July 10, 1956 S. N. BUCHANAN 2,753,742

HAND TOOL FOR CRIMPING ELECTRICAL CONNECTORS

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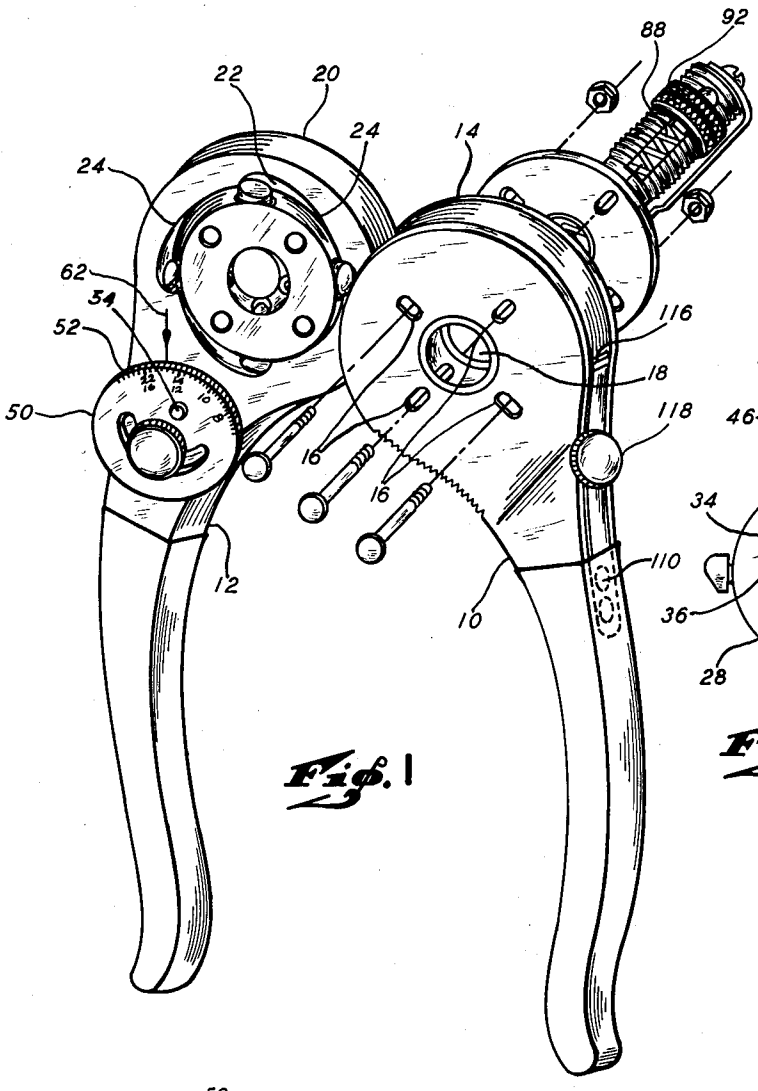


