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(54) **Title:** AN IRRIGATION SYSTEM, METHOD AND MANUFACTURING PLAN

(57) **Abstract:** The present invention relates to an irrigation system, comprising at least one tubular conduit means, that has a thin wall, such that it is capable of being essentially flattened, connectable to a water passage into it from a water source such that water entrance into it results in its widening into a configuration that is not essentially flat. The system further comprises: a plurality of connector components located along the length of said tubular conduit means and protruding from its external surface area that are adapted to selectively enable anchoring of irrigation extensions into them, in a manner that enables connecting said irrigation extensions for allowing water entrance into them from said tubular conduit means; a connector assembly, that enables connecting said tubular conduit means in series with an at least one additional such tubular conduit means; and wherein said irrigation system is characterized by that said connector assembly enables a face to face connection of a portion of said tubular conduit means wall with another portion of said additional tubular conduit means wall in order to seal said connection against leakage of water.

An Irrigation System, Method and Manufacturing Plan

Field of the Invention

The present invention relates to the agricultural irrigation systems in general, and to the field of agricultural irrigation systems operating at low pressures in particular.

Background of the Invention

Even nowadays, the majority of cultivated agricultural areas world wide that require irrigation, are irrigated using traditional irrigation methods. Such methods, for example, are based on using open aqueducts (ditches) and relying on the gravitational forces to lead and deliver the water unto the areas being cultivated in order to flooding them, or alternatively have the water flow to the furrows.

By its nature, such an irrigation method is an extremely wasteful one, considering the large quantities of water that is lost as a result of both evaporation on the one hand and seeping into the ground on the other hand. This traditional method is also responsible for on going and accumulating damage done to the (agricultural) soil as a result of erosion and flooding, and to environmental pollution (i. e., contamination) by the runoff water that many times is saturated with fertilizers and chemical substances.

In the recent years, a substantial increase of using pipe means as the conduit for the water flow has evolved. These pipes are of relatively large diameters and made of relatively very thin walls, such that has a capability of being essentially flattened – rolled for "traveling" (being transported) if desired, and amenable to be coupled with a water source, so that when water enters into them, it results in a change of the inner cross section of this water conduit means, such that they are no longer "essentially flat" as it was when no water was flowing in them.

Such tubular conduits means, known in the professional jargon of this discipline as "lay flat poly-pipes", are a relatively low cost substitute that is deployed in the field instead of using the cited main irrigation ditches in the gravitational flooding irrigation infrastructure.

For transportation, these tubes are rolled into a small volume, cylindrically shaped. The farmer punctures (makes holes) in the conduit means at selected "appropriate locations" along the length of the deployed poly- pipe walls, enabling water shedding to flood the furrows

along the conduit, or – in more advanced implementations, the farmer connects anchoring means to the wall of the pipe – at appropriately selected locations along its length, points that enable controlled water exit flow from them – or pulls – from these points – watering extensions (for example – dripper tubes, that are fed by the water of the lay flat poly – pipe).

Let us stress that irrigation pipes of the lay flat poly-pipes type, are required to be essentially low cost, simple and user friendly – as they are intended to serve the specific agricultural sector that cannot cope with acquiring and using advanced and expensive irrigation systems.

Irrigation systems based on the lay flat poly-pipe deployed piping have to be easy and fast for assembling and spreading in the field. As per the aspect of their compatibility with the ground topography, they should be versatile and fit its associated features (as this property dictates the capability of exploiting the gravitational forces to lead and deliver the water through the pipe), as well as the ability to employ it for supplying the water to the various required locations that – it is to be remembered, their whereabouts relative to the pipe are most times given in advance, namely the area to be watered and its topography (for example - furrows that already exist in the field, such as up to this time were watered using the "old" infrastructure of open ditches).

Moreover, a system based on the lay flat poly-pipes must also be compatible with other already existing equipment and infrastructure in the field, such as e.g. the water supply source, water pumps and the like.

In addition, the system have to be modular in their design, in a manner that would – as said, enable their deployment in accordance with the topography of the ground (i. e., compatibility) and renders them the potential of being easily expanded and upgraded in the future by adding more components.

Thus for example, stemming from the above cited modularity aspect, a typical agricultural irrigation system based on the deployment of lay flat poly-pipes network should be required to enable the connection of the water conduit means in series to an additional water conduit means in a manner that increases, when necessary, the length of the conduit means already in use, as well as to enable at times variations in the direction of water flow by means of branch extensions, various angles and etc.

Patent application GR 2000100422 describes a connector assembly fit to be used with a lay flat poly-pipes system that includes two floating nuts (see ibid, the components that were

designated 2) that tighten the ends of the pipes towards a bridging bushing (the components designated 3), by screwing them on the thread formed on the circumference of the bridging bushing.

Consider another system, one that is dubbed *LPS*™ (commercial name) and that appears at the internet address: WWW.netafim.com wherein use is made of adjustable metal clasps in order to fasten and clasp the walls of the pipes towards an adapting component that bridges between them (sometimes while "bridging" over the mismatch between the differences in the diameters of the pipes).

Any professional experienced in this field would understand that we are referring to assemblies of various connectors that are complicated in their structure, bulky and clumsy when it comes to operation and maintenance.

