May 28, 1963 C. A. AQUILLON 3,091,276

CRIMPING APPARATUS

Filed June 19, 1961 2 Sheets-Sheet 1

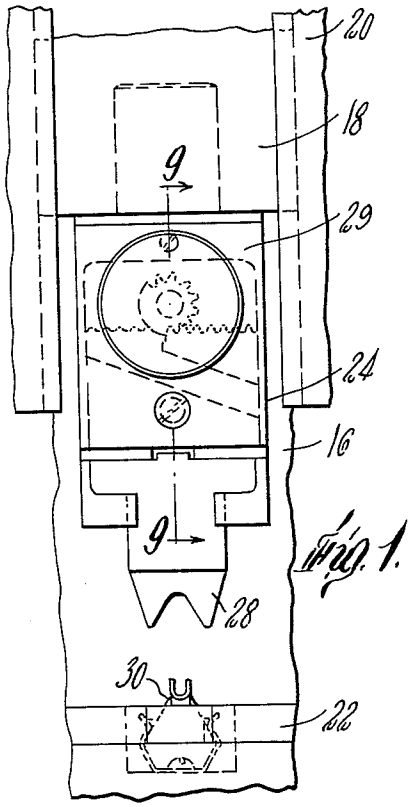


Fig. 1.

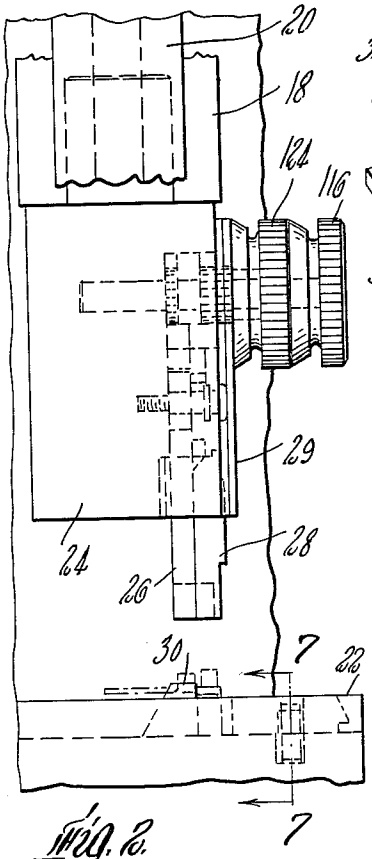


Fig. 2.

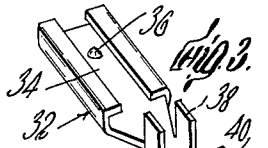


Fig. 3.

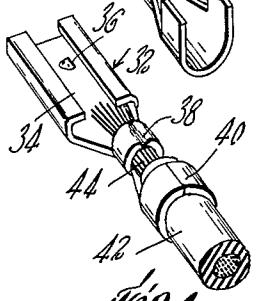


Fig. 4.

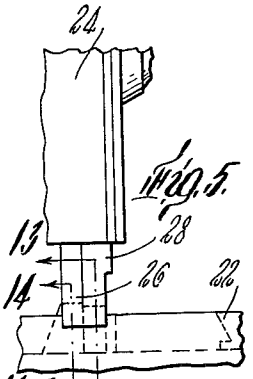


Fig. 5.

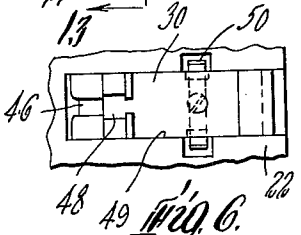


Fig. 6.

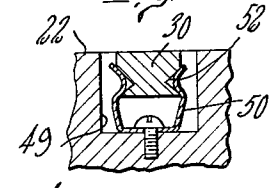


Fig. 7.

