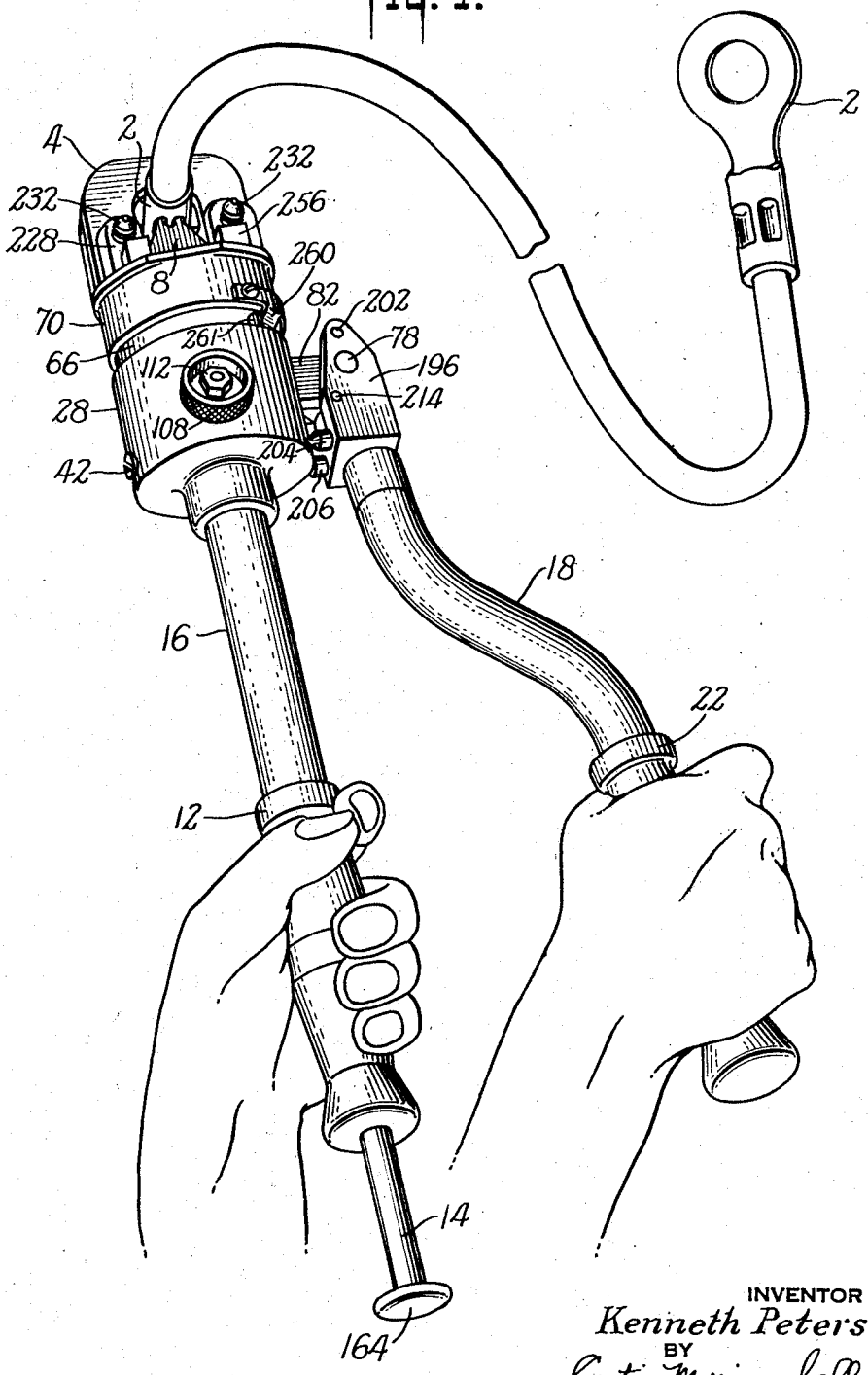
Dec. 14, 1954 K. E. PETERSON 2,696,850

CRIMPING DEVICE

Filed June 10, 1950 4 Sheets-Sheet 1

Fig. 1.



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4 Sheets-Sheet 2

Fig. 2.

