Sept. 12, 1950 H. HUBBELL ET AL 2,521,722

SINGLE CONDUCTOR LOCKING CONNECTOR

Filed Feb. 2, 1944

Fig. 1.

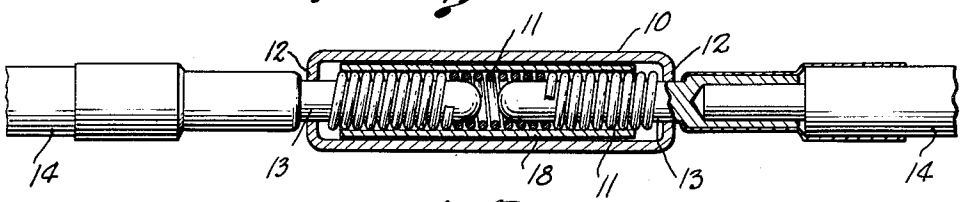


Fig. 2.

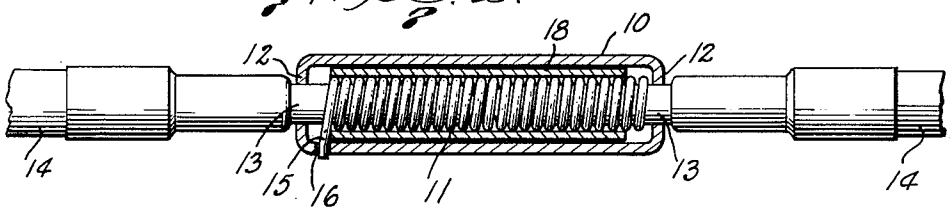


Fig. 3.

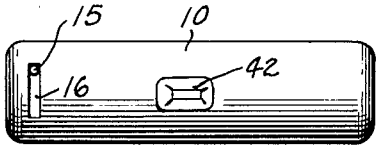


Fig. 7.

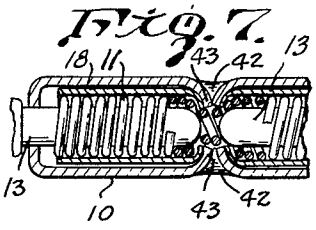


Fig. 4.

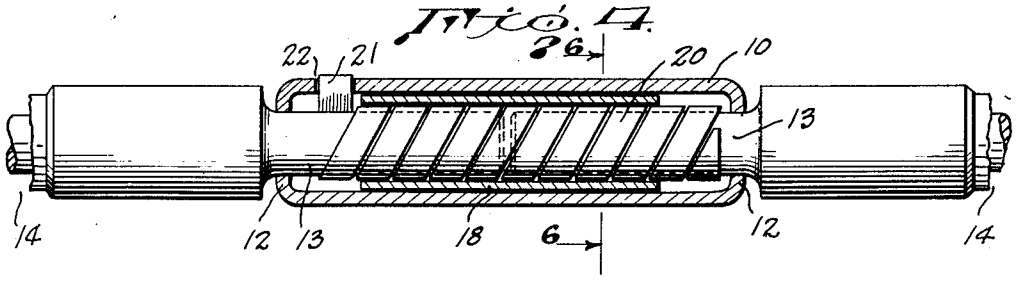


Fig. 5.

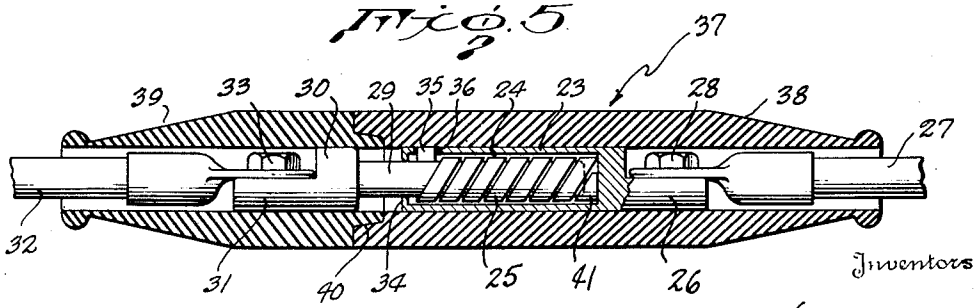
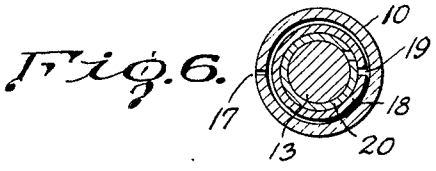


Fig. 6.



