April 13, 1937. W. F. BLEECKER 2,076,613

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Filed March 15, 1935 2 Sheets-Sheet 1

Fig. 1.

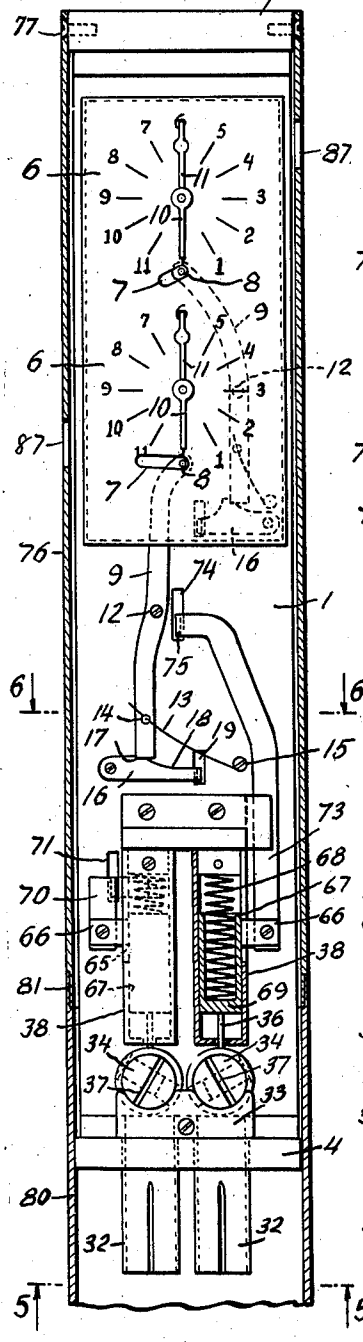


Fig. 2.

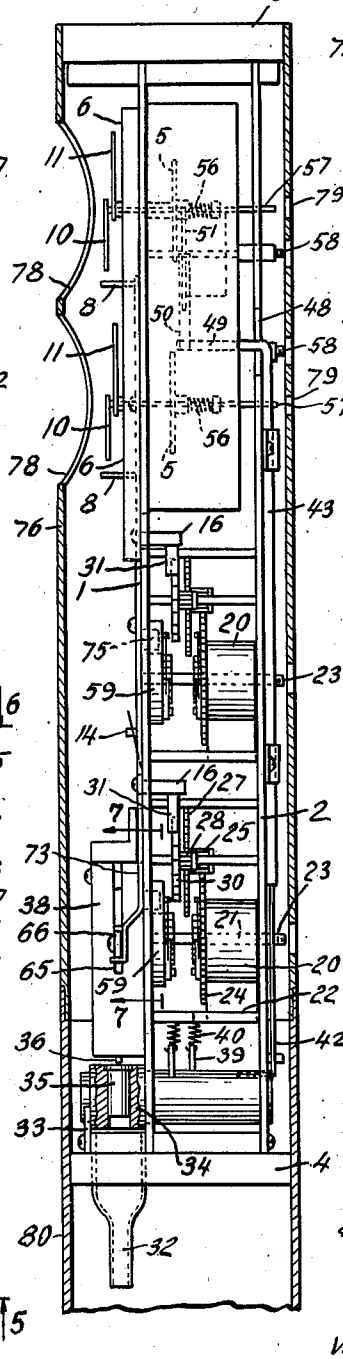
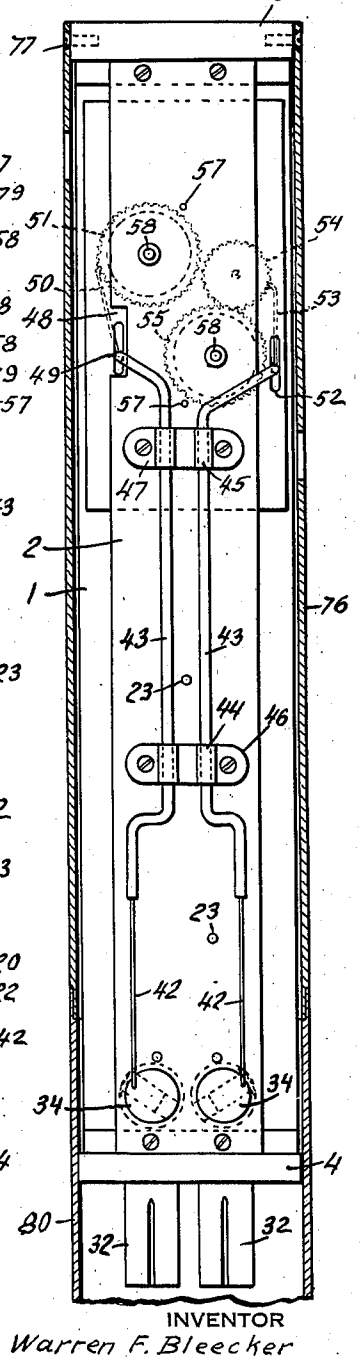


