No. 720,073. PATENTED FEB. 10, 1903.

N. SCHMITT & J. KRANNICHFELDT.

ELECTRICAL FUSE HEAD AND FUSE.

APPLICATION FILED SEPT. 10, 1900.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

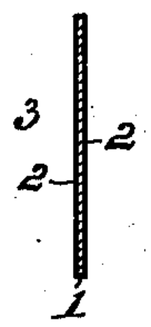


Fig. 2.

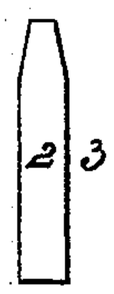


Fig. 3.

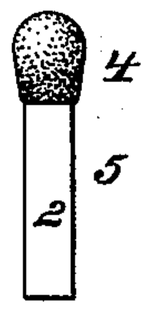


Fig. 4.

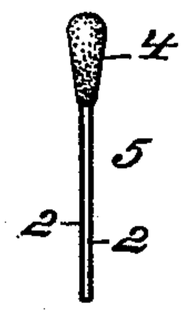


Fig. 5.

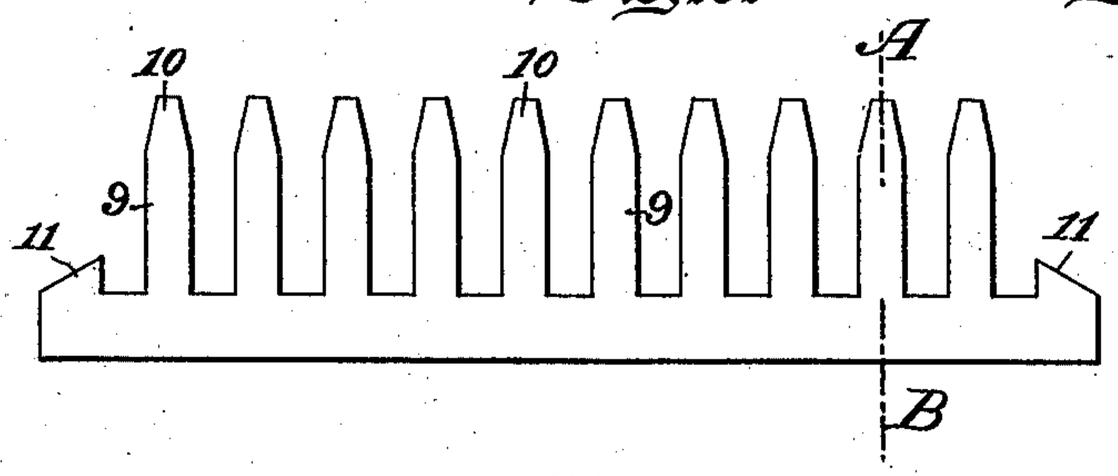


Fig. 6.

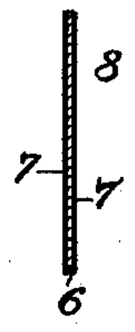


Fig. 7.

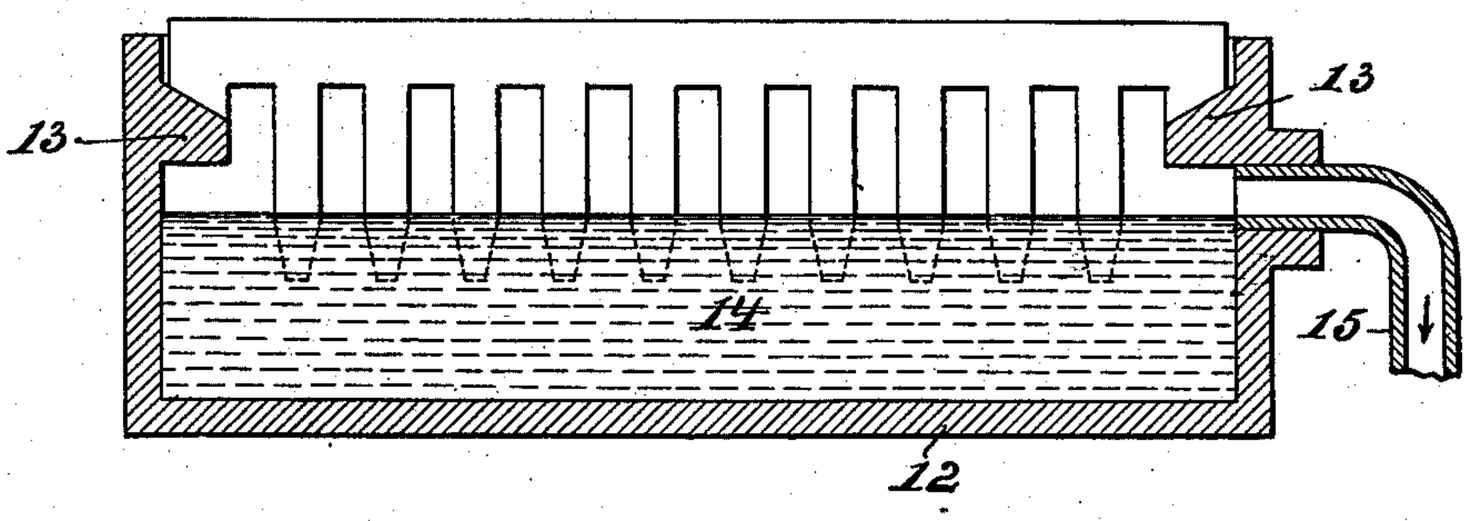
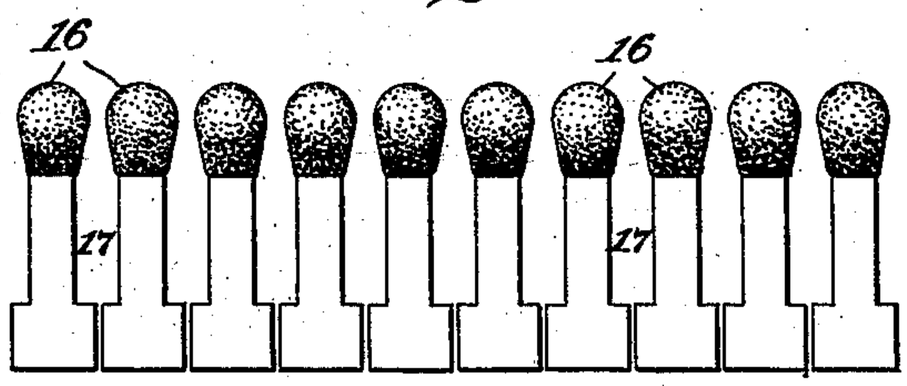


