

Jan. 4, 1944.

R. H. McCABE

2,338,524

METHOD OF MAKING ELECTRICAL TERMINAL FIXTURES

Filed June 8, 1940

2 Sheets-Sheet 1

Fig. 1.

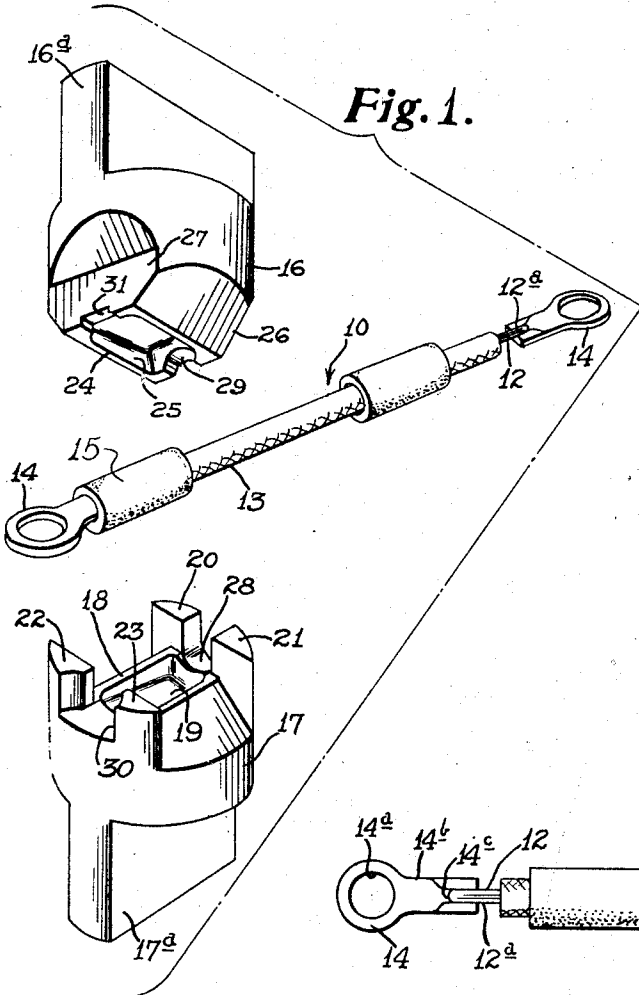


Fig. 2.

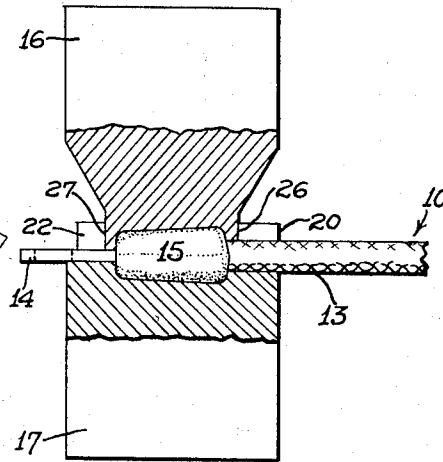


Fig. 3.

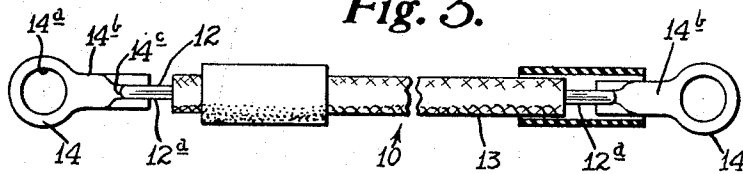


Fig. 4.

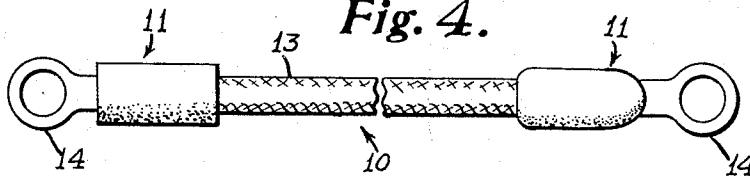
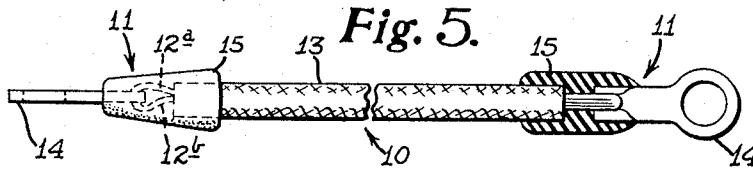


Fig. 5.



