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FLUID CONDUCTOR AND TAKE-OFF APPARATUS

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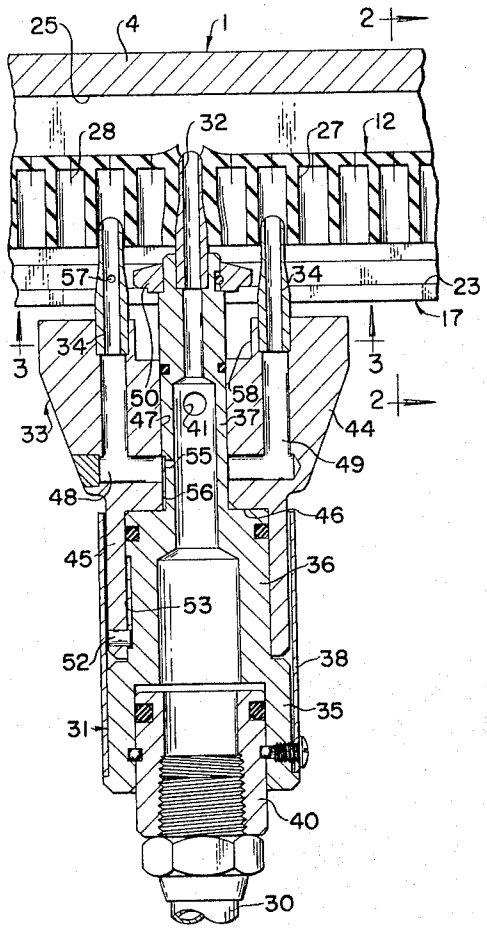

FIG. 1

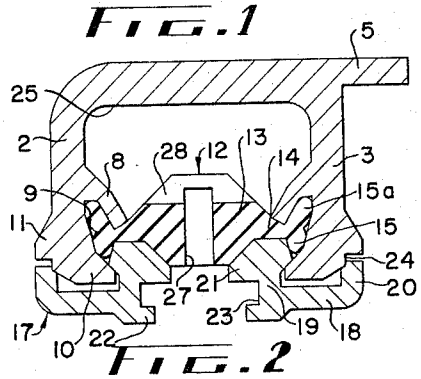

FIG. 2

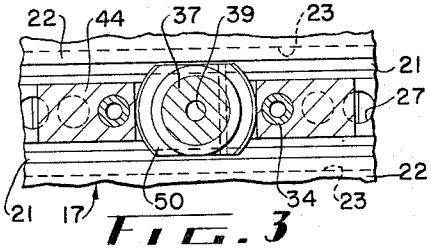

FIG. 3

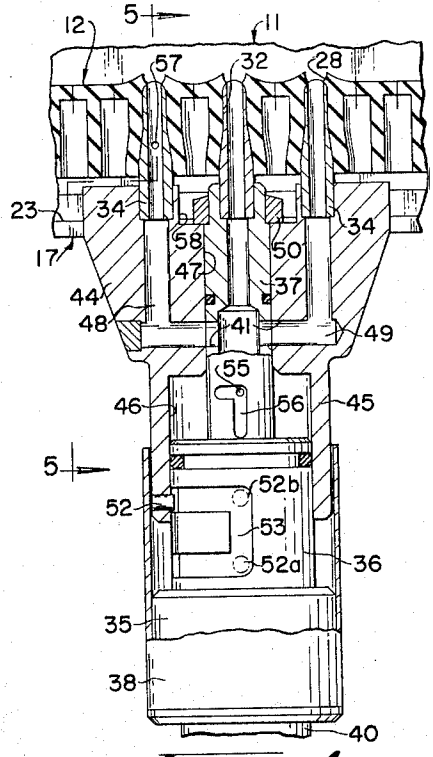

FIG. 4

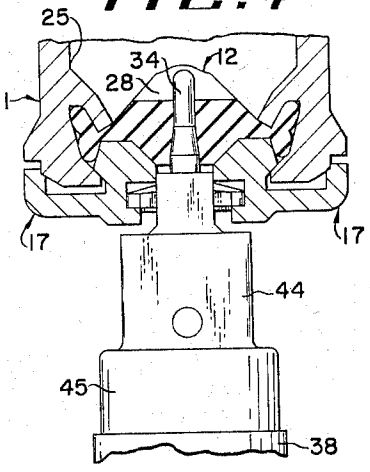

FIG. 5

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FLUID CONDUCTOR AND TAKE-OFF APPARATUS

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This invention relates to a fluid conductor and take-off apparatus of the kind adapted to deliver pressure fluid to fluid operated tools and the like; and, more particularly, the invention relates to a plug-in, take-off device for use with a pressure fluid conduit which may be tapped at any point along its length.

