Aug. 23, 1927. 1,640,165

A. VARAUD

CLOCKWORK OPERATED MECHANICAL FUSE FOR SHELLS AND THE LIKE PROJECTILES

Filed May 13, 1924 4 Sheets-Sheet 1

Fig. 1.

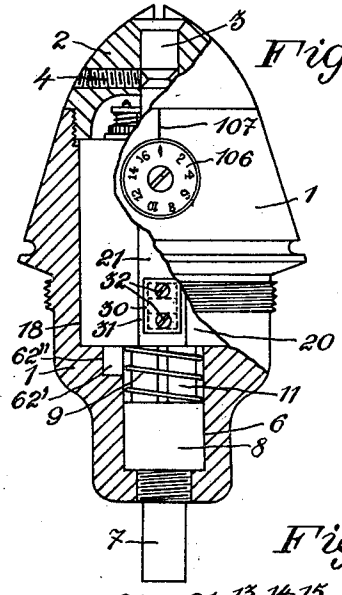


Fig. 2.

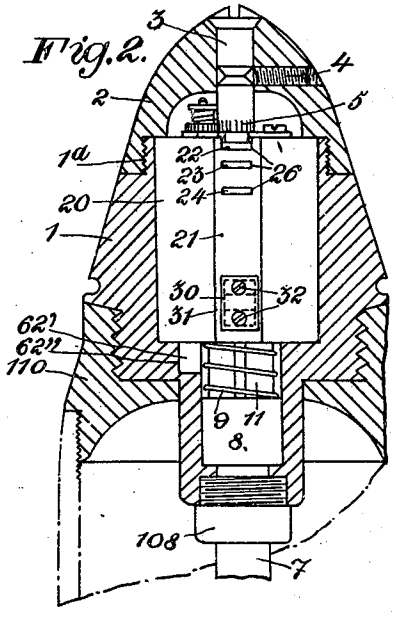


Fig. 6.

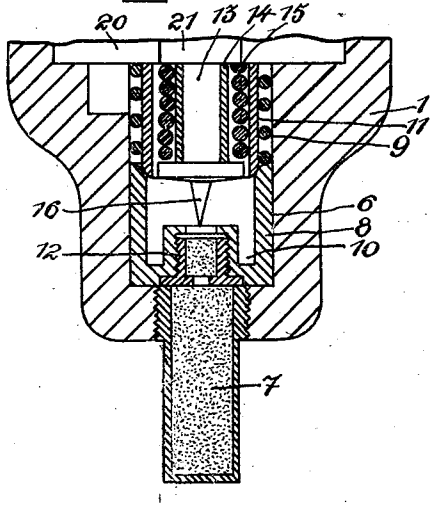
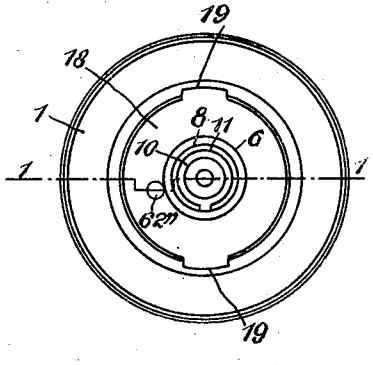


Fig. 5.



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A. VARAUD

CLOCKWORK OPERATED MECHANICAL FUSE FOR SHELLS AND THE LIKE PROJECTILES

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Fig. 3.

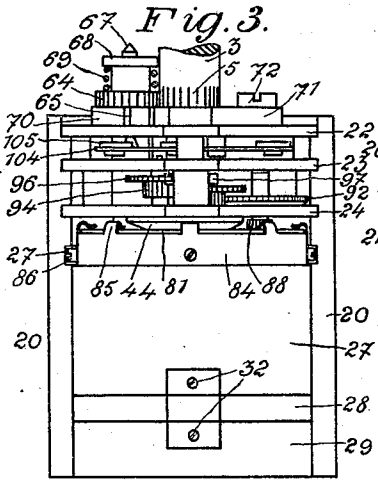


Fig. 23.

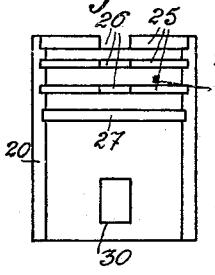


Fig. 24.

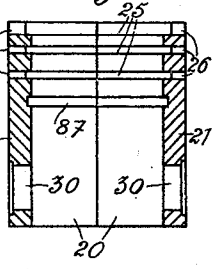


Fig. 21.

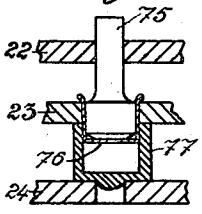


Fig. 22.

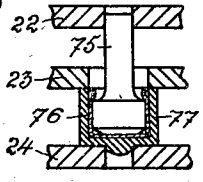
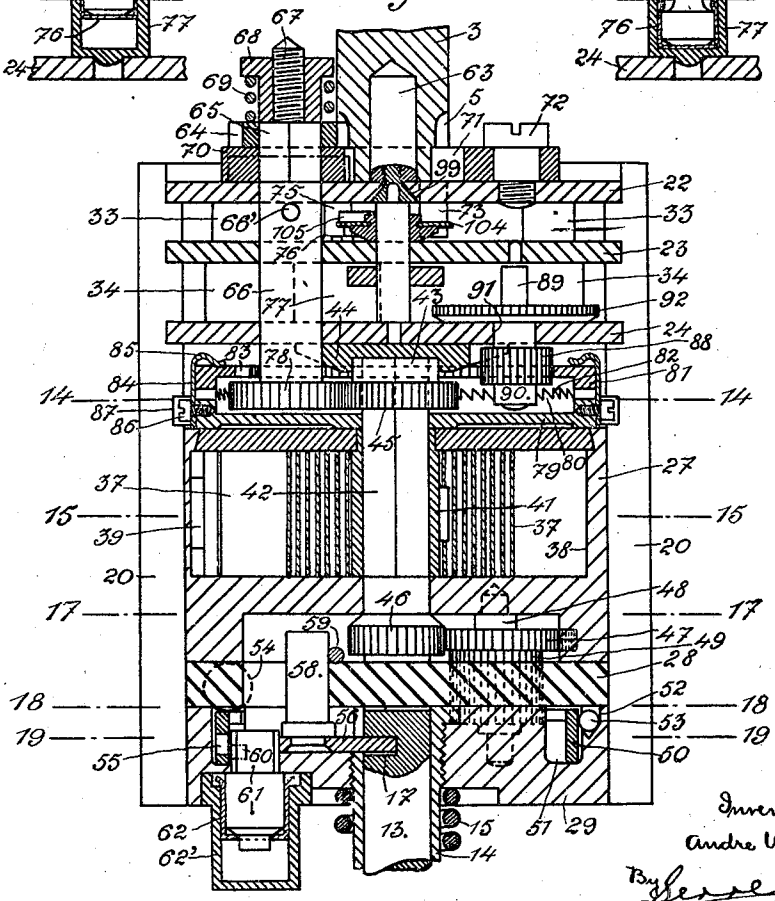