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2 Sheets-Sheet 2

Fig. 7.

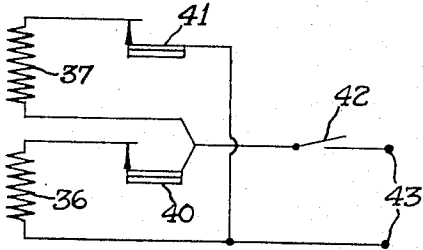
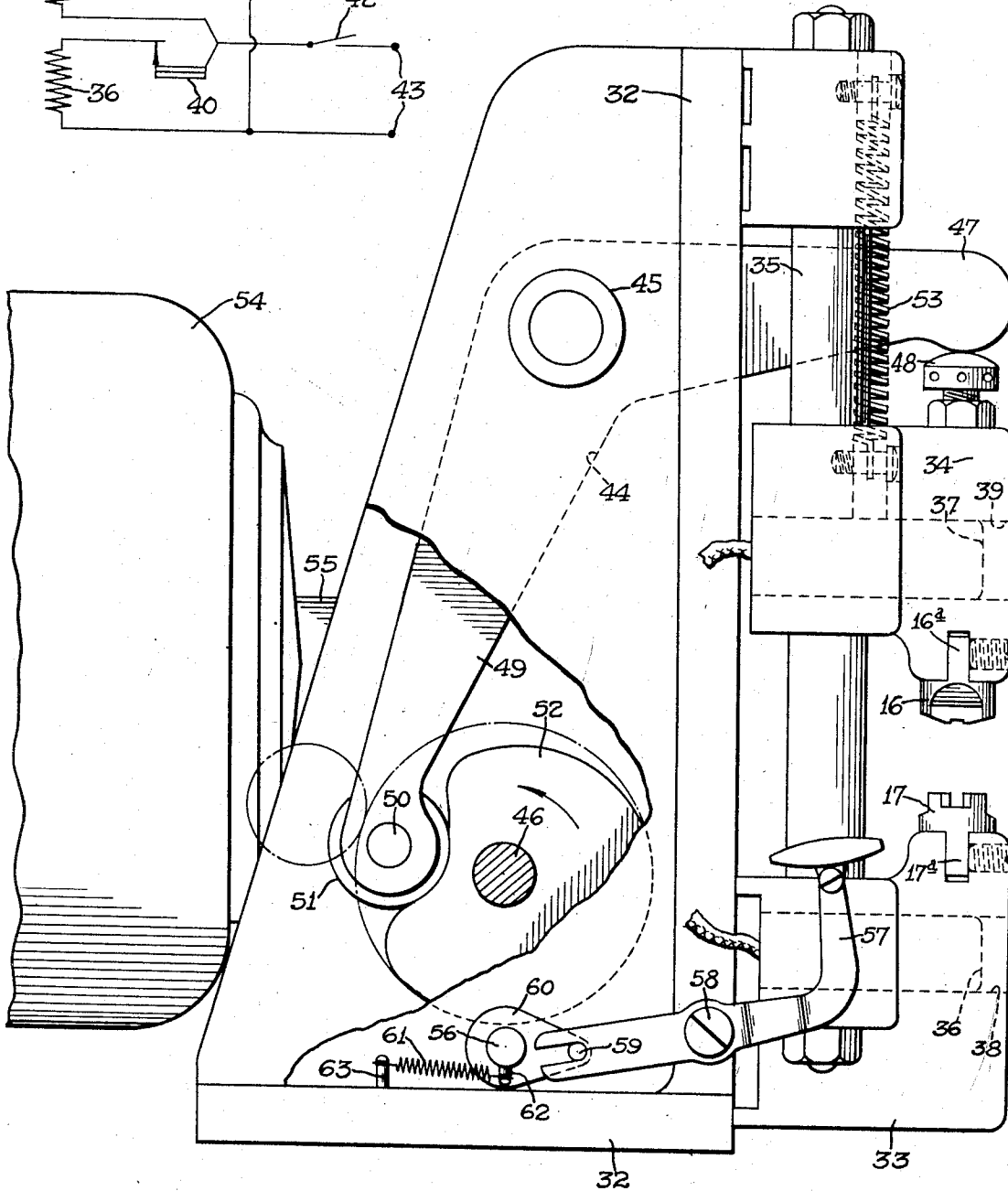


Fig. 6.



