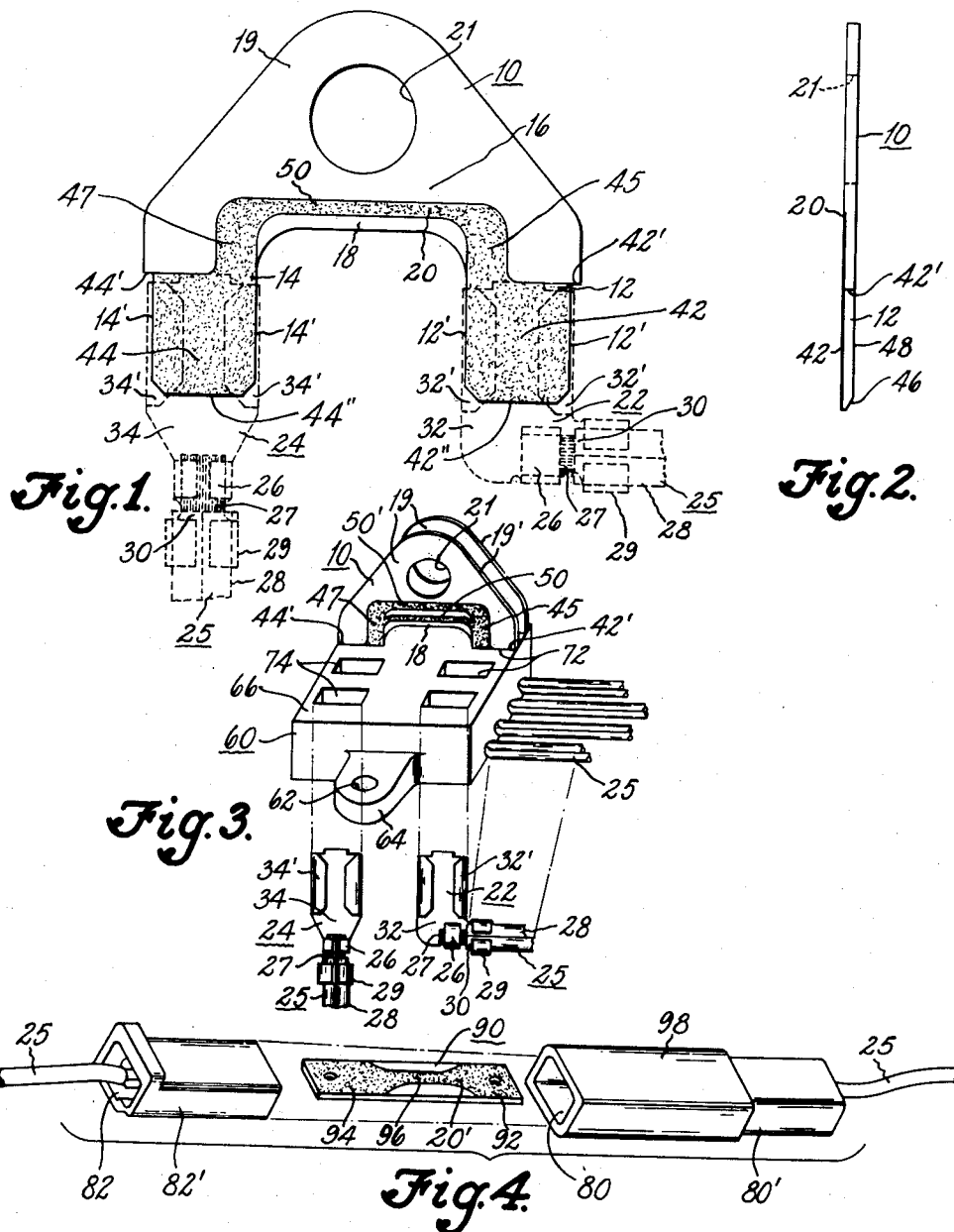


June 14, 1960

R. H. SIMS ET AL
PRINTED CIRCUIT TYPE FUSE

2,941,059

Filed Sept. 16, 1957



INVENTORS
ROBERT H. SIMS
BY HERBERT R. LILLEY

D. C. Staley
ATTORNEY

1

2,941,059

PRINTED CIRCUIT TYPE FUSE

Robert H. Sims, Oak Park, and Herbert R. Lilley, Pontiac, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed Sept. 16, 1957, Ser. No. 684,032

4 Claims. (Cl. 200—129)

This invention relates generally to printed circuit type electric components, and particularly, to printed circuit type fusible protective devices or fuses operative to interrupt an electric circuit on occurrence of overload currents or short circuit currents.

