April 16, 1929. H. H. HELLER ET AL 1,709,015

WIRE SPLICING PROCESS AND APPARATUS

Filed Jan. 20, 1926 3 Sheets-Sheet 1

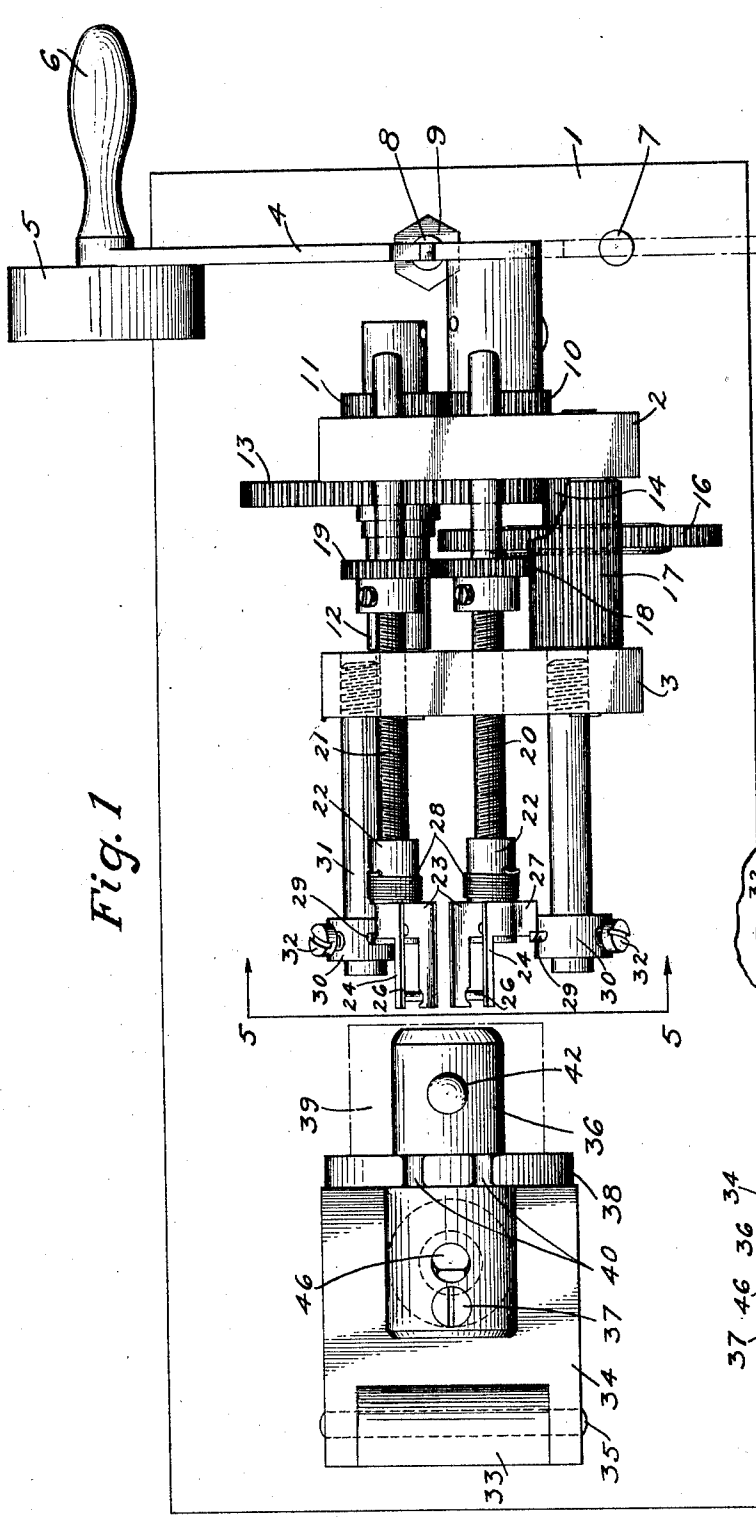


Fig. 1

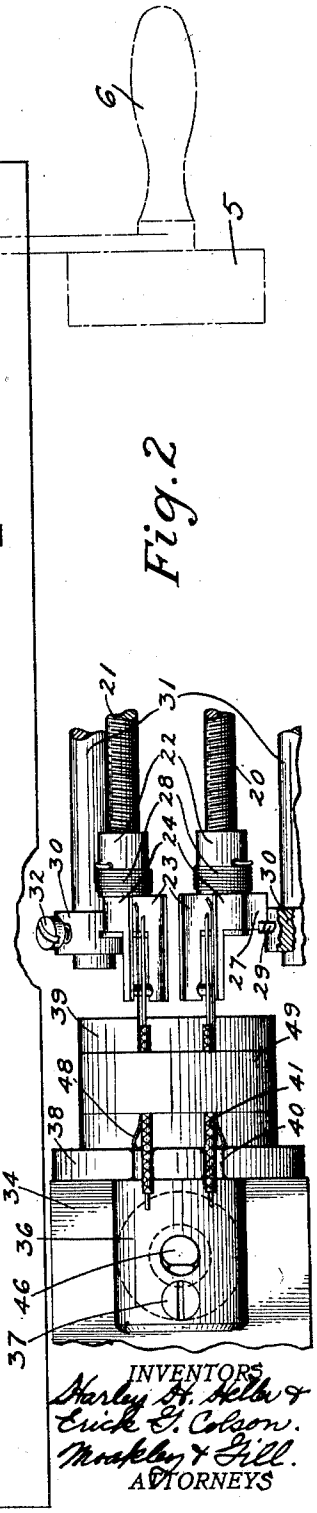


Fig. 2

