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Harwood et al.

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[54] **LATCHING SYSTEM FOR AN ELECTRICAL CONNECTOR PLUG AND ASSEMBLY**

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[52] **U.S. Cl.** ..... **339/59 R,** 339/91 R

[51] **Int. Cl.** **H01r 13/54**

[58] **Field of Search** ..... 339/59, 61–63, 339/91, 18 R, 18 B

[56] **References Cited**

UNITED STATES PATENTS

3,192,499	6/1965	West	339/91 R
3,250,551	5/1966	Draudt	339/91 R X

FOREIGN PATENTS OR APPLICATIONS

1,490,668	6/1969	Germany	339/59 R

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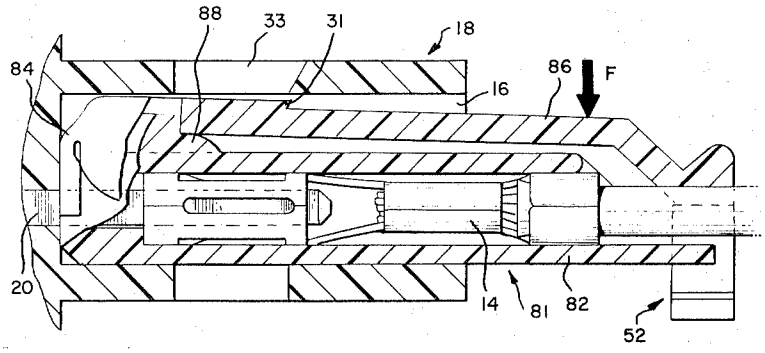
[57] **ABSTRACT**

A latching system for an electrical connector plug is capable of being utilized with a receptacle having a female cavity in a closely packed array of additional plugs and receptacles. A male electrical contact is disposed within the cavity which includes in one of its sidewalls a latching window. The plug formed of a resiliently deformable material includes a body having forward and rearward end portions and a latch. The plug is shaped to be received within the cavity of the receptacle at the forward end portion of the body. A female electrical contact is disposed within the body of the plug and mateable with the male contact in the receptacle when the plug is received within the receptacle. The latch is hingedly connected at a first end to the body at the forward end portion and extends in general alignment with, and along, the body. The latch has a latching lug extending outwardly from a location between the first end and a second end of the latch in general alignment with the window of the cavity with the plug inserted therein. A protuberance extends outwardly from the body to make contact with the latch between the first end and the latching lug so that the latch may be resiliently deformed about the protuberance for relative movement toward the plug against inherit biasing of the latch caused by its deformation. A resiliently deformable collar extends from the second end of the latch to partially encircle the rearward end of the body to maintain the latch in a biased condition at a predetermined displacement from the body. The predetermined displacement is sufficient enough to allow the latching lug to extend into the window of the cavity to retain the plug within the receptacle. The latch is capable of being further deformed toward the body to disengage the latching lug from the window to allow withdrawal of the plug. Thus, the collar maintains the latch and the body at the desired displacement for easy alignment of the plug with the cavity and maintains the latch in a biased condition for positive latching.