Fig. 4.



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A. VARAUD

CLOCKWORK OPERATED MECHANICAL FUSE FOR SHELLS AND THE LIKE PROJECTILES

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Fig.8.

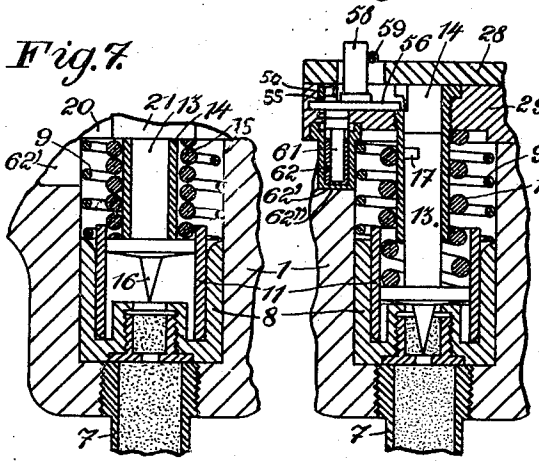


Fig.7.

Fig.9.

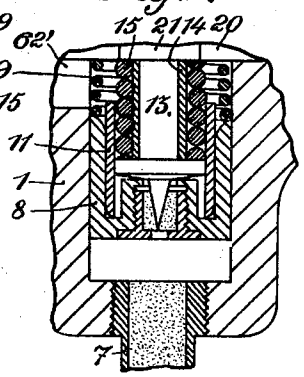


Fig.20.

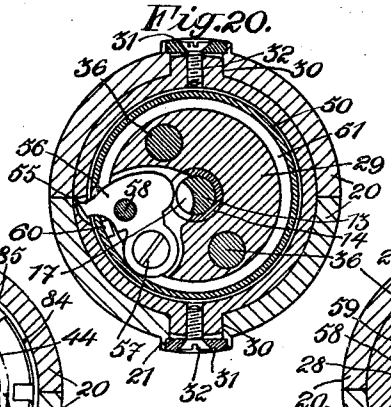


Fig.13.

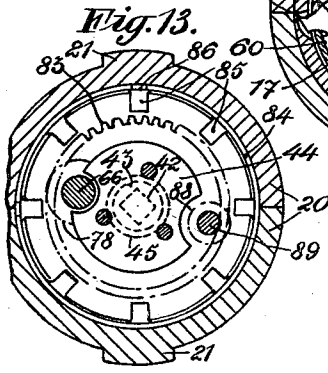
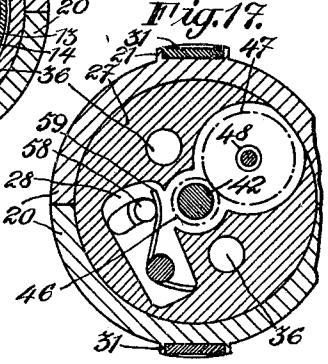


Fig.17.



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CLOCKWORK OPERATED MECHANICAL FUSE FOR SHELLS AND THE LIKE PROJECTILES

Filed May 13, 1924 4 Sheets-Sheet 4

Fig. 10.

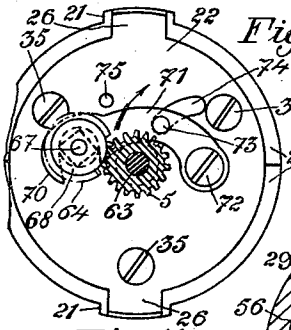


Fig. 14.

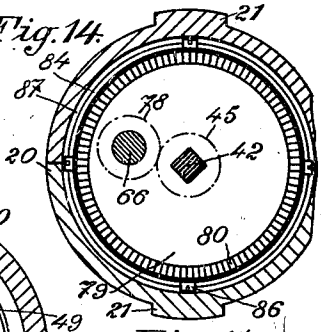


Fig. 18.

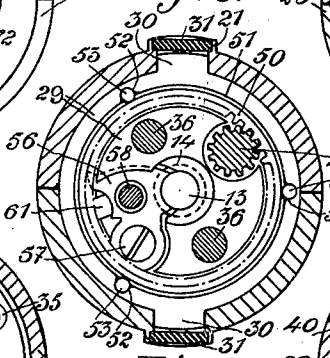


Fig. 11.

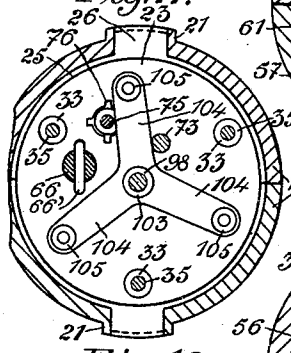


Fig. 15.

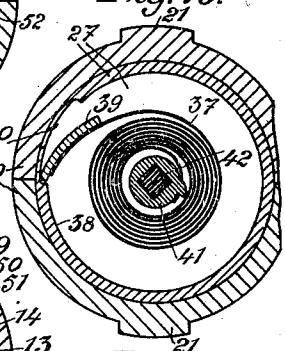


Fig. 19.

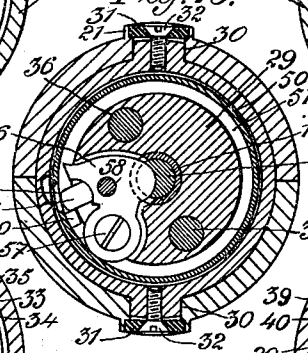


Fig. 12.

