

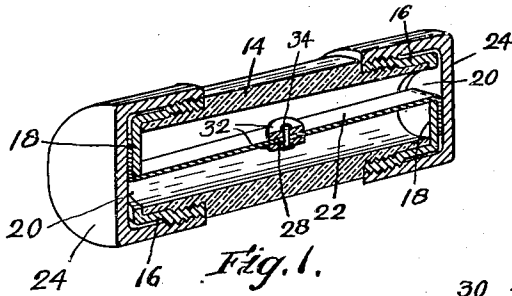
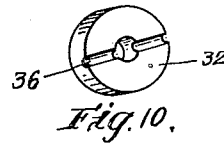
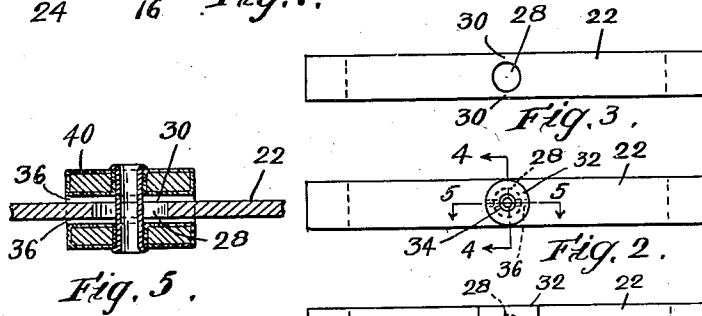
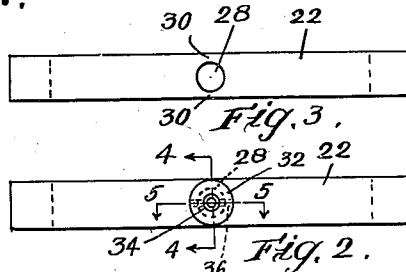
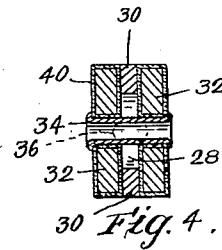
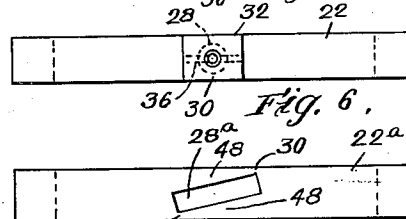
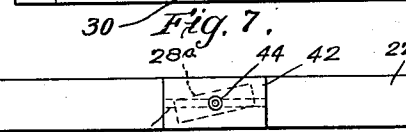
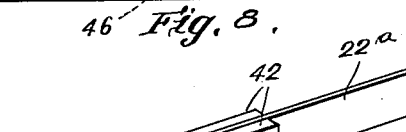
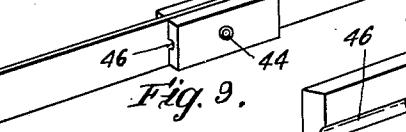
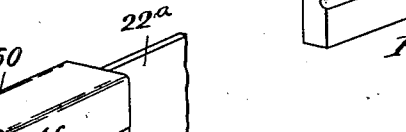
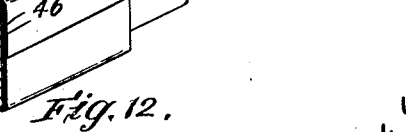
Sept. 22, 1936.

M. B. WOOD

2,055,115

ENCLOSED ELECTRIC FUSE AND FUSIBLE ELEMENT THEREFOR

Filed April 5, 1933



Inventor.

Wm. B. Wood

[Signature]
att'y

UNITED STATES PATENT OFFICE

2,055,115

ENCLOSED ELECTRIC FUSE AND FUSIBLE
ELEMENT THEREFOR

Morris B. Wood, Newburyport, Mass., assignor to
The Chase-Shawmut Company, Newburyport,
Mass., a corporation of Massachusetts

Application April 5, 1933, Serial No. 664,600

33 Claims. (Cl. 200—135)

This invention relates to enclosed electric fuses, particularly those designed for the renewing of their fusible elements, and fusible elements therefor.

5 An electric fuse of the renewable or refillable type usually has a fusible element consisting of a strip of fusible metal having one or more readily fusible portions of reduced cross-sectional area that are adapted to melt when traversed by an
10 excessive current. These portions are adapted to melt, or the fuse to blow, as nearly instantly as may be when traversed by a high overload or short circuit current but are desired to carry a temporary moderate overload current, such as caused
15 by the starting of an electric motor, without interrupting the circuit.