Fig. 8.



Witnesses:
Wilhelm Vogt
Thomas M. Smith.

Inventors:
Nikolaus Schmitt and
Johann Krannichfeldt
By J. Walter Douglas
Attorney.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 9.

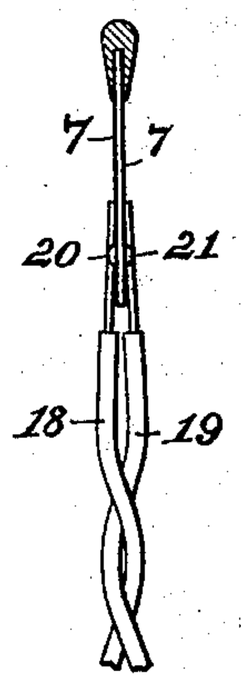


Fig. 10.

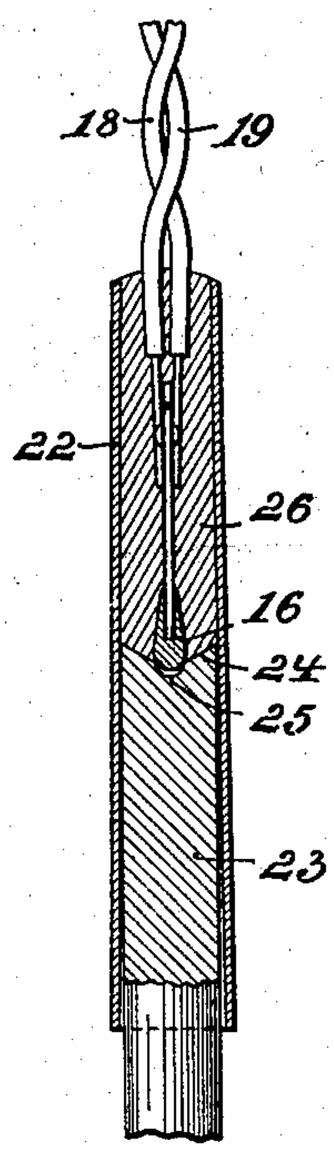


Fig. 11.

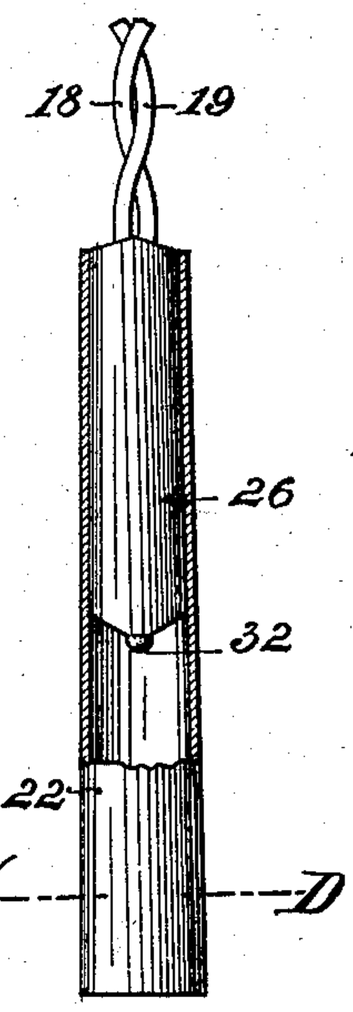


Fig. 12.

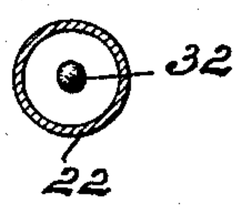


Fig. 13.

