

L. MEISTER
MACHINE FOR TESTING ARTICLES HAVING PARTS
SUBJECT TO CENTRIFUGAL ACTION
Filed Oct. 15, 1942 2 S

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Fig. 1. A detailed technical drawing of a circular mechanical device, likely a watch movement, showing various components and their assembly. The drawing includes numerous numbered parts and dashed lines indicating internal mechanisms and alignment. Key features include:

- Central Component (1):** A large circular plate with a central hole (1') and a gear-like outer edge (2).
- Peripheral Components:** Multiple concentric circles (10, 12, 16, 19) arranged around the perimeter, possibly representing jewels or contact points.
- Internal Mechanisms:** Dashed lines show internal gears (e.g., 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100) and other internal parts.
- Mounting and Adjustment:** A central screw (3) is used for adjustment. A large screw (4) is used for mounting. A small screw (5) is used for adjustment. A large screw (6) is used for mounting. A small screw (7) is used for adjustment. A large screw (8) is used for mounting. A small screw (9) is used for adjustment.

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Aug. 8, 1944.

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2,355,092

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Fig. 3.

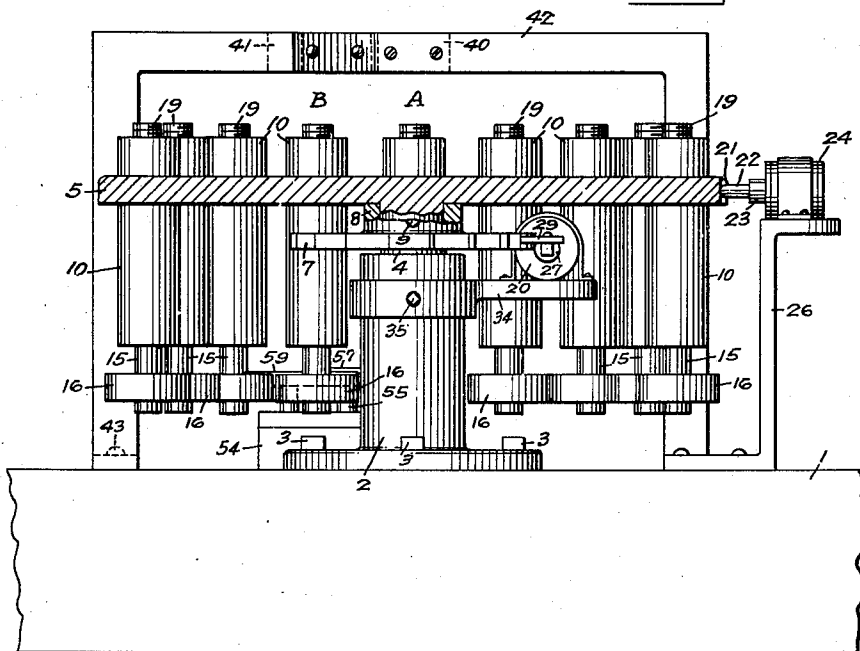
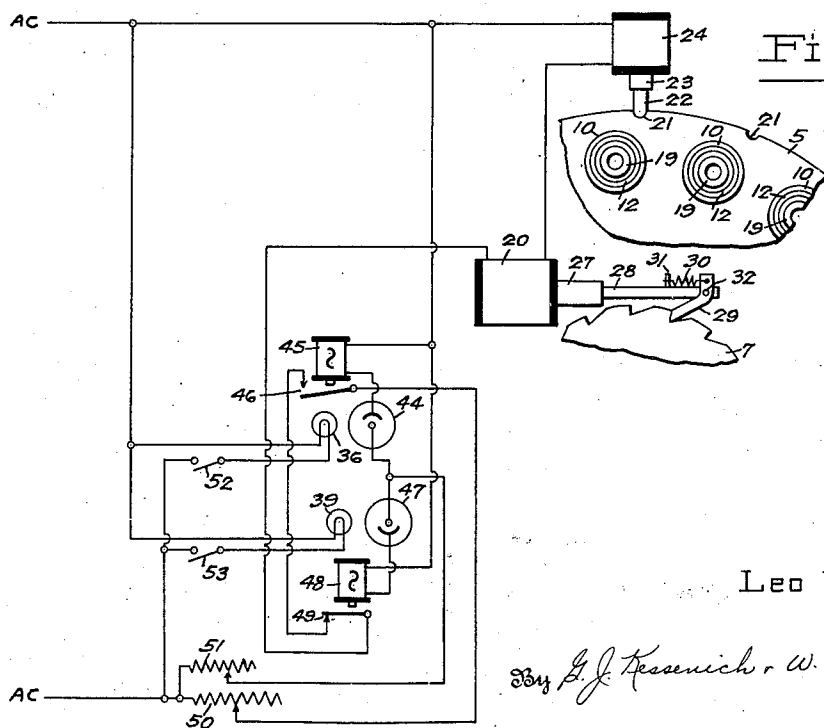


Fig. 4.