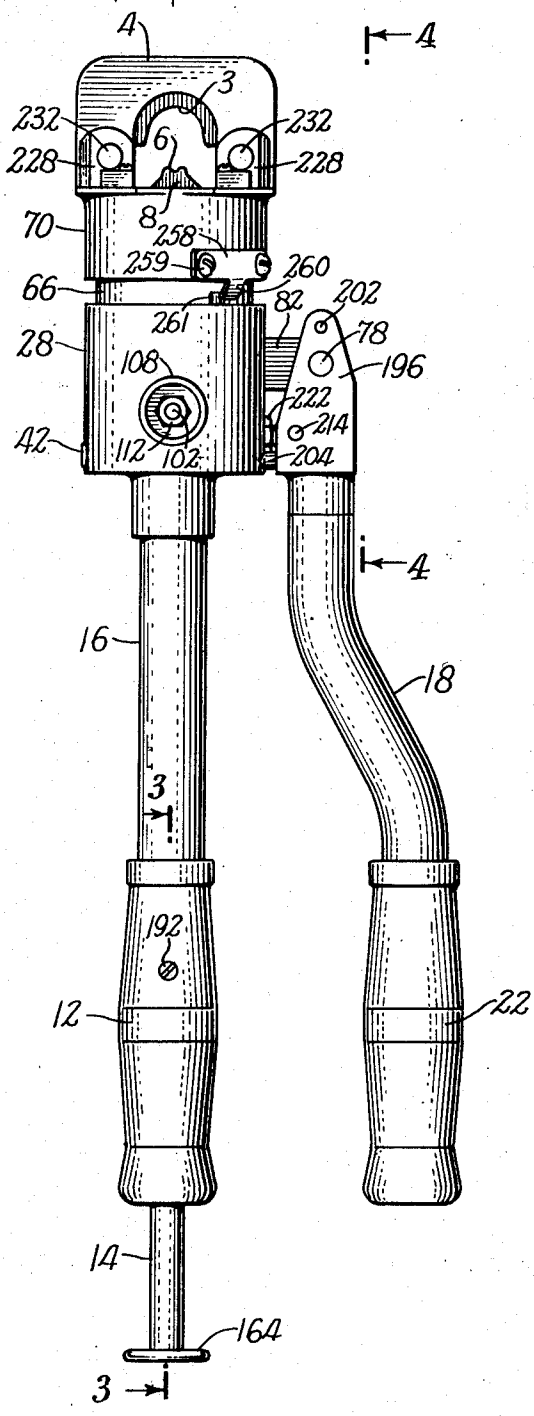
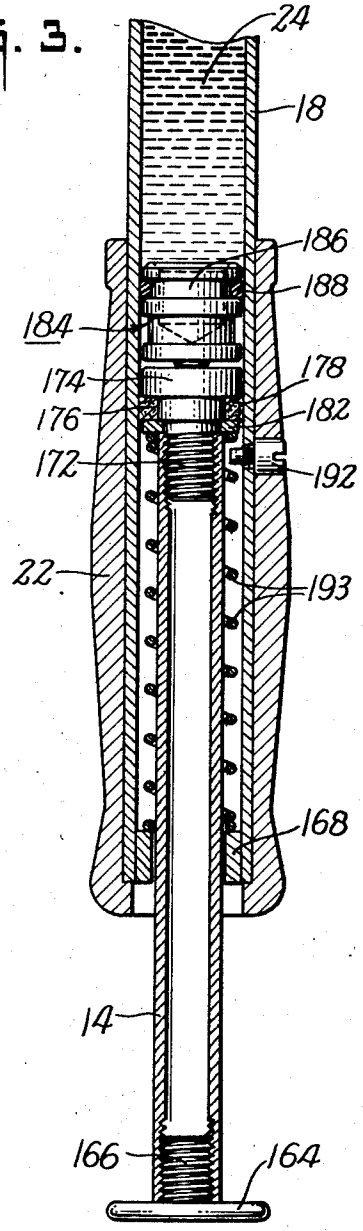


Fig. 3.



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Fig. 4.