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WIRE SPLICING PROCESS AND APPARATUS

Filed Jan. 20, 1926 3 Sheets-Sheet 2

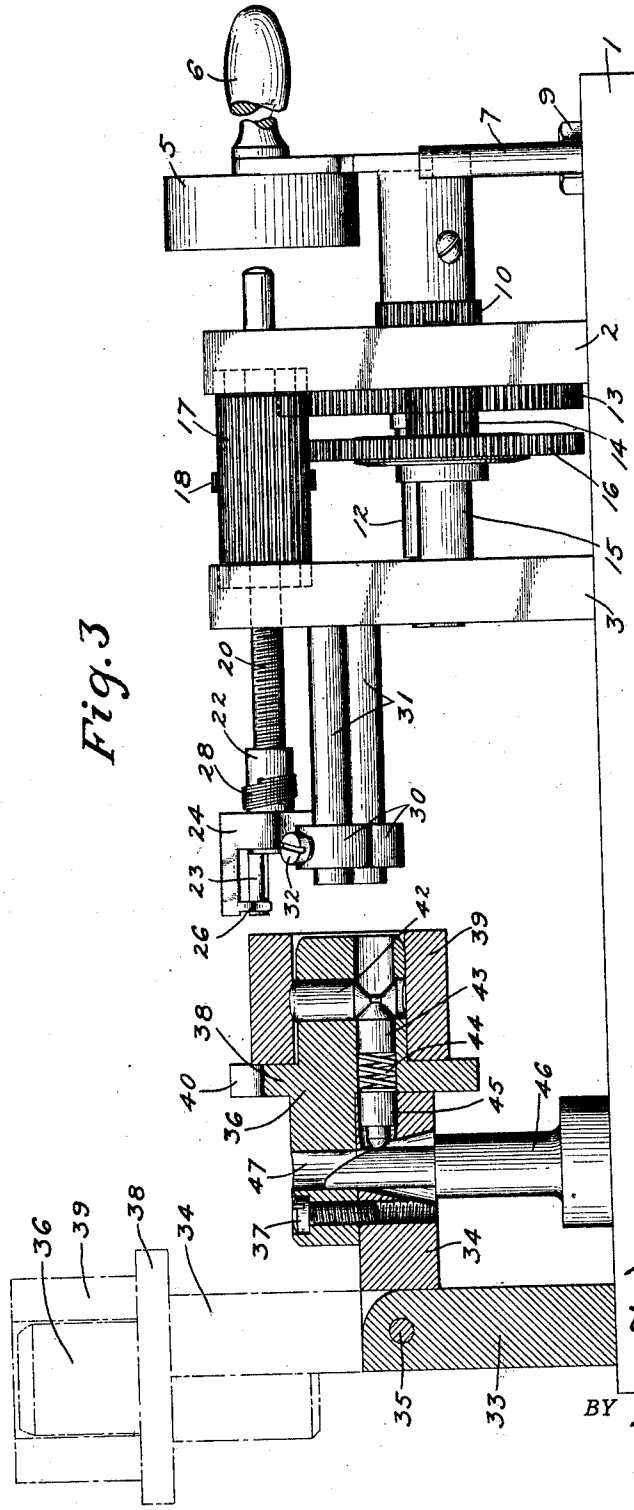


Fig. 3

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WIRE SPLICING PROCESS AND APPARATUS