One additional example – as per the aspect of being able to obtain from agricultural irrigation systems that are based on employing a lay flat poly type pipe water conduit means - a water flow to various sites whose location in relation to the pipe is dictated in advance -

Patent application GR 2000100422 describes a connection of a rigid thread bracket to the wall of a lay flat poly type pipe by inserting the bracket from the outside inwards (using a rotational movement). Unto such a thread connector's bracket it is possible to connect irrigation extensions – for example a dripper's pipe. Patent US 6871880 also describes a structure of a rigid adapter that is – as the previous cited one, amenable to being installed on the wall of a lay flat pipe in order to enable connection of an irrigation extension to it. Patent application WO 0206681 also describes a rigid bracket that enables the connection of an extension to the wall of a lay flat pipe.

Any professional experienced in this field would understand that such brackets and connectors are fit, essentially, for an external installation on the walls of the lay flat pipes that have relatively thick walls, but would not necessarily fit for being installed on the walls of thin walled pipes of the lay flat poly pipe type.

Any professional experienced in this field would understand as well that, in these publications, complex solutions are described, solutions that demand a high degree of expertise from the farmer. The farmer is required to punch holes in the pipes in the field, in some of the cases, even when the pipe is filled up with water, and to install there, as said, brackets that are – all of them, composed from a relatively large number of parts – that as said, might require in some cases that they would be installed under a flow of rapid flowing

water from the pipe. After they have been installed, the rigid brackets are left so that they protrude from the walls of the pipes, hence lower and hamper the possibility of rolling the pipes to a roll amenable for easy handling and transporting.

Patent application US 2004222321 describes a low pressure irrigation system based on the recognized lay flat poly-pipe that is manufactured from an opaque material that reflects the sun radiation – thus limiting the temperature of the water flowing in it, hence reducing the phenomena of microorganisms and algae growth inside the conduit means. Also in the system described in the latter patent application, the farmer is the one that has to punch holes in the pipes in the field at the locations in which he intends to use for obtaining water from the pipe, and to insert, himself, the bracket components unto which he would eventually connect the irrigation extensions.

On the other hand, patent application WO 2005084418 describes an irrigation pipe such that along its length there are embedded, in advance, a number of connector means that are adapted for the connection unto them of irrigation extension means, and they were formed, as said, at the walls of the pipe in an integral manner during the process of its manufacturing (by extrusion or by forming a flat sheet that is later folded into a cylindrical profile).

Any professional in this field would understand that this solution is not different in its essence from the known technology from days yore, of manufacturing integral drip emitters pipes. That technology requires restoring to the use of a complicated and synchronized manufacturing array, synchronized because it is necessary to provide rigid components to be embedded at the correct instant and place – on the inner wall of the flexible pipe and during the continuous process of it being manufactured (by extrusion, for example). Before – they were drippers and in the patent application being discussed now the reference is to the rigid connectors. As per the connector component itself (for example - a nut) that is being integrally embedded in the wall of the pipe, it does not impart any advantages to the farmer, explicitly: if the connector means is damaged, it becomes impossible to attach an irrigation extension to it.

All that, and more: in the common configuration, in which the pipe is made of polyethylene material, it would be expected that the connectors (such as threaded nuts), that – in accordance with the application that is being considered herein, would be integrally mounted on the wall of the pipe – will also be made of polyethylene (because designing it from a different material would prevent optimal recycling of the system). Under these

circumstances, any professional in this field would understand that a threaded connector formed from polyethylene is prone to "creeping phenomena" - as time passes and thus in the long run there exists the danger of loosing the sealing of the connector (as the nut and bolt polyethylene made coupling is prone to be partially released).

Thus, prior to the current invention, the irrigation systems based on lay flat type tubular conduit pipes, were subject to noticeable drawbacks. The connector assemblies used for connecting the pipes in series one to the other were complex, non reliable and not user friendly (both for assembling and in operation). Similarly, connector components used to connect extensions such as watering links were intricate and complicated for assembling on the pipe's wall or such that did not impart advantages to the user in case of failures.

Summary of the Invention

The present invention constitutes a complete and innovative irrigation system, based on using a lay flat type pipe that overcomes the drawbacks of existing systems as were pointed out above. The invention presented herein after will be described in terms of applications referring to agricultural irrigation with water. However, it is obvious that the invention is not restricted solely to this field, but rather the invention is also applicable to different implementations of the presented systems.

An irrigation system in accordance with the present invention is easy to use, requires only minimal maintenance and is user friendly. Simultaneously, the system is relatively low priced and enables it marketing at a reasonable price (which is required by the target users niche). The system is adaptable to being installed on the existing infrastructure while totally and wholly integrating into this infrastructure (for example – the given terrain and its topography and the current systems existing there). The system is connectable to existing water sources and does not require investment of energy nor added pumping activity or pressure build up. The system, being modular in its construction, is given to fast folding for transportation (in the field or elsewhere from site to site) – thus providing flexibility from the aspect of providing water flow to the desired areas and directions, and is potentially open for future expansion and adaptation to varying conditions of the agricultural areas intended for watering.

An irrigation system in accordance with the present invention is characterized by that that the connector assembly which is used in it when required for connecting one lay flat

tubular conduit means in series to a second lay flat tubular conduit means, enables the connection by providing a face to face contact between a portion of the pipe wall of one tubular conduit means with a second wall portion of the other tubular conduit means while enabling sealing conditions thus preventing water leakage and loss.

In an irrigation system in accordance with the present invention, there is also embodied a general method for connecting one tubular conduit means in series with a second tubular conduit means while forming face to face contact between the wall portions of the tubular conduit means that are fastened one unto the other without detracting from the water flow cross section inside the tubular conduits.

