

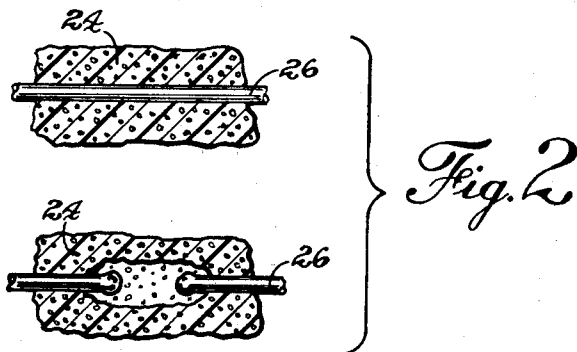
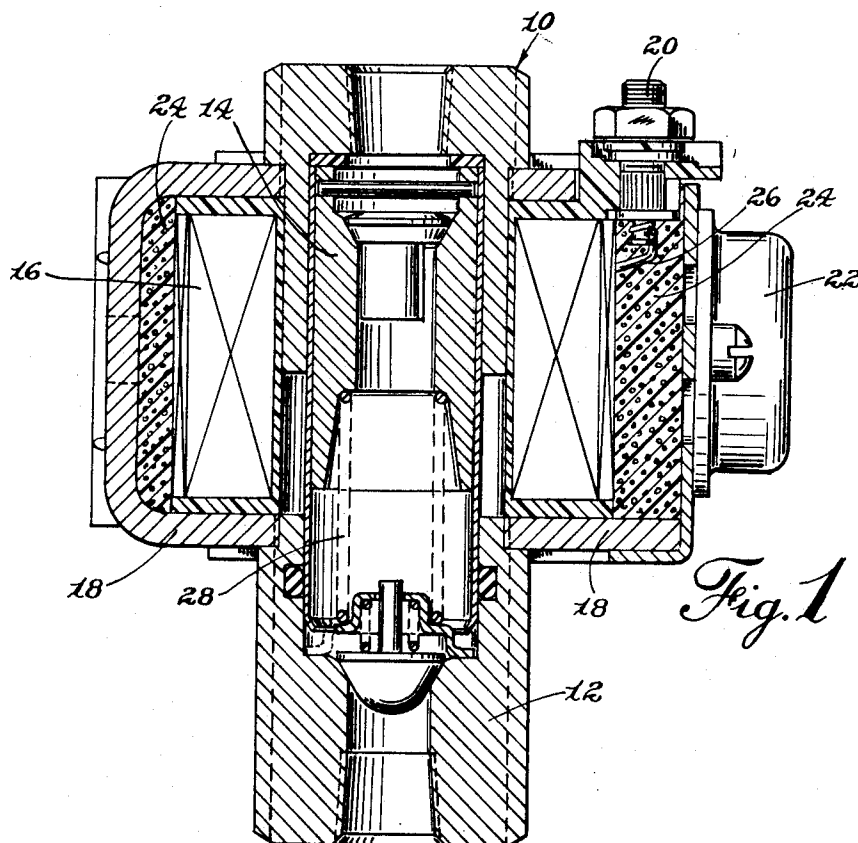
Jan. 27, 1970

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3,492,619

FUSE WITH FUSE WIRE EMBEDDED IN PLASTIC FOAM

Filed Oct. 5, 1967



WITNESS:

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1

3,492,619

FUSE WITH FUSE WIRE EMBEDDED IN PLASTIC FOAM

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Filed Oct. 5, 1967, Ser. No. 673,106

Int. Cl. H01h 85/18

U.S. Cl. 337—276

3 Claims

ABSTRACT OF THE DISCLOSURE

A fuse for providing electrical overload protection. By imbedding fuse wire of a predetermined size in a solid plastic foam, the fuse is provided with heat, shock and electrical insulation. The plastic foam also acts as a fire retardant in the event of parting of the fuse wire and momentary arcing while allowing molten fuse metal to flow only enough to break the electrical path.

In the manufacture and use of transistor-controlled electromagnetic plunger pumps, the statistical failure of transistors requires that fuse protection be provided to prevent electrical overload and destruction of the pump. The fuse must also be capable of withstanding the shocks and vibrations encountered in any application, such as vehicle-mounted fuel pumps, equipment that must withstand vibration and shock specifications, as well as the vibrations caused by the reciprocating action of the plunger. Since pumps of this nature are extensively used in the automotive industry as fuel pumps, an additional requirement is imposed. This requirement is that if the fuse operates as a fuse, it must not create a fire hazard.

The use of conventional, encapsulated fuses is undesirable because of the ease of breakage and because of the increase in per unit cost that use of such a fuse would occasion.

