United States Patent

[11] 3,583,424

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[45] Patented **June 8, 1971**

[54] **CONDUIT SYSTEM**
10 Claims, 20 Drawing Figs.

[52] **U.S. Cl.** **138/156,** 138/166, 138/168
[51] **Int. Cl.** **D03d 49/24**
[50] **Field of Search** 138/1, 156, 169

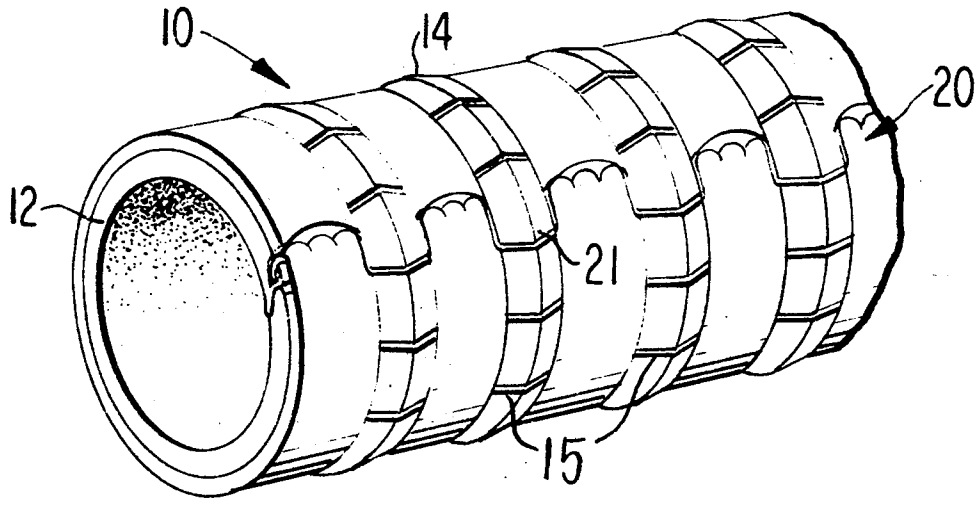
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Primary Examiner—Henry S. Jaudon
Attorney—Jones and Thomas

ABSTRACT: A conduit system comprising a conduit openable along its length, from either of its ends, or intermediate its ends. The conduit includes an outer body or shell fabricated of substantially inelastic metal, and an inner flexible liner. The conduit defines a seam along its length, and the seam sections are connectable together by means of spaced hook members integrally connected to the body portion of one seam section and each projecting into an opening defined adjacent the opposite seam section. The outer body includes annular corrugations spaced along its length and the corrugations are serrated to enable the outer body to bend.



