Jan. 22, 1963 H. E. COOTES ETAL 3,074,155

HAND TOOL

Filed March 27, 1958 2 Sheets-Sheet 1

Fig. 6

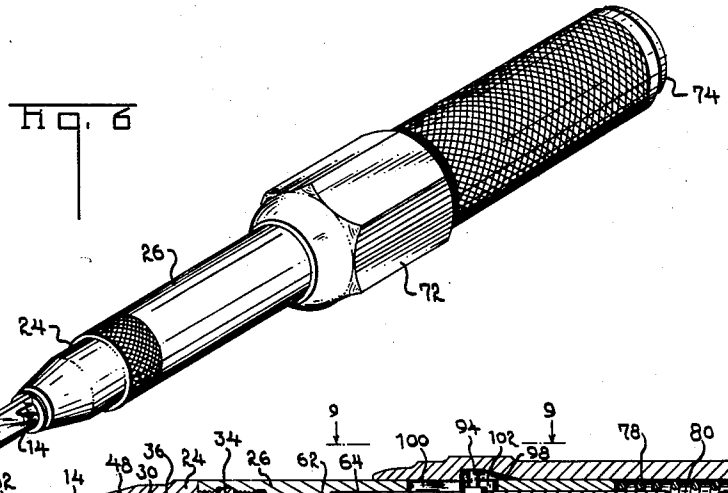


Fig. 1

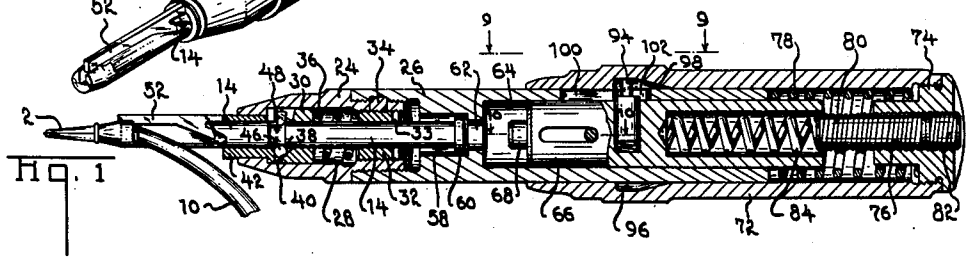


Fig. 2

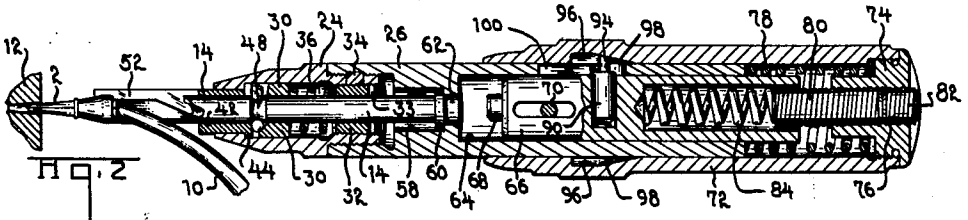


Fig. 3

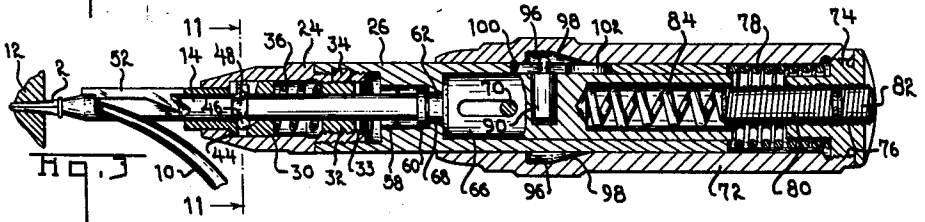
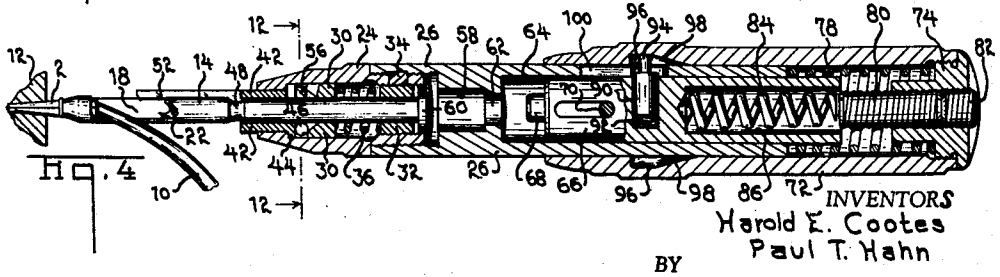


