Oct. 5, 1954 P. C. HITCHCOCK 2,691,083

ONE TIME FUSE

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Fig. 1.

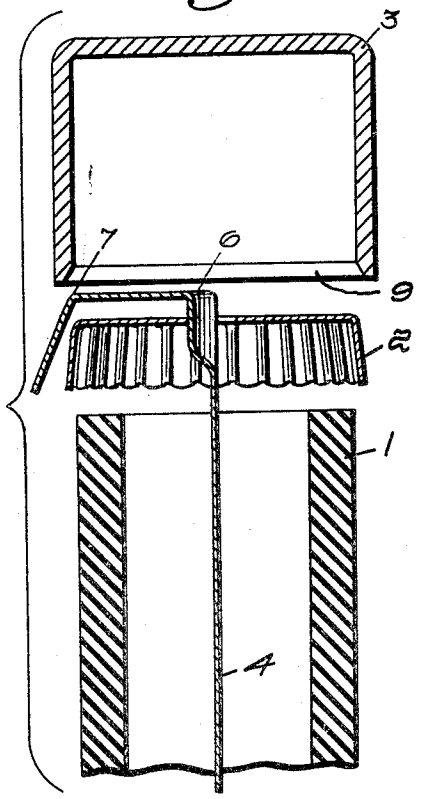


Fig. 2.

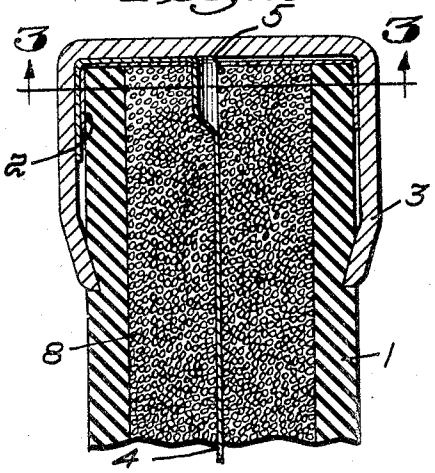


Fig. 4.

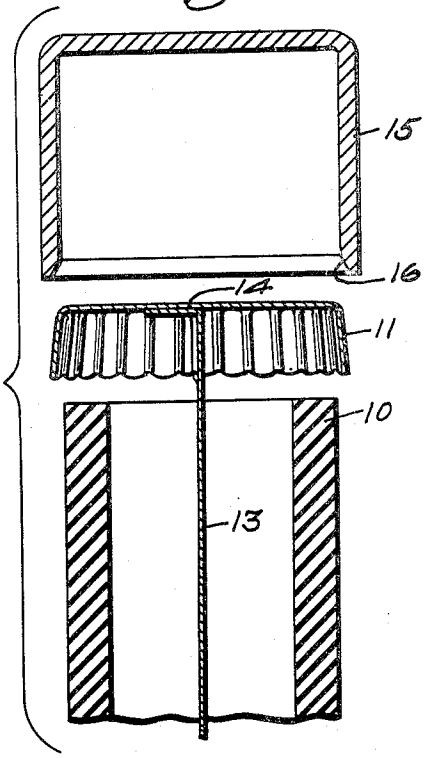
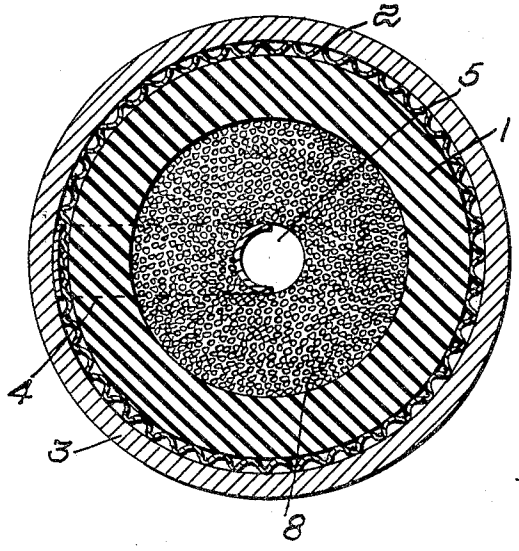


Fig. 3.



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Fig. 5.