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UNITED STATES PATENT OFFICE

2,355,092

MACHINE FOR TESTING ARTICLES HAVING
PARTS SUBJECT TO CENTRIFUGAL AC-
TION

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Application October 15, 1942, Serial No. 462,193

2 Claims. (Cl. 73—51)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a testing machine, which among other things, is useful for testing the arming and non-arming mechanism of fuzes or fuze parts of projectiles.

Projectiles of certain types are so constructed that they explode or detonate on, or very shortly after, impact. In this type the explosion or detonation is initiated from a primer which is fired by some type of firing pin. Before the projectile is fired from or loaded into a cannon, this firing pin is locked into inoperative (disarming or non-arming) position by means which will release the firing pin from its locked condition at some time between the time the projectile starts its motion and the time it reaches its target. This arming and disarming means is very frequently so designed that it may be controlled from the centrifugal action produced by the rotation of the projectile about its longitudinal axis, this motion being imparted to the projectile by the rifling in the artillery piece. This means, firing pin, primer and other related parts are associated in an assembled unit called a fuze.

The arming and non-arming means referred to above frequently take the form of two plungers, diametrically opposite and urged towards, and frequently into contact with each other, by a coil spring back of each plunger. When the plungers are in their innermost position they engage with and lock the firing pin, so that the latter is incapable of then striking the primer. When the projectile turns about its longitudinal axis at the intended speed, the plungers are urged outwardly against the springs back of each of them, owing to centrifugal action. After the plungers have been spread apart by the centrifugal action, the firing pin is unlocked from inoperative position or condition and is then in condition to strike the primer when the projectile strikes against a body. The machine of the present invention is particularly concerned with testing the type of fuze or fuze part which is armed by centrifugal action.

In these fuze units with which the present invention is concerned, the aforementioned plungers, or at least the inner ends thereof, may be seen by looking through the fuze unit at one end, at least at some stage of its assembly. That is to say, some sort of passage exists from end to end of the fuze or part, through which rays of light

may pass. When the plungers occupy their innermost or non-armed position, this passage way for light is wholly or partially blocked; and when they are spread apart in armed or arming position, the passageway is unblocked, and light may pass from end to end of the fuze or fuze part. It is especially with the testing of this type of fuze or part that the present invention finds useful application, although it may be applied in other situations where like or analogous conditions prevail.

For the purpose of disclosing the invention, it is described below as applied to the type of artillery fuze or fuze part delineated above.

Among the objects of the present invention is to provide apparatus by the use of which the rotation of a projectile produced by rifling can be simulated, and the fuze or fuze part subjected to this rotation to test or observe the operation of the arming and non-arming component or components before assembly with other components or application to a projectile.

In general, the invention comprises subjecting the fuze or fuze part to rotation at a speed at which it is intended that the fuze should be armed, and thereafter at a speed at which it is intended that the fuze should not be armed, i. e., non-armed, and utilizing the position or relative positions of the arming or non-arming means under these conditions of rotation to give positive indication when an arming or non-arming component of a fuze or fuze part is or is not functioning properly under the conditions of rotation stated above. As applied to two oppositely disposed plungers, which are spring pressed towards each other and which lock the firing pin in inoperative condition when the spring pressed plungers occupy their innermost position, the invention comprises rotating the fuzes or fuze parts at a chosen speed at which it is intended that the plungers should spread apart and unlock the firing pin, and thereafter rotating the fuzes or fuze parts at a chosen speed at which it is intended that the centrifugal force shall be insufficient to spread the plungers apart to unlock the firing pin for action, and from the position of the plungers under these two conditions of rotation obtaining an indication whether the plungers are operating as intended under the two conditions of rotation.

In the accompanying drawings forming part hereof, and in which the same numeral indicates the same part in the several figures,

Figure 1 is a plan view of a machine embodying the invention.

Figure 2 is a section on the line 2—2 of Figure 1, however with certain parts in elevation.

Figure 3 is a section on the line 3—3 of Figure 1 with most of the parts shown in elevation.