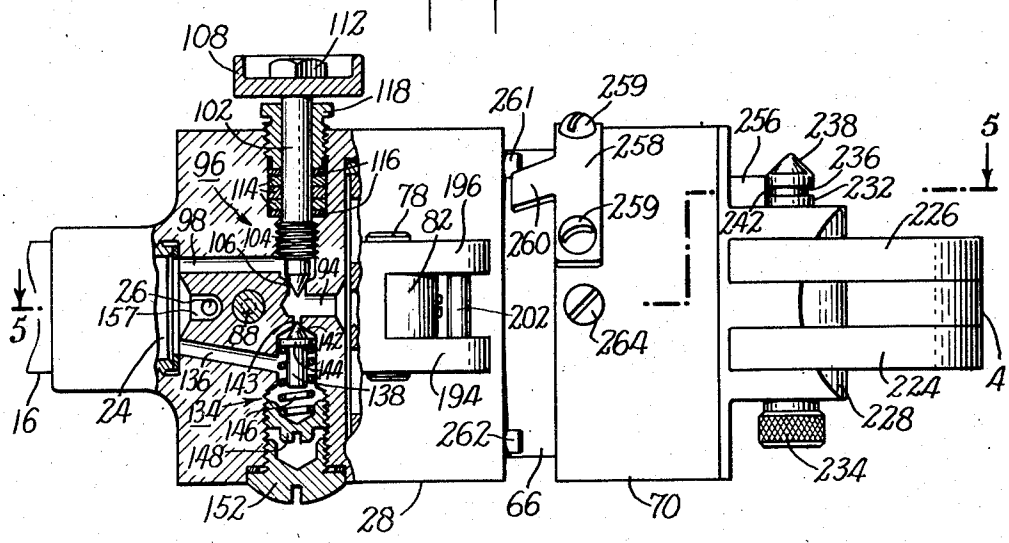
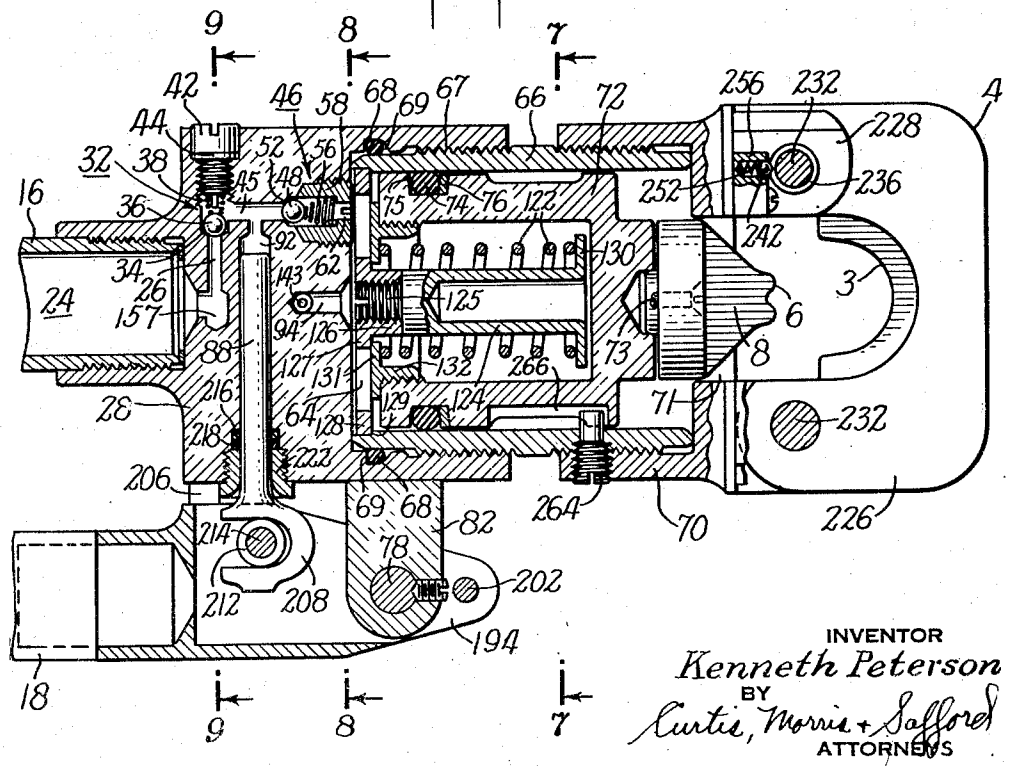


Fig. 5.



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Fig. 6.

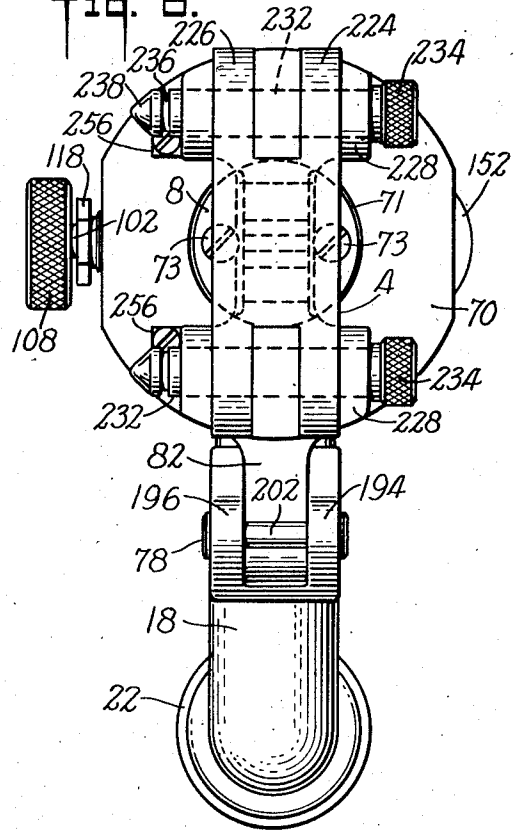


Fig. 7.

