Feb. 28, 1939. H. H. WERMINE 2,149,002

METHOD AND APPARATUS FOR MAKING DIVISIBLE ELECTRICAL CONDUCTORS

Filed Jan. 18, 1936

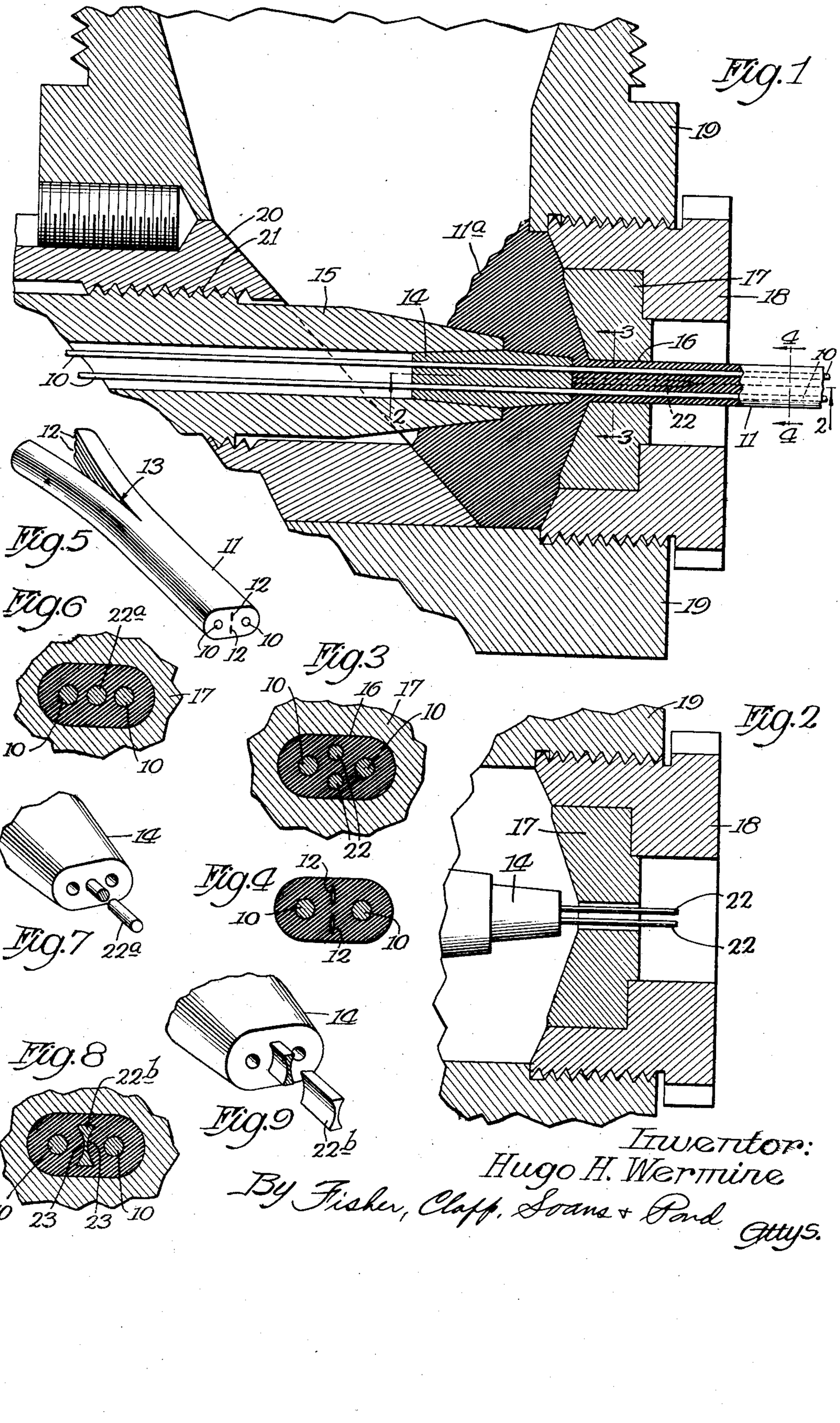

Fig. 1

Fig. 5

Fig. 6

Fig. 7

Fig. 3

Fig. 4

Fig. 9

Fig. 8

Fig. 2

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Patented Feb. 28, 1939 2,149,002

UNITED STATES PATENT OFFICE

2,149,002

METHOD AND APPARATUS FOR MAKING DIVISIBLE ELECTRICAL CONDUCTORS

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Application January 18, 1936, Serial No. 59,661

6 Claims. (Cl. 18—13)

This application is a continuation in part, of my co-pending application, Serial No. 753,657, filed November 19, 1934.