Fig. 4



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2 Sheets-Sheet 2

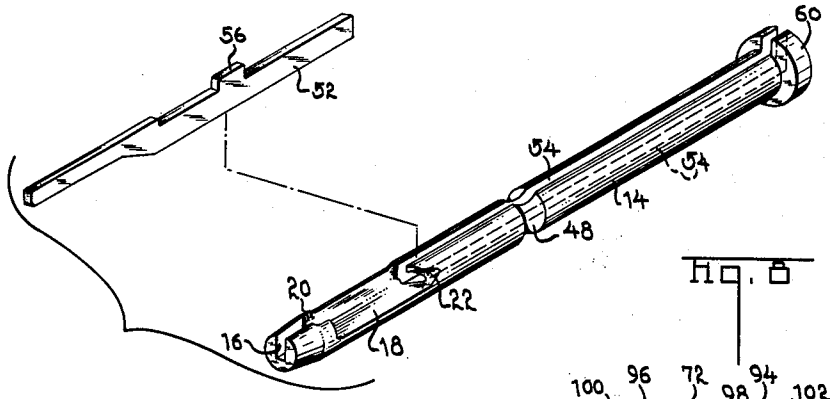


Fig. 8

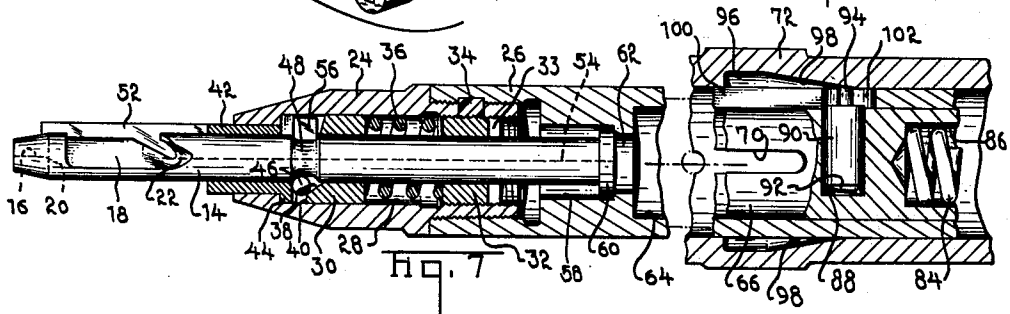


Fig. 7

Fig. 9

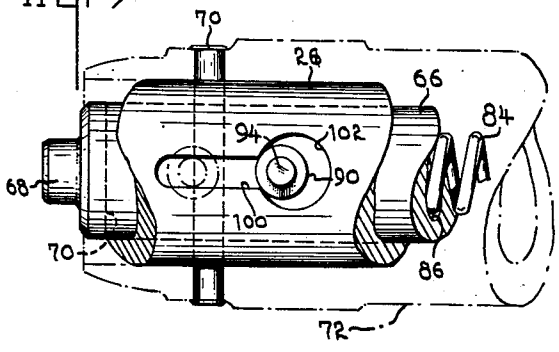


Fig. 10

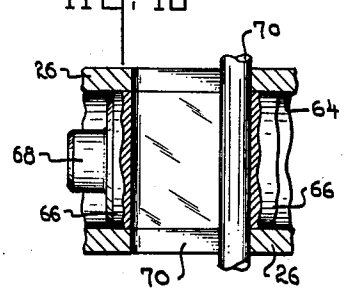


Fig. 5

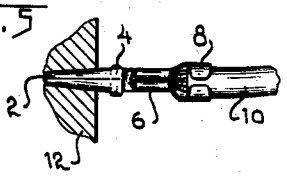


Fig. 11

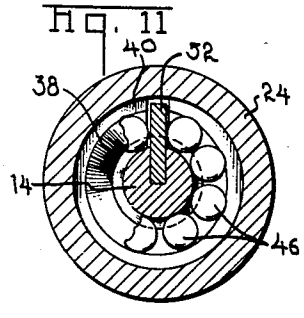
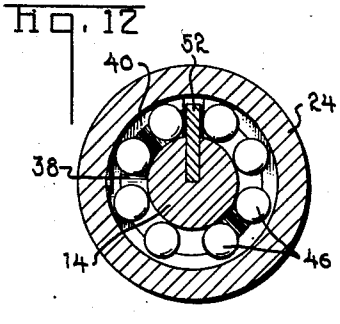