An object of this invention is to provide a new type of fusible protective device for use in electric circuits.

Another object is to provide a fusible protective device having a rigid insulating base with one side covered with electrical conducting material in a manner to provide a current conducting bridge which is interrupted by excessive heating due to electric current in excess of the current capacity of the bridge of conducting material.

Another object is to provide a fusible protective device of printed circuit type construction including a fuse material bonded to an insulator board for use in an electric circuit.

Another object is to provide a fuse and fuse block assembly including a molded fuse block of insulating material having openings for insertion of electric terminals connectible in an electric circuit together with a fuse material bonded on an insulator board as a printed circuit type fuse engageable between the terminals as a circuit protecting device.

Another object is to provide a fuse and fuse block assembly including an insulating housing for connection with electrical terminals in an electric circuit to include a printed circuit type fuse of conducting material on an insulating board inserted between the terminals.

Another object is to provide a fusible protective device including a U-shaped insulator board with leg portions inter-connected by a bridge adapted both as a handle for manually inserting and removing the protective device relative to the terminals in an electrical circuit and as a base for electrical conducting fuse material secured as a printed circuit to each leg portion and across the bridge of the insulator board.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the invention is clearly shown.

In the drawings:

Figure 1 is a plan view of a fusible protective device in accordance with the present invention.

Figure 2 is a side elevational view of the device in Figure 1.

Figure 3 is a perspective view of a fuse and fuse block assembly in accordance with the present invention.

Figure 4 is an exploded perspective view of a modified printed circuit type fuse and fuse block in accordance with the present invention.

In Figure 1 there is a printed circuit type electric component including an insulator board generally designated by numeral 10 of an insulating material such as a fiber, synthetic resin, or plastic capable of withstanding heat to an extent necessary in accordance with the present invention. Plastic or resinous sheet material either with

2

or without fillers, such as fabric, mica, woven glass cloth, etc., may be used. Either cold setting or heat setting resins may be used such as phenol-formaldehyde, phenolfurfurol, furan, urea-formaldehyde, melamine, methylmethacrylate, polystyrene, polyethylene, vinyl, and nylon resin. In any event, the base or insulator board 10 preferably is formed of insulating material providing advantages of light weight and easy formation in manufacturing a printed circuit type electrical component including the underlying insulating material upon which conducting material is "printed." A suitable relationship is established between the insulator board and the conducting material such that moist and humid climatic conditions will not have deteriorating effects on the printed circuit type fusible protective device of the present invention.

The insulator board 10 shown in Fig. 1 is a substantially U-shaped rigid insulating base including leg portions 12 and 14 joined to each other by an intermediate portion or bridge 16. In the embodiment of the invention illustrated in Fig. 1, the bridge 16 includes a lower surface area 18 on which fusible electrical conducting material is provided and an upper surface 19 providing a panel portion for manually inserting and removing the insulating base 10 from electrical terminals engaging the printed circuit material as will be described in further detail below. The handle portion 19 can be formed extending upwardly from the lower surface 18 of the bridge 16 such that a wing-like structure which can be grasped by fingers or a suitable tool, such as pliers, for inserting and removing the fusible protective device 10 in an electric circuit. Also as an aid for inserting and removing the printed circuit type fuse with the wing-like structure, an aperture or recess 21 is provided in the handle portion 19 such that finger tips can securely engage opposite surfaces of the insulating board 10 in the upper portion 19. It is also possible that a hooked rod may be inserted through the hole 21 for pulling the device 10 out of an electric circuit as in the present invention.

A fusible electrical conducting material, generally indicated by numeral 20, is shown provided on the insulator board 10 in Fig. 1. This conducting material 20 can be applied in any manner such as by a dipping operation, a coating method, a bonding of electric conducting material to the insulator board or by wedging of the electric conducting material into a notched recess that may be provided in bridge portion 18 and around the corners of the leg portions 12' and 14', respectively. In any event the method of securing the electrical conducting material to the insulating board can be any of various known methods familiar to those skilled in the art of printed circuits whereby a proper printed circuit relationship is established between the conducting material 20 and the insulator board 10.