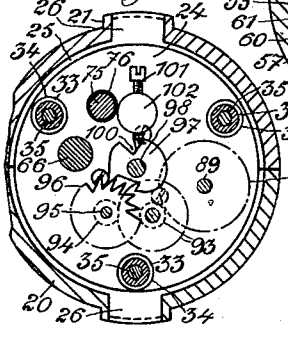
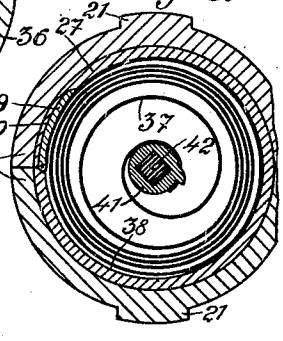


Fig. 16.



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Patented Aug. 23, 1927. 1,640,165

UNITED STATES PATENT OFFICE.

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CLOCKWORK-OPERATED MECHANICAL FUSE FOR SHELLS AND THE LIKE PROJECTILES.

Application filed May 13, 1924, Serial No. 712,960, and in Switzerland August 2, 1923.

This invention concerns improvements in or relating to clockwork operated fuses for projectiles of the type in which the release of a striker device is controlled by a rotary member whose angular position can be set or adjusted before firing and which is driven by the clockwork in a direction opposite to its direction of setting movement while the projectile is in flight.

In the fuses of this type the driving member of the clockwork movement, which may either be the barrel shaft or the going barrel, can describe but a single revolution around itself for determining the maximum duration of the operation of the clockwork movement. This fact necessitates the use of a gear train at a very great multiplication for transmitting the driving power of said member to the last movable part of the gear train or the escapement wheel which as is known must rotate at the speed which will suffice for entertaining the oscillations of the regulator of the clockwork movement.

In practice it has been established that as a consequence of this very great multiplication the driving power is reduced to such an extent that on its arrival at the escapement wheel, it is no longer capable of imparting to the regulating member sufficiently strong impulses for keeping up its oscillations, and that it is even too weak to overcome inertia of the escapement wheel and of the regulating member as well as the resistances generated by the centrifugal force in the case of projectiles the initial angular speed of which is superior to 16,000 R. P. M.

Since it is impossible to increase the strength of the driving spring beyond the limit of the resistance of the teeth of the train gearing, it is proposed in accordance with this invention to utilize a barrel shaft, which is a drive shaft, arranged in the axis of the fuse in such a manner as to be capable of making several revolutions on its axis, on the one hand in one given direction prior to the firing for effecting simultaneously the winding of the power spring and the regulating of the time interval determining the ignition of the charge of the projectile, and on the other hand, in an opposite direction during the trajectory under the action of the power spring for rotating a revoluble member controlling the unlocking of the striker member and for transmitting the driving power to the regulating device of the clockwork.

The annexed drawings illustrate by way of example two constructional forms of the invention adapted to be applied to a shrapnel with double effect.

Fig. 1 is a lateral elevation of the first constructional form partly in section on the line 1—1 of Fig. 5.

Fig. 2 is an axial section of the second constructional form adapted to fit the ogival counterpart of a shell showing in elevation the detonator arrangement and the housing enclosing the clock movement which is the same in both constructions, which latter do not differ except in certain details of the body of the fuse and of the detonator arrangement.

Fig. 3 is an axial section of the housing showing the different parts of the clockwork movement in elevational view.

Fig. 4 is an axial section of the clockwork movement and of its casing taken on the line 4—4 of Fig. 10.

Fig. 5 is a plan view on the lower part of the first form of construction of the body of the fuse, the clockwork movement and the housing being omitted.

Figs. 6–9 are detail views showing separately in axial section, the first form of the detonator arrangement respectively during the manipulation of the shell, at the moment of firing, at the moment of explosion when the shell explodes in the air and on the impact when its function is brought about by percussion.

Fig. 10 is a plan view of the clockwork movement taken above the forward or top plate thereof.

Figs. 11 to 13 are transverse sections taken respectively below each of the three plates.

Fig. 14 is a transverse section taken on the line 14—14 of Fig. 4.

Figs. 15 and 16 are similar transverse sections taken on the line 15—15 of Fig. 4 showing the driving spring respectively in its wound and unwound position.

Figs. 17 to 19 are transverse sections taken respectively on the lines 17—17, 18—18 and 19—19 of Fig. 4.

Fig. 20 is a section analogous to Fig. 19 showing the striker abandoned to the action of the percussion spring.

Figs. 21 and 22 are detail views showing

separately a safety member in operative and inoperative position, respectively, and

Figs. 23 and 24 are likewise detail views showing separately the housing in elevational interior view of one of its halves, and an axial section taken perpendicularly to the plan of the junction of its two halves.

In referring now to the first form (Figs. 1 and 3 to 24), it will be seen from Fig. 1 that the tubular body of the fuse is made in two parts, 1 and 2, screwed one to the other. The part 1 shows on its periphery the groove and screw-threads usually provided for enabling the fuse to be secured to the ogival relay piece or counterpart of the shrapnel.

Fitted in the axis of the ogival nose 2 so as to be capable of rotating freely on itself, is a key 3 which is prevented from being axially displaced by a radial screw 4 adapted to co-operate with a circular groove in the periphery of the key. This key carries at its other extremity or engaging end a pinion 5 cut directly from its stem, and the function of which will be described later on. The detonator arrangement of the fuse is lodged in a cylindrical cavity 6 provided axially in the lower portion 1. It comprises (Figs. 1 and 6 to 9) the usual capsule or cartridge 7 containing fulminate and screwed into the lower extremity of the portion 1 of the body of the fuse; an ignition charge carrier 8 subjected to the action of a spring 9 tending to hold it to the bottom of the cavity 6 and provided with a deep circular groove 10; a safety member 11 constituted by a split ring which normally has a diameter a little larger than the groove 10 but which possesses sufficient elasticity to enable it to enter this groove under the action of inertia on the departure of the projectile; a cap 12 screwed axially into the central nipple of the socket 8 and a percussion pin 13 lodged in a tubular guide 14. This pin is subjected to the action of a percussion spring 15 bearing on the one hand on the bottom of the casing containing the clock movement and on the other against a collar formed near the head of the percussion pin and terminating in the percussion or striking point proper 16. This percussion pin is provided, moveover, near its upper end with a lateral notch 17 (Figs. 4, 8, 19 and 20), the object of which will later on be fully explained.

