Oct. 19, 1965 F. J. SMITH ETAL 3,212,316

FLUID OPERATED CRIMPING TOOL

Filed Oct. 23, 1963 3 Sheets-Sheet 1

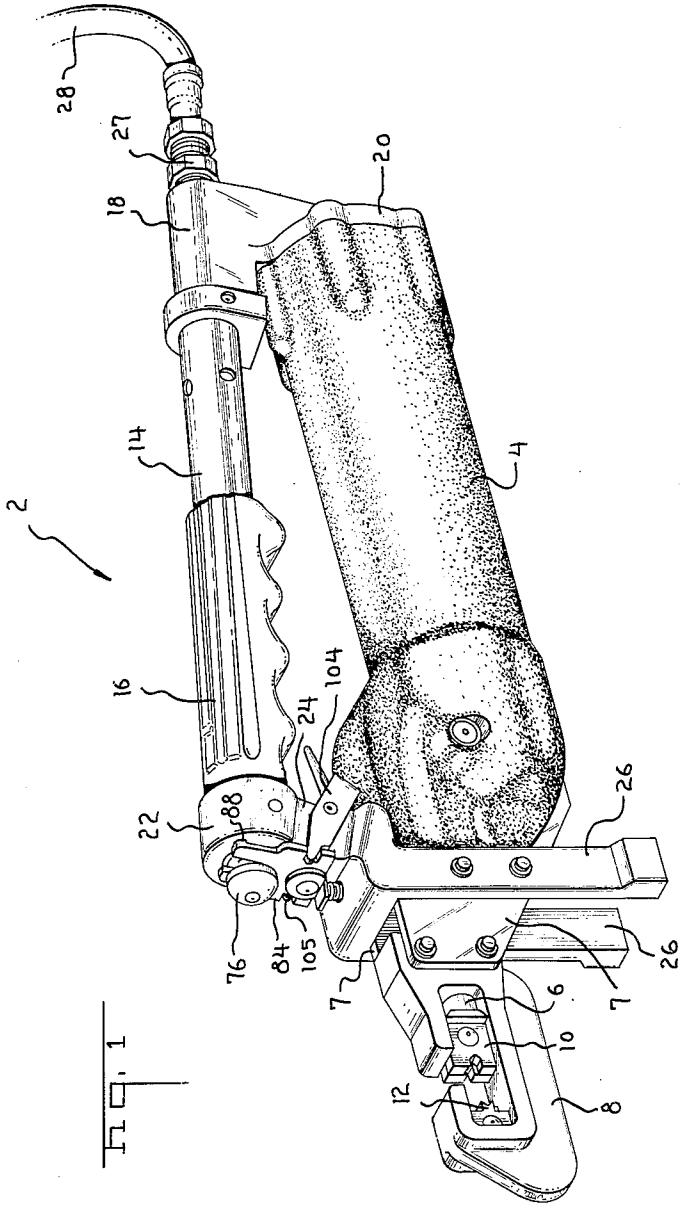

FIG. 1

Oct. 19, 1965 F. J. SMITH ETAL 3,212,316

FLUID OPERATED CRIMPING TOOL

Filed Oct. 23, 1963 3 Sheets-Sheet 2

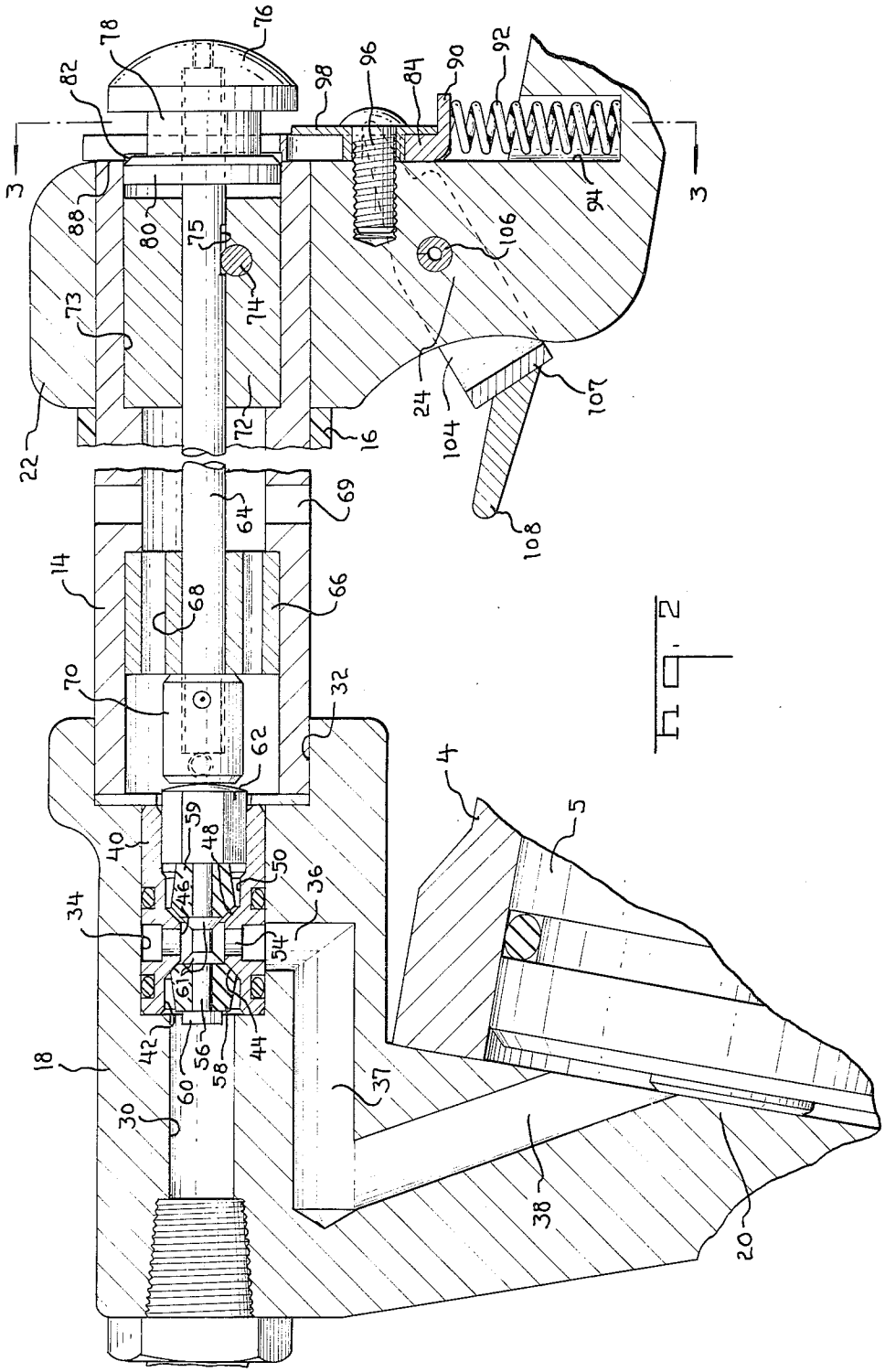

FIG. 2