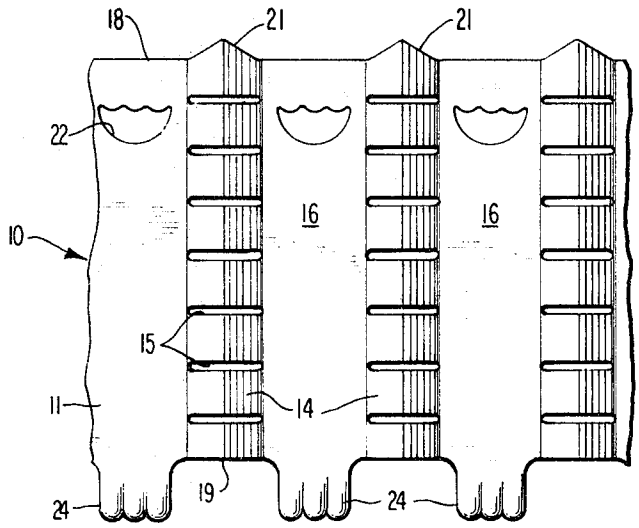


FIG. 1

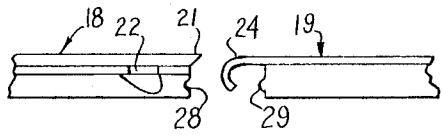


FIG. 4

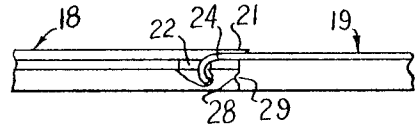


FIG. 5

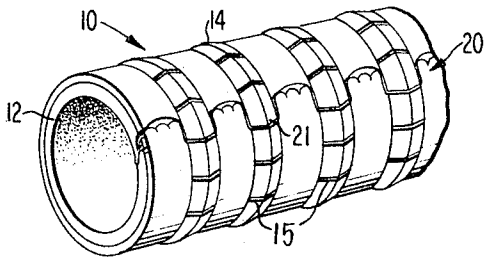


FIG. 2

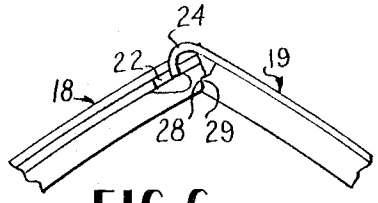


FIG. 6

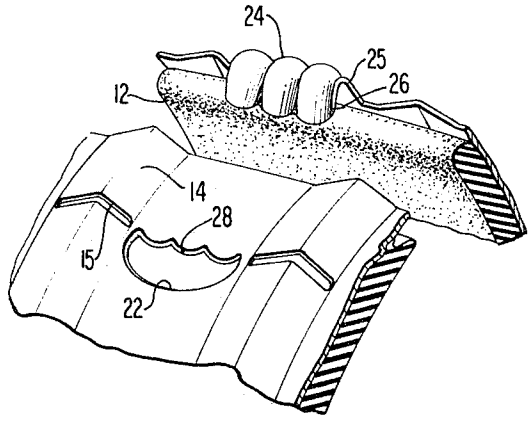


FIG. 3

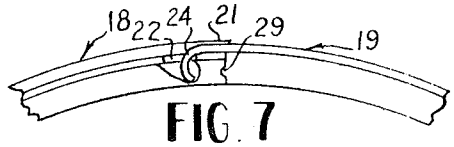


FIG. 7

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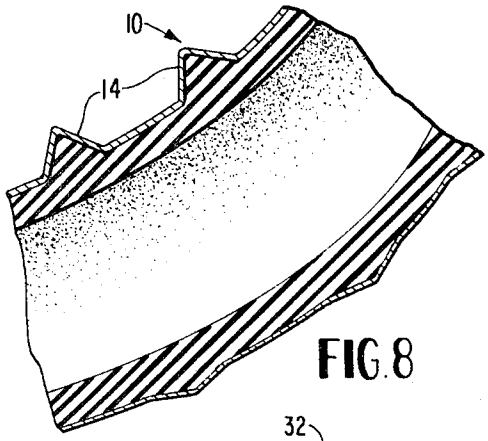