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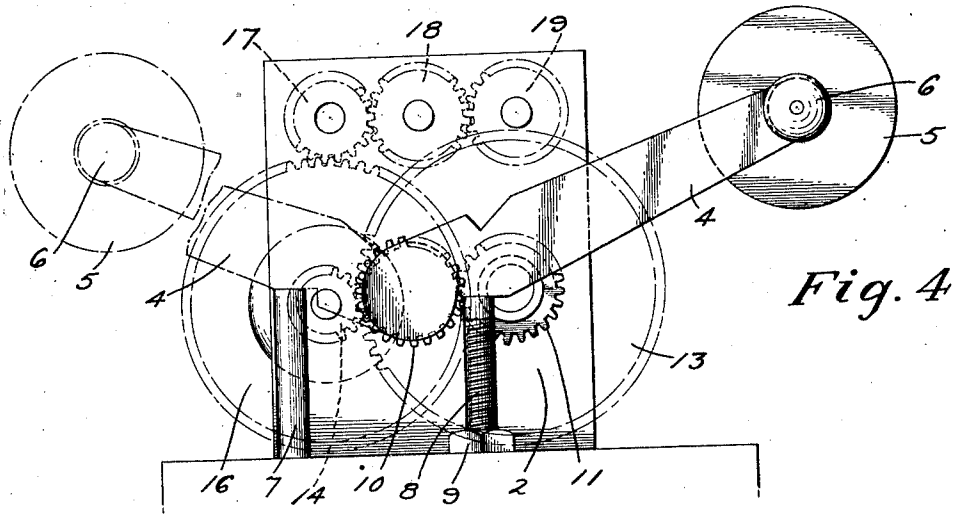


Fig. 4

Fig. 5

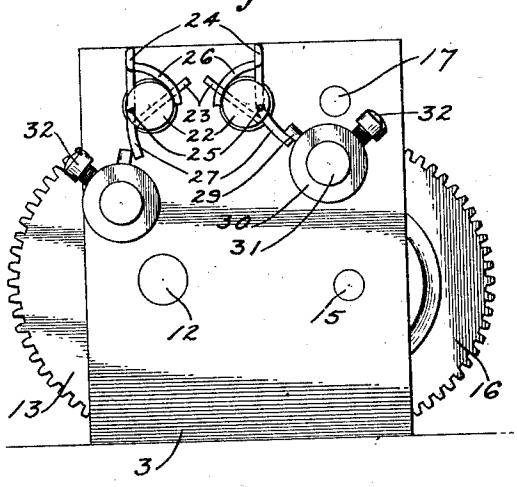


Fig. 6

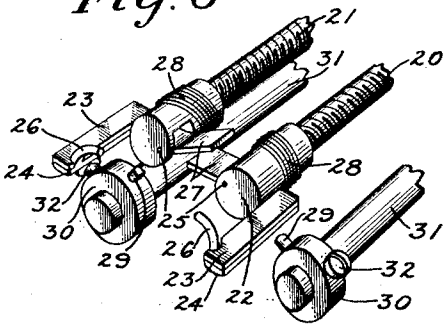
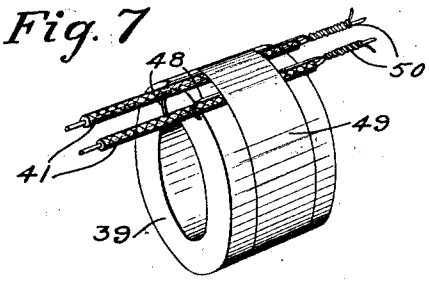


Fig. 7



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Patented Apr. 16, 1929. 1,709,015

UNITED STATES PATENT OFFICE.

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WIRE-SPLICING PROCESS AND APPARATUS.

Application filed January 20, 1926. Serial No. 82,477.

This invention relates to the splicing of electrical conductors and particularly to the splicing of lead wires to the terminal wires of electrical coils.

The principal object of this invention is to provide a simple, rapid and efficient process and apparatus for the splicing of wire, whereby an effective splice is rapidly produced without the necessity of touching the wire with the hands, so that the completed splice may be immediately soldered, if desired, without further preparation such as fluxing, cleaning or the like. However, for many purposes the splices will be sufficiently tight to obviate the soldering process.