Oct. 19, 1965 F. J. SMITH ETAL 3,212,316

FLUID OPERATED CRIMPING TOOL

Filed Oct. 23, 1963 3 Sheets-Sheet 3

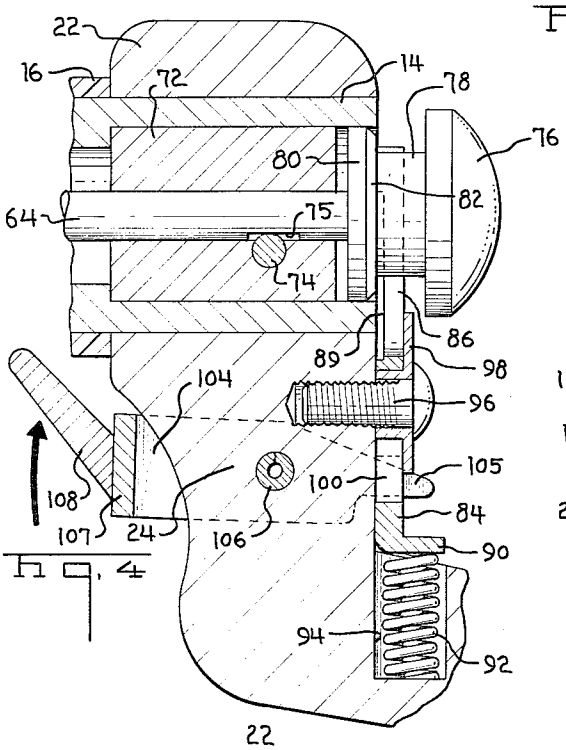

Fig. 4

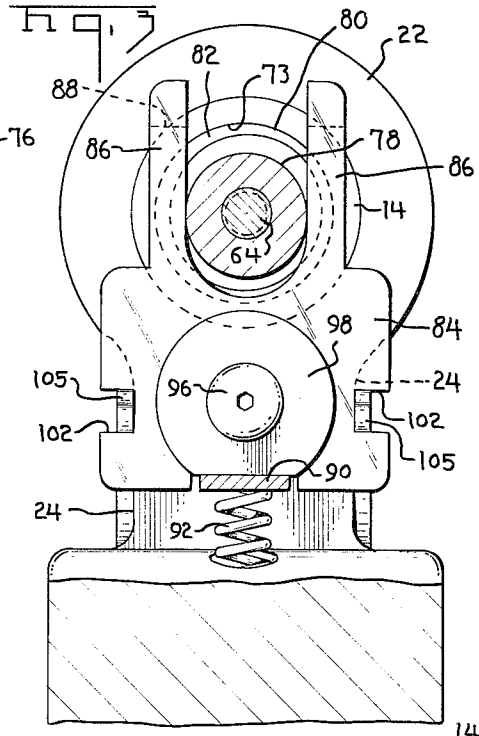

Fig. 3

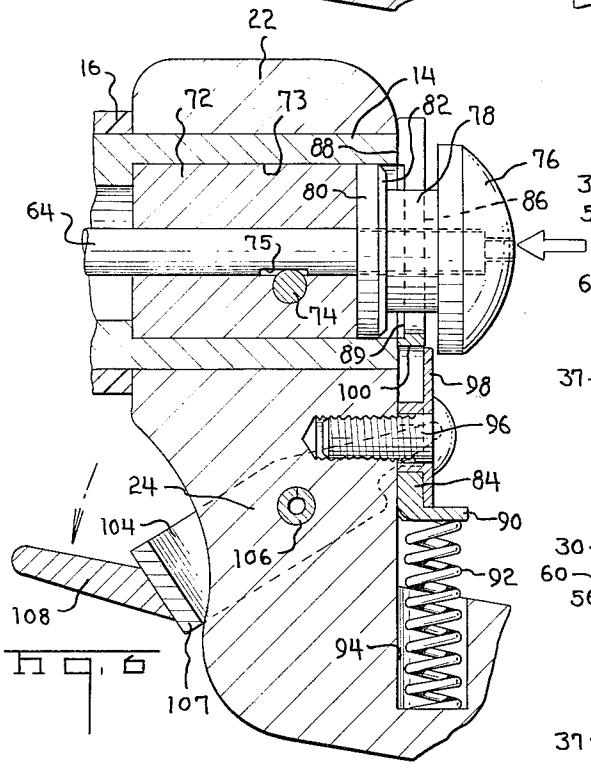

Fig. 6

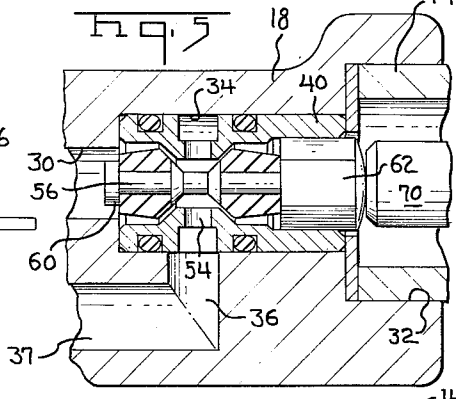

Fig. 5

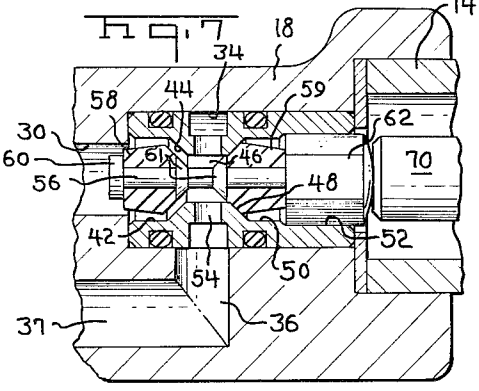

Fig. 7

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3,212,316

FLUID OPERATED CRIMPING TOOL

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6 Claims. (Cl. 72—412)

This invention relates to fluid operated crimping tools for crimping elecrtical terminals onto wires.

