

No. 678,757.

Patented July 16, 1901.

L. OBRY.

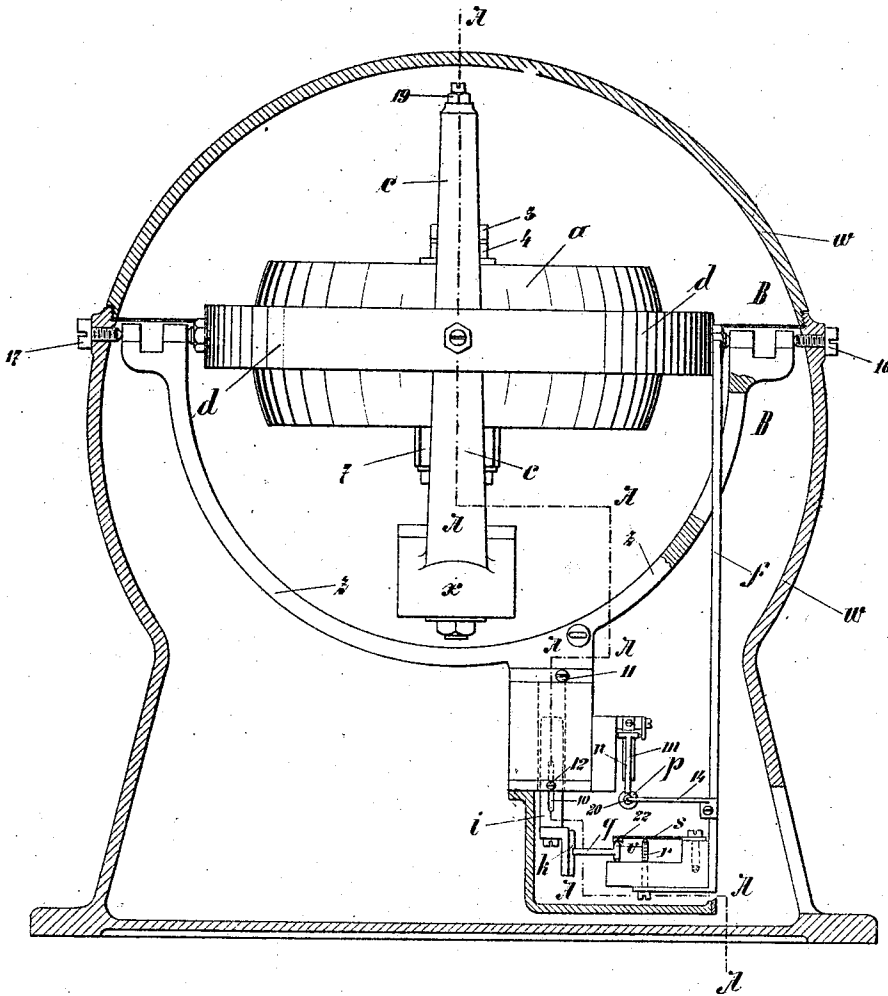
APPARATUS FOR AUTOMATICALLY FIRING SHIPS' GUNS.

(Application filed Dec. 7, 1900.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1.



Witnesses.
for Witness
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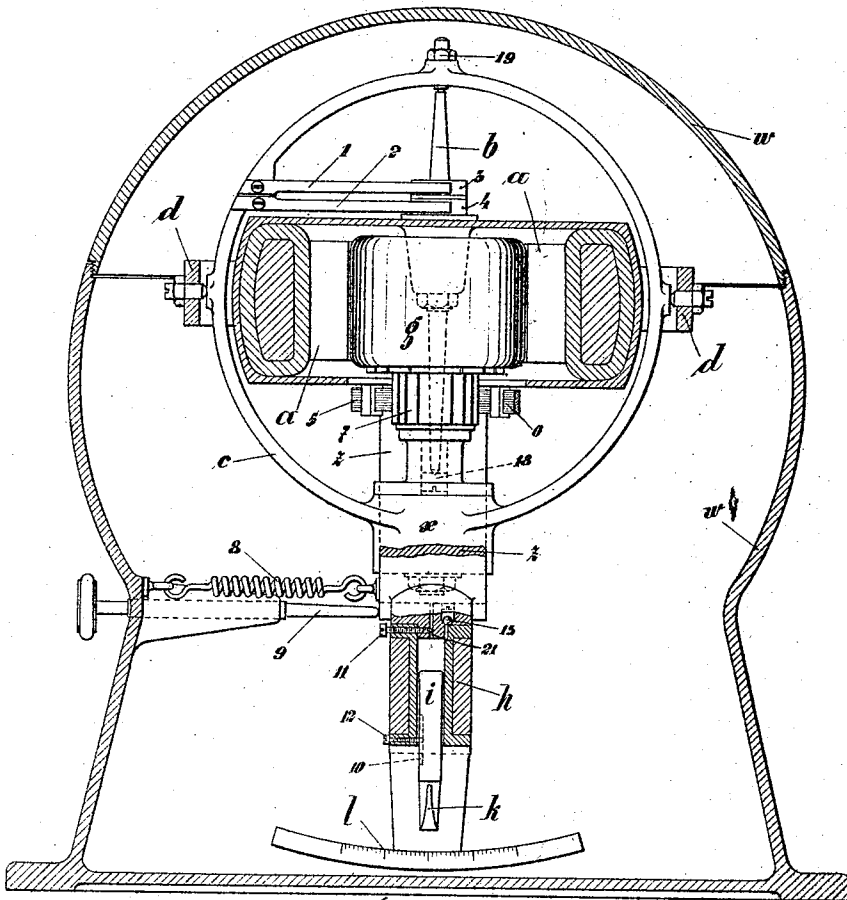
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(No Model.)

