July 10, 1951 K. W. SWAIN 2,560,138

RENEWABLE FUSE

Filed Jan. 29, 1948

Fig. 1.

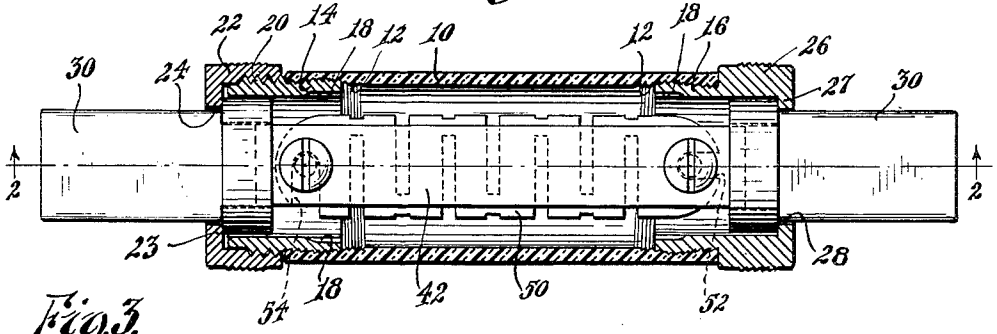


Fig. 3.

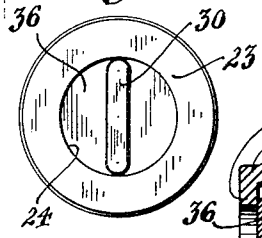
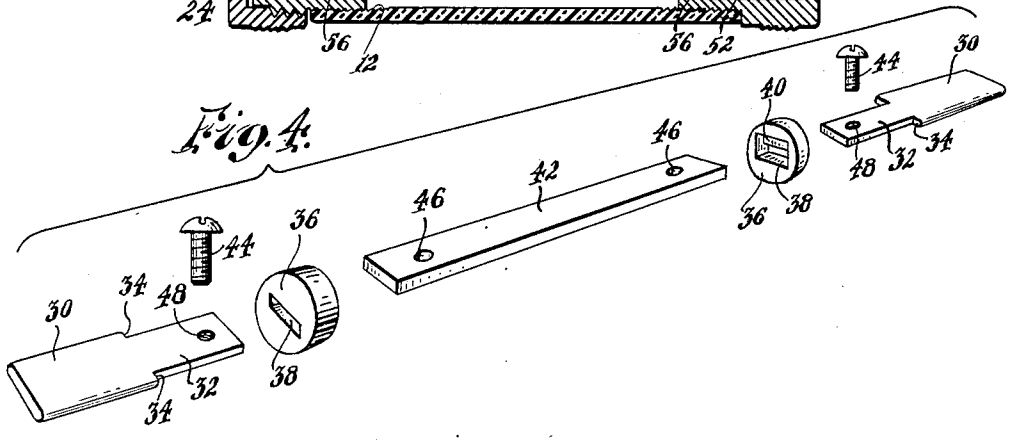


Fig. 2.

Fig. 4.



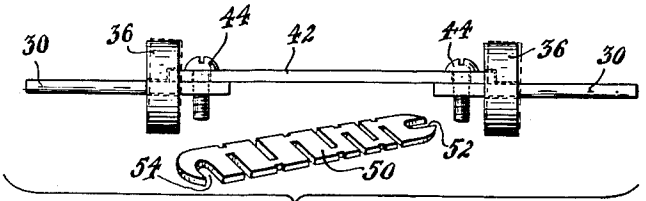


Fig. 5.

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RENEWABLE FUSE

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12 Claims. (Cl. 200—131)

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This invention relates to improvements in renewable fuses of the knife blade cartridge type. More particularly it provides improvements whereby substantial savings may be effected in the costs of manufacture and initial assembly of such fuses and which facilitate the removal therefrom of blown or otherwise defective fuse links and substitution therein of new links. Also, the improved structure results in fuses which operate several degrees cooler than the available comparable fuses of the same rated capacity under similar service conditions, and which provide longer time delay on moderate overload.

It is among the objects of the invention to provide renewable cartridge fuses of the blade-terminal type wherein the removable link-carrying unit comprises a minimum of parts which quickly may be assembled into a rigid unit on which a fuse link may be mounted without disturbing the rigidity of the unit.