An object of this invention is to provide a plug-in take-off device for a fluid conductor which is easily inserted into and locked to the conductor.

Another object of this invention is to provide a plug-in take-off device for a fluid conductor having power assist means for fully inserting the device into the fluid conductor.

A further object of this invention is to provide a plug-in take-off device for insertion through normally closed openings in the wall of a fluid conductor.

A still further object of this invention is to provide a plug-in take-off device for insertion through normally closed openings in the resilient wall of a pressure fluid conductor, the take-off device having a single probe to be inserted manually and having power assist means for inserting additional probes.

A still further object of this invention is to provide an elongated fluid conductor having longitudinally spaced, normally sealed openings along the length thereof, and a plug-in take-off device having power assist means for fully coupling the device to the fluid conductor.

The novel features of the invention, as well as additional objects and advantages thereof, will be understood more fully from the following description when read in connection with the accompanying drawings in which:

FIG. 1 is a longitudinal sectional view of a fluid conduit and of a plug-in take-off device, with the take-off device partially inserted in the conduit;

FIG. 2 is a transverse sectional view of the conduit, taken along the line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a longitudinal sectional view, similar to FIG. 1, showing the take-off device fully inserted into the conduit; and

FIG. 5 is a view of the plug-in device looking along the conduit.

Referring particularly to FIGS. 1 and 2 of the drawings, one form of fluid conduit for use with the present invention comprises an elongated, metal, generally C-shaped three-sided housing or body **1** having a pair of generally parallel side walls **2** and **3** that are joined together by a transverse wall **4**. The wall **4** defines a projecting flange **5**, through which may be provided suitable holes for the purpose of securing the housing **1** to a mounting wall or work bench. Each of the inner surfaces of the walls **2** and **3** is provided with a laterally projecting, downwardly inclined rib **8**, which is longitudinally grooved to form a pocket or recess **9** terminating adjacent the open side of the housing in a lip **10**. Each of the walls **2** and **3** is also provided with an external, laterally extending rib **11** for a purpose which will be explained subsequently.

The open side of the C-shaped housing **1** is normally closed by a deformable wall member **12** formed of a resilient, flexible substance such as rubber or rubberlike material, defining the fourth side of the conduit. The

wall **12** is coextensive in length with the housing **1**, and has a relatively thick center section **13**. From each side of the section **13** extends a relatively thin section **14**, terminating at is free edge in an enlargement comprising a generally cylindrical bead **15** and an integral rib **15***a*. Inasmuch as the sections **14** are thinner than the central section **13**, the sections **14** are more flexible than the central section. The over-all width of the wall **12** is such as to enable the beads and ribs **15**, **15***a* to be received in the respective groves **9** with little, if any, distortion of the sections **14**.

Retainer strips **17** are provided for removably retaining each of the side edges of the wall **12** and its associated groove **9**. Each retainer strip comprises a generally channel shaped member having a web **18** and sides **19** and **20**. The side **19** terminates in an enlarged head **21**, which seats on the lip **10** of the associated housing wall, and includes an external rib **22** defined by an extension of the web **18** where the side **19** is joined to the web, the head **21** and rib **22** defining a groove **23**. The side **20** engages a shoulder **24** formed on the adjacent wall **2** or **3** to lock the retainer strip to the housing. The rib **11** provides a bearing surface for a prying tool which may be used to disengage the retainer strip side **20** from the shoulder **24**. When the retainer strips **17** are locked in place in the position shown, the beads and ribs **15** and **15***a* are securely held within the respective recesses **9** of the housing **1** so as to preclude inadvertent separation of the wall **12** from the housing **1**. The confronting walls **19** are spaced apart to permit engagement of the wall section **13** by a take-off device yet to be described, the confronting grooves **23** providing means for locking a take-off device to the conduit as will be described.