1 Claim, 10 Drawing Figures



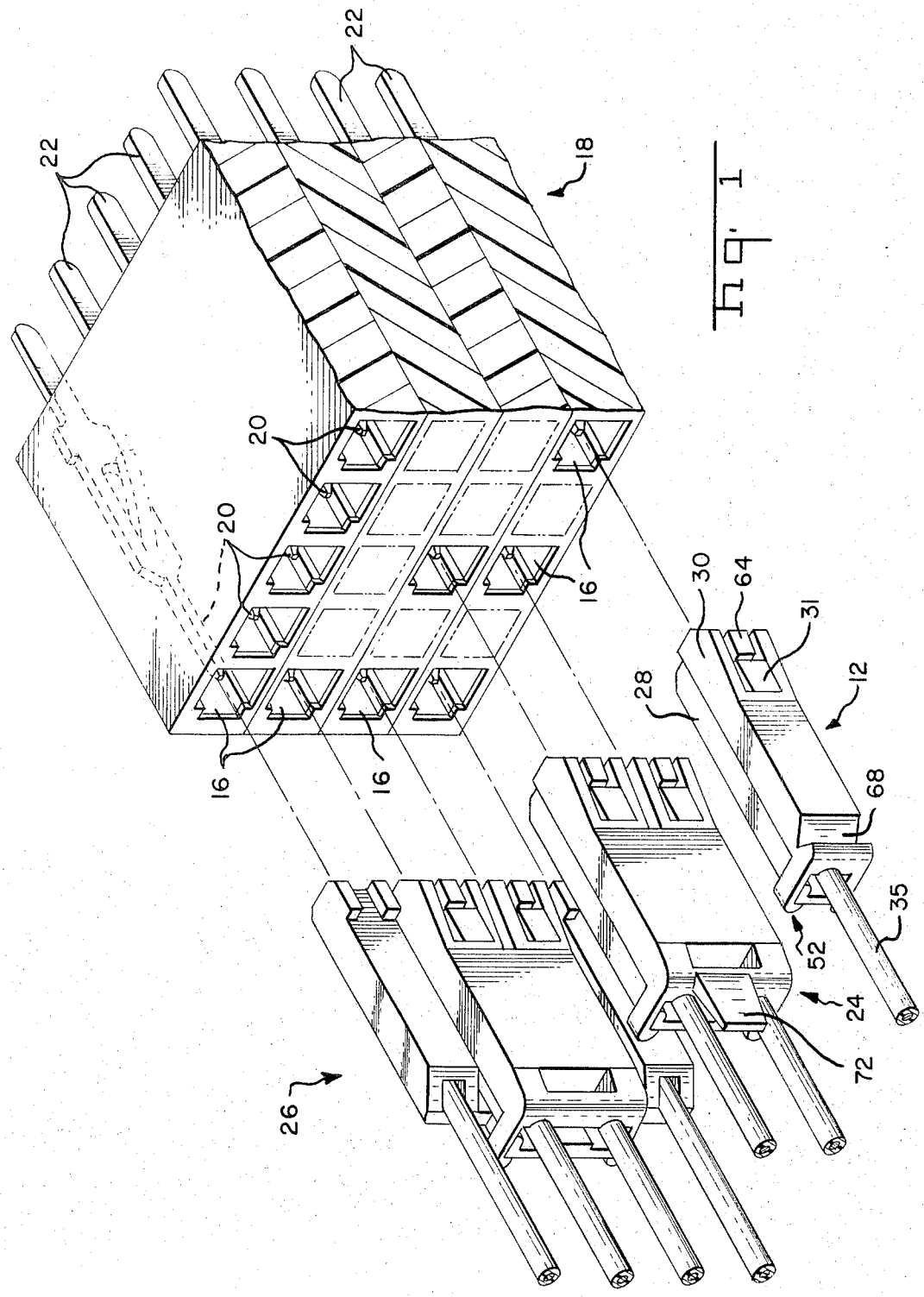


Fig. 1

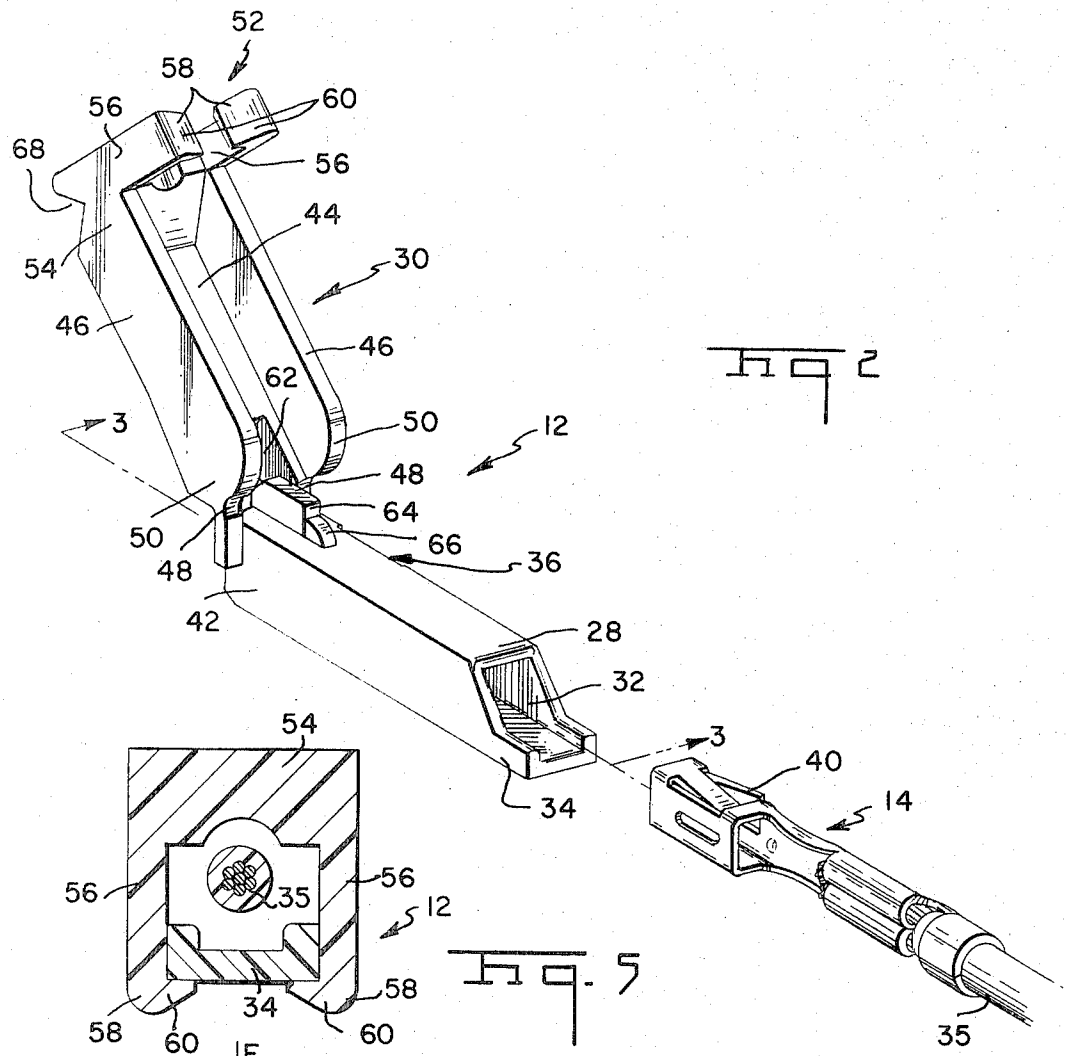


Fig. 2

Fig. 5

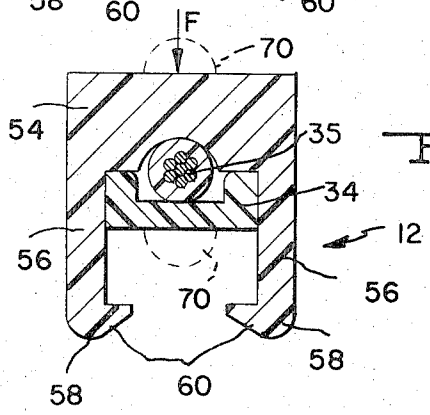


Fig. 6

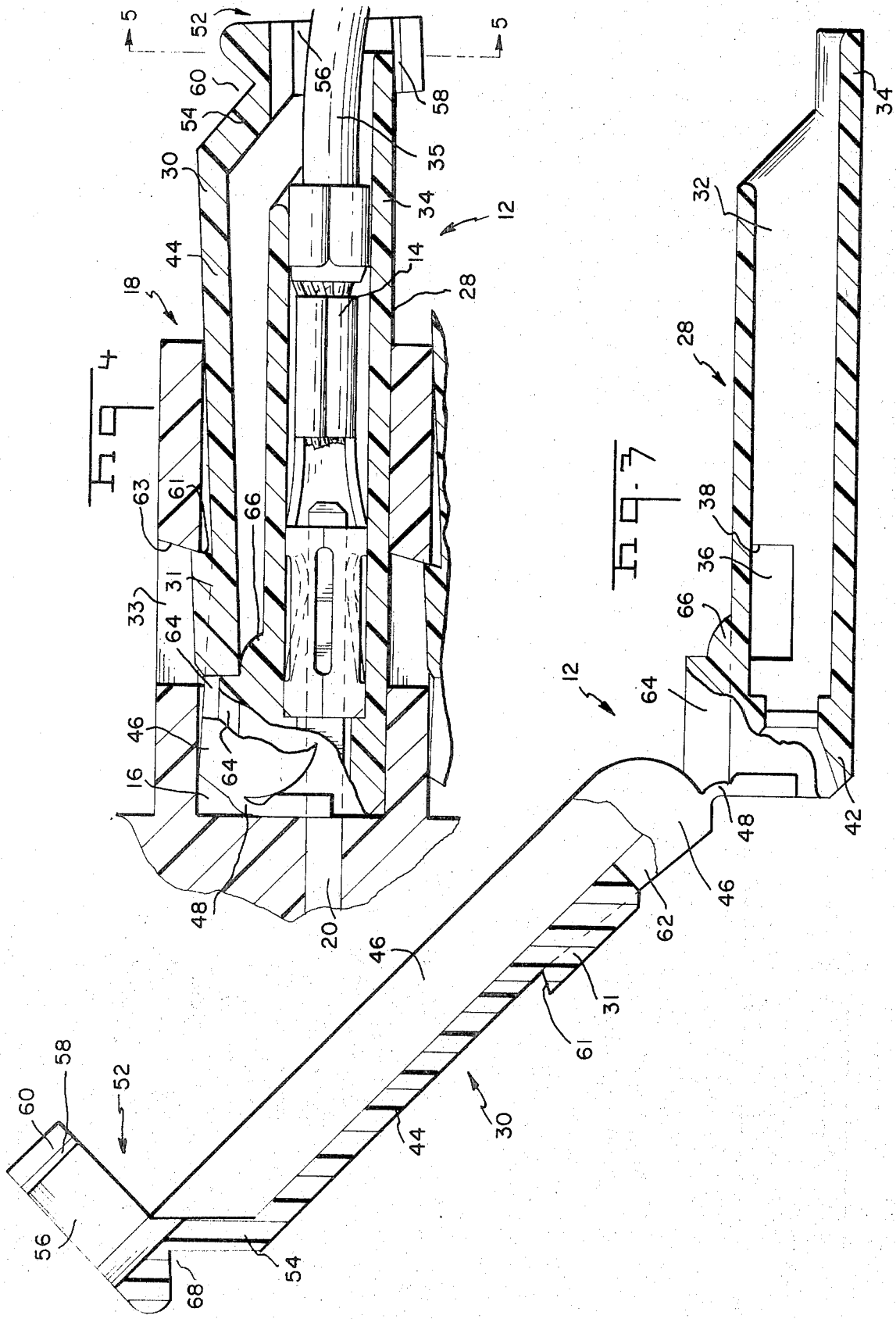

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FIG. 4

FIG. 7

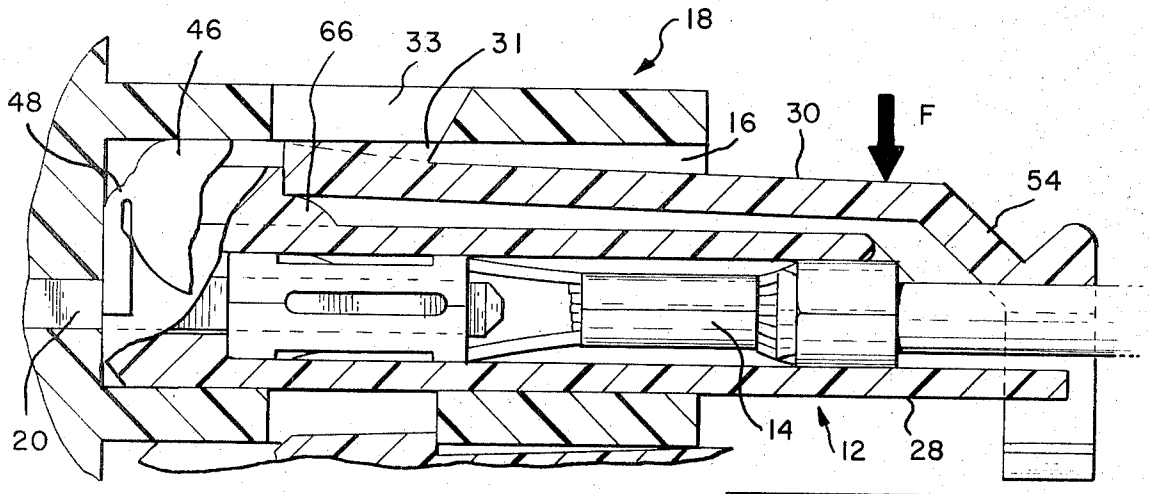

Fig. 7

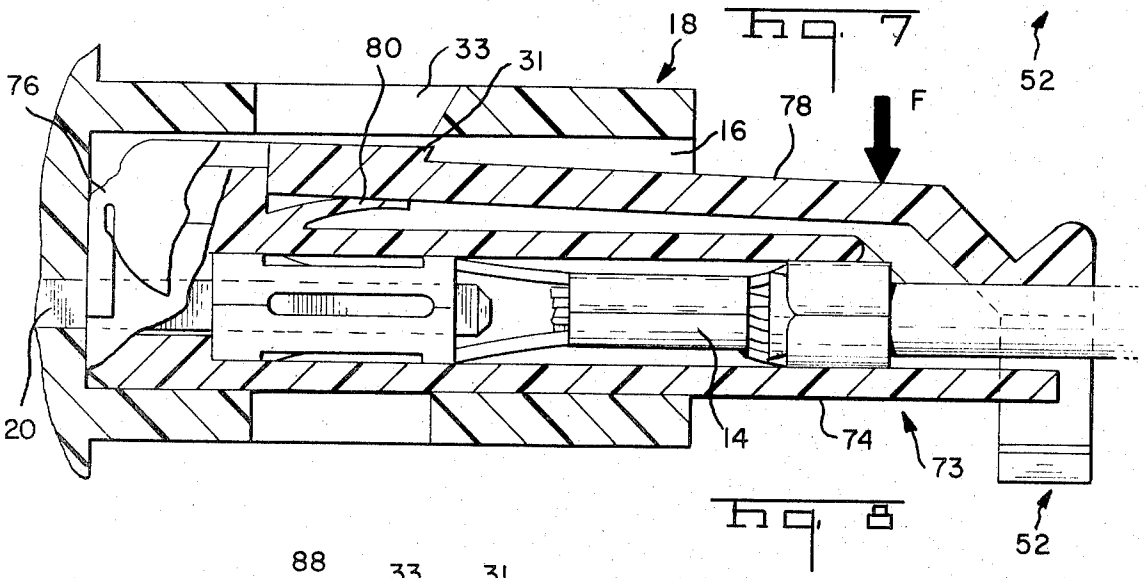

Fig. 8

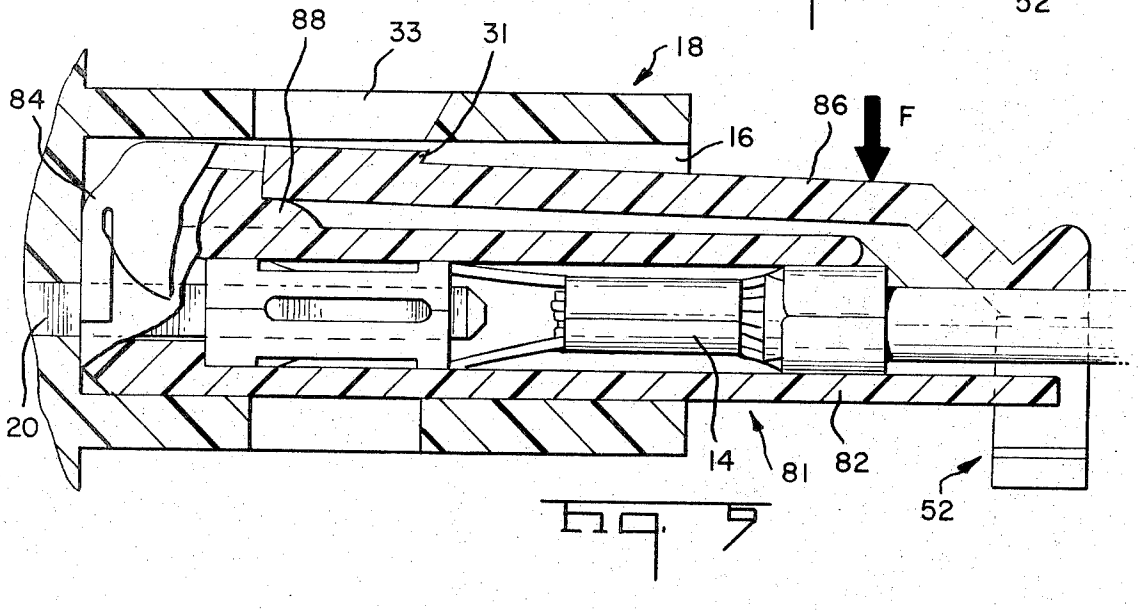

Fig. 9

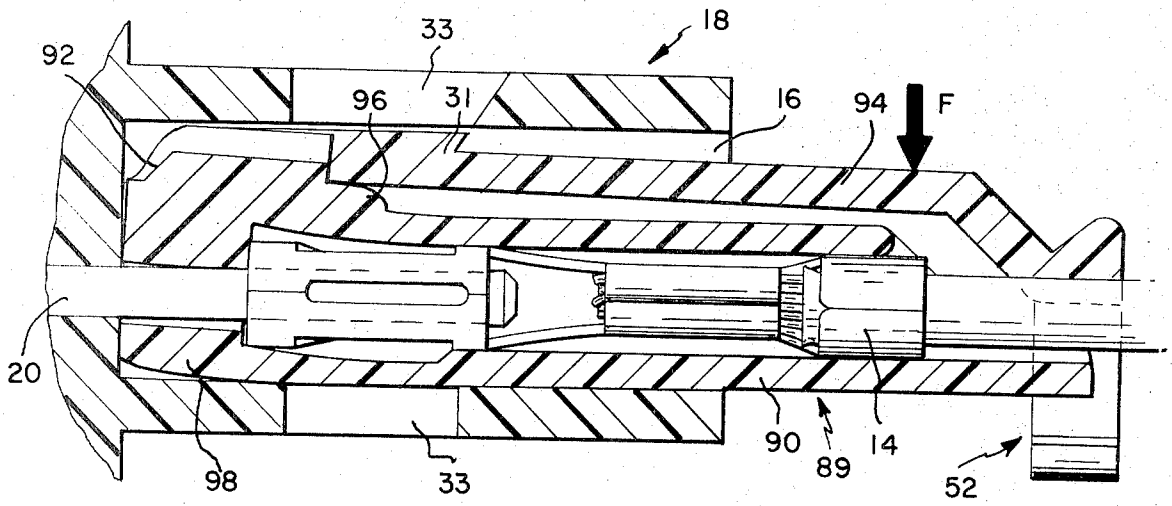

Fig 10

LATCHING SYSTEM FOR AN ELECTRICAL CONNECTOR PLUG AND ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a latching system for an electrical connector plug utilized with a cavity of a receptacle which includes a latch biased away from a body of the plug but being maintained within a predetermined displacement from the plug. Maintaining the latch in a biased position allows easy alignment of plug with the cavity of the receptacle even if the plug and receptacle