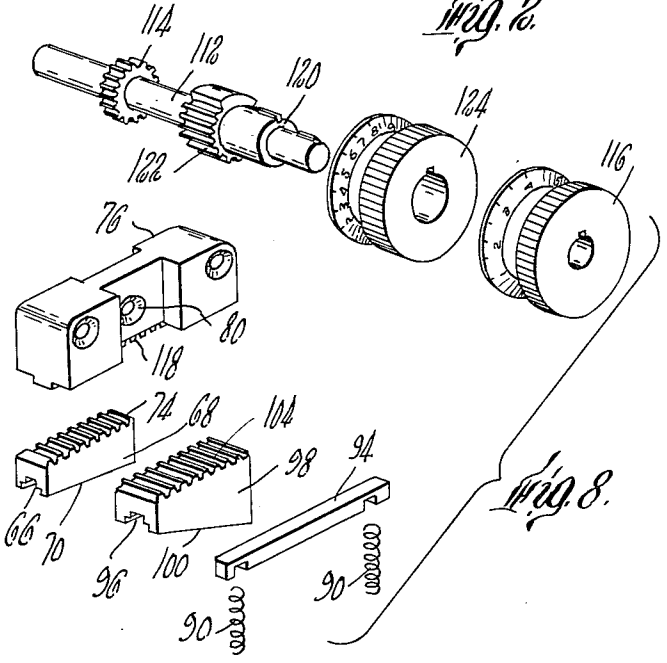


Fig. 8.

May 28, 1963 C. A. AQUILLON 3,091,276

CRIMPING APPARATUS

Filed June 19, 1961 2 Sheets-Sheet 2

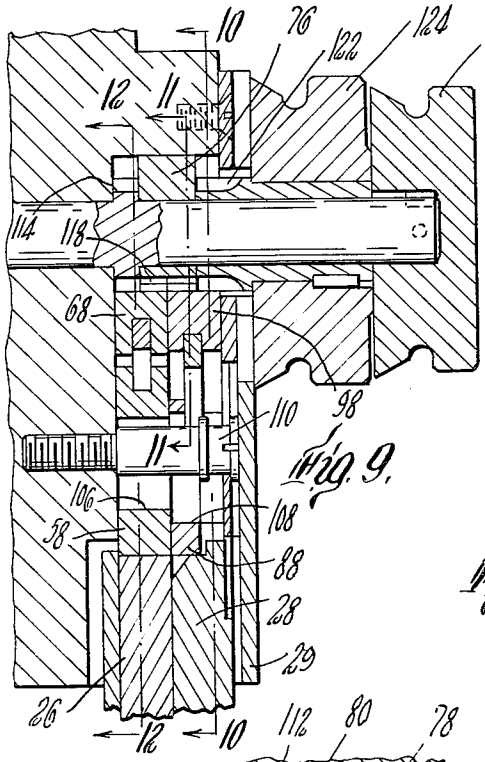


Fig. 9.

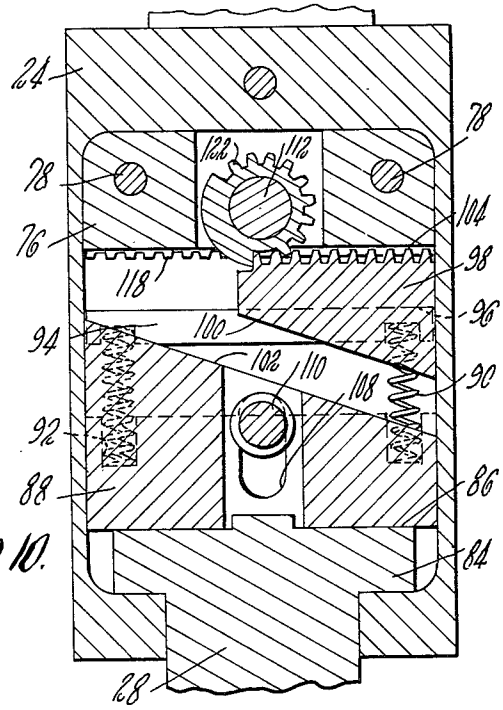


Fig. 10.

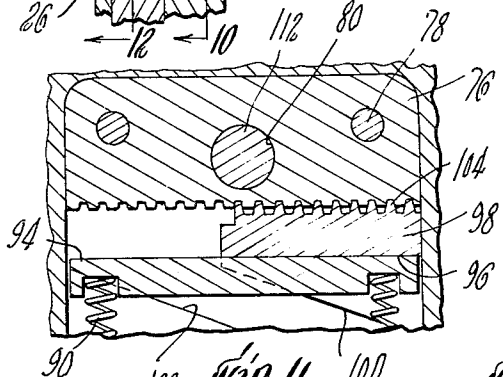


Fig. 11.