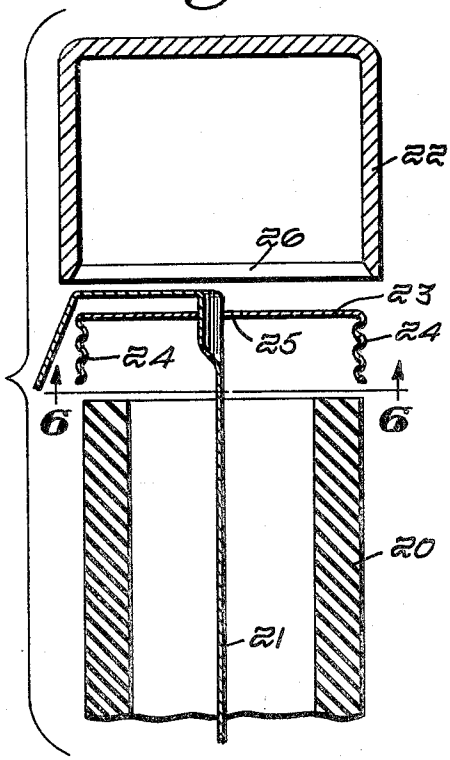


Fig. 6.

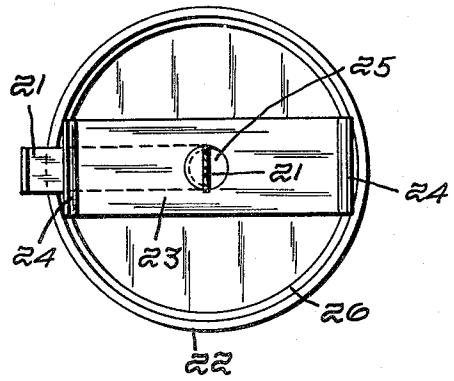


Fig. 7.

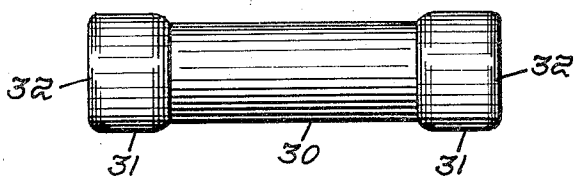
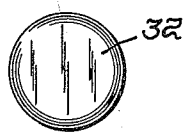


Fig. 8.



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2,691,083

ONE TIME FUSE

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Application April 6, 1953, Serial No. 347,036

11 Claims. (Cl. 200—132)

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This invention relates generally to protective devices, and more particularly to electric fuses for the protection of electric circuits against excessive currents.

A fuse structure related to my present invention is disclosed in my co-pending patent application Ser. No. 240,553, filed August 16, 1951 for Electric Fuses, and it is one object of my present invention to improve the structure disclosed in my above patent application.

Another object of my invention is to provide a cartridge fuse of the non-vented type which is less expensive to manufacture than the fuses of this type which were known heretofore.

In non-renewable or one time cartridge fuses the connections between the terminal caps and the fuse link are generally soldered, brazed or welded to insure low $I^2.R$ losses and permanence. Soldering, brazing and welding are, however, relatively expensive and time consuming operations. It is, therefore, another object of my invention to provide a non-renewable or one time cartridge fuse having resilient clamping connections between the terminal caps and the fuse link which connections have low $I^2.R$ losses and a high degree of permanence.

Still another object of my invention is to provide a cartridge fuse of the non-vented type having means for establishing conductive connections between the terminal caps of the fuse and the fuse link at points of the fuse structure which are situated on the inside thereof and which points are completely surrounded and protected by the terminal caps.

Another object of the invention is to provide a cartridge fuse wherein a line or point contact is established between the fuse link and the terminal caps or ferrules of the fuse.

Further objects and advantages of this invention will become apparent as the following description proceeds, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

For a better understanding of this invention reference may be had to the accompanying drawing which illustrates several embodiments thereof.

