MAGNET CONTROLLED FLUID-PROOF CONNECTOR

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MAGNET CONTROLLED FLUID-PROOF CONNECTOR
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ABSTRACT OF THE DISCLOSURE
A fluid-proof connector for making electrical connections under water is provided with a magnetically responsive switch for controlling application of power to the connector in such a manner that power is only available when the connections are made and is automatically blocked from passing to the connectors whenever the connections are broken. The connector itself comprises a socket body having one or more elongated sockets for cooperation with a plug body having one or more elongated plugs. The magnetically responsive switch is preferably in the form of a reed type switch carried in the socket body. One of the plugs of the plug body includes a magnet imbedded therein in such position that it will actuate the magnetic switch in the socket only when the plug is fully inserted in the socket. Actuation of the magnetic switch by the magnet in the plug serves to close a suitable circuit so that power may then be passed between contacts in the other sockets and on the other plugs of the connector bodies. Separation of the plug from the socket will result in automatic opening of the magnetically responsive switch so that power is removed from the connectors whenever the contacts are subject to being exposed to the surrounding water.

This invention relates generally to fluid-proof connectors and more particularly to fluid-proof connectors for underwater operations of the type shown in United States Patents 2,721,727 and 3,277,424.

BACKGROUND OF THE INVENTION
Underwater connectors of the type described in the above referred to patents comprise essentially a socket body having an elongated socket for cooperation with a plug body having an elongated plug. The socket is cylindrical and the plug is correspondingly of cylindrical shape and dimensioned to fit snugly within the socket. Electrical socket contact means in the form of a ring are provided in the socket wall with exposed contact surfaces substantially flush with the socket wall. The plug in turn includes plug contacts for mating with the provided socket contact surfaces substantially flush with the cylindrical exterior surface of the plug. A fluid egress means provides communication between the rear portion of the socket and the exterior of the socket body.

With the foregoing arrangement, the plug may be inserted into the socket and urged into a fully inserted position such that water in the socket is purged through the water egress means and the respective plug and socket contact are wiped clean and dry before actually being placed into electrical engagement. The snug relationship of the elongated plug in the socket assures that the electrical contacts will be maintained in a dry and insulated condition from the surrounding water.

In using connectors of the above described type, power is never applied to the power lines connected by the connectors until the connection has been made. In other words, once the connector plug and socket bodies have been properly mated together there are no exposed contacts to the surrounding water and it is safe to apply power through the connection. However, should the plug accidentally become disengaged from the socket there would then be exposed live contacts to the water with resulting electrolytic action that could damage the conductors as well as essentially short-circuit the electrical supply.

It is also possible that when connectors are disengaged the power from a remote source might accidentally be applied resulting again in short-circuiting of the power through the water medium and pitting of the exposed contacts.

BRIEF SUMMARY OF THE INVENTION
The present invention comprises an improved fluid-proof connector similar in many respects to the connectors described in the heretofore mentioned United States patents so that all of the advantages of a fluid-proof or watertight connection is assured. In addition the present invention contemplates the provision of magnetically responsive switch means preferably imbedded in the socket body for cooperation with a permanent magnet imbedded in one of the plugs for the plug body. The positioning of the magnet in the plug is such that it will only be positioned juxtaposed the magnetically responsive switch in the socket when the plug is fully inserted in the socket. The switch itself is normally open and constitutes part of an electrical circuit controlling power to the connector. It is only possible, accordingly, for electrical power to be supplied to the connector when the magnetically responsive switch is closed and this latter condition can only obtain when the plug is fully inserted in the socket. Thus there is avoided completely the possibility of exposed live contacts to the surrounding water.

In a preferred embodiment of the invention the socket body is provided with an additional magnetically responsive switch connected in series with the first magnetically responsive switch. A second permanent magnet is mounted for manual movement on the socket body to a position remote from the additional switch to a position juxtaposed the additional switch to close the same. This control permits manual switching of the power on and off after the connectors have been connected together.

BRIEF DESCRIPTION OF THE DRAWINGS
A better understanding of the invention will be had by new referring to the accompanying drawings in which:

FIGURE 1 is a fragmentary perspective view partly schematic in form illustrating the plug and socket bodies prior to connection together designed in accord with the present invention; and,

FIGURE 2 is an enlarged cross-sectional view of the plug and socket bodies connected together and also illustrating schematically associated circuits.

Referring first to FIGURE 1, the fluid-proof connector includes a socket body 10 having at least one and preferably four elongated sockets 11, 12, 13, and 14 extending into the body from a front face. A fluid egress means communicates with the rear portions of these sockets so that water may escape from the rear portions of the sockets as indicated by the openings 15 and 16 for the sockets 11 and 12.

Normally, a source of electrical energy would be connected to the socket body since contacts within the sockets are less exposed than those on the plug and thus less liable to be manually inadvertently touched. Thus, as shown in FIGURE 1 there is provided a source 17 connected to suitable contacts within the socket body. The socket body 10 also includes a manually movable member 18 in the form of a ring-shaped element for enabling a manual switching operation to take place all as will become clearer as the description proceeds.