When the deformable wall **12** is secured to the housing in the manner described, there is defined an elongated conduit which may be closed at its opposite ends by suitable sealing walls (not shown), the interior of the conduit defining a closed chamber **25** in which pressure fluid such as air may be maintained under pressure. One of the end walls may be provided with a suitable fitting for connecting the conduit to a source of pressure fluid. The pressure of fluid in the chamber **25** tends to force the wall **12** outwardly of the housing so as to maintain the central portion **13** in snug engagement between and against the heads **21** of the retainer strips **17**; and the outer sides of the wall section **13** taper and converge toward one another complemental to the adjacent surfaces of the heads **21** so that the pressure of the fluid in the chamber wedges the wall against the heads **21**. The tapering sides of the wall section **13** cooperate with the beads and ribs **15**, **15***a* to prevent displacement of the wall **12** from the housing, and the beads and ribs seal the open side of the housing to prevent the escape of fluid between the member **12** and the housing. Both the outer and inner surfaces of the central part **13** of the wall **12** are flat, as is best shown in FIG. 2.

Extending inwardly from the outer surface of the wall section **13** is a plurality of longitudinally and equally spaced ports or bores **27** that are open externally, but which terminate short of the chamber **25**. The section **13** of the deformable wall is provided with a plurality of longitudinally spaced transverse slits **28** each of which extends from the inner surface of the wall section **13** toward the outer surface thereof; and the slits are so located with respect to the bores **27** that each slit communicates with a corresponding bore. Each slit is of such depth as to intersect the adjacent bore, but terminates short of the exposed or outer face of the center section. The wall portions on opposite sides of each slit normally abut each other to seal the slits and prevent loss of fluid therethrough; and each of the slits **28**, with its as-

sociated bore 27, defines a valved opening from the conduit chamber 25.

As shown in the drawings a plug-in fluid take-off device, according to the present invention, is in the form of a plug adapted for connection to one end of a flexible supply hose 30 for a pneumatic tool, and which may be inserted into the above described conduit at any point along its length. The plug comprises generally an inner body 31 having a single probe 32, and an outer body 33 having two probes 34, the outer body partially enclosing the inner body. The inner body 31 is made up of three cylindrical portions separated by transverse shoulders; these portions consisting of a relatively large diameter head 35 at the rearward end of the body, an intermediate diameter piston 36, and a forwardly projecting stem 37. The probe 32, which is a tubular member, extends forwardly from the stem 37 and is rigidly fixed thereto. A sleeve 38 is fixed on the head 35, by means of suitable screws for example, and extends forwardly over the piston 36 to define an annular space between the piston and the sleeve. The body 31 is provided with an axial passage 39 which extends from the forward end of the stem, communicating with the probe 32, and opening to a rearward facing recess in the head 35 within which is rotatably mounted a swivel coupling 40. The swivel coupling is sealed relative to the recess by means of a suitable O-ring, and is provided with a rearward threaded opening for receiving a fitting for the hose 30. Two oppositely directed radial ports 41 are provided in the stem 37, communicating the axial passage 39 with the exterior of the stem.

The outer body 33 comprises a forward foot 44 which is generally rectangular in cross section, and to which two forwardly extending probes 34 are rigidly secured. The probes 34 are identical to the center probe 32; and the structure and function of these probes will be referred to subsequently in greater detail. The extreme forward end of the foot 44 is reduced in width, as best seen in FIGS. 3 and 5, so that it may be received between the retainer strips 17 of the conduit. The body 33 also includes a rearwardly extending cylindrical wall 45 which defines a cylinder chamber 46 for the piston 36 of the body 31. A bore 47 extends forwardly from the cylinder chamber 46, through the foot 44, to accommodate the stem 37. The foot is provided with two L-shaped passages 48 and 49 which extend rearwardly from respective probes 34, then transversely inwardly opening to the bore 47.

Each of the probes 32 and 34 is a tubular member having a smaller external diameter at its forward end and a larger external diameter at its rearward or base end where it is secured to the stem 37 or the foot 44. The diameter at the forward end is slightly less than the diameter of a bore 27, and the forward tip is rounded for ease of insertion into the bore. The diameter at the rearward end is slightly greater than the diameter of a bore 27, providing for a tight fit between the probe and the wall of the bore, when the probe is fully inserted, to prevent leakage of pressure fluid therebetween.