It is an object of the present invention to provide a fusible element, and an electric fuse containing the element, wherein the fusing of the
20 more readily fusible portion of the element is delayed by the application of a heat absorbing mass or plate that is in direct heat absorbing contact with the more readily fusible portion, or the portion of reduced cross-sectional area, so
25 that heat is abstracted directly from the more readily fusible portion and is directly absorbed by the heat absorbent mass without causing the heat to travel lengthwise of the body of the fusible element. The fusible element with which this
30 invention is more particularly concerned comprises a flat fusible strip that is relatively wide and thin and the heat absorbent mass in accordance with this invention is applied against the broad
35 surfaces of the reduced or more readily fusible portion of the strip so that the heat passes transversely of the fusible element and directly into the absorbent mass, and hence the heat is removed at its source, without being caused to traverse and heat up sections of the fusible element
40 adjacent the more readily fusible portion. In accordance with this invention the heat absorbent mass is a non-conductor with respect to the circuit through the fuse terminals and is of relatively infusible material so that it does not add
45 to the arc gases when the fuse blows.

A further object is generally to improve the construction and operation of electric fuses and fusible elements therefor.

Fig. 1 is a perspective sectional view of an electric fuse embodying the present invention.

Fig. 2 is a plan view of the fusible element or link of Fig. 1.

Fig. 3 is a plan view of the fusible element of Figs. 1 and 2 with the heat absorbent plates removed.

Fig. 4 is an enlarged section taken along line 4—4 of Fig. 2.

Fig. 5 is an enlarged section taken along line 5—5 of Fig. 2.

Fig. 6 is a view similar to Fig. 2 but illustrating a modified shape of heat absorbent plates.

Fig. 7 is a view similar to Fig. 3 but illustrating a fuse link having a modified construction for obtaining the readily fusible sections.

Fig. 8 is a view similar to Fig. 2 of the fusible element of Fig. 7 with heat absorbent plates thereon.

Fig. 9 is a perspective view of the fusible element of Fig. 8.

Fig. 10 is a perspective view of one of the heat absorbent plates of Figs. 1 and 2.

Fig. 11 is a perspective view of one of the heat absorbent plates of Figs. 8 and 9.

Fig. 12 is a perspective detail of a fusible element having a further modified form of heat absorbent plates.

The electric fuse embodying the present invention is here shown as of the refillable type and has the tubular insulating casing 14, usually composed of fibre, provided with end ferrules 16 that have end walls 18 that overlie the ends of the casing, the end walls having openings 20 therein through which the ends of the fusible element 22 are extended. The ends of the fusible element are reflexed over the end walls 18 and are clamped thereagainst by end caps 24 that are removably screw-threaded on the ferrules 16. So far as the present invention is concerned the means for securing the fusible element 22 within the enclosing casing is not important and any suitable means may be employed and for the purposes of this invention are to be considered the equivalent of the means herein illustrated. The fusible element 22 comprises a relatively broad, thin and long strip of fusible metal, usually zinc, the strip being of uniform width and thickness and cross section from end to end except at the more readily fusible portion thereof. The strip or link is provided with an opening 28 midway between its ends so that when the link is in the casing the opening is about in the middle of the casing between the end terminals thereof. The opening in Fig. 3 is circular and reduces the cross-sectional area of the link thereat and thus provides between the opening and the opposite sides of the link more readily fusible portions 30 which are adapted to melt or fuse when the link is traversed by a current that generates more heat in the readily fusible portions than can be absorbed by these portions

and the rest of the link and by the terminals 24 and the enclosing casing and dissipated by the casing and terminals.

