Nov. 16, 1948. L. MEISTER 2,453,720

APPARATUS FOR DETECTING PERFORATIONS IN AMMUNITION FLASH TUBES

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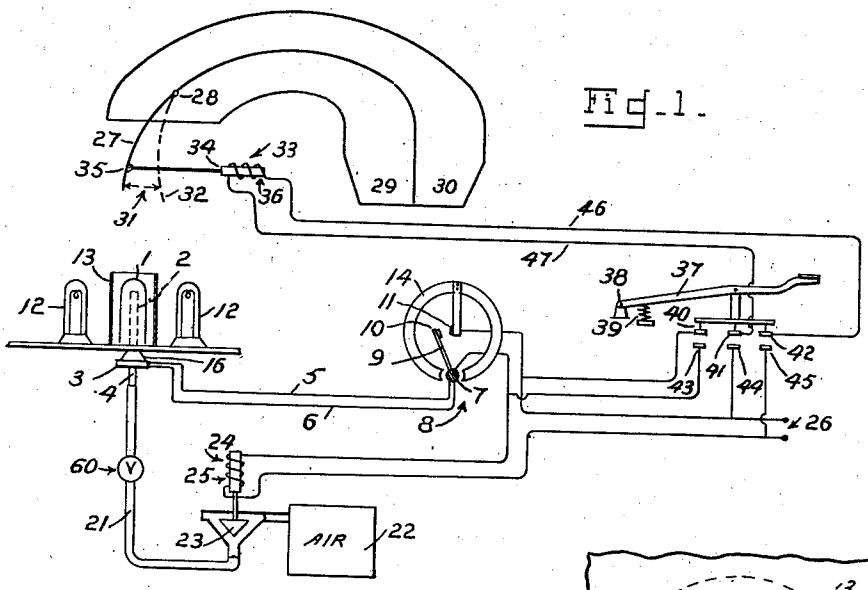


Fig. 1.

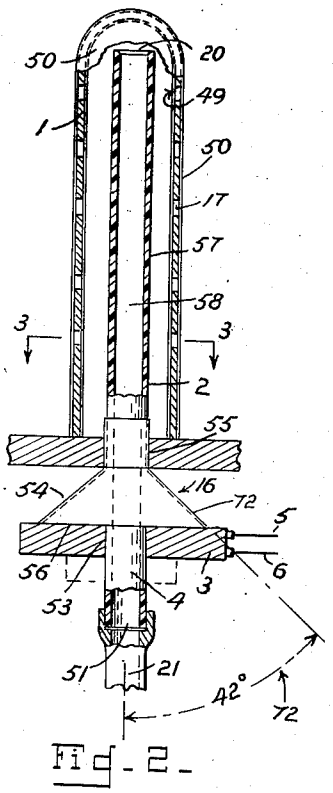


Fig. 2.

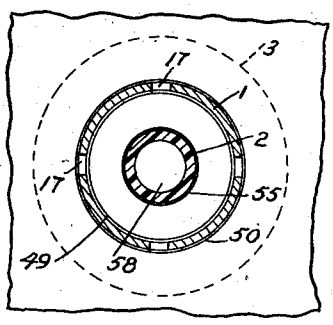


Fig. 3.

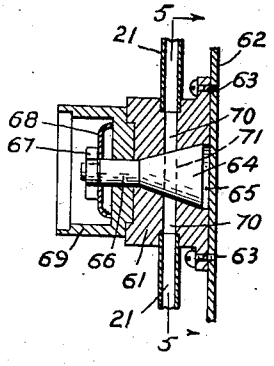


Fig. 4.

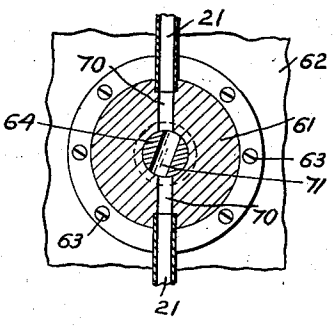


Fig. 5.

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APPARATUS FOR DETECTING PERFORATIONS IN AMMUNITION FLASH TUBES

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8 Claims. (Cl. 209—111)

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

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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 inspection devices, and is a continuation-in-part of my co-pending application Ser. No. 451,679, filed July 20, 1942, for Testing apparatus, now Patent No. 2,385,367, dated September 25, 1945.

A purpose of the invention is to provide a simple, quick and effective method of inspecting primers for artillery ammunition and the like to determine that no undesired openings or pinholes exist therein.

Another purpose is to provide a method of automatically selecting defective primers and segregating them from acceptable primers.

A further purpose is to provide an automatic method of ejecting defective primers from the inspection device.

An additional purpose is to avoid the limitations of the use of a visual method of discovering defective primers.

Other purposes will become apparent from the description set forth herein.