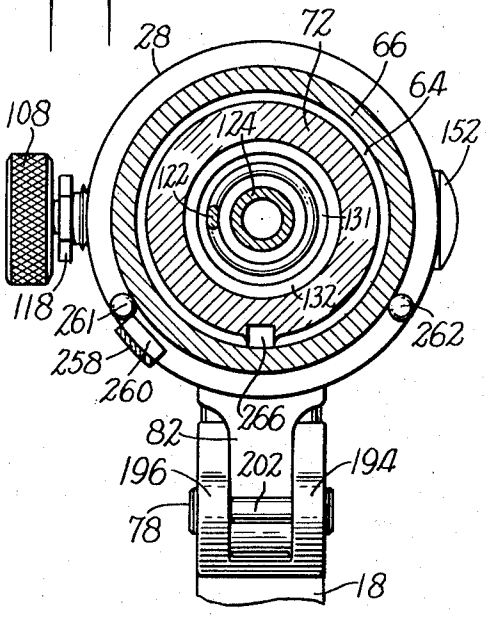


Fig. 8.

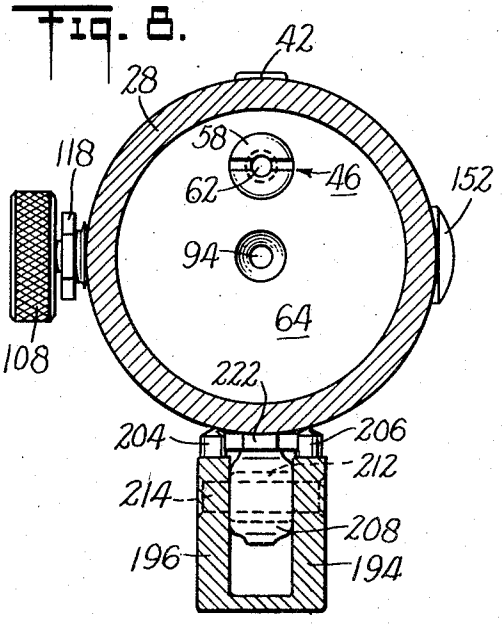
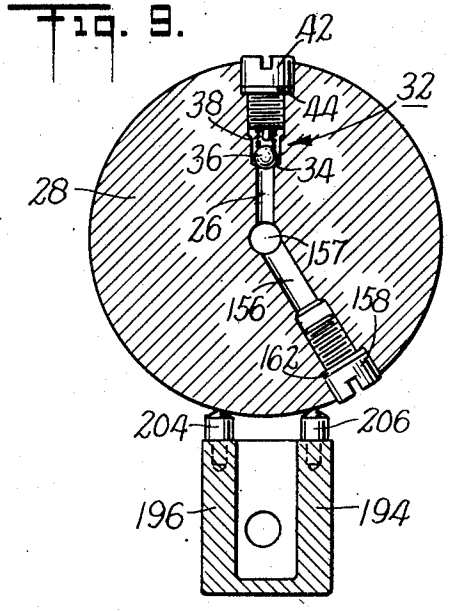


Fig. 9.



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2,696,850

Patented Dec. 14, 1954

2,696,850

CRIMPING DEVICE

Kenneth E. Peterson, New Cumberland, Pa., assignor to Aircraft-Marine Products, Inc., Harrisburg, Pa.

Application June 10, 1950, Serial No. 167,459

5 Claims. (Cl. 140—113)

This invention relates to hand-operated tools for crimping electrical connectors or terminals to wire conductors. The invention has particular utility and advantage in the crimping of large size terminals.

A very high pressure is required to crimp connectors formed of heavy gauge metal to insure a good mechanical and electrical connection between the wire and the terminal or connector. Such pressures are readily achieved by crimping machines that are permanently installed in a particular location. However, it is difficult to obtain the required pressure in a hand-operated portable tool so constructed that it can be operated conveniently by one person. Some means of obtaining the necessary high leverage ratio must be provided, that is, the hand-operated part of the tool must traverse a relatively large distance under such force as to produce a very small movement of the crimping die at the required high pressure. This makes it difficult for the operator to hold the terminal and wire in the proper position in the crimping die while the die components are moved through a sufficient distance to obtain a preliminary grip on the connector.

The present invention is described as embodied in a hydraulically operated tool in which rapid initial movement of the die components can be obtained by one-hand operation of the tool, leaving the other hand free to position the connector in the tool. After the connector has been gripped by the jaws or die of the tool, an auxiliary force-multiplying hydraulic system is operated by hand to complete the crimping operation.