Figure 4 is a schematic view showing how certain parts of the machine are interrelated with an illustrative circuit including photoelectric cells and relays.

Referring to the drawings, a base 1 is provided as a support for parts of the machine. A standard 2 is secured to base 1 by means of screws 3 and serves as a bearing for the vertical shaft 4 which is integral with or attached to disk 5. Ball bearings 6 may be placed in a suitable race between the lower end of the shaft 4 and the bottom of the bearing in standard 2. The shaft 4, turning in the bearing in standard 2, acts as a rotating support for the disk 5 which is attached to it.

As shown, the shaft 4 is somewhat longer than the depth of the bearing in the standard 2, so that the under side of the disk 5 is spaced somewhat from the top of the standard 2. A ratchet wheel 7 having a hub 8 is fitted on the shaft 4 between the under side of the disk 5 and the top of the standard 2. A set screw 9 is provided in the hub 8 to fix the ratchet wheel 7 on shaft 4. Therefore, disk 5, ratchet wheel 7, and shaft 4 rotate together on a vertical axis as one member. As will be seen from an inspection of Figures 1 and 2, the vertical axis of the shaft 4 passes through the center of ratchet wheel 7 and the center of disk 5.

The disk 5 carries a plurality of tubular members or holders 10 which pass through the disk 5 and which are fixed to it. The tubular members 10 are arranged in the form of a circle and are positioned near the outer edge of the disk 5, the center of this circle being at the center of the disk 5. These tubular members extend for most of their length below the disk 5. They are each provided with a shoulder 11 at their bottom so as to provide a central round opening smaller than the opening at their tops. The interiors of these tubular members are finished to act as bearings for the spindles 12. There is a spindle 12 fitted in each tubular member 10, and each spindle may be rotated in its corresponding tubular member.

Each spindle 12 comprises a cylindrical body portion having an opening 13 which passes longitudinally from end to end of the spindle. The longitudinal axis of the opening 13 coincides with the longitudinal axis of the spindle. Each spindle is reduced in diameter at the lower end to form a shoulder 14, the reduced end 15 passing through and below the opening at the lower end of the tubular member 10. The ends 15 of the spindles 12 extend far enough below the bottom of the tubular members to receive friction drive wheels 16, one friction drive wheel being fixed on each spindle. All of the friction drive wheels 16 are in the same horizontal plane.

Ball bearings 17 are shown between the shoulder 14, of the spindles 12, and the shoulder 11 of the tubular members 10. The spindles, at their tops, are provided with a tapered socket 18, shaped to receive a fuze or fuze part 19 to be tested according to the invention. This socket is to be shaped, of course, according to the shape of the article desired to be held therein. As will be understood from the foregoing all the spindles and their coaxing tubular members 10 are of like construction.

The ratchet wheel 7 is rotated intermittently, each motion of it being the circumferential dis-

tance between corresponding parts of adjacent teeth. Electromagnetic means indicated generally by the numeral 20 is used to accomplish this step by step motion. In the embodiment of the invention illustrated there are seventeen teeth shown on the ratchet wheel 7, and there are an equal number of spindles 12 and coaxing tubular members 10. The spindles 12 and tubular members 10 are distributed, like the teeth of the ratchet wheel 7, at equal intervals in their circular arrangement, and as a consequence when the ratchet wheel 7 performs a step by step motion, the spindles 12 with their coaxing tubular members 10 are moved, step by step, a circumferential distance equal to the circumferential distance between the centers of the spindles. The number of teeth on the ratchet wheel 7 may be made different from seventeen according to need or the design of the machine.

The disk 5 is provided with notches 21 in its rim. The reduced end 22 of the plunger 23 of the plunger electromagnet 24 engages in these notches 21 at the end of each step by step motion of the disk 5, whereby the disk 5 is locked temporarily. When the next step of the motion is started the plunger is removed from the notch, with which it has been in engagement, and engages with the next notch presented to it in the rotation of the disk 5. The plunger electromagnet 24 may be of any suitable construction including a solenoid within which the plunger 23 slides. A coil spring 25 is positioned in the solenoid behind the plunger 23 to urge the plunger towards the disk 5. From the construction shown, it will be seen that when the electromagnet 24 is energized, reduced end 22 of the plunger 23, acting as a stop for the disk 5, is drawn away from the disk 5, thereby releasing the disk for motion. The electromagnet 24 is secured to and held in position by a bracket 26 secured to base 1 of the machine.