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2,338,524

METHOD OF MAKING ELECTRICAL
TERMINAL FIXTURES

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Application June 8, 1940, Serial No. 339,469

2 Claims. (Cl. 18—59)

The present invention relates to methods of making electrical terminal fixtures.

In electrically operated and controlled appliances and machines, considerable wiring is utilized, which requires a large number of electrical terminal fixtures, each of which must be adequately secured to the connecting wiring and thoroughly insulated from adjacent parts in order positively to prevent short circuits. Ordinarily, rubber and like materials are employed to insulate the connections between the terminal fixtures and the associated wiring.

While terminal fixtures utilizing insulation of the type described are reasonably satisfactory in general, they are entirely unsuited for use in certain types of machines, such as calculating machines, due to the deteriorating effects upon rubber and like materials of oils and lubricants normally present in the machines, and of heat developed incident to operation of the machines.

Accordingly, it is an object of the present invention to provide an improved method of making an electrical terminal fixture, which is not injuriously affected by being subjected to oils, lubricants and considerable heat, and which is especially suited for use in a machine, such as a calculating machine, wherein it is subjected to oil, lubricant and a high ambient temperature.

Another object of the invention is to provide an improved method of making an electrical terminal fixture which requires a minimum number of simple and easily performed steps.

A further object of the invention is to provide an improved method of making an electrical terminal fixture utilizing a single heated die deforming operation to apply an insulating, embedding and anchoring body to certain elements of the terminal fixture.

In general, the objects, as set forth above, are in part attained in accordance with the present invention by providing an electrical terminal fixture comprising an electrical conductor having an insulating cover, a portion of the conductor projecting from the cover, an electrical terminal connected to the projecting portion of the conductor and a body of rigid insulating material. More particularly, the body of insulating material is molded into embedding relationship with respect to the projecting portion of the conductor and the adjacent portions of the cover and the terminal, and into interlocking relationship with respect to the adjacent portions of the cover and the terminal, whereby the connection between the projecting portion of the conductor and the terminal is thoroughly insulated and relieved of strain. The insulating body of the terminal fixture is formed of a rigid, inactive, lubricant resistant, heat resistant, insulating material. Preferably, the insulating body of the terminal fixture

is formed of a material consisting essentially of a cellulose ester resin, such as "Tenite."

In accordance with another feature of the invention, the electrical terminal fixture is made in accordance with an improved method which comprises placing a preformed rigid, self-supporting tubular sleeve of a thermo-plastic insulating material in surrounding relationship with respect to the bared portion of an electrical conductor having an insulating cover and the adjacent portion of the cover and the adjacent portion of an electrical terminal secured to the bared portion of the cover, and then subjecting the sleeve to a heating and deforming operation in order to mold the sleeve into intimate contact with the bared portion of the conductor and the adjacent portions of the cover and the terminal. More particularly, the sleeve, after being placed in surrounding relation with respect to the elements of the terminal fixture mentioned, is positioned between a pair of complementary heated molding dies; the dies are then moved rapidly into firm engagement with the sleeve in order to heat the sleeve; and then the dies are forced gradually together in order to mold the sleeve into intimate contact with the bared portion of the conductor and the adjacent portions of the cover and the terminal.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and its method, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which Figure 1 in an exploded perspective view of a partially completed electrical terminal fixture, which is made in accordance with the method of the present invention, and die apparatus which may be utilized in accordance with the method of the present invention, the die apparatus being shown in open position; Fig. 2 is a side elevational view, partly broken away, of the terminal fixture and the die apparatus shown in Fig. 1, the die apparatus being shown in closed position; Figs. 3, 4 and 5 are fragmentary side elevational views of the terminal fixture, illustrating the various steps in the method of making the same; Fig. 6 is a fragmentary side elevational view of a machine press which may be utilized in conjunction with the die apparatus shown in Figs. 1 and 2 in making the terminal fixture; and Fig. 7 is a schematic diagram of an electrical circuit for heating and for controlling the temperature of the die apparatus.

