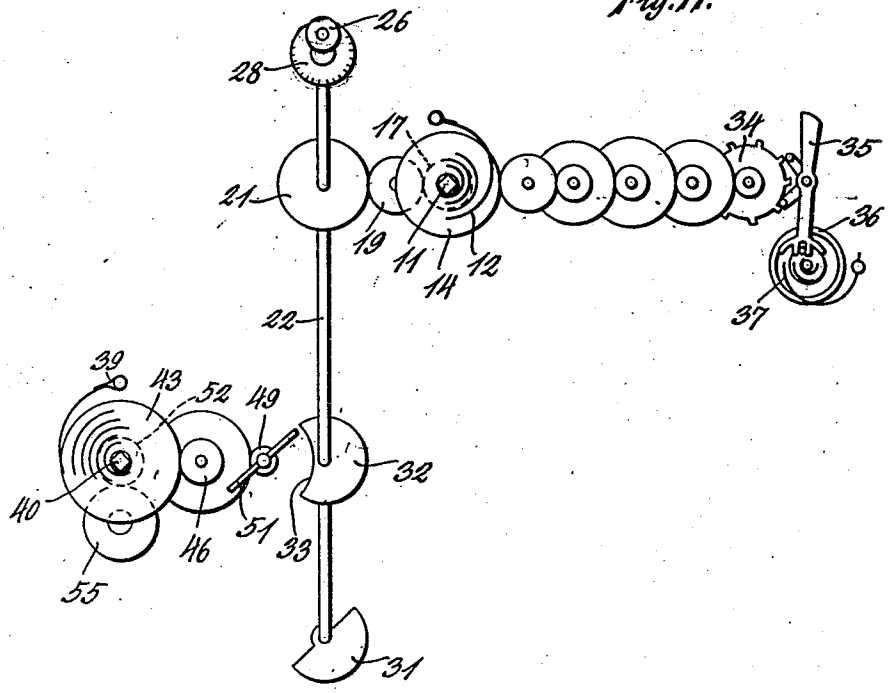


Fig.12.

Inventor

Frank Lesh.

By A. J. O'Brien

Attorney

Patented Aug. 13, 1929. 1,724,294

UNITED STATES PATENT OFFICE.

FRANK LESH, OF CASPER, WYOMING, ASSIGNOR OF ONE-HALF TO JOSEPH D. RICHIE, OF CASPER, WYOMING.

BOMB.

Application filed July 7, 1928. Serial No. 290,921.

This invention relates to improvements in bombs of the type used by oil well shooters for exploding large charges of nitroglycerine or other high explosives.

In "shooting" wells, a large amount of nitroglycerine is lowered to the bottom of the well, after which a bomb is lowered into the well so as to occupy a position adjacent the nitroglycerine. It is necessary to withdraw some of the casings after the charge of explosive and the bomb have been put into place and when this is done dirt, sand and rock will fall down from the walls of the well and completely bury the explosives. It is therefore essential that the bomb shall be so constructed that it will automatically explode at a predetermined time as the caving in of the well wall when the casing is withdrawn will break any electrical conductor that might otherwise be employed for exploding the bomb.

The withdrawal of the casing requires a large amount of labor and considerable time and for this reason the explosion of the bomb must be deferred until after this labor has been completed.

It is obviously important for the workmen to know the exact time when the bomb will explode so that they can plan their work so as to have everything in readiness for the explosion, and therefore the bomb should be operated by a time controlled mechanism that can be set to explode the bomb at any time desired.

It is evident that a premature explosion of a bomb of this type is likely to cause a large amount of material damage and perhaps the loss of life and therefore it is essential that the bomb shall be provided with a safety device that will prevent it from exploding prematurely.

It is the object of this invention to produce a bomb that shall be so constructed that it will not explode prematurely and which can be set so as to explode at any predetermined time.