Fig. 12



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United States Patent Office 3,074,155 Patented Jan. 22, 1963

3,074,155

HAND TOOL

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Filed Mar. 27, 1958, Ser. No. 724,352
11 Claims. (Cl. 29—206)

This invention relates to tools for inserting pins or the like into receptacles or other bodies. The invention is disclosed herein in an embodiment adapted to the insertion of taper pin electrical connectors into complementary receptacles, however, it will be apparent that the invention is amenable to other uses.

Taper pin electrical connectors have been widely accepted in the electrical arts and are used in vast numbers, particularly in the construction of complex circuits in computers or the like where large numbers of connections are required and relatively small diameter wires are involved. Electrical connections are made with taper pin connectors by merely inserting the pin into a receptacle and preferably by applying an impact force to the pin. The receptacle may provide multiple tapered openings for several pins so that several conductors can be connected at a common junction. If the pin is inserted properly into the receptacle, it will withstand substantial pullout forces and the electrical integrity of the connection between the pin and the receptacle will be resistant to the deleterious effects of, for example, vibration and corrosion.

It has been found that the soundness of an electrical connection between an inserted pin and a receptacle can be established if a pull-out test force is applied to the pin. For example, one commonly used type and size of taper pin will, after proper insertion, withstand a pull-out force of up to about 25 pounds but an improperly inserted pin will be removed from the receptacle if a pull-out test force of 10 pounds or less is applied. Thus the soundness of the connection can be established if a 10 pound pull-out test is applied at the time of insertion.

An object of the present invention is to provide an inserting tool for pins or the like which embodies a compulsory pull-out test feature such that a technician using the tool is required to perform a pull-out test on the pin after insertion. A further object is to provide an insertion tool having means positively to lock the pin to the tool so that the tool can be held in any orientation without having the pin fall out of the tool before insertion. A further object is to provide an insertion tool having both means to lock the pin to the tool and a pull-out test feature, the means for locking the pin being constructed in such manner that the pin is released from the tool only after a pull-out test has been carried out thereby to insure that a technician using the tool will perform such a test on every pin after insertion.

These and other objects are achieved in a tool comprising a rod or the like having a pin-receiving recess at one end and locking means for locking the pin in the recess. The locking means and the rod are movable relative to each other from a first position in which the pin is in locked engagement to the rod to a second position in which the pin is released from locked engagement. A detent or similar device is provided for maintaining the rod and locking means in the first relative position, this detent means being operative to release the rod from the locking means upon application of a predetermined test force so that the rod and locking means are permitted to move to their second position to release the pin. The inserting force for the pin is applied to the rod in any convenient manner, for example by a spring loaded hammer, and transmitted through the rod to the pin.

For more complete disclosure of a preferred embodiment, reference is made to the accompanying drawings in which:

FIGURE 1 is a cross-sectional view of a tool in accordance with the instant invention showing the parts in the positions which they occupy at the beginning of an inserting operation;

FIGURES 2, 3, and 4 are views similar to FIGURE 1 but showing the positions of the parts at various stages of the inserting operation. FIGURE 2 shows the parts after the inserting force has been initially applied, FIGURE 3 shows the positions of the parts after the inserting force blow by the hammer has been delivered, and FIGURE 4 shows the relative positions of the parts after the pull test has been completed and the terminal has been released from the tool;

FIGURE 5 is a fragmentary view of a taper pin electrical connector of a type adapted to be inserted by the disclosed embodiment of the invention;

FIGURE 6 is a perspective view of the embodiment of FIGURE 1;

FIGURE 7 is an enlarged view of the tool showing details of the pull test feature of the tool and the triggering detent;

FIGURE 8 is an exploded perspective view of a rod and key which form parts of the preferred embodiment;

FIGURE 9 is a fragmentary view taken along the line 9—9 of FIGURE 1;

FIGURE 10 is a view taken along the line 10—10 of FIGURE 1;

FIGURE 11 is a view taken along the line 11—11 of FIGURE 3; and

FIGURE 12 is a view taken along the line 12—12 of FIGURE 4.