are to be located within a closely packed array of additional plugs and receptacles and insures positive latching and unlatching of the plug with and from the cavity of the receptacle.

2. Description of the Prior Art

Transmission networks in the telephone industry include thousands of electrical conductor wires. Typically, these wires are electrically and mechanically terminated at the rear bay of main or intermediate frames installed at central offices of telephone companies. These wires may serve any of a variety of functions such as carrying incoming or outgoing signals, or carrying signals between the main frame and various test equipment installed at the central office.

The primary purpose of the main frame is to provide a central location at which interconnections between these wires can be made as desired on the front bay of the frame. Typically, the wires terminated at the rear bay of the frame are electrically and mechanically attached to contact terminals mounted in the frame, the attachment being made by either the wire-wrap or soldering techniques. These techniques provide a more or less permanent connection in the sense that the wires cannot be readily detached from the terminals. While permanent connections between the terminals and the wires at the rear bay of the frame are ordinarily desirable, such connections between interconnecting wires and the terminals at the front bay of the frame are not desirable since these connections need to be frequently detached to change the interconnections between the wires terminated at the rear bay of the frame.

One type of interconnection system which has been used heretofore involves terminating the ends of the interconnecting wires to jacks which are pluggable into the main or intermediate frames. These jacks are retained in the frame by conventional detents on the contact terminals mounted in the jacks which mate with conventional complementary detents on the contact terminals mounted in the frame when the respective contact terminals on the jack and the frame are mated.

The incorporation of the detent retention system into the mating contact terminals of the jack and the frame creates certain problems.

On the one hand, if the detents and contact terminals are designed such that a high extraction force is required to unmate them to thereby avoid frequent accidental removal of the jacks from the frame, the plating on the contact surfaces at which the electrical connection is made will be subjected to a high degree of wear each time the jack is removed from the frame which will lead to the need for frequent repair or replacement of the contact terminals in the jack and frame. Furthermore, in view of the fact that an operator may be making hundreds of interconnections each day, an extraction force of from five to ten pounds for each jack imposes a heavy burden on the stamina of the average operator.