Referring now more particularly to the drawings, in Figs. 1 to 5, inclusive, there is illustrated an electrical terminal link 10 carrying electrical terminal fixtures 11 on the opposite ends thereof, each of the terminal fixtures embodying the con-

struction and arrangement of, and being made in accordance with the method of, the present invention. More particularly, the terminal link 10 comprises an electrical conductor 12 having an insulating cover 13 of any suitable type, the cover 13 being illustrated as of the insulating fabric type. Portions 12a of the conductor 12 project from the opposite ends of the cover 13 and are suitably secured to associated electrical terminals 14, each of the terminals 14 comprising an eyelet 14a adapted to receive an associated electrical connecting stud and a tail 14b. More specifically, each projecting end portion 12a of the conductor 12 is secured to the tail 14b of the associated terminal 14. Preferably, each projecting end portion 12a of the conductor 12 extends through an opening 14c provided in the tail 14b of the associated terminal 14 and is return bent, as indicated at 12b, in order positively mechanically to anchor the conductor 12 to the terminal 14. Further, in order to perfect the electrical connection between each end portion 12a of the conductor 12 and the tail 14b of the associated terminal 14 a suitable amount of fused metal, such as solder or the like, is provided therebetween. Finally, each of the terminal fixtures 11 comprises, in addition to the conductor 12 having the cover 13 and the terminal 14, an insulating body 15 molded into embedding relationship with respect to the projecting end portion 12a of the conductor 12 and the adjacent portions of the cover 13 and the tail 14b of the associated terminal 14 and into interlocking relationship with respect to the adjacent portions of the cover 13 and the tail 14b of the associated terminal 14.

More particularly, the body 15 is formed of a hard, rigid, inactive, oil and lubricant resistant, and heat resistant insulating material, the body 15 being formed of hard insulating material in order positively to armor and thoroughly to insulate the connection between the projecting end portion 12a of the conductor 12 and the tail 14b of the associated terminal 14, and being formed of rigid material in order positively to relieve this connection of strain. Also, the body 15 of the terminal fixture 11 is formed of inactive insulating material containing no acid residue in order positively to prevent corrosion of the connection between the projecting end portion 12a of the conductor 12 and the tail 14b of the associated terminal 14. Finally, the body 15 of the terminal fixture 11 is formed of oil and lubricant resistant and heat resistant insulating material in order positively to prevent deterioration of the terminal fixture when subjected to service in the presence of oils and lubricants and a high ambient temperature, which service conditions are encountered when the terminal fixture is utilized in certain machines, such as calculating machines.

Preferably, the body 15 of the terminal fixture 11 is formed of the thermo-plastic insulating material known as "Tenite," this material having the properties mentioned above and consisting essentially of a cellulose ester resin, principally a cellulose acetate resin.

Referring now more particularly to Figs. 1, 2 and 6, there is illustrated die apparatus which may be utilized in making the terminal fixtures, this die apparatus comprising an upper movable die 16 provided with a supporting tail 16a and a lower stationary die 17 provided with a supporting tail 17a. The lower die 17 comprises a body portion 18 having a molding cavity 19

therein and two pairs of upstanding guide projections 20, 21 and 22, 23; while the upper die 16 comprises a body portion 24 having a molding cavity 25 therein and a pair of guide faces 26 and 27. The upper and lower dies 16 and 17, respectively, are so constructed and arranged that the upper die 16 is adapted to be forced into engagement with the lower die 17; whereupon the respective body portions 24 and 18 thereof are brought into superimposed relationship, thereby to form a composite molding cavity, including the complementary molding cavities 25 and 19 respectively provided in the body portions 24 and 18 of the upper and lower dies 16 and 17, respectively. Also, when the upper die 16 is forced into engagement with the lower die 17, the pairs of guide projections 20, 21 and 22, 23 respectively engage the guide faces 26 and 27, thereby positively to insure proper alignment of the body portions 24 and 18 of the respective upper and lower dies 16 and 17.

Further, the pair of guide projections 20 and 21 carried by the lower die 17 are so constructed and arranged that a semicylindrical recess 28 is formed therebetween which is adapted to cooperate with a complementary semi-cylindrical recess 29 formed in the body portion 24 of the upper die 16 in order to provide complementary clamping jaws adapted to receive and firmly clamp the cover 13 of the conductor 12 when the upper die 16 is forced into engagement with the lower die 17. Similarly, the pair of guide projections 22 and 23 carried by the lower die 17 are so constructed and arranged that a notch 30 is formed therebetween which is adapted to cooperate with a complementary notch 31 formed in the body portion 24 of the upper die 16 in order to provide complementary clamping jaws adapted to receive and firmly clamp the tail 14b of the associated terminal 14 when the upper die 16 is forced into engagement with the lower die 17.