This invention relates to improvements in electrical conductors and more particularly to duplex conductors of the type typified by so-called lamp cord which is now available on the market in the form of a more or less transversely oval-shaped rubber strip in which the conductors are embedded in predetermined spaced relation to each other. Such lamp cord is available in various colors to suit the requirements of different situations and it is characterized by the absence therefrom of the more or less conventional braided fabric covering. Such fabric coverings or sheaths, as heretofore commonly used, have been more or less necessary for the purpose of binding separate insulated conductors together in a single cable or lamp cord, and such braided or like sheaths have been a frequent source of annoyance because of the tendency of the fabric sheath to fray at the ends of the cord or at intermediate points when the braided fabric is worn.

The present type of rubber-covered lamp cord embodies a pair of conductors, either with or without servings of cotton thread or the like, and a one-piece or unitary coating of rubber or similar insulation material. Such cord may be manufactured very economically and at low cost by the simple operation of extruding suitable rubber compound around properly spaced and guided conductor wires. However, one of the difficulties experienced in employing such rubber covered duplex conductor is that it is very difficult to split or divide a length of the duplex conductor into separate insulation covered wires, for example, at the end of a length of the cable for the purpose of connecting the wires to the terminals of a lamp socket, connector plug or other electrical device. In splitting such conductor, it is found that the line of division has a very noticeable tendency to migrate from the desired line of separation toward one or the other of the conductor wires with the resultant baring of portions of the wire which it is preferred to keep covered.

It is the object of the present invention to provide a duplex or multi-wired electrical conductor cable or cord embodying an arrangement whereby separation of the wires with the retention thereon of an adequate covering of insulation material is facilitated.

Another object of the invention is to provide apparatus for producing cable embodying the above described arrangement economically and at low cost.

Other objects and advantages of the invention will be understood by reference to the following specification and accompanying drawing wherein there are illustrated three specific forms of electric conductor cable embodying the invention, and portions of apparatus for producing the improved cable.

In the drawing:

Fig. 1 is a fragmentary illustration in section of an extruding head adapted to produce lamp cord embodying the invention;

Figs. 2 and 3 are sections on the lines 2—2 and 3—3, respectively of Fig. 1.

Fig. 4 is a section on the line 4—4 of Fig. 1, through the cable produced by the apparatus shown in Fig. 1;

Fig. 5 is a perspective of a length of cable produced by the apparatus shown in Fig. 1;

Fig. 6 is a section corresponding to Fig. 3, but showing a modified arrangement;

Fig. 7 is a fragmentary perspective of an element of apparatus used in producing the cable form represented in Fig. 6;

Fig. 8 is a cross section also similar to Fig. 3, but showing another arrangement embodying the invention, and

Fig. 9 is a perspective similar to Fig. 7, but showing the form of a portion of the apparatus employed in producing the arrangement illustrated in Fig. 8.

Referring now to the drawing, the form of lamp cord illustrated in Figs. 4 and 5 embodies a pair of electric wires 10, 10, which are preferably, although not necessarily, of stranded construction so as to be flexible to meet the usual requirements of so-called lamp cord. The wires 10, 10 are disposed in substantially parallel but spaced relation and they are enclosed in a jacket or shield 11 of rubber or other suitable insulation material which serves to maintain the conductors in their predetermined spaced parallel relation.