Fig. 1

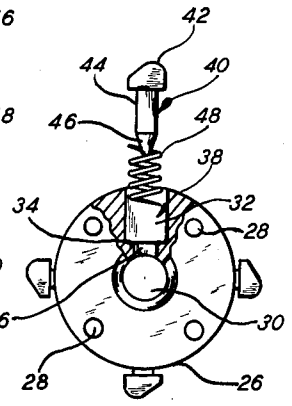


Fig. 4



Fig. 5

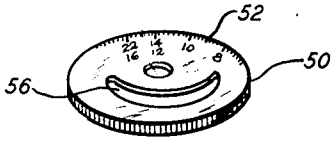


Fig. 6

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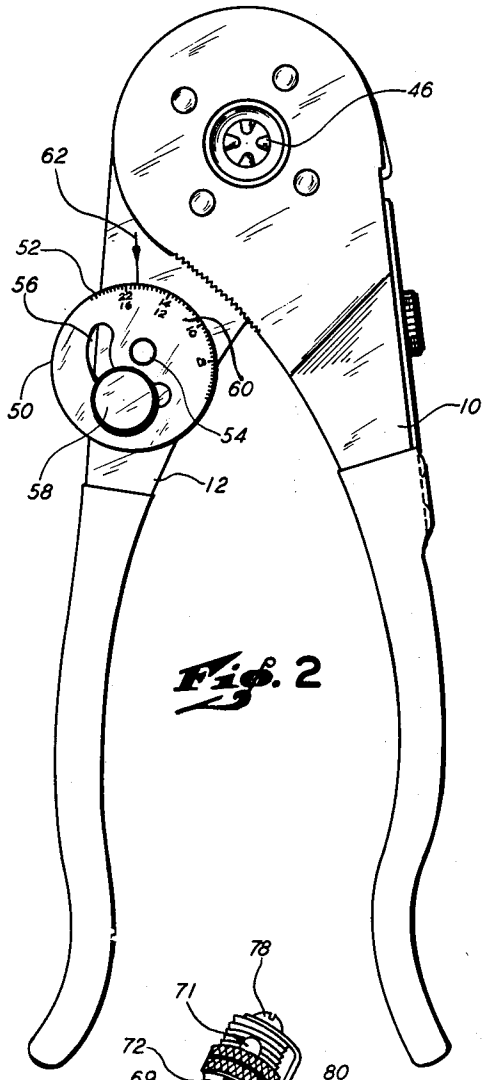


Fig. 2

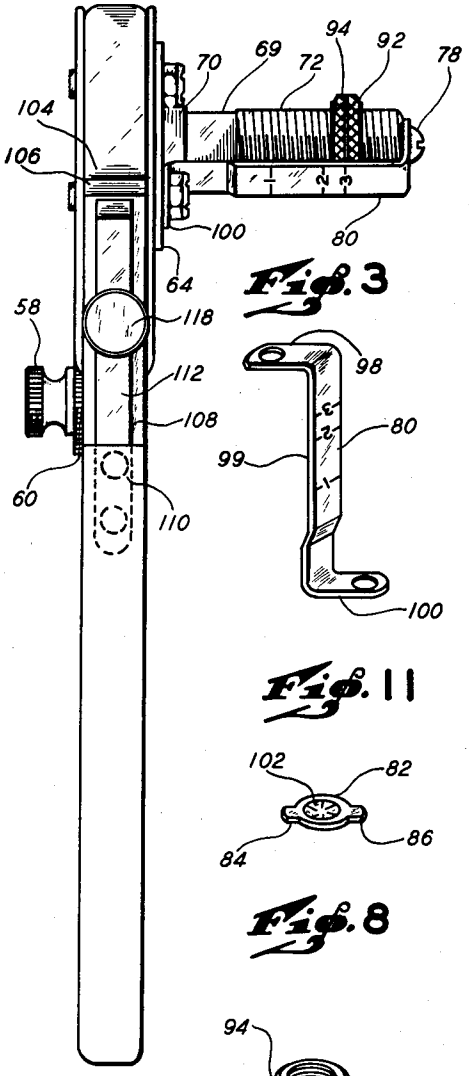


Fig. 3

Fig. 11

Fig. 8

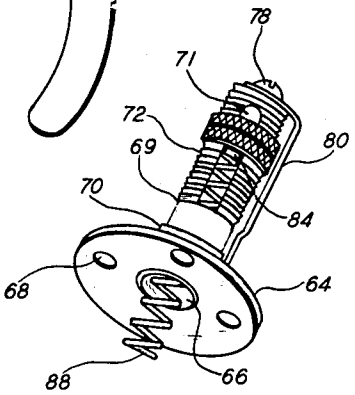


Fig. 7

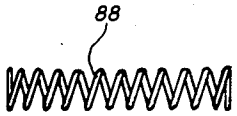


Fig. 9

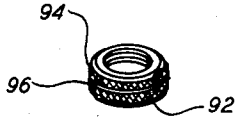


Fig. 10

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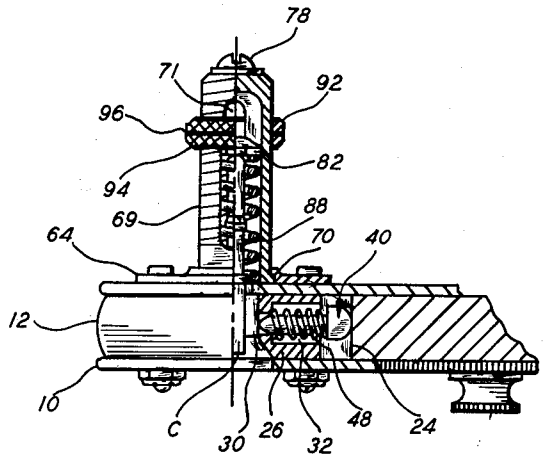


