# United States Patent [19]

**Hall, Jr.**

[11] **3,844,013**

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[54] **EXTRACTION TOOL**


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[73] Assignee: **AMP Incorporated**, Harrisburg, Pa.



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[52] **U.S. Cl.** ..... **29/203 H**

[51] **Int. Cl.**..... **B25b 7/00**, B25b 27/02

[58] **Field of Search**..... 29/203 H, 203 HC, 203 HT, 29/203 B, 200 H, 200 B, 200 D



[56] **References Cited**

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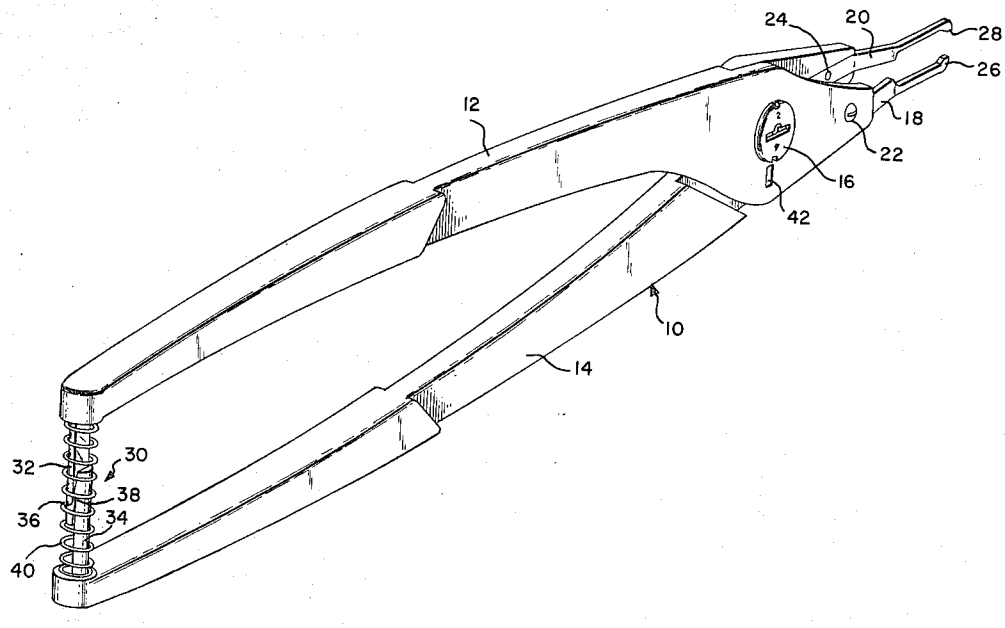
*Primary Examiner*—Thomas H. Eager



[57] **ABSTRACT**

A plier type extraction tool is disclosed for removing 2 contact and 4 contact connector plugs from connector receptacles without disturbing adjacent plugs in an array of closely stacked plugs. The tool has two elongated handles pivotally attached by a rotatable adjustment member which, according to its positioning, varies the distance between the free ends of the tool worktips. The worktips are detachably assembled on one end of each handle and each work tip has on the free end thereof a projection extending toward the opposite worktip. The projections engage and depress flexible latch arms on the connector plug to be removed, thus freeing it for removal from the associated receptacle assembly. The opposite ends of the tool handles have stroke limiting means controlling the maximum opening and closing of the tool.


