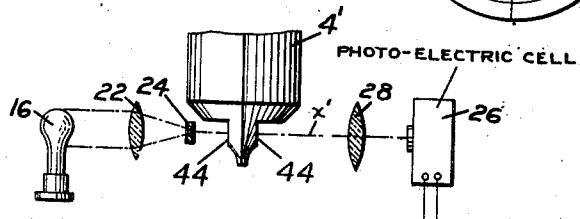
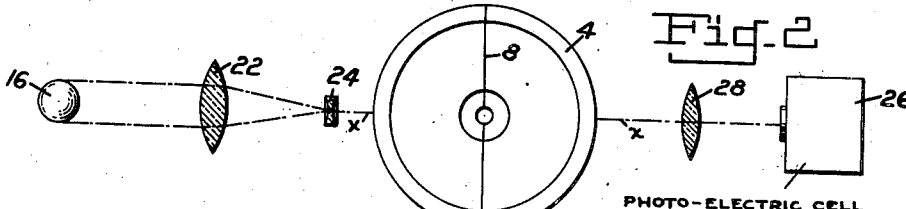
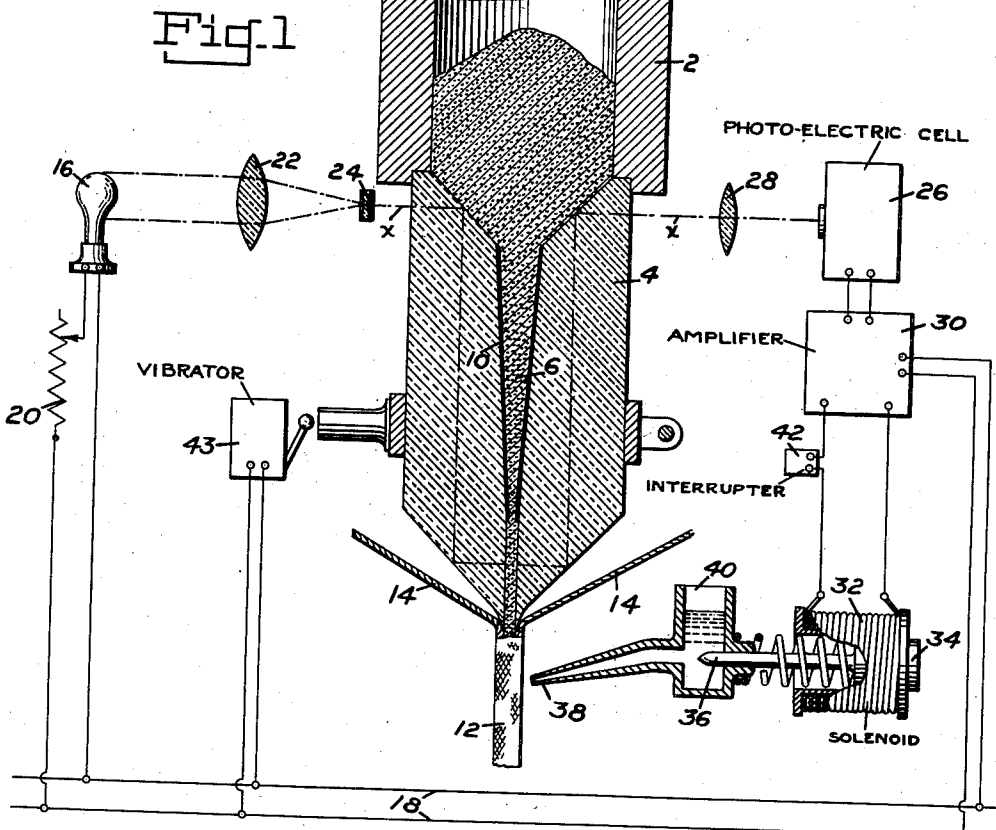


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TESTING APPARATUS
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TESTING APPARATUS

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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 testing apparatus, particularly to testing as applied to a fuse train during the powder loading process.

In the process of machine loading powder into a fuse train, it sometimes happens that the powder nozzle clogs for a time, with the result that no powder is loaded into the fuse even though manufacture of the fiber fuse cover continues. The result is that it becomes difficult to detect what part of the fuse train is loaded and what part is not.

It is the object of this invention to provide a testing device which makes detection of unloaded fuse trains easy. The loading machine feeds powder to the fuse train as the fiber is being twisted to form the jacket or cover. The powder is fed through a nozzle which has a light path through it directed across the powder path. A beam of light or other wave energy is directed toward the powder path and, if no powder is passing through the nozzle, continues across the powder path to a light sensitive relay which operates a signal means to indicate that the fuse train is not being loaded.

The specific nature of the invention as well as other advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawing in which:

Fig. 1 of the drawing shows one embodiment of the invention, with parts broken away and in section.

Fig. 2 is a top view of a portion of the system of Fig. 1. For simplicity, the nozzle is shown empty in this figure.

Fig. 3 is a view of part of a system similar to that of Fig. 1, but showing a modification.

Referring to the drawing in detail, at 2 is shown part of a powder source which feeds the powder to a nozzle 4. Nozzle 4 is provided with a powder path which preferably consists of a longitudinal bore 6 gradually diminishing in diameter from the powder entrance end to give a funnel effect. When there is no powder in the bore, the nozzle has a light path through it across the powder path. This light path is indicated by the dot-dash line *x*, which is shown as completed in order to indicate the light path in its entirety, even though the passage of light is actually blocked when powder passes in an unbroken stream through bore 6.