Fig. 1 further illustrates phantom representations of female electrical terminals 22 and 24. Shown with each of the terminals is a conductor 25 fastened by crimping lateral tangs 26 thereof onto a wire 27 covered by an insulating material 28 which is also secured by crimped tabs 29 to the conductor receiving portion 30. Each terminal is further provided with a flattened floor portion, 32 and 34, engageable with the leg portions 12 and 14, respectively, of the insulator board 10. Each floor portion is provided with laterally bent over side wing portions 32' and 34' which are curved around the edges 12' and 14' of the leg portions to be in sliding engagement with the electrical conducting material 20 provided on each of the legs 12 and 14 of the insulator board 10. An electrical contact is established through engagement of the bent over side wing portions 32' and 34' of the terminals against the electrical conducting material 20,

3

As shown in Fig. 1, the electrical conducting material 20 on the leg portions 12 and 14 covers the entire surface area of the leg portions with metallic material represented by numerals 42 and 44, respectively. The leg portion 12 and 14 are reduced in size laterally to provide shoulders 42' and 44' respectively on each of opposite sides of the insulator board 10. The shoulders 42' and 44' serve as stops to prevent excess movement of the insulator board 10 relative to the terminals 22 and 24 when legs 12 and 14 are inserted and engaged onto the floor portions 32 and 34 relative to the bent over side wing portions 32' and 34'. Thus the shoulders 42' and 44' are adapted as stop members to engage against ends of the bent over side wing portions 32' and 34'.

As mentioned earlier, the electrical conducting material 20 can be secured to the insulator board 10 in any suitable manner. Fig. 2 illustrates a side view of the insulator board 10 covered with electrical conducting material 20 as described with Fig. 1. The shoulder 42' is visible in Fig. 2 and a bevelled or tapered end portion generally indicated by numeral 46 is shown as provided on each of the leg portions 12 and 14 of the insulator board. Only the leg portion 12 is visible in Fig. 2, but it is to be understood that a bevelled portion 46 is provided on leg portion 14 just as is provided for leg portion 12. This bevelled portion facilitates insertion of the leg portions into the terminals 22 and 24 described with Fig. 1. Further, the bevelled portion 46 assures that the bent over side wing portions 32' and 34' of the terminals are permitted to slide positively over the surfaces 42 and 44 of the printed circuit conducting material on the legs 12 and 14, respectively, prior to positive electrical engagement relative to the conducting material. After passing over the bevelled portion 46, the side wing portions are in sliding engagement with the electrical conducting material and a back surface 48 of the insulator board. Due to the guiding action of the bevelled portion 46, the side wing portions of the terminals will not damage or tear away the end tab areas 42'' and 44'' of the conducting material 42 and 44 on the leg portions 12 and 14, respectively, of the insulator board 10. As is apparent in Fig. 2, the conducting material 20 has been bonded or coated to the insulator board 10 on surface outlined with Fig. 1 on one side of the insulator board.

It is to be understood that the electrical conducting material as bonded or secured to the insulating board 10 is such that heating of the conducting material caused by electric current carried by a bridge portion 50 of the electrical conducting material secured to the bridge surface 18 as shown in Fig. 1 will determine the fuse rating of the device in the present invention. In addition to being affected by the electrical resistance of the type of metal or alloy material used in forming the conducting material 20, the fuse rating is dependent upon and is variable in accordance with the shape and thickness of material provided in the bridge 50 of conducting material. The current rating can be appreciably altered by providing wider and thicker portions of conducting material in the bridge 50. In keeping with the present invention, varying fuse ratings, such 6, 12, 14, 15, 20, 25, etc., amperes, can be provided with the device of the present invention. However, it is necessary that the insulator board 10 be formed of an insulating material capable of withstanding the heating of current carried by the conducting material bridge 50 in a continuous electric circuit up to and including the fuse rating of the particular printed circuit type fuse provided in accordance with the present invention. For purposes of illustration, the printed circuit type fuse illustrated in Figs. 1 and 2 may be used in an electrical circuit of an automobile (not shown) in which a fuse block is provided at a convenient location such as on a fire wall or behind a dashboard (not shown) of a vehicle.

A molded plastic fuse block 60 is shown in a perspective view of Fig. 3. This fuse block 60 can be suitably at-

4

tached to a fire wall or dashboard of an automobile by means of a bolt or screw (not shown) which may be inserted through a hole 62 provided in a lateral flange 64 for mounting purposes with the fuse block 60. Fig. 3 illustrates the substantially U-shaped printed circuit type electric component 10 of the present invention inserted with legs 12 and 14 (not visible in Fig. 3) extending into openings 72 and 74, respectively, as provided with the fuse block 60. A plurality of these openings 72 and 74 spaced longitudinally and laterally relative to each other can be provided on each of opposite sides of the fuse block 60 so that a bank or plurality of printed circuit type electric components 10 can be mounted in a row with the fuse block to serve multiple circuits connected through conduits 25 which are attached to the terminals 22 and 24 described with Fig. 1. A pair of terminals 22 and 24 are shown in Fig. 3 for insertion in the foremost openings 72 and 74 of the block 60 shown in the view of Fig. 3. The openings 72 and 74 may extend transversely through the body of the fuse block 60 permitting the terminals 22 and 24 to be inserted from the bottom of the fuse block while the printed circuit type fuses of the present invention can be inserted from the top 66 of the fuse block. If necessary, a cover, not shown, of insulating material can be secured to the bottom of the fuse block to insulate and close off the bottom of the openings of 72 and 74 into which the terminals 22 and 24 are inserted.