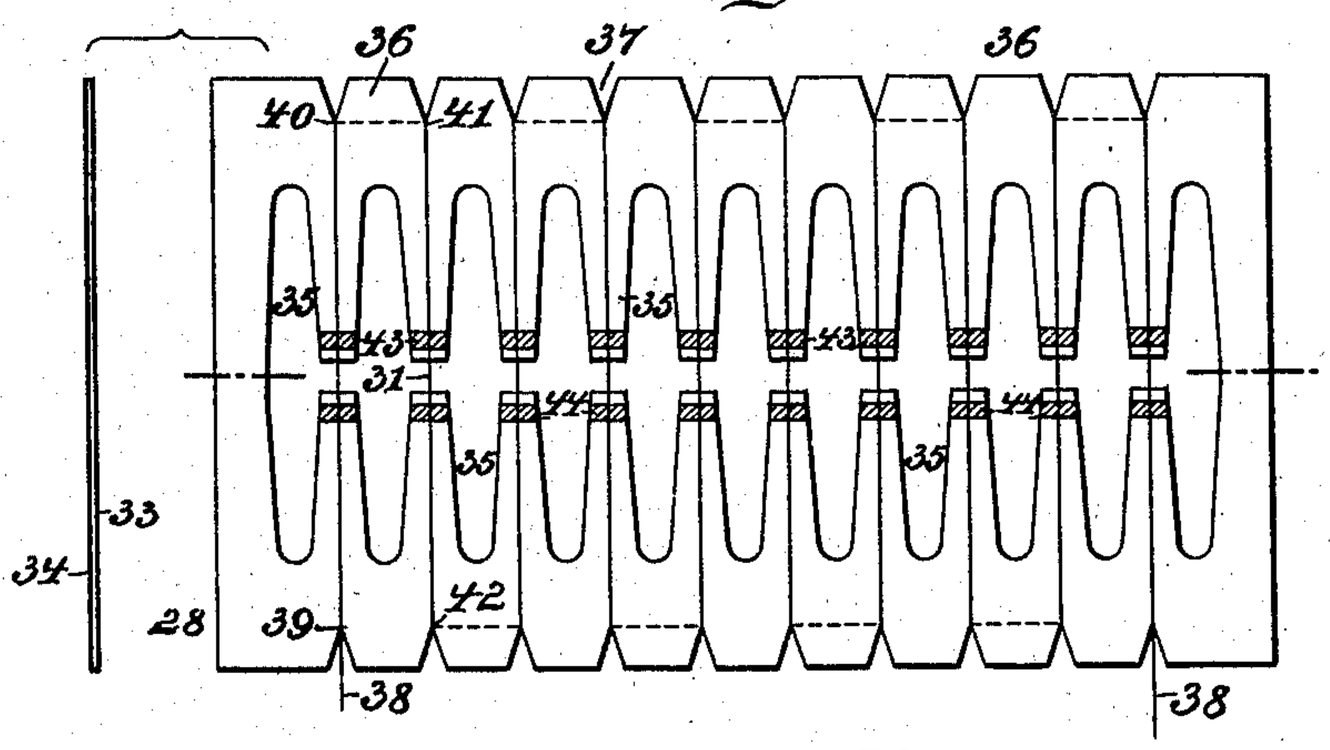


Fig. 14.

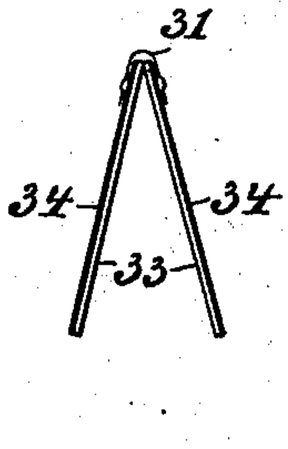
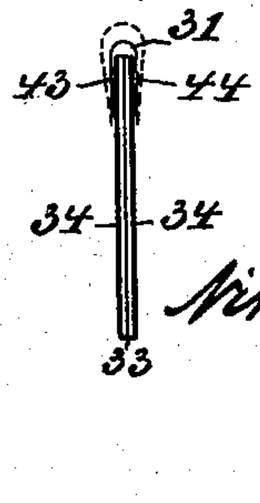


Fig. 15.



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By J. Walter Douglas
Attorney.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 16.

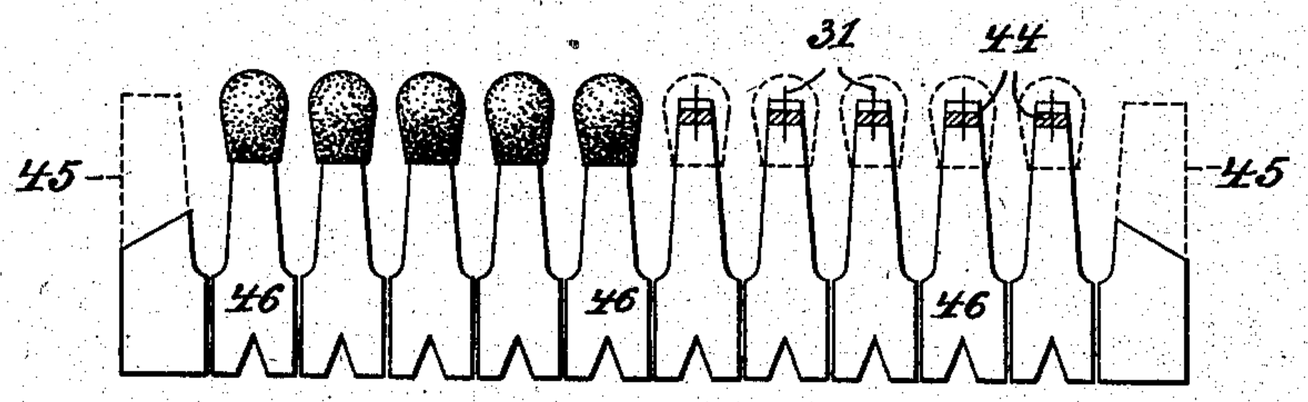


Fig. 21.