Fig. 3.



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BOMB

Filed March 15, 1935 2 Sheets-Sheet 2

Fig. 4.

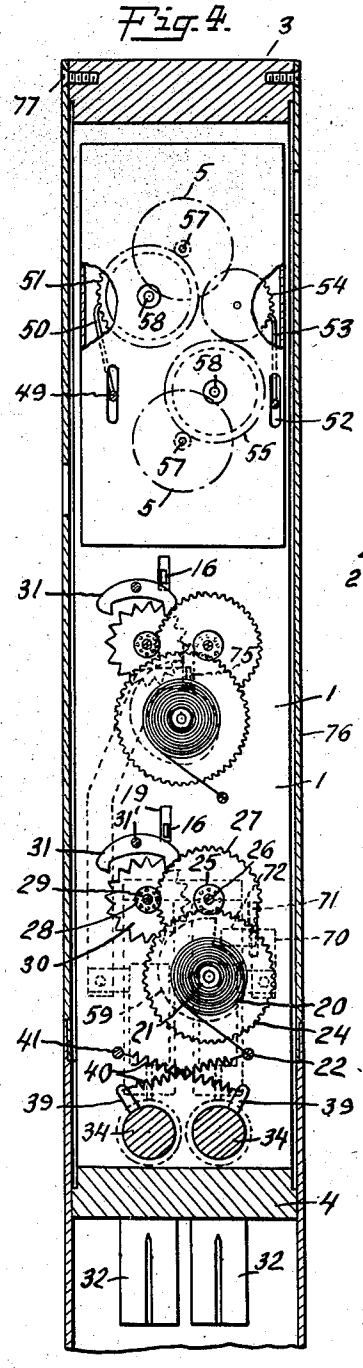


Fig. 5.

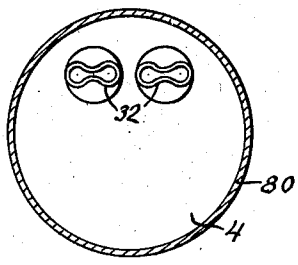


Fig. 6.

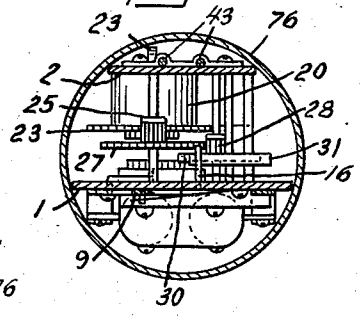


Fig. 7.