Fig. 1 is an exploded view of the constituent parts of fuse embodying the present invention, the parts being shown in longitudinal sections;

Fig. 2 shows the same parts as Fig. 1 in assembled positions;

Fig. 3 is a section along 3—3 of Fig. 2;

Fig. 4 is a view similar to that of Fig. 1 of another embodiment of the invention;

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Fig. 5 is a view similar to that of Figs. 1 and 4 of a further embodiment of the invention;

Fig. 6 is a section along 6—6 of Fig. 5;

Fig. 7 is a side elevation of a fuse embodying the present invention, and

Fig. 8 is an end view of the structure shown in Fig. 7.

Referring now to Figs. 1 to 3, inclusive, the fuse shown therein comprises a tubular casing 1 made of a suitable insulating material as, for instance, hard fiber or a synthetic-resin-glass-cloth laminate. Both ends of casing 1 are closed by a first pair of caps or link-supports 2 mounted on casing 1. A pair of terminal caps or a second pair of caps 3 is mounted on each end of casing 1. Figs. 1 to 3 show but one end of casing 1, one of both link supports 2 and one of both terminal caps 3 and it will be understood that the structure on the end of casing 1 which has been omitted is identical to the structure at the end of casing 1 that has been shown. Link support 2 consists of highly resilient sheet metal, e. g. Phosphor bronze, and is laterally fluted or corrugated substantially in the fashion of a bottle-cap of the crown cork type. Link-support 2 has substantially the shape of a truncated cone and the lateral parts thereof have a radially outward bending tendency.

The fuse link 4 is arranged within casing 1 coaxially with respect thereto. The link-supports 2 are each provided with an opening or aperture 5 for the passage of the axially outer ends of fuse link 4. Link 4 is preferably made of silver or copper and of the ribbon type. It is bent to channel-shape at the points where it passes through the circular openings or apertures 5 provided in the caps or link-supports 2. The transverse bending of fuse link 4 tends to increase the dimensional stability thereof. The outer ends or terminals of link 4 are bent angularly at two points designated by the reference numerals 6 and 7. The bend at 6 is approximately 90 degrees, whereas the bend at 7 is less than 90 degrees before the parts are assembled (Fig. 1) and approximately 90 degrees after the parts are assembled (Figs. 2 and 3).

Casing 1 is filled with a pulverulent heat absorbing and arc-quenching material 8 such as, for instance, pure quartz sand before all of the caps 2 and 3 are mounted thereon. To facilitate mounting of caps 3 upon caps or link-supports 2 the former are provided with a conical or flaring entrance portion 9.

The first step in the process of assembling the fuse structure consists of inserting fuse link 4 into casing 1. Thereupon one of the two link-

supports 2 is mounted upon casing 1 whereby one end of link 4 is safely centered with regard to casing 1. Thereupon link 4 is bent at the points 6 and 7 substantially as indicated in Fig. 1. The next step consists in mounting more or less loosely a terminal cap 3 upon link-holder 2. Then the entire structure is turned upside down and the pulverulent arc-quenching material 8 is filled into the open end of casing 1. Thereafter the open end of casing 1 is closed by a cap-shaped link-holder 2, link 4 is bent at two points 6 and 7 and a terminal cap 3 is mounted more or less loosely on casing 1 and link-holder 2. Finally the fuse is fed into a crimping machine where the outer or terminal caps 3 are crimped as clearly shown in Fig. 2.

Thus it is possible to achieve permanent low resistance connections between the terminal caps 3 and the link 4 and to maintain the fuse link securedly in a position coaxial with respect to the tubular casing 1 of the fuse without resorting to soldering, welding or brazing operations.

When the axially outer caps 3 are mounted upon the axially inner caps or link-holders 2, the inside surfaces of the former are being resiliently engaged by the lateral fluted portions of the latter. The lateral fluted portions of the axially inner caps or link-supports 2 are being compressed by the axially outer caps 3 and then tend to snap outwardly and rest with considerable pressure against the inner surfaces of the axially outer caps 3. The compression of link-supports 2 is highest at the points thereof where the link 4 is wedged between the link-supports 2 and the axially outer or terminal caps 3. Consequently link 4 is pressed under considerable pressure against the inner surfaces of terminal caps 3, thus insuring a maximum of contact pressure and a minimum of contact resistance.