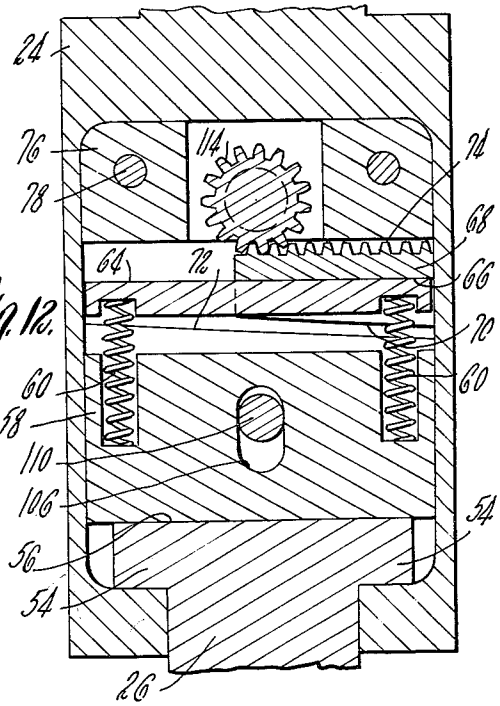


Fig. 12.

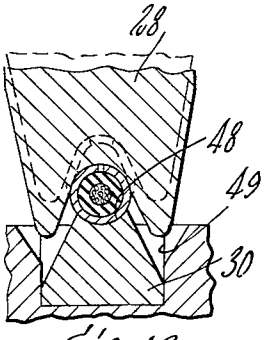


Fig. 13.

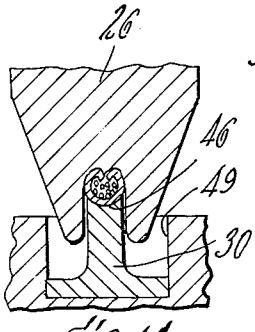


Fig. 14.

United States Patent Office 3,091,276 Patented May 28, 1963

3,091,276
CRIMPING APPARATUS

Charles A. Aquillon, Newtonville, Mass., assignor to Ark-Les Switch Corporation, Watertown, Mass., a corporation of Massachusetts

Filed June 19, 1961, Ser. No. 118,035
8 Claims. (Cl. 153—1)

This invention relates to a machine or apparatus for crimping sheet metal electrical terminal lugs in order to fasten them to insulated wires. More particularly the invention is directed to such a machine which is adjustable to crimp the body of a terminal lug properly for electrical connection to wires of different sizes or gauges, which wires have insulating sheaths thereon of different thicknesses or outside diameters to which the body of the lug also must be crimped or fastened.

In fastening a terminal lug or similar connector to an insulated wire it is required not only that the lug make proper electrical connection to the wire but it is vital that the insulation surrounding the wire also be held firmly by the lug in order to support the wire so that mechanical strain is not carried by the conductor alone and so that the insulation will not split or creep along the wire and expose it beyond the lug. For this reason improved solderless lug designs provide for portions intended to grip and hold the insulation as well as portions for insuring good electrical connection of the lug to the wire or cable within the insulator. If all wires or cables were of one size or if all insulation were of one thickness for each wire size, there would be little problem in designing tools or machines to fasten lugs to insulated wires. However, wires come in many sizes, and the thickness of insulation, even on wire or cable of a single size, varies between wires intended for different uses and manufactured to different standards. Therefore, a machine or tool for crimping terminal lugs to insulated wires has but limited usefulness unless it can be adjusted to accommodate lugs of different sizes, wires of different sizes and insulation of different thicknesses.

One object of the present invention is to provide a tool or machine for crimping lugs or connectors to insulated wires, the machine being adjustable for a wide range of wire sizes and outside insulation diameters, using a variety of lugs.

Another object is to provide such a machine in which the adjustment may be made easily and quickly for changes in either or both the wire size and insulation diameters.

A further object is to provide in such a machine a reinforcing arrangement to prevent damage to the adjusting mechanism while the clinching or crimping operation is being carried out.

Still another object is to provide a means which locks the adjustment against accidental change while the machine is being used.