In the art of making electrical coils, particularly for use in radio and ignition apparatus for example, the wound units are usually manufactured by automatic winding machines, and, in order to be complete for the use intended, leads must be spliced, soldered or otherwise attached to the terminals of the wound unit. Heretofore this has been done by hand, whereby the insulation was removed from the terminals and the leads by scraping, brushing or grinding, and the splice also was usually made by hand by twisting the wires together. Inasmuch as the bare surfaces of wire are highly susceptible to the accumulation of deteriorating foreign matter, such as the excretion from the hands, which, in addition to preventing an effective electrical bond between the wires, commonly has a subsequent harmful effect upon an apparently good joint causable by the deposited body acids, which often results in the disintegration of the joint at a considerably later time. This invention is preferably used in connection with the insulation removing process and apparatus disclosed in the copending application of Harley H. Heller, Serial No. 79,011, filed January 2, 1926, which comprises a process and apparatus for removing the enamel insulating coating from wire by subjecting it to a combined rolling and rubbing action between relatively moving elements preparatory to the splicing, soldering or like operation for the purpose of attaching leads or other conductors thereto, without touching the same with the hands.

This invention comprises a process and apparatus for splicing wires, and consists in subjecting the ends of the wires to a twisting operation which results either in a twisted joint of equally and uniformly twisted wires, or a joint having one wire, usually the fine wire, twisted substantially helically around the other wire in such a manner that an extremely tight and effective electrical joint results between the wires, which were preferably prepared in accordance with the aforementioned invention. The resultant joint is of sufficient tightness that, for the relatively higher voltage usages, the soldering operation may be readily dispensed with.

One type of apparatus for effecting the process disclosed by this invention consists essentially of coacting jaws which grip the two or more terminals of wire along the length which is to be spliced, and twist them together by a combined simultaneous rotary and retracting motion in such a manner that the wires, while being twisted together, are gradually emerging from between the jaws, at the edges of which the twisting action takes place. When the twisting operation is completed, the twisted splice extends between the coil face and the edges of the twisting jaws, the end of the splice remaining gripped between the jaws, and consequently leaves an extremely short untwisted length of each wire which may be left as they are or cut off, as desired. If the joint is to be soldered the protruding splice may be dipped in molten solder or treated with a soldering iron in a manner well known in the art.

Other advantages and objects in this invention will become apparent upon examination of the accompanying drawings which illustrate a preferred embodiment of an apparatus for effecting the invention and described hereinafter. In the drawings, in which like reference characters designate like parts in several views:

Figure 1 is a plan view of an apparatus for splicing wires embodying this inventions, the other extreme position of the operating crank being shown in phantom;

Fig. 2 is a plan view of the twisting mechanism proper, showing a coil in readiness for having leads spliced thereto;

Fig. 3 is side elevation of the apparatus, the coil holding and positioning means be-

ing shown in section and its initial position in phantom;

Fig. 4 is an end view showing the actuating gear arrangement and the other extreme position of the operating crank in phantom;

Fig. 5 is an end view of the wire gripping jaw mechanism taken along the line 5—5 of Fig. 1;

Fig. 6 is a perspective illustration of the gripping mechanism at the beginning of the twisting action in which the jaws are closed; and

Fig. 7 is an illustration of a coil to which terminals have been spliced in accordance with this invention.

Referring particularly to Fig. 1, numeral 1 designates a bed plate or the like to which the several stationary parts of the machine may be fastened. Rigidly mounted to base plate 1 are two similar standards 2 and 3 which carry the actuating movable parts of the apparatus, standard 2 mounting the operating crank 4 having a weight 5 and handle 6 at its extremity. The throw of crank 4 is limited to the left as shown in phantom in Fig. 1 by a pin 7 mounted in base plate 1, and its throw toward the right is limited by a similar pin 8, which however is adjustable vertically by means of nut 9 so that the right hand throw of crank 4 may be varied for purposes to be hereinafter explained. Coaxial and integral with the hub of crank 4 is a pinion 10 which meshes with a coacting pinion 11, the collar of which is pinned to shaft 12 which passes through standard 2 and is journalled in standard 3. A relatively large gear 13 is rigidly mounted on shaft 12 so as to rotate therewith as pinion 11 is revolved, which in turn meshes with pinion 14 integral with shaft 15 which also carries integral gear 16, shaft 15 being journalled in standards 2 and 3.