The various objects, advantages, and features of the present invention, for example, relating to the quick initial take-up, automatic pressure limit indication and control, free piston construction to minimize length of quick take-up plunger and to permit additional hydraulic fluid to be easily withdrawn from the reservoir, will be in part pointed out in and in part apparent from the following description considered in conjunction with the accompanying drawings in which:

Figure 1 is a perspective view of a hand-operated crimping tool embodying the present invention;

Figure 2 is an elevational view of the tool shown in Figure 1;

Figure 3 is an enlarged partial sectional view taken along line 3—3 of Figure 1;

Figure 4 is an enlarged side view of the head portion of the tool taken along line 4—4 of Figure 2, with certain parts of the tool cut away to show the internal construction;

Figure 5 is a sectional view taken along line 5—5 of Figure 4;

Figure 6 is a top view of the tool shown in Figure 2;

Figure 7 is a sectional view taken along line 7—7 of Figure 5;

Figure 8 is a sectional view taken along line 8—8 of Figure 5; and

Figure 9 is a sectional view taken along line 9—9 of Figure 5.

The particular tool illustrated in the drawings is adapted to form a crimp of the general type described more fully in the patent application of Thomas C. Freedom, Serial No. 655,747, filed March 20, 1946, now U. S. Patent 2,535,013. This crimp is formed by placing the ferrule of a terminal 2 between the inner surface 3 (see Figures 1, 2, and 4) of a nest 4 and the corrugated or "indented" surface 6 of a movably supported die 8, the wire being suitably positioned within the ferrule of the connector.

The operator may support the tool with one hand by means of a hand grip 12 and hold the connector in proper position between the nest 4 and die 8 with the other hand. A plunger or take-up rod 14 at the bottom of the tool is then pressed against the body of the operator or on a fixed surface, for example the top of a workbench, so as to force the plunger 14 longitudinally into a combination handle and oil cylinder 16. This movement of the take-up rod 14 produces a rapid movement of the die 8 relative to the nest 4 so that the connector is quickly gripped by the tool with sufficient force to hold it in the desired position. At this time, both hands of the operator are freed for further operation of the tool by which the crimping operation is completed.

The increased force necessary for this final crimping is obtained by pumping a pivotally supported handle 18, which also is provided with a suitable hand grip 22. Automatic means are provided within the tool for preventing the application of excessive force to the connector, and for indicating when the crimping operation is completed.

When pressure is applied to the oil, or other suitable liquid, in the reservoir 24 in the handle 16 by movement of the take-up rod 14, the oil is forced through a passageway 26 (see Figure 5) formed within a valve body 28, and through an intake valve, generally indicated at 32. In this example, the valve 32 is formed by a valve seat 34, formed by an annular shoulder in passageway 26, against which is pressed a steel valve-ball 36 by a helical spring 38 maintained under compression between the ball 36 and the end of an intake-valve cap screw 42, which is in threaded engagement with the valve body 28. A gasket 44, of copper or other suitable material, is positioned beneath the head of the cap screw 42 to prevent leakage of the oil.

After passing the intake valve 32, the oil is forced through a passageway 45 and a check valve, generally indicated at 46, which in this example comprises a steel check-valve ball 48 which is pressed against a valve seat 52 by a helical compression spring 56 which rests against an internal shoulder formed on a check-valve retaining screw 58 in threaded engagement with the valve body 28.

After passing the check valve 46, the oil emerges through an opening 62 (see also Figure 8), in the center of the check valve retaining screw 58, into a main cylinder chamber 64. The cylinder walls of this chamber 64 are formed by a cylindrical sleeve member 66 which is threaded into the valve body 28 as at 67.

In order to prevent oil leakage along the threads 67 between the valve body 28 and the sleeve member 66, while permitting relative rotation of these two parts for a purpose which will be explained later, an O ring 68, of suitable synthetic polymer or other material that is not affected adversely by the oil or other liquid used in the hydraulic system, is positioned in a groove 69 around the inner surface of the valve body 28.

A head 70 is in threaded engagement with the other end of the sleeve member 66. This head, which supports the nest 4, is provided with a central opening 71 (see also Figure 6) for the die 8.

The pressure of the oil in the chamber 64 causes a piston 72 to move longitudinally within the sleeve member 66 toward the right as viewed in Figure 5. The die 8 is secured to the face of the piston 72 by screws 73 (best shown in Figure 6) so that the piston forces the die 8 into the nest 4.

In order to prevent the leakage of oil along the inner walls of the sleeve member 66, an O ring 74 of suitable

material, is positioned in a groove 75 extending circumferentially around the outer surface of the piston 72. A backing washer 76 for example of leather is positioned within the groove 75 adjacent the O ring 74.

The internal diameter of the oil reservoir 24 in the handle 16 relative to that of the cylinder sleeve 66 is such that the allowable movement of the take-up rod 14 is sufficient to cause the die 8 to grip the connector 2 which is to be crimped.

After the connector 2 has been secured in its proper position between the die and the nest by the above described action, the operating handle 18 (Figures 1 and 2), which is supported by a pivot pin 78 that extends through a lug 82 projecting from valve body 28, is given a pumping motion with respect to the handle 16. This movement of the operating handle 18 causes a plunger 88 (Figure 5) to reciprocate within a bore 92, which communicates with the passageway 45 between the intake valve 32 and the check valve 46, and pumps additional oil from the reservoir 24 into the cylinder chamber 64.