As heretofore mentioned electromagnet 20 is used to accomplish the step by step motion of the ratchet wheel 7 and of the disk 5 moving therewith. This electromagnet is of the type which includes a solenoid having a plunger which moves axially of the solenoid. The plunger of this magnet is indicated by the numeral 27. A rod 28 forms an extension of this plunger. Rod 28, at its forward end, pivotally carries a pawl 29 which engages the teeth on the ratchet wheel 7. A coil spring 30, attached at one end to the pawl and at the other end to a pin 31 on the rod 28, tends to rotate the pawl counter-clockwise about its pivotal connection 32 with the rod 28. The plunger 27 of the electromagnet 20 acts against a coil spring 33 placed behind it. When the electromagnet is energized, to draw the plunger 27 within the solenoid thereof, the pawl 29 moves the ratchet wheel 7 one tooth. At the moment when electromagnet 20 is energized to move the ratchet wheel 7, electromagnet 24 is also energized to remove the stop 22 from the notch 21, with which the stop is engaged, so that the ratchet wheel, and the disk 5 may be moved. Electromagnet 20 is secured to and held in position by an arm 34 which engages around standard 2. Set screw 35 fixes the position of arm 34 relative to standard 2.

Two stations are established along the circular path of the spindles 12. For purposes of reference these are respectively called station A and station B. The positions of these stations are indicated by the arrow heads of the lead lines of the letters A and B appearing in Figure 1.

An electric lamp 36 is placed below, and spaced from, the spindle 12 and friction drive wheel 16 at station A. Electric lamp 36 is secured within a housing 37 which is completely closed against the passage of light, except through an opening 38 in its top. The lamp 36 and opening 38 are so positioned with respect to the spindles 12 that light passes through the opening 38 into the longitudinal opening 13 in a spindle 12 when a spindle 12 is at station A. Another electric lamp 39 (see circ it in Figure 4) is similarly arranged in a housing below the spindle at station B. Light entering the spindles 12 at stations A and B will pass completely through them if its passage is not blocked by some portion of the fuzes or fuze parts which are positioned in the cavities or sockets 18 at the tops of spindles 12.

The numerals 40 and 41 indicate two housings supported a short distance above spindles 12 and the fuzes or fuze parts at stations A and B respectively. These housings each contain a photoelectric cell and relay, the circuit of which they form part being diagrammatically shown by the usual symbols in Figure 4. The two housings 40 and 41 are secured to a bracket 42 which bridges a part of the disk 5, and which is attached to base 1 of the machine by screws 43. The bottom of each housing has an opening through which light passing through the spindles 12 and fuzes or fuze parts, at stations A and B, may come into contact with the photoelectric cells.

The circuit shown in Figure 4 for purposes of illustration may be supplied with alternating current electricity. The electric lamps previously referred to are indicated by the numerals 36 and 39 in this figure. Numerals 44 and 45 indicate respectively the photoelectric cell and relay for station A. When relay 45 is energized, the circuit is closed at the contacts 46. The relay 45 is energized when light from the electric lamp 36 acts upon photoelectric cell 44, and when light ceases to act upon the photoelectric cell 44, the relay 45 is deenergized and the contacts 46 separate. Numerals 47 and 48 indicate respectively the photoelectric cell and relay for station B. Relay 48 acts oppositely to relay 45, in that when it is energized it separates the contacts at 49. Relay 48 is energized when light from lamp 39 comes into contact with the photoelectric cell 47. Electromagnets 20 and 24, contacts at 46 and 49, and variable resistance 50 are in series across the lines supplying the electric power. A variable resistance 51 may be inserted in the line connected with the photoelectric cells. Switches 52 and 53 may be provided for the lamps 36 and 39. It is to be understood that any circuit including photoelectric cells and relays suitable for controlling the action of electromagnets 20 and 24 in the manner herein described may be used instead of the circuit illustrated.

At station A the spindle 12 is driven at a number of revolutions per minute at which it is intended that the plungers of the fuze or fuze part shall spread apart, while at station B the spindle 12 is driven at a number of revolutions per minute at which it is intended that the said plungers shall not be spread apart. This driving of the spindles at the two stations may be accomplished in various ways, one of these being illustrated in Figures 1 and 2 and described below.