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SINGLE CONDUCTOR LOCKING CONNECTOR

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12 Claims. (Cl. 287—76)

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This invention relates to a connector for connecting electrical conductors or leads, and has for an object to provide a simple and effective means for connecting such conductors which is of very simple construction and may be easily and quickly manipulated to either connect or disconnect the conductors, but in which, after the connection is made, the conductors are substantially locked so that they will not separate inadvertently or with considerable strain on the conductors, although it is preferred that the connection yield or separate before there is sufficient strain to break the lead or conductor.

Another object is to provide a connector which will insure good electrical contact without the necessity of soldering or similar operations.

With the foregoing and other objects in view we have devised the construction illustrated in the accompanying drawing forming a part of this specification. It is, however, to be understood the device is not limited to the specific construction and arrangement shown but may include various changes and modifications within the scope of the invention.

In these drawings:

Fig. 1 is a partial side elevation and partial longitudinal section through a connector with the conductors connected thereby;

Fig. 2 is a similar view showing a slight modification;

Fig. 3 is a side elevation of the connector of Fig. 2 with the conductors removed;

Fig. 4 is a view similar to Figs. 1 and 2 showing another modification;

Fig. 5 is a similar view showing another modification more particularly adapted for large connectors;

Fig. 6 is a transverse section substantially on line 6—6 of Fig. 4, and

Fig. 7 is a longitudinal section showing one way of securing the spring against turning.

Referring first to Fig. 1, the connector comprises an external sleeve 10 enclosing a substantially cylindrical coiled spring 11, the ends of the sleeve 10 being turned inwardly, as indicated at 12, to retain the spring within the sleeve, and these inturned ends are provided with openings for insertion of pins 13 connected in any suitable or desired manner to the insulated or other leads or conductors 14. The internal diameter of the coils of the spring 11 is somewhat less than the external diameters of the pins 13 so that when the pins are inserted in the spring the spring is expanded somewhat and due to its resilient action firmly grips the pins, making good

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electrical contact therewith and also substantially locking the pins within the connector, because when there is strain placed on the pins, tending to pull them straight out from the spring, this action tends to elongate the spring and this elongating action tends to contract the coils of the spring making them grip the pin more firmly. In fact the greater the tension tending to pull out the pin the greater is the gripping action of the spring on the pin. The pin, however, may be readily inserted in or removed from the spring by applying a relative turning action between the spring and the pin while pushing the pin into the spring or drawing it out of the spring. Thus, when inserting the pin into the spring, if it is turned in the direction opposite to the direction of the coiling of the spring it will tend to unwind the spring making it somewhat larger or expanding it so that the pin will readily move into the coil. Thus for example, if the spring is wound left-hand or counterclockwise, when inserting the pin if it is turned to the right or clockwise at the same time the force is applied tending to push the pin into the spring it will tend to open up or expand the spring and the pin will readily slide into place. Similarly, if it is desired to disconnect the conductor or remove the pin from the connector, if tension is applied tending to pull it out of the spring and at the same time it is turned to the right or clockwise it will expand the spring sufficiently to permit ready withdrawal of the pin from the spring. But, as indicated above, a straight pull on the pin without the relative turning action would tend to elongate the spring and tend to grip the pin more tightly and effectively prevent inadvertent separation of the pin from the connector or release of the pin under severe strain.

However, as the surface of the pin is preferably substantially cylindrical and relatively smooth, the pin and spring may be so designed or proportioned that there is not a positive complete locking of the pin in the spring but the maximum grip of the spring is such that the pin will be withdrawn before there is sufficient strain to break the lead or the connector. In the arrangement shown in Fig. 1, both pins are gripped and held by the operator for insertion or removal of one pin when the other pin is in place in the spring, but in the disconnecting operation only one pin will be removed because there is always a slight variation in the different end portions of the spring and the pins so that one pin is always gripped somewhat tighter than the other, and the less tightly gripped pin will be the one that is

released under the relative turning and pulling operation. With this arrangement of Fig. 1 while one pin is removed the other pin remains within the connector. In other words, only one pin can be removed and the connector will remain attached to the other pin or conductor, because after one pin is removed, if it is attempted to remove the other pin by gripping it and the sleeve 10, the sleeve will merely turn on the spring and there will be nothing to hold the spring to secure relative turning of the pin in the spring to give the expanding operation.