A still further object is to provide a crimping machine in which crimping of lugs of different sizes or types may be accomplished in the same machine as occasion demands.

In carrying out the objects of this invention in one embodiment thereof, a crimping press is provided with separate movable elements for shaping or forming the wire-connecting portion and the insulation-gripping portion of a terminal lug. The drivers for the forming elements are each provided with a separate wedge-like member, each adjustable through a gear from an adjusting knob between positions which vary the effective length of movement of the forming elements. Teeth on the wedge members which mesh with the adjusting gears are used in a novel ratcheting arrangement which holds the wedges in

their adjustment and this part of the machine is also designed to reinforce the adjusting mechanisms against damage during action of the forming elements.

Other objects, advantages and further details of that which is believed to be novel and included in this invention will be clear from the following description and claims, taken with the accompanying drawings in which is illustrated an example of adjustable crimping machine embodying the present invention and incorporating the improved adjustable wedge-like members and associated elements.

In the drawings:

FIG. 1 is a front view of the essential parts of a crimping machine or press according to this invention;

FIG. 2 is a side view of this machine;

FIG. 3 is an enlarged perspective view showing a terminal lug of a type which may be crimped or formed in the machine;

FIG. 4 is a similar perspective of the lug of FIG. 3 but with a length of insulated wire positioned in it and the lug crimped around the wire and around the insulation;

FIG. 5 is a side view of only the crimping parts of the machine showing them in the positions they occupy when connecting a terminal lug to a wire end;

FIG. 6 is a plan view of the lug holder or anvil in the machine of FIG. 5;

FIG. 7 is a sectional view on the line 7—7 of FIG. 2, showing how the anvil is removably held in the table of the machine;

FIG. 8 is an exploded perspective view, showing the adjustment knobs, driving gears, wedge-like adjustment members and associated parts of a press according to the invention;

FIG. 9 is an enlarged vertical sectional view through the machine, on the line 9—9 of FIG. 1;

FIG. 10 is a sectional view through part of the adjusting mechanism for the insulation-gripper forming drive on the line 10—10 of FIG. 9;

FIG. 11 is a similar view through another part of the adjusting mechanism on the line 11—11 of FIG. 9;

FIG. 12 is a sectional view like FIG. 10, but on line 12—12 of FIG. 9, showing part of the adjusting mechanism for the wire-connection forming drive;

FIG. 13 is an enlarged sectional view on line 13—13 of FIG. 5, showing details of the tip of the insulation-gripper forming tool, and

FIG. 14 is a similar section, on line 14—14 of FIG. 5, showing details of the tip of the wire-connection forming tool.

In carrying out the objects of this invention in one embodiment thereof, the body or frame 16 of a press carries a movable ram 18 which is guided in ways 20 in movement toward and away from the base table or bed 22 of the press. The bed of the press is fixed relatively to the moving ram, and the drive for the ram may be powered electrically, hydraulically, mechanically, or even manually. However, as will be apparent below, movement of the ram toward the base table is limited. All of the elements above described may be regarded as more or less conventional in production machines for forming or crimping terminal lugs to the ends of insulated wires.

In the embodiment shown, the end of the ram is provided with a box-like carrier and adjuster 24 for a pair of lug forming tools 26 and 28. A suitable cover plate 29 is provided to close the open front of the carrier 24. The carrier 24 and the tools 26 and 28 are movable with the ram toward and away from a replaceable anvil or lug holder 30 which is carried by the table 22 and serves as a jig or fixture for holding and properly positioning a terminal lug 32 with respect to the forming tools.

One form of lug which may be crimped by the machine

of this invention is shown in FIGS. 3 and 4. It includes the usual tail piece 34 with a detent or dimple 36 therein and has a pair of upstanding wire connection tabs 38 and a pair of upstanding insulation gripper tabs 40 integral therewith. In connecting this lug to a piece of wire the end of the piece is stripped of its insulation 42, thereby exposing the bare wire strand or strands 44. The stripped end of the wire is inserted in the unformed lug shown in FIG. 3 with the end of the insulation straddled by the insulation gripper tabs 40 and the bare wire straddled by the wire connection tabs 38. Assuming that the lug with the stripped wire therein has previously been placed on the lug holder or anvil in the press, when the machine is operated the tools 26 and 28 are intended to form or crimp the tabs 38 and 40 respectively around the bare wire 44, to form electrical connection of the lug with the wire, and around the insulation 42 to grip the insulation securely.