In the manufacture and loading of ammunition primers for artillery shells, it is customary to insert a liner of paper or the like into the flash tube and to coat the exterior of the flash tube with a sealing compound like pitch, to keep out moisture which might render the primer inoperative if it gained access to the black powder contents of the flash tube.

Thus it is necessary to inspect the flash tube after the paper liner has been inserted and the outer pitch covering applied, and before filling it with black powder. The inspection should disclose any openings or pinholes in the pitch tube covering. The visual method of inspection does not yield good results because tiny pin holes are not easily seen. The present invention proposes to improve the inspection procedure by means of a device by which light passing through a pinhole in the flash tube covering automatically causes the defective tube to be ejected from the machine and dumped into a separate container for rejects.

Reference is now had to the drawings in which;

Figure 1 is a diagrammatic and schematic partly cut-away view of the working parts of the

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whole device, showing the primer flash tube in the machine in position for inspection,

Figure 2 is an elevational cut-away view of a flash tube with paper liner and pitch covering, the tube surmounting a plastic inspection post,

Figure 3 is a sectional view taken on the line 3—3 of Fig. 2,

Figure 4 is a side sectional view of the regulation valve 60, and

Figure 5 is a view taken along line 5—5 of Fig. 4.

In Figure 1, a coated and lined primer flash tube 1 which is to be inspected for pinholes, is placed over a plastic hollow inspection post 2 which has a photoelectric cell 3 over its lower end 4. The output wires 5 and 6 of the photoelectric cell 3 are connected directly across the coil of a sensitive relay 8 having an armature 9 carrying a movable contact 10 adapted to engage a fixed contact 11 whereby an external circuit may be closed. The relay 8 has a permanent magnet 14 between the poles of which the pivoted movable coil 7 tends to rotate in a clockwise direction as the current generated by the photoelectric cell 3 passes through the coil. The armature 9 mounted on coil 7, and carrying contact 10 on its outer end, rotates with coil 7 and thus engages stationary contact 11. A number of one hundred watt incandescent lamps 12, are disposed around the test post 2 and connected to a current source whereby they are kept lighted during testing and their light is cast on the outside of the flash tube 1 being inspected. Four or more of the lamps 12 should be used for good illumination. A dispersion cylinder 13 of frosted glass or the like is mounted between the lamps 12 and the test post 2 to scatter the light as it impinges on the exterior of the flash tube 1. If any pinholes exist in the flash tube 1, the light from the four lamps 12 passes through the pinholes and into the test post 2, through its polished side surfaces 57 being transmitted longitudinally within the test post 2 toward the enlarged portion 16 of the test post. The surface 56 of post 2 is sanded so that the light passes out of the test post 2 through the surface 56 and against the sensitive upper surface of the photoelectric cell 3. The cell 3 converts the light into electric current sufficient to actuate the coil 7 of the relay 8 moving the

armature 9 and carrying the contact 10 against the contact 11.

The test post 2 has a longitudinal bore 58 open at the end 20 and connected at its other open end 51 with a hollow tube 21 which connects to a compressed air tank 22. A valve 23 in the tube 21 is actuated by a solenoid 24 having a plunger 25 and adapted to open the valve 23 when current passes thorugh the solenoid 24, thus permitting compressed air to pass from the tank 22 through the tube 21 and through the bore 58 in the test post 2. Current is admitted to the solenoid 24 from the power source 26 by the relay 8 bringing the two contacts 10 and 11 together. It is thus apparent that when the valve 23 is open, permitting the compressed air to pass through it, the effect of the air blast is to blow the flash tube 1 off the end of the test post 2. Thus a defective flash tube permits light to pass through it, releasing the compressed air and ejecting the defective tube.

An adjustable regulator valve 60 is inserted in the tube line 21 for controlling the strength of the air blast by reducing the size of the passageway for the air passing through the tube 21. As shown in Figures 4 and 5, the valve 60 has a base 61 attached to a support 62 by means of screws 63. A plug 64 frusto-conical in shape is rotatably fitted into a corresponding frusto-conical bore 65 in the base 61. The plug 64 has a cylindrical extension 66 with a nut 67 threaded to the outer end of the extension. A steel spring washer 68 mounted over the extension 66 serves to maintain the conical plug 64 under longitudinal tension tightly within the conical bore 65. The cup shaped member 69 is held against the base 61 by means of the pressure exerted against it by the spring washer 68. A transverse bore 70 in the base 61 and a corresponding bore 71 in the conical plug 64, aligned therewith, is connected at both ends with the air line 21 so as to provide a continuous air passage as shown. Since the nut 67 holds the spring washer 68 under pressure, the effect is to draw tightly together the assembly comprising the member 69, the member 64, nut 67 and washer 68 so that rotation of member 69 causes the entire said assembly to rotate as a unit. By rotating member 69, the size of the air passageway may be adjusted. It has been found that an air blast pressure of 35 pounds per square inch in the test post is suitable for blowing off a flash tube about four inches in length. Where the flash tube is longer and hence heavier, a higher air blast pressure would be necessary. The longer flash tube will necessitate the use of a correspondingly longer test post.