The link-centering passages 5 in link-supports 2 do not need to be circular to bend the end portions of link 4 to channels having a considerable dimensional stability; this end may be achieved by curvilinear link-centering passages 5 the geometrical configuration of which is other than circular.

Caps or link-holders 2 are made of relatively thin and relatively resilient sheet metal, whereas terminal caps 3 are relatively thick and relatively rigid. The axially outer terminal caps 3 are considerably longer than the axially inner caps or link-holders 2. The shorter the lateral fluted portions or corrugated skirts of link-holders 2, the higher the spring force by which the terminals of fuse link 4 are being pressed against the inner surfaces of terminal caps 3.

In the embodiment of the invention illustrated in Fig. 4 casing 10 is intended to be closed by a link-holder or cap 11 to which a ribbon type fuse link 13 is spot-welded at 14. This spot-weld is located within casing 1 upon complete assembly of the fuse structure and is not subject to the disadvantages of prior art welding connections between a fuse link and a terminal cap. Terminal cap 15 has a conical or flaring entrance portion 16 and is intended to be mounted on cap 11 and casing 1 in a way similar to that shown in Fig. 2. Upon mounting of terminal cap 15 on the axially inner cap 11 the semi-assembled fuse structure is turned upside down and filled with a suitable pulverulent arc-quenching substance, which may either be of the inert or non-gas-evolving type, or of the gas-evolving type, as desired. The end of the casing 10 last to be closed is provided with a pair of superimposed caps of the type shown in Fig. 1 and the link 13 is clamped between these superimposed caps in the fashion illustrated in Figs. 2 and 3.

The structure shown in Figs. 5 and 6 is similar to that shown in Figs. 1 to 3, inclusive, except for the fact that a substantially U-shaped laterally corrugated bracket has been substituted in Figs. 5 and 6 for the corrugated conical link-supporting cap 2 of Figs. 1 to 3.

Referring now to Figs. 5 and 6, reference numeral 20 has been applied to a casing of insulating material in which the link 21 is held in coaxial position by means of a pair of brackets 23 of which only the upper bracket 23 has been shown in Figs. 5 and 6. Brackets 23 are of relatively short length and consist of relatively thin, highly resilient sheet metal, e. g. Phosphor bronze. Each of the above pair of link-supporting brackets 23 is mounted on one of the axially outer ends of casing 20. The lateral portions 24 of brackets 23 are fluted or corrugated, as best shown in Fig. 5, and overlap the outer surface of casing 20 when mounted thereon. Brackets 23 are each provided with a curvilinear perforation 25. Fuse link 21 is threaded through the perforation 25 in each of the two brackets 23 and thereby held in a position substantially coaxially with respect to casing 20. Fuse link 21 is bent to form a channel at the points thereof situated immediately adjacent to perforations 25. The terminal caps 22 have a conical or flaring entrance portion 26 which facilitates the mounting thereof on brackets 23 and casing 20. The terminal caps 22 are of considerably greater length than the corrugated side portions 24 of brackets 23 and cover completely all of brackets 23 upon being mounted upon casing 20. The sheet metal of which terminal caps 22 are made is thicker and more rigid than the sheet metal of which brackets 23 are made. Each bracket 23 is biased radially outwardly by the resiliency or springiness inherent in the material of which it is made.

When all constituent parts of the fuse structure are assembled in the same general fashion indicated in Fig. 2, the axially outer ends or terminals of link 21 are being clamped between the radially outer corrugated surfaces 24 of brackets 23 and the internal cylindrical surfaces of terminal caps 22 on account of the resiliency inherent in the material of which brackets 23 are made.

It will be noted from Figs. 1 to 3, inclusive, that terminal caps 3 have a smaller internal diameter than the largest diameter of link-supporting caps 2 when in non-compressed condition, and that link-supporting caps 2 are compressed by terminal caps 3 to substantially cylindrical shape upon complete assembly of the fuse structure.

In the structure illustrated in Figs. 4 and 5 the terminal caps 22 have a smaller internal diameter than the largest distance between the outer surface of the corrugated or fluted side portions 24 of brackets 23, and brackets 23 are compressed by caps 22 to substantially prismatic shape upon complete assembly of the fuse structure.