On the other hand, if the detents and contact terminals are designed such that a low extraction force is required to unmate them, the jacks become susceptible to being accidentally removed from the frame merely by the act of spreading apart of the various interconnecting wires in order to find the jack which the operator desires to remove from the frame. Also, jacks utilizing this type of retention system which has a low extraction force encourages removal thereof by pulling on the interconnecting wires which emanate from the jack.

OBJECTS AND SUMMARY OF THE INVENTION

The latching system incorporating the present invention eliminates all the aforementioned problems and disadvantages of the above described retention system used heretofore in an interconnection system.

An object of the invention is to provide a latching system in which the retention of individual resiliently deformable connector plugs within the connector receptacles is achieved by a novel mechanical system which is separate from the electrical and mechanical mating connection between the contact terminals respectively of the plug and receptacle.

Another object of the invention is to provide a latching system as described above wherein the plug includes a body and a latch generally aligned with, and flexibly movable toward, each other with the latch having an outwardly extending lug disposable with a window defined in the receptacle to retain the plug inserted therein.

A further object of the invention is to provide a latching system as described above wherein the latch is biased away from the body but maintained within a desired predetermined distance from the body to facilitate alignment of the plug with the receptacle while providing positive retention of the plug inserted therein.

These and other objects of the invention are achieved in a preferred embodiment thereof wherein a latching system is provided for an electrical connector plug which is capable of being utilized with a receptacle having a female cavity in a closely packed array of additional plugs and receptacles. A first electrical contact means is disposed within the cavity and a first interengaging means is disposed within the cavity. The latching system comprises the plug which includes a body having forward and rearward end portions and a latch. The plug is shaped to be received within the cavity of the receptacle at least at the forward end portion of the body. A second electrical contact means is disposed within the body of the plug and mateable with the first electrical contact means of the receptacle when the plug is received within the cavity. The latch has a first end and a second end and extends in general alignment with, and along, the body. The first end of the latch is connected to the body at the forward end portion.

The latch has a second interengaging means disposed between the first and second ends of the latch in general alignment with the first interengaging means of the receptacle when the plug is received within the receptacle.

A longitudinal portion of the latch extending from the second end to a location on the latch beyond the second interengaging means and the body are capable

of relative movement toward and away from each other in a plane generally intersecting the longitudinal axis of the body.

The latching system also includes means for biasing the aforementioned longitudinal portion of the latch in relation to the body such that the longitudinal portion of the latch tends to normally assume a displacement from the body.

The system further includes means for retaining the body and the longitudinal portion of the latch within a desired predetermined displacement from each other when the plug is separated from the receptacle. The predetermined displacement is less than the normal displacement.

The first and second internegaging means are disposed in coupling relationship when the plug is received within the receptacle and the body and the longitudinal portion of the latch are disposed at the aforementioned desired predetermined displacement from each other. The first and second interengaging means are disposed in an uncoupled relationship when the body and the longitudinal portion of the latch are moved toward each other to allow insertion of the plug into the receptacle and removal of the plug from the receptacle. Thus, retaining the portion of the latch at the desired predetermined position makes the plug readily alignalbe with the cavity of the receptacle during insertion and withdrawal while maintaining the longitudinal portion of the latch in a biased condition for positive latching.

BRIEF DESCRIPTION OF THE DRAWINGS

In the course of the following detailed description reference will be frequently made to the attached drawings in which:

FIG. 1 is a perspective view of an electrical connector assembly embodying the principles of the present invention having single-contact, two-contact and four-contact plugs aligned for insertion into cavities of a receptacle array:

FIG. 2 is a perspective view of the preferred single-contact plug prior to insertion of the contact and prior to positioning of the latch;

FIG. 3 is a sectional view of the plug as shown generally along line 3—3 of FIG. 2;

FIG. 4 is a sectional side view of the plug shown in FIG. 2 as received within a receptacle cavity and retained therein by the latch;

FIG. 5 is a view of the plug and its latch as seen along line 5—5 of FIG. 4;

FIG. 6 is a view of the plug and its latch as seen in FIG. 5 showing their relative positioning during unlatching;

FIG. 7 is a sectional side view of the preferred plug and latch configuration with the latch positioned for unlatching;

FIG. 8 is a sectional side view of an alternative plug and latch configuration with the latch positioned for unlatching;

FIG. 9 is a sectional side view of another alternative plug and latch configuration with the latch positioned for unlatching; and

FIG. 10 is a sectional side view of still another alternative plug and latch configuration with the latch positioned for unlatching.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, FIGS. 1, 2, 3 and 4 show a preferred plug 12 made of a resiliently deformable material such as nylon and including various features of the present invention. The plug 12 houses a single female contact 14 therein and is shaped to be received within any one of a plurality of cavities 16 of a receptacle array 18. Each cavity 16 of the array 18 housed therein a male contact 20 which mates with the female contact 14 of the plug 12 when the plug 12 is fully inserted into the cavity 16. The male contact 2o extends beyond the receptacle array 18 to provide a portion 22 capable of receiving wire wrapping or some other means of termination known in the art. As shown in FIG. 1, the basic configuration of the plug 12 may be modified to provide a two-contact plug 24 and a four-contact plug 26 to add flexibility to the connector system so that simultaneous multiple interconnections may be made. Although the plugs 24 and 26 utilize a double latching system, the features and characteristics of that system are so similar to the latching system utilized with the plug 12 that a detailed description of the plug 12 will sufficiently disclose the latching system and be equally applicable for the plugs 24 and 26.