**4 Claims, 7 Drawing Figures**



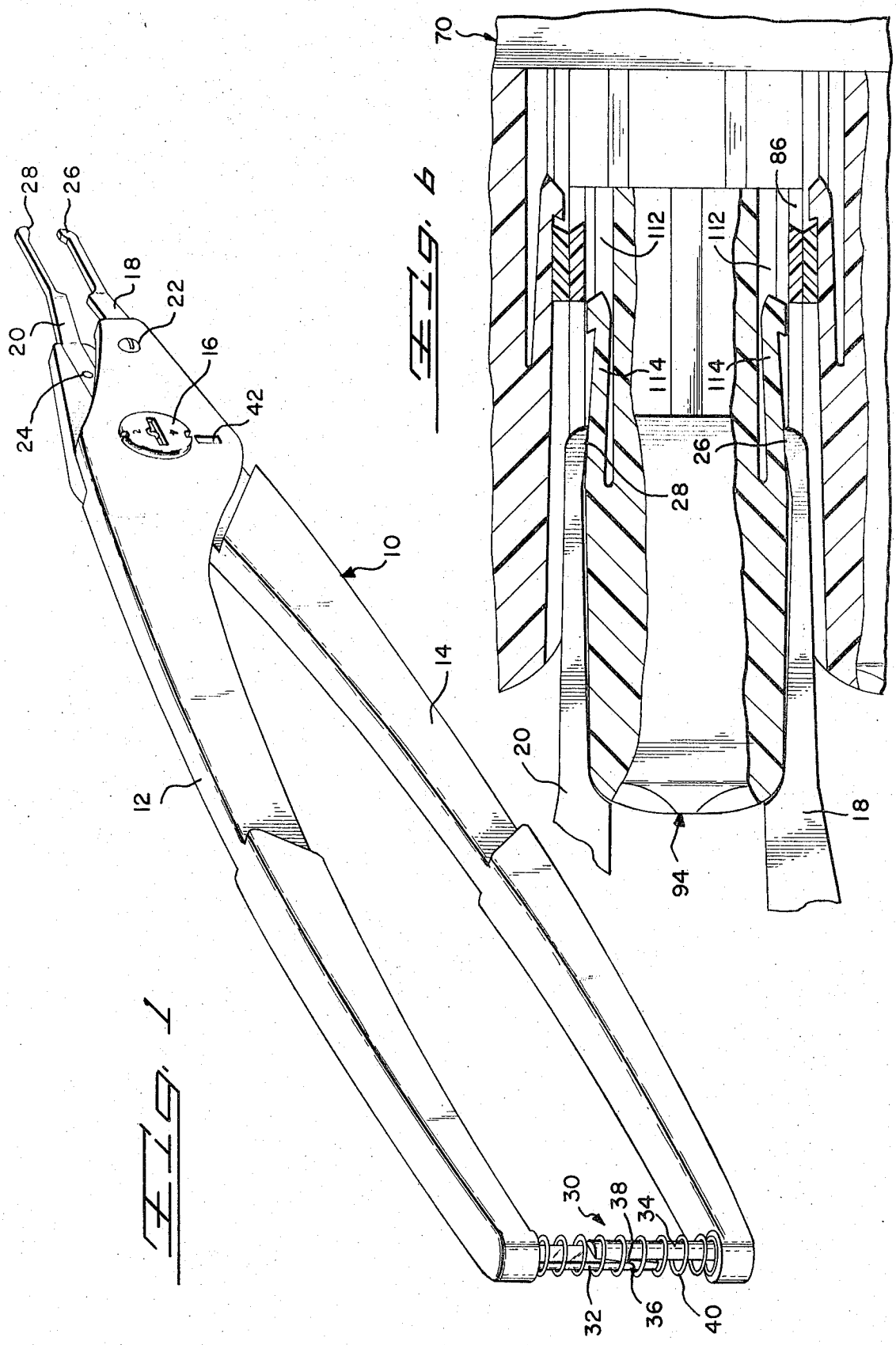

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FIG. 6

FIG. 7

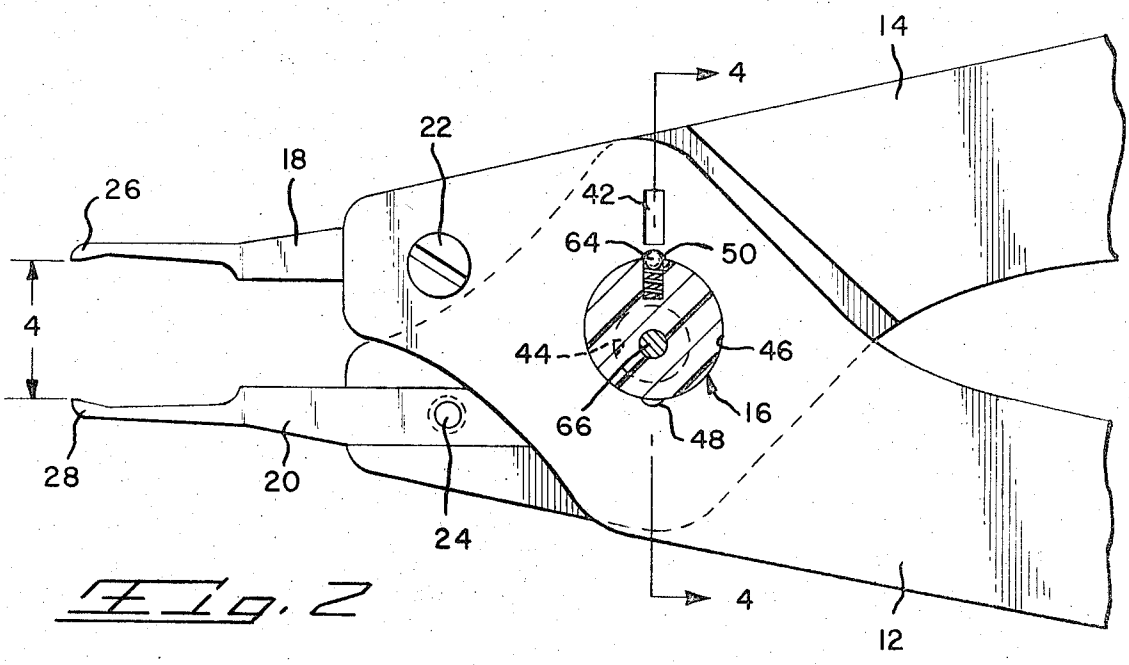



Fig. 2

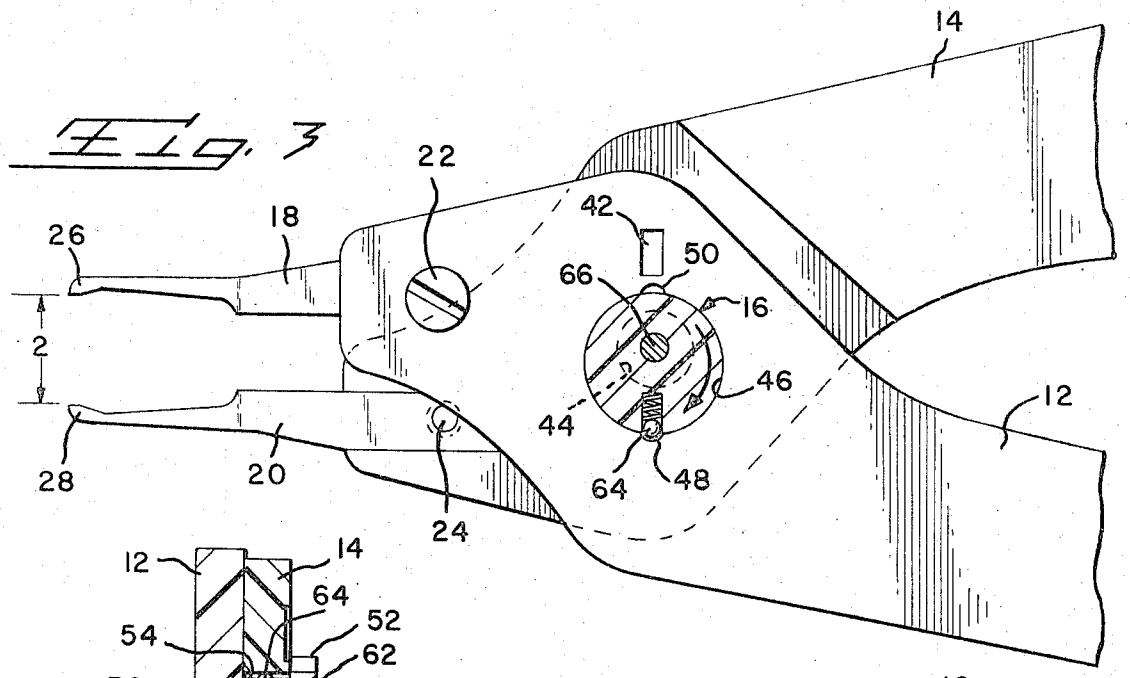



Fig. 3

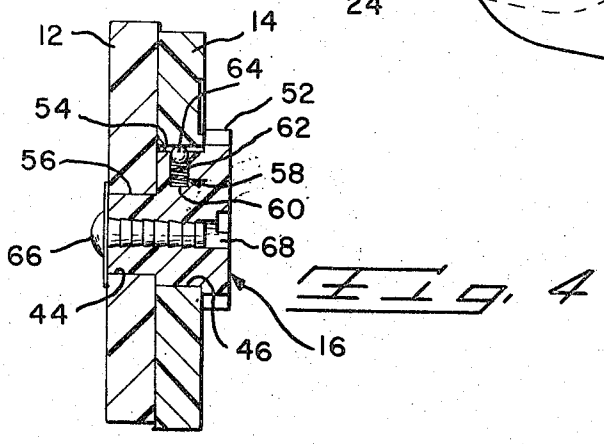



Fig. 4

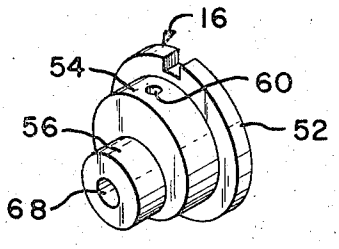



Fig. 5

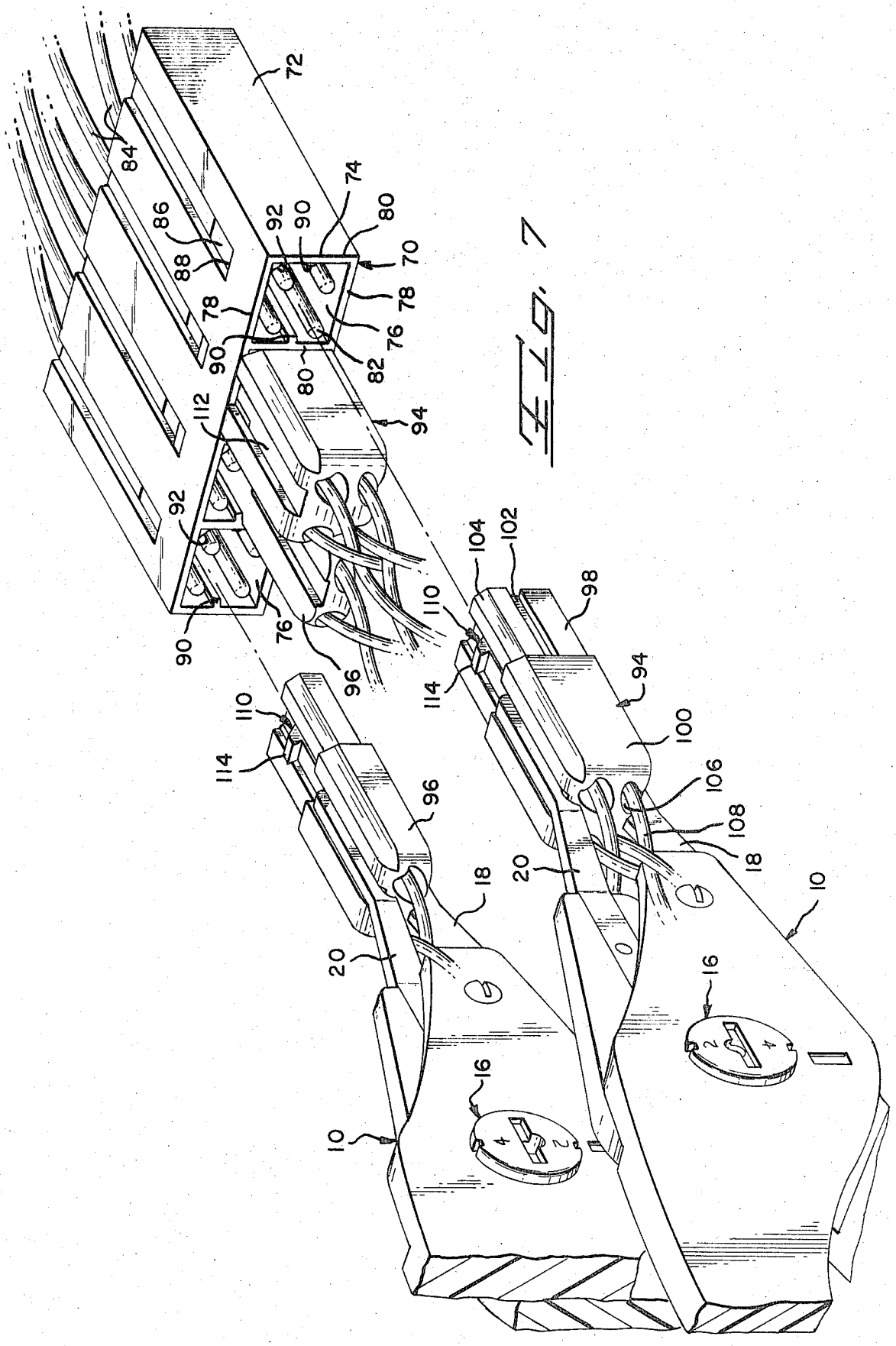

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FIG. 7

# EXTRACTION TOOL

## BACKGROUND OF THE INVENTION

1. The Field Of The Invention

The present invention relates to a plier type tool for extracting plugs arranged in closely spaced arrays and in particular to a tool which is readily converted to enable extraction of either dual connector plugs or quad connector plugs.

2. The Prior Art

There are many types of interconnection systems which involve the high density termination of the ends of wires in plugs which are insertable into receptacles in main or intermediate frames. The plugs are retained in the receptacles by conventional detents on the plugs which mate with conventional complementary detents on the receptacle when the respective contact terminals on the plug and receptacle are mated. Since these plugs are closely spaced and there are numerous wires extending therefrom, it becomes quite difficult to unplug or disengage a specific plug without accidentally dislodging one or more of the adjacent plugs.