Fig. 16

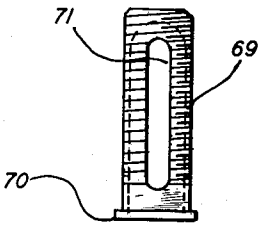


Fig. 14

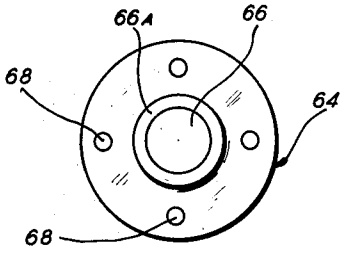


Fig. 12

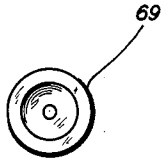


Fig. 15

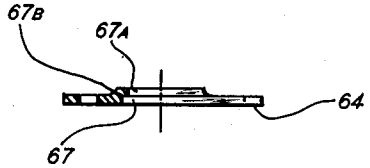


Fig. 13

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HAND TOOL FOR CRIMPING ELECTRICAL CONNECTORS

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Application July 20, 1953, Serial No. 369,102

2 Claims. (Cl. 81—15)

This application is a continuation-in-part of my co-pending application Serial No. 309,317 filed September 12, 1952, now abandoned.

The present invention relates generally to electrical apparatus and more particularly to an improved tool for joining an electric connector with a conductor by swaging a conductor receiving portion of the connector into close intimate contact with the bared ends of the conductor.

Electric connectors of the type under consideration normally have a cylindrical socket portion for accommodating the bared ends of the conductors therein and a terminal engaging portion integrally connected in axial alignment with the socket portion. The connector is affixed to the conductor by compressing the cylindrical socket portion into contact with the bared ends of the conductors previously placed therein. The metal comprising the conductor is very ductile and readily responds to such a cold working operation. Various tools for performing this swaging action are currently in use in the electrical trade. One such tool includes a series of forming pins radially movable within an opening in a retainer member adapted to receive the connector. These forming pins are moved into pressure contact with the outside surface of the connector at a plurality of radially spaced points. The cylindrical wall of the conductor receiving socket of the connector is deformed, in response to the pressure exerted by the forming pins, into engagement with the bared ends of a conductor placed in the socket.

A feature of this invention includes the provision of novel means for controlling the movement of the forming pins in a tool of the type referred to above. The limit of the inward movement of the forming pins in the tool as they converge upon a connector having a conductor disposed therein is important because the tool is required to unite large size conductors as well as small size conductors with connectors. It may be readily appreciated that the distance the pins move inwardly in order to unite a No. 16 conductor with its associated connector is far greater than the distance the pins are required to move in order to join a No. 8 conductor with its associated connector. If the movement of the forming pins is not controlled and the pins converge upon a connector having a No. 8 conductor therein and move the distance ordinarily necessary to swage a connector onto a No. 16 conductor, there is strong possibility that one or more of the strands of the No. 8 conductors will be fractured or severed and reduce the mechanical efficiency of the connection.

Another feature of this invention is to provide a novel means for locating the connector in the tool so that the indentations on the connector resulting from the swaging action will be spaced a proper distance from the end of the connector so as to insure an efficient connection. This means includes an adjustable stop member that supports the terminal engaging portion of the connector and has a particular configuration for centering the connector in the tool.

Other features and objects of the invention will be

apparent upon a consideration of the following description of a preferred embodiment of the invention and the drawings in which:

Fig. 1 is an exploded view in perspective of the individual elements of the tool prior to their assembly;

Fig. 2 is a side view of the assembled tool;

Fig. 3 is an end view of the assembled tool;

Fig. 4 is a side view, partly broken away for clarity of the forming pin retainer;

Figs. 5 and 6 are perspective views of an element for selectively limiting relative convergent movement of the handles;

Fig. 7 is a view in perspective of the means for locating a connector within the tool;

Figs. 8 through 15 are views in perspective of the individual elements comprising what is shown in Fig. 7; and

Fig. 16 is a side view partly in section of part of the tool, illustrating the position of the adjustable connector locating means of Fig. 7.

