ABSTRACT: A screwless connecting terminal for electric leads comprising at least one bent clamping spring defining an aperture at one end, a terminal housing in which said clamping spring is located, and a contact plate associated with said clamping spring, characterized by the feature that said clamping spring engages by said aperture round a reduced part of said contact plate and is kept under tension thereby.
ELECTRICAL CONNECTOR

This invention concerns a screwless connecting terminal or connector to which the ends of electric leads are connectable without screws.

Conventional connecting terminals have a terminal housing in which a contact plate is mounted. The bent ends of a clamping spring are supported on this contact plate and are in engagement with the walls of the housing under the force of the spring.

The ends of the leads to be connected are inserted between the bent clamping spring ends and the contact plate by raising the clamping spring ends from the contact plate. With the use of these connecting terminals a disadvantage is that the contact pressure is received with or without clamped conductors by the terminal housing, since the clamping springs are in contact with the terminal housing under pressure.

Furthermore, such connecting terminals are expensive on account of their complicated construction and manufacture and when carrying large currents have a high contact resistance.

It is the object of the present invention to provide a screwless connecting terminal or connector for joining electric leads which avoids the present disadvantages and, due to its simple construction, easy manufacture and reliable efficiency, is economical, has low contact resistance when carrying large currents, and automatically maintains its contact pressure.

In accordance with the present invention, a screwless connecting terminal or connector for joining electric leads having at least one bent clamping spring provided in a terminal housing and in forced engagement with a contact plate, is characterized in that the clamping spring encloses the contact plate, serving as abutment, at its bent end, and is kept under tension by said contact plate.

In a preferred embodiment, the clamping spring, together with the contact plate, is constructed as a self-contained unit; and the end region of the contact plate is located in an opening with play.

The contact plate may also be formed as a double-walled plate from a strip of material, and the clamping spring may be secured by a screw, rivet or the like or by a clip or locking connection, to the contact plate.

One end region of the contact plate may be constructed as a connecting member, such as a plug, contact sleeve, pinch connection, solder lug or the like, and the terminal connection may be arranged in a housing which is at least partially flexible or resilient, or in a housing provided with an actuating pressure member for the clamping spring.

In another embodiment of the invention, the connecting terminal or connector is formed as banana plug and its contact plate with the clamping spring is bent out of a strip of material, the clamping spring with the plug opening being secured under spring tension in an opening in the contact plate or the end region of the contact plate.

The clamping spring may be arranged with the contact plate at the contact end of a housing and the terminal member extending out of the housing may be formed as a plug.

The screwless connecting terminal or connector of the present invention is simple in design, easy to manufacture and reliable in operation. The connecting terminal or connector is preferably constructed as a self-contained unit so that the contact pressure is maintained with or without clamped conductors at the connecting terminal itself, and is not transmitted to the terminal housing.

In addition, this connecting terminal or connector has the required low contact resistance when carrying large currents, and is very economical.

Furthermore, the connecting terminal or connector of the present invention can be readily and rapidly assembled; it is manufactured from material of high conductivity and represents the best possible type of connection and connecting device for electric leads.

Embodiments of the present invention will be described hereinafter with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of a screwless connecting terminal or connector for electric leads, formed of a contact plate and clamping spring and arranged in an insulating terminal housing.

FIGS. 2-5 are perspective views of other embodiments of screwless connecting terminals or connectors.

FIG. 6 is a longitudinal section through a terminal housing with inserted connecting terminals, FIG. 7 is a plan view of the same terminal housing comprising connecting terminals, shown partly in section, FIG. 8 is a perspective view of the same connecting terminal split at the clamping spring end, FIG. 9 is a longitudinal section through a modified terminal housing with inserted connecting terminal, FIG. 10 is a perspective view of a connecting terminal formed as a banana-shaped or split plug, FIG. 11 is a perspective view of a modified terminal connector formed as a banana-shaped or split plug, FIG. 12 is a perspective view of a modified double connecting terminal or connector, FIG. 13 is a perspective view of a modified screwless connecting terminal or connector comprising a contact plate displaceably secured under tension in W-shaped recesses of a terminal member, FIG. 14 is a cross section through the same connecting terminal or connector taken on the line 1-1 of FIG. 13 with two clamped leads, FIG. 15 is a cross section through the same connecting terminal or connector with one clamped lead, FIG. 16 is a cross section through the same connecting terminal or connector provided with several separately pinched conductors of two cables, FIG. 17 is a perspective view of a modified embodiment of connecting terminal or connector, FIGS. 18 and 19 show front views of other constructions of connecting terminals or connectors.