A deflector plate 27 is pivotally mounted on pivot 28 so that as the defective flash tube 1 is ejected by the air blast, it is thrown into a rejects hopper 29.

If the flash tube is not automatically thrown into the rejects hopper 29 then it has passed the test and is to be thrown into hopper 30. It may be removed from test post 2 by hand and placed with the acceptable flash tubes in hopper 30. Or it may be removed and so placed mechanically. For this purpose, the vane 27 must be rotated through the angle 31 to the position 32 so that an air blast through test post 2 will blow it right into the hopper 30. A solenoid 33 has a plunger 34 attached to vane 27 at any suitable point 35, the plunger passing through and being actuated by current passing through coil 36 whereby the plunger 34 is drawn into the center of coil 36 thereby rotating vane 27 to position 32 and exposing hopper 30 for acceptable flash tubes.

A foot treadle 37, having a pivot 38 at one end and a return spring 39 carries moving contacts 40, 41 and 42 adapted to engage stationary contacts 43, 44 and 45 respectively. When the pedal 37 is depressed by the operator for an acceptable flash tube, the contact 40 engages contact 43 closing the circuit to the valve solenoid 24 and actuating it, causing an air blast through the test post 2 thereby ejecting the acceptable flash tube 1. At the same time the pressure of the operator on the foot pedal 37 has caused contacts 41 and 42 to engage contacts 44 and 45 respectively so that current is fed to the two leads 46 and 47 to the solenoid coil 36, causing the plunger 34 to be drawn into the solenoid coil 36 and pulling with it the vane 27 rotating it to the position 32. Thus the hopper 30 is exposed and the acceptable flash tube is ejected into it by the air blast.

The light bulbs 12 may be replaced by other convenient sources of high illumination if desired. For example, a coil of fluorescent light tubing may be placed around the test post 2 for this purpose, or mercury vapor lights may be used. By using a colder light source, it may be placed closer to the object being tested without having any excess heat present to affect the pitch covering of the flash tubes being tested, or the plastic test post 2. The photocell 3 may also be more sensitive to the cold light or the mercury vapor light, with corresponding advantages in greater ability to detect very small pinholes.

It will be seen from Figure 2 that the flash tube 1 is an elongated cylindrical tube, closed at one end by being spun, or by a cap or other suitable method, and is provided with a plurality of spaced holes 17 in the sides of the tube through which the flash of the black powder contents comes out to ignite the main charge in the shell case. A paper liner 49 is inserted inside the flash tube, and a pitch coating 50 applied over the entire exterior of the tube except the open end, so as to completely seal off any pinholes that might admit moisture to the black powder which is to be inserted into the flash tube later.

As shown in Figure 2, the test post 2 consists of a cylinder of acrylic plastic having a central bore 58 for passage of the air blast. It also has both ends 20 and 51 of the plastic coated with a black paint to reflect the light from the ends back into the plastic. A raised plastic collar 16 is formed on the lower portion of the tube in the position indicated in the drawing, so that the length of the test post 2 above it is sufficient to accommodate and receive the entire length of the flash tubes being tested. The frusto-conical collar 16 is circular in cross section and slopes outward so that at its narrowest it has a diameter equal to the outside diameter of the cylindrical tubing of the test post 2 and at its widest its diameter is equal to that of the light-sensitive face of the photoelectric cell 3. It is noted that the photoelectric cell 3 must have a bore 53 through its center so as to make it annular in shape, for allowing the lower end 4 of the test post to pass through it. A coating 72 of opaque black paint is applied over the sloping sides 54, a small part 55 of the vertical sides, and both ends of the plastic 20 and 51, so as to cause the light to be reflected back into the plastic. The lower surface 56 of the collar 16 is sanded or made irregular so as to permit maximum egress of light from the plastic to the surface of the photocell 3. The rest of the internal and external surface of the test post is

polished smooth. The light passing through a pinhole in a defective flash tube passes into the polished sides of the test post **2**, down the plastic walls, and spreads out in the conical collar, leaving through the sanded surface **56** and impinging upon the photocell surface. Due to the particular shape of the plastic body the light is thus led downwardly without substantial loss, to the tubular conical portion from where it is projected onto the photoelectric cell. The test post is preferably made of the plastic material, methyl methacrylate, commonly referred to as "lucite" and "plexiglas." It has been found that the best results are obtained when the angle **72**, between the longitudinal axis of the test post and the sloping surface **54** of the conical collar is 42 degrees, and that increasing or decreasing the said angle results in a greatly diminished efficiency of light transmission to the photocell. Other materials such as clear glass may be used for the test post **2** but the light transmission efficiency thereof is much less so that not enough light is transmitted to detect the smaller holes in the flash tube covering.