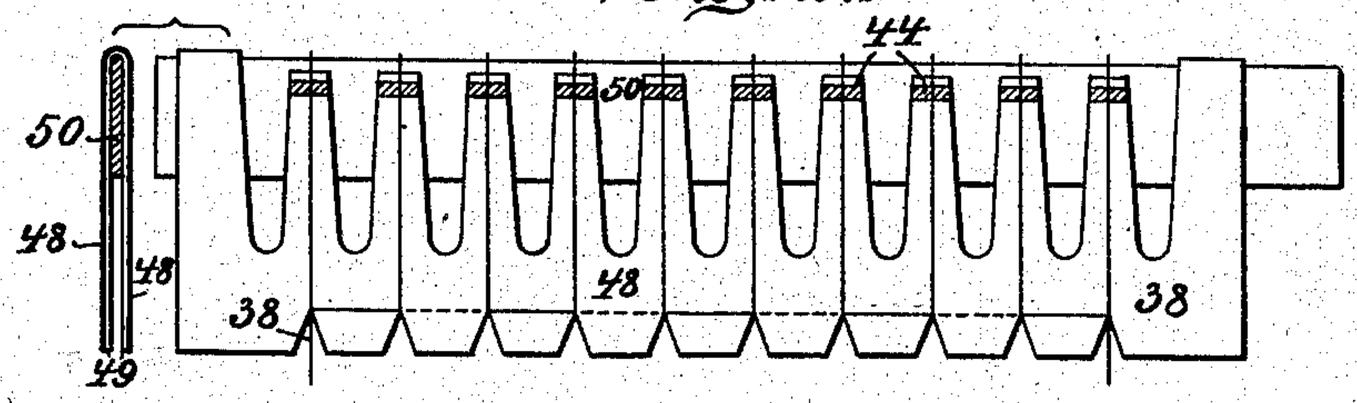


Fig. 17.

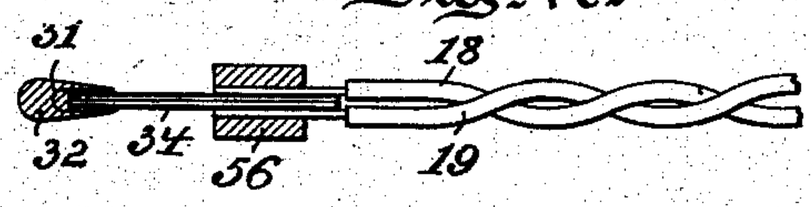


Fig. 18.

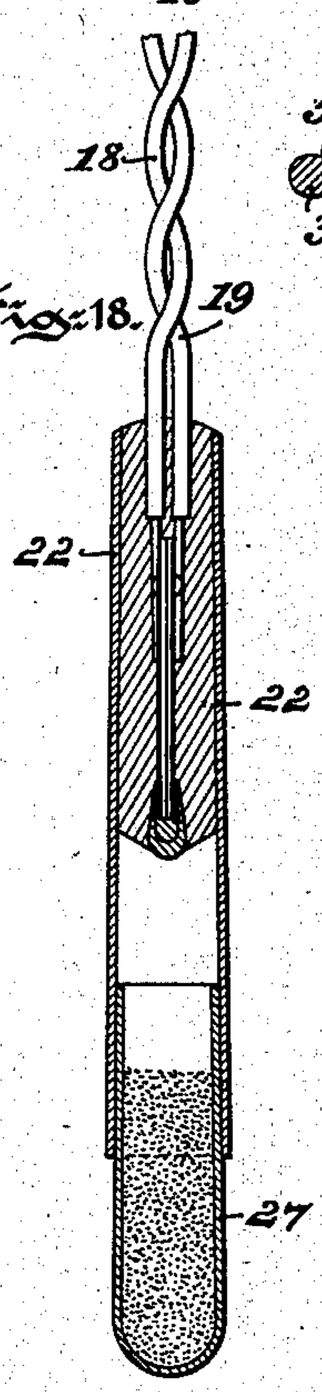


Fig. 19.

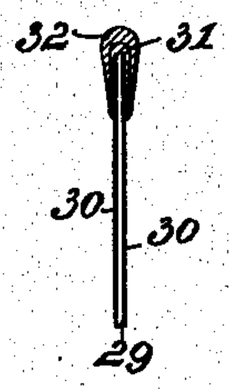


Fig. 20.