It is apparent that the U-shaped printed circuit type electric fuses illustrated in Figs. 1, 2, and 3 when mounted as shown in Fig. 3 provide electrical connection between terminals 22 and 24 in staggered relationship longitudinally and laterally relative to the plurality of openings 72 and 74 provided with the insulating fuse block 60. Furthermore, the handle portion 19 of the insulator board 10 extends upwardly from the conducting material 20 a sufficient amount such that the conducting material 20 is spaced well below edge portion 19' of each handle portion 19. Thus, the conducting material 20 forming the bridge 50 of electrical conducting material on the bridge surface 18 is spaced well away from the edges 19' and is remote from any shorting connection with other wiring or metal which may be adjacent to the fire wall or dashboard of the motor vehicle (not shown).

Figure 3 illustrates a slightly modified version of the printed circuit type fuse of Fig. 1 in that an additional bridge 50' of conducting material is shown secured to the insulator board 10. The bridges of conducting material 50 and 50' illustrated in Fig. 3 are spaced parallel to each other and each is electrically connected with conducting extensions 45, and 47, respectively provided between the conducting material 42 and 44 on the legs 12 and 14, respectively. The purpose of the parallel bridges 50 and 50' is to provide for better heat dissipation from the bridges when larger fuse ratings, such as 30 amperes, are provided with the printed circuit type fuse of the present invention. However, the parallel bridges 50 and 50' can also be provided with the smaller ampere fuse ratings for facilitating heat dissipation so long as the shape and thickness of the bridges are in accordance with the particular fuse rating requirements.

The holes 21 provided in each wing-like handle portion 19 of the insulator board 10 are clearly visible in the perspective view of Fig. 3. With the close spaced relationship of the printed circuit type fuses in a row or bank using fuse block 60 as shown in Fig. 3, it is often difficult for finger tips to be inserted between alternate printed circuit type fuses to remove a burned out fuse. Therefore, it may be advisable to remove a burned out printed circuit type fuse from block 60 with a tool such as may be formed by a wire having a hooked end to be inserted into the holes 21 for removal of a fuse. Fig. 3 also illustrates shoulder portions 42' and 44' in engagement with the top surface of the fuse block 60 as stops or abutments

5

also engagable with wing portions of the terminals 22 and 24 as mentioned earlier.

Figure 4 illustrates another embodiment of a printed circuit type fuse and fuse block assembly in accordance with the present invention. Electrical terminals of a straight type such as terminal 24 outlined in Fig. 1 and illustrated in Fig. 3 are inserted into hollow interior portions 80 and 82 of insulating housings 80' and 82'. The insulator board 10 is now formed of a straight piece 90 of insulating material onto which a conducting material generally indicated by numeral 20' is bonded or suitably secured providing end contacting portions 92 and 94 which are connected by a bridge portion 96 formed of a predetermined shape and thickness to provide proper fuse rating for a printed circuit type fuse in accordance with the present invention. The straight type of printed circuit protective device illustrated in Fig. 4 can be used in electrical circuits where no fuse block or terminal board is provided such as in a power supply line to an electrical device. An example of such a use would be in an automotive radio (not shown) where a fuse often is inserted in series with a power supply line and where ends of wires can be provided with terminals, such as the terminals 24 shown in the drawings, permitting telescoping engagement of the insulating housing members 80 and 82 completely enclosing the straight printed circuit type fuse having the insulating board 90 and conducting material 20'. Thus the printed circuit type fuse is enclosed by a shielding portion 98 of the one housing 80'. Ends 92 and 94 of conducting material of the printed circuit type fuse are in good electrical engagement with bent over wing portions of terminals as described with Fig. 1 above.