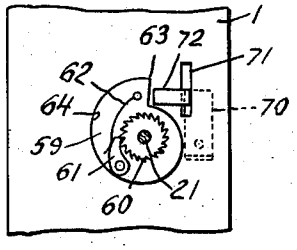
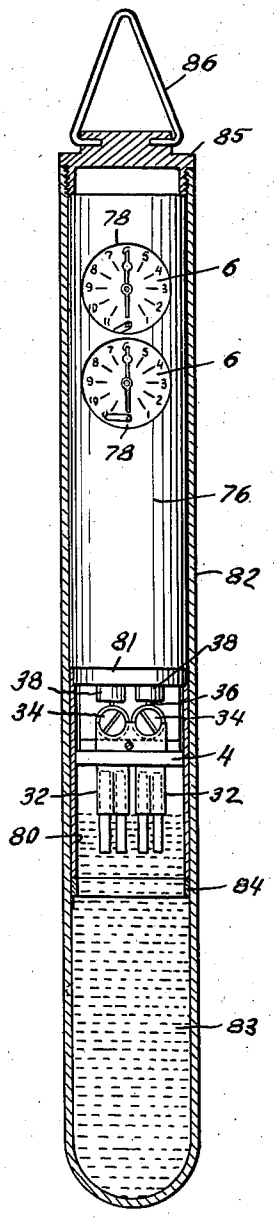


Fig. 8.



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Application March 15, 1935, Serial No. 11,219

14 Claims. (Cl. 102—4)

This invention relates to time bombs and more particularly to a bomb adapted for use in "shooting" oil wells, although the device is not restricted to such use.

In the operation of oil wells it is customary to shoot a well by means of a main shattering charge of high explosive. This shattering charge is lowered into the well and a time bomb containing a time controlled mechanism, a detonator and an initial exploder is loaded into the well in proximity to the main shattering charge. The time bomb is arranged in a water tight casing and is pre-set to operate at a certain time. Upon operation it detonates the fuse or cartridge and ignites the initial exploder. This shatters the bomb casing and ignites the main shattering charge in the well.

A bomb of this type must possess certain characteristics. It must be rugged in construction so that it will not be easily damaged or allow its working parts to become disarranged during handling and transportation. It must also be accurate, that is, it must function at the time and place desired to perform its functions. Above all, however, it must be safe to permit its handling by persons only moderately skilled in its use. This is essential to prevent destruction of life and property.

In the present invention I have provided a bomb having these characteristics. The bomb of this invention is provided with a breech block which is movable into an inoperative and loading position. In other words, to place the detonator or cartridge in the bomb it is necessary to move the breech block into a position out of alignment with the firing pin. The breech block is then returned to its operative position by the operation of the time controlled mechanism so that a definite period of time must elapse before the breech block is in such position that the firing pin can cause the bomb to be operated. The safety device is an important improvement not only in that it requires the lapse of a certain period of time after the bomb has been loaded before it can operate but in that the bomb can not be loaded without moving the breech block to the safety position. In many devices of this sort the safety device must be set by a separate operation after the bomb has been loaded and if the user neglects to set the safety device through carelessness or other reason it is ineffective. While the safety device is controlled through the clock work mechanism it is so arranged that it does not interfere with the normal operation of the clock, that is, it does not place any additional load on the main spring. Additional work placed on the main spring of a clock, which is designed to operate the clock mechanism only, causes it to run improperly because this extra labor creates an unbalanced condition which upsets the entire mechanism.

I further provide a separate escapement for the release of the firing pin. While this escapement is released by the clock work mechanism, the operation of it by a separate mechanism also avoids the placing of extra labor on the main spring of the clock, and therefore provides greater accuracy of operation and less possibility of derangement of the clock mechanism.

In the accompanying drawings I have shown one embodiment of the invention. In this showing,

Fig. 1 is a front elevation of a duplex bomb, parts being shown in section and the outer casing in which the time control mechanism and its associated parts are mounted, being shown in section;

Fig. 2 is a side view of the time control mechanism and associated parts, parts being shown in section, with the casing also in section;

Fig. 3 is a rear elevation;

Fig. 4 is a view from the rear with the rear plate removed;

Fig. 5 is a horizontal, sectional view on line 5—5 of Fig. 1 looking in the direction of the arrows;

Fig. 6 is a similar view on line 6—6 of Fig. 1 looking in the direction of the arrows;

Fig. 7 is a detailed view of the cam which operates the firing pin and its associated parts; and

Fig. 8 is a vertical, sectional view showing the mechanism arranged in the outer waterproof casing with the initial exploding charge in the bottom of the casing.