FIG. 8

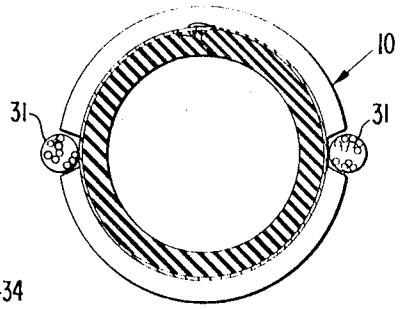


FIG. 9

FIG. 10

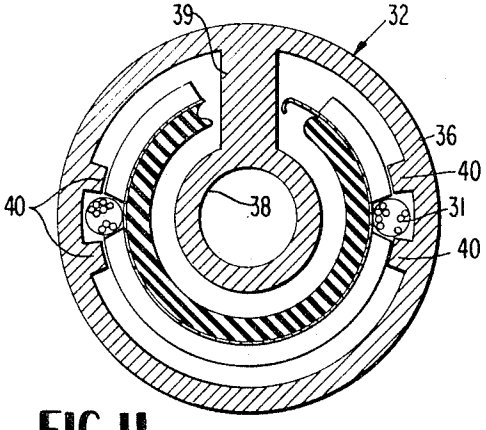


FIG. 11

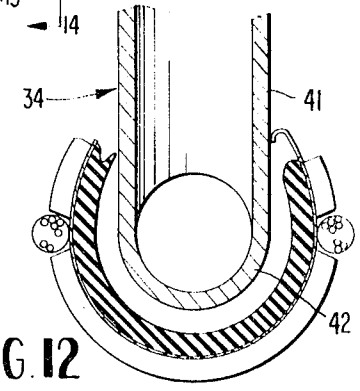


FIG. 12

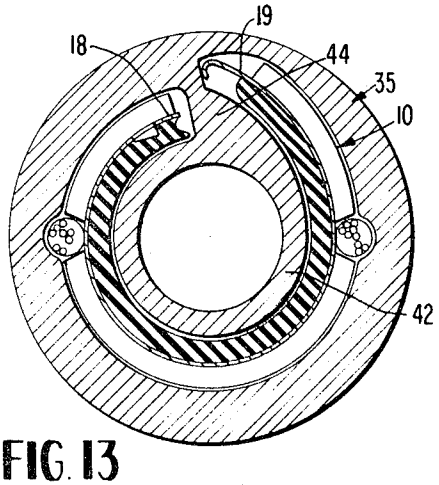


FIG. 13

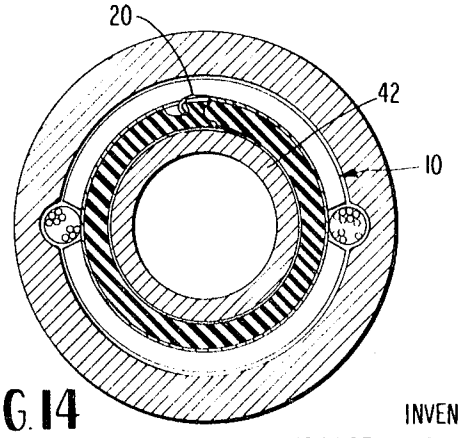


FIG. 14

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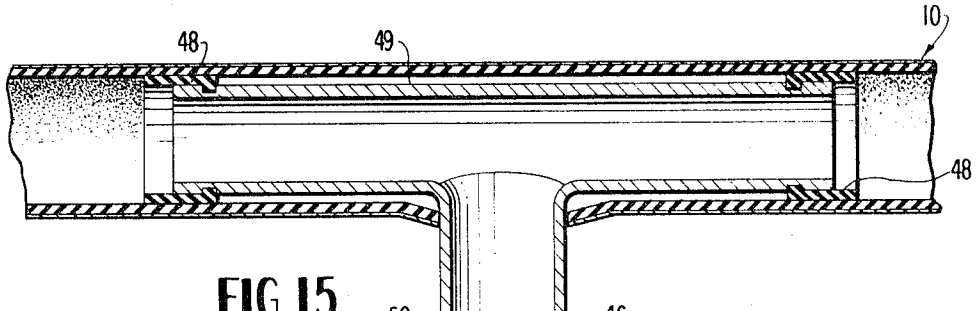