The above and other objects that will hereinafter appear are attained by means of a construction that will now be described in detail and reference for this purpose will be had to the accompanying drawings in which the preferred construction has been illustrated and in which:

Fig. 1 is a vertical section taken on line 1—1, Fig. 2;

Fig. 2 is a transverse section taken on line 2—2, Fig. 1;

Fig. 3 is a vertical section to a somewhat enlarged scale taken on line 3—3, Fig. 2;

Fig. 4 is a longitudinal diametrical section of one of the anvils;

Fig. 5 is a top plan view looking downwardly along plane 5—5, Fig. 1;

Fig. 6 is a section taken on line 6—6, Fig. 1;

Fig. 7 is a section taken on line 7—7, Fig. 1;

Fig. 8 is a section taken on line 8—8, Fig. 1;

Fig. 9 is a section taken on line 9—9, Fig. 5;

Fig. 10 is a section taken on line 10—10, Fig. 6;

Fig. 11 is a section taken on line 11—11, Fig. 8; and

Fig. 12 is a diagrammatic view showing the relationship of the several driving springs and the other operative parts connected therewith.

In the drawings numeral 1 represents the base of the bomb and 2 the metal tube which forms part of the bomb structure. Secured to the metal tube a short distance above the base 1 is a partition 3. This partition, as well as the base 1, is held in place by means of screws 4. Secured to the tube at spaced distances and located above the partition 3, are four other partitions which have been designated by numerals 5, 6, 7 and 8. These partitions are separated by means of spacers 9 and held together by means of screws 10. Partitions 5, 6, 7 and 8, as well as partition 3, form bearings for different spindles and arbors that form part of the operating mechanism which will now be described in detail. Pivoted in suitable bearings in partitions 7 and 8 is an arbor 11. This forms the spring arbor to which one end of spring 12 is connected in the manner shown in Figure 6. The other end of spring 12 is connected to one of the spacers 9. Nonrotatably secured to the arbor 11 is a ratchet wheel 13 and located directly above this ratchet wheel and rotatable with respect to it and with respect to the arbor 11, is a gear wheel 14. This gear wheel has its outer periphery provided with teeth 15. A pawl 16 is pivotally connected with this gear and is held in operative engagement with the ratchet wheel 13

by means of a suitable spring which has not been shown. Rotatably secured to the lower end of arbor 11 is a pinion 17. This pinion has an arm 18 whose outer end is bent upwardly at right angles and projects through an opening in the gear 14. Pinion 17 cooperates with a gear 19 that is pivoted at 20. Gear 19 is meshed with another and larger gear 21 that is secured to a rotatable spindle 22 by means of a friction clutch arrangement which has been illustrated in Figure 9 from which it will be seen that the gear 21 is provided with an elongated hub 23 that is split longitudinally and has one end provided with a screw 24 whose inner end engages the groove 25 in the spindle 22. Screw 24 is adjusted so that there will be considerable friction and which will make it possible for the gear 21 to rotate the spindle 22 and at the same time permit the spindle to be rotated with respect to the gear when sufficient force is applied to the cap 26. Cap 26 is secured to the upper end of spindle 22 by means of a pin 27 and is provided with a circular disk 28 that is provided on one side with a scale or dial 29 which divides the circumference of this disk into twenty-four equal parts which are numbered consecutively from one to twenty-four in the manner shown in Figure 5. Spindle 22 extends through all the partitions and has its lower end pivoted in the bearing 30 in base 1 in the manner shown in Figure 1. Secured to the lower end of spindle 22 directly above partition 1 is a safety device 31 which consists of a substantially semicircular disk of considerable thickness. Reference will be had hereinafter to this disk and to the function which it performs in the operation of this apparatus. Secured to spindle 22 between partitions 3 and 5 is a detent disk which has been indicated by reference numeral 32. This disk has one side provided with a curved notch 33. The function of this detent and its mode of operation will be hereinafter more fully described.