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Fig. 2.



Witnesses.

for Witness
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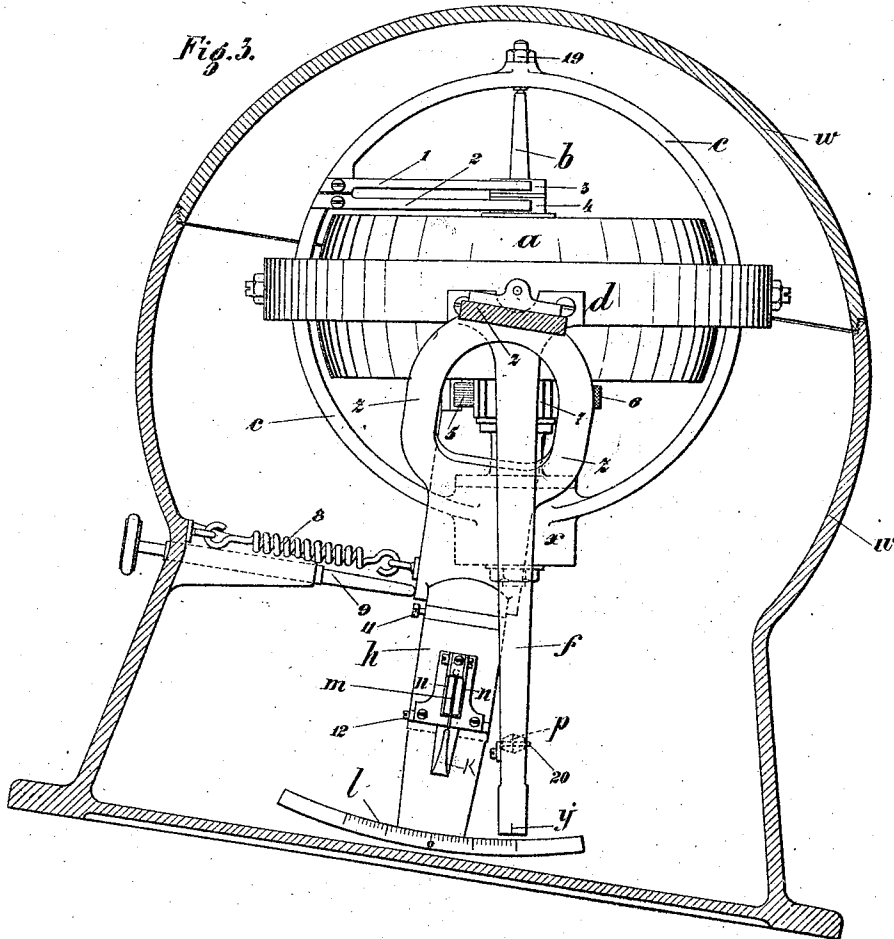


Fig. 4.

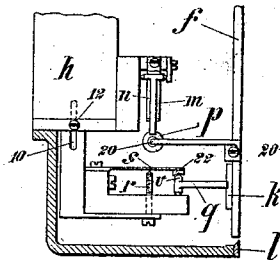
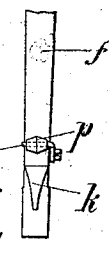


Fig. 4 a.



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UNITED STATES PATENT OFFICE.

LUDWIG OBRY, OF TRIESTE, AUSTRIA-HUNGARY.

APPARATUS FOR AUTOMATICALLY FIRING SHIPS' GUNS.