FIG. 15

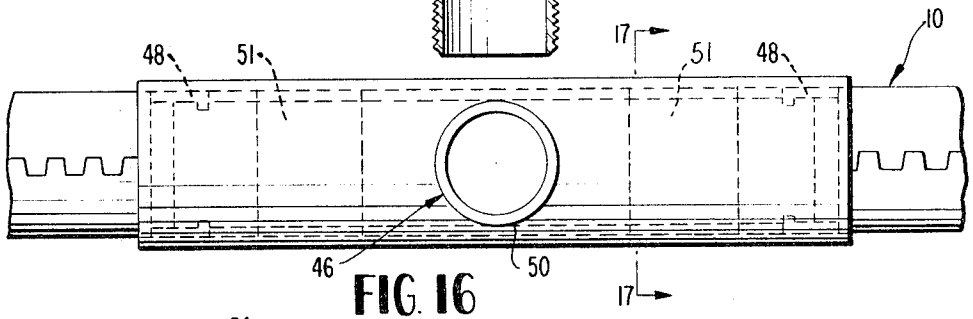


FIG. 16

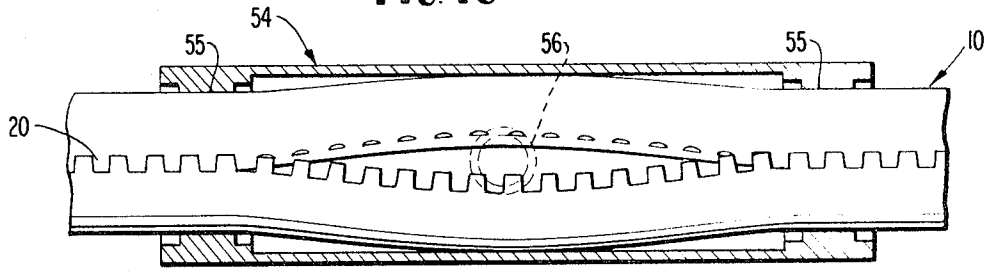


FIG. 18

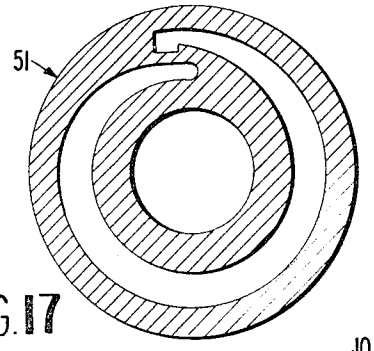


FIG. 17

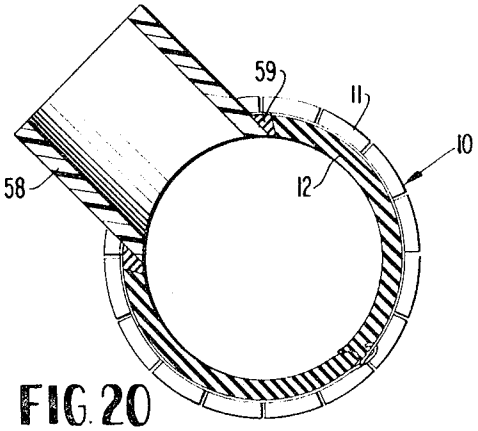


FIG. 20

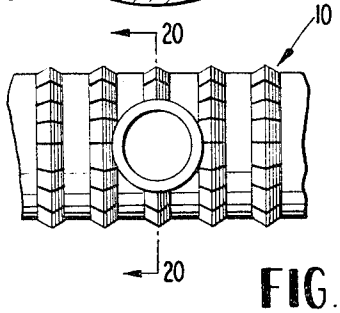


FIG. 19

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CONDUIT SYSTEM

BACKGROUND OF THE INVENTION

Conduits presently is use for irrigation and other purposes are difficult to handle and operate because of their bulkiness and weight, and when a conduit reaches a certain size or length, it cannot be dragged by pulling from one end without danger of damaging the conduit and destroying its fluid tight integrity.

With regard to irrigation, one of the more popular usages of flexible conduits is to extend a conduit and a tow wire from a source of water, and connect the conduit and tow wire to a self-propelled sprinkler trolley. When the conduit is charged with water pressure, the sprinkler sprays the water out from the trolley and the trolley reels in or walks up the tow cable, dragging the conduit behind it. Of course, as the trolley gets closer to the source of water, it drags more and more conduit behind it. The weight of the conduit and the water present in the conduit creates a significant drag on the trolley, tow cable, and the portion of the conduit which has turned to follow the trolley. After a predetermined amount of conduit has turned to follow the trolley, the conduit will rupture. Thus, the length of conduit usable with the trolley and tow cable arrangement is limited.

The trolley and tow cable arrangement is also limited in its irrigating functions in that the trolley must walk up the tow cable directly toward the origin of the tow cable, without turning corners or otherwise changing direction. Of course, this arrangement is ineffective when the trolley is to move along the rows of a crop that have been curved in accordance with the contour of the land. Furthermore, when the conduit is turned to follow the cart, its turning space is usually large, which limits its use to open spaces usually wider than the spaces between rows of crops.

In some instances it is desirable to connect a second conduit to a main conduit at an interval between its ends. Unless the main conduit has an auxiliary outlet connection placed at a convenient location along its length, the second conduit cannot be connected to the main conduit without virtually destroying the main conduit.

SUMMARY OF THE INVENTION

Briefly described, the present invention comprises a conduit system for irrigation, fluid handling, and other purposes. The conduit includes an openable seam which can be progressively opened from either end of the conduit, or can be opened at a point intermediate the ends of the conduit. Means are provided for supplying or withdrawing fluid from the conduit at one of its ends and progressively opening the conduit without interrupting the flow of fluid through the conduit and reeling in the opened portion of the conduit.

Thus, it is an object of this invention to provide a conduit system which is openable along its length from either end, or from virtually any point along its length.

Another object of this invention is to provide a conduit system for irrigation and other purposes which includes a fluid tight seal extending along its length which can be opened, as desired, at any position along its length.

Another object of this invention is to provide a conduit system with means of supplying or withdrawing liquid from the conduit from either end of the conduit while reeling in or playing out additional lengths of conduit without interrupting the flow of fluid through the conduit.

Another object of this invention is to provide means for connecting a first conduit to a second conduit, means for charging the conduits with fluid, and means for moving the first conduit along the length of the second conduit without interrupting the flow of fluid through the conduits.

Another object of this invention is to provide a conduit which is openable along the length and dimensionally stable both longitudinally and diametrically, yet is flexible along its length.

Other objects, features and advantages of the present invention will become apparent upon reading the following specification, when taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view of the conduit in its opened condition.

FIG. 2 is a perspective illustration of the conduit in its closed condition.

FIG. 3 is a detailed showing of the seam latching mechanism.

FIG. 4, 5 and 6 are progressive schematic illustrations of the latching mechanism, showing the manner in which the latching mechanism is connected.

FIG. 7 is an illustration similar to FIG. 6, but showing the configuration of the conduit when fluid pressure is applied.