The connecting terminal or connector 10 of the present invention for the screwless connection of electric leads or the like has a plane striplike contact plate 11, in the center area of which a clamping spring 12 is secured by means of a screw, rivet or the like 11a. This clamping spring 12 is bent at both ends and encloses the end portions of the contact plate 11, said contact plate 11 serving as abutment, keeping the clamping spring 12 under tension. The bent ends of the clamping spring 12 are each provided with an opening 13 positioned in each case round the end 14 of the plate which is reduced at the ends. The opening 13 of the clamping spring 12 is larger than the cross section of the reduced plate end 14 so that the clamping spring 12 displaceably encloses the ends of the contact plate 11.

The openings 13 in the clamping spring 12 and the contact plate 11 are provided in the lower contact region with at least one recess 15, such as a channel, notch or the like determining the position of an inserted electric lead.

This connecting terminal or connector 10 is arranged in an insulating terminal housing 16, the contact plate 11 being secured to the housing 16. Said terminal housing 16 may be made from a flexible or resilient material so that the ends of the clamping springs for receiving a current conductor can be effected by deforming the housing. At least the upper side of the housing is made resilient, since the movement of the clamping spring 12 for the insertion of the lead between the clamping spring and contact plate 11 must be effected from the top.

FIG. 2 of the drawings shows a modified construction of a connecting terminal or connector 17. A clamping spring 18 bent at one end engages through its opening 13 the reduced end 14 of a contact plate 19. Said contact plate 19 is formed of a strip of material bent at the reduced end 14 and resembles a plane double-walled plate. The end 20 of the clamping spring 18 opposed to the bends extends downwardly with a certain
The contact plate 39 is supported on a tongue 43 and is secured thereto by the clamping spring 40. In the region of the curved parts 40a of the clamping spring the tongue 43 is recessed for the movement of the clamping spring 40. The part of the tongue in contact with the housing wall in the insertion region is provided as a stop 43a, the surface of which, adjacent to the clamping spring 40, is slanted. This stop 43a with its inclined surface serves as an abutment for the lower portions of the clamping spring and prevents twisting of the clamping spring members 40a when the electric terminal leads are pulled out.

The clamping spring 40 can also be fitted with more than two clamping spring members 40a so that several leads can be clamped together.

The members 39a of the contact plate 39 at the connecting end partly project into the insertion openings 37 of the housing 36 and come into contact with an upper abutment. Two recesses 44 are provided on the top of the housing 36, near the bend of each clamping spring 40, through which a screwdriver or the like can be inserted for moving the clamping spring 40 downwardly when inserting the electric leads.

Such a terminal housing 36 provided with a connecting terminal or connector 38 represents a terminal body which can be used for the connection of several, for example, four electric leads (two on each side). In addition, a lead can be connected in this terminal body to the connecting member 41; one such connecting terminal and two leads may extend in the region of the clamping spring 40. The modified terminal housing 45 shown in FIG. 9 of the drawings, has a boxlike base member 46 in the two ends of which insertion openings 47 are formed. A contact plate 49 supported by member 48 is secured by its ends in the insertion openings 47 acting as abutments at the top. A clamping spring 51 at its ends and supported in the center area with a bend on the contact plate and held with tension on the contact plate 49 owing to its curved (W-shaped) formation, forming an independent unit with the contact plate 49, engages both ends of the contact plate. An actuating pressure member 52 covering the top of the terminal housing 45 is secured to the clamping spring 51, said pressure member 52 being movable into the base member 46 for moving the clamping spring 51. With this actuating pressure member 52, when one end is pressed, said member moves the bent end of the clamping spring 51 downwardly for the insertion of electric leads, about the center bend of the clamping spring 51.