An object of the invention is to provide an improved crimping tool for crimping electrical terminals onto wires. A further object is to provide a tool adapted to be held in the hand during usage and including an improved handle arrangement. A futher object is to provide a tool having a two-stage actuating mechanism such that the operator can cause the crimping dies to move partially into engagement with each other in one operation and can subsequently cause complete closure of the dies in a separate operation. A still further object is to provide a crimping tool having means for partially closing the dies in order to grip an uncrimped terminal between the die surfaces so that the operator can then insert the wire into the terminal and subsequently cause final closure of the dies.

These and other objects of the invention are achieved in a preferred embodiment thereof comprising a pneumatic piston and cylinder and a piston rod having a movable crimping die concatenated therewith. A tool head is mounted on the cylinder and a fixed die is mounted in the tool head for cooperation with the movable die to crimp a terminal onto a wire upon movement of the dies towards each other. A carrying handle is mounted on, and extends alongside the cylinder and is secured thereto by means of a pair of brackets at its forward and rearward ends. A compressed air inlet passageway is provided in the rearward bracket and a valve means in this passageway controls the admission of compressed air to the cylinder. This valve means is normally maintained in the fully closed position and is capable of being partially opened to admit low pressure compressed air to the cylinder thereby to drive the piston forwardly and partially close the crimping dies. The thrust exerted on the dies when the valve is in this partially opened position is not, however, sufficient to crimp the terminal so that an uncrimped terminal positioned between the dies will be gripped and held in position to permit the operator to insert the wire. The valve can also be moved to a fully opened position in which it admits relatively high pressure compressed air to the cylinder which, in turn, will exert sufficient force on the piston to crimp the terminal.

The valve is controlled by means of a trigger and button on the forward end of the handle, the arrangement being such that on pulling the trigger mechanism the valve is partially opened to permit movement of the dies towards each other under the influence of a relatively low thrust. Upon pressing the button, the valve is shifted to its fully open position to cause crimping of the terminal as described above.

In the drawing:

FIGURE 1 is a perspective view of a crimping tool embodying the principles of the invention.

FIGURE 2 is a longitudinal section view showing the carrying handle, the inlet valve, and the valve control mechanism contained within the handle, the parts being shown in their normal positions with the valve closed.

FIGURE 3 is a view taken along the lines 3—3 of FIGURE 2.

FIGURE 4 is a fragmentary sectional side view showing the forward portion of the handle and illustrating the positions of the control trigger and the control button when the valve is in its partially open position.

FIGURE 5 is a fragmentary sectional view showing the relative positions of the parts of the control valve when the valve is in its partially open condition.

FIGURE 6 is a view similar to FIGURE 4 but showing the positions of the valve control mechanism when the valve is shifted to its fully open position.

FIGURE 7 is a view similar to FIGURE 5 but showing the positions of the parts when the valve is fully opened.

Referring first to FIGURE 1, one form of tool 2 in accordance with the invention comprises a cylinder 4 having a piston 5 (FIGURE 2) therein and a piston rod which actuates a reciprocable ram 6. The ram is axially offset from the cylinder in the tool shown and is not directly mounted on the piston rod but is actuated by a toggle mechanism contained within the lefthand end of the cylinder. This toggle mechanism is normally broken and is straightened by means of a cam on the end of the piston rod. This type of arrangement is shown, for example, in U.S. Patent 2,897,703. This invention is not limited to the toggle arrangement between the piston rod and the ram shown in Patent 2,897,703 but can be used in tools in which the ram is directly connected or otherwise concatenated with the piston rod.

A generally C-shaped tool head 8 is mounted on the forward end of the tool between a pair of plates 7 extending from the cylinder and a fixed die 12 is mounted in this head for cooperation with a movable die 10 on the end of the ram 6 to crimp an electrical terminal onto a wire. A carrying handle 14, comprising a hollow metal tube, extends alongside the cylinder 4 and has a grip portion 16 at its forward end for purposes of operator convenience and comfort. This carrying handle is connected to the cylinder by means of brackets 18, 22, the rearward bracket 18 being integral with a plate 20 which functions as a cover for the rearward end of the cylinder. The forward bracket 22 has a neck portion 24 extending towards the cylinder and has offset legs 26 which straddle, and are fastened to, the plates 7. These legs extend beyond the plates 7 and are enlarged at their ends to form a mounting stand for the tool so that, if desired, it can be positioned on a surface during use.