FIG. 8 is a longitudinal cross-sectional illustration of a portion of the conduit, showing the manner in which the conduit bends along its length.

FIG. 9 is a lateral cross-sectional illustration of the conduit, taken transversely of the longitudinal axis of the conduit.

FIG. 10 is a side view of the conduit, showing the manner in which the conduit is converted from its flat configuration to its tubular configuration and charged with fluid; with portions of the figure being shown in cross section and in dashed lines for clarity.

FIG. 11 is a cross-sectional view of the tube former, taken along lines 11–11 of FIG. 10.

FIG. 12 is a cross-sectional view of the fluid charging pipe, taken along lines 12–12 of FIG. 10.

FIG. 13 is a cross-sectional view of the conduit closing mechanism, taken along lines 13–13 of FIG. 10.

FIG. 14 is a cross-sectional view of the conduit closing mechanism taken along lines 14–14 of FIG. 10.

FIG. 15 is a cross-sectional view of the conduit and its fluid extracting device.

FIG. 16 is a side view of the conduit and a fluid extracting device which includes conduit opening devices.

FIG. 17 is a cross-sectional view of the fluid extracting device, taken along the lines 17–17 of FIG. 16.

FIG. 18 is a cross-sectional view of a modified fluid extracting device.

FIG. 19 is a side view of the conduit, showing the construction of a permanently connected branch connection in the conduit.

FIG. 20 is a cross-sectional view of the conduit and its branch connection, taken along lines 20–20 of FIG. 19.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing in more detail, in which like numerals indicate like parts throughout the several views, FIG. 1 shows a portion of conduit 10 in its open, flat configuration. Conduit 10 includes shell or body portion 11 and liner 12 (FIG. 2). Body 11 is fabricated from a inelastic semirigid material, such as spring steel, while liner 12 is fabricated of a fluid impervious flexible material such as neoprene. Body 11 is corrugated at spaced intervals along its length, and corrugations 14 extend laterally the length of conduit 10, from one side to the other side of body portion 11. Corrugations 14 are externally convex, and each corrugation 14 is serrated by a series of slits 15 which extend transversely of each corrugation 14, generally parallel to the longitudinal axis of conduit 10. The arrangement of corrugations 14 and its serrations 15 is such that a relatively inflexible strip 16 is positioned between adjacent ones of corrugations 14, and corrugations 14 render body portion 11 flexible along its length.

The opposite edges 18 and 19 of body portion 11 together with the adjacent opposite edges of liner 12 form seam strips which are connectable together to form seam 20 (FIG. 2) of the conduit when in its closed configuration. Seam strip 18 includes protrusions 21 at space intervals along its length at the end of each corrugation 14. Each protrusion 21 extends

beyond the margin of the edge of body portion 11, and is peaked because of corrugation 14. Latch openings 22 are spaced inwardly from seam strip or edge 18, and are positioned in each of the inflexible strips 18, between corrugations 14. Hooks or latches 24 protrude from seam section or edge 19, and mate with latch openings 22. As is shown in FIG. 3, each latch 24 includes shank 25 and connecting tab 26. Shank 25 extends generally parallel to the surface of body portion 11, while connecting tab 26 is bent inwardly and back toward the inner portion of conduit 10. Shank 25 and connecting tab 26 are fluted to increase their strength characteristics. Each latch opening 22 has its bearing surface 28 shaped to match the convolutions of latches 24.

As is shown in FIGS. 4—7, conduit 10 is formed into a tubular configuration by latching together seam strips 18 and 19. Body portion 11 is urged into a concave configuration so that hooks 24 move toward their respective latch openings 22. Hooks 24 are extended up over the edge of the opposite seam strip 18, while protrusions 21 of seam strip 18 are moved up over the edge of seam strip 19. The connecting tab of each hook 24 is then moved into its latch opening 22. During this movement conduit 10 will have been compressed into a configuration where its seam strips 18 and 19 remain substantially flat and parallel to each other while the remaining portion of the conduit assumes a concave configuration. After hooks 24 are received in their respective latch openings 22, conduit 10 will be released, and its natural elasticity will cause it to assume a substantially rounded tubular configuration, but with the seams possibly forming a ridge or peak along the length of the conduit as shown in FIG. 6. When in this configuration, the elastic liner 12 will be pressed together at its seam strips. Also, when fluid pressure is applied internally of the conduit, the conduit will assume a circular cross-sectional configuration, as shown in FIG. 7, and liner 12 will remain pressed together at its seam strips to a substantial extent.