Arranged in the axis of the portion 1 of the body of the fuse co-axially with the cavity 6 containing the detonator, is a cavity 18 (Figs. 1 and 5) likewise cylindrical, but of much larger diameter than the cavity 6 and in which is mounted a housing 20 (Fig. 1) containing the clockwork movement. This cavity 18 has longitudinal grooves 19 in diametrical opposition which cooperate with longitudinal projections or ribs 21 on the periphery of the casing. The casing is built up of two semi-cylindrical sections rigidly connected between them on the one hand by means of slot and tenon joints, rendering them integral with three plates 22, 23 and 24, arranged in super-position Figs. 3 and 4, between and above which are arranged different parts of the clock-work movement, and on the other hand by means of diametrically opposite screws 32 (Figs. 2 and 3) screwed into plates 31 which close two angular notches 30 provided in the housing and in the parts which will later on be described. The plates 22, 23 and 24 have a diameter slightly greater than the interior of the housing 20 and engage in corresponding circular grooves 25 in the walls of the latter. These plates are each likewise provided with two tenons diametrically opposite and engaging with grooves 26 (Fig. 23) provided in the projections 21 of the housing 20. The spring of the clock-work movement is accommodated in a tenoned casing 27 which is adjusted in the interior of the housing between the lower plate 24 and a strengthening steel plate 28 resting on a washer 29 which is likewise provided with tenons and constitutes the bottom of the housing as shown in Figs. 3 and 4. The tenons of the casing 27 and of the plate 28 and washer 29 are diametrically opposite and are superposed in such a manner as to become consolidated in the two notches 30 which are diametrically opposite one to the other and provided in the ribs 21 of the housing. The screws 32 traverse the plates 31 and the lugs of the casing 27 and of the washer 29. The plates 22, 23 and 24 may be spaced by three posts 33 (Figs. 11 and 12) mounted on which are sleeves 34 (Figs. 3 and 4). The top plate 22 is secured over the forward extremity of these posts 33 with the aid of screws 35 (Fig. 10). The drum 27 and the plate 28, and washer 29 are assembled between them by means of two steel pins 36 (Figs. 17 to 20).

The motor spring 37 for the clockwork (Figs. 4, 15 and 16) is lodged in a cylindrical cavity 38 within the casing 27. Its outer end is fixed to a strap 39 pivoted to its casing 27 in a manner to take cover inside a notch 40 in the wall 38 when the spring is expanded as shown in Fig. 16. Its inner end is fixed to a collar 41 mounted on a square part of a central shaft 42 disposed axially in the housing. This shaft serves, on the one hand, for winding the spring 37 with the aid of a winding mechanism which will hereinafter be described, and on the other hand for transmitting the driving power on the one hand with the aid of a pinion 46 to the parts of the clockwork mechanism controlling the function of the striking pin of the fuse, and, on the other

hand, with the aid of a ratchet 79 to the clockwork regulating device of which the different gear wheels are distributed between the plates 22, 23 and 24. The shaft 42 by means of its lower extremity is supported and adapted to turn on the centre of the steel plate 28 while at its upper extremity which forms a cylindrical enlargement 43, it turns in a dish shaped bearing 44. This dish-shaped member 44 is secured below the lower plate 24. The shaft 42 thus serves equally as a member for sustaining the centre of the plate 24 and to aid the latter to bear the effort of flexure due to the inertia to which it is subjected at the moment of the departure of the projectile to which the fuse is applied. The shaft 42 carries at its upper end a pinion 45 the function of which will be described later on, and at its other extremity a pinion 46 which meshes with a toothed wheel 47 keyed on to one end of a regulator stub shaft 48 journalled on the one hand in the bottom of the casing 27, and on the other hand in the bottom washer 29.

This shaft 48 which serves for the transmission of the motive force to the retaining device of the striker, and for regulating this device before firing, carries at its other end a pinion 49 which is in constant mesh with the inner teeth of a crown piece 50 which rotates freely in an annular groove 51 provided in the bottom washer 29.

In the wall of the cavity 51 for the crown piece 50 are arranged at 120°, one to the other, three notches 52 in which operate three balls 53 (Fig. 18). In openings of the steel plate 28 are lodged three other balls 54 (Fig. 4) on which rolls the upper face of the crown piece 50, while the periphery of this crown rotates on the balls 53. In the flange of the crown piece which projects parallel to the axis of the fuse is a notch 55 (Figs. 4, 19 and 20) in which engages the nose of a retaining lever 56 at the moment the striker is liberated. This lever 56 is pivoted about a screw 57 which is screwed into the bottom washer 29, and carries a vertical pin 58 against the free end of which operates a spring 59 lodged in the bottom of the casing 27 (Fig. 4). This spring 59 tends normally to maintain the lever 56 in contact with a boss 61 which is integrally feathered to a socket 62 which is automatically retracted under the action of momentum of inertia on the departure of the projectile, and tends to cause the nose of the lever 56 to penetrate in the notch 55 when the boss 61 is retracted and the notch 55 is in register with the said nose. The boss 61 and sleeve 62 operate in a guide 62′ which is secured beneath the bottom washer 29 in a cylindrical cavity 62″ provided in the bottom of the cavity 18 (Fig. 5).