When the inner and outer bodies 31 and 33 are assembled together, as shown in the drawings, the stem 37 is received within the bore 47, the piston 36 is received within the cylinder chamber 46, and the cylinder wall 45 is received within the annular space between the piston and the sleeve 38. The sleeve 38, then, defines an extension of the head 35 to provide an enlarged gripping surface for the plug. The center probe 32 is disposed between, and in line with, the probes 34; and the center-to-center distance between the adjacent probes of the plug is twice the center-to-center distance between adjacent bores 27 of the deformable wall 12 of the conduit. A locking cam 50 is affixed to the forward end of the stem 37 for longitudinal and rotational movement therewith, the probe 32 extending forwardly of the cam 50. As best seen in FIGS. 1 and 3, the cam has flatted sides so that it

may be received between the ribs 22 of the retainer strips 17; and the cam may then be rotated to engage the grooves 23 to lock the plug to the conduit, as will be described presently. The bodies 31 and 33 are movable both rotationally and axially relative to each other; and both the relative rotational movement and the relative axial movement are limited by a pin 52 fixed to the cylinder wall 45 and extending inwardly therefrom to coact with a rectangular groove 53 provided in the cylindrical wall of the piston 36, as best shown in FIGS. 1 and 4. The pin and groove permit 90° of relative rotation.

In FIG. 1 the plug is shown in condition for manual insertion into the conduit. The bodies 31 and 33 are collapsed axially, the piston 36 being fully received within the cylinder chamber 46, and the center probe 32 extending forwardly beyond the outer probes 34. The body 31 is rotated to its counterclockwise limit, relative to the body 33, as viewed from the rearward end of the plug. In this relative condition of the inner and outer bodies, the pin 52 occupies the position 52*a* relative to the groove 53, shown in phantom in FIG. 4. The cam 50 is then positioned so that its flat sides lie parallel to the plane defined by the three probes, as seen in FIG. 3. With the operator then gripping the plug at the sleeve 38, the plug is partially inserted into the conduit, as shown in FIG. 1, the plug being oriented relative to the conduit so that the probes 32 and 34 enter certain of the bores 27 of the deformable wall 12. The center probe 32 is inserted into a bore 27 by the operator to a point where the adjacent wall portions of the associated slit 28 are separated to provide communication between the conduit chamber 25 and the axial passage 39 of the body 31. The penetration of the probe 32 into the bore is limited by engagement of the cam 50 with the heads 21 of the retainer strips 17, the cam then being positioned for locking engagement with the grooves 23.

As soon as the passage 39 is communicated with the conduit chamber 25, the hose 30 and a tool connected thereto are subject to conduit pressure, and pressure fluid is directed to the cylinder chamber 46 through a radial port 55 which opens to an L-shaped groove 56 in the exterior wall of the stem 37. The longitudinally extending leg of the L-shaped groove 56 extends rearwardly to the shoulder between the stem 37 and the piston 36 and, therefore, communicates with the cylinder chamber 46. When the chamber 46 is pressurized, the piston 36 will be urged relatively out of the chamber to effect axial extension of the bodies 31 and 33. It is desired to prevent this until the locking cam 50 has been securely locked in the conduit grooves 23, in order to prevent withdrawal of the center probe 32. Therefore, a vent path from the cylinder chamber 46 is provided by the L-shaped passage 48, in the foot 44, one end of which now communicates with the L-shaped groove 56 and the other end of which is vented to atmosphere through its associated probe 34 which is not yet fully inserted into a bore 27. Additionally, the associated probe 34 is provided with a radially opening port 57.

In order to lock the body 31 to the conduit, the outer body 31 is rotated to its clockwise limiting position, relative to the inner body 33; and the bodies now have the relative rotational positions shown in FIG. 4. The locking cam 50 has now been rotated 90° from the position shown in FIGS. 1 and 3, and is securely locked in the conduit grooves 23, as best shown in FIG. 5, to prevent further axial movement of the body 31 relative to the conduit. In the relative axial condition of the bodies shown in FIG. 1, the lateral leg of the L-shaped groove 56 lies in the same transverse plane as the lateral leg of the L-shaped passage 48; therefore, during the greater portion of the above mentioned rotation, the groove 56 remains in communication with the passage 48 to maintain the above described vent path to atmosphere. However, before the body 31 reaches the limit of rotation relative to the body 33 and after the cam 50 is well locked into the

grooves 23, the groove 56 is rotated out of communication with the passage 48, as best shown in FIG. 4, and the vent path from the cylinder chamber 46 is now closed.