Moreover, an irrigation system in accordance with the present invention is characterized by that that the same connector assembly is a multi purposes and multi implementations one – a connector assembly that as said, serves for connecting lay flat tubular conduit means in series – does also serve for other implementations in the system. For example – the beginning and the end of a line, bridging over pipes of different diameters, flow narrowing function in order to regulate the water flow pressure, changing the direction of the flow and also for branching the flow.

In one preferred embodiment of an irrigation system in accordance with the present invention, the connector units that are located along the lay flat type tubular conduit means while they protrude from its outer surface area (and are adapted to a selective connection of irrigation extensions to them in a manner that enables connecting watering extension for the passage of water into them from the tubular conduit means), are outlet tubules. These outlet tubules are bendable and are pre-located by way of heat welding unto the outer surface of the tubular conduit means along its length.

By implementing connector components of the outlet tubules type and by positioning them in advance along the tubular conduit means and upon its external wall, an irrigation system in accordance with the present invention imparts to its user the advantage of redundancy. Redundancy in all that is concerned with his ability to continue and use a damaged connector. For example, in case of a failure, the farmer has to chop the damaged end from the outlet tubule and to link what remained from the chopped outlet tubule with the irrigation extension.

This and even more: the outlet tubules that are heat welded as said on the external surface area of the tubular conduit means, might arrive as they are sealed and soldered at their

ends. In such a manner it provides the farmer operational flexibility from the aspect of which outlet tubule to use first. In accordance with the agricultural species or as per specific terrain conditions that might influence his selection, he truncates the end of specifically selected outlet tubules and makes it into a water shedding one.

In an additional and different preferred embodiment of an irrigation system in accordance with the present invention, the system is characterized by that that the major accessories that are required in the system are non rigid items that can be flattened and hence given to convenient folding and bending, and in consequence easily transported. For example - bridging means between different diameters, various flow narrowing implements for regulating the water pressure or means for varying the flow direction sense and forking extensions.

In an irrigation system in accordance with the present invention, there is embodied as well a general method for heat welding positioning of the outlet tubules along the tubular conduit means over its external surface area.

The present invention includes in its scope also an aspect of manufacturing arrays that enable positioning the outlet tubules components by heat welding unto the external wall of the conduit means along its length, wherein we are referring to a lay flat pipe that its production has been completed as well as to a lay flat pipe during the continuous process of its being manufactured.

Brief Description of the Accompanying Figures

The present invention will be described herein under in conjunction with the accompanying figures. Identical components, wherein some of them are presented in the same figure – or in case that a same component appears in several figures, will carry an identical number.

Figure No. 1 constitutes an illustration of an example of an irrigation system in accordance with the invention.

Figure No. 2 constitutes a cross section view in perspective of an example connector assembly wherein it is installed in an irrigation system in accordance with the invention for connecting the tubular conduit means in the system in series to an additional similar tubular conduit means.

Figure No. 3 presents an illustration of the installation of a connector assembly serving in an irrigation system in accordance with the invention, in order to connect a tubular conduit means in series to an additional tubular conduit means, wherein the connector assembly is of the type that includes two bisected flange components.

Figure No. 4 constitutes a view in cross section of a sample connector assembly wherein it is installed in an irrigation system in accordance with the invention in order to connect the tubular conduit means in series to an additional (similar) tubular conduit means, wherein the connectors' assembly is of the kind that includes an electrically triggered incandescent wire means.

Figure No. 5 constitutes a close up view in perspective of typical outlet tubules in an irrigation system in accordance with the invention, wherein an anchoring means is installed in one of them and a watering extension (such as the drippers hose shown in the illustrated example) is coupled to it.

Figure No. 6 constitutes a close up view in perspective of a typical outlet tubule in an irrigation system in accordance with the invention, wherein it is installed with a branching extension component.

Figure No. 7 constitutes a cross section view of a line termination in an irrigation system in accordance with the invention.

Figure No. 8 constitutes a cross section view of an example of a flow narrowing assembly used for regulating the water pressure in an irrigation system in accordance with the invention.

Figure No. 9 constitutes another example of a flow narrowing assembly applicable for regulating the water pressure in an irrigation system in accordance with the invention.

Figures No. 10a to No. 10e constitute a continuum of illustrations describing the stages of a probable method for positioning the outlet tubules components by way of heat welding them along the tubular conduit means and over the external wall surface of the conduit serving in an irrigation system in accordance with the invention.

Figure No. 11 constitutes a schematic illustration of a sample production array for implementing the method whose stages are illustrated in figures No. 10a to No 10e above, after completing the production of the tubular conduit means as a tubular profile.

Detailed Description of Preferred Embodiments of the Invention

Let's refer to **Figure No. 1**. Figure No. 1 constitutes an illustration of an irrigation system 10 in accordance with the present invention.

Irrigation system 10 includes a tubular conduit means 15 that has a wall 17, amenable to be flattened into an essentially flat condition (that is not illustrated). Conduit 15 is connected to a water passage into it from a water source 19. Tubular conduit means 15 is a lay flat type pipe - water entrance into it results in the widening of the conduit to the illustrated shape that in essence is not flat any more.

In the preferred embodiment of the invention, tubular conduit means 15 is a lay flat pipe of the poly-pipe type. The "lay flat poly-pipe" type of pipes are manufactured in relatively large diameters (for example: 160 to 400 mm), from polyethylene or polypropylene materials or their combination, using various production processes - for example, a production process known as "film blowing process". These pipes have relatively very thin walls (e. g., 0.5 to 2 mm) and they are low weight and hence very convenient for transporting as well as for deployment in the field area and for folding anew after their use (if desired to transfer them to another site).