For a single size and style of lug to be electrically and mechanically connected to a single size wire which is covered by insulation of a uniform known thickness, the lug is placed on an anvil 30 which has been provided with a socket or dwell 46 fitting the wire connection tabs of the lug and a similar socket or dwell 48 fitting the insulation gripper tabs of the lug, leaving the upper ends of the tabs exposed for engagement with the forming tools 26 and 28. If it is desired to work with a lug of different size or style which cannot be supported properly by the anvil then being used, the anvil is removed from the table 22 of the press, being removably held thereon through its seating in a groove 49 in the table and by a spring clip 50 having arms which engage depressions 52 on either side of the anvil or lug holder. After removal of the unwanted anvil, another anvil is selected of the proper shape and size for the lug intended to be used. This other anvil is then placed in the table groove 49 and pressed within the clip 50 until its spring arms snap into the depressions 52, firmly holding the anvil in position.

The forming tool 26 for the wire connection tabs and the forming tool 28 for the insulation gripper tabs are designed to crimp the lug tabs properly over wire sizes and insulation diameters covering a substantial range, provided that the length of the driving stroke of the ram and of tool carrier 24 is precisely limited with respect to the table 22 and the anvil 30 thereon. The present invention is intimately concerned with the means for varying the effective stroke of the forming tools 26 and 28 to suit the press for different wire and insulation sizes. Of course, the tools themselves may be removed and replaced with others, but this should not be necessary unless a tool becomes worn or damaged or unless the size of a wire or of the insulation to be operated upon lies outside the range of adjustment of the particular set of tools being used.

Each of the forming tools is mounted in a similar fashion within the tool holder. For example, the wire crimp tool 26 is slidably mounted in the holder 24 and has shoulders 54 which limit its movement out of the holder. The upper horizontal edge 56 of this tool bears against the bottom horizontal edge of a wire crimp pressure plate 58, also slidably mounted within the holder. This is best seen in FIGS. 9 and 12. The plate 58 is biased toward the tool 26, which in turn is biased toward its outermost position in the holder 24, by a pair of compression springs 60, seated in sockets 62 near each end of the plate 58. The other ends of the springs 60 are seated against a guide bar 64 which is thereby forced within and against a guiding groove 66 in a wedge like adjustment member 68. The lower faces 70 of this member on either side of the groove 66 are slanted from the horizontal, as indicated, and there are corresponding slanting faces 72 on the top edge of plate 58.

The top horizontal face of the adjustment member 68 is provided with cross-wise extending teeth 74. One half of the width of the tips of these teeth bears against one half of the bottom of a ratchet block and bearing member

76 which is solidly fixed within the tool holder as by machine screws 78. There is a central hole 80 in block 76, for purposes which will later be evident. The other half of the bottom of the block 76 is similarly engaged by one half of the width of the tips of teeth on an adjustment member for the insulation crimp tool 28, in a sequence of similar parts starting with crimp tool 28, having shoulders 84 and upper edge 86, bearing against pressure plate 88, compression springs 90 in sockets 92, guide bar 94 riding in groove 96 of wedge like adjustment member 98, having slanted lower faces 100 cooperating with slanted upper faces 102 on plate 88. The top of this plate is provided with teeth 104 whose tips bear against the other half of the bottom of the ratchet block 76 as above explained and as seen best in FIG. 9.

Ignoring the adjustments for the moment, and assuming that the wedge-like members 68 and 98 are in the positions shown in FIGS. 12 and 10 respectively, when the press is operated the following actions take place:

As the ram 18 descends it moves the tool carrier 24 with it, and the tips of tools 26 and 28 will engage the ends of tabs 38 and 40 on a lug seated in the lug holder or anvil. As the ram and tool carrier continue to descend, the tools 26 and 28 will start to slide upwardly with respect to the moving carrier because their tips are stopped by engagement with the lugs to be crimped. This compresses the springs 60 and 90 because the bottoms of the plates 58 and 88 are engaged against the top faces 56 and 86 of the tools. Vertical movement of the plates 58 and 88 in the carrier is guided and limited by slots 106 and 108 respectively in the plates, within which a shouldered guiding screw 110 will ride, this screw being suitably threaded into the carrier. The side walls of the carrier also guide the plates in their vertical movement, but prevent sidewise movement.