Pressure fluid directed to the chamber 46 now acts to effect relative axial extension of the bodies; and the body 33 is therefore urged forwardly to fully engage the probes 34 is respective bore 27, the probes 34 separating the adjacent wall portions of the associated slits 28 to provide communication between the conduit chamber 25 and the foot passages 48 and 49. The bodies 31 and 33 have now assumed the relative axial and rotational condition shown in FIG. 4, the lateral legs of the foot passages 48 and 49 having now moved into alignment with the radial ports 41 of the stem 37 to communicate the foot passages with the axial passage 39. All three probes 32 and 34 are now effective to communicate the conduit chamber 25 with the passage 39 and, therefore, with a pressure fluid actuated tool connected to the take-off device.

In order to withdraw the plug from the conduit, the body 31 is first rotated to its counterclockwise limiting position, thereby rotating the locking cam to the position shown in FIGS. 1 and 3 (the pin 52 moving to the position 52*b* shown in phantom in FIG. 4). The plug may then be manually withdrawn from the conduit.

With the conduit and plug-in device described above, despite the fact that the components may be designed for ease of insertion of the plug into the conduit, it will be seen that it may be difficult to force the probes of the plug into the conduit. This will be particularly true where the conduit includes a resilient wall and valved openings of the type described herein, considering further that the pressure of fluid in the conduit is opposing any penetration of the conduit. It will further be recognized that it may be desirable to provide many more probes for a single plug; and this would be determined partially by the size of the probes and partially by the volume of pressure fluid desired to be taken from the conduit. Of course, the resistance to penetration would be increased both by increased size of probes and increased number of probes. The principal feature of the plug-in device of the present invention is that it is only required to manually insert a single probe into the conduit; and the plug has built in power assist means to then insert the other probes, regardless of size or number.

What is claimed is:

1. A plug-in take-off device for a fluid conductor comprising:
- a first body having a probe for insertion into a conductor;
- a second body having at least one additional probe for insertion into a conductor; said probe having fluid passage means therein;
- means mounting said bodies for limited movement relative to each other; fluid actuated means defined by said bodies for effecting said relative movement in one direction;
- and means communicating said fluid actuated means with said probe of said first body whereby, when the probe is inserted into a fluid conductor, fluid from the conductor is directed to said fluid actuated means to move said second body to insert its associated probe into the conductor; and outlet means from said probes.

2. A plug-in take-off device for a fluid conductor comprising:
- a first body having a probe for insertion into a conductor;
- a second body mounted on said first body for limited movement relative thereto; said second body having at least one additional probe for insertion into a conductor, extending in the direction of said probe of said first body;
- fluid actuated means defined by said bodies for effecting movement of said second body in a direction to extend its additional probes;
- and means communicating said fluid actuated means with said probe of said first body.

3. The plug-in take-off device set forth in claim 2 including means for latching said first body to the conductor.

4. The plug-in take-off device set forth in claim 3 including valve means for controlling the flow of fluid from said probe of said first body to said fluid actuated means; and said valve means being actuated in responsive to the actuation of said latching means.

5. A plug-in take-off device for a fluid conductor comprising:
- a first body having a single tubular probe at one end, for insertion into a conductor, and means defining an outlet opening; passage means communicating said probe and said outlet opening; means for securing said first body to the conductor;
- a second body mounted for longitudinal movement relative to said first body, having at least one additional tubular probe at one end extending in the direction of the probe of said first body; passage means in said second body communicating with said additional probe;
- fluid actuated means defined by said bodies for effecting said movement of said second body in a direction to insert its associated probe into a conductor; means communicating said fluid actuated means with said passage means in said first body; and said passage means in said first and second bodies being communicated with each other when said probe of said second body is inserted into a conductor.

6. A plug-in take-off device for a fluid conductor comprising:
- a first body having a single hollow probe at one end for insertion into a fluid conductor, and means defining an outlet opening at the other end; passage means in said first body connecting said probe and said outlet means;
- means on said first body, adjacent to said probe, for latching said body to the conductor;
- a second body mounted on said first body for limited longitudinal movement relative thereto; said second body having a foot at one end carrying additional hollow probes for insertion into the conductor; said additional probes extending in a direction parallel to said single probe;
- piston and cylinder means defined by said bodies, respectively, for effecting movement of said second body in a direction to extend said additional probes; and means communicating said cylinders means with said passage means in said first body to direct fluid to said cylinder and piston means, when said probe of said first body is inserted into the conductor.

7. The plug-in take off-device set forth in claim 6 including valve means for controlling the flow of fluid to said cylinder and piston means.