In the illustrated example, tubular conduit means 15 constitutes a two-layered pipe wherein the internal layer 21 – the layer that faces the flowing water as they enter into the conduit, has a darker pigmentation in comparison to the pigmentation of the external layer 23 of the conduit.

Any experienced professional would understand that such a construction reflects the sun rays radiation, and hence it reduces the heating of the water and in consequence reduces the phenomena of growing micro organisms and algae inside conduit 15. Note, as any professional in this field understands, that the pipe might also be made of several layers as a multi-layered pipe (and not just the couple of layers as cited).

Irrigation system 10 comprises, in addition, several connector components 30 that are located along tubular conduit means 15 and protrude outwards from its external surface area 23.

In the illustrated example, connector components 30 are in the configuration of bendable outlet tubules 33 that, as would be explained later on, are positioned by heat welding unto the external surface area 23 of tubular conduit means 15.

Outlet tubules 33 might be made of sectors of a pipe that serves as irrigation extensions, for example – a sector of a 16 mm diameter polyethylene pipe with 0.2 mm thick wall, or of the same wall thickness of 0.2 mm but with a 22.2 mm diameter.

Any experienced professional would also understand that the capability – in accordance with the invention, to use connector components made of the same materials as the tubular conduit means itself, improves the capability for fully exploiting the system when recycling.

Unto connector components 30, the farmer may anchor – as he wishes (namely – selectively) irrigation extensions 35. The anchoring of irrigation extensions 35 is performed in a manner that enables the coupling of the irrigation extensions 35 unto a water passage into them from the tubular conduit means 15 and through them to the surface of the area that is to be irrigated.

In the illustrated example, the outlet tubules 33 are supplied in a closed and sealed condition of their ends 34. Subject to the specific irrigation requirements of the area to be watered, the farmer truncates the ends of the outlet tubules unto which he intends to connect with the irrigation extensions, while the rest of the outlet tubules remain sealed at their ends and are not active in the irrigation run – that is to say the do not shed water.

In the illustrated example, the treatment refers to irrigation extensions of the type of integral dripper hoses, but any professional in this field would understand that the extensions might as well be just simple hoses, dripping hoses of different type or any other water delivering implement.

In the same vein, the farmer might also prefer to flood the area by truncating an end of an outlet tubule and forming a local flooding 36.

As per configuring the connector components 30 as outlet tubules 33, any professional in this field would appreciate the inherent simplicity (in accordance with the present invention) for operating the connector components 30 – namely just to truncate its end. On the other hand, if it becomes necessary – it is possible to seal anew an active connector component (for example, by installing a plug or a stopper, by tying it or even by soldering it in the field).

Irrigation system 10 comprises in addition several connector assemblies 40 that enable, inter alia, when it is required to lengthen the main supply line (i. e., pipe) of the system, to

connect tubular conduit means 15 in series to another, similar tubular conduit means (which we designated for example 15').

As can be seen in figure No. 1 (and would be explained later on), those same connector assemblies 40 are also used, in other devices that are assembled in system 10 that is illustrated as an example only in the figure – for terminating the line (device 70), as well as for bridging between one diameter of a tubular conduit means in the line to another tubular means with a different diameter (device 60), or for narrowing the flow path and thus regulating the water pressure in the system (assembly 80), varying the direction of the flow (device 85) and splitting the flow in the line (device 90).

Any professional in this field would understand that employing the same connector assemblies as said for serving differing functions (requirements) one from the other in the system, lowers its costs and simplifies the system and its logistics.

It is not superfluous to add and state here, that system 10 might include or be integrated into other means that are known and recognized from days yore to any professional in this field, such as for example a fertilizing tank or a pump, a water meter (for controlling the flow rates), a filter, a pressure regulator and an assemblage of water reservoirs for maintaining the required water pressure in the system. In a schematic manner all these are illustrated in the figure and designated there as 95.

Reference is being made now to **Figure No. 2**. Figure No. 2 constitutes a cross section view in perspective of an example connector assembly 40 as it is installed in an irrigation system 10, and connects tubular conduit means 15 in series with an additional tubular conduit means 15'.

Connector assembly 40 comprises two flange components 202 and 204 respectively that are identical one with the other (a fact that necessarily indicates that the connector is nearly fool proof as per errors when assembling, simple and priced low).

Flanges 202 and 204 are each formed with circumferential brackets 206 and 208, respectively, that protrude from them.

Circumferential brackets 206 and 208 enable, on their surfaces, the bending and folding of an end portion from the wall of tubular conduit means 15 and 15'. The bending and the folding might be carried out manually – for example by the farmer in the field, and when doing so, he bends as said, the end of the tubular conduit means around its circumference, in the direction from the inside outwards, by approximately an 180° angle.

Connector assembly 40 includes an array of fastening means 210 that are locatable around each of the flange components 202 and 204 for fastening the two flange components one towards the other.

In the illustrated example, the two flange components 202 and 204 are each formed with a circumferential assemblage of through (passing) bores 212. In the illustrated example, the array of fastening means 210 includes several screws 214 that are adapted for being installed in the circumferential assemblage of through (passing) bores 212. Several nuts 216 are adapted for being screwed on screws 214 in order to fasten the two flange components one towards the other. Here, as well, threading the screws and the nuts for fastening the flange components one to the other can be accomplishes manually, for example by the farmer in the field.

Any professional would understand that the array of fastening means might also be in another and different configuration (for example, an array of eccentric fasteners, or static screw heads that protrude from the surface area of one flange component and enter the bores formed in the second flange component).