In order to prevent the key 3 from being inadvertently rotated in counter-clockwise direction in rewinding, the crown piece 50 is provided with an internal radial lug 60 (Fig. 19) which comes to bear against a flattened portion of the boss 61 as long as the latter is in its operative position and when the crown piece 50 has not been operated to effect the regulation of the fuse. As long as the boss 61 is in its operative position that is to say, during the entire transport, the manipulation and charge of the shell, this lug 60 bears against the flattened portion of the boss 61 and thereby prevents the crown piece 50 from being rotated in clockwise direction and consequently any accidental liberation of the striker pin 13. On the other hand, however, the boss 61 does not prevent the crown piece 50 from being displaced in the counter clockwise direction for an angle less than 360° when it is desired to effect the regulation of the fuse. This regulation is effected with the aid of the key 3 which is turned in clockwise direction with the aid of a timing apparatus at the required angle to obtain the range of the firing required. In turning the key, of which the lower end is guided by an axial pin 63 secured on the upper plate 22, rotation is imparted by means of the pinion 5 to a sliding pinion 64 freely fitted on a square portion 65 on a rewinding shaft 66 rotatable in the three plates 22, 23 and 24. This shaft is prevented from performing axial movements in one direction by a pin 66′ which bears on the under face of the top plate 22 and in the other direction by a disc (described later on) by which its lower extremity is lightly supported. At its upper end the shaft 66 is prolonged by a reduced thread portion 67 screwed on which is a nut 68 having a collar which serves as supporting surface for a spring 69 by unclutching the sliding pinion 64 from the pinion 5 when this pinion is freed by the fork 70 of a lever 71 (Fig. 10) pivotally mounted on a screw 72 screwed into the top plate 22.

In addition to this fork 70 (Fig. 10) the lever 71 carries a nipple 73 which plays in a circular slot 74 provided in the top plate 22 and the function of which will be described later on. The lever 71 is maintained in its operative position as shown in Fig. 10 up to the moment of the departure of the projectile by a projection 75 acting through the inertia in a manner analogous to that of the boss 61 of the retaining device of the striker. This projection, shown separately in Figs. 21 and 22, is like the boss 61 integrally spring feathered to a sleeve which plays in an opening of the plate 23, and in a cylindrical guide under the action of inertia at the moment of the departure of the projectile. When the lever 71 is freed by

this part 75 which then assumes its retracted position as shown in Fig. 22, it pivots about the screw 72 under the action of the centrifugal force and thus abandons the sliding pinion 64 to the action of the spring 69.

When the key 3 is actuated as indicated above the sliding pinion 64 which is maintained in mesh with the pinion 5 of the key until the moment of the departure of the projectile by the lever 71 is actuated in the counterclockwise direction and in its rotation actuates the shaft 66. As the latter carries keyed on its lower extremity a pinion 78 which is in constant mesh with the rewinding pinion 45 of the central shaft 42, this latter is thus rotated in clockwise direction, thereby on the one hand rewinding the power spring 37 and, on the other hand, causing the crown piece 50 of the striker retaining device to be rotated in counter-clockwise direction through the intermediary of the gear train 46, 47 and 49 with the result that the regulation of the fuse is realized simultaneously with the winding of the power spring.

When, after having been liberated at the moment of the departure of the projectile by a ratchet device which will hereafter be described, the driving shaft 42 commences to rotate in counterclockwise direction under the action of the force stored up in the power spring, all of the rotating members of the winding mechanism and of the regulating device of the fuse describe in an inverse sense the same course which they have accomplished during the action of rewinding with the exception, however, of the key, of which the pinion 5 is then uncoupled from the sliding pinion 64 which is then found to be in a retracted position, as represented in Fig. 4 in dotted lines.

The crown 50 thus returns to its initial position which it occupied before the rewinding of the fuse and which is its position at the outset, but when at this moment the boss 61 is no longer in the path of the nipple 60 and as, on the other hand, the released power of the driving spring combines to act on the crown member 50, this latter continues to rotate in clockwise direction until the moment arrives when this notch 55 comes to lie precisely opposite the nose of the locking lever 56. Under the action of the spring 59 this lever 56 is then rotated in counter clockwise direction through an angle sufficient to be withdrawn completely from the notch 17 of the striker 13, that is to say, for effecting the instantaneous release of the said striker.

In order that the force stored in the power spring 37 should not be released after the winding has been effected, before the required moment, that is to say, before the departure of the projectile, a ratchet device is employed which is combined with the regulating device for the clockwork.

This device comprises a disc 79 keyed on the square portion of the central shaft (Figs. 4 and 14) beneath the pinion 45 and provided with a cylindrical flange extending towards the point of the fuse, and cut in which are ratchet teeth 80 enabling this disc to act as a ratchet wheel. This ratchet 79 rests on the top cover of the casing 27 and carries a crown wheel 81. Cut in this crown wheel is a ratchet rim 82 adapted to engage with the teeth 80 on the ratchet wheel. This crown wheel 81 performs the function of a pawl and is normally maintained in position on the ratchet 79 so that the teeth 80 and 82 are held in engagement by means of a ring 84 screwed to the periphery of the ratchet with the aid of screws 86 (Fig. 4). This ring has its upper side provided with claws forming springs 85, the free extremities of which bear on the top of the crown pawl 81. A circular groove 87 is cut in the housing 20 opposite the ratchet wheel 79 for the free passage of the screws 86.

During winding and simultaneous regulation of the fuse, the ratchet wheel 79 rotates with the shaft 42 in clockwise direction without causing the rotation of the pawl member 81 due to the ratchet arrangement of the teeth 80 and 82 and because the pawl member 81 can then axially displace itself in opposition to the action of the spring 85 to allow the teeth 82 to pass. During this time the pawl member 81 is held stationary in the revoluble sense by means which will be described later on. When, however, at the moment of the departure of the projectile, the pawl member 81 is liberated by said means, the driving shaft is free to commence its rotation in counterclockwise direction under the action of the power spring 37 because nothing now prevents the ratchet wheel 79 from carrying the pawl member 81 with it. This latter, in rotating, drives in its turn with the aid of the teeth 83 on its inner periphery, a pinion 88 which is mounted by means of a screw 90 to the lower end of a short shaft 89 adapted to transmit the motive power to the regulating mechanism of the clockwork. This shaft 89 rotates in a circular opening 91 provided in the plate 24 and carries on its parts above this plate a toothed wheel 92 adapted to actuate a multiplying gear train 93 (Fig. 12) situated between the plates 23 and 24. The last pinion 94 of this gear train is keyed on a shaft 95 of an escapement wheel 96 which cooperates with a swivelling member 97 mounted on the shaft 98 of the regulator. This shaft 98 is placed axially in the fuse between the key 3 and the driving shaft 42. It rotates on the one hand in a bearing plug 99 screwed into the centre of the top plate