In the fuse link illustrated in Fig. 7 the opening 28a is rectangular instead of circular and the axis of the opening is inclined with respect to the longitudinal line of the fuse link so that the opposite corners of the opening are disposed most closely adjacent the opposite long edges of the link and hence provide more readily fusible sections 30 thereat. In either construction of link the most heat is developed at the regions of least cross-sectional area or in the more readily fusible portions 30 when the link is traversed by a current. When the current is less than sufficient to cause the fuse to blow the heat is dissipated from the more readily fusible portions by radiation into the air surrounding the link and by conduction along the length of the link into the end terminals where it is there dissipated. When, however, the current is sufficiently great, heat is developed in the more readily fusible portions faster than it can be dissipated and the temperature rises ultimately to the melting point of the metal and the circuit is thereupon interrupted. If the current is moderate the interruption is effected with little melting of the link. If the current is high, however, a strong arc is set up between the separated portions of the link and much of the link is melted and vaporized by the heat of the arc so that the link is burned or consumed a considerable distance from the initial point of separation. The time required for the more readily fusible portions to melt depends upon the amount of heat that can be absorbed by the more readily fusible portions and can be conducted lengthwise of the link. Since the cross section of the more readily fusible portion is small the amount of heat that can be absorbed thereby is insignificant. The conduction of heat lengthwise of the fuse link is slow due to the cross-sectional dimensions of the body of the link, the relatively long distance from the more readily fusible portion to the terminals, and to the poor heat conducting property of the link metal. Hence the fuse link, per se, and as illustrated in Figs. 3 and 8, will blow shortly after the application of a moderate excessive current, say 100% overload, and will blow almost instantly upon the application of a greatly excessive current. In accordance with the present invention the delaying of the blowing of the fuse link on moderate overloads is provided by abstracting heat directly from the more readily fusible portions of the link and transversely of the link without the necessity for traveling lengthwise of the link, or into the body of the link, by the application of heat absorbent masses directly to the more readily fusible portions. In the construction of the link illustrated in Figs. 1 through 5 and 10, the heat absorbent masses comprise plates 32 in the form of circular discs that are applied against the opposite faces of the fuse link and in intimate heat conducting relation with the readily fusible portions 30, the plates being secured to the link in any suitable manner as by a rivet 34 that is passed centrally therethrough and through the middle of the opening 28, and the opening 28 preferably although not necessarily being freely vented to the interior of the fuse casing conveniently by means of a slot or channel 36 that is formed in an inner face of one of the discs and extends from the rivet 34 to the outer periphery although,

since the discs are identical, it is convenient to have a slot 36 in each disc. The discs have a diameter that is about equal to the width of the fuse link at the more readily fusible portions thereof, no advantage being gained in having the discs much larger than this in diameter and the effectiveness of the discs being reduced if they do not engage as much of the available surface area of the more readily fusible portions as is practicable. The discs are relatively thick as compared with the thickness of the fuse link and have large mass or volume as compared to the mass or volume of the more readily fusible portions 30 of the fuse link and are composed of material having good heat absorbing ability so that the discs can absorb and store within themselves a much greater amount of heat than can be stored within the more readily fusible portions 30 at a temperature up to the melting point of these portions. Preferably although not necessarily the discs are composed of metal and are insulated from the link in some convenient manner, preferably by having an outer insulating portion or skin 40. The disc, for instance, may be composed of iron, or steel or other ferrous alloy, and the insulating surface 40 thereof may be an insulating iron alloy that is an integral part of the disc. If the discs are of iron this insulating alloy can be applied by the so-called "Parkerizing" process and the composition of the insulating skin in this case is said to be an iron manganese phosphate. The discs also can be composed of aluminium and treated to form an integral skin of electrically insulating aluminium oxide thereon. The insulating skins are preferably either good heat conductors or else are so thin that they do not offer deleterious impedance to the flow of heat from the more readily fusible portions of the fuse link into the absorbent masses. The thickness of the insulating skin of both of the examples given is less than one one-thousandth of an inch. Preferably the absorbent masses have a higher specific heat-storage capacity than the material of the fuse link although this is not essential when there is no restrictions to giving the absorbent masses sufficient dimensions to absorb heat from the more readily fusible portions of the fuse link about as rapidly as heat is generated therein and to keep the temperature thereof below a fusing point for a sufficient period of time. With the same thickness and width of heat absorbent plate the length of the plate governs the time of blowing the fuse.

With the type of fuse link illustrated in Figs. 7, 8 and 9, the heat absorbent plates 42, corresponding to the plates 32, are rectangular and are disposed on opposite sides of the link 22a in intimate heat-receiving contact with the portions of the link between the slot 28a and the long side edges of the link. The plates overlie the opening 28a and are secured together by a rivet 44, the opening 28a when desired being ventilated as before by slots or channels 46 in the faces of the plates that abut against the link. The plates 42, other than their shape, can have the same characteristics as have been described in connection with the plates 32. With the type of fuse link illustrated in Figs. 7, 8 and 9, the inclined rectangular opening 28a provides the link with portions 48 that lie adjacent the long sides of the link and are more readily fusible than the body or the unslotted portion of the link and terminate in the portions 30 having the least cross-sectional area and thereby being the most readily

fusible portions of the link. The link, however, ordinarily blows at the portions of least area, especially when the heat absorbent plates 42 are associated therewith.