In accordance with the present invention, an outstanding feature of connector assembly 40 incorporated as said in system 10, is that in order to seal the contact against water leakage, connector assembly 40 enables the connection through face to face contact of a portion of the wall of one of the tubular conduit means with a similar portion of an additional tubular conduit means. In the illustrated example – a wall portion that is bent and folded over circumferential bracket 206 of flange component 202, forms face to face contact with the wall portion that is bent and folded over circumferential bracket 208 of flange component 204.

Any professional would understand as well that a flange component that serves in a connector assembly of the system in accordance with the invention might also be formed with a bracket that fits for being used to carry a pressure gauge. For example (that is not illustrated) – forming a through passing bore with a thread on it at the wall of the flange's circumferential bracket, in a manner such that after assembling the connector assembly in the irrigation system, it is feasible to pierce the wall of the pipe that has been bent and folded over the bracket above the threaded bore, and to continue and pierce through it the inner wall of the pipe - and then install from the outside, a pressure gauge inside the threaded bore.

Let's refer to **Figure No. 3**. Figure No. 3 constitutes an illustration of the installation of a connector assembly 340 that is a variation of connector assembly 40. In the illustrated

example, connector 340 is utilized for connecting a tubular conduit means 15 in series to an additional (similar) tubular conduit means (designated 15') when desired to lengthen the main supply line of an irrigation system in accordance with the present invention.

Note that in connector assembly 340 the flange components 302 and 304 are each formed with, respectively, a bisecting groove 352 and 354. Such construction enables the installation of the flange components as bisected rings, from the side, over the tubular conduit means. The construction of the flanges as bisected rings as said, alleviates also the above cited folding and bending tasks of the wall portions of the tubular conduit means over the circumferential brackets formed in the flange component. In the illustrated example the bisecting grooves pass through one of the through passing bores 312 that are formed in each one of the flange components, but any professional in this field would understand that the groove might also be formed between bores.

An irrigation system in which there are implemented connectors of the connector assemblies 340 type, might also include splitter means 360 for splitting the bisected flange component – and thus alleviate its installation. In the illustrated example, splitter means 360 is installed over a circumferential setup 312 of through passing bores on the two flanks of bisecting groove 354.

Connector assemblies 40 and 340 enable the forming of a connector that is amenable to being disassembled. Any professional in this field would understand that this attribute enables disassembling irrigation system 10 down to its basic components – either for transporting when desired or in order to repair or replace a defective component.

At the same time, there might be instances wherein in an irrigation system based on the lay flat pipe types, it is desired to form a robust and disposable one time connector that can not be disassembled.

Reference is being made to **Figure No. 4.** Figure No. 4 constitutes a cross sectional view of an example connector assembly 440. Connector assembly 440 is installable in an irrigation system 10 in accordance with the invention, in order to connect the tubular conduit means 15 in the system - in series to an additional (similar) tubular conduit means 15', wherein the connector assembly is of the kind that includes an electrically triggerable incandescent wire means 470 for forming a robust and disposable (one time) connector that can not be disassembled.

In the field of piping connectors, there are known and recognized "electro fusion" type of connectors. Connector assemblies specific to the irrigation systems sector that are based on the lay flat type pipes, they too might implement a similar "electro fusion" technology.

In accordance with the illustrated example, the incandescent wire 470 is installed in flange component 402, in order to solder sectors of the pipes 15 and 15' walls one to the other, after they were fastened one to the other. The farmer in the field would need an electric battery or a generator to serve as a power source. Another possibility is that connector assembly 440 would include a "burst" (break in) battery means integrally installed within the flange component that is formed with the incandescent wire (component 402 in the illustrated example). The integral battery will serve for a one time generation of the voltage required for rendering the incandescent wire red hot. Any experienced professional would understand that just the same, both flange components may include the incandescent wire and the integrally included one shot power source.

Considering the foregoing deliberations and referring to connector assemblies 40, 340 and 440, any professional in this field would appreciate that in the manner the connector assemblies function, there is actually embodied a general method for connecting one tubular conduit means in series to a second tubular conduit means in irrigation systems based on the lay flat type pipes.

The method includes the stages of installing two flange components, each one of them on its specific tubular conduit means; and in the next stage - folding and bending in an outwards direction a wall portion from an end of each one of said tubular conduit means, over all their circumferences and inserting and including the circumferential brackets of each of these flange means, inside the fold that has been formed at one end of the respective tubular conduit means. Following this, a stage of fastening the two flange means one towards the other, using an array of fastening means is being performed so that the wall portion that is folded and bent over the circumferential bracket in one flange component would form face to face contact with the wall portion that is folded and bent over the circumferential bracket of the second flange component.

In a preferred embodiment of connector assembly 340, the method includes an additional stage of parting (or in other word: splitting) at least one of said two flange components that is formed as a bisected ring in order to install it on the tubular conduit means

from the side and thus alleviating the tasks of folding and bending the wall portion of the tubular conduit means over the circumferential bracket formed in the flange component.

In another and additional preferred embodiment of connector assembly 440, the method in accordance with the invention includes a stage of soldering the two portions of the walls one to the other.

An outstanding advantage of the structure of the connector assembles, 40, 340 and 440 lies in the fact that its installation is performed externally and does not reduce the free cross section area for the flowing water in the tubular conduit means 15.

Any experienced professional would understand as well that the implementation of the assemblies is also enabled under field conditions, and the person installing the system is only required to cut, more or less straight, the ends of the pipes and to a execute a continuum of extremely simple operations, such as threading, bending and folding, fastening etc.