The shield or jacket of insulation material is formed integrally about the conductor wires and is provided with a pair of chambers 12, 12 which are spaced transversely of the plane of the wires 10, 10 and disposed approximately midway or equi-distantly spaced from said wires. The chambers 12, 12 extend longitudinally of the cable and serve to guide the splitting of the insulating sheath intermediate the wires 10, 10 as indicated at 13 in Fig. 5. The cross sectional size of the chambers 12, 12 may be varied considerably, but it is preferable that they be of such size and shape that the width of the insulation material

which must be severed or torn in the plane of the openings or chambers 12, 12 is not materially greater than, and preferably less than, the smallest transverse dimension of the rubber insulation material in any plane extending longitudinally of and through either wire.

For forming the described cable, the wires 10, 10 are guided through suitably spaced apertures in a tip 14 carried by the tip-supporting element 15 of a rubber or like material extruding head. The cross sectional shape of the rubber jacket is determined by the shape of a die opening 16 in a die piece 17 which is supported by means of a nut or the like indicated at 18 and carried by the main casing 19 of the extruding head. The tip-supporting element 15 is also carried by the main casing or housing 19 through the agency of a sleeve 20 which is suitably locked in place in the housing. As indicated, the tip holder 15 is adjustable forwardly and rearwardly relative to the die 17, in this instance being mounted through the agency of screw-threading 21 in the sleeve 20.

Suitable uncured or unvulcanized plastic rubber or similar composition 11*a* is forced under pressure through the die opening 16 around the spaced conductors 10, 10 which are guided through said die opening by the tip 14 as clearly indicated in Fig. 1 of the drawing. The means for feeding the insulating composition 11*a* under pressure may be a conventional screw press or other means such as is ordinarily used in extruding machines of the type indicated.

For forming the chambers 12, 12, a pair of pins 22, 22 are mounted in the wire guide or tip 14 and project forwardly therefrom through the die opening 16 and beyond the front end of the die as clearly shown in Figs. 1 and 2. The projecting parts 22, 22 of the wire guide may be arranged in various degrees of spaced relationship and in some instances they may even be disposed in contact with each other. It will be apparent that the presence of the projecting pins 22, 22 will result in the formation of the chambers 12, 12 in the insulating material intermediate the wires.

The projecting pins 22, 22 preferably project substantially beyond the outlet end of the die opening 16 as indicated in the drawing, it being found that the production of the cable may then be practiced without maintaining any finely adjusted relationship between the wire guiding tip 14 and the inner end of the die 17.

It is noted that within the die opening 16 there is considerable pressure on the insulating composition and that such pressure probably has the effect of more or less compressing the rubber-like insulation material. When the rubber emerges from the die opening 16 it may expand slightly, so that there will be tendency for the composition to close around the ends of the pins 22, 22. However, the length of the pins may be considerably varied. In fact, they may be short enough to terminate within the die opening, but in that event it is advantageous to feed the insulating composition through the die opening somewhat slower and at a lower pressure.

The insulation material covered wires issuing from the extruding head are then subjected to vulcanization or other treatment for imparting to the composition the permanent but resilient qualities of soft vulcanized rubber. Such vulcanization or treatment may be carried on either by the batch method or by a continuous process.

The chambers formed by the pins 22, 22 may, in some instances, tend to close up so as to appear more like elongated, slightly open slits as indicated in Fig. 4, such closing being perhaps due to the tendency of the insulating composition to expand upon issuance from the die. Whether or not the chambers thus formed contain either air or some other fluid has not been ascertained. They may contain air, which may possibly find its way thereinto from the front end of the cable as it issues from the extruding head. However, it appears likely that the chambers contain certain fluids in the form of gases produced as an incident to the vulcanizing step.

The extent or degree of opening maintained may be varied and it may be controlled by suitably regulating the pressure under which the insulating material is fed into and through the die, by suitably adjusting the length of the pin or pins which produce the openings, and by regulating or maintaining the consistency of the insulation material as required to secure the desired open condition of the openings. It is preferable that the openings be permitted to, or so shaped that they occupy only a small cross-sectional area. The area of the opening is not of material importance, except in so far as it bears on the cross-sectional size of the finished conductor. In order that the latter may be maintained as small as practicable, it is desirable that the openings be permitted or caused to close up to present the slit-like appearance shown in Fig. 4. In this way, the cross-sectional size of the finished conductor is maintained at a minimum while affording a maximum thickness of insulation around each wire.