SPECIFICATION forming part of Letters Patent No. 678,757, dated July 16, 1901.

Application filed December 7, 1900. Serial No. 39,087. (No model.)

To all whom it may concern:

Be it known that I, LUDWIG OBRY, engineer, a citizen of the Empire of Austria-Hungary, residing at Trieste, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Apparatus for Automatically Firing Ships' Guns; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to improvements in the type of apparatus for automatically firing ships' guns the moment the line of sight is horizontal, described in specification belonging to Letters Patent No. 595,820, granted to me.

In order that my invention may be more fully understood, I will now proceed to describe the same in connection with the accompanying drawings, marked with letters and figures of reference indicating like parts in the various figures.

Figure 1 is a side view of my improved apparatus with casing in section. Fig. 2 is a partial section on line A A, and Fig. 3 a partial section on line B B, of Fig. 1, viewed from the right side of the apparatus when in action. Figs. 4 and 4^a are modifications.

In carrying out my invention I fit the whole of the apparatus into a ball-like casing *w*, screwed together in two parts. In the casing *w* are employed, opposite to each other, two center screws 16 and 17, between which is pivotally suspended a bow *z*, which is placed under the influence of a spring 8, Fig. 2, and by a screwed spindle 9, mounted in the casing *w*, can be set accurately vertical. Between the pivoted ends of the bow *z* a ring *d* is mounted horizontally in such a manner that its center of oscillation coincides with that of the bow *z*. Between the two pins employed on the horizontal ring *d*, at right angles to its center of oscillation, is mounted a ring *c*, also capable of oscillation. This vertical ring has fixed to its lower part the armature *g* of a small dynamo, the magnetic field *a* of which is mounted rotary and sur-

rounds the armature bell-like. The circuit is formed partly by two springs 1 2, gliding upon the collars 3 4, and partly by the brushes 5 6, which are fixed to and rotate with the magnetic field *a* and glide on the stationary collector 7. The spindle *b* of the magnetic field is mounted between two centers 18 and 19, the lower one, 18, (see dotted lines Fig. 2,) being employed at the bottom of a cavity formed in the armature, and the upper one, 19, in the top of the vertical ring *c*.

In order to position the center of gravity of the vertical ring *c* as low as possible and cause the same to regain its vertical position automatically, a balance-weight *x* is employed at its lowest point.

The described cardanic suspension of the electromagnet *a* causes same to adjust itself horizontally independent of the position of the casing—i. e., the spindle *b* will take up an exact perpendicular position, and if there is imparted to the magnetic field *a* a very rapid rotation—say six to twelve thousand revolutions—the stability of the axis *b* will be such as not to be influenced in any way by the oscillation of the casing. The arm *f*, which is affixed on the horizontal ring *d* and reaches down a recess in the bow *z*, remains therefore undisturbed in the vertical plane of the spindle *b* and mathematical axis 16 17, while the magnetic field *a* rotates rapidly. For instance, assuming that this apparatus is fitted up with its axis 16 17 parallel to the longitudinal axis of the ship, the bow *z*, rigidly connected with the casing, will participate in the rolling motion, and the parts fixed to the latter would oscillate past the arm *f*, which remains at rest. Thus if a switch device is arranged on the arm *f*, which comes in action the moment the point marked *o* of the graduated scale 1 on the bow *z* oscillates past the mark *y* on the arm *f*, Fig. 3, the moment the cross-axis of the ship passes the horizontal position the circuit would be closed. If this circuit is used as ignition-line of an elevated but untrained broadside-gun, the arm *f* would cause ignition the moment the line of sight is horizontal.

By "line of sight" is understood the line in which the barrel-axis falls at an elevation of zero degrees.

As explained in the specification belonging

to the Letters Patent hereinbefore referred to, it is necessary that the ignition take place a certain time (called "advance ignition time") before the moment in which the cross-axis of the ship passes the position of rest—*i. e.*, before the line of sight passes the horizontal—as the explosives of which the charge is composed do not explode simultaneously and the projectile requires a certain time to run through the barrel. Furthermore, it is also desirable, and which has not been mentioned in the specification hereinbefore referred to, that the projectile is to leave the barrel before it passes the line of sight, as the projectile in passing through the barrel has participated in the rolling motion and after leaving the barrel has the tendency of continuing such motion up or down, which tendency is best compensated for by causing the ignition to take place in advance in such manner that the projectile leaves the barrel while still slightly inclining toward the line of sight. In the specification of the patent hereinbefore referred to this problem has been solved without taking into consideration the last-named vertical component of the gun by displacing the part forming contact from its position of rest a certain angle (hereinafter termed the "advance ignition angle") for the passage of which the advance ignition time is required. This provision has for its basis the incorrect assumption that the angular velocity with which the rolling ship passes its position of rest is constant, as only in this case a constant advance ignition angle would always give the same advance ignition time.