Another object is to provide renewable knife blade cartridge fuses having a removable link-carrying unit comprising a minimum number of parts and having its opposite end portions identical.

A further object is to provide a renewable knife blade cartridge fuse whose removable link-carrying unit is identical in structure at each end and is insertible in its casing with either end of the unit constituting the leading end when the unit is being inserted through an end of the casing.

Yet another object is to provide a renewable knife blade cartridge fuse whose removable link-carrying unit has a relatively massive heat-conducting member loosely mounted on each end portion of the unit for self-adjusting clamping coaction with end elements of the fuse casing.

Still another object is to provide a renewable knife blade fuse wherein relatively massive heat-conducting members coact with end elements of the fuse casing to close the opposite ends of the casing and wherein vent passages having substantial surface areas for cooling extend directly through the said massive members to atmosphere.

A yet further object is to provide a renewable knife blade fuse wherein relatively massive heat-absorbing members are mounted on the knife blade elements at opposite ends of the fuse casing and coact with end elements of the casing to close the opposite ends thereof, each said heat-absorbing member being adapted to quickly absorb considerable amounts of heat incident to a fusing of a fusible element of the fuse, and each having vent passages leading directly through it

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to atmosphere, with substantial areas of vent passage walls for cooling the venting gases.

Another object is to provide a renewable knife blade fuse having a minimum number of parts which may be readily and economically assembled to produce a fuse having superior time delay and low-temperature operating characteristics.

It is, moreover, my purpose and object generally to improve the structure and operation of knife blade cartridge fuses and especially such fuses of the renewable type.

In the accompanying drawing:

Fig. 1 is a side elevation of a renewable knife blade fuse embodying features of the invention, the casing elements being in medial cross-section;

Fig. 2 is a cross-sectional view on line 2—2 of Fig. 1;

Fig. 3 is an end elevation of the fuse of Figs. 1 and 2;

Fig. 4 is an exploded perspective view of the removable link-carrying unit of the fuse of Figs. 1 and 2; and

Fig. 5 is a side elevation of the assembled link-carrying unit, with the fuse link shown in separated relation.

Referring to the drawing, the tubular casing member 10 may be made of vulcanized fibre or other suitable insulating material, each end portion of the tube being interiorly threaded at 12 for receiving one of the exteriorly threaded metal ferrules 14, 16, one ferrule being screwed into one end of the tube and one into the other end, and both being permanently secured against removal from the tube as by having the metal deformed outwardly at 18 into the tube walls at one or more locations around the walls.

At least one of the ferrules 14, 16, herein shown as the ferrule 14, is in the form of a sleeve which has substantial projection out of the insulating tube and whose projecting portion is provided exteriorly with the screw threads 20 which are substantially larger than the threads within the tube, so that an end cap 22, with relatively large diameter central opening 24 therethrough, may be screwed on the ferrule 14. Both end ferrules may be the same, with an end cap screwed thereon, but I prefer to form the end cap 26 integral with ferrule 16 so that it becomes permanently fixed on the end of the tube when the ferrule 16 is secured. However, the end cap 26 has a relatively large diameter central opening 28 therethrough similar to that in end cap 22 and the outward appearance of the two end caps on the tube is substantially the same.

The removable unit of the fuse assembly com-

prises two similar terminal blades 30, each having its inner portion 32 reduced in width to provide the oppositely disposed inwardly facing shoulders 34. A relatively massive disk 36 is mounted on the reduced portion 32 of each blade 30, each disk having a slot 38 therethrough for slidably receiving the portion 32 of a blade, so that the disk may be slipped on the portion 32 and be seated against the shoulders 34.

A rectangular recess 40 is formed in the inner face of each disk 36, along one side of the reduced portion 32 of a blade 30, with said portion 32 constituting one wall of the recess, and a stiff bar 42 of insulation material has its opposite end portions slidably and non-rotatably engaging in said recesses of the oppositely disposed disks 36, with a flat surface of the bar engaging flatwise against the reduced portion 32 of each blade so that each end portion of bar 42 may be effectively and securely clamped to the adjacent portion 32 by a single screw 44 passed loosely through a hole 46 in the bar and screwed into a threaded hole 48 in the portion 32, with each screw 44 having substantial threaded extent beyond the portion 32.