A long pinion 17 which is journalled in standards 2 and 3 and arranged so as to be rotated by gear 16, drives meshing pinions 18 and 19 which are rigidly mounted on screw shafts 20 and 21, respectively. Shafts 20 and 21 are provided with right- and left-hand screw threads respectively, and are each threaded through standard 3 so as to advance or retract therethrough depending upon which way crank 4 is thrown. Accordingly, the ends of shafts 20 and 21 slip back and forth through standard 2 and pinion 18 moves longitudinally back and forth along pinion 17, which is made long for that purpose.

The gripping heads 22 are rigidly mounted on the extremities of right- and left-hand screw shafts 20 and 21, and reciprocate and rotate therewith accordingly. The relatively stationary jaws 23 of the gripping heads 22 are fastened thereto so as to project radially beyond them as illustrated. The extreme ends of the gripping heads are notched radially for the reception of the movable jaws 24 which pivot about the pins 25 as is most clearly shown in Figs. 5 and 6, the angular movement of the jaws being guided by arcuate pins 26 which slide in notches provided in the edges of relatively stationary jaws 23. The movable jaws 24 have depending lugs 27 to which one of the ends of spiral torsion springs 28 are fastened, the coil thereof encircling the bodies of gripping heads 22 to which the other ends of the springs are fastened. Springs 28 are adapted to maintain jaws 23 and 24 in a normally closed position by forcing the coincidence of the jaw faces as shown in Fig. 6. The jaws are opened by the engagement of lugs 27 with fixed trip pins 29 in collar 30 mounted on stationary rods 31, which project horizontally from standard 3, and are adjustable angularly thereon by means of set screws 32. Trip pins 29 are so positioned that the wire receiving jaws 23 and 24 are opened at the instant that the lead of screw shafts 20 and 21 brings lugs 27 into the proper radial and axial positions to engage them. In brief, the rotation of lugs 27 and consequently relatively movable jaws 24 is stopped at a sufficient interval before the rotation of jaws 23 is stopped to effect the opening of the jaws as shown in Figs. 1, 2, 3 and 5, against the torsional retention exerted by springs 28 to keep the jaws closed. Any reverse movement causes the disengagement of lugs 27 from trip pins 29, whereupon the jaws are immediately closed by springs 28, as is shown in Fig. 6.

As illustrated in the drawings, the embodiment of an apparatus for effecting this invention has been adapted for the attachment of lead wires to the terminal wires of electrical coils. The particular coil holding and positioning means shown comprises a vertical block 33 mounted on base plate 1, opposite to the twisting mechanism, and having a bifurcated bar 34 pivotal thereon about pin 35. The coil holding stud 36 is rigidly mounted on bar 34 by means of tap screw 37 and is provided with a collar 38 against which the end of the coil 39 abuts, as is illustrated in Figs. 1, 2 and 3. If leads are to be attached to the coils in the manner illustrated, collar 38 is preferably provided with lead guide slots 40 so that the leads 41 may be more readily positioned on the coil as desired, as shown in Fig. 2.

In order to insure that coil 39 is securely held in operative position, a movable pin 42 is provided on stud 36, which is adapted to frictionally engage a point on the inner surface or core of the coil so as to cause it to be drawn tightly around stud 36 so as to be virtually gripped between the lower surface of stud 36 and pin 42. Upon referring to Fig. 3 it will be evident that the outward

radial thrust of pin 42 is effected by the engagement of the chamfered nose of pin 43 with the similarly shaped annular slot in pin 42. A coil spring 44 is interposed between pins 43 and 45, the latter being actuated by the cam action of the tapered tip of pin 46 which is vertically mounted in base plate 1 so as to register with a hole 47 provided therefor in the under surface of bar 34. Accordingly, it will be evident that the lowering of bar 34 from the position shown in phantom in Fig. 3 into the subsequent operative position involves the engagement of pin 45 with the tapered surface of pin 42 and the consequent axial movement thereof which is transmitted by spring 44 to pin 43 causing the radial movement thereof to engage the core of coil 39. Conversely, the raising of bar 34 disengages pins 45 and 46 and pin 42 is consequently released from coil 39, allowing it to be readily removed from stud 36.