Referring to the drawings, the unit consisting of the clock work, the escapement, the firing pin, the movable breech block and the holder for the dynamite caps is shown in duplicate, the bomb herein shown being what is known as a duplex bomb which is simply two bombs built on one frame to provide a more convenient form of using two independent units than having them mounted separately. The duplex bomb is used to a great extent in the industry to minimize the possibility of failure of explosion after the bomb and main shattering have been placed in the well. The mechanism of the duplex unit is merely duplicated and a description of one of the complete units will therefore describe the construction. The bomb is of the mechanically operated type

as distinguished from the electric type. As shown, the parts are supported on two spaced parallel plates, a front plate 1 and a rear plate 2. These plates are secured to upper and lower discs 3 and 4 which are preferably circular in shape and form guides for arranging the bomb unit in its casing. At the top the device is provided with a pair of clock units 5 of ordinary construction. As shown, each of these units is provided with a dial 6. The dials are numbered counter-clockwise from 0 to 11 and in setting the bomb the clock hands are arranged the desired number of hours from the 0 which is equivalent to 12 o'clock on the ordinary time piece. Each dial is provided with a slot 7 through which projects a pin 8 carried by a pivoted lever 9. As shown the minute hand 10 of the clock is shortened so that it can rotate and pass the pin 8 without striking it. The pin is adapted to be moved by the hour hand 11 when it reaches the 0 hour.

The pivoted levers 9 extend downwardly on the outer side of the front plate and are pivoted intermediate their ends at 12 as shown. They are normally held in the inoperative position by springs 13, one end of which is secured to a pin 14 carried by the lever adjacent its lower end and the other end of which is coiled about a screw 15 arranged on the plate 1. The lower end of the lever cooperates with an escapement release member 16 to normally hold this member in its lower or inoperative position. As shown, when the parts are in this position the end of the lever 9 is seated in a notch 17 in the escapement control member to hold it down. When the lever 9 is swung about its pivot in a counter-clockwise direction by the hour hand 11 of the clock, it is positioned over a cut-away portion 18 of the escapement control member permitting the escapement control member to move upwardly. The escapement control member extends through a slot 19 in the plate.

Mounted on suitable shafts between the two plates 1 and 2 is a mechanism similar to the alarm mechanism of a clock and adapted to be released by the upward movement of the escapement control member 16. As shown in Fig. 4 of the drawings a spring 20 is secured to a shaft 21, the opposite end of the spring being fastened to a rod or pin 22 arranged between the two plates. The end of the shaft 21 projects through the rear plate 2 as shown at 23 (see Fig. 2) and is threaded for the reception of a key to permit winding of the control mechanism. Shaft 21 carries a gear 24 meshing with a pinion 25 on a shaft 26 and this shaft carries a gear 27 meshing with a gear 28 on escapement shaft 29. The escapement shaft is provided with a star wheel escapement 30 and an escapement member 31 is pivotally mounted on a pin 31' above the star wheel. When the escapement control member 16 is permitted to move upwardly by the lever 9 the escapement 31 is released permitting the spring 20 under tension to rotate the shaft 21.