A taper pin electrical connector of one well known type is shown in FIGURE 5 to comprise a tapered pin portion 2 having a circumferential collar or bead on its inner end where it is integral with a crimp 6 by means of which the pin is connected to the conducting core of a conductor 10. Advantageously an additional crimped connection 8 is provided between the connector and the insulation covering of the wire. In use, the tapered end portion 2 is inserted into a tapered receptacle in a connector member 12 which, for example, can take the form of a block providing multiple tapered apertures so that a plurality of pins can be inserted to form a common junction of the conductors to which they are attached.

A preferred embodiment of the invention which is particularly adapted to the insertion of taper pin connectors of the type shown in FIGURES 1–5 comprises a rod 14 having a recess 16 at its end extending axially therealong which recess is adapted to receive the crimped portion 6 of the connector. Recess 16 is enlarged at its inner end to form a pocket at 20 and communicates with a somewhat larger recess 18 so that when the taper pin is in position in the tool as shown in FIGURE 1, collar 4 of the pin abuts the end of the tool while the insulation crimp 8 fits within pocket 20 of recess 16 and the conductor 10 is received within recess 18.

A collet 24 surrounds rod 14 intermediate the ends thereof and is threadedly engaged with a barrel 26 which contains an impact hammer and triggering mechanism as described below. Collet 24 is centrally bored at 28 and slidably receives a collar or bushing 30 through which rod 14 slidably extends. Bore 28 is threaded internally at its inner end and receives a centrally bored nut 32 through which rod 14 also slidably extends. This nut provides kerfs 33 for a wrench and can be adjusted to regulate the force of the pull test applied to an inserted pin, as described below, and it is desirable therefore to provide means securely to lock the nut in a given position of adjustment. In the preferred embodiment such means is provided in the form of a plastic lock member 34 partially

and compressively received in an opening in collet 24 and extending into a recess in barrel 26. The compressed plastic plug 34 engages the threads on nut 32 and thereby prevents it from slipping from a given position of adjustment.

A coil spring 36 surrounds rod 14 and is interposed between the opposing faces of collar 30 and nut 32. Collar 30 provides on its opposite face a bevelled surface 38 which however does not extend to the edges of the collar but which merges with a flat surface 40 which extends around the periphery of the edge. The end of bore 28 is of reduced diameter and accommodates a bushing 42 having a circumferential flange 44 thereon which fits over the shoulder defined at the reduced diameter end of the bore. A plurality of ball-bearings 46 are disposed between bevelled surface 38 and the face of flange 44 and, since collar 30 is urged leftwardly as viewed in FIGURE 1 by spring 36, these ball-bearings are urged into a circumferential groove 48 in rod 14. Advantageously, this groove is of a width somewhat greater than the diameter of the ball-bearings so that very limited free movement of rod 14 is permitted for reasons which will be apparent from the description below. As best shown in FIGURE 8, the sides of groove 48 extend substantially normally of the base of the groove and its depth is less than the radius of the ball bearings. A key 52 extends axially along rod 14 and is received within an axially extending slot 54. This key provides a projection or ear 56 which extends into a cut away portion of collar 30 so that the key and the collar, in effect, constitute an extension of barrel 26. When the rod is in the position of FIGURE 1, the end of key 52 partially closes recess 16 and locks the connector within the recess.

Barrel 26 provides an enlarged bore 64 which extends leftwardly from its end, as viewed in FIGURE 1, in which is disposed a reciprocable hammer 66 having a reduced diameter projection 68 on the end thereof. Bore 64 communicates, by means of a reduced diameter passageway 62, with a bore 58 within which an enlarged head 60 of rod 14 is slidably received. Projection 68 of hammer 66 is of a length such that when the hammer reaches the end of its travel in bore 64, the projection will extend beyond the limits of passageway 62 to engage the head 60 of the rod. It should be pointed out at this point that the limited free movement of rod 14 permitted by virtue of oversized groove 48, should be sufficient to permit the head 60 of the rod to seat itself against the shoulder formed by bores 58 and 62 so that when the hammer is triggered and rod projection 68 travels through passage 62, the force of the hammer will be transmitted to head 60 of the rod.