Apparatus embodying this invention may be applied to the making of twisted joints or splices between virtually any kinds and gauges of wire, merely by enlarging or decreasing the sizes of operating parts, or by altering the arrangement and spacing of the twisting shafts to suit desired conditions. Likewise, other stationary wire holding or gripping means, such as are well known in the art, may be used in place of the coil holding and positioning means illustrated and described.

Having explained the function of the invention and described a preferred embodiment of an apparatus for effecting the same, the method and operation thereof will now be further disclosed in detail. The wires, having been bared of insulation in order to make an effective electrical joint, are arranged parallelly so that the ends thereof project horizontally and are substantially even if the wires are of approximately equal gauge, but if of a different gauge the finer wire is arranged so that it extends beyond the heavier wire since it must be wrapped around the heavier wire and should therefore be longer. Referring to Fig. 2, for example, the coil terminals 48 have been drawn out of the coil 39 and stretched across its edge to project beyond the opposite face from which they were drawn, as shown. The coil 39 is then slipped over stud 36, which is initially in the vertical position shown in phantom in Fig. 3, so that the terminal wires 48 are on top and are disposed horizontally when the stud 36 is moved into the operative position shown in Fig. 2. When stud 36 is thrown downwardly, the tapered surface of pin 46 acts as a cam to move spring-separated pins 43 and 45 longitudinally as a unit, so that pin 45 is actuated by the tapered surface of pin 46 causing upward radial movement of pin 42 to engage the core of the coil and hold it securely in place on stud 36 in the manner heretofore explained and illustrated by the longitudinal section in Fig. 3. Lead wires 41 are then laid in grooves 40 and parallel to terminal wires 48 so that all of the wire ends will splice approximately even and project beyond the face of the coil. A strip of adhesive tape 49, illustrated in Figs. 2 and 7, a metallic clip, not shown, or any other means of fastening may be utilized to hold the wires in place.

The projecting ends of the wires, which are to be joined together, lie in the open jaws 23 and 24, which are held open by the engagement of trip pins 29 with lugs 27 on jaws 24. The extent of jaw opening is governed and limited by adjustable stud 8 against which operating crank 4 strikes at one extreme limit of its throw. The adjustment of stud 8 accordingly varies the travel of screw rods 20 and 21 to which the wire gripping heads 22 are rigidly attached, and hence the extent of engagement of lugs 27 with trip pins 29 and the consequent jaw opening may be adjusted as desired. Thus the smaller and larger gauge wires are provided for by the adjustment of stud 8. This adjustment may also be effected by the radial alteration of the position of trip pins 29.

Upon a slight angular upward movement of operating crank 4 from the position shown in Fig. 1, lugs 27 will become disengaged from trip pins 29, and coiled springs 28 will effect the gripping closure of jaws 23 and 24 upon the wires lying between them. Further motion of operating crank 4 through its complete arc, which is limited by its engagement with pin 7, revolves gears 10, 11, 13, 14, 16, 17, 18 and 19 to effect the rotation of screw rods 20 and 21 which are threaded through stationary standard 3. The rotation of screw rods 20 and 21 causes the simultaneous eccentric rotation and progressive retraction of gripping jaw heads 22 away from coil 29, and the consequent gradual withdrawal of the jaws from the wires they grip. The combined rotation and retraction of gripping heads 22 causes the wires to be twisted together at the point where they emerge from the edge of the jaws as the jaws are drawn along and toward the ends of the wire.

Inasmuch as lead wires are ordinarily of a larger gauge or stranded, and consequently stiffer than the coil wire terminals 48, the coil wire is tightly bound helically around the terminal, thereby making a very tight splice which is so effective electrically that subsequent soldering may often be dispensed with, especially when a relatively high voltage is utilized. When wires of the same gauge are spliced, they are uniformly twisted around each other to make a symmetrical helical joint.