The parts heretofore described are exact duplicates of each other for the two clock mechanisms and control or release devices. Due to the necessity of mounting one of the alarm or release devices over the other, the connections between the release devices and the firing pin operating mechanism is slightly different. As shown, a pair of dynamite cap holders 32 are mounted on the lower disc 4 and communicate with openings extending through the lower disc (see Fig. 2). A breech block support 33 is arranged on the upper side of the disc 4 in communication with the dynamite cap holders. A pair of breech blocks 34 are mounted on the breech block holder and each of the breach blocks is provided with an opening through it adapted to receive a primer cap or cartridge 35 (see Fig. 2). The breech blocks are in the form of cylinders which are rotatably mounted in aligned openings in the front and rear plates 1 and 2. A firing pin 36 is arranged over each of the breech blocks and when the breech blocks are in operative position, the firing pin is in alignment with the cartridge 35 as shown in Fig. 2 of the drawings so that upon operation of the release mechanism the cartridge will be fired to explode the dynamite caps arranged in the dynamite cap holders 32. As stated, however, the breech blocks are rotatable and are provided with slots 37 in their faces to permit them to be turned outwardly to arrange the cartridge receiving opening beyond the firing pin housing 38 for the insertion of the cartridge 35. This is the safety position and it will be apparent that if the firing pin is released while the breech block is in this position, the firing pin will merely strike a portion of the side of the breech block and will not detonate the cartridge. While the breech blocks may be turned outwardly by the user of the bomb, their return movement is controlled by the clock mechanism 5. As shown (see Fig. 4) each of the breech blocks is provided with a radial arm 39 and a coil spring 40 is connected to this arm. The end of one of the coil springs is connected to the pin 22 to which the end of spring 20 is connected and the end of the other spring is connected to a similar pin 41 arranged between the front and rear plates. These springs tend to move the breech blocks forwardly to operative position but this movement is controlled by mechanism shown in Figs. 3 and 4 of the drawings to prevent such return to operative position before the lapse of a certain period of time. As shown (see Fig. 3) a spring 42 is connected to the rear face of each of the breech blocks, the upper ends of these springs are connected to arms 43 slidably mounted in sleeves 44 and 45 formed in supporting plates 46 and 47 secured to the rear plate 2. The upper end of one of these arms is offset and arranged in a recess 48 in the rear plate 2. It then extends toward the front plate as shown at 49 and is provided with a spring 50 on its end which is adapted to engage the teeth of gear 51 carried by the main spring shaft of the upper clock mechanism. The other arm extends through a slot 52 in the plate of the clock mechanism and is likewise provided with a spring 53 on its end. This spring is adapted to engage the teeth of a gear 54 driven by the gear 55 on the shaft of the main spring of the lower clock mechanism. The springs 50 and 53 are held against upward movement and rotation of the breech blocks 34 to their operative position is thus prevented except when the clock mechanism has moved a sufficient distance to permit, by rotation of gears 51 and 54, the springs to ride upwardly a sufficient distance that the breech blocks may revolve to their operative positions. In connection with this safety control mechanism attention is called to the fact that the engagement of the springs 50 and 53 with the clock mechanism exerts a force on the clock mechanism in the direction in which the clock is running and does not place extra labor on the clock mechanism. Thus, the main spring shaft of the upper clock and the associated gear 51 revolve

in a clockwise direction in Figs. 3 and 4 of the drawings and the force of the spring 40 transmitted through the connections pushes the gear in the normal running direction. The additional gear 54 of the lower clock mechanism which is operated by the gear 55 on the main spring is for the purpose of also engaging the spring 53 with a gear running in such direction that the force exerted by the spring 53 will tend to push the clock mechanism rather than retard it. This is due to the fact that the spring 53 is arranged on the opposite side and must therefore engage a gear running in a counter-clockwise direction.

The wire 42 because of its flexibility permits the breech to move about its axis in response to the action of spring 40 as soon as the bar or rod 43 has moved a pre-determined distance away from the breech. The wire is not limber enough to permit its distortion end-wise so as to permit the breech to turn too quickly. The spring pawls 50 and 53 have sufficient tension to remain in contact with the teeth of the gears 51 and 54 but do not offer resistance to the free turning of the clock movement.