It has been noted that with this type of retention system that the detent means must apply sufficient pressure to discourage extraction of the plugs by simply pulling on the associated wires, which, of course, will cause the wires to eventually become detached from the contacts within the plug. On the other hand, if the detent pressure is very high, so as to discourage removal of the plug by pulling on the wires, it can become quite tiresome for the operator who must constantly overcome these high pressures during a normal day's work.

It is therefor desirable to have a tool which can be used to overcome the force of the detent means holding a plug in a connector receptacle to enable a rapid and sufficient removal of the plug from a closely spaced array of plugs without dislocating any of the adjacent plugs.

## SUMMARY OF THE INVENTION

The present invention is a plier-like tool formed by two handle members pivotally joined together adjacent one respective end thereof by an adjustment member. Detachable worktips extend in cantilever fashion from the one end of each handle with a projection on the free end directed towards the opposite worktip. The other end of the handle members are provided with interengaging limit means which limit the opening end closing movement of the tool.

It is therefor an object of the present invention to provide an extraction tool which is adapted to remove both two connector plugs and four connector plugs from closely spaced arrays of receptacles without interfering with the mating of plugs in adjacent receptacles.

Another object of the present invention is to provide an extraction tool having replacable worktips thus facilitating repair of the tool.

It is another object of the present invention to provide an improved extraction tool having means limiting the opening and closing movement thereof as well as attached means for controlling the allowable opening movement of the worktips.



It is a further object of the present invention to provide an improved extraction tool which may be readily and economically produced.

The means for accomplishing the foregoing and other objects and advantages of the present invention will become apparent from the detailed description which follows and which makes reference to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the subject extraction tool;

FIG. 2 is a detailed view of the head portion of the tool set for extraction of a four contact plug;

FIG. 3 is a view similar to FIG. 2 showing the tool set for extraction of a two contact plug;

FIG. 4 is a vertical section taken along line 4—4 of FIG. 2;

FIG. 5 is a perspective view of the adjustment member;

FIG. 6 is a detailed view, partly in section, showing the operation of a subject tool during extraction of a four contact plug from a closely spaced array of connector receptacles and mated plugs; and

FIG. 7 is a perspective view showing a first tool gripping a two contact plug and a second tool gripping a four contact connector plug, both plugs being aligned for insertion into the single illustrated row of receptacles of an associated connector assembly.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

The subject extraction tool 10 is of the plier type having an elongated adjustable handle 12 and an elongated pivot handle 14. The handles are pivotally attached together adjacent one of their respective ends by an adjustment member 16. Each of the tool handles has, at its aforementioned respective one end, an elongated worktip 18, 20 detachably secured to the respective handle by the screws 22, 24. The worktips are generally parallel to one another and have an inwardly directed free end portion 26, 28, respectively. The opposite end of the tool handles are provided with the limit means 30 which includes a pair of overlapping members 32, 34 integral with the handles and extending toward one another with interengaging shoulders 36, 38. A helical biasing spring 40 is mounted around the overlapping members of the limit means 30.