22 and serving also for the mounting of the nipple 63 used for centering the key on the plate 22, and on the other hand in a bushing (not shown) secured to the centre of the plate 24. The anchor 97 as shown in Fig. 12 has its periphery provided with a sector shaped notch 100 in which operates the conical point of a set screw 101 which is mounted in a plug 102 secured on the lower plate 24. In setting the point of this screw to a greater or smaller depth in the notch 100, the amplitude of the oscillations of the anchor may be precisely controlled, and consequently also those of the balance governor, which is likewise keyed on the shaft 98. This governor which is located between the plates 22 and 23 is constituted by a hub 103 carrying three wings 104 disposed at 120° (Fig. 11). Each of these wings carries at its free extremity a weight 105. This governor 103, 104 remains stationary to the moment of the departure of the projectile, due to the fact that one of the wings 104 is prevented from rotating in clockwise direction by the nipple 73 carried by the centrifugal lever 71.

The immobilization of the governor 103, 104, to the moment of the departure of the projectile determines the immobilization in the angular sense of the pawl member 81 because this member is maintained in a constant relation of mesh with the anchor of the escapement by the multiplicator gear train 93.

Fig. 1 shows a dial 106 having indications in multiple of twos from 2–16 and serves as indicator of the firing time to which the fuse has been set. The device is rendered integral with the key 3 by any appropriate means, not shown, so as to be displaced in regard to a fixed index 107 in a manner proportionate with the rotation of the key during which the winding and regulation of the fuse is effected.

The function of this constructional form of the fuse is as follows: Asuming that the power spring can be given eight winding turns and that the ratchets 80 and 82 have 200 teeth; assuming, moreover, that this fuse is of a manufacture regulated for a minimum ignition of half a second, with on the other hand one winding turn of its power spring wound beforehand in reserve, independently of the eight possible turns and with the plugs 61 and 75 in such position that no accidental function of the clockwork need be feared during the manipulation of the shell to which the fuse is applied. It is also then necessary that the split ring 11 of the detonator is in its operative position, Fig. 6, in order to ensure that during its manipulation there should be no accidental function of the double acting detonating device, that is to say that the ignition charge carrier 8 could not come into contact with the point 16 of the striker as is the case on the impact of the shell when its function is brought about by percussion (Fig. 9). These conditions prevailing, the number of possible positions of setting of the fuse with a proportionate corresponding winding will be determined by the product of the number of teeth on the ratchet 79 (say 200) by the number of winding turns, that is to say, the number of revolutions described by the driving shaft during the regulation and simultaneous winding of the fuse (say eight revolutions) resulting thus is $200 \times 8 = 1{,}600$.

If it is assumed that the chosen unit of setting is the hundredth part of a second, the maximum setting and its corresponding winding will then give a duration of the function of the clockwork movement between the instant of the departure of the shell and the instant of the liberation of the striker equal to sixteen hundred hundredths of a second, that is to say, 16 seconds. The fuse can thus be set to the hundredths of a second for durations of ignition between one half and sixteen and a half seconds. This setting is effected by turning the key 3 with the aid of an appropriate timing device in clockwise direction until the indicator of this apparatus gives the respective indications in seconds and hundredths of seconds required. The number of seconds is then equally indicated by the dial 106, Fig. 1.

Thus, for example, if it is desired to obtain an ignition interval of 10.59 seconds; the key 3, which is displaced with the same speed as the power shaft 42, is first rotated five complete revolutions on itself, so as to bring the figure 10 on the dial opposite the index 107, and then through an angle of 9/100ths of a revolution (59−50:9). In so doing the power shaft 42 will likewise be rotated through five revolutions and 9/100ths of a revolution in the clockwise direction with the aid of the gear train 5, 64, 78 and 45. During this rotation the power shaft will carry with it the ratchet 79, which is integral therewith, and there will be $200 \times 5 + 9. = 1009$ successive ratchet engagements of the pawl member 81, because this latter during this time remains stationary in the revoluble sense in the position which it occupied at the outset by the centrifugal locking lever 71 of the governor 103 and 104 with the aid of the stop 73.

Through the reducing gear train 46, 47, 49, this rotation of the power shaft will be transmitted on the other hand simultaneously to the crown member 50, which therefore will rotate in counter clockwise direction through an angle which in regard to the length of its possible course (the limits of which are determined by the stop 60 cooperating with the two flattened opposite faces on the nipple 61), will be in the pro-

portion of 10.59 to 16, because this crown member will describe a little less than a complete revolution on itself during the maximum duration of the clockwork movement which is 16 seconds. It will thus be seen that in turning the key 3 in a clockwise direction through the required angle, the winding and setting of the fuse will be effected simultaneously.

The shell is then ready for being fired. At the moment of the departure of the projectile the plugs 61 and 75 are retracted under the action of inertia as has already been described, the stop 75 abandoning the lever 71 to the action of the centrifugal force, while the plug 61 liberates the locking lever 56 which, however, remains in the operative position by its nose, which bears against the inner surface of the cylindrical flange on the crown member 50.

The lever 71 in being displaced under the action of the centrifugal force moves the pin 73 to the outer extremity of the slot 74, that is to say, to a position where this pin admits of the free oscillation of the governor 103 and 104. On the other hand by its displacement the lever 71 liberates by its fork 70 the sliding pinion 64 which under the action of the uncoupling springs 69 assumes the position indicated in broken lines in Fig. 4. The key 3 is thus uncoupled from the winding mechanism of the fuse and consequently is not partaking of the movement of this mechanism during the working of the clockwork.

No further obstacle is then offered to the rotation of the power shaft in counter-clockwise direction under the action of the power spring 37. As the centrifugal force in acting on the coils of this spring tends to increase its force, an acceleration of the speed of the flow of the motive force, would be created in the absence of the regular mechanism, the function of which latter is precisely to retard this flow in a manner to compensate this acceleration and to suppress the other irregularities of the action of the spring in the clockwork of an ordinary kind.

The multipilcator gear train 93 connecting the pawl member 81 mechanically to the escapement wheel 96, gives a multiplication of 45, that is to say, for one revolution of the pawl member 81, the escapement wheel 96 describes forty-five revolutions.