In assembling these parts, starting at one end, one of the disks 36 is slipped on the reduced portion 32 of one of the blades 30, and one end of bar 42 is inserted in recess 40 in the disk so as to rest flatwise against the reduced portion 32 of the blade, after which a screw 44 is inserted through hole 46 in the bar and screwed into threaded hole 48 in blade portion 32 until the bar 42 and portion 32 are clamped securely together. The other end is assembled in the same manner to provide an extremely strong and rigid unit as shown in Fig. 5, which is ready for convenient mounting thereon of the fuse link 50.

The fuse link 50 may be of any conventional or special design and is shown provided at one end with a customary notch 52 extending longitudinally of the link inward from the link end, whereby this end of the link may be engaged around the threaded projecting portion of one of the screws 44. The other end of the link has a notch 54 extending laterally inward from one side edge, so that this end may be swung into engagement with its screw 44, with the first mentioned screw serving as a pivot. The opposite ends of the link then may be secured in place by means of the nuts 56, one being screwed on each screw 44, preferably with a washer 58 and locking spring 60 intervening between the fuse link and the nut on each screw.

It will be apparent from the foregoing description, in connection with the drawing, that both ends of the link supporting removable unit are precisely the same, as best seen in Fig. 5. Also, it will be apparent from an examination of Figs. 1 and 2 that the disks 36 have exterior diameter less than the interior diameter of the ferrules 14, 16, but only slightly less. Hence, with a casing as illustrated in Figs. 1 and 2, either end of the removable unit may be inserted first through the end of the casing which is to the left in the drawing, assuming that end cap 22 has been removed. The unit will be inserted until the leading disk 36 engages the annular vertically disposed portion 27 of end cap 26, following which the end cap 22 may be screwed on the ferrule 14 with its annular vertically disposed portion 23 engaging the adjacent disk 36. Tightening of cap 22 puts the interior unit under endwise compression between the annular vertically disposed portions 27 and 23 of the end caps, with the disks

36 clamped tight against the opposite ends of the bar 42.

It is a feature of importance that each disk 36 has appreciable looseness on the blade portions 32 after the removable unit has been assembled as in Fig. 5, and prior to clamping of the unit within a casing. Actually appreciable clearance is provided between the blade portions 32 and the walls of the disk slots 38 and between the end portions of bar 42 and the walls of the disk recesses 40, excepting that wall of each recess 40 which is provided by a blade portion 32 and against which the end portions of the bar 42 are tightly clamped by screws 44. Hence, in Fig. 5, each disk 36 can be tilted slightly as indicated by the dotted lines in Fig. 5. As a result, when the removable unit is being clamped within a casing, the disks are self-adjusting to an appreciable extent to overcome minor departures from precision dimensioning of parts.

Referring to this assembled unit of Fig. 5, and to the exploded representation of its elements as represented in Fig. 4, it will be apparent that each of the relatively thick disks 36 is slidably mounted on a knife blade but is positively locked against rotation thereon, and that each disk slidably engages over an end of the insulating bar 42, whose ends extend into the disk recesses 38. Hence, each end of bar 42 is positively locked by a disk 36 against relative rotation of a knife-blade and the bar about the axis of a clamping screw 44. This function of inter-engagement of the ends of the insulating bar in the recesses of the disks to prevent relative rotation of the blades and the bar about the axes of the screws 44 definitely avoids any mis-alignment of the blades and bar both at the time of initial assembly and when the fuse, in service, is subjected to stresses which tend to cause mis-alignment of the blades and the bar, such as stresses incident to expansion of parts when a fuse has been operating at elevated temperatures. In this connection, it is important to note that the dimensions of the knife blades, disks and bars may vary quite appreciably with temperature changes, and the dimensions of the bar 42 in particular may vary considerably with changes in moisture content. However, the variations of the knife blades and bar primarily affect their lengths, the width dimensions being so relatively small that any width variations are inconsequential. Hence, the width dimensions of the bar, and of the disk recesses, and of the portions 32 of the knife blades, may be controlled within rather close limits to be substantially uniform in each fuse regardless of temperature and moisture conditions. The bar 42, on the other hand, is assembled with its ends located within the disk recesses but short of the bottoms of the recesses when the disks are against the knife blade shoulders 34, so that variations in its length are accommodated within the recesses. However, during mounting of the inner unit in a fuse casing, each disk slides on its knife blade into contact with the adjacent end of the bar, they being thus self-adjusting for endwise clamping of the bar regardless of its length variations. However, the described locked alignment of blades and bar is maintained whether the bar extends little or much into the disk recesses.