When the twisting operation is completed the twisted splice extends between the coil 39 and the edges of the jaws of the gripping heads 22, between the jaws of which the free ends of the wire are still retained. These free ends, however, are usually so short that they may be ignored or they may be cut off, as desired. An illustration of the completed coil is shown in Fig. 7, the leads 41 being ready for attachment to the terminals apparatus, and the spliced length 50 may be dipped into a bath of molton solder or treated with a soldering iron in the well known manner. In order to return the machine to its initally operative position in readiness for the next splicing operation, operating crank 4 is thrown over into the position shown in Figs. 1, 3 and 4, which causes the engagement of lugs 27 on the gripping heads 22 with stationary trip pins 29 to effect the opening of the jaws for the reception of the next wires to be spliced. Inasmuch as the twisting effect takes place at the edges of the jaws as the wire emerges therefrom, the jaws need only be of short length so that the wires are line-gripped, or the jaws may be long as illustrated in the drawings and which is preferable, since the trailing wire ends are kept straight thereby. By the use of cam and power means, the operation of the machine could obviously be made semi-automatic in any of the manners well known in the art, and the size and capacity of the machine could likewise be altered to accommodate various conditions.

While this specification describes and the accompanying drawings illustrate a preferred embodiment of apparatus for effecting the invention, it will be understood that changes may be freely made in form and detail without departing from the spirit of the invention within the scope of the appended claims.

We claim:—

1. The process of joining parallel wire ends which consists in gripping the ends at the base of the intended joint, and retracting the grip with a twisting motion along the wires to be joined so as to twist them together.

2. The process of splicing wires, which consists in arranging them parallelly, gripping them at the base of the intended splice, and retracting the grip with a rotary motion along the wires so as to twist them together.

3. The method of attaching lead wires to the terminal wires of an electrical coil, which consists in laying the lead wires parallel to the terminal wires, gripping the length of wires to be spliced, and gradually decreasing the gripped length with a retrogressive twisting action.

4. The method of attaching lead wires to the terminal wires of an electrical coil, which consists in gripping the parallel wires at the base of the intended splice, moving the gripping contact retrogressively toward the ends of the wires, and simultaneously rotating the gripping contact to twist the wires together.

5. The method of splicing lead wires to the terminal wires of electrical coils which consists in gripping the parallel ends of the wires, and simultaneously retracting and rotating the grip so that the wires are twisted together as they are released.

6. An apparatus for splicing wire comprising means for holding the wires stationary near the base of the intended splice, means for gripping the wires at the base of the intended splice, and means for simultaneously rotating and retracting said gripping means to twist said wires together.

7. A machine for making a twisted wire splice comprising a means for holding the wires in parallel relation, jaws for gripping the wires at the base of the intended splice, means for progressively retracting said jaws, and means for rotating said jaws simultaneously with the retracting action.

8. A machine for splicing leads to coil terminals comprising means for holding the coil, means for parallelly gripping the lead and terminal wire ends, and means for simultaneously rotating and retracting the gripping means to twist the wires together.

9. In a wire splicing machine, the combination of coacting normally closed wire gripping jaws, means for opening said jaws, resilient means for closing said jaws, and means for simultaneously rotating said jaws and moving them parallel to the axis of their rotation.

10. In a wire splicing machine, the combination of coacting wire gripping jaws, screw means mounting said jaws, means for rotating said screw means to effect axial movement thereof, resilient means for maintaining said jaws in normally closed correlation, and positive jaw opening means effective in one position of said screw means.

11. A machine for making a twisted wire splice comprising eccentrically rotatable coacting jaws, means for simultaneously rotating and progressively advancing or retracting said jaws, resilient means for closing said jaws, and means for temporarily opening said jaws.

12. A machine for splicing lead wires to the terminal wires of electrical coils comprising a coil holder, rotatable jaws immediately adjacent said coil in one extreme position, means for opening said jaws while in said position, resilient means to normally close said jaws, screw means rigidly mounting said jaws, and means for rotating said screw means to simultaneously rotate or progressively retract said jaws from said coil.

13. In a machine for splicing wire leads to the terminal wires of a coil, a rigid support for the coil, normally closed jaws, a

screw mounting the same, means for rotating said screw to simultaneously rotate and advance or retard said jaws, and trip means to open said jaws when adjacent said coil for the reception of the wires.

14. In a machine for splicing leads to a coil, a support for the coil comprising a stud adapted to be inserted into the coil, means for mounting said stud pivotally, a radial pin in said stud, and cam means for projecting said pin outwardly to engage the coil to fix it in position on said stud.

15. In a machine for splicing leads to a coil the combination of splicing mechanism, a pivotal support for the coil, a rigid bar to which said support is hinged, a cam means adapted to engage said support in its operative position, and a pin in said support adapted to be actuated by said cam means to grip the coil to said support.

In testimony whereof, we have affixed our signatures.

HARLEY H. HELLER.
ERICK G. COLSON.