As best seen in FIGS. 2, 3 and 4, the plug 12 primarily includes a body 28 and a latch 30. To retain the plug 12 within the cavity 16 of the receptacle array 18, the latch 30 is generally biased away from the body 28 and includes an outwardly extending lug 31 which is received within a window 33 (FIG. 4) in a sidewall of the cavity 16 when the plug 12 is fully inserted therein. The biasing and latching functions are described in greater detail hereinbelow.

Extending longitudinally through the body 28 is a chamber 32 which is shaped to receive the female contact 14 with its associated wire 35 extending beyond a rearward end portion 34 of the body 28. An opening 36 in one side of the body 28 provides a surface 38 upon which a locking lance 40 of the female contact 14 will rest to retain the fully inserted female contact 14 within the body 28.

The latch 30 of the plug 12 has a generally U-shaped cross-section and includes a base wall 44 and a pair of sidewalls 46. The latch 30 is pivotally connected to the body 28 at its forward end portion 42 by each of a pair of flexible, resiliently deformable hinges 48. Each of the pair of hinges 48 extends outwardly from opposite sides of the body 28 to join the latch 30 at a first end 50 of each respective sidewall 46. The hinges 48 and sidewalls 46 of the latch 30 are disposed at opposite sides of the body 28 to provide sufficient space therebetween to receive the body 28 therein when the latch 30 is pivoted at the hinge 48 to a position generally parallel with the body 28.

As seen in FIGS. 2 and 3, the plug 12 is initially formed with the latch 30 angularly displaced from the body 28 so that the resiliently deformable hinges 48 provide biasing to the latch 30 when the latch 30 partially surrounds the body 28 as is desired during utilization of the plug 12 in conjunction with the receptacle array 18 as shown in FIGS. 1 and 4. It is desirable to have the latch 30 in this biased position relative the body 28 to provide more positive latching when the plug 12 is inserted in the cavity 16. It is also desirable that this relative position be maintained when the plug

12 is separated from the receptacle array 16 so that the plug 12 will be more convenient to handle and more readily alignable with the cavity 16 during insertion. A preferred means of retaining this relative position of the latch 30 throughout such above-described utilization of the plug 12 is provided by a resiliently deformable collar, indicated generally at 52. The collar 52 maintains a second end 54 of the latch 30 and the rearward end portion 34 of the body 28 at a maximum desired displacement to retain the biased latch 30 generally parallel with the body 28.

The collar 52 includes a pair of hooked members 56 which extend coplanarly from the sidewalls 46 toward the rearward end portion 34 of the body 28. Each of the hooked members 56 includes a retaining tab 58 having inwardly tapered outer surfaces 60. After the plug 12, as shown in FIGS. 2 and 3, has been produced, the latch 30 is pivoted relative the body 28 against the biasing force of the hinges 48 until the surfaces 60 of the tabs 58 make contact with the rearward end portion 34 of the body 28. As force is applied to decrease the displacement between the latch 30 and the body 28, the rearward end portion 34 of the body 28 cams against the surfaces 60 of the tabs 58 to deflect the hooked members 56 apart. When the second end 54 of the latch 30 and the rearward end portion 34 of the body 28 are at the aforementioned desired displacement, as shown in FIG. 5, the hooked members 56 return to their undeflected position and, with the tab 58, partially encircle the rearward end portion 34 to retain the latch 30 in a biased, generally parallel position with respect to the body 28.

The general alignment of the plug 12 with the cavity 16 and its retention therein are best seen in FIG. 4. The cross-sectional dimensions of the plug 12 at the forward end portion 42 of the body 28 are slightly less than the corresponding dimensions of the cavity 16 and generally remain constant during operation of the latch 30 so that the contacts 20 and 22 are maintained in alignment during insertion and withdrawal of the plug 12. When the plug 12 is being inserted into the cavity 16, the latch 30 is displaced toward the body 28, in a manner to be described in detail hereinbelow, by the operator or by the camming action of the leading surface of the lug 31 until the lug 31 is aligned with the window 33. The biased latch 30 generally returns to the desired predetermined displacement from the body 28 so that the lug 31 extends into the window 33. Tapered surfaces 61 and 63 respectively of the lug 31 and the rearward wall of the window 30 insure overlapping, positive retention of the plug 12 until outside forces are applied to again displace the latch 30 toward the body 28 and allow withdrawal of the plug 12. In the preferred embodiment 12, as shown in FIGS. 1, 2, 3, 4 and 7, additional features have been included to improve the operation and reliability of the latching system. Because of the relatively small cross-sectional dimensions of the hinges 48, other means have been added to the plug 12 to prevent the hinges 48 from being strained to a point of failure and to provide additional biasing to further insure positive latching. An opening 62 in the base wall 44 of the latch 30 is provided between the hinges 48 so that a shoulder 64 extending from the body 28 will be received therein when the latch 30 is positioned in general alignment with and along the body 28. As a result, of withdrawal force is applied to the body 28, such as by pulling on the wire 35, while the plug 12 is being retained within the cavity 16, the force will be transferred to the latch 30 through the shoulder 64 and the opening 62 rather than by the hinges 48 to relieve any strain to which they might otherwise be subjected. A protuberance 66 extends from the body 28 at the shoulder 64 toward the base wall 44 to make contact therewith. The height of the protuberance 66 is such that the resiliently deformable latch 30 must be deformed about the protuberance 66 to displace the second end 54 of the latch 30 toward the rearward end portion 34 of the body 28 less than the desired predetermined displacement therebetween. Therefore, additional biasing is provided to the latch 30 by its tendency to return to a natural, undeformed position.