The adjustable handle 12 is provided with an indicia 42 adjacent the adjustment member 16. This indicia may be in the form of either a groove or a projection and it is used only as a reference for the two positions of the adjustment member.

The configuration and operation of the adjustment member 16 can be more readily seen from FIGS. 2 through 5.

The pivot handle 14 is provided with a first bore 44 while the adjustable handle 12 is provided with a second bore 46 which is axially offset from the bore 44 as well as having a larger diameter than said first bore. Recesses 48, 50 are formed in opposite sides of the second bore 46. The adjustment member 16 has a first cylindrical face portion 52 of a first diameter, a second cylindrical cam portion 54 of a second diameter and which is coaxial with the first portion 52 and a third cylindrical pivot portion 56 of a third diameter and which is axially offset with respect to the portions 52 and 54. The

cylindrical cam portion **54** is provided with a detent means **58** comprising a radially directed bore **60,** a spring **62,** and a detent pin **64.** A retention means **66** is driven into a bore **68** in the adjustment member to secure it in the bores **44** and **46** and to thereby secure the handles together. It should be noted that bore **68** is concentric with the pivot portion **56** but axially offset with respect to the face portion **52** and cam portion **54.**

The operation of the extraction tool will be described with reference to FIGS. **6** and **7** which show a vertical section through a multilayered array of receptacles and a single row of receptacles, respectively.

The receptacles **70** are arranged in a closely spaced array. Each receptacle **70** is comprised of a rectangular block **72** and a forwardly extending flange or hood portion **74** defining an open aperture **76.** Each of the hood portions **74** is formed by two pairs of oppositely disposed, spaced and interconnected walls **78, 80** which extend forwardly from the receptacle block **72.** The walls are integrally connected with like walls of the adjacent hood portions. Each of the receptacle blocks **72** is provided with a plurality of cavities (not shown) adapted to receive a plurality of contact pins **82** therein. Each contact pin **82** extends through the cavities toward the rearward end of the block **72** where they are appropriately electrically and mechanically connected to suitable electrical leads **84.**

The pair of walls **78** have windows **86** formed therein which define shoulders **88** towards the free end of the hood. Guide rails **90** and a polarizing means **92** are formed within the hood.

The connector plugs are shown as a four contact plug **94** and a two contact plug **96.** The primary difference between the plugs is their thickness with the four contact plug clearly being twice as thick as the two pin plug. Each of the four contact plugs **94** is rectangular in section and has a forward and a rearward portion **98, 100,** respectively. The forward portion of each plug is receiveable within the hood portion of the receptacles. Thus it is necessary for the forward portion to have a profile substantially identical to that of the hooded portion of the receptacle in order to have the desired polarizing effect for proper mating of the plug in the receptacle. The forward end **98** includes longitudinal channels **102** and bevelled edge **104.** The exterior dimension of the rearward portion **100** is not in excess of the exterior dimensions of the receptacle hood so that the plugs may be arranged in the receptacles in a closely spaced array. Longitudinally extending cavities **106** are formed through the plugs and adapted to receive therein a contact terminal (not shown) which are electrically and mechanically connected to suitable leads **108.**

The forward portion of the plug which mates with the associated receptacle is provided with a latching system **110.** The latching system includes a channel **112** formed in opposite walls of the plug and extending the length thereof. The channels have a greater depth in the forward portion of the plug and a latch arm **114** extends forwardly from the rearward portion along the axis of said channel.

The two contact plug **96** is similar to the four contact plug but has only one latch arm **114.** The lower wall of this plug is also provided with a longitudinal channel to receive one worktip of the tool.

The subject tool is used to remove a plug from the associated receptacle by sliding the worktips along the oppositely disposed channels to their maximum extent. A small amount of pressure is then applied to rotate the latch arms **114** inwardly thus freeing them from the shoulders **88** and allowing the withdrawal of the plug from the receptacle. It can be seen that this is a relatively quick and easy removal motion requiring no wiggling or oscillating movement of the plug during the plug removal operation. It is a simple matter for the operator to merely rotate the adjustment member **16** to select the appropriate spacing of the worktips **18, 20** for the removal of either a two contact plug or a four contact plug.