When the operating handle 18 is moved outwardly from the suporting handle 16, the movement of the plunger 88 in the bore 92 draws additional oil through the intake valve 32 into the chamber formed by the bore 92. When the operating handle 18 is subsequently forced toward the handle 16, so that the plunger 88 moves inwardly of the bore 92, the oil in the passageway 45 and bore 92 cannot return to the reservoir 24 because of the checking action of the intake valve 32 and therefore is forced through the check valve 46 into the pressure chamber 64 within the main cylinder 66. This oil cannot return to the bore 92 when the handle 18 is again reciprocated, because of the check valve 46. Thus, continued pumping of the handle 18 forces additional oil into the cylinder 66 thus increasing the force applied to the die 8. Because of the small diameter of the plunger 88 and bore 92 relative to the internal diameter of the cylinder sleeve 66, a large force-multiplying effect is obtained which is sufficient to insure adequate crimping of even very large connectors or terminals.

A manual control is provided for releasing the pressure from the cylinder, after the connector or terminal has been crimped to the wire, and permits the oil to flow from the chamber 64 back into the reservoir 24. This is accomplished by means of a passageway 94 which extends from the bottom of the cylinder chamber 64 (see Figure 4) to a needle valve, generally indicated at 96, which is connected to the reservoir 24 in the handle 16 by a passageway 98. The valve 96 comprises a valve needle 102 having a threaded portion in engagement, as at 104, with a radial bore in the valve body 28. The valve needle 102 has a pointed end portion that seats against a conoidal shoulder at the junction of passageways 94 and 98, as at 106.

A control knob 108 is secured to the valve needle 102, as by a nut 112 in threaded engagement with the outer end of the needle 102, so that by rotating the knob 108, the valve 96 can be opened or closed as desired.

In order to prevent the leakage of oil around the valve needle 102 suitable packing 114 is maintained under pressure between two washers 116 by a packing nut 118 which is threaded into the valve body 28.

When the needle valve 96 is opened by rotating the control knob 108, the piston 72 is returned to its original position as shown in Figure 5 by a helical compression spring 122 which forces the oil through the passageways 94 and 98 back into the reservoir 24. This spring 122 is positioned around a spring-retainer post 124 which has a projection 125 of reduced diameter on its lower end that is in threaded engagement with and supported by a central hub 126 of a spider 127 having an outer ring 128 which abuts an internal shoulder 129 on the sleeve 66.

One end of the spring 122 abuts an outwardly extending annular flange 130 on the end of the spring-retainer post 124, and the other end of the spring 122 abuts an inwardly extending annular flange 131 on a spring-retaining nut 132 that is in threaded engagement with the internal wall of the piston 72.

Thus, as the piston 72 is forced under pressure along the axis of cylinder sleeve 66 to form the crimp in the connector 2, the spring 122 is compressed by the movement of the spring-retaining nut 132 so that, when the hydraulic pressure is released, for example, by opening the needle valve 96, the spring 122 expands, returning the piston 72 to the end of the cylinder and forcing the oil through the passageways 94 and 98 into the reservoir 24 in the handle 16.

In order to prevent the application of excessive pressure on the connector 2, a limit valve, generally indicated at 134, is arranged to permit some of the oil to return from the chamber 64 through a passageway 136 into the oil reservoir 24 in the handle 16, whenever the pressure of the oil in the chamber 64 exceeds a critical value. The sudden reduction of pressure in the cylinder 64 also serves to indicate to the operator that the crimping operation has been completed.

The valve 134 comprises a needle 138 which has a pointed end 142 that seats against a conoidal shoulder formed at the end of a small diameter passageway 143 that communicates with the passageway 94. An annular collar 144 is formed integrally with the needle 138 and serves as a stop for a coiled compression spring 146, the opposite end of which is positioned against an internal shoulder in an adjustment screw 148 that is threaded into a radial opening in the valve body 28. A cap screw 152 also is threaded into this same opening and protects the screw 148 from inadvertent adjustment.

Whenever the pressure in the cylinder chamber 64 exceeds a certain critical value, the pressure against the exposed surface of the needle 138 will overcome the force of the spring 146 and open the valve 134 to permit some of the oil to flow from the chamber 64 through the passageway 136 into the reservoir 24. However, as soon as the valve 134 opens the oil acts against the collar 144 so that substantially less force is required to maintain the valve in open position. The force required to open the valve 134 is controlled by adjusting the position of the screw 148 to vary the force exerted by the spring 146.