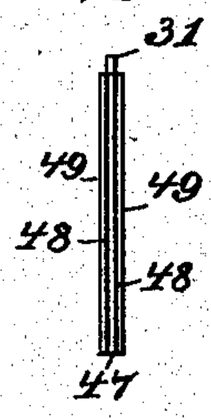
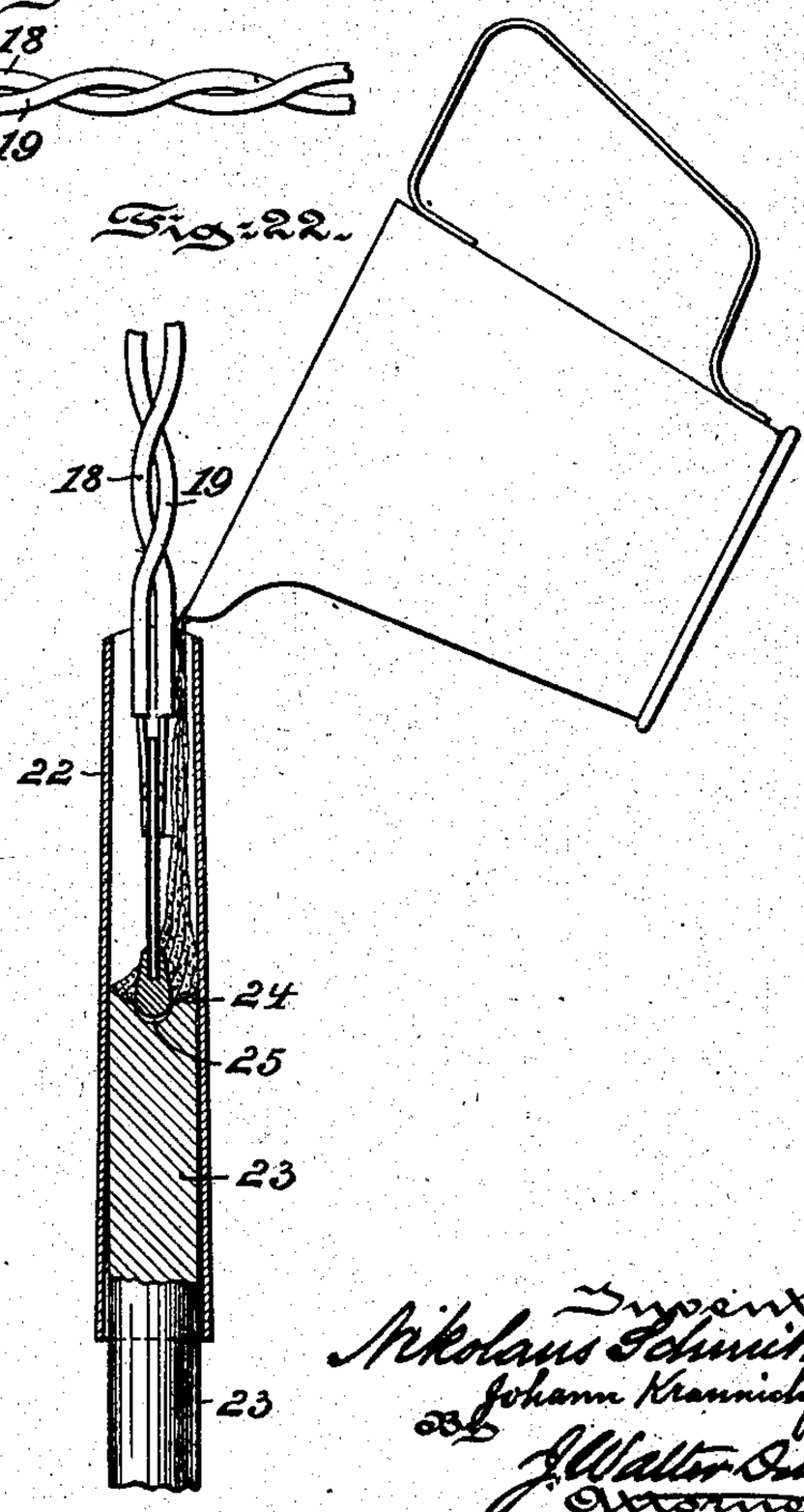


Fig. 22.



Witnesses:
Wilhelm Voigt
Thomas M. Smith.

Inventors:
Nikolaus Schmitt and
Johann Krannichfeldt
By J. Walter Douglass
Attorney.

UNITED STATES PATENT OFFICE.

NIKOLAUS SCHMITT, OF KUPPERSTEY, AND JOHANN KRANNICHFELDT, OF COLOGNE, GERMANY.

ELECTRICAL FUSE-HEAD AND FUSE.

SPECIFICATION forming part of Letters Patent No. 720,073, dated February 10, 1903.

Application filed September 10, 1900. Serial No. 29,502. (No model.)

To all whom it may concern:

Be it known that we, NIKOLAUS SCHMITT, technical engineer, of Kupperstey, and JOHANN KRANNICHFELDT, merchant, of Cologne, in the Empire of Germany, have invented new and useful Improvements in the Manufacture of Electrical Fuse-Heads and Electrical Fuses, of which the following is a full, clear, and exact specification, reference being had therein to the accompanying drawings, in which—

Figure 1 is a vertical section through a portion of a fuse-head made according to the present invention. Fig. 2 is a front view of Fig. 1. Fig. 3 is a front view of a fuse-head; Fig. 4, a side view thereof. Fig. 5 is a front view of a toothed strip. Fig. 6 is a section on the line A B of Fig. 5. Fig. 7 is a vertical section of a device for dipping the strip into a pulpy priming composition. Fig. 8 is a front view of several fuse-heads separated from a strip. Fig. 9 is a side view of a fuse-head with conducting-wires. Fig. 10 is a section along the longitudinal axis of an electrical mine-exploder. Fig. 11 is a side view, partially in section, of the mine-exploder represented in Fig. 10. Fig. 12 is a section on the line C D of Fig. 11. Fig. 13 is a front view of a perforated strip with conducting-wires. Fig. 14 is a side view of the strip represented in Fig. 13, partially bent double. Fig. 15 is a side view of the strip represented in Fig. 13, entirely bent double. Fig. 16 is a front view of a row of fuse-heads for electrical ignition by incandescence, some finished, others unfinished. Fig. 17 is a side view, partially in section, of an incandescent fuse made according to the present invention. Fig. 18 is a section through the longitudinal axis of a mine-exploder with incandescent ignition. Fig. 19 is a side view, partially in section, of a fuse-head with incandescent wire. Fig. 20 represents a section through a connecting-strip used in the manufacture of fuses, the conductive coatings of which are covered with insulating material. Fig. 21 represents a special method of producing incandescent fuses. Fig. 22 represents a method of fixing the fuse-heads into the fuse-coverings by molding the latter on the fuse-heads.

The strip represented in Figs. 1 and 2 consists of a strip 1, made of paper, cardboard, celluloid, vulcanite, mica, wood, or other suitable material, which is either entirely or almost entirely electrically non-conductive.