In the modification illustrated in Fig. 12 the fuse link 22a is provided with generally rectangular heat absorbent plates 50 which are composed throughout of an inherently electrically insulating but heat absorbent material as quartz, fibre and the like, the plates being formed and applied to the fuse link in the manner described and illustrated in connection with Figs. 7, 8 and 9, and held in position by one or more convolutions of a binding material 52 as a band of paper which is wrapped about the plates and the link and has its end adhesively affixed to a part of the band. While the insulating plates 50 have certain advantages, in general metal plates as heretofore described are preferred by reason of their usually greater specific heat-absorbing ability.

With any one of the above constructions, when the fuse is subjected to a greatly excessive overload as a short circuit, the fuse blows almost instantly at the portions of least cross-sectional area or the portions 30, the amount of heat developed by the excessive current being so great that it can not be absorbed by the heat absorbent plates quick enough to materially delay the time of blowing of the fuse. Thus the presence of the plates does not noticeably change the short-circuit performance of the fuse link without the plates. When, however, the fuse link is subjected to a more moderate overload, as say a 100 or 200% overload, the rate of generation of heat in the more readily fusible portions of the link is relatively so slow that the heat can be absorbed by the plates about as soon as it is generated, so that the temperature rise and fusing of the more readily fusible portions are materially and advantageously retarded. The heat absorbing plates are composed of a material that is relatively infusible as compared with the material of the fuse link so that upon the blowing of the fuse the plates do not become volatilized and add vapors to the fuse vapor, a feature that is of marked advantage in keeping down the internal pressures resulting from operation under severe overloads. It is found that by the use of heat absorbent plates the entire fuse link can be thinner than without the plates. This is an important feature as there is thus less material in the fuse link that can be consumed by the arc and hence the internal pressure developed by the fuse upon interruption is less than is developed by the thicker fuse without the heat absorbent plates.

Since the heat absorbent plates are in close contact with the fusible element they provide between them a narrow groove or slot in which the circuit interrupting arc is formed when the fuse melts. Due to the narrow dimension of the slot the arc is in close relation with the heat absorbent plates and thus has a tendency to be extinguished more rapidly than if the plates were absent; and the arc heats up the air in the opening of the fuse so that the expanding air tends to blow the arc outwardly from the slot thereby assisting in extinguishing the arc. When the plates are composed of iron or other magnetic material the plates tend to act magnetically on the arc to move it inwardly of the opening, thereby tending to hold the arc in position against the outwardly flowing blast of air and hence further aiding in the rapid extinguishment of the arc and the reduction of generation

of arc gases and elevated pressures within the enclosing casing. The effect of the air blast is not materially diminished by the presence of the ventilating ducts or channels 36 and 46 as these channels can be small in cross-sectional area to offer material resistance to a sudden expulsion of gas therethrough although freely venting the fuse opening under normal current carrying conditions of the fuse element. The ventilating channels, however, are not necessary so far as the action of the heat absorbent plates is concerned and can be eliminated when desired.

I claim:

1. An electric fuse comprising a fusible element having a body portion and a more readily fusible portion, and means to abstract heat directly from said more readily fusible portion comprising a heat absorbent member that lies alongside said more readily fusible portion and in heat absorbing relation therewith, and thin electrically insulating means interposed between said member and said more readily fusible portion.
2. An electric fuse comprising a fusible element having a body portion and a more readily fusible portion, and means to abstract heat from said more readily fusible portion comprising a heat absorbent metal member which lies close to said more readily fusible portion and is in heat receiving relation therewith, and an electrically insulating member interposed between said metal member and said readily fusible portion.
3. An electric fuse comprising an enclosing casing having terminals at the ends thereof, a flat fusible strip located within said casing having its ends connected with said terminals and an intermediate more readily fusible portion of reduced cross-sectional area, a heat absorbing metal member disposed against the flat face of said strip and in contact with said more readily fusible portion, and means insulating said member from the circuit of said fuse strip.
4. An electric fuse comprising a fusible element having a more readily fusible portion, and means to abstract heat directly from said more readily fusible portion comprising a heat absorbing plate that has means insulating it from the circuit of said fusible element and is disposed in heat absorbing relation with said more readily fusible portion.
5. An electric fuse comprising a fusible element having a more readily fusible portion and a heat absorbent metal plate for delaying the heating of said more readily fusible portion closely confronting said more readily fusible portion and a thin electrically insulating member interposed between said plate and said more readily fusible portion.
6. An electric fuse comprising a fusible element having a more readily fusible portion and a heat absorbent plate having an electrically insulating skin disposed in contact with said more readily fusible portion.
7. An electric fuse comprising a fusible element having a more readily fusible portion and a heat absorbent metal plate disposed in contact with said readily fusible portion, said plate having integral therewith an electrically insulating skin that insulates it from said fusible element.
8. An electric fuse comprising a fusible element having a more readily fusible portion and a heat absorbent metal plate disposed in contact with said readily fusible portion, said plate having integral therewith an electrically insulating skin that insulates it from said fusible element, said