As is shown in FIGS. 4—7, liner 12 defines a concave groove 28 along the edge of seam strip 18, and a convex mating rib 29 along its edge at seam strip 19. Rib 19 is moved into groove 28 as seam 20 is formed, to create a fluid tight seam along the lengths of conduit 10.

As is best shown in FIG. 8, conduit 10 is flexible along its length when it is in tubular form. While the material from which body 11 is fabricated normally would be rather inflexible when in exact tubular form, corregations 14 and their serrations 15 render conduit 10 flexible or bendable along its longitudinal axis. When conduit 10 is bent, the corrugations on the inside of the bend tend to contract, while the corrugations on the outside of the bend tend to expand. With this arrangement the conduit can be bent without significant distortion in the material of body portion 11.

As is shown in FIG. 9, conduit 10 can be constructed with supporting cables 31 connected thereto and extending along its length, Cables 31 can be brazed to the inflexible strips 16 between adjacent corrugations 14, and the portions of corrugations 14 adjacent cables 31 can be removed, if necessary, to accommodate cables 31. While cables 31 may render conduit 10 less flexible, conduit 10 retains some of its ability to bend around cables 31 since cables 31 are made from woven rod and are contractable, and conduits 10 retain virtually all of their ability to bend with cables 31. Also, cables 31 are quite useful in handling and positioning conduit 10, and inhibit the longitudinal stretching or elongation of conduit 10.

As is best shown in FIG. 10, conduit 10 is transformed from its flat configuration of FIG. 1 to its tubular configuration of FIG. 2 by means of tube former 32, supply pipe 34, and closing device 35. The tube former, supply pipe and closing device are integrally connected to each other to form a unitary mechanism; however, FIG. 10 shows these elements in unconnected spaced relationship for clarity.

Tube former 32 is tubular, and as shown in FIG. 11 includes shell 36, core 38, and connecting leg 39. Core 38 can be solid or tubular as shown, and connecting leg 39 suspends core 38 in a generally concentric relationship with shell 36. Guide ribs 40 are spaced from each other on opposite sides of the internal surface of shell 36, to guide cables 31 through tube former 32. Conduit 10 enters tube former 32 in a generally flat configuration and is guided into a crescent configuration as is shown in FIG. 11, with ribs 40 being positioned on opposite sides of cables 31. Conduit 10 is still open as it emerges from tube former 32, and passes about normal leg 41 of supply pipe 34. Parallel leg 42 of supply pipe 34 extends along the length of conduit 10, and beyond closing device 35 (FIG. 12). Closing device 35 surrounds parallel leg 42, and is connected to parallel leg 42 by means of zipper connection 44 (FIG. 13). Zipper connection 44 is shaped to guide seam sections 18 and 19 of conduit 10 into closed relationship with a zipper-cam movement, so that seam section 18 and 19 move toward each other and are connected with each other in the motion as illustrated in FIGS. 4, 5 and 6. As is shown in FIG. 14, when conduit 10 reaches the end of closing device 35, seam 20 has been formed. Parallel leg 42 of supply pipe 34 extends beyond closing device 35 (FIG. 10), and flexible sealing sleeve 45 is connected to the end of parallel leg 42 and flares into contact with the inside surface of conduit 10. Sealing seam 45 forms a sliding seal with conduit 10 which is virtually fluid impervious.

As is shown in FIG. 15, conduit 10 can be opened at a point intermediate its ends, and liquid extractor 46 inserted to form a T connection with the conduit, Liquid extractor 46 comprises a T-shaped tube with a diameter less than the diameter of conduit 10, and sealing sleeves 48 are connected to the head 49 of the T-shaped tube. Center leg 50 projects through the open seam of conduit 10, and is threaded for connection to an auxiliary conduit. With this arrangement, the fluid pressure within conduit 10 will be blocked from the open portion of the seam of the conduit by means of sealing sleeves 48, and extractor 46 will function to allow fluid to flow through conduit 10 as usual, and also to flow through a branch connection.

As is shown in FIG. 16, extractor 46 can be combined with conduit seam closing devices, so that extractor 46 can be moved longitudinally of conduit 10 without interrupting communication through conduit 10 or with the secondary conduit connected to extractor 46. Closing devices 51 (FIG. 17) are positioned adjacent center leg 50 of the extractor 46, while sealing sleeves 48 are placed beyond the closing devices. With this arrangement, the extractor can be moved longitudinally with conduit 10, and one closing device 51 will function to open conduit 10, while the following closing device 51 will function to close conduit 10, which creates a moving opening along the length of the conduit through which center leg 56 can project. Of course, sealing sleeves 48 maintain a sliding seal with the internal surface of conduct 10, so that the fluid integrity of conduit 10 will not be interrupted.