Nozzle 4 is preferably made in two parts, being divided substantially on a diameter, as shown in Fig. 2. To prevent the passage of stray light across the nozzle, the cooperating surfaces at the split are preferably coated with a black paint 8, which may also extend to that portion of the bore through which the light beam is not intended to pass. The coating in the bore is indicated at 10, Fig. 1.

As the powder leaves the exit end of nozzle 4, it passes into the cover 12 which is being twisted as it is loaded. Two of the yarn strands going to make up cover 12 are indicated at 14. Inasmuch as the cover twisting machine per se forms no part of this invention, the machine is not shown.

Wave energy, such as light, may be provided for passage through the nozzle by any suitable source, such as light bulb 16 which receives its energy from a power source (not shown) through lines 18 and resistance 20. The light from bulb 16 is collected by condensing lens 22 which transmits it to collimating lens 24 in order that substantially parallel light may be directed into nozzle 4.

Nozzle 4 is preferably made of any suitable transparent material, such as glass or one of the transparent resins or plastics available. If desired, the place at which the narrow beam of light enters nozzle 4 may be flattened, to eliminate refraction. The four reflecting surfaces inside the nozzle may be similarly treated to prevent or decrease dispersion. At the other side of the powder path, in position to receive light which passes through the nozzle when there is no powder in bore 6 to impede it, is a light sensitive means such as photoelectric cell 26. A lens 28 may be provided to collect the light leaving the nozzle to transmit it to the cell 26.

Cell 26 may be any suitable relay sensitive to the kind of wave energy used. Where ordinary light is used, cell 26 may be a "photoelectric" or "photo-emissive" tube, or it may be a "photovoltaic cell," of the wet or barrier layer type. These are usually grouped indiscriminately under the term photoelectric cell. Whatever type of relay is used, its output may be magnified in amplifier 30 which takes its power from lines 18. The output of the amplifier may be utilized in any of a number of ways, or in combinations thereof. For example, the power output of amplifier 30 may be used to stop the twisting mechanism which forms the fuse cover 12, or it may ring a bell, turn on a light, or the like, or it may do all of those things. In the application of the invention illustrated, a

paint spotting mechanism is used to mark that part of the fuse cover which has no powder in it. This is accomplished by a solenoid 32 which is energized when light strikes the sensitive element of cell 26. A movable armature 34 carries a piston 36 of a simple pump operating to deposit paint through tip 38 from reservoir 40 upon fuse cover 12. An interrupter 42 is placed in the amplifier-solenoid circuit to break the circuit so that it may immediately be reestablished if light is still passing to cell 26. In this manner, means are provided to keep the paint pump operating so long as there is no powder flowing through nozzle 4. Tip 38 will preferably be small enough so that paint will be prevented from dripping out by surface tension while piston 36 is withdrawn.

In order to decrease the tendency of the powder to clog in its passage through the nozzle, a vibrator 43 may be provided to continuously agitate the nozzle. Vibrator 43 may be any of a suitable type, but is shown in the drawing as being electrical, receiving power from lines 18.

In the modification of Fig. 3, a powder nozzle 4' has recesses 44 cut to permit ray x' to take a more direct path through nozzle 4'. Wave energy source 16, lenses 22, 24 and 28, and cell 26 may be similar to, or the same as, those elements in Figs. 1 and 2. Where it is feasible to use the embodiment of Fig. 3, it will be found to be considerably simpler.

Operation.—So long as powder flows through bore 6, the passage of light to the photoelectric cell is blocked. However, if bore 6 becomes clogged in its tapering portion, the portion below will empty, and light from bulb 16 will reach cell 26. Solenoid 32 will thereupon be energized, actuating piston 36 to eject a spot of paint upon cover 12. Interrupter 42 breaks the circuit, restoring piston 36 to the position shown in Fig. 1 under the influence of the spring. If the clog in

bore 6 has not yet cleared, the cycle will repeat, putting another paint spot on the empty fuse train. Detection of the defective fuse train can then be made merely by looking for the paint spots.

I claim:

1. Testing apparatus comprising a cylindrical transparent powder dispenser having conical surface ends, a powder passage through the cylinder from end to end, means to direct light wave energy through the dispenser across the powder passage, energy sensitive means positioned to receive the wave energy from the dispenser, signal means connected to receive impulses from the energy sensitive means, said dispenser being split along the axis of the powder passage, the surfaces of the split being coated with an opaque paint, and the plane of the split being across the direction of the wave energy passing through the dispenser.

2. The apparatus of claim 1, characterized in that there is an opaque coating on the powder passage except for that portion intended to permit the passage of the light wave energy.

3. In a fuse-loading machine, a transparent powder nozzle formed with an interior cone shaped receiving end presenting opposite inwardly inclined reflecting surfaces and similarly inclined outer surfaces adjacent its lower end whereby a light path is formed extending substantially throughout the entire length of the nozzle, and a powder conduit extending through the nozzle, means for directing a light beam into said nozzle against certain of said opposite inwardly inclined reflecting surfaces for reflection lengthwise of said nozzle to follow said light path, and a light sensitive means along the light path adapted to receive the light which has passed through the nozzle.

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