Still further movement of the ram and carrier toward the anvil will first close the space between the slanted faces 70 and 72 and then impose further movement of the ram on the tip of tool 26, crimping the tabs 38 around the wire 44 of a cable end in the lug. At about the same time, the slanted faces 100 and 102 will meet each other and the tool 28 will be similarly driven to crimp the tabs 40 around the insulation. This is so, because the wedge-like members 68 and 98 will be pressed upon by the block 76 as the ram descends.

Now, as to the adjustment, it is obvious that as the wedge-like members are moved from the positions shown in FIGS. 10 to 12 to positions toward the other side of carrier 24, the vertical spaces will be reduced between the matching slanted faces 70 and 72 and faces 100 and 102. In such changed positions the engagement of the pairs of faces will take place earlier in the operation of the ram and carrier so that at the end of the ram stroke the tools will have traveled further toward the anvil and could therefore crimp a lug on a wire of smaller size than before.

To obtain lateral movement of the members 68 and 98 for this adjustment, an adjustment shaft 112 is rotatably mounted in the carrier 24, passing through the hole 80 in block 76, and this shaft carries a wire crimp adjustment gear 114 thereon alongside the block 76. An adjustment knob 116 is fixed to the outer end of this shaft so that the position of the member 68 may be controlled and indicated from outside the carrier.

The spur gear 114 meshes with one half the width of teeth 74 on the member 68 so that as the knob 116 is rotated the adjustment member will be driven. It has previously been noted that half the width of the tips of teeth 74 engage against the bottom of block 76. However, the underside of the block 76 is not flat but is provided with teeth 118 of the same pitch as teeth 74 but of substantially less depth. These stub-teeth are used as a ratcheting arrangement, so that as the adjustment is made the teeth 74 will ride over the teeth 118, being per-

mitted to do this by compression of springs 60 without becoming entirely disengaged from the gear 114.

The insulation crimping tool 28 is adjustable through mechanisms similar to those for the wire crimping tool. The adjustment shaft 112 carries a rotatable adjustment collar 120, having a gear segment 122 thereon at one end, alongside the other side of block 76. An adjustment knob 124 is keyed or otherwise secured against rotation on the other end of the collar so that the gear 122 may be rotated and its position indicated by the knob from outside the tool carrier. Gear 122 meshes with one-half the width of the teeth 104 on the wedge-like adjustment member 98, so that turning of the knob 124 can move the member 98 from one side to the other of the carrier. The ratcheting action of the other half of teeth 104 with one half the width of stub-teeth 118 is the same as the action between teeth 74 and 118 on the other side of the block 76. However, the angle of slope of faces 100 and 102 is greater than that of faces 70 and 72. This means that, for the same degree of angular rotation of the adjustment knobs, the adjustment of the insulation crimping tool will be coarser and will cover a wider range of dimensions than that of the wire crimping tool. Because the full range of adjustment is not needed, the gear 122 is made segmental. However, if a wider range of adjustment for the insulation crimper is desired, gear 122 may be complete.

Thus, the block 76 supports both the members 68 and 98 against upward movement and consequently protects the adjusting gears 114 and 122, shaft 112 and collar 120 against damage by undue stress when the press is being operated. At the same time, the sub-teeth 118 serve as a ratchet-bar to give definite positions of adjustment to both members 68 and 98, holding these members against sidewise displacement when the press is being operated and against accidental movement at other times.

If lugs of forms different from the ones illustrated are to be crimped in a press according to the invention, it may be necessary to replace the crimping tools and anvil with forming elements designed specifically for the different lug forms.

The tool carrier 24 and ratchet block or bearing member 76 are in effect part of the ram because all are secured together and move together as a unit. Similarly, the pressure plates 58 and 88 may be regarded as parts of the tools 26 and 28 because they move with their respective tools and could be made in one piece. They are made separable at the horizontal edges 56 and 86 only for ease in changing the tools without disturbing the rest of the mechanism.