In Figs. 6 and 7, there is illustrated the production of another arrangement of conductor embodying the invention. In this form only one pin designated 22*a* is carried by the wire guiding tip 14. The pin 22*a* is located intermediate the two wires 10, 10 in the plane thereof and serves to produce only a single opening or chamber in the conductor. Such single opening obviously serves the purpose of a pair of openings or chambers as above explained and provides a stronger bond between the respective halves of the rubber jacket around the respective conductor wires 10, 10. Conductor wire embodying this form of the invention may be somewhat more difficult to separate than the form illustrated in Figs. 4 and 5, and in some instances such increased strength may be desirable.

In Figs. 8 and 9, another arrangement is shown. In this arrangement, a single chamber forming pin 22*b* is employed, the pin in this instance being somewhat hour-glass in cross section. The cross sectional shape of the pin 22*b* is such that it embodies an elongated dimension extending transversely of the plane of the wire 10, 10, to form an opening or chamber in the insulation jacket, which opening extends beyond the opposite sides of the pair of wires 10, 10. In this arrangement a weaker bond is provided between the opposite halves of the insulation material around the respective conductors so that separation of the cable into independent insulation covered wires is facilitated. The hour-glass shape of opening is also advantageous in that the central portions of insulating material indicated at 23, 23 on opposite sides of the hour-glass shaped opening may abut each other to thereby prevent complete closing of the opening portions adjacent the widened ends of the opening. During the process of vulcanization, such abutting portions may be more or less united but the joint so formed is comparatively weak and does not hinder separation of the wires in the manner explained.

It will of course be apparent that the formation of chambers as above explained may be practiced in connection with conductor cables of more than two wires so as to permit separation of such wires, for example in a three-wire cable. Also the wires of a multi-wired cable may be located all in a common plane or they may be arranged concentrically about a predetermined axis or any other relationship.

Other changes may be made in the conductor structure, in the method of producing the same and in the apparatus therefor, without departing from the spirit of the invention, the scope of which should be determined by reference to the following claims, the same being construed as broadly as possible consistent with the state of the art.

I claim:

1. In an extruding head, a die having an opening therein, means for guiding a plurality of conductors to the die, means for applying insulating material to the conductors as they pass through the die, said guiding means having a portion projecting through and beyond the die opening for forming and preserving a continuous fluid chamber in the insulating material between a pair of conductors.

2. In an extruding head, a die having an opening therein, means for guiding a plurality of conductors to the die, means for applying insulating material to the conductors as they pass through the die, said guiding means having a wide and relatively thin portion projecting through and beyond the die opening and in spaced relation thereto to provide passageways for the conductors and their coverings of insulating material for forming and preserving a continuous fluid chamber in the insulating material between a pair of conductors.

3. In an extruding head, a die having an opening therein, means for guiding a plurality of conductors to the die, means for applying insulating material to the conductors as they pass through the die, a prong projecting from said guiding means through and beyond the die opening for forming a continuous chamber in the insulating material between the conductors.

4. The method of making divisible duplex insulation covered electric conductor which consists in extruding insulating compound in plastic condition around a pair of spaced wires so as to form a unitary insulated sheath embracing said wires, forming in said sheath as an incident to extrusion of the plastic material, an internal void disposed intermediate and spaced from the wires, and then treating the sheath to cause it to become resilient.

5. In the method of forming an electrical cable or cord, the steps comprising passing a plurality of electrical conductors through an extruding machine, applying a unitary coating of insulating material thereto, and simultaneously forming a fluid chamber within the insulating material between a pair of conductors.

6. In an extruding head, a die having an opening therein, means for guiding a plurality of conductors to the die, means for applying insulating material to the conductors as they pass through the die, and fixed means projecting into the die opening for forming a continuous weakened zone in the insulating material in a plane between the conductors.

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