8. The plug-in take-off device set forth in claim 6:
- wherein said second body is mounted on said first body for limited rotational movement relative thereto;
- wherein said latching means comprises a member engageable with the conductor in one relative rotational condition of said bodies;
- and said bodies defining a vent for said piston and said cylinder means; said vent being closed in said one relative rotational condition of said bodies.

9. A plug-in take-off device for a pressure fluid conductor comprising:
- a first body having fluid passage means therein; a single probe at the forward end of said body for insertion into a conductor to communicate the conductor chamber with said fluid passage means; means in said body defining a fluid outlet opening communicating with said passage means;
- a second body mounted on said first body for limited

longitudinal movement relative thereto between rearward and forward positions; fluid passage means in said second body; a plurality of probes at the forward end of said second body for insertion into a conductor to communicate the conductor chamber with said fluid passage means; said probes of said second body lying rearward of the probe of said first body in said rearward position;

fluid actuated means defined by said bodies for moving said second body from said rearward position to said forward position, wherein said probes lie side by side; means communicating said fluid actuated means with said fluid passage means in said first body; and said fluid passage means in said first and second bodies communicating with each other in said forward position.

10. The plug-in take-off device set forth in claim **9**:

wherein said fluid actuated means is in constant communication with said fluid passage means in said first body;

including means defining a vent for said fluid actuated means open when said second body is in said rearward position; and means for closing said vent when said second body is in said rearward position to effect the movement to said forward position.

11. The plug-in take-off device set forth in claim **9**:

including latching means mounted at the forward end of said first body for latching engagement with a conductor upon rotation thereof relative to the conductor; said first body being mounted for limited rotational movement relative to said second body between latching and unlatching positions;

said bodies defining a rotary valve for controlling the flow of fluid to said fluid actuated means; and said valve being controlled by the rotational movements of said bodies between said latching and unlatching positions.

12. The plug-in take-off device set forth in claim **11**:

wherein said fluid actuated means is in constant communication with said fluid passage in said first body;

wherein said first and second bodies define a vent for said fluid actuated means in said rearward and unlatching positions; wherein said vent is closed when said first body is rotated to said latching position to effect the operation of said fluid actuated means;

and said vent defining said rotary valve.

13. In a fluid conductor and take-off system:

an elongated fluid conductor having longitudinally equally spaced, normally closed ports in one wall thereof, communicating with the conductor chamber;

a plug-in take-off device comprising first and second bodies, said second body being mounted on said first body for limited movement between rearward and forward positions; a hollow probe mounted at the forward end of said first body and at least one hollow probe mounted at the forward end of said second body, for insertion into said conductor ports to open said ports; said probes of said second body lying to the rear of said probe of said first body in said rearward position;

said first body having fluid passage means therein communicating with its associated probe, and an outlet opening communicating with said fluid passage; said second body having fluid passage means therein communicating with its associated probes;

fluid actuated means defined by said bodies for urging said second body from said rearward position to said forward position, to position all of said probes in side by side relation; means communicating said fluid actuated means with said passage means in said first body;

and said passage means in said first and second bodies being communicated with each other when said second body is in said forward position, to communicate all of said probes with said outlet openings.

14. The fluid conductor and take-off system as set forth in claim **13**:

wherein said conductor comprises an elongated, rigid, generally C-shaped, housing and a wall formed of resilient deformable material;

and wherein each of said ports comprises a bore extending from the outer face of said wall but terminating short of the inner face thereof, and a transverse slit extending from the inner face of said wall at least to the point of termination of the bore; the wall portions on either side of said slit normally abutting each other to seal the port and adpated to be separated by one of said probes to open the port.

15. A fluid conductor and take-off system as set forth in claim **13**:

wherein said conductor comprises an elongated, rigid, generally C-shaped, housing and a wall formed of resilient deformable material; said conductor ports being disposed in said resilient wall; said housing defining confronting grooves disposed on either side of said resilient wall;

cam means, mounted at the forward end of said first body, formed to be received between said confronting grooves of said housing and to be rotated into locking engagement with said confronting grooves; said first body being mounted for limited rotational movement relative to said second body.

16. The fluid conductor and take-off system set forth in claim **15**:

wherein said first body is mounted for rotational movement between unlocking and locking positions;

and said first and second bodies defining rotary valve means for controlling the flow of fluid to said fluid actuated means; said valve means being operative to prevent tthe actuation of said fluid actuated means in said unlocking position, and to effect the actuation.

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