In order to fill the reservoir 24 with oil, a passageway 156 (see Figure 9) extends from the junction 157 of passageway 26 with the oil reservoir 24 to the outer surface of the valve body 28. This opening is normally closed by a cap screw 158 which is threaded into the valve body 28 and seats against a suitable shoulder on which is mounted a gasket 162 of copper or other suitable material.

The construction of the piston assembly in the handle 16 is shown most clearly in Figure 3. A disc-like knob 164 in secured to the end of the take-up rod 14, for example by a projection 166 in threaded engagement with the take-up rod 14. This take-up rod 14, which may be solid but is illustrated as tubular in the present embodiment, extends through a suitable opening in the outer end of handle 16, at which point it is surrounded by a bushing 168, and is secured as by a threaded projection 172 to a guide member 174. This guide member is provided with an annular groove into which is fitted a felt wiper 176 for preventing the accumulation of dust and dirt which would cause scoring of the cylinder wall. The wiper 176 is retained in position between a shoulder 178 on the guide member 174 and a metal washer 182 tightened between the guide member 174 and the end of the take-up rod 14 by means of the threaded projection 172.

A piston, generally indicated at 184, is positioned within the reservoir 24, but is not connected to the guide member 174. The piston 184 is provided with an annular groove 186 surrounded by an O ring packing 188, formed of synthetic polymer or other material which will provide the desired compression characteristics but which is unaffected by the oil or other liquid contained in the reservoir 24.

A screw 192 extends through the side wall of the handle 16 into the interior of the handle and is positioned so that the washer 182 on the guide member 174 will strike the end of the screw 192 and limit the downward movement of the take-up rod 14.

After the take-up rod has been forced into the handle 16 to close the die and nest sufficiently to grip the connector, subsequent pumping motion of the operating handle 18 draws more oil from the reservoir 24 and forces it into the chamber 64. In order to permit this oil to be drawn readily from the reservoir 24, the piston 184 is not connected to the guide member 174 on the take-up rod 14. Thus, as the additional oil is drawn from the reservoir 24, the piston 184 moves along the reservoir 24 away from the end of the guide member 174, and is forced back in the reservoir 24 against this guide member 174 when the oil is returned to the reservoir 24 after the crimping operation is completed.

The take-up rod 14 is advantageously of such length

that it is pushed substantially all the way into the handle **16** at the time the preliminary grip on the connector **2** is obtained. This construction is made possible by the free piston head **184** whereby additional liquid can be withdrawn from the reservoir **24** without further movement of the take-up rod **14**.

A light compression spring **193** is positioned around the take-up rod **14** between the end of the handle **16** and the guide member **174** on the end of rod **14**. This spring serves to hold the take-up rod **14** within the handle **16** when additional oil is being withdrawn from the reservoir **24** by the auxiliary high-pressure pump.

The operating handle **18** is supported by means of two ears **194** and **196** (Figures 2 and 7) integral with the handle **18** positioned on opposite sides of the lug **82** extending outwardly from the valve body **28**. These ears **194** and **196** are pivotally secured to the lug **82** by the pin **78**. The movement of the operating handle **18** is limited in one direction by means of a limit pin **202** which extends between the ears **194** and **196** at the end of handle **18**. The movement of the handle **18** in the outward direction is limited when the pin **202** strikes the surface of the supporting lug **82**, and in the opposite direction by two stop screws **204** and **206** (see also Figure 8) which extend from the inner surface of the handle **18**, below the plunger **88**, and abut the outer surface of the valve body **28** when the plunger **88** is in its innermost position.

The plunger **88** is secured to the operating handle **18** by a C-shaped head portion **208** (Figure 5) having an open slot that extends over a roller **212** rotatably supported by a pin **214** that extends between the ears **194** and **196** of the operating handle **18**.

In order to prevent oil from leaking around the plunger **88**, an O ring packing **216** is positioned around the plunger **88** between a shoulder on the bore **92** and a backing washer **218**, of leather or other suitable material, held in position by a packing nut **222** that is threaded into the valve body **28**.

It is, of course, not necessary that the particular die and nest illustrated in the drawings be used and other shapes or types can be employed. In order to facilitate the replacement of the nest **4** and die **8**, the nest is provided at each end with two projecting ears, as illustrated at **224** and **226** in Figure 6. These ears are positioned in spaced slots formed in a projection **228** on the upper surface of the head **70**. (See also Figure 4.) A hinge pin **232** extends through the ears **224** and **226** of the nest **4** and the projection **228** and is provided at one end with a knurled head **234**, and near the opposite end with a peripheral groove **236** by means of which the hinge pin **232** is locked in position. The end of the hinge pin adjacent the groove **236** is tapered as at **238** to permit easy insertion of the hinge pin when the nest is being changed.