The other bent end of the clamping spring 51 may also be raised from the electric lead 44 by moving the other end of the actuating pressure 52 downwardly for the purpose of clamping the electric lead. The parts of the members 48 at the insertion end also serve as stops 48a and prevent twisting of the lower parts of the clamping spring when the electric leads are drawn out of the opening 50 in said clamping spring.

A screwless connecting terminal or connector 53 is shown in FIG. 10 of the drawings as a banana-shaped or split plug and formed from a strip of material into a contact plate 54 and a clamping spring 55. The bent clamp spring 55 has an opening 56 at one end and extends through an opening 57 at the end of the contact plate 54. The contact plate 54 and the clamp spring 55 are shaped as a cylindrical plug 58 at one end so that the connecting terminal 53 is insertable by this pluglike connecting member 58 into a socket. An electric lead 59 may be inserted and clamped in the opening 56 in the clamping spring 55 below the contact plate 58. The clamp spring 55 may be enclosed at the connecting end together with the contact plate 54, by a terminal housing 60 consisting of flexible or elastic material, said terminal housing 60 being provided at the connecting end with a hinged cover 61 with passage openings 62 for the electric lead 59 terminal 54 receiving the banana-shaped plug 53. A presser 63 may be arranged on the housing 60 for actuating the clamp spring 55 during insertion of the lead.

The connecting terminal or connector 64 shown in FIG. 11 of the drawings is also formed as a banana-shaped plug and corresponds in its design to the connecting terminal 53. The
The apertures 112 of the clamping member 111 are W- or M-shaped. The contact plate 115 is tiltable about an abutment of the clamping member 111 and provided at the clamping ends with straight clamping edges 116. The contact plate 115 is formed with an angular or arcuate cross section and to provide the inner edges on the concave side as clamping edges 116, the convex side surface of the contact plate 115 is tiltable supported on the abutment of the clamping member 111.

The spring clamping member 111 is shaped as a curved clamping spring with a W- or M-shaped basic form (see FIGS. 13–16). The contact plate 115 is mounted in the center area of the clamp on the clamping member 111 by a rivet 117.

The rivet 117 is disposed in a bore 110 of the clamping member 111 and can be displaced (tilted) with the contact plate 115 relatively to the clamping member 111; at the same time, the center area of the clamping member serves as an abutment for the contact plate 115 and apertures 112 are formed in the turned down ends 119 of the clamping member 111.

In the embodiment shown in FIG. 17 a screwless connecting terminal or connector 120 has a U-shaped yoke as clamping member 121, in both shanks 122 of which an aperture 112 is formed. The contact plate 115 is displaceably mounted in the apertures 112 and has a compression spring 123. It is held by this compression spring 123 tiltably in the apertures 112; the compression spring 123 is arranged between the crosspiece of the stirrup and contact plate 115.

A screwless connecting terminal and contactor 124 according to another embodiment of FIG. 18 has two U-shaped yokes adjacent to each other as clamping members 125, which jointly engage the contact plate by the apertures 112 formed in the shanks. With each yoke there is associated a compression spring 123 which extends between the contact plate 115 and the yoke crosspiece to keep the contact plate 115 displaceably with tension in the apertures 112 of the clamping member 125.

FIG. 19 shows another embodiment of a screwless connecting terminal or contactor 126 which has a U-shaped yoke as a clamping member 127, in the side recesses 112 of which the contact plate 115 is kept under tension by means of two compression springs provided between contact plate 115 and yoke crosspiece. The apertures 112 of all the above described embodiments are each formed in the shanks 119 and 122 of the clamping members 111, 121, 125, 127 in the free ends of the shanks opposite the crosspiece and are of similar form; the shanks 119, 122 of the clamping members 111, 121, 125, 127 are disposed by the portion receiving the apertures 112 at an angle relative to each other, so that the leads 114 clamped between the shanks 119, 122 and contact plate 115 in the apertures 112 are retained reliably, since, due to the inclined formation of the clamps, a cone effect is obtained preventing extraction of the leads 114 or 114a.