The subject extraction tool has been described with reference to a single embodiment. It is to be understood that other embodiments and modifications of the tool may be anticipated without departing from the spirit or essential characteristics of the subject invention. The present description and illustrations should therefor be considered as being merely illustrative and not restrictive.

What is claimed is:

**1.** An extraction tool for removing individual electrical contact plugs from a closely spaced array of electrical contact receptacles, in which each said plug have, at least, one transversely extending latching means lying within a longitudinally extending channel which must be depressed into the channel in order to facilitate removal of said plug, said tool comprising:

an elongated pivot handle;

an elongated adjustable handle;

adjustment means pivotally connecting said handles together adjacent one respective end thereof;

work tips detachably fixed to extend from said handles adjacent said one end thereof, each said work tip having a shoulder at the free end thereof directed towards a like shoulder on the other of said work tips; and

limit means at the other end of said handles, said limit means including overlapping members having one end integral with each of said handles and lip means locking engageable with each other, and spring means normally biasing said handles apart bringing said lips of said overlapping members into engagement.

**2.** An extraction tool according to claim **1** wherein said adjustment means is an integral member including:

a cylindrical pivot portion received in said pivot handle,

a cylindrical cam portion axially offset from said pivot portion and received in said adjustable handle, whereby rotation of said adjustment means moves the pivot axis and thereby controls the maximum opening and closing movement of said worktips.

**3.** A tool for actuating a latching system which system provides individual connections between each of an array of closely stacked connector plugs and each of an array of closely stacked connector receptacles which receive said plugs in rows and for gripping an individual one of said plugs to facilitate its insertion into, and extraction from, an associated one of said receptacles simultaneously as said tool actuates said latching system, said latching system including a first interengaging means defined at spaced intervals along an inte-

rior surface of each of two parallel elongated walls of each of said receptacles which walls receive a forward portion of each of said plugs there between with a rearward portion of each of said plugs extending outwardly from said walls, a channel defined in each of two opposite sides of said rearward portion of each of said plugs extending from a rearward end to a forward end of said rearward portion, a flexible latch arm connected to said rearward portion of each of said plugs within at least one of said channels at a position therein short of the forward end of said rearward portion, second interengaging means defined on the end of said latch arm and aligned with one of said first interengaging means of said receptacle wall, said flexible latch arm being flexibly pivotally moveable about its location of connection to said rearward portion between a latching position in which said second interengaging means is disposed in a coupling position in overlapping relation with said one first interengaging means to prevent extraction of said plug from said receptacle and an unlatching position in which said second interengaging means is displaced inwardly from said location of connection toward said plug to allow extraction of said plug from said receptacle, said tool comprising:

an elongated pivot handle;

an elongated adjustable handle;

adjustment means pivotally attaching said handles together adjacent one of their respective ends, said adjustment means including a pivot portion inserted in said pivot handle and a cam portion inserted in said adjustable handle;

an elongated worktip removably attached to extend from each of said handles at said one end of said handles, said worktips being aligned generally parallel to each other, said worktips being moveable with respect to each other upon corresponding movement of said handles, said worktips each having an inwardly directed shoulder on a free end thereof and an interior surface portion adjacent to said shoulder, said shoulders and surface portions of said respective worktips being disposed in opposed spaced relationship, each of said shoulders being engageable with a respective one of said flexible latch arms at an actuating position located forwardly of said location of connection of said latch arm to said rearward portion of said plug after said worktips have been inserted into said passageways, each of said surface portions of said worktips being engageable with a bottom wall of each of said channels of said rearward portion of said plug when said worktips are moved toward each other causing said latch arms to flex from their latching position to their unlatching positions;

stroke limiting means disposed at respective other ends of said handles for limiting the length of an arcuate stroke through which said handles may travel when said handles are pivotally moved relative to each other, the displacement between said shoulders of said worktips being determined by the setting of said adjustment member to be slightly greater than the cross-sectional thickness of said plug between said channels of said plug when said other ends of said handles are disposed at the maximum limit of their stroke, said latch arms being flexed to their respective unlatching positions by said worktips when said other ends of said handles are disposed at the minimum limit of their stroke; and

biasing means disposed at said respective other ends of said handles for maintaining said handles in relation to each other at the maximum limit of their stroke.

**4.** The tool according to claim **3** wherein said adjustment means is an integral member with said pivot portion and said cam portion axially offset with respect to each other.

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