Referring now more particularly to Figure 12, it will be seen that gear wheel 14 is connected by means of a gear train to an escapement which comprises an escapement wheel 34 and escapement lever 35 and a balance wheel 36. The balance wheel is controlled by means of a hair spring 37, all in the manner well understood in connection with clock mechanisms. It is apparent that gear wheel 14 can only rotate at a speed which is determined by the escapement and therefore the spring 12, together with the gear train and the escapement form a mechanism that operates at a predetermined speed and in which the different gear wheels require a predetermined amount of time for each rotation. Since the arbor 11 is thus rotated at a predetermined rate, it is evident that the spindle 22 which is connected to this arbor by means of a gear train consisting of a pinion 17 and gears 19 and 21 will also rotate at a predetermined rate. In the actual construction the parts have been so adjusted that spindle 22 will make one complete revolution in twenty-four hours, although it is, of course, evident that any other rate of rotation may be employed, but for the purpose of this explanation it will be assumed that spindle 22 rotates one complete revolution in twenty-four hours and that therefore each of the divisions on the scale 29 represent one hour in time.

Located between partitions 5 and 6 is a spring 38 which has one end fastened to a stationary post 39 and the other end secured to the arbor 40. Arbor 40 extends upwardly through partitions 7 and 8 and terminates in a square end portion 41 that can be engaged by a key by means of which it is rotated for the purpose of tensioning the spring. Secured to the arbor 40 between partitions 3 and 4 is a ratchet wheel 42 and located above this ratchet wheel is a gear wheel 43 that is provided on its lower surface with a recess in which the ratchet wheel 42 is located. Secured to the gear wheel 43 is a pawl 44 that is adapted to engage the teeth of the ratchet wheel 42 and is urged towards the ratchet wheel by means of the spring 45. Gear wheel 43 cooperates with a pinion 46 that is attached to an arbor 47 to which is also attached a gear wheel 48. Gear wheel 48 cooperates with a pinion 49 that is rigidly attached to a shaft 50 that carries two fan blades 51. These fan blades form a retarding device and also cooperate with member 32 to form a detent. Secured to the lower end of arbor 40 is a pinion 52 which is of considerable width in the manner shown in Figure 11. The partition 3 is provided with a threaded opening 53 in which is located a threaded latching member 54 that extends downwardly and is formed integral with a gear wheel 55. The parts are so arranged that when the arbor 40 is rotated in the direction of the arrow in Figure 11, in which direction the spring 38 is tensioned, that gear wheel 55 and plug 54 will be rotated so that the latter will move downwardly. It will be seen from Figure 11 that the latching member 54 is provided with a conical point 56.

Referring now to Figure 5 it will be seen that the upper end of arbor 41 is provided with a gear wheel 57 that has been shown as having six teeth 58. One of these teeth 58′ is longer than the other teeth. Secured to a pivot 59 is another gear wheel 60 that in the illustration shown is provided with five teeth 61. The depression between each of these teeth is of sufficient depth to permit the long tooth 58′ to pass but one of these depressions which has been indicated by

numeral 62 is shallower than the others and will not permit the long tooth 58 to pass. With the parts as shown in Figure 5, it is apparent that the arbor 41 can be rotated in the direction of the arrow, but that it cannot be rotated in the opposite direction and therefore it is apparent that when the tooth 58′ engages the depression 62, that these two parts form a lock or a stop that limits the rotation in this direction. The gears 57 and 60 in Figure 5, are in the position in which they are found when the latching member 54 occupies the position shown in Figure 3.

Attention will now be directed to Figure 12 in which the relationship of the detent 32 and of the retarder blades 51 has been shown. From this figure it will be seen that the cut-out portion 33 of the detent member 32 is curved substantially concentric with the arbor 50 and therefore when this detent is in such a position that its center of curvature coincides with the axis of arbor 50 the blades 51 will be free to rotate, but if it is rotated a few degrees away from this particular position, the ends of the blades 51 will strike the detent 32 which will therefore hold the blades against rotation. If spring 38 is tensioned by rotating the arbor 40, the parts with which it is associated will be held against rotation so long as the detent 32 has any portion thereof interposed in the path of the blades 51, but if spindle 22 is rotated to a predetermined position, the detent 32 will be moved out of the path of rotation of blades 51 and spring 38 will then function to rotate the arbor 40 in such a direction as to move the latching member 54 from the position shown in Figure 3 to the position shown in Figure 11.