The thickness of the strip 1 varies and depends upon the nature and purpose of the fuse to be produced and the specific current resistance of the priming composition, and in certain cases also upon the nature of the electrical machine employed for the purpose of firing the fuse.

The strip 1 is, generally speaking, made in the shape of a small flat stick, and in the present instance the upper end thereof is pointed, which, however, is not always essential. Both sides of the strip 1 are provided with an electrically-conductive coating 2. These coatings can consist of metal foil, metal paper, or thin sheet metal, which is fixed by some suitable means to the strip 1—for instance, by a galvanic process or by sticking or sewing the coating material to the strip 1.

The combination of the strip 1 and the coatings 2 produces a connecting-strip 3, which in this case, as hereinbefore mentioned, and represented in Fig. 2, is somewhat pointed; but the shape of the connecting-strip is of no importance and can be of almost any kind as long as it remains essentially that of a flat stick. At its upper end the connecting-strip 3 carries a globule 4 of congealed priming composition. The globule 4 surrounds the end of the connecting-strip in such a manner as to form a bridge between the two coatings 2. (Shown in Figs. 3 and 4.) It is immaterial that this piece of priming composition should be globular. It may be conical, flat, or of any other shape. When the globule 4 has been fixed to the connecting-strip 3, a fuse-head 5 has been produced, which can be used as an electrical mine-exploder.

It is obvious that the manufacture of these fuse-heads would be rather expensive if each of them were made separately. It is therefore advisable to adopt a process by which a large number of fuse-heads are produced simultaneously and as much alike as possible. The latter is a very important point. A process of this kind is as follows: A thin plate 6 of any suitable material—such as cardboard, celluloid, or the like—or instead of the said

plate a number of thin sheets of such material placed one on top of the other, is provided on both sides with an electrically-conductive coating 7. The plate and the coatings are connected in any suitable manner—for instance, as described in connection with the production of the fuse-head 5, by attaching the coatings 7 to the insulating-plate 6 by means of some adhesive material. Out of the plate thus produced strips 8 are stamped, which have the appearance of combs and are provided with tooth-like spurs 9, the free ends of which, as shown in Fig. 5, terminate in points 10. It is not essential that the spurs 9 should terminate in points. They can be of different shape to that shown in Fig. 5. At each end of the strip 8 is an elevation 11, which can be utilized to insure that the points 10 are uniformly moistened with priming composition. For this purpose the strips 8 are turned from the position shown in Fig. 5 to the position shown in Fig. 7 and dipped into a vessel 12, provided with two parallel ledges 13, which serve as supports. The said vessel 12 contains the priming composition 14, which is preferably caused to flow slowly and continuously into the vessel 12 and out of it through a tap 15. This has the effect that the surface of the priming composition is always at exactly the same height, so that the points 10 of the strip 8, which rest upon the ledges 13, will always be dipped to exactly the same extent into the priming composition. Consequently if the nature and consistency of the priming composition is not variable the drops 16, Fig. 8, of composition which adhere to the points 10 when the strip 8 is removed from the vessel 12 will always be of exactly the same size. The said drops 16 congeal rapidly. After the congelation thereof the points 10 of the strips 8 can be dipped into some liquid which will impart to the heads a certain color, unless, as is preferable, the priming composition is colored beforehand. Frequently, however, the heads 16, whether colored or uncolored, are dipped into some liquid which covers them with a fine coating for the purpose of protecting the priming composition from atmospheric influences. Suitable liquids for this purpose are solutions of shellac, wax, or stearin, dissolved wax or dissolved stearin, and the like. After the strips 8 have gone through some or all of these processes they are divided by any suitable means into separate fuse-heads 17—for instance, by dissecting the strips 8 at suitable places. Of course the separation of the fuse-heads can also be effected by cutting through the base of the spurs 9 in a longitudinal direction—*i. e.*, by cutting away the strip 8. Each of the fuse-heads 17 thus obtained is then connected conductively with two conducting-wires 18 and 19, which are carefully insulated from each other. This is effected by soldering the wire 18 by means of a drop of metal 20 to one of the metallic coatings 7 and by soldering the wire 19 by means of a drop of metal 21 to the other metallic coating 7. Of course the conductive connection between the fuse-head 17 and the wires 18 and 19 can also be effected by other means—for instance, by means of a clip 56, Fig. 17, which presses the conducting-wires firmly against the metallic coatings 7. The result is in any case a fuse-head which can be fired by sending an electrical current of sufficient tension through the said wires 18 and 19.

As the fuse-heads with conducting-wires are otherwise not suitable for transport, not having sufficient capacity to resist mechanical influences, it is advisable to adopt a novel method of securing them. (Represented in Fig. 10.) This method consists in inserting the fuse-head, provided with the conducting-wires 18 and 19, priming-cap 16 downward into a sheath 22, consisting of paper, cardboard, celluloid, metal, or some other suitable material. Preferably the sheath 22 should be slightly tapering, as represented in Fig. 10; but sheaths of other convenient shapes can be employed.