In Figs. 2 and 3 is shown a slight modification in which after one pin is removed from the connector the other pin may also be removed. Or that is, with this construction either one or both pins may be removed. To secure this effect means is provided to permit limited turning movement only of one end of the spring in the sleeve. In the arrangement shown, one end of the spring is turned outwardly, as indicated at 15, and seated in an elongated recess or slot 16 in the sleeve 10. This will permit sufficient relative turning movement of the spring in the sleeve to secure the necessary expanding operation of the spring to release the pin, but it will also prevent turning of the spring in the sleeve after one pin has been removed so that the other pin may also be turned relative to the spring to expand the spring sufficiently to release this pin also.

To insure that there is sufficient electrical conducting capacity through the connector it is preferred that the end walls 12 be pinched inwardly far enough to tightly grip the outer surfaces of the pins 13 to make good electrical contact so that the outer sleeve forms a supplementary conductor for the spring, and the portion of the spring between the inner ends of the pins is not required to carry the full current. For this purpose the openings in the end walls 12 may be somewhat smaller in diameter than the exterior diameter of the pins and the sleeve 10 be a longitudinally split sleeve, as indicated at 17, Fig. 6, and made as a spring or resilient sleeve so that when the pins are inserted they will slightly expand the sleeve and its resilient action will clamp the end walls against the pin to insure good electrical contact. The conducting capacity of the spring may also be supplemented by an independent conducting sleeve 18. This may be a relatively thin bronze spring sleeve longitudinally split at one side, as indicated at 19, Fig. 6, and embracing the spring and by its resilient action tending to clamp itself against the outer periphery of the spring to give a good electrical contact therewith. This sleeve is of sufficient length so as to extend outwardly well beyond the free inner ends of the pins 13 and well overlap these pins so as to effectively supplement the conducting capacity of the portion of the spring between the inner free ends of the pins. Also as it is a split spring sleeve it will yield or expand to permit the spring to expand for the inserting and removal operations of the pins as described above.

In Fig. 4 is shown a slight modification in which the coil spring 20 corresponding to the spring 11 is of flat wire instead of round wire, as shown in Figs. 1 and 2. The operation and effect is the same except that this gives greater conductive effect for the spring, that is, greater cross sectional area of the wire for a smaller external diameter, permitting the use of stronger springs with greater cross sections without materially increasing the diameter of the connector. Flat wire also increases the gripping surface between the wire and the pin and electrical contact. This spring may also have the outwardly turned end 21 extending into an elongated slot or recess 22 in the sleeve 10 for the same effect as the outwardly turned end 15 in the slot or recess 16 of the first form, to permit limited relative turning movement between the spring and the pin, and permit removal of either pin and prevent collapse of the spring. In either form if it is desired to have the connector permanently connected to one conductor and have it adapted for insertion and removal of a single pin, one end of the spring may be permanently connected to one lead or conductor or to the sleeve 10 by soldering, brazing or other suitable means.

In Fig. 5 is shown a modified construction intended more particularly for use with relatively large conductors for relatively heavy current. In this case the enclosing member or sleeve 23 corresponding to the external sleeve 10 has a chamber 24 in which the coiled substantially cylindrical spring 25 corresponding with the springs 11 and 20 may be located. The chamber 24 is closed at one end and the member is provided with a flattened portion 26 to which the lead or conductor 27 may be connected by any suitable means such as the screw 28. The pin 29 corresponding to the pins 13 is connected to a block 30 also having a flattened portion 31 to which the other lead 32 may be similarly connected by a screw 33. The end of sleeve 23 opposite the end portion 26 is turned inwardly as indicated at 34 corresponding to the ends of the sleeve 10 in the other forms and may be arranged to grip or tightly contact pin 29 to give good electrical connection, as described in connection with the first form, this sleeve being also preferably a split spring sleeve to secure this effect. Also the free end of the spring 25 may be turned outwardly as shown at 35 to extend into an elongated slot or recess 36 in the sleeve to permit limited turning movements only between the spring and the sleeve to insure release of the pin from the spring and also to prevent collapse of the spring, as described in connection with the other forms. The whole connector may be enclosed in an insulating cover 37 made of rubber or suitable composition and it is preferably composed of two sections 38 and 39, the section 38 enclosing the sleeve 23 and its connecting means to the conductor 27, while the section 39 encloses the outer block or end portion 30 of the pin and the means for connecting it to the conductor 32. There is preferably a telescoping joint 40 between the adjacent ends of sections 38 and 39 to make a closed joint. The inner end portion 41 of the spring could be free in the enclosed sleeve or it could be anchored to the sleeve as by soldering, brazing or other suitable means.