The spring pressure on the wedge-like members 68 and 98 is important in permitting the ratcheting action of these adjustable members across the stub-teeth of the block 76 and in holding the teeth 74 and 104 seated between teeth 118 during operation of the press to prevent displacement of the adjustable members. The springs might be mounted otherwise than as shown, as long as the ratcheting and holding actions are accomplished.

As will be evident from the foregoing, certain aspects of this invention are not limited to the particular details set forth as an example, and it is contemplated that various and other modifications and applications of the invention will occur to those skilled in the art. Therefore, the appended claims are intended to cover such modifications and applications as do not depart from the true spirit and scope of the invention.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. In a machine for fastening an electrical connector to both the bared wire and insulation of a piece of insulated wire, said machine having a ram movable toward an anvil which holds a connector therein for fastening to a piece of insulated wire which has been bared and said ram carrying a wire-connection forming tool and an insulation-gripper forming tool which fasten corresponding parts of a connector to a wire held by the anvil, an improved means for adjusting the position of said tools carried by said ram, comprising a slanted face on each of said tools, a pair of wedges with corresponding slanting faces positioned next to said slanted tool faces, a horizontal face with teeth thereon on each wedge, a spur gear journaled in said ram engageable with portions of said teeth on one wedge, a second gear engageable with portions of the teeth on the other wedge, a horizontal face on said ram carrying a rack with stub-teeth thereon engageable with portions of said teeth on both wedges, and separate knobs for rotating said spur gear and said second gear whereby the positions of said wedges may be adjusted so that their slanted faces are next to different portions of the corresponding slanted tool faces.

2. In connector-crimping apparatus of the type having an anvil, a ram movable toward said anvil, a forming tool carried by said ram and cooperating with said anvil to crimp a connector on a wire placed between the tool and anvil when the ram approaches the anvil, that improvement in means for varying the distance of approach of said tool to said anvil comprising a spur gear journaled in said ram and having gear teeth, a wedge movably interposed between said ram and said tool, teeth on said wedge engageable partially with said gear teeth, shallow ratchet-teeth on said ram engageable partially with said teeth on the wedge, means biasing said wedge teeth toward engagement with said gear teeth and said ratchet-teeth, and a control for rotating said spur gear whereby said wedge may be adjustably positioned between said ram and said tool by rotation of said spur gear and held in adjusted position by said ratchet teeth.

3. In a machine for securing a lug to a wire, said machine having an anvil, a ram movable relative thereto, a lug forming tool carried by said ram and cooperating with said anvil to secure a lug to a wire placed between said tool and anvil when said ram is moved to carry said tool toward said anvil, an improved means for adjusting the distance of approach of said tool to said anvil, comprising a wedge movably interposed between said ram and said tool, a horizontal rack on said ram, having teeth, a horizontal face on said movable wedge, having teeth engageable with said rack teeth, a sloping face on said wedge opposite said horizontal face, a corresponding sloping face on said tool facing said sloping face on the wedge, and means for moving said wedge, ratcheting said wedge teeth over said rack teeth, whereby the position of the wedge between said rack and said tool is adjusted and its adjusted position is held by engagement of the wedge teeth with the rack teeth on the ram.

4. In connector-crimping apparatus of the type having an anvil, a ram movable toward said anvil, and a forming tool carried by said ram and cooperating with said anvil to crimp a wire within a connector placed between the tool and anvil when the ram approaches the anvil, means for varying the distance of approach of said tool to said anvil comprising a spur gear journaled in said ram and having gear teeth, a wedge movably interposed between said ram and said tool, means guiding said wedge in its movement, teeth on said wedge having parts engageable with said gear teeth, shallow ratchet-teeth on said ram engageable with other parts of said teeth on the wedge, springs biasing said wedge guiding means to urge said wedge teeth toward engagement with said gear teeth and said ratchet-teeth and biasing said tool away from said wedge, and a control knob for rotating said spur gear, whereby said wedge may be adjustably positioned between said ram and said tool by rotation of said spur gear by said knob, the springs holding the wedge against the ratchet teeth in adjusted position.