When a spindle 12 is at station A and the plungers of the fuze or fuze part are spread apart, light passes from the lamp 36 below it through the opening 13 in the spindle and upon the photoelectric cell 44 in the housing 40. The contacts

46 which are normally open, when no light passes to photoelectric 44, are closed by the relay 45 when light passes to the photoelectric cell. At station B, light passes from the lamp 39 into the opening 13 in the spindle 12, but is stopped by the plungers in the fuze or fuze part before it is able to reach the photoelectric cell 47; and as a consequence the contacts at 49, which under normal conditions are closed, remain closed. In the event that light fails to reach the photoelectric cell 44 at station A, that is to say, when the speed of rotation of the spindle 12 fails to spread apart the plungers of the fuze or fuze part, the contacts at 46 remain open, and the electromagnets 20 and 24 are not energized. Likewise the electromagnets 20 and 24 are not energized when light strikes photoelectric cell 47 at station B accompanied by opening of the contacts at 49.

The driving of spindles 12 at stations A and B may be accomplished by means of friction drive from an electric motor in housing 54 secured to base 1 of the machine. The shaft 55 of the motor carries two friction drive wheels 56 and 57, the latter being smaller in diameter than the former. Drive wheel 56 makes driving contact with a friction idler wheel 58 which transmits motion by friction to wheel 16 of spindle 12 at station A. At station B, rotary motion is transmitted to wheel 16 by the idler friction wheel 59 which receives its motion from wheel 57 on the motor shaft 55. The speeds of the wheels 16, and therefore of the spindles, at stations A and B may be chosen or fixed at any desired value according to the thing being tested with the machine.

Operation.—The fuze parts 19 to be tested are placed in sockets 18 of spindles 12. At station A the fuze parts rotate with spindles 12 at a speed at which it is intended that the plungers in fuze parts 19 shall separate to arm the fuze; while at station B the fuze parts 19 are rotated with spindles 12 at a speed at which it is intended that the said plungers shall not separate, and therefore remain in their non-arming position. When the plungers in the fuze part separate at station A, light passes from the lamp 36 to photoelectric cell 44, and relay 45 is energized and closes contacts 46. The closing of contacts 46 enables electric current to pass in series through electromagnets 20 and 24 to energize them, provided the contacts at 49 are also closed. Contacts at 49 will be closed provided the rotation of the fuze part 19 on spindle 12 does not spread the plungers of the fuze part apart at station B to permit the passage of light from lamp 39 to photoelectric cell 47. If light reaches photoelectric cell 47, relay 48 would be energized and the contacts at 49 would be separated, thus preventing the passage of current through electromagnets 20 and 24.

It will therefore be seen that electromagnets 20 and 24 will be energized only when light passes to photoelectric cell 44 at station A accompanied by failure of light at station B to reach photoelectric cell 47. Under these conditions, the plungers in the fuze parts are occupying their intended positions under the conditions of rotation selected for stations A and B.

When the electromagnets 20 and 24 are energized, stop 22 is removed from the notch 21 it engages, and plunger 27 pulls rod 28 and pawl 29 so as to turn the ratchet wheel 7 one tooth counter-clockwise. This causes the spindle 12 which was heretofore at station A to be advanced to station B and another spindle to be advanced to

station A, whereupon driving wheels 56 and 57 bring the spindles to the desired or intended speed of rotation. Stop 22 again engages with a notch 21 after the disk 5 has rotated to advance a spindle to station A or has moved a spindle from station A to station B. If the fuze parts now at stations A and B operate to permit passage of light to photoelectric cell 44 at station A and to prevent the passage of light to photoelectric cell 47 at station B, then the electromagnets will advance another spindle 12 to station A. It will therefore be seen that any fuze part which does not operate as intended at stations A and B will prevent the energizing of electromagnets 20 and 24 and the machine or disk 5 will stop.

I claim:

1. A machine for testing articles which have a passage through which light may pass when the said articles are rotated at sufficient speed, the said machine comprising conveying means for moving the said articles in succession to two stations, means for rotating an article at one of said stations at a chosen speed and for rotating said article at the other of said stations at a different

chosen speed, a photoelectric cell for each of said stations for receiving light which may pass through said passage in the article rotating at each of said stations, means for introducing light into said passage at each of said stations, and driving means for said conveying means under control of both of said photoelectric cells.

2. A machine for testing articles which have a passage through which light may pass when the said articles are rotated at sufficient speed, the said machine comprising conveying means for moving the said articles in succession to two stations, means for rotating an article at one of said stations at a chosen speed and for rotating said article at the other of said stations at a different chosen speed, a photoelectric cell for each of said stations for receiving light which may pass through said passage in the article rotating at each of said stations, means for introducing light into said passage at each of said stations, and electromagnetic driving means for said conveying means under control of both of said photoelectric cells.

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