The base 1 is provided with two downwardly extending bosses 63 which have axial openings 64. These openings are composed of three sections, *a*, *b* and *c*. Section *b* is smaller in diameter than section *c* and section *a* is larger in diameter than either of the other two. An anvil 65 of the shape illustrated in Figure 4 is adapted to be inserted in each opening 64 and has its end 66 of somewhat larger diameter than the lower end whereby a shoulder 67 is formed that is adapted to rest on the shoulder between sections *b* and *c*. This anvil has a central opening 68 and is adapted to receive a cap 69 of the type employed in connection with shotguns or other fire arms. When this anvil is in place, its upper end will extend slightly above the upper surface of the base 1. Base 1 is provided with two spaced lugs 69 and 70 between which is pivoted a hammer 71. This hammer is secured to the lugs by means of a pintle 72 and is provided with a notch 73. A spring 74 has two coils which surround the pintle 72 and these coils have their connecting portions 75 resting on the upper surface of base 1, while the free ends 76 of these coils extend onto the upper surface of the hammer 71 in the manner shown in Figure 3. The upper end of hammer 71 is provided with a conical opening 77 which is adapted to receive the conical projection 56 of the latching member 54. When the hammer is moved upwardly into the position shown in Figure 3, and the arbor 40 is rotated in the direction indicated by the arrow, the latching member 54 is moved downwardly so that its end 56 will enter the conical recess 77 and hold the hammer in the position shown in opposition to the action of the spring.

I want to call attention at this point to the positive construction of the latching means just described. Since the latching member 54 has a threaded connection with the partition, it cannot be moved longitudinally without first being rotated and therefore there is scarcely any chance of this latching member being accidentally displaced so as to release the hammer prematurely. When the latching member 54 is rotated so as to move it upwardly it will release the hammer and the spring will rotate the latter about its pivot until its lower surface strikes the caps 69 and explodes them.

In order to increase the factor of safety and to make it absolutely sure that the hammer cannot explode the caps 69, except at a predetermined time, the spindle 22 has been provided with a safety device 31, which consists of a substantially semi-circular disk that is provided with a hub 78 and is non-rotatably secured to the spindle 22. The hammer 71 has the shape indicated by the dotted lines in Figure 2 from which it will be seen that one corner is cut at forty-five degrees so as to leave diagonal surface 79 and this surface has a circular recess 80 that fits about the hub 78. When the safety member 31 is in such a position that the diametrical surface is parallel with surface 79, the hammer may pass into contact with the caps, but if the safety member is in any other rotary position, it will be interposed between the under surface of the hammer and the upper surface of base 1 so that if the hammer should be accidentally released, it would strike the upper surface of the safety member and not come in contact with the caps and in this manner a premature explosion would be prevented.

In the above description it has already been explained that the spindle 22 is rotated by means of a time controlled mechanism in such a way that it will make one complete revolution in twenty-four hours and that the flange 28 is provided with a scale 29 which is graduated into twenty-four equal divisions, each of which represents one hour of time. I have also explained that the spindle 22 is secured to gear wheel 21 by means of a friction clutch comprising a screw 24 so that

it may be rotated with respect to gear wheel 21. When the bomb is prepared for use, the number of hours that are to elapse between the time it is set and the time at which the explosion is to take place is decided on after which the flange 28 is rotated together with the spindle 22 until the pointer 81, Fig. 5, points to the desired number of hours. In the drawing pointer 81 has been shown as indicating zero which corresponds to the relationship between the hammer and the safety member shown in Figure 2. If the spindle is rotated away from zero position, safety member 31 will be moved into a position in which it will be interposed between the hammer and the base and will act as a stop for the hammer.