Also, the appreciable cracks between the blade portions 32 and the disks 36 thereon constitute venting passages through which hot pressure gases can escape to atmosphere between the relatively large-area cooling surfaces of the disks and

blades, while other gases escape between the large-area peripheral surfaces of the disks and the adjacent ferrules and thence between the annular vertically disposed portions 23 and 27 of the end caps and the engaged adjacent marginal portions of the disks, these gases too being cooled to safe discharge temperatures.

It has been mentioned previously herein that my improved cartridge fuses operate several degrees cooler than prior comparable fuses under comparable service conditions. This cooler operation no doubt results in part from the more effective venting both through and around the disks 36. But the relatively massive character of the disks plays an important part in the dissipation of heat generated under conditions of normal loads and moderate overloads. Each disk constitutes a substantial heat-conducting mass which absorbs considerable amounts of heat and which has relatively large surface areas for dissipating heat directly to atmosphere at the large end openings 24 in the caps and indirectly to atmosphere through the end caps and ferrules. Also, the substantial heat-absorbing nature of the disks 36 increases time delay on moderate overloads. On short circuits, and the like, the massive disks 36 act as heat absorbers which substantially reduce the temperature of the hot gases prior to their venting and which condense the molten products of the fusing.

The disks 36 may be made of any good heat-conducting material having the required rigidity of mass. I have found that powdered copper molded according to known procedures provides excellent heat-absorbing and heat-dissipating disks 36 which may be economically produced with the required accuracy of dimension, and with desired uniformly smooth surfaces. As previously explained, when these disks are mounted on the unit of Fig. 5, their appreciable looseness makes it unnecessary to have that exactness of precision dimensioning of the casing parts and of the insulating bar which otherwise would be essential.

I claim as my invention:

1. In a knife blade cartridge fuse having a tubular casing, a unit insertible in and removable from the casing, comprising a pair of knife blade terminals, means for mounting a fusible element in electrical connection with said terminals, a relatively thick circular mass of heat-conducting material slidably and non-rotatably mounted on each said terminal, abutment means on each said terminal limiting movement of a said mass in outward direction along the terminal, a stiff bar of insulating material rigidly inter-connecting said terminals, each end of said bar having angular cross-section, walls defining an angular recess in each said mass in one of which recesses each angular end of said bar is engaged limiting movement of said masses in directions inward along said terminals and positively locking said circular masses and the bar against relative rotation., said circular masses of heat-conducting material each having appreciable looseness on its terminal and between the said limiting abutment on the terminal and the adjacent end of said bar whereby said masses can be tilted slightly in different directions on their terminals, and substantial venting passages leading between relatively large-area cooling surfaces of the masses and terminals directly through said masses, and means on the opposite ends of the said casing for engaging only annular marginal portions of said circular masses for clamping them against the opposite ends of said stiff bar.

2. In a renewable knife blade cartridge fuse, a fuse link mounting unit comprising a pair of knife blade terminals, means for mounting a fuse link on the unit in electrical connection with said terminals, a relatively massive disk slidably mounted on each terminal, each said disk having a slot therethrough whereby it may be slipped on a terminal with appreciable looseness between the terminal and the walls of the slot, a relatively stiff insulating bar extending between and secured to the inner end portions of said terminals inward of said massive disks on the terminals, each end portion of the bar having angular cross-section, and each said disk having an angular recess in its inner face for engaging with appreciable looseness over the adjacent angular end of said bar for positively locking the disks and bar against any substantial relative rotation, and means on each said terminal outward of the disk thereon restricting outward movement of the disk and providing for only limited movement of the disks between said restricting means and the ends of said bar, whereby said disks are self-adjusting when said unit is mounted in a fuse casing with said slots in the disk providing venting passages leading directly through the disks between the slot walls and the adjacent surfaces of the terminals.

