March 15, 1966 J. J. PHILLIPS 3,241,095

SEALED TERMINAL STRUCTURE

Filed Oct. 29, 1962

FIG. 1.

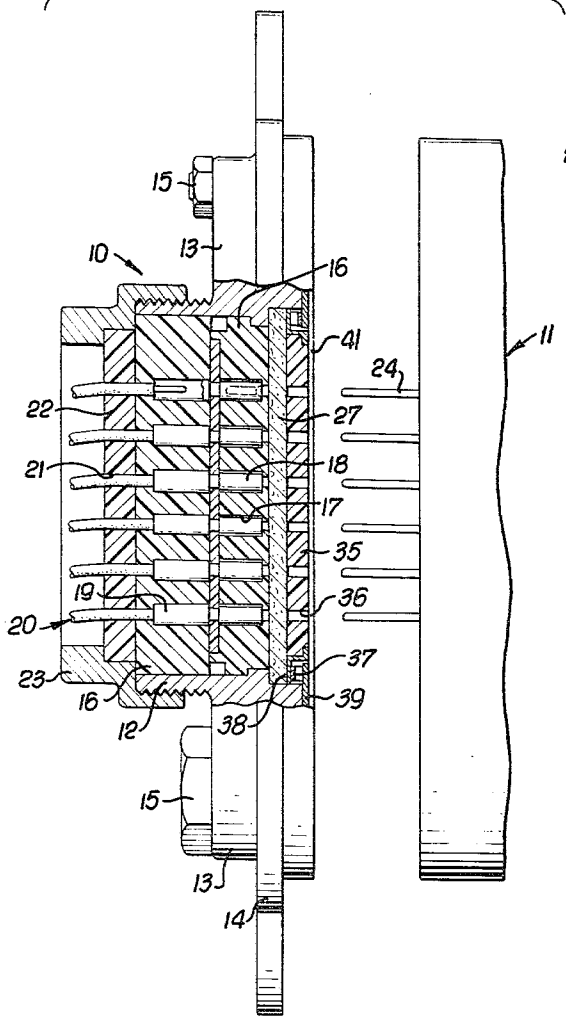


FIG. 2.

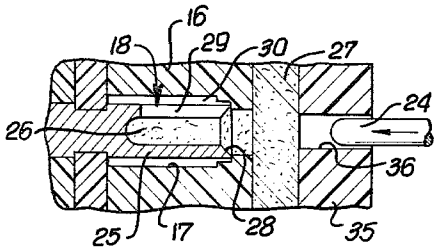


FIG. 4.

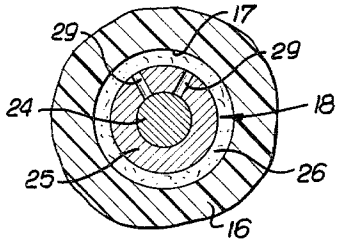


FIG. 5.

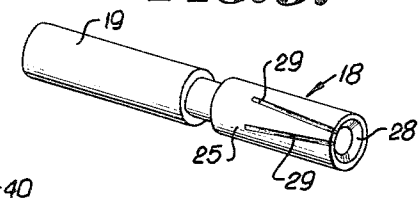
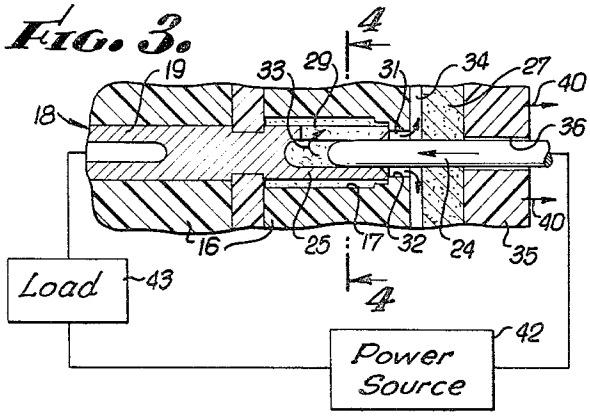


FIG. 3.



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SEALED TERMINAL STRUCTURE

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This invention relates generally to what may be characterized as sealed terminal structure, and more particularly has to do with improvements with the sealing of electrical terminal sockets at all times before, during and after terminal pins are received in the sockets, the sealing action preventing exterior fluid access to the socket and pin contact zone.

Apparatus with which the invention is concerned generally includes terminal connection members, such as plug and receptacle bodies having multiple terminal sockets and pins adapted to interfit as the plug and receptacle bodies are brought relatively together. Problems have existed in the past as respects maintaining a suitable seal preventing exterior fluid access to the pin contact areas of the socket terminals, the fluid tending to reach such areas via paths established by or during pin penetration to the sockets. For example, in underwater umbilical connection apparatus the water tends to reach the sockets when the pins are suddenly removed therefrom. Efforts have been made to overcome this problem by utilizing a sealing material over-lapping the socket entrances, and of a penetrable construction, in order that the pins might penetrate through the seal and into the sockets. While this approach is considered to have merit, an additional problem arises by virtue of the tendency of the penetrated sealing material, and particularly solid material, to be carried into the sockets and to build up therein, resisting penetration of the pins into the sockets. With repeated connection and disconnection of the terminal plug and receptacle parts, the problem becomes more critical since more and more of the sealing material builds up in the sockets.