Referring now to the plug portion of the connector...
of FIGURE 1, this member comprises a plug body 19 including a plurality of elongated plugs 20, 21, 22, and 23 dimensioned to be received respectively in the sockets 11, 12, 13, and 14. Plug contact means are shown on each of the plugs and take the form of imbedded conductors having exposed surfaces such as indicated at 24, 25, for the plugs 20 and 21 and dual contacts 26 and 27 on the single plug 22. Each of these plug contacts have exposed surface portions substantially flush with the exterior surface of the plugs. Normally, the plug would be connected to a suitable load schematically indicated at 28 which may constitute an electrical device to be driven under water.

While multiple sockets and plugs have been illustrated, it is to be understood that the connector need only include one elongated socket and one elongated plug. In the particular example chosen, the plugs 20 and 21 and associated plug contacts 24 and 25 constitute power contacts while the plug 22 and associated contacts 26 and 27 constitute control contacts for which purpose it will become clearer as the description proceeds. The plug 23 is of smaller diameter to correspond with the smaller diameter socket 14 and serves merely to facilitate insertion of all the plugs in the respective sockets in a consistent manner.

The socket and plug bodies 10 and 19 respectively are formed of hard rubber-like material such as neoprene which constitutes an excellent electrical insulation. When the respective plugs are received in the sockets, water in the sockets will be purged out the rear egress means in the form of the openings 15 and 16 and the flush contact surfaces will be wiped clean and dry against the interior walls of the sockets.

The structure described thus far in FIGURE 1 incorporates essentially the basic features of the under-water connectors described in the heretofore referred to United States patents.

Referring now to FIGURE 2, further details of the connector of the present invention will be evident. As shown, the sockets 11 and 12 for the socket body 10 include socket contact means 29 and 30 in the form of ring conductors imbedded in the interior walls of the sockets respectively. These socket contact means have exposed surface portions substantially flush with the interior wall of the sockets and are positioned such that when the corresponding plugs 20 and 21 are fully received in the sockets, the plug contacts 24 and 25 will electrically engage the socket contacts 29 and 30.

In the particular embodiment chosen for illustrative purposes, the socket contacts 29 and 30 connect through conductors 31 and 32 through a suitable cable to relay switch contacts 33 and 34 respectively. A double pole relay switch 35 functions to connect electrical power from a source 6 to the contacts 33 and 34 upon energization of a corresponding control relay coil 35'. The relay coil 35' constitutes part of an electrical circuit which is completed upon insertion of the various plugs into the socket openings. When the relay 35' is energized, the double pole switch 35 will close on the contacts 33 and 34 to pass power through the socket contacts 29 and 30 to the plug contacts 24 and 25 and thence through conductors 37 and 38 to the load 28.

Operation of the relay coil 35' to provide power to the power contacts is effected upon insertion of the control plug 22 in the socket 13. This latter socket 13 includes socket contact means 39 and 40 imbedded in the interior wall in axially spaced positions with contact surface portions exposed and flush with this interior wall. These socket contacts are positioned to electrically engage the plug contacts 26 and 27 when the plug is fully inserted in the socket. A normally open magnetically responsive switch means such as a reed type magnetic switch 41 is imbedded in the socket body as shown and connected in series with the socket contact 39 and the conductor extending from the socket body to the relay coil 35'. An additional normally open magnetically responsive switch means 42 is also provided within the socket body and is connected in series with the switch 41 as shown.

A permanent magnet 43 is completely imbedded in the nose portion of the plug 22 in a position to be juxtaposed the switch 41 when the plug 22 is fully received in the socket 13. The presence of this magnet 43 will close the contacts of switch 41. A second magnet 44 is carried in the movable ring member 18 on the socket body in such a manner as to be positionally manually adjacent to the additional magnetic responsive switch 42 such that when in the position illustrated in FIGURE 2, the switch contacts for the switch 42 will be closed.

The plug contacts 26 and 27 are internally connected as shown so that a complete circuit is provided to the relay coil 35' when the switches 41 and 42 are closed through the medium of the socket contact 39, plug contact 26, plug contact 27, and socket contact 40. It will be clear that de-energization of the relay coil 35' can be effected by rotating the ring member 18 to remove the magnet 44 from a position close to the additional magnetically responsive switch 42 thus causing this switch to open and breaking the series circuit. A key flange 45 is provided to permit rotation of the member 18 and yet lock this member against axial movement.

OPERATION

In operation, assume that the connector socket and plug bodies 10 and 19 of FIGURE 1 are under water and that the plug body is connected to a load 28 as shown.

With reference to FIGURE 2, with the plugs removed from the sockets, the magnetically responsive switch 41 will be open since the magnet 43 in the nose of the plug 22 is removed from any position adjacent to the switch.

Normally, the additional magnetically responsive switch 42 would be in open condition. It being assumed that the ring member 18 has been rotated to a position to remove the presence of the magnet 44.