3. In a renewable knife blade cartridge fuse having a tubular insulating casing, a fuse link mounting unit insertible in and removable from the casing, comprising a pair of knife blade terminals, each having an inner end portion of reduced width whereby inwardly facing edge shoulders are provided on each terminal, means for mounting a fuse link on said unit in electrical connection with said inner end portions of the terminals, a massive slotted disk slidably mounted on the reduced portion of each terminal and having appreciable looseness thereon, each said disk having an angular recess in its inner face, a stiff insulating bar extending between said terminals and secured to the inner end portions thereof with each end of the bar angular in cross-section and engaged in a said disk recess whereby the disks and bar are positively locked against relative rotation, and means on the opposite ends of said insulating casing for clamping said disks against the ends of said bar with the disks self-adjusting on said terminals in response to the clamping pressure and with said appreciable looseness of the disks on the terminals providing venting passages leading directly through said disks to atmosphere.

4. In a knife blade fuse having a tubular casing, a unit insertible and removable through an end of the casing comprising a knife blade terminal at each end of the unit, means for mounting a fusible element on said unit in electrical connection with said terminals, a relatively stiff insulating member extending between the terminals and secured to the inner end portions thereof for maintaining them in predetermined spaced relation and against relative rotation, a generally circular body slidably mounted on each terminal and having generally parallel outer and inner faces, abutment means on each terminal limiting outward movement of a said body along a said terminal, each said body having a recess in its inner face, and said insulating member having its end portions slidably and non-rotatably engaged in said recesses and constituting the only means limiting inward movement of said

bodies along said terminals and positively locking said bodies and said insulating member against relative rotation; and annular means on each end of said casing for engaging the margin of the outer face of a said body, said annular means at at least one end of the casing being operable to effect a clamping of said bodies against the ends of said insulating member, with said annular means and said bodies coacting to close the opposite ends of said tubular casing.

5. In a knife blade fuse having a casing and having a pair of knife blade terminals projecting out of the casing at the opposite ends thereof each of said terminals having abutment means thereon between its ends, means for mounting a fuse link in electrical connection with said terminals, a slotted disk mounted loosely on the inner end portion of each terminal with said abutment means limiting outward movement of the disks along the terminals, an insulating member connected to and extending between the inner end portions of said terminals, the opposite ends of said insulating member being in the path of inward movements of said disks and constituting the only means limiting inward movements of said disks along said terminals, and means on said casing for effecting movements of said disks relative to said terminals into clamping engagement with the opposite ends of said insulating member.

6. In a knife blade fuse having a tubular insulating casing, a unit insertible in and removable from the casing comprising a pair of knife blade terminals each having abutment means thereon between its ends, means for mounting a fuse link on said unit in electrical connection with the terminals, a slotted disk loosely arranged on the inner end portion of each terminal with said abutment means on the terminals limiting outward movement of the disks along the terminals, the two said disks being identical, an insulating member connected to and extending between the inner end portions of said terminals, each end of the insulating member constituting an abutment between which and a said terminal abutment means each said slotted disk can move appreciably in directions along its terminal, said disks having dimensions whereby either end of said unit may be inserted through an end of said casing, and annular means on each end of the casing for engaging outer portions of said disks to draw them relatively toward each other with said disks moving relative to their respective terminals into clamping engagement with the opposite ends of said insulating member and with said terminals extending through the slots in the disks with appreciable clearance.

7. In a knife blade fuse having a tubular insulating casing, a unit insertible in and removable from the casing comprising a pair of knife blade terminals each having abutment means thereon between its ends, means for mounting a fuse link on said unit in electrical connection with the terminals, a slotted disk loosely arranged on the inner end portion of each terminal with said abutment means on the terminals limiting outward movement of the disks along the terminals, an insulating bar connected to and extending between the inner end portions of said terminals, there being a recess in the inner face of each said disk and the end portions of said bar being slidably and non-rotatably engaged in said recesses of the disks limiting outward movement of the disks along the terminals and positively locking the disks and bar against relative rotation;

annular abutment means on one end of said casing for engaging the margin of the outer face of one of said disks, and removable annular means on the other end of the casing for engaging the margin of the outer face of the other one of said disks, said removable annular means being operable along the casing to urge said disks relatively toward each other with the said insulating bar constituting the sole means limiting their relative movement toward each other.