While the foregoing specification sets forth the invention in specific terms, it is to be understood that numerous changes in the shape, size, arrangement and materials may be resorted to without departing from the spirit and scope of the invention claimed herein.

I claim:

1. An inspection device for discovering defective ammunition flash tubes containing holes, comprising a source of light; means for projecting said light through said holes; a photoelectric cell having a light sensitive surface; means for gathering any projected light and for directing said gathered light onto said light sensitive surface, said last mentioned means being formed of methyl methacrylate and comprising a frusto-conical portion, a cylindrical extension integral and coaxial with said conical portion and extending from the smaller end of the frusto-conical portion, said extension being receivable in said flash tubes being tested and the larger base of said conical portion being arranged for directing said gathered light onto said light sensitive surface; and means actuated by said photoelectric cell responsive to said gathered directed light for ejecting from the device any flash tubes having holes.

2. In an instrument for testing the perforate or imperforate condition of a hollow object having closed side walls, a base, a light-conducting tube projecting from a first side of said base, said object being adapted to extend over and about said tube, said tube having a portion flared outwardly and away from the second side of said base, a light source adjacent said tube on said first side of said base, and light-responsive means adjacent the flared end portion of said element.

3. An instrument for testing a flash tube having supposedly imperforate side walls, a test post of light-conducting plastic having a frusto-conical exterior flange adjacent one end, the larger end of said flange being substantially planar, a photoelectric cell having its light-receiving face closely adjacent said planar end, the other end of said post being adapted to have a flash tube slid thereover, a light source positioned about said other end of said post, means shielding said flange from said light source, and means responsive to energization of said cell for removing said tube from said post.

4. An instrument for testing the perforate or

imperforate condition of a hollow object having a closed end and side walls, a base, a tube of light-conducting material extending through said base, a source of light adjacent said tube on a first side of said base, an element of light-conducting material fitting about said tube and having a portion flared outwardly away from said tube on the second side of said base, and photo-electric cell means in contact with the flared end of said portion and responsive to any light passing from said source to said tube through perforations in the wall of said object while the same extends over and about said tube on said first side of said base.

5. In an instrument for testing for perforations in the walls of a generally cylindrically rigid object having one end open and one end closed, a base, an open-ended tube of light-transmitting plastic extending through said base, said object being positioned over the first portion of said tube at a first side of said base, said tube having a circumferentially-extending frusto-conical projection on the other side of said base, a photoelectric cell in light-responsive relation with the base of said projection, a source of light adjacent said tube on the first side of said base, and means responsive to energization of said cell in response to any light passing from said source through said object to said tube, to automatically remove said object from its position over said tube.

6. In an instrument for testing for perforations, the supposedly imperforate wall of a generally cylindrical flash tube having one end closed and one end open, an opaque base having an opening therethrough, a tube of acrylic plastic extending through and fitting said opening, said tube having a frusto-conical flange extending outwardly and away from said base at one side thereof, a photo-electric cell in light-receiving contact with the larger end of said flange, a source of supply of pressure fluid, conduit means including a valve connecting said supply with the interior of said tube, a source of illumination adjacent said tube on the other side of said base, and means operated by energization of said cell in response to light passing from said source through a perforation in the wall of a flash tube to said plastic tube and thence to said cell, to open said valve and force said flash tube from its position over said plastic tube.

7. In a device for testing and sorting ammunition flash tubes having supposedly imperforate side walls and a closed end, a base having an aperture therethrough, a testing tube of acrylic plastic fitting said aperture and extending to both sides of said base, the end of said testing tube at a first side of said base being substantially coextensive with a flash tube when the latter is placed thereover to rest on said base, said testing tube having a frusto-conical flange on the second side of said base, extending outwardly and away therefrom and having a planar end, a light-responsive cell in light-sensitive association with said planar end, a source of pressure fluid, a conduit, including a valve, said conduit connecting said source with the interior of said testing tube, a switch, a first circuit closing said switch in response to energization of said cell, a second circuit opening said valve in response to closing of said switch, and a source of illumination closely adjacent and extending about said testing tube exteriorly of a flash tube thereover.

8. The device as recited in claim 7, first and second chutes having mouths in substantial alignment with said testing tube on the first side of said base, a vane adapted to be pivoted between a first

and a second position to deflect a flash tube into a respective one of said chutes, and a second manually operated switch operative to pivot said vane from said first to said second position and simultaneous open said valve independently of said first switch, whereby said source of pressure blows imperforate flash tubes into said second chute and perforate flash tubes into said first chute.

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