The hinge pin is retained in position by means of a ball **242** (Figure 5) that extends into the groove **236** under the pressure of a spring **252** positioned in a bore in a shoulder **256** that may be formed integrally with the projection **228**. The opposite end of the nest **4** is connected to the head **70** in exactly the same manner so that it is unnecessary to describe this construction in detail. Thus, the nest **4** can be removed readily by removing the two hinge pins **232** without the use of auxiliary tools.

The angular position of the nest **4** and the die **8** relative to the body and handles of the tool can be adjusted by rotating the head **70** and associated parts relative to the valve body **28**. The extent of this adjustment is limited by a head index stop **258** (see Figure 4) secured to the outer surface of head **70** by screws **259** and having projection **260** extending into the space between two limit screws **261** and **262**.

The head **70** is in threaded engagement with the main cylinder sleeve **66** and relative rotation of these parts is prevented by a guide screw **264** that is threaded into the head **70** and extends through a hole in the main cylinder sleeve **66** into a slot **266** extending longitudinally along the outer surface of the piston **72**. Thus, the nest **4**, the head **70**, the sleeve **66**, the piston **72**, and the die **8**, which is secured to the piston **72** by the screws **73**, rotate as a unit in the threaded connection **67** joining the valve body **28** and the sleeve **66** so as to allow convenient positioning of the crimping head.

It is thus seen that I have provided a tool for crimping connectors and terminals that is well adapted to attain the ends and objects hereinbefore set forth, and which is subject to a variety of modifications so that it may be best fitted for a particular use. It is to be understood that the embodiment of the tool described and shown herein is for the purpose of illustrating the invention in accordance with the statutory requirements and that it is not intended to be exhaustive or limiting of the invention, the scope of which is defined by the following claims.

I claim:

1. In a hand-operated tool for crimping connectors to wire wherein a die and nest are forced toward each other under high pressure, apparatus for hydraulically operating said tool including: a main body; a cylinder supported by said body and having a main piston therein arranged to cause relative movement between said nest and die; first piston-actuating means for causing rapid take-up of said piston to cause said nest and die to grip and hold the connector in crimping position including first and second handles for supporting said tool, a liquid-holding reservoir within said first handle, a passageway communicating with said reservoir and said cylinder, first and second check-valves at spaced positions in said passageway oriented to prevent liquid flowing from said cylinder toward said reservoir, a first plunger having a diameter smaller than the diameter of said piston and slidably positioned in said reservoir for increasing the pressure therein to force liquid from said reservoir into said cylinder, a plunger-actuating rod extending longitudinally through the end of said handle and arranged to exert only uni-directional force on said first plunger, and means limiting extent of movement of said plunger-actuating rod; and second piston-actuating means for causing said nest and die to crimp the connector including a force-multiplying pump communicating with said passageway and having a second plunger slidably mounted within said body and operatively secured to said second handle and having a diameter smaller than the diameter of said first plunger, said second handle being pivotally supported by said body.

2. A hand-operated crimping tool of the type adapted to crimp an electrical connector to a conductor comprising a movable die mechanism having opposing die members arranged to support and crimp an electrical connector, a body portion supporting said die mechanism, first and second handles extending from said body portion, a hydraulic ram mechanism at least partially enclosed within said body and having a cylinder chamber and a movable piston in said chamber arranged to close said dies to hold and crimp an electrical connector, reservoir means and hydraulic fluid contained therein, fluid-conducting means communicating with said chamber and with said reservoir means, check valve means in said conducting means arranged to prevent the flow of fluid therethrough from said chamber to said reservoir means, first pump means including a reciprocating plunger having a longitudinally-movable operating rod extending outwardly from the end of one of the handles of said tool and movable longitudinally with respect thereto to force said hydraulic fluid from said reservoir means into said chamber to close said dies to grasp an electrical connector, and second pump means separate from said first pump means and operatively connected to said handles and responsive to pumping action therebetween to force said hydraulic fluid from said reservoir means into said chamber to apply crimping force to said dies, whereby said reciprocating plunger can be operated while manually holding the connector between the die members causing the die members to close and grasp the connector with sufficient force to hold it so that the operator can then use both hands to operate the two handles to apply crimping pressure to the connector.

3. A crimping tool as claimed in claim 2 wherein said reservoir means is in one of said handles and said plunger of said first pump means is within said reservoir, said operating rod extending into said reservoir and abutting said plunger so as to push it in one direction along said reservoir, said plunger being free of said rod to permit it to move out of engagement with said rod.

4. A crimping tool as claimed in claim 2 wherein one of said handles is pivotally supported by said body portion and said second pump means includes a pump piston connected to said pivotally mounted handle, the area of

said pump piston being substantially less than the area of said plunger.

5. A crimping tool as claimed in claim 2 including an auxiliary fluid conducting means communicating with said chamber and said reservoir and including therein a normally-closed valve, said valve being operatively responsive to a predetermined pressure in said chamber to open and permit fluid to pass therethrough from said chamber back to said reservoir.

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