This invention relates to an improved tool of the general type disclosed in United States Letters Patent 2,467,012, issued to Fritz Deuschle and assigned to Buchanan Electrical Products Corporation. Briefly, this tool includes two relatively movable handle members **10** and **12** adapted to be pivotally connected at one of their extremities. Handle member **10** is generally U-shaped in section and has an enlarged section **14**, at one extremity thereof that includes aligned openings **16** and **18**. The openings **16** are designed to accommodate fastening units such as bolts or the like when the component parts of the tool are assembled. These openings are arranged symmetrically about and spaced radially from central opening **18** through which the connector is inserted in the tool in a manner to be later described. Handle member **12** has a structural configuration similar to that of handle member **10**. However, the member **12** is constructed of solid material such as cast iron and its enlarged extremity **20** has an opening **22** considerably larger than the openings **16** and **18** mentioned above. Opening **22**, the center of which is in axial alignment with the center of opening **18** when the enlarged portion **20** is received within section **14** has about its periphery a series of connected cam surfaces **24**.

A cylindrical forming pin retainer **26** is adapted to be connected to handle member **10**, when openings **28** extending through the retainer are aligned with openings **16** in the member **10** so that fastening units may be passed therethrough. The retainer **26** has a central aperture **30** that is axially aligned with openings **18** in handle member **10** when the retainer is assembled in the handle members. Extending radially from the aperture **30** intermediate the length of retainer **26** are a series of passageways **32**, preferably four in number. These passageways, spaced at ninety degree intervals midway between adjacent pairs of openings **28**, are circular in section and contain a shoulder **34** defined by the juncture between a constricted portion **36** and the main passageway section **38**. Disposed in the passageways are forming pins **40**, each having an enlarged top portion **42** that engages cam surface **24** on handle member **12** and a cylindrical body portion **44** integrally connected with said top portion and being provided with a connector engaging end **46**. A spring member **48**, located between the bottom surface of the top portion **42** and the shoulder **34**, urges the forming pin into contact with the cam surface **24**.

In assembling the tool, the retainer assembly is placed in opening **22** in handle member **12** which is then force fitted between the enlarged portions **14** of handle member **10** as shown in Fig. 1.

The individual parts are fastened together with openings **16** and **28** and **18** and **30** in alignment. It may be readily appreciated that relative movement between the unattached ends of handles **10** and **12** toward one another

will cause cam surfaces 24 to force the forming pins 40 across aperture 30 against the action of spring member 48. When the handle members are moved relatively way from one another the forming pins are, by action of the springs, maintained in contact with that part of the cam surface 24 that enables the pins to be retracted from the aperture 30.

As previously pointed out, the distance that the forming pins move transversely across the aperture 30, which accommodates a connector to be united with a conductor, varies with the size of conductor involved. The movement of the pins is in direct response to the relative movement of the handle members. Therefore, an arrangement for controlling the relative movement of the handles toward one another will, in turn, control the movement of the pins. Figs. 5 and 6 illustrate one such arrangement for accomplishing this function. A circular stop element 50, having a knurled circumference 52, is rotatably mounted on handle member 12 by means of pin 54. The pin 54 is offset from the center of the stop element so that the latter moves eccentrically about the pin. An arcuate slot 56, having a radius, the center of which is pin 54, is located on the stop element. Handle member 12 in addition to having a bore to receive pin 54, has also a threaded bore, communicating with the arcuate slot, that receives a set screw 58 which, in turn, locks the stop element in any one of a plurality of predetermined positions. Indicia 60, referring to various size conductors, are provided on the upper surface of the stop element. A reference mark 62, located on the handle member 12, is aligned with the various indicia on the stop element as determined by the particular conductor and connector involved. For illustration, if it is desired to unite a No. 12 wire conductor with a connector, set screw 58 is manipulated to allow the stop element to be rotated about a pin 54 until the indicia mark 60 referring to No. 12 is in alignment with the index mark 62, the set screw is turned down on the stop element so as to frictionally lock it in place. As the handles are moved toward one another, the leading edge of handle member 10 will engage the surface of the stop element and prevent further movement in that direction. When it is desired to swage a connector onto a No. 8 wire conductor, the stop element is adjusted so that a different portion of its knurled periphery is offered for engagement with handle member 10, which portion, incidentally, is located at a different distance from pin 54 than the previously selected engagement surface.

In order to utilize the tool under circumstances where it may be necessary to unite connectors of various lengths with conductors, the tool is provided with a connector supporting or locating arrangement that includes a movably mounted connector support element adapted to support the terminal contacting portion of the connector in such a manner that the conductor engaging portion of the connector is positioned within the tool so that the forming pins will engage the connector engaging portion at a predetermined distance from the unattached conductor engaging extremity of the connector. An arrangement for moving the supporting element in relation to the particular size connector to be united with a conductor, is also provided.