Hammer 66 has a pin-slot connection 70 with barrel 26 and with an outer barrel or handle 72 in which the ends of the pin are mounted as shown in FIGURES 9 and 10. A cap 74 is threaded into the open end of outer barrel 72 and provides an internally threaded boss 76 extending axially towards hammer 66. This boss threadedly receives an adjusting stud 80 and a locking stud 82. Adjusting stud 80 at its lower end bears against a coil spring 84 received within an axial bore 86 in the hammer and a spring 78 is interposed between cap 74 and inner barrel 26 so that inner barrel 26 is biased leftwardly, as viewed in FIGURE 1, and outer barrel 72 is biased rightwardly.

A transverse bore 88 in hammer 66 accommodates a cylindrical detent 90 biased by means of a spring 92 to extend partially through a circular opening 102 in barrel 26. Detent 90 provides a reduced diameter projection 94 on its end which normally projects into an internal groove 96 in handle 72. The diameter of this projection is slightly less than the width of a slot 100 which extends axially along barrel 26 from opening 102. Groove 96 in handle 72 merges with a sloping cam surface 98 so that when the outer handle is moved relatively leftwardly as viewed in FIGURE 1 the detent is pushed inwardly against the force of spring 92.

In use, at the beginning of an inserting operation the parts will be substantially as shown in FIGURE 1 with a connector locked within recess 16 by key 52 and with its tip 2 extending beyond the end of rod 14. When the connector is thus locked within the rod, the tool can be held in any orientation without dropping the connector or having it become disengaged from the tool. This feature is advantageous in that pins or connectors can be inserted in any desired orientation such as overhead or horizontally if the receptacles are so mounted.

The operator grasps the tool by the handle 72 and pushes the pin into the receptacle. On the first light application of inserting force to the handle, the entire tool will move relatively leftwardly as viewed in FIGURE 1 with respect to rod 14 so that the head 60 of this rod will seat itself at the shoulder between bores 58 and 62 (FIGURE 2). As previously mentioned the limited relative movement is permitted by virtue of the fact that groove 48 is of a width slightly greater than the diameter of ball bearings 46. Upon further application of an inserting force by the operator, outer handle 72 is moved relatively leftwardly with concomitant compression of springs 78 and 84 and as this outer handle moves leftwardly, it progressively cams detent 90 inwardly against the compression of spring 92. When this detent has been cammed inwardly to the extent that the larger diameter portion 90 is pushed entirely within transverse bore 88 in hammer 66, the hammer is triggered and projected relatively leftwardly by spring 84 until end portion 68 of the hammer contacts head 60 of the rod. The kinetic energy of the hammer is thus transmitted to the rod and thence to the connector through collar 4 thereof. It should be noted at this point that the limited free motion of rod 14 relative to the other parts of the tool is of importance in this step of the operation for the reason that, since the rod is permitted to move freely a short distance, all of the energy of the hammer will be transmitted directly to the pin and will not be absorbed by the tool body itself by transmission through ball-bearings 46.

After the hammer has delivered its blow to the rod, the parts will be in the position of FIGURE 3 and it only remains for the operator to release the taper pin connector from locked engagement to the rod. This is done by pulling rightwardly on the tool handle to apply a pull set force thereto. When this pulling force is applied, the face of flange 44 is pressed against the ball-bearings and the ball-bearings in turn are pressed against the right hand side of groove 48 and against bevelled face 38 of collar 30. When this pulling force reaches the predetermined level for the test, the ball-bearings are cammed outwardly from groove 48 by the reaction forces from the side of groove 48 and collar 30 is pushed by the ball-bearings relatively rightwardly from the position of FIGURE 3 to the position of FIGURE 4 with concomitant compression of spring 36. After the ball-bearings have been cammed out of groove 48, the barrel and other parts of the tool including key 52 can be slid relatively rightwardly with respect to rod 14 thereby to move the key to a position removed from recess 16 and release the taper pin from confined engagement. Of course, if the pin has not been inserted properly or if, for any other reason, it will not withstand the test force, the pin will be removed from the receptacle before the pull test force reaches a level which is sufficiently high to cam the ball-bearings out of groove 48.