FIG. 18 shows a modified extractor 54 which does not utilize the internal tube of the T-shaped extractor 46. Extractor 54 is clamped onto conduit 10 after an opening has been made in seam 20 and before fluid pressure has been applied to the conduit, and annular seals 55 of extractor 54 sealingly engage the external surface of conduit 10 on opposite sides of the opening therein. Branch conduit connection 56 extends away from extractor 54, so that when conduit 10 is charged with fluid, the fluid is free to flow through the opening formed in seam 20 and into branch connection 56 of extractor 54.

As is shown in FIGS. 19 and 20, a permanent branch connection can be made to conduit 10. A circular opening is made in body 11 and liner 12. Branch conduit 58 is inserted through the aligned openings, and sealing pad 59 is inserted over branch conduit 58 and inserted between body portion 11 and liner 12. Sealing pad 59 is connected to branch conduit 58, body portion 11 and liner 12 by means of an adhesive, to form a fluid tight connection. Branch conduit 58 can be fabricated of a flexible, deformable material, such as plastic or rubber, or can be fabricated of a more rigid material, such as iron or steel. With this arrangement, conduit 10 is still openable along its length and can be stored in a flat, opened configuration, without also storing the internal space normally defined within a tubular conduit.

While body portion 11 has been illustrated as being generally flat when opened along its length, it may be desirable to form the body portion in a generally concave configuration with the seam sections turned slightly up to facilitate the forming of the body portion into its tubular form.

OPERATION

Conduit 10 can be transformed from flat configuration (FIG. 1) to tubular configuration (FIG. 2), or vice versa, by manual means, or by passing the conduit through a closing device of the types shown in FIGS. 10, 13, or 17. After conduit 10 has been formed in a tubular configuration, it can be opened at any point intermediate its ends by merely disengaging one or more of its latches 24 from a latch opening 22. Conduit 10 can be continuously charged with fluid pressure as it is being formed, by the apparatus shown in FIG. 10, or a branch conduit can be connected to conduit 10 and moved along the length of conduit 10 without destroying fluid communication between the conduits, as shown in FIGS. 15—18.

While body portion or shell 11 of conduit 10 has been disclosed as being fabricated of spring steel, it should be understood that various other materials may be utilized. Body portion 11 should be of such strength characteristic so that it is able to withstand large internal pressures, and occasional external abrasions, etc. It should be noted that latches 24 are of unitary construction with body portion 11, so that both latches, latch openings 22, and body portion 11 can be fabricated from a single piece of material. Furthermore, latches 24 form and extension of body portion 11, and are positioned at the ends of relatively inflexible circular strips 16, which function to place a series of semirigid bands around liner 12 along the length of conduit 10. While any tubular structure is normally inflexible along its longitudinal axis, corrugations or crimps 14 and their respective serrations 15 render conduit 10 flexible or bendable along its length, as shown in FIG. 8. When conduit 10 is bent, the corrugations in the bent portion will deflect or expand and contract, with the portions of the corrugations on the inside of the bend tending to contract and portions of the corrugations on the outside of the bend tending to expand.

Protrusions 21 spaced along seam section 18 at the end of each corrugation 14 overlap the opposite seam section to assure a positive latching function of latches 24. It is virtually impossible to destroy the integrity of seam 20 by pressing on or adjacent seam section 18, since protrusions 21 are supported by the opposite seam section 19. Thus, even when conduit 10 is not charged with fluid pressure, its tubular or circular configuration will be assured.

In the event that an extremely low pressure is experienced within conduit 10 that would normally tend to collapse the conduit, a slight collapse of the conduit will be tolerated until the seam strips become parallel with each other, as shown in FIG. 5, whereupon air can leak through the seal into the conduit. When internal pressure is regained, the conduit will assume its pressurized position (FIG. 7), whereupon the seam sections are in positive contact with each other and seal the conduit.

The unused portion of the conduit can be stored in its opened, flat condition, so that the dead interior volume and the liquid carried thereby do not occupy storage area. The open conduit can be stored on a reel and transported in this compact convenient arrangement, and played out, formed as a tube and used as desired.

At this point, it should be apparent that a conduit system is disclosed which is highly useful and versatile for irrigation and other purposes. The conduit can be opened along its length for storage purposes so that the area normally defined within a tubular conduit and the liquid confined therein does not also have to be stored, and only the length of conduit which is desired to be used must be used. Many and various other advantages should be apparent in the disclosed structure.