In considering thoroughly the circumstance that the velocity with which an oscillating body passes its position of rest does not only depend on the length of the pendulum—*i. e.*, on a constant in the construction of the ship—but also on the amplitude of oscillation, the above assumption must be found incorrect and the construction based thereon somewhat defective.

The velocity with which the ship passes its position of rest will, according to the known physical law, increase with the extent of the amplitude, and as the advance ignition time is a constant depending on the length of the barrel and the burning velocity of the explosives the advance ignition angles must consequently all the more increase and decrease with the extent of the rolling motion as the vertical component imparted to the projectile by the oscillation of the gun-barrel will be greater the quicker the barrel oscillates—*i. e.*, the greater the rolling motion is—and this vertical component can only be compensated for by causing the angle of the barrel-axis relative to the line of sight (at the moment the projectile leaves the barrel) to increase and decrease with the rolling motion. According to the present invention this problem is solved in the following manner: Upon the bow *z*, set in oscillation with the ship, is secured a vertical solenoid *h*, into the cavity of

which, closed at the top, is fitted air-tight a sliding core *i*, the movement of which is limited by a screw 12, engaging in a groove 10 therein. When the solenoid *h* is inducted, the core *i* is raised, and thereby the air in the said solenoid-cavity caused to escape rapidly through an outwardly-opening valve 13, so that this motion will take up very little time. If afterward the solenoid-circuit is broken, the core *i* will fall by its gravity in accordance with the amount of air entering the solenoid-cavity through the channel 21, so that the velocity of the fall of the core *i* can be regulated at will by the adjustment of the throttle-screw 11. In lieu of using an air-brake an oil or glycerin brake may be employed, giving the same result.

To the bow *z* is fixed a switch device which is inserted into the circuit of the solenoid. This switch device consists of two springs *n n*, Fig. 3, arranged tong-like opposite each other, and of a tongue *m* employed between the latter, capable of turning and formed of conductive material and in contact with both of the springs *n*. Upon the arm *f*, which is always at rest, is arranged in the field of oscillation of the tongue *m* a double cone-like abutment *p*, mounted upon a horizontal screw 20, carried by the arm 14 and so set that the bases of the cones forming the abutment coincide with the vertical plane of the axial line 16 17, the path of which is indicated on the arm *f* by the mark *y*, Fig. 3. The abutment *p* is formed in such manner that it stops and bends the tongue *m* when the latter has approached the vertical position a certain angle. This breaks the contact *n n*, which causes the solenoid *h* to be free from current and the core *i* from this moment to drop at a constant velocity regulated by the throttled air. If the bow *z* has oscillated past its position of rest, the tongue *m* will leave the abutment *p* and return to its middle position, whereby the solenoid-circuit is closed and the core *i* raised, which play constantly repeats itself as soon as the bow *z* oscillates past its position of rest. Upon the solenoid-core *i* is arranged a vertical wedge-like plate *k*, the thin end of which points upward, and which when the core *i* descends passes vertically through the field of oscillation of a horizontal tongue *q*, employed on the arm *f*, and coinciding with the vertical plane indicated by the mark *y*, already described. In Figs. 1 and 2 the wedge-like plate *k* is shown descending and in Fig. 3 in its highest position. When the tongue *q* is at rest, the contact formed by the spring *s* and the set-screw *r* is closed; but if the tongue *q* is turned out of its position of rest the knife-edged upper end of the tongue-axis *v*, upon which rests the grooved plate 22, depressed by and fixed to the spring *s*, causes the latter to be raised, and thereby contact between the spring *s* and the set-screw *r* to be broken. The breaking of the contacts *r s* thus takes place the moment the tongue *q* is pressed out of its position of rest by the oscil-

lating prism k . This circuit-breaking may effect the closing of the ignition-circuit in any suitable manner, the latter obviously being controlled by a circuit-breaker such as described in the specification hereinbefore referred to. Thus we must bear in mind the fact previously stated—for instance, that the core i will begin to drop at a constant velocity when the bow z is about three degrees from the vertical, and that the circuit at $r s$ will be broken the moment the tongue q is met by one side of the wedge-shaped plate k . The quicker the bow z , and thereby the wedge k , oscillates through the position of rest, the quicker will the plate k approach the stationary tongue q and the shorter will be the time between the beginning of the drop of the core i and the moment the wedge k strikes the tongue q .