In an experiment conducted on a system as per the invention, a connector assembly similar to connector assembly 340 was utilized. The connector assembly comprised 8 mm screws with wing nuts that served as the fastening means of the assembly. The tubular conduit means used was a lay flat poly type pipe made of two polyethylene layers whose diameter was 280 mm and wall thickness of 0.9 mm. The screws of the connector assembly were fastened using the wing nuts and closing them manually without resorting to use any other fastening tool. The tubular conduit means was filled up with water at 4 meter height for 10 hours. The connector remained perfectly impervious until the designed splitting open of the tubular conduit means itself (that happened, as expected, when the water was increased to 6.5 meters).

In another experiment, the connector assembly comprised six 8 mm screws with wing nuts and also only manual fastening. The tubular conduit means used was again a lay flat poly type pipe made of two polyethylene layers of 200 mm diameter and wall thickness of 0.8 mm. The tubular conduit means was exposed to water at 4 meter inside water warming up bath at a temperature of 60°C. Also in this experiment – the connector remained impervious for two and a half hours until the designed splitting open of the tubular conduit means itself (that happened as expected, when the water pressure was increased to 5.5 meters).

In yet another experiment, the water was drained and refilled again and again cyclically from a tubular conduit means, and it did not detract from the imperviousness of the connector assembly.

Hence, once the efficiency of a connector assembly of the type of connectors such as the 40, 340 and 440 has been proved and it is found that they do not constitute a weak point in an irrigation system that is based on the lay flat poly-pipe tubular conduit means, any professional would appreciate that an irrigation system in accordance with the invention might be implemented not only for gravitational based irrigation means (in which relatively low pressure prevails in the system), but also in watering systems that mandate building high water pressures in the system.

Thus for example, it is possible to install – in a system as per the invention, tubular conduit means of the lay flat poly-pipes variety having small or relatively intermediate diameters (such as for example 75 to 280 mm) and relatively thick wall thickness (such as for example 0.8 to 2.5 mm) and to increase the water pressure value that prevails in the tubular conduit means upwards – up to approximately 10 meter of water.

Let's refer to **Figure No. 5**. Figure No. 5 constitutes a close up perspective view of typical outlet tubules 33 and 33' in an irrigation system 10 in accordance with the invention, wherein an anchoring means 550 is installed in outlet tubule 33 and an irrigation extension (in the illustrated example – integrally built dripper hose 35) is coupled to it.

As was explained earlier (when referring to figure No. 1), in system 10 that constitutes a preferred embodiment of an irrigation system in accordance with the invention, connector components 30 constitute bendable outlet tubules 33. The outlet tubules 33, as would be explained below, are positioned by heat welding unto the external surface area 23 of tubular conduit means 15.

In this preferred configuration, the outlet tubules arrive initially wherein they are sealed and soldered at their end. Note that the illustration of outlet tubule 33' shows that its end section 34 is closed and sealed, as said.

On the other hand, outlet tubule 33 is shown in the figure after the sealing sector that was earlier at its end – was truncated and clipped by the farmer. The farmer decided to activate outlet tubule 33 and turn it into a water shedding source (for example, in accordance with the growing crop near it or due to specific terrain conditions). Hence, aided by a sharp tool (for example - a knife) he cut down sector 34 and in this case, anchors anchoring means 550 unto the remainder of outlet tubule 33 while leaving outlet tubule 33' intact and therefore not activated.

In consideration of the fact that as per the latter embodiment of the invention the outlet tubule is formed from essentially a sector of a typical irrigation extension, anchoring means 550 might be any two sided anchoring means that has been implemented earlier for connecting watering extensions in series. Such anchoring means is known and recognized by experts in this field, and might be based, for example, on a barbed connector and a floating nut (on each of their two sides).

In case it becomes necessary to replace the anchoring means, the anchoring means would be dismantled, and if the outlet tubule was damaged in the process, all that the farmer is required to do is to cut an additional sector off the outlet tubule and to continue to use the remaining part for anchoring the irrigation extension to it (aided by the anchoring means).

Thus, by implementing connector components of the outlet tubules type, and positioning them in advance along the tubular conduit means and upon their external side wall surface, an irrigation system as per the present invention imparts to the user redundancy in all that is concerned to his ability to continue using the connector.

At times the farmer might desire to dismantle the irrigation extension or to shut down a specific water outlet. To enable achieving this task, the system might include several plugs (that are not illustrated) that would enable each one of them, a reversible closing down of the activated outlet tubule, namely a closure that might be reopened of an outlet tubule. Other accessories that fit for this task are flat clasps (that are not illustrated) that seal the otherwise normally folded ends of irrigation extensions. In this case too, reference is made to means that are known and recognized to farmers and expert professionals in this field. Alternatively, it is possible to solder anew the end of the outlet tubule (employing a portable solder).

Any professional in this field would appreciate the fact that the preferred embodiment of system 10, in which use is made of outlet tubules 33 serving as connector components 30, is an embodiment that enables the farmer to cope with components that he is familiar with for years (such as irrigation extensions). The outlet tubules that are positioned in advance along the length of the lay flat poly pipe walls and are ready to be exited (by cutting off their ends 34) are components which are already known and familiar to the farmer. In contradistinction to low pressure irrigation systems we referred to above, within the section describing the background to the present invention – the farmer is not required to cope with connectors of a new kind. Moreover, for accomplishing the sealing anew of the outlet tubule 33, he is not obliged to locate and find a specific component (such as a threaded plug component of the

kind he need in the earlier presented systems), but he can, just fold the outlet tubule and close it with a clasp (in the same manner he is used to employ for watering extensions).