Since the contact plate 115 of the screwless connecting terminal or contactor 110, 120, 124, 126 is mounted displaceably in the recesses of the clamping members 111, 121, 125, 127 a good clamping action is obtained; the contact plate 115 automatically swivels to accommodate the inserted leads 114 or 114a, and has a strong pressure action due to the supporting or mounting on an abutment 111, 122.

The leads 114 are always clamped with three point mounting by means of linear contact and the leads 114a are compressed in a bunch and also prevented from slipping out of the sides by the shape of the aperture, whereby a high contact pressure is ensured.

Since the contact plate is tiltable about its longitudinal axis, either one or two leads may be inserted into the apertures; in the case of two inserted leads the contact plate exerts an approximately uniform pressure on both leads.

If diagonally opposed leads are used, a sufficient contact pressure is achieved. The naturally resilient formation of the clamping spring as a clamping member and the compression springs of the yokes formed as clamping members, give the contact plate a strong pressure action so that adequate contact pressure is ensured in each method of clamping.
The leads can be easily inserted into the apertures between clamping member and contact plate.

At the same time it is a great advantage for several electrical leads to be connected together in the smallest space.

It is possible to manufacture such screwed and connecting terminals and connectors in other forms and to make the shapes and sizes of the clamping parts different. For example, it is

within the scope of the present invention to provide the screwed connecting terminal and connector 110, as shown in FIGS. 13–16, as a one-sided embodiment; the clamping member 111 is connected as a bent clamping spring with only one side 112 provided with a clamping surfaces 113 opposed to each other at an angle, said aperture being divided by the clamping surfaces 113 into two clamping regions.

A contact plate 115 is applied with tension on this clamping member 111 and the contact plate 115 extends into the aperture 112 for securing the leads 114 to be electrically con- nected. In this embodiment it is preferable to secure one end of the contact plate 115 to the clamping member 111 so that the other end of the clamping plate 115, disposed in the aperture 112, is in pressure contact with the clamping member 111.

I claim:

1. A screwless connecting terminal for electric leads includes a terminal housing, a contact plate positioned within said terminal housing and having a first face and an oppositely disposed second face, a clamping spring positioned within said terminal housing and supported on said contact plate, wherein the improvement comprises said clamping spring extending along said clamping plate and having a first part supported on said contact plate, a second part extending from said first part and disposed in outwardly spaced relationship from the first face of said contact plate, and a third part bent from the second part toward said contact plate and having its end remote from the second part spaced outwardly from the second face of said contact plate, the third part of said clamping spring having an opening therein through which said contact plate extends and the edge of the opening facing the second face of said contact plate being biased into engagement with said contact plate for securing one or more electric leads therebetween, and said second and third parts of said clamping spring being displaceable relative to said contact plate for spacing the contacting edge of the opening therein from the second face of said contact plate for inserting one or more electric leads therebetween.

2. A connecting terminal, as set forth in claim 1, wherein the edge surface of the opening in the third part of said clamping spring which is biased into engagement with the second face of said contact plate is located in a plane disposed angu- larly to the plane of said contact plate when an electric lead is secured therebetween for effecting a wedgelike gripping action on the lead.

3. A connecting terminal, as set forth in claim 1, wherein a groove is provided in the second face of said contact plate and extends therealong transversely of the third part of said clamping spring for forming a recess for receiving an electric lead to be held between said contact plate and clamping spring.

4. A connecting terminal, as set forth in claim 1, wherein said clamping spring has a second part and third part extending from each of two opposite sides of said first part and each of said third parts has an opening therethrough through which said contact plate extends for forming points of engagement at the opposite ends of said contact plate for one or more electric leads.

5. A connecting terminal, as set forth in claim 1, wherein the first part of said clamping spring is fixed to said contact plate by the first face thereof at the end of said contact plate opposite the end which extends through the opening in said clamping spring.