Attached to the outer surface of the handle member 10, opposite the side that engages the stop element 50, is a disc-like plate member 64 having a central opening 66, defined by a circular embossment 66A and a series of radially spaced openings 68 adapted to receive the fastening units referred to above for securing the plate to the handle. The opening 66 has an enlarged portion 67 and a constricted portion 67A in axial alignment therewith so as to form a shoulder 67B. A tube-like housing or stud 69, provided with an open inner end and a closed outer end, is mounted within opening 66 in plate 64. The inner open end of the stud is provided with a peripheral flange 70 having a thickness substantially the same as the depth of the enlarged portion 67 of opening 66. The external

surface of stud 69 is threaded from the outer end to a point between the ends thereof and has disposed therein two diametrically opposed longitudinally extending slots 71. Mounted for movement within stud 69 is a connector support element 82, as shown in Fig. 8, provided with a generally circular central portion, having one surface dished or dimpled, from which two diametrically opposed ear portions 84 and 86 project. The parts are so constructed and proportioned that the support element 82 may be inserted through the slots 71 when its transverse or short axis is parallel to the longitudinal axis of the slots. Then, after the central portion is confined within the limits of the stud with the ear portions only of the support element extending through the slots 71, beyond the radial limits of the slot, the support element is rotated through an angle of 90° so the dished surface thereof confronts the inner open end of the stud.

To prevent unrestrained movement of the support element within the stud, a circular nut 92 having a knurled periphery 94 and a circumferential groove 96 impressed thereon is threadedly mounted on the external surface of the stud so as to engage the outer surface of the support element. Cooperating with the nut 92 is a compression spring 88 assembled within the stud 69 so that one end forcibly engages the inner surface of the support element and the other end thereof engages that portion of the handle member adjacent opening 18.

In assembling the connector supporting means with the tool, plate 64 is introduced over the outer end of the stud and moved along the length of the stud until the flange 70 on the latter element is received in the enlarged portion 67 of the opening 66 and further movement is prevented by the engagement of the shoulder 67B with the flange 70, it being understood that nut 92, support element 82 and spring 88 were previously assembled within the stud prior to the assembly of the stud and plate in the manner mentioned above.

The parts are so contructed and dimensioned that when the plate, with the stud positioned therein, is affixed to the handle through the openings 68, the end of the spring remote from that engaging the support element, contacts that portion of the handle immediately adjacent opening 18 and is placed under compression thereby so as to exert a continuing outward force against support member 82.

To assist in determining the relative position of support 82 with respect to the plate defined by the forming pin axes, a longitudinally extending scale 80 having oppositely directed apertured foot portions 98 and 100 is connected to plate 64 through the fastening elements and foot portion 100. Foot portion 98 is affixed to the top surface of the outer end of the stud 71 by virtue of screw 73. Integrally connecting the two foot portions of the scale is an intermediate portion 99, having indicia impressed thereon, adapted to register with the circumferential groove 96 on the nut 92.

It may be readily appreciated that the spring 88 exerts a continuing outward force, which is resisted by the nut member 92, on the support 82 as pointed out above. In the event it is desired to unite a connector having a relatively short length with a conductor, the nut is advanced inwardly along the external surface of the stud against the action of the spring until the groove 96 registers with a mark on the scale 99 which, through a predetermined calculation, indicates that the forming pins will be properly located with respect to the tubular body of the connector when the connector is placed with its terminal engaging portion within the coils of spring 88 and abutting support 82. If, however, it is desired to use the tool to unite a relatively long connector with a conductor, then the nut 92 is retracted along the threaded surface of the stud toward the closed end thereof, until the groove 96 is in registry with an appropriate mark on the scale 99. During this retrograde movement of the nut, the normal tendency of the spring 88 to urge the support outwardly

of the stud, maintains the former in engagement with the nut.

Thus it may be readily appreciated that connectors having different lengths may be positioned within the tool so that portion of the conductor engaging part of the connector that is to be swaged into contact with the conductor may be determined by adjusting the support element either to or from the tool as the occasion demands. The terminal contacting portion of the connector lies within the coils of spring **88** and engages the support element **82**, as clearly shown in Fig. 16 wherein connector C is placed in the tool prior to the forming operation.