Reference is being made to **Figure No. 6**. Figure No. 6 constitutes a close up view in perspective of a typical outlet tubule 33 in an irrigation system 10 in accordance with the invention, wherein it is installed with a branching component 660.

Extension component 660 enables piloting the water flow from outlet tubule 33 to several watering extensions 35. In the illustrated example, branching component 660 splits the water flow into two watering extensions, but any professional in this field understands that it is feasible to produce a variety of branching components having a splitting capability to additional extensions (or to just achieve this capability by connecting in series several branching components).

Anchoring means 550 (see above, under reference to Fig. No. 5) serves here also for connecting outlet tubule 33 on the one hand to the watering extensions 35 on the other hand.

It is possible to fabricate branching component 660 from two flexible small film pieces (for example, made of polyethylene) 662 and 664, wherein they are soldered one to the other while allowing for a water flow passage between them. In accordance with the illustrated example – flow passage 666 is similar in shape to the letter Y for splitting the flow from outlet tubule 33 to the two watering extensions 35.

As pointed above, branching components can be manufactured from two flexible films soldered one to the other, as a continuous sheet of branching components that can be manually separated on from the other (by weak separation lines). Any professional would appreciate that including such a continuous roll carrying a variety of branching components as said, as part of the accessories of the irrigation system in accordance with the invention, imparts an additional important advantage to the farmer. Such accessory produce efficiency and convenience in implementing the tubular conduit means of the system – providing water flow at the optimal locations and quantities as required.

Let's refer to **Figure No. 7**. Figure No. 7 constitutes a cross section view of a line termination device 70 (see Fig. No. 1) in an irrigation system 10 in accordance with the invention.

An outstanding attribute of an irrigation system in accordance with the present invention is the use that is made of the same connector assembly that serves for connecting in series one tubular conduit means 15 to another (a second) tubular conduit means – also for

other tasks and requirements in the system, inter alia as in the figure No. 7 illustrated example - as part of a line end 70 device.

Device 70 includes a line termination end disc component 710 that is connectable to a connector assembly as in for example connector assemblies 40, 340 and 440 (that were described above when referring to figures numbered 1 to 4) and that is used for closing the end of tubular conduit means 15 and preventing water leakage from it.

In the illustrated example, use is made of the components of connector assembly 40 - also in order to connect (in addition) unto the line end disc 710. Any professional would understand that in another configuration, it is possible to connect line end termination disc 710 to only one flange component from the two existing flange components of connector assembly 40.

Any professional in this field would also understand that using just one connector assembly for different functions in the same irrigation system proper leads directly and unmistakably clear to simplifying the system and drastically lowering its costs.

Moreover, in the illustrated example, tap means 720 is mounted on the line end termination disc 710. Tap means 720 serves for draining the water from tubular conduit means 15 when so required.

Any professional clearly understands also that the capability of draining and flushing tubular conduit means 15 without the performance of this job requiring the dismantling of the line end device of the system is a feature that greatly alleviates the chores of the farmer while at the same time simplifying the system.

Reference is being made to **Figure No. 8**. Figure No. 8 constitutes a cross section view of an example of a flow narrowing assembly 80 (see Fig. No. 1), used in accordance with the invention for regulating the water pressure in irrigation system 10.

As was explicitly stated above, a distinctive feature of irrigation system in accordance with the present invention is the manner in which use is made of the same connector assemblies that serve for connecting in series one tubular conduit means with a second tubular conduit means and as well for other functions in the system and as in the illustrated example – as being a part of the flow narrowing assembly 80 for regulating the water pressure in the system.

Flow narrowing assembly 80 includes two passage means 810 in order to bridge between one diameter tubular conduit means 15 to a second and different diameter of another tubular conduit means. Passage means 810 is formed as a funnel and it also has pipe wall that can be flattened and to an essentially flat condition. Passage means 810 is connectable to a connector assembly in the system (for example connector assemblies 40, 340 and 440 described above when referring to figures No. 1 to No. 4), in order to interconnect in series to a tubular conduit means in the system.

Any professional would understand that a passage means, such as passage means 810, might be installed in the system whenever it is desired to bridge over between one diameter of tubular conduit means 15 to another and different diameter of a different tubular conduit means (subject to using, of course, connector assemblies differing one from the other in their dimensions, each on its own side). See for example Fig. No. 1, the utilization of a passage means as said in device 60 that bridges as said between one diameter of tubular conduit means 15 in the line to a second and different diameter of another tubular conduit means.

For implementing a flow narrowing assembly 80 in order to regulate the pressure in the system, two passage means 810 are required, as said above. The assembly comprises in addition two rigid pipe components 815 and 817, respectfully; each one of them connectable to the smaller diameter from the two diameters of passage means 810 (for example, by a clasp). A valve assembly 820 (or any other kind of a narrowing assembly) is installed on its two flanks to the rigid pipe components 815 and 817, in order to regulate the water pressure level in the system.

The fact that passage means 810 itself is endowed with the lay flat property, i. e., it is not a rigid component, contributes to the simplicity of the system and to the convenience and ease of transporting it.

Referring once more to **Figure No. 1**, we can observe that a marked feature of system 10 in accordance with the invention, is the utilization, as cited also earlier, of making do with components that are not rigid, as said.

Thus for example, device 85 that changes the direction of the water flow in the line includes a direction varying means 86 for affecting this change of direction. The direction varying means 86 that has relatively thin walls, such that have a capability of being essentially flattened to an essentially flat condition, and it is connectable on its both flanks to connector assemblies in the system (for example – connector assemblies 40, 340 and 440 that were

described when referring to figures No. 1 to No. 4). In the illustrated example, the direction varying means 86 has a configuration resembling the letter L, but any experienced professional would understand that these means can also be formed in different configurations (for example – with certain angle).