In connection with the safety device attention is also called to the fact that actual operation of the clock mechanism as distinguished from mere turning of the hands of the clock, is necessary in order to cause rotation of gears 51, 54 and 55 and the movement of the breech blocks to their operative positions. As in the ordinary clock construction the hands are connected to the clock mechanism by spring clutch 56. The hands are mounted on a shaft or arbor 57 which projects through an opening in the rear plate to permit setting of the hands but this setting operation does not cause rotation of the clock mechanism and therefore will not return the breech blocks to operative position. Likewise the main spring shafts 58 of the clock project through openings in the rear plate to permit winding of the clock mechanism.

The release of the firing pin is controlled by the cam 59 which is mounted on the shaft 21 and connected thereto by pawl and ratchet mechanism so as to permit the shaft to be turned in one direction to wind the spring 20 without rotating the cam and cause the cam to rotate with the shaft when the shaft turns in the opposite direction through the action of the spring 20 when the escapement mechanism is released. A ratchet wheel 60 is mounted on the shaft and is adapted to be engaged by a pawl 61 which is held in operative position by a spring 62 carried by the cam. The cam is provided with a high point 63. The curved surface 64 of the cam is so arranged that it progressively decreases in curvature. It is well known that in placing a coil spring under tension less force is required at the outset in compressing the spring a given amount than is required when the spring is nearly compressed. In order to equalize the work to be done by the cam I therefore cause it to move the firing pin control member through a greater distance in a given time at the beginning of the compression than in the latter part of the compression. In the left hand firing pin housing 38 of Fig. 1 of the drawings which is operated by the lower cam 59, I provide a slot 65 for the entrance of an arm or rod 66. This arm or rod is rigidly connected to a sleeve 67 which carries the firing pin 36 on its lower end and which receives a coil spring 68. The lower end of the sleeve is closed by a block 69 so that the spring will be compressed between this block and the top of the housing when the sleeve is raised. The arm 66 is connected to an arm 70 which extends through a slot 71 in the front plate (see Fig. 7) and is provided with an offset end 72 which is adapted to ride on the cam 59. The construction of the right hand firing pin mechanism is substantially the same and like reference numerals are used to designate similar parts. However, this firing pin mechanism is actuated by the upper cam and the arm 66 is therefore connected to an arm 73 that extends upwardly on the outside of the front plate as shown and passes through a slot 74 adjacent the upper cam. This arm is provided with an offset end 75 (see Fig. 4) which is adapted to ride on the upper cam.

The mechanism heretofore described is arranged in a case or container 76 preferably made of light weight metal, such as aluminum. As shown the upper edge of this container is provided with openings for the reception of screws 77 which are adapted to be received in the edge of the upper disc 3. This case is provided with openings to permit access to the parts of the unit to which access must be obtained in setting the bomb. As shown it is provided with circular openings 78 through which the dials of the clocks may be seen for setting the apparatus. The opposite side of the case is provided with a plurality of openings 79 in alignment with the shafts 57 of the clocks for setting the hands, in alignment with the shafts 58 of the main springs to permit winding of the clocks and in alignment with the shafts 23 to permit winding of the springs 20 of the release mechanism. Likewise the lower end 80 of the tubular container is made in a separate piece slidable upon the lower end 81 of the main portion and when this lower end is removed access is obtained to the breech blocks for loading and to the dynamite cap containers.

The tubular container may also be provided with openings 87 by means of which the operator can see the clock mechanisms to determine whether the clocks are running.

As stated, the entire unit is adapted to be arranged in a water tight casing which is shown in Fig. 8 of the drawings. The casing 82 is closed at its lower end and is of a proper size to receive the bomb unit and a charge 83 which forms the initial exploder. The movement of the unit into the casing may be controlled by suitable stops 84. The top of the casing is closed by a threaded cap 85 which is sufficiently tight to prevent leakage of water or other liquid into the casing, even under great pressures. This cap carries a bail 86 by means of which the entire unit may be fastened to a torpedo line and lowered into a well.