Referring now to Figure 8, I wish to call attention to the fact that the arbor 50 is rotatably mounted in a bearing consisting of a bracket 82 having a curved surface 83 and which is provided with a removable complementary member 84 that is secured to the bracket 82 by means of screws 85. Arbor 50 is provided with a sleeve 86 of somewhat larger diameter whose outer surface is separated from the inner surface of the bearings by means of leather strips 87. This forms a friction device that cooperates with the retarder 51 for the purpose of controlling the operation of the device. It is, of course, understood that the friction device must be so adjusted that there is no danger of it exerting sufficient friction to prevent rotation of the retarders when they are released by the detent. Secured in section 9 of the openings 64 are mercury fulminate caps 88. These are held in openings 64 by means of friction and are so located that whenever the caps 69 are exploded the mercury fulminate will also explode and will in turn explode the dynamite 89 which surrounds them.

The mechanism which has just been described is enclosed in a glass tube 90 which is substantially a quarter of an inch in thickness and whose inner diameter is of the proper size to receive the casing 2. A cap 91 is secured to the upper end of the assembly described and has a flange 92 that extends over the tube 2 and also over the top of the tubular glass member 90 and is separated from the latter by means of a gasket 93. A strap 94 surrounds the glass tube 90 and the cap 91 and is provided at its upper end with a clamping screw 95 which cooperates with a nut 96 and which can be forced downwardly into contact with the cap so as to hold the parts rigidly in assembled position.

When the bomb is prepared for use, the hammer 71 is moved upwardly into the position shown in Figure 3, after which the arbor 40 is rotated by means of a key applied to the square end 41 so as to move the latching member 54 downwardly into the position shown in Figure 3 in which position the hammer will be positively latched and held against the action of the spring. The position of the safety member 31 is now adjusted by rotating the cap 26 so that the figure corresponding to the number of hours that are to elapse between the setting of the bomb and the explosion register with the arrow 81. A key can then be applied to the squared end 11^a of arbor 11 and the spring 12 tensioned so as to produce the necessary power for operating the clock train. The time controlled mechanism will now begin to function and will slowly rotate the spindle 22 in the manner already described. Caps 69 are put in place on top of the anvils 66 and the fulminate of mercury caps 88 are inserted into the openings 64. A few pieces of dynamite are now placed in the bottom of the glass tube after which the mechanism is inserted into the glass tube in the manner shown and secured thereto by means of the clamping strap 94 and screw 95. This bomb is now inserted in a metal box and carefully lowered through the well opening until it is finally deposited among the nitroglycerine at the bottom of the well. The rope by means of which it was lowered can now be disconnected and removed, after which the casings are pulled to the extent desired. At the elapse of the time for which the bomb was set, the spindle 22 will have been rotated to such an extent that the safety member 31 occupies the position shown in Figure 2 and at the same time the detent member 32 will occupy the position with respect to the retarder blades 51 shown in Figure 12. As soon as the blades 51 are released they are rotated by means of spring 38 and this permits the pinion 52 to rotate the gear wheel 55 and to move the latching member 54 upwardly to the position shown in Figure 11. As soon as the latching member has been moved upwardly to such an extent that the conical end 56 will be removed from the recess 77, the hammer will be released and will be rotated about its axis 72 by the action of the spring 74. As the hammer strikes the cap 69, this will explode and will in turn explode the fulminate caps and the dynamite 89, thereby exploding the nitroglycerine charge at the bottom of the well.

From the above description it will be apparent that I have produced a bomb that is well suited for use in connection with the shooting of oil wells and which can also be used at any place where a charge of high explosive is to be detonated at a predetermined time. This device, as above explained, is provided with a hammer that is latched in open position by means of a latching member which must be rotated before it can be moved longitudinally and which therefore assures a high degree of reliability, as it is almost impossible to accidentally displace such a latching member.

A safety device has been provided which consists of the member 31, which is normally interposed between the anvils and the hammer so that if the hammer is accidentally released at any other time, than that for which the bomb is set, it will not come in contact with the caps and will therefore not cause the bomb to operate. The latching member is held in inoperative position by means of a detent which permits the retarders to rotate only at the time when the safety device 31 occupies such a position that the hammer, if released, can come in contact with the cap 69.