If the velocity through the position of rest is very small, the wedge-shaped plate k has time to descend completely before meeting the tongue q , and the latter is met in its lowest position by the wedge k —*i. e.*, where it is the smallest in section.

The greater the angular velocity with which the wedge-like plate k passes through its position of rest the quicker it will approach the tongue q and the larger will be the section of the wedge-shaped plate met thereby. The advance ignition-angle, which, as will be understood, depends on half the size of the section of the wedge-like plate met by the tongue, will therefore be all the greater the higher the velocity is with which the ship passes the position of rest.

The dimensions of the wedge-like plate k depends for each ship and gun on a series of constants—*i. e.*, on the duration of the rolling motion, the length of the barrel, and the duration of the burning of the explosives—and are determined by taking into consideration the inclination of the gun-barrel necessary for the compensation of the vertical component of the projectile.

As will be seen, the problem of causing the advance ignition angle to increase and decrease with the amount of rolling motion of the ship is solved by this apparatus, so that even when the rolling motion changes the projectile will leave the gun-barrel the moment in which the line of sight is horizontal—*i. e.*, the gun-barrel forms, with the horizon, the elevation-angle predetermined.

As will be gathered from the method of working the described construction, the essence thereof lies in the condition that the parts k and q oscillate toward each other, immaterial which of the same remains in the vertical plane, and that one of the said parts will also have a lineal motion so as to cross the field of oscillation of the other part. The construction shown in Figs. 1, 2, and 3 may therefore be altered in such a manner that the tongue q is carried by the solenoid-core i and the wedge-like plate k by the arm f . (See Figs. 4 and 4^a.) In this case the thin end of

the wedge-like plate k must point downward, as shown in Figs. 4 and 4^a, so that the section of the wedge-like plate met by the descending tongue q will increase in size the quicker it oscillates, as hereinbefore described. It is also possible to mount the solenoid on the arm f and fix either the tongue q or the wedge-like plate k to the solenoid-core; but it will be obvious that in this case the other of the two parts $q k$ must be secured to the bow z .

The apparatus is worked in such a manner that the circuit controlled by the switch $s r$ when broken in any well-known manner closes the ignition-current of the gun. This ignition-circuit has a circuit-breaker inserted, which when depressed on the command "fire" causes the ignition-circuit at the right moment to be automatically closed by the apparatus.

In the example hereinbefore set forth it has been assumed, for the sake of simplicity, that the apparatus is mounted with the plane of its scale 1 in line with the vertical plane of the longitudinal axis of the ship. In mounting the apparatus in this manner it would only act correctly for broadside-guns as long as the latter remain untrained.

If the apparatus is to act correctly for trained guns, immaterial whether bow, stern, or broadside guns, it must be mounted so as to cause the plane of the graduated scale 1 to remain always parallel to the elevation plane of the gun, which can be effected in a very simple manner by causing the apparatus to participate in the training movements of the guns. In this method of mounting the apparatus the switch $s r$ will always be interrupted the moment the line of sight of the respective gun is horizontal.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is—

1. In an apparatus, such as described, for automatically firing ship-guns a device for obtaining a constant advance ignition time at various extents of rolling motion, *i. e.* for causing the advance ignition angle to increase and decrease with the extent of the rolling motion, consisting essentially of the horizontal ring of the cardanic suspension, an arm f keyed upon the axis thereof, a carrier fixed to the casing and oscillating past the said arm, a wedge-like abutment and a switch device operated by the said abutment, the said abutment or switch device being fixed whereby either is caused to move through the field of oscillation of the other at a constant velocity from the moment the elements oscillating against each other, will form together a certain angle, so that the size of the section of the abutment where the tongue and abutment meet will be larger or smaller according to the velocity of the oscillating elements, all substantially as and for the purpose set forth.

2. In a device, such as specified, for the purpose of starting and effecting the auto-

matic descent of the wedge-like abutment or
of the tongue at a constant velocity when the
parts oscillating toward each other are at a
certain angle apart from each other, the de-
5 scending part, the core of a solenoid to which
it is fixed, means for operating the circuit-
breaker inserted into the solenoid-circuit
when the parts oscillating toward each other
are a certain angle apart, whereby at this
10 moment the solenoid will be free from current
and permit its core raised at the previous

closing of the circuit to drop, and a control-
ling brake device, all substantially as and for
the purpose set forth.

In testimony that I claim the foregoing as 15
my invention I have signed my name in pres-
ence of two subscribing witnesses.

LUDWIG OBRY.

Witnesses:

J. B. RION,

E. DE CARBONIL.