Aug. 8, 1961 T. C. FREEDOM 2,995,053

EXPLOSIVE CRIMPING TOOL

Filed June 5, 1958

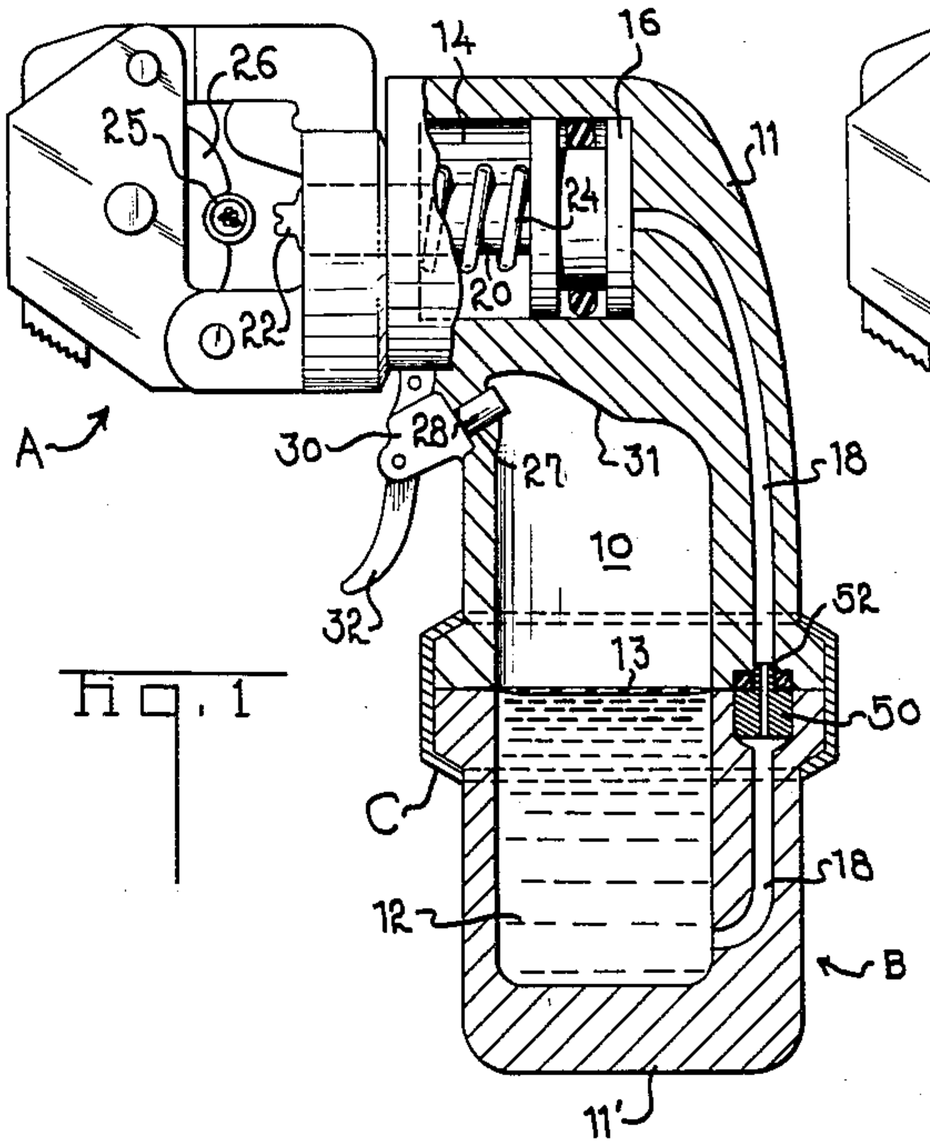

Fig. 1

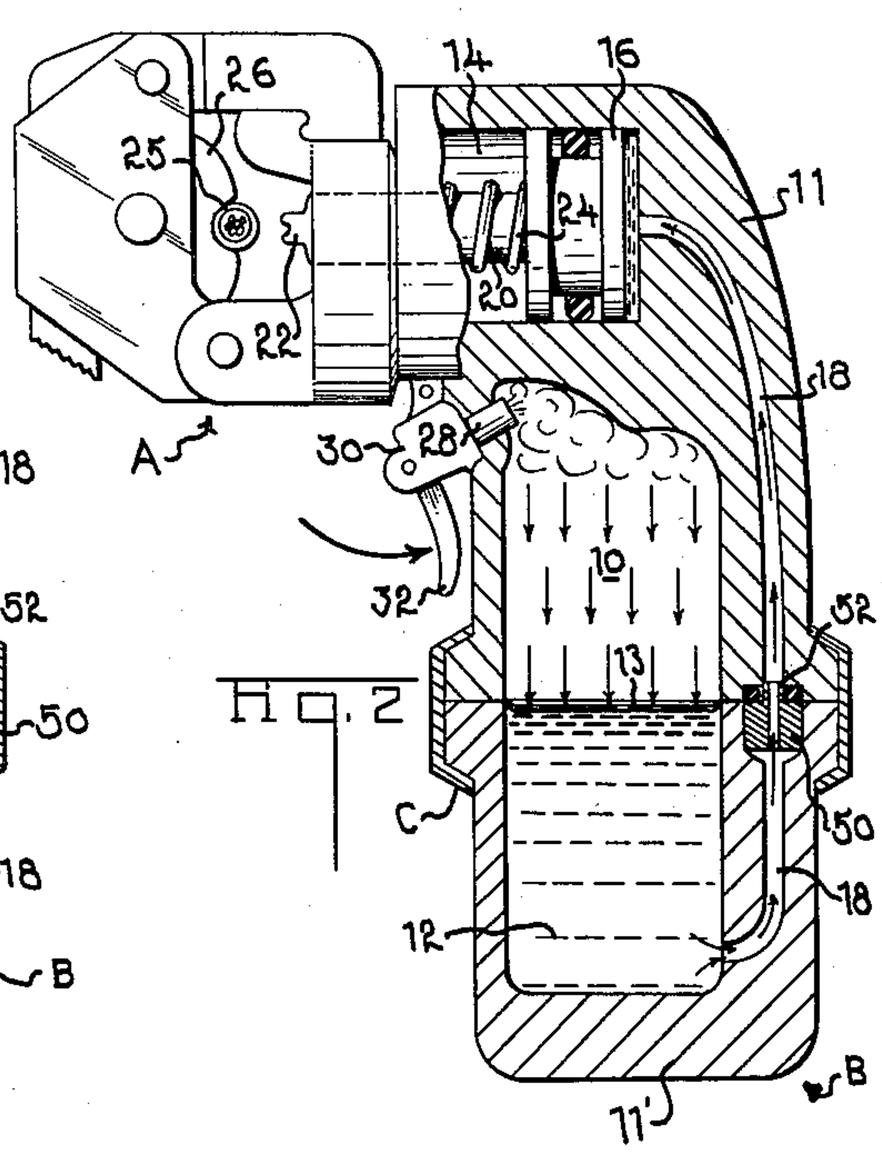

Fig. 2

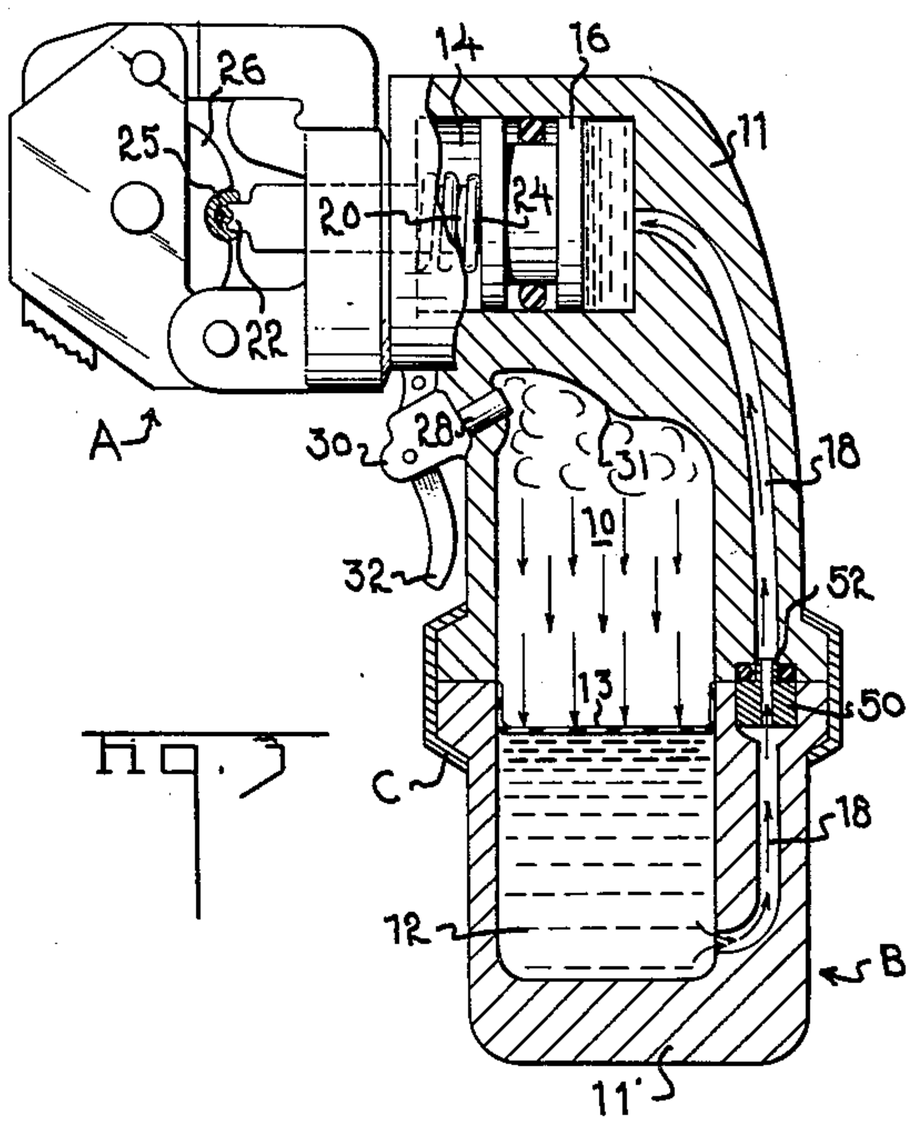

Fig. 3

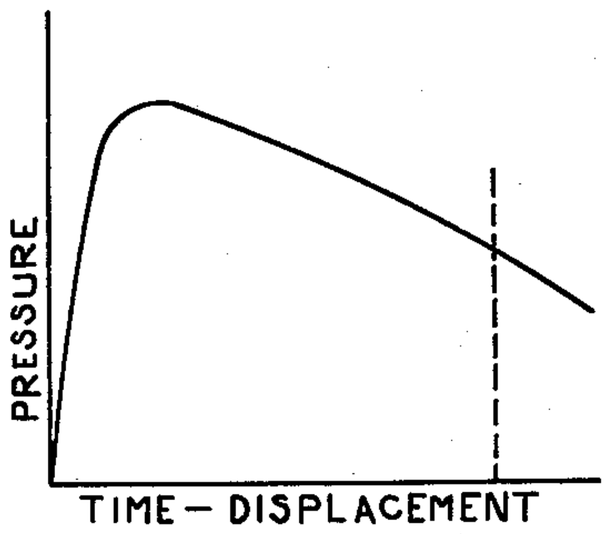

Fig. 4

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EXPLOSIVE CRIMPING TOOL

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The present invention involves a tool for cold forging electrical connectors onto conductors. More particularly it involves such a tool which is operated by gas pressure, e.g. the gasses generated by an explosive charge.

Explosively operated tools shown in the prior art are generally subject to the disadvantage that the explosive gasses operate directly on the piston which drives the crimping die. This causes a sharp, high-impact high speed thrust which may damage the connector and may shear the material due to non-uniform flow. Furthermore such tools are dangerous to operate.