skin being composed of a compound of the metal of said plate.

9. An electric fuse comprising a fusible element having a body portion and a more readily fusible portion, and a heat absorbent iron plate disposed in heat conducting but electrically insulated contact with said more readily fusible portion.

10. An electric fuse comprising a fusible element having a body portion and a more readily fusible portion, and a heat absorbent iron plate disposed in contact with said more readily fusible portion, said plate having integral therewith an insulating skin that electrically insulates it from said fusible element.

11. An electric fuse comprising a fusible element having a body portion and a more readily fusible portion, and a heat absorbent iron plate disposed in contact with said more readily fusible portion, said plate having integral therewith an insulating skin that electrically insulates it from said fusible element, said insulating skin comprising an iron manganese phosphate compound.

12. An electric fuse comprising a fusible element having a body portion and a more readily fusible portion of reduced cross-sectional area, and a heat absorbent plate for delaying the heating of said more readily fusible portion that is excluded from the current path through the fusible element and is disposed against said more readily fusible portion and is composed of a relatively infusible metal.

13. An electric fuse comprising an enclosing casing having terminals at the ends thereof, a fusible element having its ends connected to said terminals and having a body portion and an intermediate more readily fusible portion of reduced cross-sectional area, and heat absorbent metallic masses that are excluded from the current through said fusible element and overlie opposite sides of and are in direct heat receiving relation with said more readily fusible portion for delaying the heating thereof, and means securing said masses in the aforesaid relation.

14. An electric fuse comprising a fusible element having a body portion and a more readily fusible portion of reduced cross-sectional area, heat absorbent metallic masses that closely confront opposite sides of and are in direct heat receiving relation with said more readily fusible portion for delaying the heating thereof, and means which electrically insulates said masses from the circuit of said fusible element.

15. An electric fuse comprising a flat strip of fusible material having a more readily fusible portion of reduced cross-sectional area and heat absorbent members that delay the heating of said more readily fusible portion and are excluded from the link circuit disposed on opposite flat sides of said strip and upon said more readily fusible portion.

16. An electric fuse comprising a fusible strip having an opening therethrough which provides a strip with more readily fusible portions on opposite sides of said opening, and heat absorbent plates disposed on opposite sides of said strip and against said more readily fusible portions.

17. An electric fuse comprising a fusible strip having an opening therethrough which provides a strip with more readily fusible portions on opposite sides of said opening, heat absorbent plates disposed on opposite sides of said strip and against said more readily fusible portions, and means passed through said opening which secures said plates in the aforesaid relation.

18. An electric fuse comprising a fusible strip

having an opening therethrough which provides a strip with more readily fusible portions on opposite sides of said opening and heat absorbent plates disposed on opposite sides of said strip and against said more readily fusible portions, said plates overlying said opening.

19. An electric fuse comprising a fusible strip having an opening therethrough which provides a strip with more readily fusible portions on opposite sides of said opening, heat absorbent plates disposed on opposite sides of said strip and against said more readily fusible portions, said plates overlying said opening, and means for ventilating said opening.

20. An electric fuse comprising a fusible strip having an opening therethrough which provides a strip with more readily fusible portions on opposite sides of said opening, heat absorbent plates disposed on opposite sides of said strip and against said more readily fusible portions, said plates overlying said opening, and means for ventilating said opening comprising a channel formed in the inner face of one of said plates which extends from an edge thereof and opens into said opening.

21. An electric fuse comprising a fusible strip having an opening therethrough which provides the strip with more readily fusible portions on opposite sides of said opening, and heat absorbent means which are secured upon opposite faces of said strip and upon said more readily fusible portions and overlie said opening and are excluded from the current path of said strip.