In Fig. 7 is shown another way in which the spring 11 may be held from turning in the sleeve 10 so that both pins 13 may be disconnected. In this arrangement after the spring 11 is assembled in the sleeve 10, either with or without the sleeve 18, the side walls of the sleeve are punched inwardly as indicated at 42, preferably from opposite sides of the sleeve and two or four of these punchings may be used. As the walls of the sleeve are punched inwardly projections 43 are formed on the inner side of the sleeve, and if sleeve 18 is used similar projections are formed in this sleeve, which extend between coils of the spring and separate them or may bend the wire

of the spring, effectively holding the spring against turning in the sleeve. These punchings may be used either in conjunction with or independently of the out-turned ends **15**, **21** and **35** of the spring seated in openings in the enclosing sleeve. This is a quicker way of securing the spring.

It will be understood from the above the device is of very simple construction and that the pins connected to the leads or conductors may be inserted in or removed from the connector easily and quickly by a very simple operation, but that when inserted in the connector the pins are tightly clamped and substantially locked against inadvertent separation or removal from the connector. Also that although the connector may be made in practically any sizes, depending on the sizes of the conductors and the current-carrying capacities required, still its overall size is not much greater than the conductors with their insulation or the connecting portions of the pins connected to the conductors. In fact, the whole connector for numbers **16** and **18** wire is less than ¾ inch in length and less than ¼ inch in diameter.

Having thus set forth the nature of our invention, what we claim is:

1. A connector of the character described comprising a substantially cylindrical coiled spring adapted for connection to a conductor and having an open free end portion adapted for insertion of a substantially cylindrical pin connected to another conductor, the internal diameter of said free end portion being somewhat less than the external diameter of the pin so that said spring will grip the pin after insertion therein, and a split spring sleeve surrounding the spring and provided with an inturned end to retain the spring in the sleeve, and said inturned end being provided with an opening of less diameter than the pin so that as the pin is inserted it expands the sleeve to cause the inturned end to grip the pin to provide close electrical contact therewith.

2. A connector of the character described comprising a substantially cylindrical coiled spring, a split spring sleeve enclosing the spring including inturned ends to retain the spring in the sleeve and provided with openings for insertion of substantially cylindrical pins into the open ends of the spring, said openings being of less diameter than the pins so that as the pins are inserted the sleeve is expanded to cause the inturned ends to grip the pins to provide close electrical contact therewith, and the internal diameter of the spring being somewhat less than the external diameter of the pins so that the spring will grip the pins after they are inserted therein.

3. A connector of the character described comprising a substantially cylindrical coiled spring adapted for connection to a conductor and having an open free end portion adapted for insertion of a substantially cylindrical pin connected to another conductor, the internal diameter of the spring being somewhat less than the external diameter of the pin so that said spring will grip the pin after the pin is inserted therein, and a split resilient conducting sleeve embracing the spring and of an internal diameter such that it is expanded by the spring as the pin is inserted and thus provides close electrical contact with the spring to supplement the electrical conducting capacity of the spring.

4. A connector of the character described comprising a substantially cylindrical coiled spring, a sleeve enclosing the spring including inturned ends to retain the spring in the sleeve and provided with openings for insertion of substantially cylindrical pins into the open ends of the spring, the internal diameter of the spring being somewhat less than the external diameters of the pins so that the spring will grip the pins after they are inserted therein, and a split resilient conducting sleeve embracing and contacting the spring and of sufficient length to overlap the free end portions of both pins when they are inserted in the spring.