It is an object of this invention to provide an explosively operated crimping tool having operating characteristics whereby pressure generated by an explosion is stored in the tool and gradually released whereby relatively slow travel of the crimping die may be achieved.

It is also an object of this invention to provide a tool of the character described wherein the operating die is disposed from and offset with respect to the direction of pressure exerted by the explosive force.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

FIGURE 1 illustrates a plan view of a tool embodying principles of this invention, showing the tool in its initial position;

FIGURE 2 is a view similar to FIGURE 1, showing the relationship of parts immediately after the charge has been detonated;

FIGURE 3 is a view similar to FIGURES 1 and 2, showing the tool at the completion of the crimping cycle.

FIGURE 4 is a graph showing the pressure curve of the chamber.

The preferred embodiment may be comprised of a head A, and a body B. The body forms a hollow chamber 10 which may be made in two sections 11, 11', joined by a removable clamping member C. The chamber contains a hydraulic fluid 12 retained by a diaphragm 13. The diaphragm may form a seal between the sections 11, 11'.

A second chamber 14 has a driving piston 16 longitudinally movable therein. The chamber 14 is disposed laterally to the chamber 10. A narrow gauge tube 18 extends from the body of liquid 12 into communication with the chamber 14.

The piston rod 20 extends into the head A and carries a die 22 on its free end. A spring 24 seated in the chamber 14 normally urges the piston 16 into the position illustrated in FIGURE 1.