To enable a sealing substance to be molded around the fuse-head within the sheath 22, opposite the fuse-head is first placed a small block 23, fitting tightly against the sides of the sheath. In the top of the said block 23 is a funnel-shaped recess 24 with a cup-shaped orifice 25. Into the latter the priming-cap 16 of the fuse-head, inserted into the sheath, is placed, and a rapidly-congealing substance 26 is then poured into the sheath around the fuse-head. Such substance 26 can, for instance, consist of gypsum, colophonium, sulfur, caoutchouc, or other rapidly-congealing substance. The block 23 is then removed from the sheath 22, and the sealed fuse, without a detonator, can be transported any distance without the slightest danger. This fuse is capable of great resistance to external influences and is extremely reliable, owing to its construction, especially to the circumstance that the point of the priming-cap 16 projects from the substance 26, and consequently on firing the flash is forced to strike exactly through the axis of the empty part of the sheath 22, which carries the detonator 27, Fig. 18, and thus the full effect of the flash is directed against the detonator. The latter is either simply inserted into the sheath 22 or fixed into it by some suitable means. If, however, the fuse is to be brought into immediate contact with the detonator, the above-described process of surrounding the fuse-head with gypsum, colophonium, sulfur, or the like should take place in the cap of the detonator itself, and the said cap should afterward be provided with detonating composition.

Instead of the insulating-strip 1 there may be two such strips, the outside of each of which is provided with an electrically-conductive surface 2. These two insulating-strips are entirely symmetrical and are laid

or stuck together or otherwise suitably connected in such a manner that the two metallic coatings are on the outside. It is, however, also possible to place the strips in such a manner together that the said coatings are inside; but in that case an insulating layer must be placed between the said coatings. (See Fig. 20, in which the insulating layer is indicated by 47.)

A simple method of producing fuse-heads of the former description is the following: A thin sheet of cardboard, celluloid, or the like is covered on one side with an electrically-conductive surface—for instance, by placing or sticking upon it or otherwise fixing to it a sheet of metal foil. Out of the combined sheet thus obtained strips are stamped approximately in the shape of the strip 28. (Represented in Fig. 13.) These strips are bent along the middle line, as indicated in Figs. 14 and 15. The surfaces thus brought into contact with each other can then be connected together and after the fuse-heads have been produced cut into separate fuses. This method of producing fuses is important, because with a slight modification thereof an extremely simple method of producing fuse-heads for incandescent fuses is obtained. These fuse-heads, which form part of the invention and are shown in Fig. 19, consist of an insulating-strip 29 in the shape of a small flat rod and, if necessary, consisting of several strips laid one upon the other, of two electrically-conductive coatings 30 on the said strip 29, and of an incandescent wire 31, which connects two coatings 30, and of a mass of priming composition 32, surrounding the wire 31.

Another form of construction of fuse-heads for incandescent ignition is represented in Fig. 15. In this instance two insulating-strips 33, placed side by side and in some cases connected together, are employed, each of them being provided with an electrically-conductive coating 34. An incandescent wire 31 connects the two conductive surfaces with each other and is surrounded by the mass of priming composition.

A suitable method of producing the fuse-head for incandescent firing (represented in Fig. 15) is as follows: The strip 28, with metallic coating 34, (represented in Fig. 13,) is assumed to be the material with which the manufacture is begun. As indicated in the drawings, the said strip is provided with two rows of spurs 35 and two rows of spurs 36, which are placed in such a manner that each of the angular gaps 37 between the spurs 36 lies in the center line between two spurs 35. Between the gaps 37 a very fine incandescent wire is wound in such a manner that if, as indicated in Fig. 13, the twisting of the wire 38 commences at the point 39 the said wire is carried first to the point 40, from thence to the point 41, from thence to the point 42, &c., and then the ends of the wire are attached in such a manner that the wire will not become loose. Then lumps of solder 43 and 44 are affixed in such a manner that the lengths of wire between each pair of lumps 43 and 44 are exactly equal, or at least as nearly so as possible. Then the lengths of wire between the gaps 37 and the soldering-places 43 and 44 are removed, so that only the short lengths of wire 31 between opposite soldering-places remain. The strip 28 is then bent double along the center line (indicated by dots in the drawings) and the surfaces of the insulating-sheet 33, which come into contact with each other, as in Fig. 15, are connected in suitable manner—for instance, by being stuck together. The strip 28 then has approximately the shape of the strip 8, Fig. 5, except that in the latter the gaps 37 and the little loops of wire 31 are missing. The parts 45, Fig. 16, are then separated from the strip 28, and the latter is then provided in the manner described in connection with Fig. 7 with masses of priming composition 32. After this has been done the strip 28 is divided into separate fuse-heads 46, as shown in Fig. 16. The said fuse-heads can then be connected with the conducting-wires 18 and 19 by means of a sliding ring or clamp 56, which is passed over the said wires and the sides of the fuse-heads and presses the wires 18 and 19 firmly against the metallic conductive surfaces 34 of the fuse-head. The metallic contact between the sides 34 of the fuse-head and the wires 18 and 19 can also be produced by soldering or some other suitable means. That the shape of the spurs 35 is not limited to that represented in Fig. 13 is obvious. A modification of this method is represented in Fig. 21. This modification lies in the fact that the strip 28 is first bent, as shown in Fig. 14, and that then a plate 50 is inserted into the angle formed by the strip, which consists in its condition of two insulating-strips 49, facing each other and provided with metallic coatings 48. Then a thin incandescent wire is wound around in the manner indicated in Fig. 21. When this has been done, the wire is soldered to the coatings 48 in the manner described in connection with Fig. 13. The superfluous lengths of wire are removed and the plate 50 is also removed, if it consists of metal. If, however, the said plate 50 consists of some non-conductive material, it can be left and dissected with the separate fuse-heads. As indicated in Fig. 21, the plate 50 is narrower than the folded strip 28. It is advisable to make the plate 50 broader than the strip 28 and to cut or stamp therein indentations corresponding to the angular gaps 37 in the strip 28.