I also want to call attention to the fact that the time controlled means is operated by a separate spring from that which controls the latching member and that spring 12 is therefore never called upon to perform any other function than to operate the time controlled means, whereas spring 38 is limited to the function of releasing the latching means at such a time as the detent 32 permits the retarders 51 to rotate.

Having described the invention what is claimed as new is:

1. A device of the class described comprising a base having an anvil adapted to receive a cap, a hammer adapted to strike the anvil, means comprising a spring for urging the hammer towards the anvil, a latch for holding the hammer in inoperative position, a safety device normally interposed in the path of the hammer, and means for first moving the safety device to inoperative position and then releasing the hammer.

2. A device of the class described comprising a base having an anvil adapted to receive a cap, a hammer adapted to strike the anvil, means comprising a spring for urging the hammer towards the anvil, a latch for holding the hammer in inoperative position, a safety device normally interposed in the path of the hammer, means comprising a spring for moving the latching means to inoperative position, a detent for holding that latch moving means in inoperative position, and means for moving the safety device to inoperative position and then releasing the latch moving means so that the latter will function and release the hammer.

3. In a device of the class described, in combination, a base having an anvil adapted to receive a cap, a hammer adapted to strike the anvil, means comprising a spring for moving the hammer towards the anvil, a latch for holding the hammer in inoperative position, a safety device comprising a member normally located in the path of the hammer and serving to space the hammer from the anvil, a time controlled means for moving the safety device to inoperative position at a predetermined time, means comprising a spring for moving the latch to inoperative position, means for holding the latch moving means in inoperative position and means controlled by the means that controls the position of the safety device for releasing the latch moving means whenever the safety device is moved to inoperative position.

4. A bomb of the class described comprising, in combination, a base having an anvil adapted to receive a cap, a movable hammer adapted to be moved into engagement with the anvil, means comprising a spring for moving the hammer towards the anvil, a latching device for holding the hammer in inoperative position in opposition to the action of the spring, means comprising a spring for releasing the hammer, a safety device normally interposed between the hammer and the anvil so that if the hammer is accidentally released it will be prevented from striking the anvil, means comprising a time controlled mechanism for moving the safety device to inoperative position at a predetermined time and for moving the latching device to inoperative position when the safety device has been moved to inoperative position.

5. A device of the class described, comprising, in combination, a base having an anvil adapted to receive a cap, a hammer movably connected with the base, means comprising a spring for urging the hammer towards the anvil, latching means for holding the hammer out of contact with the anvil against the action of the spring, said latching means comprising a screw adapted to be moved into engagement with the hammer when rotated in one direction and to be moved out of engagement with the hammer when rotated in the opposite direction, means comprising a spring for rotating the screw out of hammer engaging position, a detent for holding said means in inoperative position, a safety device interposed in the path of the hammer towards the anvil and means for simultaneously releasing the detent and for moving the safety device to inoperative position.

6. A device of the class described comprising, in combination, a base having an anvil adapted to receive a cap, a hammer movable into and out of engagement with the anvil, means comprising a spring for moving the hammer towards the anvil, a latching device for holding the hammer spaced from the anvil against the force exerted by the spring, a safety spacing member rotatably secured to the base, said member when in a given position permitting the hammer to strike the anvil, means for rotating the spacing member, and means for releasing the hammer latching device when the spacing member reaches inoperative position.

7. A device of the class described, comprising, a base having an anvil adapted to

carry a cap, a hammer movable into and out of engagement with the anvil, a spring associated with the hammer and base for moving the hammer towards the anvil, a latching device for holding the hammer against the action of the spring, spring means for moving the latching device to inoperative position, a detent for holding the spring means inoperative, a safety device interposed in the path of the hammer towards the anvil and time controlled means for moving the safety device to inoperative position and for releasing the latching means.

In testimony whereof I affix my signature.

FRANK LESH.