The head A is latched to permit insertion of an electrical connector 25 and may contain a die nest wheel 26, e.g. the type illustrated in the patent issued to Henry W. Demler, Number 2,762,414.

The body member B has an opening 27 with an explosive cartridge 28 seated therein. A standard firing

mechanism 30, including a trigger 32 is utilized to detonate the cartridge 28. It is noted that the cartridge 28 is fired toward the curvilinear surface 31 which bears the brunt of the explosive force and smoothly redirects the pressure into the chamber 10. The diaphragm 13 follows the contour of the fluid.

The junction of sections 11, 11' will contain suitable sealing means for preventing escape of fluid as well as locating the diaphragm 13. An insert 50 may be threaded or force fitted into one section of the tube 18, with a nipple 52 projecting into the other section, surrounded by a sealing means. This insert is replaceable, e.g. by another insert having a different internal diameter to vary the rate at which the pressure is bled out of the chamber. Thus the effective internal diameter of the fluid passageway, as well as the viscosity of the fluid 12, determine the rate of travel of the piston 16 and thus the crimping die 22.

It is noted that the tool will accommodate a range of sizes. The size of the combustion chamber, the strength of the charge, the internal diameter of the tube 18 and the insert 50, and the viscosity of the fluid are all designed to crimp the largest connector in the range. A smaller connector may be crimped under the same conditions leaving an excess pressure in the chamber after the crimp is made. In fact the tool is designed so that some excess pressure is retained by the tool, even after crimping the largest connector. The net effect is that a range of connectors may be accommodated in the tool without varying any of these factors, or requiring the operator to stock a variety of charges.

Operation

A connector 25 is placed in the die nest wheel 26 with a conductor therein. A cartridge 28 is seated in the opening 27. The trigger 32 is actuated to detonate the cartridge. The explosive charge is fired at the curvilinear surface 31 and is deflected back into the chamber 10 where it is stored and gradually bled off to exert a continuous force on the fluid 12 through the diaphragm 13.

The fluid 12 is forced through the tube 18 into the chamber 14 where it provides a thrust against the working face of the piston 16.

The fluid thus drives the piston against the connector 25 and deforms it and the conductor into a secure electrical connection (note FIGURE 3). The speed of the piston 16 (and thus the die 22) may be controlled by design of the effective internal diameter of the tube 18 and choice of fluid having the desired viscosity. If it is desired to decrease the speed of the crimping operation, a smaller effective internal diameter and/or a highly viscous fluid may be provided. For more rapid crimping, a tube having a larger effective internal diameter and/or a less viscous fluid may be employed.

The graph (FIGURE 4) illustrates this "pressure-time" relationship as it occurs in the chamber. It illustrates that a relatively large pressure is built up quickly and bled off gradually.

When the crimp is completed, the pressure remaining in the chamber 10 may be bled off through opening 27 by extracting the cartridge 28. The spring 24 retracts the piston 16 and causes the fluid to return to the chamber 10. The diaphragm prevents fluid from leaking out of the tool when the tool is in a position other than vertical.

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 follow-

ing claims when viewed in their proper perspective against the prior art.

I claim:

1. A tool for crimping electrical connectors including a head with crimping dies therein, one of said dies being relatively movable toward and away from said other die, means for moving said relatively movable die including, a gas retaining chamber in communication with said movable die, means for generating a sudden, extreme pressure in said chamber, means for storing said pressure in the tool and means for transmitting the pressure from the chamber to the dies at a relatively slow rate compared to the rate of pressure generation and causing it to actuate the movable die, whereby the pressure in the chamber is gradually released to the movable die to urge the movable die toward the other die at a comparatively slow rate.

2. A tool for crimping electrical connectors including a head with crimping dies therein, one of said dies being relatively movable toward and away from said other die, means for moving said relatively movable die including a combustion chamber in said tool in communication with said movable die, means for generating a sudden, extreme pressure in said combustion chamber, means for storing said pressure in the tool and means for transmitting the pressure from the chamber to the movable die including a body of liquid disposed between the combustion chamber and the movable die to cause the pressure to actuate the movable die at a rate of speed which is considerably slower than the speed of the pressure generation, whereby the pressure in the chamber is slowly released to the movable die to urge the movable die toward the other die.

3. The device of claim 2 wherein the movable die is slidable in a second chamber and a fluid passageway leads from the combustion chamber to the second chamber.

4. The device of claim 3 including an insert in the fluid passageway, said insert having an internal diameter which is smaller than the internal diameter of the passageway.

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