Referring now more particularly to Fig. 6, there is illustrated a machine press which may be utilized in conjunction with the die apparatus including the upper and lower dies 16 and 17 in making the terminal fixture. More particularly, the machine press comprises a supporting frame 32 carrying a lower stationary die head 33 and an upper movable die head 34, the upper die head 34 being slidably mounted for reciprocating movement in the vertical direction upon a guide bar 35 carried by the supporting frame 32. The lower die head 33 is provided with facility for mounting the supporting tail 17a of the lower die 17; while the upper die head 34 is provided with facility for mounting the supporting tail 16a of the upper die 16, whereby the upper die 16 is movably mounted in cooperating relationship with respect to the lower die 17, in the manner previously explained.

As best shown in Figs. 6 and 7, an electrical circuit arrangement comprising two electrical heating elements 36 and 37 is provided for heating the upper and lower die heads 34 and 33, respectively, the heating element 36 being disposed in a suitable cavity 38 provided in the lower die head 33 and the heating element 37 being disposed in a suitable cavity 39 provided in the upper die head 34. Also, this circuit arrangement comprises two thermostatic switches 40 and 41 which are arranged in heat conducting relationship with respect to the lower and upper die heads 33 and 34, respectively, in order

to control the circuits for energizing the heating elements 36 and 37, respectively, thereby positively to govern the temperature of the upper and lower dies 16 and 17 respectively carried by the upper and lower die heads 34 and 33. Preferably, each of the thermostatic switches 40 and 41 is independently adjustable, thereby to allow independent adjustment of the heat supplied to each of the dies and consequently the temperature of each of the dies. Finally, this circuit arrangement comprises a master switch 42 for controlling the circuits of both of the heating elements 36 and 37, and a pair of circuit conductors 43 connected to a suitable source of current supply.

Referring again to Fig. 6, the machine press further comprises an operating bell crank 44 pivotally mounted on a pivot pin 45 carried by the supporting frame 32 and a drive shaft 46. The bell crank 44 comprises an arm 47 operatively associated with an adjustment screw 48 carried by the upper die head 34 and an arm 49 carrying a pin 50 rotatably supporting a roller 51, the roller 51 cooperating with a cam 52 secured to the drive shaft 46. The bell crank 44 and the cam 52 are so constructed and arranged that, when the drive shaft 46 is rotated one revolution in a counterclockwise direction, the cam 52 forces the cooperating roller 51, and consequently the arm 49 of the bell crank 44, abruptly toward the left and then gradually further toward the left, and then ultimately allows the roller 51, and consequently the arm 49 of the bell crank 44, to be forced abruptly toward the right back to its normal position. As a consequence of this operation of the cam 52 and cooperating roller 51, the bell crank 44 is abruptly rotated in the clockwise direction a predetermined angular distance about the pivot pin 45 and then gradually rotated in the clockwise direction a further angular distance about the pivot pin 45, and then ultimately abruptly rotated in the counterclockwise direction about the pivot pin 45 back to its normal position. As a result of this movement of the bell crank 44, the arm 47 thereof engaging the adjustment screw 48 moves the upper die head 34 rapidly and then gradually downwardly toward the lower die head 33 against the bias of a coil spring 53 extending between the upper die head 34 and the supporting frame 32; and subsequently permits the coil spring 53 to move the upper die head 34 rapidly upwardly away from the lower die head 33 back into its normal position. In view of the above description of the machine press it will be understood that, due to the construction and arrangement of the cam 52, the bell crank 44 and the coil spring 53, when the drive shaft 46 is rotated one revolution, the upper die 16 is first moved rapidly toward the lower die 17 and then forced gradually into engagement therewith, due primarily to the configuration of the cam 52; and then subsequently rapidly returned to its normally disengaged position with respect to the lower die 17, due primarily to the provision of the coil spring 53. Further, in this connection, it is noted that the actual stroke of the upper die 16 toward and away from the lower die 17 may be adjusted by adjusting the stroke of the upper die head 34 by means of the adjustment screw 48, thereby to govern the mating of the upper and lower dies 16 and 17, respectively, and consequently the pressure exerted therebetween.