It will further be noted that in all embodiments of the invention shown the spacing between the casing and the fuse link is uniform throughout the active length of the latter, thus precluding charring of the casing tending to occur where that spacing is not uniform.

Another important feature of the invention resides in that the axially outer or terminal caps are of the non-perforated type, the current-carry-

ing connections between the fuse link and said caps being made at the inner surface thereof.

As shown in Figs. 7 and 8 the appearance of fuses according to this invention does not materially differ from that of conventional or prior art cartridge fuses, except for the lack of any soldering, brazing or welding connection visible on the outer surfaces of the terminal caps. In Figs. 7 and 8 reference numeral **30** has been applied to designate the insulating casing of the fuse, reference numerals **31** designate the axially outer terminal caps (the axially inner caps or link-holders not being shown in Figs. 7 and 8) and reference numerals **32** designate the axially outer end surfaces of terminal caps **31**. There is no perforation or solder or brazing joint on either of both end surfaces **32**.

It will be understood that, although but a few embodiments of this invention have been shown and described in detail, the invention is not limited thereto and that the illustrated embodiments may be modified or other embodiments made without departing from the spirit and the scope of the invention as set forth in the accompanying claims.

It is claimed:

1. A one time fuse comprising a casing of insulating material, a conductive fuse link arranged within said casing, a pair of link-supports of resilient sheet metal substantially U-shaped in cross-section each arranged at one of the axially outer ends of said casing and overlapping the outer surface thereof, the lateral portions of each of said pair of link-supports being resiliently biased radially outwardly away from the outer surface of said casing, and a pair of metallic terminal caps each mounted on one of the axially outer ends of said casing over one of said pair of link-supports, the inside of each of said pair of terminal caps being resiliently engaged by said lateral portions of one of said pair of link-supports.

2. A one time fuse comprising a casing of insulating material, a pair of link-supports substantially U-shaped in cross-section each arranged at one of the axially outer ends of said casing and overlapping the outer surface thereof, the lateral portions of each of said pair of link-supports being resilient and biased radially outwardly away from the outer surface of said casing, each of said pair of link-supports having a link-centering passage arranged substantially coaxially with respect to said casing, a conductive fuse link arranged within said casing in substantially coaxial relation thereto, each of the axially outer ends of said link passing through said link-centering passage in one of said pair of link-supports and being bent to engage said lateral portions of said one of said pair of link-supports, and a pair of metallic terminal caps each mounted on one of the axially outer ends of said casing over one of said pair of link-supports, the inside of said pair of terminal caps being resiliently engaged by said lateral portions of said pair of link-supports.

3. A one time fuse comprising a casing of insulating material, a pair of sheet-metal link-supports substantially U-shaped in cross-section each arranged at one of the axially outer ends of said casing and overlapping the outer surface thereof, the lateral portions of each of said pair of link-supports being resilient and biased radially outwardly away from the outer surface of said casing, each of said pair of link-supports having a curvilinear link-centering passage arranged substantially coaxially with respect to said casing, a

ribbon type conductive fuse link arranged within said casing in substantially coaxial relation thereto, each of the axially outer ends of said link passing through said link-centering passage in one of said link-supports and being transversally bent into channel-shape by the curvilinear configuration of said link-centering passage, the extremity of each of the axially outer ends of said link being bent to engage said lateral portions of one of said link-supports, and a pair of conductive terminal caps each mounted on one of the axially outer ends of said casing over one of said pair of link-supports, the inside of each of said pair of terminal caps being resiliently engaged by said lateral portions of said pair of link-supports.

4. A one time fuse comprising a tubular casing of insulating material, a conductive fuse link arranged within said casing, a pair of spaced link-supports of relatively resilient sheet metal having fluted lateral portions and intermediate portions for centering said link in a position substantially coaxially with respect to said casing, said pair of link-supports being conductively interconnected by said link and each mounted on one of the ends of said casing, and a pair of conductive terminal caps each mounted over one of said pair of link-supports, said pair of terminal caps being engaged under pressure at the internal surfaces thereof by said fluted lateral portions of said pair of link-supports on account of the resiliency inherent in the sheet-metal of which said pair of link-supports is made.