As mentioned above, the sides of groove 48 extend normally of the bottom of the groove or, as shown in FIGURE 8, very nearly normally of the bottom of the groove. When the sides and bottom of the groove are thus formed, the camming force is developed abruptly and the tool can be calibrated for a given test force with a relatively high degree of precision.

From the foregoing description, it will be apparent that ball-bearings 46, groove 48, collar 30, and spring 36 constitute a detent means which maintains rod 14 and the

other parts of the tool in the first relative position of FIGURE 1 in which the pin is locked in confined engagement to the rod. This detent means releases the rod from the other tool parts upon application of the predetermined pulling force to permit the tool parts including key **52**, collet **24**, and barrel **26** to move relative to the rod thus to release the pin from confined engagement to the rod. Advantageously the forces of sliding friction between rod **14** on the one hand and bushing **42**, collar **30** and nut **32** on the other hand are kept to a minimum level by judicious selection of materials and dimensioning of the parts so that, after the rod has been disengaged from the other parts of the tool, only a very small pulling force is transmitted to the pin.

It will thus be apparent that after insertion of the taper pin into the receptacle, the pin can be released only by application of a pull test force to cause outward camming of ball-bearings **46** and the magnitude of this test force can be adjusted to any desired level by adjustment of nut **32** and compression of spring **36**. Thus with the use of the tool, it is not necessary to perform a separate testing operation on each inserted pin in order to be ensured of its electrical integrity since the technician using the tool compulsorily tests each connection as it is made.

It will be noted that in the preferred embodiment the rod **14** is keyed by means of key **52**, to bushing **42** and to collar **30**, and this collar and the bushing are rotatable within collet **24**. By virtue of this arrangement, if the tool handle is rotated, the pin is not rotated since collet **24** is rotatable relative to the collar, bushing and rod, and the operator can not remove a pin or disturb an inserted pin by rotating the handle.

In order to lock a pin to the rod **14**, the pin is positioned in recess **16** and rod **14** is moved relatively inwardly of collet **24** until the ball-bearings enter groove **48**. Under some circumstances, it might be necessary to remove the pin from the rod without inserting it into a receptacle, e.g. if the pin were found to be defective. This can be accomplished by merely pushing the rod inwardly of collet **24** to seat head **60** against the shoulder at the end of bore **58**. The operator then grasps barrel **26** with one hand and handle **72** with the other hand and pushes these parts into each other to trigger the hammer. Since head **60** is seated, the blow of the hammer will be delivered to the head and the rod will be moved outwardly by inertia to a distance sufficient to disengage the ball-bearings from the groove.

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. A tool for inserting a pin or the like into a receptacle comprising, a rod recessed at one end to hold said pin, pin engaging surface means in said recess for transmitting pushing and pulling forces to said pin, whereby upon application of an inserting or withdrawing force to said rod, said force is transmitted to said pin, confining means slidably mounted relative to said rod from a first position in which said recess is at least partially closed and said pin is confined within said recess to a second position in which said pin is released from confined relationship to said recess, and overload release detent means for locking said confining means and said rod in said first position, said rod and said confining means being releasable from locked engagement with each other upon application of a predetermined force sufficient to overcome said detent means whereby, after insertion of said pin into said receptacle, said predetermined force is applied to said pin as a removing test force prior to release of said pin from said recess.

2. A tool for inserting a pin or the like into a receptacle comprising, a rod having a recess at one end to hold said pin, pin engaging surface means in said recess for transmitting pushing and pulling forces to said pin, whereby upon application of an inserting or withdrawing force to said rod, said force is transmitted to said pin, a barrel in surrounding relationship to said rod, an extension of said barrel projecting toward said recess, said barrel and said rod being slidable relative to each other from a first position in which said extension confines said pin within said recess to a second position in which said pin is released from confinement in said recess, and overload release detent means for locking said barrel and said rod in said first position, said rod and said barrel being releasable from locked engagement with each other upon application of a predetermined axial force to said barrel sufficient to overcome said overload release detent means whereby after insertion of said pin into said receptacle, said predetermined axial force is transmitted to said pin as a pull test prior to release of said pin from confinement to said recess.