The rearward bracket 18 is axially bored as shown at 30 and a compressed air line 28 communicates with this bore through a fitting 27. Bore 30 is enlarged intermediate its ends to form a chamber 34 and a counterbore 32 is provided on the righthand side of the bracket which counterbore receives the end of the handle 14. A passageway 36 extends laterally from central chamber 34 thence rearwardly as shown at 37 and thence obliquely towards the cylinder at 38 thereby to permit passage of compressed air from the air line to the rearward end of the cylinder.

A stationary cylindrical valve bushing 40 is mounted in chamber 34 and is axially bored and counterbored to provide, as viewed from left to right in FIGURE 2, a uniform diameter counterbore 42, a conical valve seat surface 44, a central bore 46, and adjacent conical valve seat surface 48, a uniform diameter bore 50 of a diameter equal to that of the counterbore 42, and an enlarged counterbore 52. A passageway 54 in the central bore 46 communicates with the passageway 36, 37, and 38. A valve piston 56 mounted in the valve body 40 has an enlarged diameter rearward end 60 and a pair of opposed integral collars 61 intermediate its ends. The righthand end of the valve piston has an integral polygonal section 62 which is slidably contained in the counterbore 52 of the valve body. The reason for the provision of the polygonal section 62 of the valve piston within the counterbore 52 is to permit passage of an exhaust air stream as is described below. A sealing ring 58 is contained between the collar 60 and lefthand collar 61 and a similar sealing ring is provided between the righthand

collar **61** and the polygonal end **62** of the valve piston. These sealing rings are provided with opposed conical surfaces which conform to the conical surfaces **44**, **48**. It will thus be apparent that when the valve piston is in the position shown in FIGURE 2, the valve is closed and compressed air can not flow from the air line to the rearward end of the cylinder. The valve is fully opened when the valve piston is moved to the position shown in FIGURE 7. The valve piston is normally maintained in the position of FIGURE 2 by the effect of the compressed air on the enlarged end **60** of the end portion of the piston and on the surface of the sealing ring **58**.

The movement of the valve piston **56** is controlled by a rod **64** which extends axially through the tube **14** and is supported by a bearing **66** at its rearward end and a bearing **72** at its forward end. The bearing **66** is provided with one or more passageways **68** to permit passage of exhaust air to exhaust ports **69** in the handle. The bearing **72** is contained in a counterbore **73** of the forward end of tube **14** and is held in position by means of a pin **74**. A flat **75** is provided on the rod **64** in the vicinity of the pin **74** to prevent rotation of the rod. An enlarged cylindrical contact boss **70** is provided on the rearward end of the rod **64** and behind the bearing **66**. This boss bears against the face of the polygonal portion **62** of the valve piston **56** so that upon leftward movement of the rod **64** as viewed in FIGURE 2, the valve piston will be moved from the relative position of FIGURE 2 to the positions of FIGURES 5 and 7.

Rod **64** extends forwardly beyond the tube **14** through the bracket **22** and has a control button **76** on its end. This button has a reduced diameter portion **78** intermediate its ends and has an integral collar **80** on its lefthand side as viewed in FIGURE 2, this collar being provided with a forwardly facing conical camming surface **82** on its edge and being of a diameter such that it is slidably received within the counterbore **73** of the tube **14**.

As is explained more fully below, the operation of the tool requires that the rod **64** be initially moved a short distance leftwardly as viewed in FIGURE 2 to partially open the valve. Later, the rod is moved an additional leftward distance to fully open the valve. The partially opening of the valve is accomplished by means of a latch plate **84** which is located against the end of the tube **14** and the bracket **22**. This latch plate is centrally notched to define a pair of feet **86** which straddle the axis of the control rod and which extend between the enlarged end of the button and the collar **80**. The width of the central notch in the plate **84** is less than the diameter of the counterbore **73** and the undersides of these feet which bear against the surface of the bracket are cut away as shown at **89**. At their upper ends then, as viewed in FIGURE 2, feet **86** have bearing surfaces **88** which normally bear against the end face of the tube **14**. When this plate is moved relatively downwardly however, the bearing surfaces **88** move against and over the conical surface **82** of the collar **80** and thereby move the control button and the rod leftwardly a short distance.

The plate **84** is slidably held against the surface of the bracket **22** by means of a fastener **96** which extends through a flanged bushing **98** which, in turn, extends through a slot **100** in the plate. This slot **100** extends transversely of the axis of the control rod **64** so that the plate is permitted to move downwardly from the position of FIGURE 2 to the position of FIGURE 4.