The present invention has as its major object to overcome the problem mentioned above by means of a novel and unusual solution providing for the progressive escape of the sealing materal from the sockets as pin terminals are inserted therein, with the result that the electrical connection of the plug and receptacle bodies is found to be much more satisfactory, in that malfunctioning due to the build up of sealing material in the sockets is eliminated.

Speaking first with respect to the novel socket and sealing combination, the invention broadly contemplates the provision of sealing material at the socket entrances and into which the pin penetrates to enter the socket, the material being characterized as penetrable and flowable within the socket when the pin enters therein. Further, the socket has an exit port into which seal material may escape from within the socket interior when the pin enters therein. In addition, and as will be described in greater detail, means may be provided for confining the socket exit port in such manner that material which escapes into the port tends to return or recirculate toward the socket entrance upon repeated penetration of the pin into the socket. As to the sealing material itself, it typically includes viscous liquid in the socket, and the material may also include a confining and compressible solid or semi-solid layer overlapping the socket entrance and exposed to the liquid therein prior to penetration of the pin through the layer. As the pin enters the socket, it displaces liquid therein which then flows generally toward the socket entrance and exerts hydraulic pressure against the compressible layer for compressing the same. Typically,

means is provided to yieldably urge the layer in the general direction of pin penetration, whereby the layer and the viscous liquid are maintained in pressurized state for sealing against the pin as it is moved toward or away from the socket.

Other objects and advantages of the invention include the provision of a multiple electrical terminal pin and socket structure, the sockets having exit ports for the sealing material to prevent undesired build up thereof in the sockets, as well as the particular structural arrangement of the socket's exit ports, as related to the compressible layer and the means for pressurizing same, to secure the aforesaid advantages and results. Finally the invention contemplates the provision of a novel and highly effective electrical arc suppressor.

These and other objects and advantages of the invention, as well as the details of an illustrated embodiment will be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 is a section showing a receptacle body embedding the multiple sockets with their exit ports, and also carrying the sealing material, a detached terminal plug with terminal pins also being shown;

FIG. 2 is an enlarged sectional showing of a terminal pin advancing to penetrate a terminal socket;

FIG. 3 is a view like FIG. 2, showing a pin penetrating a socket;

FIG. 4 is an enlarged cross-section taken on line 4—4 of FIG. 3; and

FIG. 5 is a perspective view showing an electrical terminal socket provided with exit ports for sealing material.

Referring first to FIG. 1 the apparatus is shown to include receptacle means **10** and a plug **11**, which is adapted to interfit with the receptacle as the two are brought together. Typically, but not necessarily, the plug and receptacle will be separated in an underwater environment, as, for example during launching of a missile.

The receptacle includes a tubular body **12** which is flanged at **13** for connection to a panel **14** as by means of suitable connectors **15**. Contained within the body **12** is a mass of insulative material **16** which may comprise suitable potting resin. The latter contains a large number of bores **17**, each of which receives a tubular electrical terminal socket **18**, the sockets being spaced apart and extending generally parallel, as shown. Electrical connection is made to the end portions **19** of the sockets as by means of suitable connectors generally indicated at **20**. Openings **21** are provided through a back-up plate **22** for the body **16**, a retainer **23** holding the plate in position at the rearward side of the body.

In accordance with the invention, sealing material is provided at the socket entrances into which the pins **24** penetrate to enter the sockets, the material being characterized as penetrable and flowable within the sockets when the pins enter therein. As an example of such sealing material, reference is made to FIG. 2 wherein the forward portion **25** of the socket is shown to contain a viscous liquid sealing material designated at **26**, and typically comprising a silicone grease. For this purpose, the material known in the trade as DC 11, manufactured by the Dow Corning Company, has been found entirely suitable. Also, the sealing material illustrated includes a compressible layer or sheet **27** overlapping the entrances **28** of the sockets and exposed to the viscous liquid therein prior to penetration of the pin **24** through the layer and entrance of the pin into the socket. Typically, the layer **27** is of gel composition, as for example a silicone gel. For this purpose, the material known in the trade as Sylgard 51, manufactured by the Dow Corning Company, has been found entirely suitable.

Also in accordance with the invention, the sockets have exit ports into which the sealing material may escape

:om within the socket interiors when the pins enter ıerein. As one example of this, the forward portion 5 of the socket shown in FIGS. 2 through 5 is gen-rally tubular and has exit ports in the form of slots 29. hese extend lengthwise along the tubular portions from ıe socket entrance ends, the slots typically but not neces-ırily extending radially through the tubular wall to com-ıunicate with any clearance 30 between the socket and ıe bore 17. Whether or not there is such clearance 0, the exit ports do provide for escape of sealing ma-:rial from within the socket interiors when the pins enter ıerein. Typically, the exit ports communicate directly r indirectly with the zones proximate the entrances to ıe sockets, as for example the zone shown at 31 in IG. 3. One way of accomplishing this is to provide ıeans confining the socket exit ports whereby material :caping into the ports tends to flow along a path re-ırning toward the socket entrance zones upon repeated enetration of the pins into the sockets. One such means shown in FIGS. 2 and 3 to comprise that portion of ıe body 16 provided the bore 17 and the smaller bore 2 forming the zone 31.