Finally, the machine press comprises a motor 54 adapted to operate continuously and suit-

able clutch mechanism 55 arranged between the motor 54 and the drive shaft 46. Preferably, the clutch mechanism 55 is of the character of that disclosed and claimed in Theodore S. Bindscheller Patent No. 1,658,036, issued February 7, 1928, and comprises a trip shaft 56 and a trip lever 57, the trip lever 57 being pivotally mounted on a pivot pin 58 carried by the supporting frame 32 and connected by a pin and slot arrangement 59 to a lever 60 carried by the trip shaft 56. The trip shaft 56 is biased to a normal position by a coil spring 61 extending between a pin 62 carried thereby and a pin 63 carried by the supporting frame 32, and is adapted to be tripped by the operation of the trip lever 57. More particularly, the trip shaft 56 is biased in a clockwise direction by the coil spring 61 and is adapted to be rotated in a counterclockwise direction against the bias of the coil spring 61 when the trip lever 57 is depressed in an obvious manner. The clutch mechanism 55 is so connected and arranged that, when the trip shaft 56 is tripped, the drive shaft 46 is automatically clutched to and subsequently declutched from the motor 54, whereby the drive shaft 46 is rotated precisely one revolution.

From the foregoing explanation of the mode of operation of the machine press, it will be understood that each time the trip lever 57 is depressed the trip shaft 56 is tripped, thereby to cause the drive shaft 46 to be clutched to the motor 54 and rotated one revolution in the counterclockwise direction; whereupon the upper die 16 is moved into closed position with respect to the lower die 17 and then moved into open position with respect thereto.

In making the electrical terminal fixture in accordance with the method of the present invention, the conductor 12 having the insulating cover 13 is first provided and then a portion of the insulating cover 13 is removed from the conductor 12 adjacent one end thereof in any suitable manner, in order to provide the bared projecting end 12a of the conductor 12. The bared projecting end 12a of the conductor 12 is cleaned in any suitable manner and inserted through the opening 14c formed in the tail 14b of the provided terminal 14. Subsequently, the bared projecting end 12a of the conductor 12 is returned upon itself in order mechanically to secure the conductor 12 to the tail 14b of the terminal 14. Further, the connection between the bared projecting end 12a of the conductor 12 and the tail 14b of the terminal 14 is reinforced by fused metal, such as solder or the like, thereby further to secure the connection and to insure a good electrical bond between the conductor 12 and the terminal 14.

A preformed or premolded hard, rigid sleeve of the previously mentioned thermo-plastic insulating material, which is subsequently deformed in order to produce the insulating body 15, is then placed upon the opposite end of the cover 13, in the event that it has not previously been placed thereupon. At this point it is noted that, in making the electrical terminal link 10 comprising terminal fixtures 11 on either end thereof, it is advisable to place two of the sleeves mentioned upon the cover 13 of the conductor 12 before securing the oppositely projecting bared ends 12a of the conductor 12 to the associated terminals 14, in the manner previously explained. In any event, at this time, the insulating sleeve surrounding the cover 13 of the conductor 12 is slid longitudinally along the cover 13 from a position, such as indi-

cated on the left-hand side of Fig. 3, to a position, such as indicated on the right-hand side of Fig. 3; whereby the sleeve is disposed in surrounding relationship with respect to the bared portion 12a of the conductor 12 and the adjacent portion of the cover 13 and the adjacent portion of the tail 14b of the associated terminal 14.

After the insulating sleeve has been positioned with respect to the connection between the bared projecting end 12a of the conductor 12 and the tail 14b of the terminal 14, the assembly is positioned in the lower die 17 supported by the lower die head 33 of the machine press, as clearly shown in Fig. 1. More particularly, at this time, the insulating sleeve is disposed in the open top of the molding cavity 19 provided in the body portion 18 of the lower die 17; the tail 14b of the terminal 14 is positioned in the notch 30 disposed between the pair of upstanding guide projections 22 and 23 carried by the lower die 17; and the portion of the cover 13 adjacent the bared projecting end 12a of the conductor 12 is positioned in the recess 28 disposed between the pair of upstanding guide projections 20 and 21 carried by the lower die 17. At this time, the insulating sleeve carried by the conductor 12 and positioned in the molding cavity 19 provided in the body portion 18 of the lower die 17 is in readiness to be acted upon by the upper and lower dies 16 and 17, respectively, thereby to mold the sleeve into the body 15 of the terminal fixture.