The principal advantages possessed by the above-described fuse-heads and fuses and the methods of producing them are the facility and accuracy with which correct and equal distances between the poles of ignition, or, in other words, the correct and equal lengths of the incandescent wires, are obtained. This is one of the most important points in connection with the manufacture of electrical

fuses. Another very important point is the easy and secure method of providing the fuse-heads with priming composition and the possibility of producing simultaneously large quantities of fuse-heads of exactly similar nature and condition both in the case of fuse-heads with and without incandescent wire. The complete protection of the priming and poles of ignition or the incandescent wire against external damage, moisture, and displacement may also be mentioned.

Having thus described the nature and objects of our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. An electrical fuse, comprising in combination a short, thin, flat and flexible strip of non-conductive material, a short, thin, flat and flexible strip of conductive material attached to each face of and carried by said non-conductive strip and a mass of priming composition connecting the two conductive surfaces, substantially as set forth.

2. An electrical fuse, comprising in combination, a short, thin, flat and flexible strip of non-conductive material, a short, thin, flat and flexible strip of conductive material attached to each face of and carried by said non-conductive strip, a wire connecting the said conductive surfaces, and a priming composition covering said wire, substantially as set forth.

3. An electrical fuse, comprising in combination, a flexible strip of non-conductive material, a flexible strip of conductive material attached to each face of, and carried by, said non-conductive strip, a mass of priming composition connecting the two conductive surfaces, an electric conductor attached to each conductive strip at some distance from the priming mass, substantially as set forth.

4. An electrical fuse, comprising in combination, a strip of non-conductive material, a layer of conductive material attached to each face of said conductive material, a globule of priming composition connecting the said conductive surfaces, and a thin layer of protective material enveloping said globule, substantially as and for the purposes set forth.

5. An electrical fuse, comprising in combination, a strip of non-conductive material, a layer of conductive material attached to each face of said non-conductive material, a globule connecting said conductive surfaces, a sheath surrounding said layers of conductive and non-conductive materials and said globule, and a protecting and holding molded mass inside said sheath and surrounding said layers of conductive and non-conductive materials and leaving the extreme head of said globule free, substantially as set forth.

6. An electrical fuse and detonator, comprising in combination, a strip of non-conductive material, a layer of conductive material attached to each face of said non-conductive material, a globule connecting said conductive surfaces, a sheath surrounding said layers of conductive and non-conductive materials and said globule, a protecting and holding molded mass inside said sheath and surrounding said layers of conductive and non-conductive materials and leaving the extreme head of said globule free, a detonating compound placed in said sheath adjacent to the exposed head of said globule, substantially as set forth.

7. An electrical fuse, comprising in combination, a strip of non-conductive material, a layer of conductive material attached to each face of said non-conductive material, a wire connecting said conductive surfaces, a priming composition covering said wire, a sheath surrounding said layers of conductive and non-conductive materials and said globule, and a protecting and holding cast mass inside said sheath and surroudding said layers of conductive and non-conductive materials and leaving the extreme head of said globule free, substantially as set forth.

8. The method of manufacturing fuses, which consists in forming a comb-shaped strip of non-conductive material, with projections at the ends and coated on each side with a layer of conductive material, secondly, in dipping the tips of the comb into a priming composition kept at a constant level in a vessel, the projections at the ends of the comb resting on the sides of the vessel, thirdly, in removing the comb from said vessel, and allowing the liquid on the tips to congeal, fourthly, in cutting up the comb into separate bars, substantially as set forth.

9. The method of manufacturing fuses, which comprises forming a blank of non-conductive material notched on opposite sides and having oppositely-situated tongues cut out in the middle and coated on one side with a conductive material, winding a wire from notch to notch at opposite sides so as to longitudinally intersect each tooth, attaching the wire at a point near the end of each opposite tooth, and cutting off the wire between each point of attachment and the edges of the blank, doubling the blank along the central line and attaching the adjacent surfaces, dipping the tips in a priming composition, and cutting up the blank into separate fuses, substantially as set forth.

10. The method of manufacturing fuses, which comprises forming a blank of non-conductive material notched on opposite sides and having oppositely-situated tongues cut out in the middle and coated on one side with a conductive material, doubling said blank along the central point and placing a strip of material in the fold so as to separate the opposite tips of said blank, winding a wire from notch to notch at opposite sides so as to longitudinally intersect each tooth, attaching the wire at a point near the end of each opposite tooth and cutting off the wire between each point of attachment and the edges of the blank, dipping the tips in a priming composition, and cutting up the blank into separate fuses, substantially as set forth.

11. The method of manufacturing combined fuses and detonators which comprises forming a fuse consisting of a strip of non-conductive material coated on each side with conductive material, attaching a globule of priming material to connect the conductive surfaces, and an insulated wire to each conductive surface, placing said fuse in a sheath and against the conical end of a removable plug in said sheath, pouring a molten substance which hardens at ordinary temperatures into said sheath and around said fuse, substituting a case containing a detonating substance for said plug, substantially as set forth.

12. The method of manufacturing fuses, which comprises forming a strip of non-conductive material coated on each side with conductive material, applying a mass of priming composition in electrical connection with the conductivs surfaces, and means to connect each conductive surface with a source of electricity, placing said fuse in a sheath, and pouring a molten substance which hardens at ordinary temperatures into said sheath and around said fuse, substantially as set forth.

In testimony that we claim the foregoing as our invention we have signed our names in presence of two subscribing witnesses.

NIKOLAUS SCHMITT.
JOHANN KRANNICHFELDT.

Witnesses:
KARL SCHMITT,
GUS. SCHULZ.