During this rotation of the power shaft under the action of the spring 37 in counter-clockwise direction and the function of the regulating device, all the other rotatable parts of the fuse, with the exception of the key 3 and of the pinion 5 cut in this key, will turn in the inverse sense through an angle which they have traversed during the winding and simultaneous setting of the fuse, plus a certain angle determined by the travel to be yet traversed by the crown member 50 commencing from its initial position of setting to half a second in order to arrive in its position for liberating the striker.

The necessary motive force for causing the crown member 50 to traverse this complementary path and for driving all the rotatable parts which are mechanically connected to this crown piece is provided for by the reserve winding turn given to the spring 37 in the course of manufacture of the fuse. As soon as the notch 55 in the crown member 50 arrives opposite the nose of the lever 56, the latter is thrown by the action of the spring 59 and the centrifugal force in counter-clockwise direction about its pivot 97, thus incidentally abandoning the striker to the action on the percussion spring 15. The function of the percussion mechanism is as follows: On the departure of the projectile, the split safety ring 11 is by the inertia forced into the interior of the cavity 10 in the socket 8 which carries the percussion cap (Fig. 7). During the whole flight or travel of the shell 6, this percussion cap remains remote from the point 16 of the striker due to its own inertia. In the normal function the shell, which is then operating as an ordinary fuse, bursts at the moment of the liberation of the striker 13, of which the point 16 pierces the cap 12 as indicated in Fig. 8. However, if for one cause or another the shell encounters an obstacle before the percussion action is released by the lever 56, the socket 8 is thrown forward upon the point 16 of the striker at the moment of this impact under the action of the live force stored up in it as indicated in Fig. 9. The shell then acts as a percussion device.

The regulation of the regulator mechanism of the clockwork with the aid of the screw 101 should be effected at the end of the manufacture of the fuse for each piece separately.

The second constructional form (Fig. 2) does not differ from the first, except by the fact that the portion 2 of the body of the fuse is screwed externally on to a reduced screw threaded portion 1^a of the portion 1, and by the fact that the fulminate container 7, instead of being screwed directly into the lower extremity of the portion 1 of the fuse, is forcibly engaged in a socket 108 containing a fulminate cartridge and itself being screwed into the lower end of the portion 1.

In this form the connector ring 110 is also shown by means of which the fuse is secured in the eye piece of the shell.

Various modifications could be devised of one or the other of the forms of the fuse represented without departing from the spirit of the invention.

For example, other safety means functioning either by inertia or by centrifugal

force could be added to the plugs 61 and 75 for the purpose of preventing premature function of the fuse.

The regular mechanism instead of comprising an anchored escapement device such as shown and a governor actuated solely by the motive force could be constituted by an escapement device with a dead beat escapement and a regulator with a spiral cylindrical spring. Further the winding and the simultaneous regulation of the fuse with the aid of the key 3 could be effected directly by hand. In this case, the point of the fuse should be constituted by an ogival cap integral with the key 3 which can be displaced angularly on the part 2 of the body of the fuse for actuating the key 3. In this case this cap could have its lower edge provided with a graduation co-operating with a fixed index marked on the part 1 of the body of the fuse for indicating the precise angle to be described by the cap in its manipulation.

The percussion spring 15 instead of being mounted around the guide tube 14 of the striker could be lodged in an axial opening formed in the power shaft 42 and in a circular corresponding central opening provided in the steel washer 28. In this case, instead of acting on a collar near the point 15 of the striker, it would act against the upper face of the latter.

Instead of utilizing the lever 56 directly for retaining the striker in cocked position by engaging in the notch 17 thereof across a corresponding notch in the guide 14, use could be made of three balls lodged in three circular openings arranged at 120° in the guide 14 and co-operating with a circular groove in the striker 19 retaining the latter in the cocked position when these balls are immobilized in the guide 14 with the aid of a gland arranged to slide on this guide and subjected to the action of a spring (which, for example, could be the percussion spring 15) but held against the action of this spring by the lever 56 as long as the nose of this lever has been unable to penetrate into the notch 55. Finally the grooves 26, provided in the housing, could be machined only to the depths of the circular groove 25 in which case the corresponding projections of the plates would obviously be smaller, or these three grooves could be merged into a single one milled longitudinally in each half of the housing at the external extremity of the latter up to the height of the lowest plate 24 on a proportion of only the thickness of the housing. The two grooves 30 should likewise only be milled on a portion of the thickness of the housing and for the sake of greater convenience in manufacture could be prolonged to the lower edge of the housing.

I claim:

1. In a clockwork operated fuse for artillery projectiles, a striker member, a revoluble member adjustable in one direction to an angular position prior to firing for controlling the striker member, a clockwork, a regulating device therefor, a power spring, and a barrel shaft mounted in the axis of the fuse and adapted to turn several revolutions in one direction prior to firing for simultaneously winding the power spring and moving the said revoluble member to position to regulate the time interval determining the ignition of the charge of the projectile and also adapted to be turned by the spring in the opposite direction during the flight of the projectile for then moving the revoluble member and also transmitting power to the said regulating device of the clockwork.

2. In a clockwork operated fuse for artillery projectiles, a striker member, a crown wheel having internal teeth and revolubly adjustable in one direction to an angular position prior to firing for controlling the striker member, a clockwork, a regulating device therefor, a power spring, and a barrel shaft mounted in the axis of the fuse and adapted to be turned several revolutions in one direction prior to firing for simultaneously winding the power spring and turning the said crown wheel to position to regulate the time interval determining the ignition of the charge of the projectile and also adapted to be turned by the spring in the opposite direction during the flight of the projectile for turning the said crown wheel and transmitting driving power to the said regulating device of the clockwork.

3. In a clockwork operated fuse for artillery projectiles, a striker member, a crown wheel having internal teeth and adjustable in one direction to an angular position before firing for controlling the striker member, a clockwork escapement device, a power spring, a barrel shaft mounted in the axis of the fuse and adapted to be turned several revolutions in one direction prior to firing, a double reduction gear connecting the barrel shaft with the said crown wheel, and a multiplication gear connecting the said barrel shaft to the said escapement device whereby when the barrel shaft is turned in one direction before firing it simultaneously winds the power spring and sets the crown wheel in position for controlling the striker member and is turned by the action of the spring in the opposite direction during the flight of the projectile for actuating the crown wheel through the double reduction gear to control the striker member and to actuate the escapement device through the said multiplication gear.