In order to accomplish molding of the sleeve mentioned into the body 15 of the terminal fixture 11, the trip lever 57 of the machine press, shown in Fig. 6, is tripped in the manner previously explained; whereupon the upper die 16 is moved rapidly toward the lower die 17 into firm engagement with the sleeve surrounding the conductor 12 in order to heat the sleeve. The upper die 16 is then forced gradually toward the lower die 17 in order to continue the heating of the sleeve surrounding the conductor 12 and to subject the sleeve to a deforming pressure, as clearly shown in Fig. 2. At this time, the cavity 25 provided in the body portion 24 of the upper die 16 engages the upper surface of the sleeve surrounding the conductor 12; and the cavity 19 provided in the body portion 18 of the lower die 17 engages the lower surface of the sleeve surrounding the conductor 12. Furthermore, the portion of the tail 14b of the terminal 14 disposed adjacent the projecting portion 12a of the conductor 12 is firmly clamped between the cooperating notches 30 and 31 provided in the lower and upper dies 17 and 16, respectively; while the portion of the cover 13 adjacent the projecting portion 12a of the conductor 12 is firmly clamped between the cooperating recesses 28 and 29 provided in the lower and upper dies 17 and 16, respectively.

As a result of the action of the upper and lower dies 16 and 17, respectively, the sleeve surrounding the conductor 12 is rendered plastic and is deformed and molded into intimate contact with the bared projecting portion 12a of the conductor 12, the adjacent portion of the cover 13 and the adjacent portion of the tail 14b of the terminal 14, thereby to interlock the adjacent portion of the tail 14b of the terminal 14 and the adjacent portion of the cover 13, after the body 15 sets, in order to relieve of strain the connection between the projecting portion 12a of the conductor 12 and the tail 14b of the terminal 14. Also, this action of the upper and lower dies 16

and 17, respectively, molds the cylindrical sleeve into the smooth rounded body 15 of the terminal fixture 11, as clearly shown in Figs. 2 and 5.

In connection with the molding or remolding of the insulating sleeve into the body 15 of the terminal fixture 11, it is noted that the temperatures of the upper and lower dies 16 and 17, respectively, must be maintained so that the insulating sleeve is subjected, during the molding operation, to a temperature of the order of 300° F. Further, it is pointed out that preformed insulating sleeves of "Tenite" of suitable length may be acquired commercially or produced initially by a suitable molding operation utilizing "Tenite" in powdered form.

Subsequently, the upper die 16 is moved away from the lower die 17, in the manner previously explained; whereupon the finished terminal fixture 11 is removed from the lower die 17 and allowed to cool. When the body 15 of the terminal fixture 11 has been allowed to cool, it sets or reassumes a hard, rigid condition and is ready for service.

While there has been described what is at present considered to be the preferred embodiment of the terminal fixture and the method of making the same in accordance with the present invention, it will be understood that various modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. The method of making an electrical insulated conductor terminal which comprises the steps of placing upon an electrical conductor, having an insulation covering and a bare conductor end portion, a sleeve of rigid thermoplastic insulating material and positioning said sleeve to surround an insulation-covered portion of said conductor, securing an electrical terminal means to said bared conductor end portion in electrically conducting relation therewith, moving said sleeve to a position in which it surrounds said bared conductor end portion, a portion of said insulation covering on said conductor adjacent said conductor end portion and a portion of said terminal means, and heating said sleeve and compressing it in molding means to mold said thermoplastic sleeve into intimate contact and solid engagement with at least said surrounded portions of said terminal and insulation covering.

2. The method of making an electrical insulated conductor terminal which comprises the steps of placing upon an electrical conductor, having an insulation covering and a bare conductor end portion, a sleeve of a rigid thermoplastic insulating material selected from the class comprising cellulose acetate and mixtures including cellulose acetate, positioning said sleeve to surround an insulation-covered portion of said conductor, securing an electrical terminal means to said bared conductor end portion in electrically conducting relation therewith, moving said sleeve to a position in which it surrounds said bared conductor end portion, a portion of said insulation covering on said conductor adjacent said conductor end portion and a portion of said terminal means, and heating said sleeve and compressing it in molding means to mold said thermoplastic sleeve into intimate contact and solid engagement with at least said surrounded portions of said terminal and insulation covering.

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