5. In a machine for securing a lug to an insulated wire, said machine having an anvil, a ram movable relative thereto, a pair of lug forming tools carried by said ram and cooperating with formations on said anvil to secure a lug to the wire and insulation of an insulated wire placed between said tools and anvil formations when

said ram is moved to carry said tools toward said anvil, and means for adjusting the distance of approach of said tools to said anvil, comprising a pair of wedges movably interposed each between said ram and of said tools, a horizontal rack on said ram, having teeth thereon, horizontal faces on both said wedges having teeth engageable with said rack teeth, springs biasing said wedges toward engagement with said rack, a sloping face on each wedge opposite its said horizontal face, a corresponding sloping face on each tool facing a said sloping face on a wedge, and means for moving said wedges independently of one another, ratcheting each said wedge over said rack teeth, whereby the positions of the wedges between said rack and said tools are independently adjusted and their adjusted positions held by spring biased engagement of the wedge teeth with the rack teeth on the ram.

6. In a machine for fastening an electrical connector to both the bared wire and insulation of a piece of insulated wire, said machine having a ram movable toward an anvil which holds a connector therein for fastening to a piece of insulated wire which has been bared, said ram carrying a wire-connection forming tool and an insulation-gripper forming tool which fasten corresponding parts of a wire to a connector held by the anvil, means for adjusting the effective positions of said forming tools carried by said ram, comprising a slanted face on each of said tools, a pair of wedges each with a slanting face positioned next to a slanted tool face and of corresponding slope, a horizontal face with teeth thereon on each wedge, a spur gear journaled in said ram engageable with said teeth on one wedge, a second gear engageable with the teeth on the other wedge, a horizontal face on said ram carrying a rack with stub-teeth thereon engageable with said teeth on both wedges, springs biasing said wedges toward said rack and said gears, and separate indicating knobs for rotating said spur gear and said second gear independently, whereby the positions of said wedges may be altered so that their slanted faces are next to different portions of the corresponding slanted tool faces and the effective positions of the tools are adjusted.

7. In a machine for crimping an electrical connector to both the bared wire and insulation of a piece of insulated wire, said machine having a ram movable toward an anvil which holds a connector therein for crimping to a piece of insulated wire which has been bared and said ram carrying a wire-connection crimping tool and an insulation-gripper crimping tool which, in cooperation with

said anvil fasten corresponding parts of a connector to a wire as the ram approaches the anvil, means for adjusting the effective crimping positions of said tools carried by said ram, comprising a tool carrier within which the tools are movably mounted on the ram, a pressure plate above each tool, a slanted face on each of said pressure plates, a pair of movable wedges with corresponding slanting faces positioned opposite said slanted pressure plate faces, guide bars for said wedges, springs extending between said pressure plates and said guide bars, a horizontal face with teeth thereon on each wedge, a spur gear journaled in said tool carrier engageable with said teeth on one wedge, a second gear in said tool carrier engageable with the teeth on the other wedge, a ratchet block in said tool carrier carrying a rack with stub-teeth thereon engageable with said teeth on both wedges, and separate coaxial knobs on said tool carrier for rotating said spur gear and said second gear whereby the positions of said wedges may be adjusted so that their slanted faces are opposite different portions of the corresponding slanted pressure plate faces and the effective crimping positions of said tools are altered.

8. In a lug crimping device having a vertically movable ram member and a forming tool member carried by said ram member cooperating with an anvil to crimp a lug on a wire held between the tool and the anvil, means for adjusting the effective positions of said ram and tool members with relation to each other and the anvil comprising a wedge movable interposed between said ram and tool members, said wedge having a horizontal face with teeth thereon and a slanted face, a slanted face on one of said members corresponding to said slanted face on the wedge, a horizontal rack on the other of said members having teeth engageable with said teeth on said wedge and a rotatable spur gear having teeth also engageable with the teeth on said wedge, whereby rotation of said spur gear will alter the position of said wedge with relation to said slanted face on said one member while ratcheting the wedge over the rack teeth on said other member.

References Cited in the file of this patent

UNITED STATES PATENTS

274,216	Morse	Mar. 20, 1883
2,880,777	Perri	Apr. 7, 1959

FOREIGN PATENTS

5,624	Great Britain	May 7, 1885