4. In a clockwork operated fuse for artillery projectiles, a striker member, a crown wheel having internal teeth and being adjustable in one direction to an angular posi-

tion prior to firing for controlling the striker member, a clock-work escapement device, a power spring, a barrel shaft mounted in the axis of the fuse and adapted to be turned several revolutions in one direction prior to firing, a revolubly mounted key, means for connecting the key to the barrel shaft, a double reduction gear connecting the barrel shaft with the crown wheel, and a multiplication gear connecting the barrel shaft with the escapement device whereby the said key may be turned to turn the barrel shaft a number of revolutions before firing to simultaneously wind the power spring and turn the crown wheel to a predetermined position and whereby during the flight of the projectile the barrel shaft is turned in the opposite direction by the power spring to turn the crown wheel through the double reduction gear to operate the striker member and simultaneously to actuate the escapement device through the said multiplication gear.

5. In a clockwork operated fuse for artillery projectiles, a striker member, a crown wheel having internal teeth and adapted to be adjustable in one direction to an angular position prior to firing for controlling the striker member, a clockwork escapement device, a power spring, a barrel shaft mounted in the axis of the fuse, a double reduction gear connecting the barrel shaft and the crown wheel, a revoluble key, means for connecting the key to the barrel shaft whereby when the key is turned the barrel shaft is turned thereby a predetermined number of revolutions before firing to simultaneously wind the spring and to set the said crown wheel through the said double reduction gear, a multiplication gear, and a device connecting the said multiplication gear to the said barrel shaft, which device is inoperative when the barrel shaft is turned by the key and is operative when during the flight of the projectile the barrel shaft is turned in the opposite direction by the power spring to thereby actuate the escapement device through the multiplication gear and also through the said double reduction gear and crown wheel to operate the striker member.

6. In a clockwork operated fuse for artillery projectiles, a striker member, a revoluble member for controlling the striker member, a barrel shaft, a power spring, a key for turning the barrel shaft in one direction prior to firing for simultaneously winding the power spring and setting the revoluble member for controlling the striker member, a clockwork escapement device, a spindle therefor, a connection between the said spindle and barrel shaft, an ignition charge carrier, and a cartridge, the said key, spindle for the escapement device, the barrel shaft, the striker member, the ignition charge carrier and the cartridge being arranged axially in the order named one behind the other from the nose of the fuse.

7. In a projectile of the type described, a clock work apparatus, a fuse device, a striker for operating the fuse device, a motor comprising a spring and power shaft, a winding stem, a connection between the said winding stem and power shaft, a stop lever for normally engaging the striker, devices for actuating the stop lever, a connection between the power shaft and the devices for actuating the stop lever, whereby the turning of the stem turns the power shaft in one direction to apply a tension thereto, to wind the clock work apparatus, and also to set the device for actuating the stop lever, means for normally maintaining the stop lever in an inoperative position, and means operative upon firing the projectile for simultaneously releasing the clock work apparatus and the means for normally maintaining the said lever in an inoperative position, whereby the motor simultaneously actuates the clock work apparatus and the devices for actuating the said stop lever.

8. In a projectile of the type described, a clock work apparatus, a fuse device, a striker for operating the fuse device, a stop lever for normally maintaining the striker in an inoperative position, a device for normally maintaining the stop lever in engagement with the striker and made operative by the firing of the projectile for releasing the stop lever, devices permitting the stop lever to become disengaged from the striker, a spring motor comprising a power shaft, and a spring for driving the same, means for turning the power shaft in one direction to wind the clock work apparatus and to set the devices for permitting the stop lever to be disengaged from the striker, means for normally maintaining the clock work apparatus in an inoperative condition, and means operative upon firing the projectile for releasing the last aforesaid means and permitting the clock work apparatus and the devices for releasing the stop lever from the striker to be simultaneously operated by the said motor.

9. In a projectile of the type described, a clock work apparatus, a fuse device, a striker for operating the fuse device, a stop lever for normally maintaining the striker in an inoperative position, a device for normally maintaining the stop lever in engagement with the striker and made operative by the firing of the projectile for releasing the stop lever, devices permitting the stop lever to become disengaged from the striker, a spring motor comprising a power shaft, and a spring for driving the same, a stem, a counter shaft, connections between the said stem and counter shaft and between the said counter shaft and power shaft, connections

also between the power shaft and the devices for permitting the stop lever to be disengaged from the striker, whereby when the stem is turned in one direction a tension is applied to the spring of the motor and the said devices for permitting the stop lever to be disengaged from the striker are set, means whereby in turning the stem in said direction the clock work apparatus is not actuated, and means operative upon the firing of the projectile for disconnecting the said stem and counter shaft, whereby the motor is released to simultaneously actuate the clock work apparatus and the devices for permitting the stop lever to be disengaged from the striker.

10. In a projectile of the type described, a clock work apparatus, a fuse device, a striker for operating the fuse device, a stop lever for normally maintaining the striker in an inoperative position, a device for normally maintaining the stop lever in engagement with the striker and made operative by the firing of the projectile for releasing the stop lever, devices permitting the stop lever to become disengaged from the striker, a spring motor comprising a power shaft, and a spring for driving the same, a stem, a counter shaft, connections between the said stem and counter shaft and between the said counter shaft and power shaft, connections also between the power shaft and the devices for permitting the stop lever to be disengaged from the striker, whereby when the stem is turned in one direction a tension is applied to the spring of the motor and the said devices for permitting the stop lever to be disengaged from the striker are set, means whereby in turning the stem in said direction the clock work apparatus is not actuated, means operative upon the firing of the projectile for disconnecting the said stem and counter shaft, whereby the motor is released to simultaneously actuate the clock work apparatus and the devices for permitting the stop lever to be disengaged from the striker, and means indicating the period during which the clock work apparatus operates before the stop lever is released from the striker.

In testimony whereof I have affixed my signature.

ANDRÉ VARAUD.