5. A one time fuse comprising a casing of insulating material, a conductive fuse link within said casing, a first pair of relatively resilient conductive terminal caps of relatively short length conductively interconnected by said fuse link, each of said first pair of terminal caps being mounted on one of the axially outer ends of said casing and overlapping the outer surface thereof, and a second pair of relatively rigid conductive terminal caps of greater length than said first pair of terminal caps, each of said first pair of terminal caps engaging under pressure the internal surface of one of said second pair of terminal caps on account of the resiliency inherent in the material of said first pair of terminal caps.

6. A one time fuse comprising a casing of insulating material, a conductive fuse link within said casing, a pair of spaced link-supporting brackets of relatively short length consisting of relatively thin highly resilient sheet metal, each of said pair of brackets being mounted on one of the axially outer ends of said casing and overlapping the outer surface thereof, a pair of performations one in each of said pair of brackets arranged substantially coaxially with respect to said casing for the passage of said link through each of said pair of brackets, a pair of terminal caps of greater axial length than said pair of brackets consisting of relatively thick and relatively rigid sheet metal, each of said pair of brackets being biased radially outwardly by the resiliency inherent in the material of said pair of brackets, the axially outer ends of said link being clamped between the radially outer surfaces of said pair of brackets and the internal surfaces of said pair of terminal caps and pressed against said internal surfaces by the resiliency inherent in the material of said pair of brackets.

7. A one time fuse comprising a tubular casing of insulating material, a conductive fuse link within said casing, a first pair of relatively resilient radially compressible metallic terminal caps each having substantially the shape of a

truncated cone in non-compressed condition, each of said first pair of terminal caps being mounted on one of the ends of said casing and said first pair of terminal caps being conductively interconnected by said fuse link, a second pair of relatively rigid metallic terminal caps each mounted on one of said first pair of terminal caps and having a smaller internal diameter than the largest diameter of said first pair of terminal caps when in non-compressed condition, said second pair of terminal caps compressing said first pair of terminal caps to substantially cylindrical shape.

8. A one time fuse comprising a casing of insulating material, a conductive fuse link within said casing, a first pair of relatively resilient radially compressible metallic terminal caps each having substantially the shape of a truncated cone in non-compressed condition, each of said first pair of terminal caps being mounted on one of the ends of said casing and provided with a perforation for the passage of said link arranged substantially coaxially with respect to said casing, said link being threaded through said perforation in each of said first pair of terminal caps and bent into engagement with the lateral portion thereof, and a second pair of metallic terminal caps each mounted on one of said first pair of terminal caps and having a smaller internal diameter than the largest diameter of said first pair of terminal caps when in non-compressed condition, said second pair of terminal caps compressing said first pair of terminal caps to substantially cylindrical shape.

9. A one time fuse comprising a casing of insulating material, a conductive fuse link arranged within said casing, a pair of link-holders of relatively resilient sheet metal tending to flex radially outwardly each arranged on one end of said casing and supporting said link in a position substantially coaxially with respect to said casing, at least one of said pair of link-holders being provided with an aperture for the passage of said link, and a pair of terminal caps of relatively rigid sheet metal each mounted on one and tending to be flexibly engaged by one of said pair of link-holders, at least one terminal of said link being clamped between one of said pair of link-holders and one of said pair of terminal caps.

10. A one time fuse comprising a tubular casing of insulating material, a conductive ribbon type fuse link within said casing, a pair of link-holders of relatively resilient sheet metal each arranged on one end of said casing, each of said pair of link-holders having a perforation arranged substantially coaxially with respect to said casing, said link being threaded through said perforation in each of said pair of link holders and twice bent at each terminal portion thereof at substantially right angles in such a manner as to lie substantially flush with the radially outer surfaces of said pair of link-holders, each of said pair of link-holders tending to flex radially outwardly on account of the inherent resiliency thereof, and a pair of non-perforated terminal caps of relatively rigid sheet metal each mounted on one of said pair of link-holders and flexibly engaged on the inside thereof by said one of said pair of link-holders, each said terminal portion of said link being tightly clamped between one of said pair of link-holders and one of said pair of terminal caps.

11. A one time fuse according to claim 10 wherein each of said pair of link-holders is corrugated at the lateral surfaces thereof.

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