Under the foregoing conditions, the relay coil 35' which may be at the surface is de-energized so that the double pole switch 35 is open as shown and no power from the source 6 is passed to the socket contacts 29 and 30. It will be evident accordingly that when the plug and socket bodies are disconnected, there are no live exposed contacts under water.

When a connection is now made by inserting the plugs into the sockets, the close dimentioning of the structure is such that any water in the sockets will be purged out of the rear egress openings 15 and 16 so that the various exposed contact surfaces are wiped clean and dry. With particular reference to FIGURE 2 as the plugs are moved into the sockets, the magnet 43 will be positioned closer to the magnetically responsive switch 41. It is possible that these switch contacts might close prior to complete insertion of the plug. On the other hand, should these contacts close there will still not be provided any power unless the ring member 18 has been manually rotated to position the magnet 44 adjacent to the additional magnetically responsive switch 42 to close its contacts. Even then, no circuit will be complete unless the plug 22 has been inserted a sufficient distance that the plug contacts 26 and 27 engage electrically the ring contacts 39 and 40. Since the various plugs are parallel to each other for reception in the parallel sockets, the plugs must simultaneously be received in the sockets and the positioning of the plug contacts is such that the principal plug contacts 24 and 25 with the socket contacts 29 and 30 will take place before or at the same time as the plug contacts 26 and 27 engage the socket contacts 39 and 40. Only under these conditions and after the ring member 18 has been manually rotated to position the magnet 44 adjacent to the additional magnetically responsive switch 42 will a circuit be completed to the relay coil 35' so that energy from the battery 50 will energize this coil. At this time, the double pole switch 35
will close on the contacts 33 and 34 and supply electrical energy from the source 36 to the principal socket contacts 29 and 30 and thus the plug contacts 24 and 25. This electrical energy will then be passed to the load 28 through the leads 37 and 38.

Should the plug inadvertently be removed from the socket, it will be immediately evident that as soon as the control plug contacts 26 and 27 disengage electrically the socket contacts 39 and 40, the circuit to the relay coil 35 will be broken so that the double pole switch 35 will open thus removing power to the socket body. Also, the circuit will be broken upon removal of the magnet 43 from the vicinity of the magnetic reed switch 41. Finally, power may be manually removed by rotating the ring 18.

The purpose for the circuit through the plug contacts 26 and 27 and corresponding ring contacts 39 and 40 is to provide a further safety feature in the event that the magnetically responsive switches should stick in closed positions. Thus even if these switches should not open upon removal of the influencing magnets, the circuit will still automatically be broken upon removal of the plug from the socket. It is thus possible for any live contacts to be exposed to the surrounding fluid medium.

The manual magnetic control in the form of the ring 18, of course, may be manually operated while the plug and sockets are engaged to provide a simple switch for switching power on and off to the load.

From the foregoing description, it will be evident that the present invention has provided a greatly improved fluid-proof connector wherein the various advantages of underwater type connectors described in the heretofore mentioned United States patents are fully realized along with the additional advantages of safety afforded by the magnetically activated switch arrangement.

While the invention has been described with respect to underwater operations, it is to be understood that the principles are applicable to connectors used in any fluid environment such as explosive gases and the like.

What is claimed:

1. A magnet controlled fluid-proof connector comprising:
   (a) a socket body having at least one elongated socket incorporating a socket contact;
   (b) a plug body having at least one elongated plug incorporating a plug contact in a position to electrically engage said socket contact when said plug is received in said socket;
   (c) a conductor extending from said socket body;
   (d) a normally open magnetically responsive switch means in said socket body connected in series between said socket contact and conductors; and
   (e) a magnet imbedded in said plug in a position to close said magnetically responsive switch means only when said plug is fully inserted in said socket and said plug contact is in engagement with said socket contact whereby an electrical circuit is completed between said conductor and plug contact and broken between said conductor and plug contact when said plug is removed from said socket.

2. A magnet control fluid-proof connector comprising, in combination:
   (a) a socket body having at least one elongated socket;
   (b) at least one socket contact means imbedded in a wall portion of said socket with a contact surface in substantially flush relationship with said wall;
   (c) a conductor extending from said socket body;
   (d) at least one normally open magnetically responsive switch means in said socket body adjacent to said socket contact connected in series between said socket contact and said conductor;
   (e) a plug body having at least one elongated plug dimensioned to be received in said socket; and
   (f) at least one plug contact means imbedded in said plug and having an exposed contact surface inter-
wall and in which said first elongated plug includes a plug contact means imbedded therein with an exposed contact surface substantially flush with the exterior surface of said plug, said socket contact means and plug contact means being connected in series with said magnetically responsive switch means and electrical circuit means such that said source of energy is only passed to said one of said contacts when the first elongated socket contact is electrically engaged with the first elongated plug contact and said magnetically responsive switch means is closed.

7. The subject matter of claim 6 in which said electrical circuit means includes a relay circuit for connecting said source to said one of said contacts.