8. In a knife blade fuse having a tubular insulating casing, a fuse link mounting unit insertible in and removable from the casing and having its opposite ends substantially identical so that either end of the unit may be inserted first through an end of the casing, said unit comprising a pair of knife blade terminals, an insulating bar connected to and extending between the inner end portions of the terminals, and a relatively thick and massive disk on each terminal, each said disk having a slot therethrough for passage of a said terminal through the disk, and each having a recess in its inner face for reception of an end portion of said insulating bar, the walls of said recesses and the end portions of said bar coacting to positively lock the said disks and bar against relative rotation, and means on the ends of said casing for engaging and clamping said disks against the opposite ends of said insulating bar.

9. In a fuse having a tubular casing and a terminal projecting generally axially at each end of the casing, means for mounting a fuse link in electrical connection with the said terminals, means at each end of the casing for closing the ends of the casing around the terminals and for providing uniform venting passages between relatively large-area heat-absorbing surfaces, said means at each end of the casing comprising a thick disk having a smooth peripheral surface of relatively large area fitting within said casing with a predetermined precise clearance whereby a relatively long annular vent passage is provided along the peripheral surface of the disk, each said disk having a slot therein through which a said terminal extends with appreciable clearance whereby venting cracks extend directly through the disks, abutment means on each terminal limiting outward movements of the disks along the terminals, an insulating bar connecting the inner ends of the terminals and having its opposite ends constituting the only means limiting inward movements of the disks along the terminals, and an annular depending flange on the casing engaging only a narrow marginal area of each said disk at one end of a said annular vent passage whereby pressure gases can escape from said passage between said flange and the engaged margin of the disk and also directly through the disks at said venting cracks.

10. In a knife blade cartridge fuse having a tubular casing, a unit insertible in and removable from the casing, comprising a pair of knife blade terminals, each having inwardly facing abutment means thereon, means for mounting a fuse link on the inner end portions of the terminals, a stiff bar of insulating material extending between and connected to the inner end portions of said terminals, each end of the bar being spaced substantially inward from said abutment means on the terminal to which it is connected, a relatively massive heat-absorbing member slidably and non-rotatably mounted on each terminal between said abutment means on the terminal and the adjacent end of said insulating

bar, said adjacent end of the insulating bar constituting the only means limiting inward movement of the heat-absorbing member along the terminal, whereby said heat-absorbing members are self-adjusting on their respective terminals for accommodating dimensional variations in the associated parts, said heat-absorbing members having diameter less than the internal diameter of the casing whereby either end of the insertible unit may be the leading end when inserting the unit in its casing, and means on the opposite ends of the casing for coacting with said heat-absorbing members to close the opposite ends of the casing with said heat-absorbing members presenting relatively large heat-absorbing surface areas in positions to be directly contacted by the hot gaseous products of a fusing within the casing.

11. In a knife blade cartridge fuse having a tubular casing, a unit insertible in and removable from the casing, comprising a pair of knife blade terminals, means for securing a fuse link on the inner ends of the terminals, a generally circular solid mass slidably and non-rotatably mounted on each said terminal, means on each said terminal limiting movement of a said mass in direction toward the outer end of the terminal on which it is mounted, each said mass having a recess therein, a bar of insulating material extending between said terminals and having its opposite ends engaged in said recesses of the solid masses, means securing said bar to each said terminal at locations spaced inward from the said engaged ends of the bar, said securing means and said recess walls of the solid masses coacting to maintain the terminals and the bar approximately in a predetermined alignment.

12. In a knife blade cartridge fuse having a tubular casing, a unit insertible in and removable from the casing, comprising a pair of knife blade terminals, means for securing a fuse link on the inner ends of the terminals, a generally circular solid mass slidably and non-rotatably mounted on each said terminal, a stiff bar of insulating material extending between said terminals, means inward from each end of said bar for securing the bar to the respective terminals, each said solid mass on the terminals having a recess therein, and each end of said bar being slidably engaged in a said recess, whereby the walls of said recesses positively lock the said terminal and bar againt relative rotation about said securing means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,861,744	Johnson	June 7, 1932
1,874,948	Fogal	Aug. 30, 1932
1,919,273	Conant	July 25, 1933
1,928,997	Kirkman	Oct. 3, 1933
1,991,876	Wood	Feb. 19, 1935
2,036,177	La Mar	Mar. 31, 1936
2,195,147	Griffith	Mar. 26, 1940
2,198,663	Floten	Apr. 30, 1940
2,280,565	Wood	Apr. 21, 1942
2,293,953	Taylor	Aug. 25, 1942