Specifically, as shown in FIG. 7, when force F is applied to the second end 54 of the latch 30 to decrease its displacement from the rearward end portion of the body 28, the latch 30 is deformed about the protuberance 66. The deformation of the latch 30 causes the latch 31 to be withdrawn from the window 33 of the cavity 16 to allow removal of the plug 12 from the receptacle 18. If the plug 12 is not in a closely packed array of additional plugs and receptacles, the operator can apply the force F to the plug 12 with his fingers as generally shown in FIG. 7. However, if the plug 12 is in a closely packed array, the rearward end portion 34 of the body 38 and the second end 54 of the latch 30 are accessible so that the jaws of a pair of needle nosed pliers, indicated at 70 in FIG. 6, can be applied to the plug 12 to cause its release and withdrawal from the receptacle 18. A notch 68 is provided at the second end 54 of the latch 30 so that the pliers 70 will not slip from the end of the plug 12 when it is being withdrawn from the receptacle 18 in this manner.

An alternative feature has been provided and is shown on the two-contact plug 24 in FIG. 1 to facilitate removal of the plug from a closely packed array. A finger tip extension 72 extends rearwardly from the second end 54 of the latch 30 allows the operator to grasp the wires extending from the plug 24 while using a single finger on the extension 72 to deform the latch and release the plug 24 and thereby allow its withdrawal from the cavity 18.

It can now be seen that by altering the cross-sectional dimensions and/or features of some of the resiliently deformable members described hereinabove, alternative latching systems can be provided to accomplish the objectives of the invention. One alternative embodiment is shown in FIG. 8 and includes a plug 73 to be utilized with the cavity 16 of the receptacle 18. The plug 73 includes a relatively rigid body 74 and a relatively rigid latch 78 connected by a flexible hinge 76. Extending outwardly from the body 74 toward the latch 78 is a resiliently deformable protuberance 80. In the plug 73, the latch 78 pivots toward the body 74 at the hinge 76 against the biasing action of the deformed protuberance 80. The plug 73 otherwise operates as does the plug 12 described hereinabove.

Another alternative embodiment is shown in FIG. 9 where a plug 81 is again utilized with the cavity 16 of the receptacle 18. However, in the plug 81, a relatively rigid body 82 and a relatively rigid latch 86 are joined by hinge 84 capable of generally longitudinal resilient deformation. Therefore, a protuberance 88, similar to the protuberance 66 described hereinabove, extending from the body 82 acts as a fulcrum about which the

latch **86** can be pivoted to unlatch the plug **81** from the receptacle **18** against the biased expansion of the hinge **84.**

Still another alternative embodiment is shown in FIG. **10** where a plug **89** is again utilized with a receptacle **18** as described hereinabove. The cross-sectional dimensions of the resiliently deformable plug **89** are such that a body **90** is relatively more flexible than a latch **94** or a hinge **92** disposed therebetween. Therefore, when the relatively rigid latch **94** is pivoted toward the body **90** having a protuberance **96** similar to the protuberance **66** described hereinabove, the latch **94** again pivots about the protuberance **96.** However, since the hinge **92** will not expand as did the hinge **84** described hereinabove, the flexible body **90** will be deformed from its natural relaxed condition about the protuberance **96** with the forward end portion **98** angularly displaced from the remainder of the body **90** to provide biasing to the latch **94.**

It can be readily seen that various combinations of the above described features can be utilized in a latching system to accomplish the objectives of the invention.

What is claimed is:

1. A latchable electrical connector plug capable of being plugged into a receptacle in a closely packed array of additional plugs and receptacles, each said receptacle having a female cavity, a male contact fixed in said cavity and a latching window in one side wall of said cavity and each said plug having a female receptacle contact mounted therein, said connector plug comprising:

an elongated body of resiliently deformable material having central bore extending between forward and rearward end portions, a locking lance receiving aperture in a side wall of said bore for fixedly retaining said female contact therein, and at least said forward end of said body having a profile adapted to be received within said cavity,

latching means hingedly connected to said forward end of said body and extending in general alignment with and along said body, said latching means including a latching lug extending outwardly of said latching means at a point in general alignment for engagement with aid latching window,

a protuberance extending outwardly from said body adjacent the hinged connection of said latching means and adapted to engage said latching means,

resiliently deformable locking means on the free end of said latching means, said locking means encircling opposite sides of the rearward end of said body and holding said latching means resiliently deformed about the protuberance for relative movement toward the plug against inherent biasing of the latching means caused by its deformation, whereby a predetermined displacement of said latching means is sufficient to allow the latching lug to be inserted into and withdrawn from said latching window.

* * * * *