5. A connector of the character described comprising a substantially cylindrical coiled spring adapted for connection to a conductor and having an open free end portion adapted for insertion of a substantially cylindrical pin connected to another conductor, the internal diameter of the spring being somewhat less than the external diameter of the pin so that said spring will grip the pin after the pin is inserted therein, an enclosing member provided with a chamber in which the spring is located and provided with an inwardly extending end wall to prevent withdrawal of the spring from the chamber, said end wall being provided with an opening for insertion of the pin into the spring, the free end of the spring being turned outwardly, and said enclosing member being provided with an elongated recess to receive said outturned end and cooperate therewith to limit turning movements of the spring in the chamber.

6. A connector of the character described comprising a substantially cylindrical coiled spring, a sleeve enclosing the spring including inturned ends to retain the spring in the sleeve and provided with openings for insertion of substantially cylindrical pins into the open ends of the spring, the internal diameter of the spring being somewhat less than the external diameters of the pins so that the spring will grip the pins after they are inserted therein, one end of the spring being turned outward, and said sleeve being provided with an elongated recess to receive said outturned end to limit turning movements of the spring in the sleeve.

7. A connector of the character described comprising a substantially cylindrical coiled spring, a split spring sleeve enclosing the spring including inturned ends to retain the spring in the sleeve and provided with openings for insertion of substantially cylindrical pins into the open ends of the spring, said openings being of somewhat less diameter than the pins so as to expand the sleeve by insertion of the pins and the inturned ends are clamped on the pins to provide close electrical contact therewith, the internal diameter of the spring being somewhat less than the external diameters of the pins so that the spring will grip the pins after they are inserted therein, and cooperating means on one free end portion of the spring and the sleeve to permit limited turning movement only of the spring in the sleeve.

8. A connector of the character described comprising a substantially cylindrical coiled spring, a split spring sleeve enclosing the spring including inturned ends to retain the spring in the sleeve and provided with openings for insertion of substantially cylindrical pins into the open ends of the spring, said openings being of somewhat less diameter than the pins so as to expand the sleeve by insertion of the pins and the inturned ends are clamped on the pins to pro-

vide close electrical contact therewith, the internal diameter of the spring being somewhat less than the external diameters of the pins so that the spring will grip the pins after they are inserted therein, and means to limit turning movements of the spring in the sleeve.

9. A connector of the character described comprising a substantially cylindrical coiled spring, a sleeve enclosing the spring including inturned ends to retain the spring in the sleeve and provided with openings for insertion of substantially cylindrical pins into the open ends of the spring, the internal diameter of the spring being somewhat less than the external diameters of the pins so that the spring will grip the pins after they are inserted therein, and inwardly projecting lugs on the sleeve engaging the spring and limiting turning movements of the spring in the sleeve.

10. A connector of the character described comprising a substantially cylindrical coiled spring, a split spring sleeve enclosing the spring including an inturned end to retain the spring in the sleeve and provided with an opening for insertion of a substantially cylindrical pin into the open end of the spring, said opening being of a size somewhat smaller than the pin so that the sleeve is expanded by insertion of the pin to cause the inturned ends to grip the pin and provide close electrical contact therewith, and the internal diameter of the spring being somewhat less than the external diameter of the pin so that the spring will grip the pin after it is inserted therein.

11. A connector of the character described comprising a substantially cylindrical coiled spring adapted for connection to a conductor and having an open free end portion adapted for insertion of a substantially cylindrical pin connected to another conductor, the internal diameter of the spring being somewhat less than the external diameter of the pin so that said spring will grip the pin after the pin is inserted therein, a split resilient conducting sleeve embracing the spring provided with an inwardly extending end wall to prevent withdrawal of the spring from the sleeve, and said end wall being provided with an opening for insertion of the pin into the spring and of less diameter than the pin so that the sleeve will be expanded as the pin is inserted to cause said end wall to grip the pin and provide close electrical contact therewith.

12. A connector of the character described comprising a substantially cylindrical coiled spring adapted for connection to a conductor and having an open free end portion adapted for insertion of a substantially cylindrical pin connected to another conductor, the internal diameter of the spring being somewhat less than the external diameter of the pin so that said spring will grip the pin after the pin is inserted therein, and a split resilient conducting sleeve embracing and closely contacting the spring and of a length to overlap a portion of the pin and extend beyond the free end portion thereof when the pin is inserted in the spring to supplement the electrical conducting capacity of the spring.

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