It is, therefore, an object of this invention to provide fuse protection for an electrical circuit which is not susceptible to breakage caused by repeated or extreme shock, presents no fire hazard when it operates as a fuse, is reliable in that fuse operation will not be occasioned by ordinary operating temperatures which are not the result of electrical overload and is low in cost.

It is a further object to provide this fuse protection to electric circuits used to control the operation of electromagnetic plunger pumps, particularly those adapted for use in the automotive industry for pumping fuel.

Further objectives will become apparent on consideration of the appended description and drawings wherein:

FIGURE 1 is a cross-sectional view of an electrical fuel pump which employs the fuse which is the subject of this invention.

FIGURE 2 shows two views of the fuse within the plastic foam and illustrates what happens upon fuse operation.

Referring to FIGURE 1, numeral 10 designates an electromagnetic plunger pump comprising inlet fitting 12, plunger 14, coil 16, coil housing member 18, electrical terminal 20, transistor 22, plastic foam 24, fuse wire 26 and spring 28. Fuse wire 26 provides the electrical connection between electrical terminal 20 and coil 16 through

2

the plastic foam 24. The configuration of the pump and the details of operation of the pump are contained in commonly-assigned, co-pending application Ser. No. 621,809, filed March 9, 1967, now U.S. Letters Patent 3,400,663. Essentially, electric current flows from an electric source not shown, to the terminal 20, through the fuse wire 26, into and through the coil 16, out of the coil 16, to the transistor 22, to ground, thus causing an electromagnetic field to be generated by the coil. As the field builds up, it pulls the plunger 14 downward against the action of the spring 28. When the transistor 22 operates to interrupt the electric circuit, the electromagnetic field collapses and the spring 28 restores the plunger to the upward position. This operation then repeats.

The plastic foam 24 electrically insulates the fuse wire 26 and supports it against breakage caused by vibrational shocks. The plastic foam may be polyurethane or the like and must melt at nearly the same temperature as the fuse, and then must re-solidify in a reduced volume.

Immediately prior to fuse operation, the amount of current being carried by the fuse wire increases, causing it to heat up rapidly. This heat build-up causes the plastic foam to melt in the region of the fuse wire. As it melts, the volume occupied by the foam decreases so that a cavity begins to form around the hot spot in the fuse wire. Melting continues and the cavity continues to grow until the temperature falls below the melting temperature of the foam. When this happens, the plastic hardens but is no longer foam in this region. Cooling takes place only when current flow ceases, and this happens when the fuse wire has become hot enough to liquify and flow, breaking the electric circuit.

The cavity formed in the plastic foam provides an ideal receptacle for this flowing metal so that the electric circuit can be broken. This is aptly shown by FIGURE 2 which illustrates the pre-fuse operation situation and the post-fuse operation situation.

Since the melting points of fuse wire and the plastic foam are nearly the same, the cavity need only get large enough for the fuse wire to flow before the electrical circuit is broken and cooling begins. The plastic foam has the additional advantage of isolating any arcing that might take place during the fuse melting and flowing stages. The plastic foam also serves to insure that the fluid being pumped will not be exposed to any arcing that takes place during the fuse melting and flowing stage. This serves to reduce the fire hazard. The foam further serves to thermally insulate the fuse from heat sinks such as the coil 16 and the housing member 18.

We claim:

1. An electrical overload fusing device comprising:
 - a housing member for a fuel pump having an interior region; means mounted on said housing for conducting electrical energy into said region; a predetermined size of fuse wire disposed within said interior region in series connection with said means to conduct electrical energy through at least a portion of said region; and
 - a solid plastic foam contained within said interior region surrounding and supporting said fuse wire thereby providing said fuse wire with vibrational and electrical insulation;

said foam having a melting temperature substantially

3,492,619

3

the same as the fuse and a capability of re-solidifying, after melting, in a reduced volume.

2. The fusing device as claimed in claim 1 wherein said plastic foam is polyurethane.

3. The fusing device as claimed in claim 2 wherein said housing is comprised of the flux conducting electromagnetic coil housing of a reciprocating plunger fluid pump.

4

FOREIGN PATENTS

853,941 11/1960 Great Britain.
929,579 6/1963 Great Britain.

5 BERNARD A. GILHEANY, Primary Examiner
H. B. GILSON, Assistant Examiner

References Cited

UNITED STATES PATENTS

1,016,443 2/1912 Sachs ----- 337—280
3,275,774 9/1966 Miller ----- 337—1 X

U.S. Cl. X.R.

10 174—31; 337—280