While the conduit has been disclosed as being used for irrigation purposes, it should be understood that virtually any fluid or semifluid materials can be transported by the conduit, including pulpwood slurries, chalk slurries, coal slurries, dust, gases, etc. The conduit can be used as a fire hose, irrigation hose, as an industrial hose, and in various other conditions. While latches 24 and latch openings 22 have been disclosed as being of unitary construction with shell 11, it should be obvious that these elements can be fabricated separately and fastened to shell 11 by rivets or by welding, etc. Also, the latches utilized can be a spring locking latch, and the conduit can be formed with two seams if desired. Furthermore, when conduit 10 is to be utilized to carry acid or abrasive materials, liner 12 can be coated with a material which resists the deleterious effect of the materials.

The liner may be subject to more rapid wear than the shell or body portion, depending upon the type materials transported by the conduit and various other conditions. Since the liner is attached to the inner surface of body portion 11 by an adhesive, it is possible to remove a worn liner and replace it with a new one.

The structure of body portion 11 is such that it retains diametrical dimensional stability, and cables 31 assure longitudinal dimensional stability, while the conduit retains its ability to bend along its length and to open or close, as may be desired. The seam construction is such that each hook operates individually, and the series of hooks do not form a rigid spine, but remain substantially as flexible as the rest of the conduit.

The construction of the conduit is such that only the amount of conduit desired for a particular job need be extended from the source to the point of delivery, and the remaining unused portion of the conduit remains stored on a reel or similar storage device. The conduit can be reeled in or out while fluid is flowing through it or while it is empty. It will be obvious to those skilled in the art that many other variations may be made in the embodiments chosen for the purpose of illustrating the present invention without departing from the scope thereof as defined by the appended claims.

I claim:

1. A fluid flow device comprising an elongated sheet of material including mating interlocking seams along its opposite longitudinal edges, said sheet of material being deformable laterally of its length to permit said seams to move into and out of abutting interlocking relationship with each other to form said sheet of material into a tube, said sheet of material being shaped to deform along its length when in its tubular configuration to permit said tube to bend along its length, and including a layer of fluid impervious sealing material bonded to its inner surface.

2. The invention of claim 1 wherein said the tube formed by said sheet of material includes generally annular corrugations spaced along its length, and connecting means adjacent said seam strips and intermediate said corrugations for holding said seam strips in abutting relationship.

3. A fluid flow conduit for flowing pressurized fluid comprising a tubular outer body fabricated from a relatively rigid material and a tubular inner sealing liner attached to the inner surface of said outer body and fabricated from a relatively flexible fluid impervious material, said outer body and inner sealing liner defining a seam extending along the length of said conduit which includes mating seam sections constructed and arranged to connect with and disconnect from each other and close or open said conduit along its length.

4. The fluid flow conduit of claim 3 and wherein one of said seam sections includes a series of spaced hook members, and the other of said seam sections includes a series of spaced openings sized and positioned to receive said hook members.

5. The fluid flow conduit of claim 4 and wherein said outer body is formed with a series of externally protruding corrugations extending generally transverse to the length of said conduit and spaced along the length of said conduit at intervals between said spaced hook members.

6. The fluid flow conduit of claim 3 and wherein said outer body is fabricated of spring steel and one of said seam sections includes a plurality of spaced hooks integrally formed with said outer body and extending beyond the edge of said inner sealing liner, and the other of said seam sections defines a plurality of spaced openings sized and positioned to receive said hooks, said inner sealing liner extending over and closing said spaced openings on the inner surface of said conduit.

7. A fluid flow conduit for flowing pressurized fluids comprising an outer rigidifying body and a pliable inner liner, separable seam extending along the length of said conduit for opening and closing said conduit along its length, said seam being constructed and arranged to maintain the edges of the outer rigidifying body in abutment with each other and the edges of said pliable liner at said seam in abutting, generally sealed relationship with each other when said conduit is closed along its length.

8. The fluid conduit of claim 7 and wherein said outer rigidifying body comprises an elongated sheet including interlocking longitudinal edges, and a series of spaced convex corrugations formed in said sheet and extending laterally across the length of said sheet.

9. The fluid flow conduit of claim 7 and further characterized by said convex corrugations each defining a series of spaced slots therein extending across the length of said corrugations.

10. The fluid flow conduit of claim 7 and further including a cable connected to and extending along the length of said outer rigidifying body.