3. A device as set forth in claim 2 wherein said detent means comprises at least one ball-bearing positioned between said barrel and said rod, a groove in said rod, resilient means interposed between said barrel and said groove forcing said ball-bearing partially into said groove whereby said barrel and said rod are locked in said first position, and said ball-bearing is forced radially away from said groove against the force of said resilient means upon application of said predetermined axial force to release said barrel and said rod from locked engagement.

4. A device as set forth in claim 3 in which said resilient means comprises a spring in surrounding relationship to said rod, a bushing slidable on said rod and slidable relative to said barrel, said bushing being interposed between said spring and said ball-bearing, whereby upon application of said predetermined axial force, said ball-bearing cams said bushing along said rod until said groove in said rod moves relatively past said ball-bearing.

5. A tool for inserting a pin or the like into a receptacle comprising, a tubular barrel having a spring loadable hammer therein, an extension on one end of said barrel, a rod slidably mounted within said barrel and projecting axially beyond said one end, a recess in said rod for reception of said pin, pin engaging surface means in said recess for transmitting pushing and pulling forces to said pin, said barrel and said rod being telescopically slidable relative to each other from a first position in which said extension at least partially closes said recess, thereby to confine said pin within said recess, to a second position in which said pin is released from confinement, overload release detent means for locking said barrel and said rod in said first position, said detent means permitting limited axial movement of said rod whereby, when said hammer strikes said rod, the energy of said hammer is transmitted to said pin and is not absorbed by said barrel, said barrel and said rod being releasable from locked engagement upon application of a predetermined axial force sufficient to overcome said detent means whereby, after insertion of said pin into said receptacle, said predetermined force is applied to said pin as a removing test force prior to release of said pin from said recess.

6. A tool for inserting a pin into a receptacle and compulsorily pull testing said pin after insertion comprising, a barrel, a rod partially received in said barrel and extending from one end thereof, said rod having a recess in its external end for reception of said pin, pin engaging surface means in said recess for transmitting pushing and pulling forces to said pin, confining means on said rod for confining said pin in said recess, said rod being movable relative to said confining means from a first position, in which said pin is confined in said recess, to a second position, in which said pin is released from confined engagement with said recess, said barrel being axially slidable relative to said rod, said confining means being fixed relative to said barrel, overload release detent means

effective between said rod and said barrel maintaining said rod in said first position relative to said confining means whereby, upon application of a predetermined pulling force to said barrel when an inserted pin is confined in said recess, said overload release detent means releases said rod from said barrel and said barrel moves axially relative to said rod thereby to release said pin from confined engagement.

7. Apparatus as set forth in claim 6 wherein said barrel contains a spring loadable hammer for delivering a pin inserting force to said rod.

8. Apparatus as set forth in claim 6 wherein said overload release detent means comprises a circumferential groove in said rod, at least one ball bearing in said groove and having portions thereof in engagement with said barrel, and spring means urging said ball bearing into said groove.

9. A tool for inserting a pin-type electrical connector into a receptacle and compulsorily pull testing said connector after insertion comprising, a rod having a recess at one end for said connector, shoulder means in said recess for transmitting inserting and withdrawing forces from said connector to said rod, an axial slot in said rod extending inwardly thereof from said one end, a key in said slot, a tubular barrel in surrounding relationship to portions of said rod and key, said key being immovable relative to said barrel, said rod being slidable relative to said barrel from a first position in which said key extends across said recess to confine said connector in said recess to a second position in which said key does not extend across said recess and said connector is released from confined engagement with said recess, and overload release detent means in said barrel and effective between said rod and said barrel for maintaining said rod and key in said first position whereby, upon application of a pulling force to said barrel after insertion of a confined pin, said barrel and key are moved relative to said rod and said pin is released from confined engagement.

10. Apparatus as set forth in claim 9 including a spring loadable hammer in said barrel for delivering a pin inserting force to said rod.

11. A tool for inserting a taper pin electrical connector into a recess, said pin having a radial projection thereon, said tool comprising, a rod having a recess for holding said pin, confining means on said tool for confining said pin in said recess, shoulder means in said recess for transmitting pushing and pulling forces to said radial projection on said pin, overload release means normally maintaining said confining means in confining relationship with respect to said recess, said overload release means being operative to release said pin from confined relationship to said recess upon application, of a pulling force of predetermined magnitude to said pin whereby, after insertion of said pin with said tool, a pull test force of predetermined magnitude is applied to said pin before said pin is released from said tool.

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