In operation the main shafts 58 of the clocks are wound. The hands of the clock mechanism are set for the desired time prior to the 0 hour by inserting keys through the openings 79 and engaging the ends of the shaft 57. The springs 20 of the release mechanism are then wound. The breech blocks are then turned to their outer positions and cartridge caps 35 placed in the openings in the breech blocks. Dynamite caps are placed in the dynamite cap holders 32 and the lower end 80 of the tube or container 76 is placed in position. The user then observes that the clock mechanisms are properly operating through the holes 87 and places the unit in the casing 82 with the charge 83 of the initial exploder. The unit is then lowered into the well on the top of the main shattering charge. When the hour hand of a clock reaches the 0 hour it contacts with the pin 8 swinging the lever 9 on its pivot to release

the escapement control member 16. In the meantime the movement of the clock gears 51 and 55 has permitted upward movement of the arms 43 and the breech blocks have turned to their operative position through the action of springs 40.

Upon release, the escapement spring 20 rotates the shaft 23 causing rotation of the cam 59 through the pawl and ratchet 60 and 61 and arm 72 is raised raising the sleeve 67 in the firing pin housing and placing the spring 68 under compression. When the arm 72 rides off of the high point of the cam the pressure of the spring 68 lowers the sleeve 67 causing the firing pin 36 to discharge the cartridge 35 and explode the dynamite caps. This ignites the initial exploding charge 83 in the bottom of the casing 82 causing it to shatter the casing and ignite the main shattering charge.

As set forth above, it will be apparent that the safety mechanism is fool-proof because it does not require a separate setting as in so many devices of this character. It is necessary to move the breech blocks to an inoperative position before the cartridges can be inserted and when the breech blocks are in this position the clock mechanism must run for a predetermined length of time before an explosion can take place. Even if the hands of the clock should be turned by the key to contact the pin 8 and thus release the firing pin 36 an explosion can not take place because the cartridge is not in position to be struck by the firing pin.

The operating mechanisms are also designed to eliminate the placing of extra work on the clock mechanism. While the clock mechanism controls the movement of the breech block to its operative position, the breech block is moved by the spring 40 and the clock mechanism merely prevents its movement before the lapse of a certain period of time. As stated above, the force exerted by the spring 40 aids the running of the clock because it pushes the gear in the normal running direction. Likewise the firing pin release mechanism is controlled by separate springs 20 and is independent of the operation of the clock mechanism. Therefore it does not interfere with the accuracy of operation of the clock.

I claim:

1. In a time controlled bomb, a rotatable breech block having an opening for the reception of a cartridge, a firing pin associated therewith, the breech block and the firing pin being arranged whereby the breech block must be rotated to bring the opening out of alignment with the firing pin to permit the insertion of a cartridge, time controlled mechanism governing the return of the breech block to its original position whereby the cartridge is brought into alignment with the firing pin, and time controlled mechanism for actuating said firing pin.

2. In a time controlled bomb, a rotatable breech block having an opening for the reception of a cartridge, a firing pin associated therewith, the breech block and the firing pin being arranged whereby the breech block must be rotated to bring the opening out of alignment with the firing pin to permit the insertion of a cartridge, means for returning the breech block to its original position, time controlled mechanism to prevent the return of the breech block to its original position until a predetermined period of time has elapsed, and time controlled mechanism for actuating said firing pin.

3. A mechanically operated time controlled bomb comprising a clock mechanism, a lever adapted to be actuated by the clock movement, an escapement control member actuated by said lever, an independent release mechanism adapted to operate upon the release of said escapement control member, and a firing pin actuated by said release mechanism.

4. A mechanically operated time controlled bomb comprising a clock mechanism, a lever adapted to be actuated by the clock movement, an escapement control member actuated by said lever, a release mechanism adapted to operate upon the release of said escapement control member, a cam actuated by the operation of said release mechanism, and a firing pin operatively connected with said cam for actuation thereby.

