March 11, 1930. P. MAHLKE 1,750,111

HIGH TENSION CABLE

Filed March 18, 1929

Fig. 1.

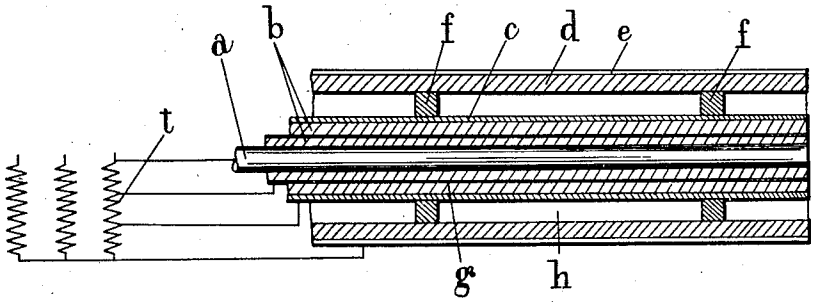


Fig. 2.

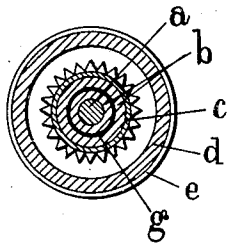
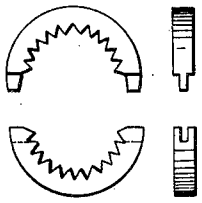


Fig. 3.



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UNITED STATES PATENT OFFICE

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HIGH-TENSION CABLE

Application filed March 18, 1929, Serial No. 348,089, and in Germany March 22, 1928.

In high tension cables of the constructional form mostly used at the present time the insulation consists of layers of paper, which are impregnated with oil or a mixture of oils and resins. The higher the tension for which the cable is intended to be used the greater must be the wall thickness of the conductor insulation. For still higher voltages the thickness of the insulation would thus become so great that the cable would no longer have the requisite flexibility for enabling it to be reeled up on the drum; the paper would break under the bending stresses, while the length of cable that could be wound on the drum would be small, and it would be necessary to make a great number of sleeve joints.

Another known suggestion for the construction of high tension underground conductors is not to use a solid wrapping on the conductor, but to keep the conductor central to the outer sheath (lead sheath, iron pipe and the like) by other means, for instance by insulating distance pieces. In such an arrangement the space between the conductor and the outer sheath is filled with air, oil or some other insulating medium. With this arrangement, however, such media are not capable of withstanding the voltage gradients which may occur in the vicinity of the conductor and this way of constructing conductors, therefore, does not prove satisfactory, where very high voltages are to be transmitted.

Attempts have already been made in the case of the cables first described above having a layered paper insulation impregnated with oil to reduce the gradient in the layers lying nearest the conductor, by placing metallic insertions within the insulating layers and superposing on these latter a different voltage to that resulting from the load distribution over the conducting surfaces in the cable. This alone, however, allows only of a moderate percentage of increase in the working voltage of cables.

The object of the present invention is to provide an underground conductor for very high voltages, the construction of which is a combination of several of the cable constructions as described above. The copper conductor *a* (compare Figs. 1 and 2) is surrounded by a high quality layered insulation *b* which preferably consists of layers of paper soaked with oil and resin. In these layers conducting layers *g* may be inserted. The layered insulation is surrounded by a metal sheath *c* (for instance a lead sheath). The lead cable thus formed is held by distance pieces *f* in a tube *d*, over which a metallic wire braiding *e* may be placed. The space *h* may be filled with oil or air (both of which may be under pressure), with compound or with some other insulating but not rigid substance. In order to get the desired effect, the potential of the lead sheath *c* and that of any conducting insertion or insertions is influenced in such a manner that the inner layers of insertion have a lower gradient than corresponds to the natural course of the voltage determined by the load distribution. The superposed voltage of the lead sheath (and in some cases of the conducting insertion) may for instance be taken by tapping from the working transformer *t*, as is shown in Fig. 1. The tubes may be made of hard paper, porcelain, glazed earthenware, some other insulating material or of metal (for instance iron). When metallized tubes are used, the metal wire braiding *e* may be omitted. The outer metallic sheaths *d* or *e* of the single conductor cable shown in the drawing would in most cases, namely in multi-conductor systems, have to be connected together at short intervals. Whether a single conducting insertion is used within the layered insulation or instead of one insertion a number of insertions, depends on the height of the voltage.

Fig. 3 shows a constructional example of a distance piece *f*. This distance piece is made in two pieces and its inner edge is serrated for allowing the insulating material to pass through.

In laying the conductors according to the invention, the lead cable is first laid in the cable conduit, the insulating or metal pipes are slipped over the lead cable and the latter is thereupon brought into its central position within the pipes by means of the distance pieces. The pipe connections are

thereupon made and the pipes filled with the insulating substance (for instance compressed air, oil or compound).

What I claim is:

1. An underground conductor for very high voltages, comprising in combination a cable consisting of a conductor, layered insulation on the conductor, a metal sheath on the said layered insulation, a pipe surrounding the said cable and distance pieces between the metal sheath of the cable and the pipe for holding the cable centrally in the said pipe, as and for the purpose set forth.

2. An underground conductor as claimed in claim 1 and comprising conducting insertions within the layered insulation, the metal sheath and the conducting insertions being capable of having such a voltage applied to them that the load on the layers lying nearest the conductor is reduced, as and for the purpose set forth.

3. An underground conductor for very high voltages, comprising in combination a cable consisting of a conductor, layered insulation on the conductor, a metal sheath on the said layered insulation, a pipe surrounding the said cable, distance pieces between the metal sheath of the cable and the pipe for holding the cable centrally in the said pipe and an elastic medium for filling the space between the metal sheath of the cable and the pipe, as and for the purpose set forth.

4. An underground conductor for very high voltages, comprising in combination a cable consisting of a conductor, layered insulation on the conductor, a metal sheath on the said layered insulation, a pipe surrounding the said cable, distance pieces between the metal sheath of the cable and the pipe for holding the cable centrally in the said pipe and an elastic medium under pressure for filling the space between the metal sheath of the cable and the pipe, as and for the purpose set forth.

In testimony whereof I have signed my name to this specification.

PAUL MAHLKE.