The plate **84** is normally biased upwardly to the position of FIGURE 2 by means of a spring **92** contained in a recess **94** in the bracket **22** which bears against the underside of a forwardly projecting flange **90** on the lower end of the plate. Downward movement of the plate **84** against the force of spring **92** is achieved by means of a yoke **104** which straddles the neck portion **24** of the bracket and is pivoted thereto as shown at **105**. The forward ends **105** of each arm of this yoke are received within notches **102** on the sides of the plate **84** so that upon clockwise movement of the yoke as viewed in FIGURE 2, the plate will be pulled downwardly. A trigger **108** extends rearwardly from the cross piece **107** of the yoke and is located beneath the grip **16** of the handle **14** in a position such that it is conveniently accessible to the index finger of the operator.

In use, and assuming the parts are in the initial positions of FIGURES 1–3, the operator first locates the ferrule portion of a terminal between the crimping surfaces of the dies **10** and **12** and, with his index finger, raises the trigger **108** to lower the plate **84** and thereby slide the ends of the feet **86** over the bevelled surface **82** of the collar **80**. As shown in FIGURES 4 and 5, this movement of the latch plate **84** will cam the collar **80** leftwardly thereby moving the rod **64** leftwardly a very slight and accurately predetermined distance. This movement of the rod and the boss **70** will cause the valve piston **56** to be shifted from the position of FIGURE 2 to the position of FIGURE 5. In the latter position, neither of the sealing rings **58**, **59** are against the surfaces **44**, **48** so that compressed air is admitted to the central chamber **46** of the valve body. The air stream divides in this chamber, a portion flowing past the sealing rings **58** and **59** and the polygonal end **62** of the valve stem thence through the passage **68** and the exhaust ports **69**. Another portion of the air stream flows through the port **54** and thence through the passageways **36**, **37** and **38** to the rearward end of the cylinder **4**. Since the compressed air is being partially exhausted, only a relatively low thrust will be imparted to the ram **6** by the piston and the dies will move towards each other until the terminal is gripped between the dies. The thrust imparted to the ram is not sufficient to crimp the terminal and the operator can then carefully position the end of the wire in the barrel of the terminal.

After the trigger has been shifted from the position of FIGURE 2 to the position of FIGURE 4, the parts will be maintained in the positions of FIGURES 4 and 5 by the effect of the compressed air stream upon the rearwardly facing surfaces of the collar **60** and the sealing ring **58**. This compressed air stream will urge the valve piston rightwardly in FIGURE 2 and the force thus developed will be transmitted through the members **62**, **70** to the rod **64** and to the collar **80**. The face of the collar **80** will thus be urged against the bearing surface **88** of the feet **86**. The resulting friction produces sufficient force to overcome the effect of the spring **92** so that the plate **84** will not be pushed upwardly to its normal position. It will thus be apparent that the plate **84** functions as a latch means during this portion of the operating cycle.

After insertion of the wire, the operator merely presses the head of the control button **76** until the rod is moved a further distance leftwardly to the position of FIGURE 6. Such movement results in complete closure of the valve, that is, in movement of the sealing ring **59** against the surface **48** so that the entire compressed air stream now flows through the port **54** thence to the rearward end of the cylinder. The thrust imparted to the ram immediately rises and the crimping die **10** is moved further against the terminal to crimp the terminal onto the wire. After crimping, the operator merely releases the button and the valve piston is shifted back to the position of FIGURE 1 under the influence of the incoming compressed air on the enlarged end **60** of the valve piston. The compressed air in the cylinder is then exhausted through the passageway **38–36** thence past the ring **59** to the interior of the handle **14** and through the exhaust port **69**. As soon as the button **76** is pressed to complete the crimping operation, the collar **80** moves away from the bearing surfaces **88** of feet **86** and the plate **84** moves upwardly under the influence of the spring **92**.

A salient advantage of the invention is that the operator can cause the crimping dies to be moved towards each other until they grip the terminal barrel. The dies

then dwell in this partially closed condition until the operator has inserted the wire into the barrel. Thereafter the operator can complete the crimping operation by pressing the control button. Moreover, the movements of the dies are brought about by control devices, the trigger and the button, which are conveniently accessible to the index finger and thumb of the hand which is used to hold the tool. The operator thus has one free hand to insert the wire into the terminal and need not concern himself with the manipulation of the controls of the tool while he is carrying out this operation. Since the positioning of the wire in a terminal is of vital importance in the attainment of an optimum crimped connection, it is a distinct advantage that this operation can be carried out carefully and without distraction when the instant tool is used.