22. An electric fuse comprising a fusible strip having an opening therethrough which provides the strip with more readily fusible portions on opposite sides of said opening, heat absorbent plates which are secured upon opposite faces of said strip and upon said more readily fusible portions and overlie said opening, and means passed through said opening and securing said plates in the aforesaid relation.

23. An electric fuse comprising an enclosing casing having terminals, a fusible strip having its ends connected with said terminals and having an opening therethrough intermediate its ends which provides the strip with more readily fusible portions on opposite sides of said opening, and heat absorbent plates which are secured upon opposite faces of said strip and upon said more readily fusible portions and overlie said opening and end parts of said strip at said opening, said plates being composed of metal and being excluded from the circuit of said strip.

24. An electric fuse comprising a fusible strip having an opening therethrough which provides the strip with more readily fusible portions on opposite sides of said opening, and heat absorbent plates which are secured upon opposite faces of said strip and upon said more readily fusible portions and overlie said opening, said plates being composed of relatively infusible metal and being excluded from the circuit of said strip.

25. An electric fuse comprising a fusible strip having an opening therethrough which provides the strip with more readily fusible portions on opposite sides of said opening, and heat absorbent plates which are secured upon opposite faces of said strip and upon said more readily fusible portions and overlie said opening, said plates being composed of metal and having means which electrically insulates them from said strip.

26. An electric fuse comprising a fusible strip having an opening therethrough which provides the strip with more readily fusible portions on

opposite sides of said opening, and heat absorbent plates which are secured upon opposite faces of said strip and upon said more readily fusible portions and overlie said opening, said plates being composed of metal and having integrally therewith an electrically insulating skin composed of a compound of the metal, which skin electrically insulates said plates from said strip.

27. An electric fuse comprising a flat fusible strip having an opening therethrough which provides the strip with more readily fusible portions on opposite sides of said opening, and heat absorbent plates which are disposed on opposite sides of said strip and are in heat absorbing contact with said more readily fusible portions, said plates being composed of a material that is relatively infusible with respect to the fuse link and the plates overlying only the region of said fuse link in the immediate vicinity of said more readily fusible portions and said opening.

28. An electric fuse comprising a flat thin fusible strip having an opening therethrough which defines more readily fusible portions on opposite sides of the opening, and plates that are electrically insulated from the circuit of the fuse and are disposed on opposite sides thereof and overlie said opening, the more readily fusible portions of said strip being located between said plates and the edges of said more readily fusible portions being exposed at the said edges of said plates.

29. An electric fuse comprising a flat thin fusible strip having an opening therethrough which defines more readily fusible portions on opposite sides of the opening, and plates that are electrically insulated from the circuit of the fuse and are disposed on opposite sides thereof and overlie said opening, the more readily fusible portions of said strip being located between said plates and the edges of said more readily fusible portions being exposed at the said edges of said plates, said plates being composed of magnetic material.

30. An electric fuse comprising an enclosing

casing, a fusible strip therein having a body portion and intermediately thereof a more readily fusible portion of reduced cross-sectional area, and a massive heat absorbent plate which closely confronts the surface of said more readily fusible portion and parts of said body portion adjacent said readily fusible portion and is in good heat receiving relation with said readily fusible portion and is excluded from the circuit of said fusible strip.

31. An electric fuse comprising a fusible strip having a body portion provided with an opening therethrough that provides the strip with readily fusible portions on opposite sides of said opening, and a massive heat absorbent plate which is attached to said strip and overlies said opening on all sides thereof and extends therebeyond lengthwise of said strip and closely confronts the surface of said readily fusible portions and is in good heat receiving relation therewith and is excluded from the circuit of said fusible strip.

32. An electric fuse comprising an enclosing casing having end terminals, and a flat fusible strip therein having its ends connected with said terminals and having intermediate its ends an opening therethrough which provides the strip with more readily fusible portions of reduced cross-sectional area on opposite sides of said opening, and heat absorbent means which closely confronts said more readily fusible portions and the strip adjacent thereto and overlies said opening and abstracts heat from said more readily fusible portions sufficiently to delay the fusing thereof when they are traversed by moderate overload currents.

33. An electric fuse comprising a flat fusible strip having end terminals and a readily fusible intermediate portion, and interconnected plates which closely confront and enclose said readily fusible portion, the space between said plates being open at least at one edge of said fusible strip.

MORRIS B. WOOD.