6. A connecting terminal, as set forth in claim 1, wherein said contact plate has recesses in the sides thereof extending between the first and second faces at a position intermediate its ends, and the first part of said clamping spring secured within the recesses in said contact plate whereby the first part of said clamping spring secured to said contact plate is in en- gagement with the first and second faces of said contact plate.

7. A connecting terminal, as set forth in claim 1, wherein a slot is formed in said clamping spring extending through at least the second and third parts thereof for splitting said clamping spring into a pair of similar clamping spring members each having an opening therethrough, and the ends of said contact plate having a forked configuration providing individual contact plate sections arranged to pass through the separate openings in said clamping spring members.

8. A connecting terminal, as set forth in claim 1, wherein said contact plate is elevated and has reduced cross-sectional portions at each end thereof, and the first part of said clamping plate is secured to said contact plate at a position interme- diate the ends of said contact plate and said clamping spring has two second parts and third parts each extending from one side of said first part toward the opposite ends of said contact plate, the third parts of said clamping spring each hav- ing an opening therethrough arranged to receive the reduced cross section portion of said contact plate.

9. A connecting terminal, as set forth in claim 1, wherein the edge of the opening in said clamping spring has a point in interme- diate its ends arranged to contact the second face of said contact plate at least when the electric leads are not disposed between the edge and said contact plate, and the surfaces of said edge extending from the intermediate portion thereof arranged in diverging relationship from the second face of said contact plate so that two separate clamping re- gions are provided between the edge of the opening and the second face of said contact plate, and means for securing said contact plate to said clamping spring so that said contact plate can be pivoted laterally about an axis extending from its point of support on said contact plate through the opening in said clamping spring and also so that the contact plate can be pivoted relative to said clamping spring.

10. A connecting terminal, as set forth in claim 1, wherein said clamping spring is U-shaped having a bight portion and a pair of legs each extending outwardly from one end of said bight portion, the bight portion of said U-shaped clamping spring forming the first part thereof intermediate its ends and the second part of said clamping spring extending from the intermediate first part to the ends of said bight portion, and each leg of said U-shaped clamping spring forming the third part thereof and having an opening therethrough arranged to receive one end of said contact plate.

11. A connecting terminal, as set forth in claim 1, wherein at least the portion of said terminal housing disposed opposite the first face of said contact plate and located adjacent to the second part of said clamping spring being formed of a flexible material so that the second part of said clamping spring can be displaced toward the first face of said contact plate whereby the contacting edge surface of the opening in the third part of said clamping spring is displaced away from the second face of said contact plate for inserting electric leads therebetween.

12. A connecting terminal, as set forth in claim 1, wherein a tongue extends inwardly from the walls of said terminal hous- ing and forms a support for said contact plate intermediate the ends thereof, and the opposite ends of said terminal housing having openings therein into which the opposite ends of said contact plate extend.

13. A connecting terminal, as set forth in claim 1, wherein the third part of said clamping spring forms an obtuse angle with the portion of the second face of said contact plate which extends through the opening in the third part and the second part of said clamping spring is disposed at an acute angle with the first face of said contact plate.

14. A connecting terminal, as set forth in claim 13, wherein the cross-sectional area of said contact plate which extends through the opening in said clamping spring has a smaller cross-sectional area than the portion of said contacting plate which extends between the opening and the point at which the first part of said clamping spring is supported on said contact plate.
15. A connecting terminal, as set forth in claim 1, wherein said contact plate is formed of an elongated metal strip bent over upon itself for at least a portion of its length, and said contact plate formed of said bent over metal strip having a first end for engagement within the opening in said clamping spring and a second end forming a connecting part such as a socket pin and the like.

16. A connecting terminal, as set forth in claim 15, wherein the bent over portion of said contact plate terminates at a point intermediate the ends thereof, and the first part of said clamping spring is inserted between and is held by the end of said bent over portion and the oppositely disposed intermediate part of said contact plate.