It is readily seen that the printed circuit type fuse in accordance with the present invention provides the advantages of simple construction due to elimination of glass tube for housing fuses such as were previously known in the art. Also eliminated are mica windows and other housing constructions formed integral with the fuse for protective purposes. The printed circuit type fuse disclosed in the present invention needs no integral housing because the printed circuit structure is adapted to be weatherproof when made in accordance with printed circuit methods of manufacture known in the art of printed circuits. The printed circuit type fuse using the conducting material 20 and insulating board 10 will not deteriorate due to weather and electrical shielding is provided with the fuse block as shown in Fig. 3 by lateral and longitudinal spacing of the U-shaped fuse device. Electrical shielding can also be provided by the housing 82' insertable into the shielding portion end (98) of a housing 80' for enclosing terminals such as 24 as well as the straight type printed circuit fuse in the present invention. Conceivably, a plurality of insulating housings 80' and 82' can be provided adjacent to each other or as in integral longitudinal row of terminal receiving insulating housings. Molded plastic fuse blocks are inexpensive to produce and the printed circuit type electrical fuse is easy to connect between electrical terminals to provide protection for overload and short circuit currents which may be encountered in electrical circuits. Savings in fuses and in materials are appreciable and the simplicity as disclosed in the present invention is especially advantageous for use with electrical circuits on automotive vehicles where multiple circuit fuse protection is provided and where fuses must be readily accessible without excessive cost in the fuse itself and components for connecting the fuse in an electric circuit.

While the embodiments of the present invention as herein disclosed constitute a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Fuse and fuse mounting means, comprising, an insulating housing means providing a plurality of cavities spaced laterally and longitudinally of each other, terminal

6

means mounted in the cavities and having a conductor receiving portion and an integral platform portion with laterally bent-over side wings, and a printed circuit type fuse including a substantially U-shaped insulator board and only one printed circuit conducting material covering part of one side of said board such that opposite ends of the U-shaped board are slidably engageable with said platform portion and side wings to effect electrical connection directly with said one printed circuit conducting material; adapted to result in disintegration of a bridge of said same printed circuit conducting material between said terminal means upon excess heating by overload current.

2. A printed circuit type fuse and fuse block assembly, comprising, a fuse block of insulating material having a plurality of openings therein, female terminal means connected directly to conductors and having integral platform portions with bent-over side wings insertable in the openings, a plurality of printed circuit type fuses each including a substantially U-shaped insulator board having leg portions integral with a bridge portion, said printed circuit type fuses also each including only one conducting material covering one side of each of said leg portions and extending integrally therebetween over a part of said bridge portion, said bridge portion including an integral extension for handling said printed circuit type fuse, said platform portions with bent-over side wings engaging directly the printed circuit conducting material on said leg portions inserted relative to only said female terminal means in pairs of openings of said fuse block, said extensions for handling each of said fuses extending in a stacked array parallel to each other with outer edges of said insulator board around each extension being spaced from the conducting material bridge as protection against electrical shorting and breaking of said printed circuit conducting material due to anything other than electrical overload in the material itself.

3. Fuse and fuse mounting means, comprising, an insulating body providing at least a pair of cavities spaced laterally and longitudinally of each other, female terminal means mounted in the cavities and having a conductor receiving portion and an integral platform portion with laterally bent-over side wings, and a printed circuit type fuse including only a substantially U-shaped insulator board and only one printed circuit conducting material covering part of one side of said board such that opposite ends of the U-shaped board are slidably and directly engageable with said platform portion and side wings to effect electrical connection directly with said one printed circuit conducting material adapted to result in disintegration of a bridge of said same printed circuit conducting material between said terminal means upon excess heating by overload current, said U-shaped insulation board at each of said opposite ends having a bevelled portion adapted to engage said platform portion of said female terminal means for guiding said ends relative to said one printed circuit conducting material so that said side wing portions of said female terminal means will not damage and tear away said conducting portion.

4. The fuse and fuse mounting means of claim 3 wherein said insulator board includes an integral handle portion intermediate said opposite ends, said handle portion having a cutout therein adapted to be engaged for pulling said opposite ends of said insulator board and conducting material out of direct electrical connection with said platform portion and side wings of said female terminal means.

References Cited in the file of this patent

UNITED STATES PATENTS

652,748	Cote	July 3, 1900
905,905	Murray	Dec. 8, 1908

(Other references on following page)

2,941,059

7

UNITED STATES PATENTS

1,644,626	Barklie -----	Oct. 4, 1927
2,468,351	Vail -----	Apr. 26, 1949
2,537,827	Heath -----	Jan. 9, 1951
2,678,982	Sundt -----	May 18, 1954
2,683,200	Matthysee -----	July 6, 1954

2,769,877
2,786,112

5

499,816
901,549

8

Sundt -----	Nov. 6, 1956
Pempey -----	Mar. 19, 1957

FOREIGN PATENTS

Great Britain -----	Jan. 26, 1939
France -----	Nov. 6, 1944