5. A mechanically operated time control bomb comprising a clock mechanism, a release member actuated by said clock mechanism, a release mechanism comprising a spring actuated shaft and an escapement connected to said shaft, said release member controlling said escapement, and a firing pin actuated by said release mechanism.

6. A mechanically operated time control bomb comprising a clock mechanism, a release member actuated by said clock mechanism, a release mechanism comprising a spring actuated shaft and an escapement connected to said shaft, said release member controlling said escapement, a cam mounted on said spring actuated shaft, and a firing pin operatively connected with said cam for actuation thereby.

7. A mechanically operated time control bomb comprising a clock mechanism, a release member actuated by said clock mechanism, a release mechanism controlled thereby, a firing pin chamber, a firing pin arranged therein, a spring engaging said firing pin and adapted to be compressed when said firing pin is retracted in said chamber, and a cam controlled by said release mechanism and adapted to release said spring when the firing pin is in retracted position.

8. A mechanically operated time control bomb comprising a clock mechanism, a release member actuated by said clock mechanism, a release mechanism controlled thereby, a firing pin actuated by the operation of said release member, a rotatable breech block for the reception of a cartridge, said breech block being adapted to be rotated to a point where the cartridge will be out of alignment with the firing pin for the insertion of the cartridge, and means associated with the clock mechanism to control the rotation of the breech block to its operative position.

9. A mechanically operated time control bomb comprising a clock mechanism, a release member actuated by said clock mechanism, a release mechanism controlled thereby, a firing pin actuated by the operation of said release member, a rotatable breech block for the reception of a cartridge, said breech block being adapted to be rotated to a point where the cartridge will be out of alignment with the firing pin for the insertion of the cartridge, means for returning the breech block to a position wherein the cartridge will be in alignment with the firing pin and means associated with the clock mechanism for preventing the return of the breech block to said position until a predetermined period of time has elapsed.

10. In a time controlled bomb, a movable breech block adapted to receive a cartridge to be fired, a firing pin associated therewith, time controlled mechanism for actuating said firing pin, said breech block being adapted to be moved to a position for the reception of a cartridge in which

the cartridge is out of alignment with the firing pin, means for returning the breech block to its initial position with the cartridge in alignment with the firing pin, a rod connected to said breech block to prevent the return of the breech block to its original position, and a pawl carried by said rod and engaging a movable part of the clock mechanism to permit movement of said rod upon the lapse of a predetermined period of time whereby the breech block will be returned to its initial position.

11. A mechanically operated time controlled bomb comprising a clock mechanism, a release member actuated thereby, a release mechanism comprising a spring actuated shaft and an escapement connected to said shaft, said release member controlling said escapement, a firing pin chamber, a firing pin arranged therein, a spring engaging said firing pin and adapted to be compressed when said firing pin is retracted in said chamber, and a cam controlled by said release mechanism and operable to retract and release said firing pin.

12. A mechanically operated time controlled bomb comprising an elongated casing, a clock mechanism mounted in one end of said casing, a release member actuated by said clock mechanism, an independent release mechanism mounted in the other end by the casing and controlled by said release member, and a firing pin actuated by the operation of said release mechanism.

13. In a time controlled bomb, a firing pin, time controlled mechanism for actuating said firing pin, a breech block associated with said firing pin, said breech block and firing pin being capable of assuming two relative positions in one of which a cartridge may be inserted into the breech block and in the other of which said cartridge is in operative position for firing, and time controlled mechanism for controlling the relative movement of the breech block and firing pin into operative position for firing.

14. In a time controlled bomb, a firing pin, time controlled mechanism for actuating said firing pin, a breech block associated with said firing pin, said breech block and firing pin being capable of assuming two relative positions in one of which a cartridge may be inserted into the breech block and in the other of which said cartridge is in operative position for firing, means for moving said breech block and firing pin relatively into position for firing, and means associated with said time controlled mechanism to prevent relative movement of the breech block and firing pin into operative position until a predetermined time has elapsed.

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