An additional feature of this invention consists in a structural arrangement for maintaining the normally expanded handle members **10** and **12** in close proximity to one another during storage or other periods when the tool is not in use. Handle member **12** has on the edge that is snugly received in member **10**, a series of stepped notches **104** and **106**. On the rear edge of member **10**, a spring steel finger **108** is attached thereto by rivets **110**. The finger **108** has a particular shape which comprises a flat strip portion **112** that lies contiguous to the handle, and a hook-like extremity **116** that engages either of the notches **104** or **106**. A set screw **118** maintains positive engagement between elements **116** and **104** or **106**.

In summarizing the operation of the tool, first, the size of the conductor and the length of the connector are ascertained. The stop element **50** controlling the limit of relative inward travel of the handle members, and in turn, the limit of travel of the forming pins, is adjusted in accordance with the size of the conductor. Then the operator adjusts the nut member **92** which, in turn, moves connector supporting member **82** relative to the forming pins so that when the connector is placed in the tool, the swaging indentations will be spaced a predetermined distance from the end of the connector. The connector is then inserted into the tool so that the terminal engaging end abuts support member **82**; the conductor is inserted into the open end of the connector and the handles are moved toward one another so that the forming pins depress the connector into intimate contact with the conductor. Thus is formed an efficient electrical and mechanical bond between the two elements.

Another important feature of the invention includes the provision of means for compressing the walls of the connector into intimate contact with the strands of the conductors in such a manner that the area of a section through the swaged connection is smaller than the area of the section prior to swaging operation and further that the points on the periphery of the swaged section lie either inside or on the circumference of the section before swaging. This is accomplished by the simultaneous movement of the forming pieces in connection with the particular configuration of the work engaging end of the pin. This latter end of the pin has a conical portion terminating in a rounded extremity so that after engagement with the outside surface of the connector an indentation, semi-spherical in shape is formed. It has been found in practice that the indented portion of the connection is displaced inwardly only, in such a manner that the conductor or conductors therein are firmly compacted and any tendency of that portion of the connector not indented to move outwardly is prevented.

Other combinations of elements capable of performing the invention as set forth in the appended claims will suggest themselves to one skilled in the art without departing from the spirit of the invention.

I claim:

1. In a compression tool including a retainer having a work accommodating passageway therethrough defining an axis, a plurality of forming pins in said retainer and having heads extending outwardly of said retainer, a first member having a plurality of interconnected cam surfaces providing an opening, said retainer being in said opening with said cam surfaces engaging said pin heads, a second member including first and second wings having aligned apertures, said wings embracing and attached to said retainer with said passageway aligned with said apertures, so that relative movement of said members will cause said cam surfaces to move said pins toward said axis: work locating means including an externally threaded tubular housing attached to one of said wings and having an open end adjacent to and aligned with said passageway, two opposed slots extending lengthwise of said housing, a work support having a body portion within said housing and ears projecting through said slots outwardly of said housing, and a nut threadedly engaging said housing and engaging said ears, so that said support will follow the movement of said nut in at least one direction adjustably to limit the depth of insertion of the work through said passageway into said housing.

2. In a compression tool including a retainer having a cylindrical inner surface defining an axis and providing a work accommodating passageway and first and second parallel surfaces perpendicular to said axis, a plurality of forming pins in said retainer and having heads extending outwardly of said retainer, a first member having a plurality of interconnected cam surfaces providing an opening, said retainer being in said opening with said cam surfaces engaging said pin heads, a second member including first and second parallel wings having aligned circular apertures coaxial with the inner surface of said retainer, said first and second wings engaging said first and second retainer surfaces, respectively, said retainer being secured to said wings, so that relative movement of said members will cause said cam surfaces to move said pins toward said axis: means for locating the work in said passageway including an externally threaded tubular housing having an open end of inside diameter greater than that of the aperture through said first wing and attached to said first wing with said open end in alignment with and adjacent to said passageway to provide a shoulder at said open end, two opposed slots extending lengthwise of said housing, a work support having a body portion within said housing and ears projecting through said slots outwardly of said housing, and a nut threadedly engaging said housing and engaging said ears on the side thereof remote from said open end, and a coil spring in said housing between said shoulder and said support biasing said support against said nut away from said open end, so that said support will follow the movement of said nut adjustably to limit the depth of insertion of the work through said passageway and into said housing.

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