A further advantage of the invention is that the valve structure is contained entirely within the handle and occupies that would otherwise be wasted. The handle itself provides a convenient means of gripping the tool where, as is often the case, it is necessary for the operator to hold the tool in one hand while he manipulates the terminal and later the wire with his other hand.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

We claim:

1. In a pneumatic crimping tool comprising a piston and cylinder, a piston rod, a movable die concatenated with said piston rod, a tool head mounted on said cylinder and a fixed die mounted on said head for cooperation with said movable die, the improvement comprising: a carrying handle mounted on, and extending alongside, said cylinder, compressed air inlet passageway means in said handle at the rearward end thereof and communicating with the rearward end of said cylinder, a valve comprising a valve piston in said inlet passageway means, a control rod extending through said handle for controlling said valve piston, a first manually operable rod control means on said forward end of said handle for moving said control rod a first fixed distance to a first position thereby to partially open said valve, means for holding said rod in said first position, and a second manually operable means for moving said rod a further distance to fully open said valve whereby, upon positioning a terminal between said dies and actuating said first manually operable means, said movable die is moved towards said fixed die under the influence of relatively low pressure compressed air, and said terminal is gripped between said dies, and upon actuation of said second manually operable means, said terminal is crimped by said dies under the influence of relatively high pressure compressed air.

2. In a pneumatic crimping tool comprising a piston and cylinder, a piston rod, a movable die concatenated with said piston rod, a tool head mounted on said cylinder at the forward end thereof, and a fixed die mounted on said tool head for cooperation with said movable die, the improvement comprising: a carrying handle mounted on, and extending alongside, said cylinder, a compressed air inlet passageway in said handle at the rearward end thereof communicating with said cylinder at its rearward end, a valve comprising a valve piston in said inlet passageway, said piston being normally maintained in closed condition by compressed air from said source and being axially slidable towards an open position, a rod extending coaxially in said handle and having its rearward end in engagement with said valve piston, said rod extending forwardly beyond the forward end of said handle, a first manually operable rod moving means on said forward end of said handle for moving said control rod a first fixed distance thereby to move said valve piston and partially open said valve, latch means for holding said rod in said first position whereby relatively low pressure compressed air is admitted to said cylinder to drive said movable die towards said fixed die under the influence of a relatively low thrust sufficient to grip a terminal between said dies without crimping, and a second manually operable rod moving means for moving said rod a further distance to fully open said valve thereby to admit relatively high pressure compressed air to said cylinder sufficient to increase the thrust applied to said ram to a level sufficient to crimp said terminal.

3. A device as set forth in claim 2 wherein said first rod moving means comprises a plate movable transversely of the axis of said rod, a cam surface on said rod extending obliquely of the axis of said rod, and means on said plate for engaging said cam surface thereby to move said rod axially.

4. A device as set forth in claim 2 wherein said first rod moving means and said latch means comprise a plate on said carrying handle at the forward end thereof, said plate extending transversely of the axis of said rod and having a notch therein, said rod extending through said notch, a collar on said rod adjacent to said plate, camming means effective between said plate and said collar for moving said rod axially upon movement of said plate in its own plane, and trigger means for moving said plate transversely of the axis of said rod.

5. A device as set forth in claim 4 wherein said second rod moving means comprises a button on said rod at the forward end thereof.

6. In a fluid operated crimping tool comprising a piston and cylinder, a piston rod, a movable die concatenated with said piston rod, a tool head mounted on said cylinder and a fixed die mounted on said head for cooperation with said movable die, the improvement comprising: a carrying handle mounted on, and extending alongside, said cylinder, compressed fluid inlet passageway means in said handle at the rearward end thereof and communicating with the rearward end of said cylinder, a valve in said inlet passageway means, a control rod extending through said handle for controlling said valve, a first manually operable rod control means on said forward end of said handle for moving said control rod a first fixed distance to a first position thereby to partially open said valve, means for holding said rod in said first position, and a second manually operable means for moving said rod a further distance to fully open said valve whereby, upon positioning a terminal between said dies and actuating said first manually operable means, said movable die is moved towards said fixed under the influence of relatively low pressure compressed fluid, and upon actuation of said second manually operable means, said terminal is crimped by said dies under the influence of relatively high pressure compressed fluid.

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