The arrows 33 in FIG. 3 show the path of flow of the :aling material as it escapes from the socket interior ıto the exit port slot 29 and into the entrance zone 31, om which the material is then displaced outwardly into ıe region 34 adjacent the compressible layer 27. In this ınnection, the invention not only provides for escape of scous sealing material 26, but also for escape of particles the layer 27 which are broken off therefrom by the n as it penetrates therethrough. Such solid particles e carried into the socket interior, and may escape there-om as described.

The invention also includes means yieldably urging the aling material in the general direction of pin penetra-ın, for confining the sealing material as shown in FIG- and also typically pressurizing said material proximate e socket entrances. One such means is illustrated to ımprise a plate-like body 35 containing openings 36 rough which the pins 24 penetrate. One method of ıusing the plate body 35 to yieldably pressurize the seal-g material is to mount the plate as shown in FIG. 1. s illustrated, a circular wavy spring 37 is provided in e space between a ring 38 carried by the body 35 and ring 39 carried by the receptacle body 12, the spring :ing compressed between the rings to create the yield-ıle force exertion transmitted by the plate 35 to the aling means. In this connection, the plate 35 func-ons to move away from the sockets, as shown by the rows 40 in FIG. 3 during displacement of sealing ma-rial through the exit port slots 30 and into the region 34 jacent the compressible layer 27. Reference to FIG. will show that clearance is provided at 41 at the plug le of the plate 35 to receive the latter as it moves away ɔm the sockets under the displacement action of the aling material.

Finally, FIG. 3 shows a source 42 of electrical power d a load 43 connected in series circuit relation with e socket structure 18 and the pin 24. Any tendency for cing to develop during withdrawal of the pin from the cket is efficiently suppressed by the sealing means, since e compressible layer 27 closes about the nose of the ı 24 as it is retracted through the layer, by virtue of the essurization of the sealing means.

I claim:

1. In combination, an electrical terminal socket for ceiving an electrical terminal pin through the socket en end, sealing material at said open end and into which e pin penetrates to enter the socket, said material being aracterized as penetrable and flowable within the cket when the pin enters therein, the socket having an it port into which material may escape from within the cket interior when the pin enters therein, body means contain the sealing material escaping from said exit

port whereby material escaping into said port tends to flow along a path returning toward the socket entrance upon repeated penetration of the pin into the socket, and means for transmitting force in the general direction of pin penetration to pressurize said material escaping from said exit port, said material including viscous liquid in the socket and a compressible layer overlapping said entrance of the socket and exposed to the liquid therein prior to penetration of the pin through said layer and entrance of the pin into the socket, said layer being located to transmit said force to pressurize said liquid.

2. The invention as defined in claim 1 in which the socket has a generally tubular portion, said exit port being in the form of a slot extending generally lengthwise along said tubular portion and from the socket entrance.

3. The invention as defined in claim 1 in which said layer is of gel composition.

4. In combination, an electrical terminal pin, an electrical terminal socket receiving the pin through the socket entrance, sealing material at said socket entrance and penetrated by the pin, said material being characterized as penetrable and flowable within the socket when the pin enters therein, the socket having an exit port into which said material may escape from within the socket interior when the pin enters therein, and means to contain the sealing material escaping from said exit port and to transmit force in the general direction of pin penetration to pressurize said material escaping from said exit port, said last named means including a body containing an opening through which the pin penetrates and mounted for movement toward and away from said socket entrance, and said last named means including a spring exerting force acting on said body.

5. The invention as defined in claim 4 including an electrical circuit having components connected with said pin and socket for supplying sufficient voltage application thereto to create arcing which is suppressed by said material upon separation of said pin and socket.

6. In combination, a plug mounting a plurality of electrical terminal pins, a receptacle mounting a plurality of electrical terminal sockets receiving said pins through the socket entrances, sealing material at said socket entrances and penetrated by said pins, said material being characterized as penetrable and flowable, within the sockets when the pins enter therein, the socket having exit ports into which said material may escape from within the socket interiors when the pins enter therein, means to contain the sealing material escaping from said exit ports, and means including a body movable toward and away from the socket entrances and penetrated by the pins for maintaining said material pressurized during entrance of the pins into the sockets and escape of said material into said exit ports, said last named means including a yieldable element acting to transmit force exerted by said body.

7. The invention as defined in claim 6 in which said material includes viscous liquid in said sockets.

8. The invention as defined in claim 7 in which said material includes a viscous liquid confining compressible layer exposed to the liquid in the sockets during penetration of the pins through said layer and entrance of the pins into the sockets.

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