Another example – device 90 that branches the flow in the line and splits it into two separate paths, includes direction varying means 91 (shaped like the letter T). It too has walls that have a capability of being essentially flattened to an essentially flat condition, and it is connectable to connector assemblies in the system (once more, for example like connector assemblies 40, 340 and 440 that were described when referring to figures No. 1 to No. 4).

As said, any professional in this field understands that using just one type of connector assembly for different functions in the same irrigation system proper leads directly and unmistakably clearly to simplifying the system and drastically lowering its costs.

Let's refer to **Figure No. 9**. Figure No. 9 constitutes a cross section view showing another example of a flow narrowing assembly 980 for regulating the water pressure in an irrigation system in accordance with the invention.

Flow narrowing assembly 980 might be preferable to assembly 80 described above (see figure No. 8 discussion) because employing narrowing assembly 980 might result in shortening the time required for filling the entire length of the tubular conduit means with water, and also improve the uniformity of distributing the water along the entire length of the tubular conduit means.

Flow narrowing assembly 980 includes a portion of flattenable tubular conduit means 915, that is adapted to be connected on both its flanks to tubular conduit means 15 and 15', respectively. The connection might be done using connector assemblies 40, 340 and 440 (that were described when referring to figures No. 1 to No. 4). In the illustrated example, connector assemblies 40 are implemented in order to connect in series of the assembly between two tubular conduit means.

Within portion 915, there is positioned a flow narrowing means 920. Flow narrowing means 920 is also formed (as some others) as a sector of a flattenable tubular conduit means, and is affixed around its circumference on its one end, to the internal wall of portion 915 (for example – by heat soldering). Flow narrowing means 920 converges in its dimensions in the direction of the envisaged water flow 925 (see arrow), and formed there with a spout sector

930. Spout 930 is located within the internal space 935 that is bounded by tubular conduit means portion 915.

As the pressure rises inside internal space 935, a choking effect is executed on spout sector 930, concurrently diminishing the dimensions of the water free pass through it. In consequence, a pressure regulation occurs inside said tubular conduit means.

Regarding this accessory, as holds for some of the others, any professional would appreciate the fact that the invention provides accessories that are amenable to be flattened and that can be couple with or integrated into other components of the system by the one uniform connector assembly that is used in the irrigation system for a myriad of other implementations.

An irrigation system, as per the invention – might include inter alia also a kit for making repairs in the field, for example of holes in the tubular conduit means or damage to some of the system's accessories –such that are also endowed by lay flat properties as explained in full, and especially in the case of failures in the thin and sensitive wall of the lay flat pipes.

Such a repair kit (that is not illustrated) might include a piercing means for forming holes and in particular for improving the shape of a hole so that it would have a smooth and complete round circumference thus enabling to plug it with a ready made stopper when required, or alternatively squeezing some spongy material to achieve the same kind of repairs. It was found out that using a spongy material made of closed cells construction enable fast and reliable repairs of holes that were torn in lay flat poly pipe type of conduit means.

Hence – in an irrigation system in accordance with the present invention that includes a repairs kit as said, there is also embodied a general method for repairing holes that developed in the tubular conduit means of an irrigation system based on the lay flay type pipes. A method that includes the stages of improving the holes unto a smooth configuration around its circumference and squeezing material of the above cited spongy structured material into the holes.

Reference is being made to **Figures No. 10a to No. 10e**. Let's start by stating in advance and reminding the reader that – as was explained above when referring to figures No. 1, No. 5 and No. 6 - that a preferred embodiment of irrigation system in accordance with the invention is characterized by that that connectors 30 are in the configuration of outlet tubules 33. Outlet tubules that are pre-installed from the outside along tubular conduit means 15, which is of the lay flat poly-pipe type, on its external surface area 23 (see figures), and are

bendable in a manner that enables folding and transporting of the tubular conduit (wherein outlet tubules 33 are easily bent in an orientation which is along the tubular conduit means).

Figures No. 10a to No. 1e constitute a continuum of illustrations describing the stages of a one probable method for positioning by heat welding the outlet tubules 33 from the outside, along a tubular conduit means 15 and over its external wall surface 23.

In figure No. 10a – the stage of establishing the location at the wall of tubular conduit means 15 is illustrated. This location is intended for connecting outlet tubule 33 so that it faces bracket assembly 1010.

Illustrated in figure No. 10b is the stage of creating an opening 1020 at the wall of tubular conduit means 15. This opening is intended for connecting outlet tubule 33 and is formed at this stage while biasing the circumferential edge of opening 1020 to bend and be pulled so that it will be protruding outside of external surface area 23 of tubular conduit means 15.

In the illustrated example, the task of forming opening 1020 and extending the edges of the opening to protrude outwards are performed by cutting pin 1030. After the wall of tubular conduit means 15 is coupled flush with bracket assembly 1010, the pin is made to protrude outwards from bracket assembly 1010, wherein against it and on the other side – out and away from the tubular conduit means – a supporting bushing 1040 is positioned.

Any professional would understand that this stage of forming the opening and biasing the edges of the opening to bend and be pulled and protrude outwards from the external surface area of the tubular conduit means, might also be performed by using other (and different) means for cutting, biasing and supporting.

In figure No. 10c the stage of positioning outlet tubule 33 from the outside is illustrated. One end of outlet tubule 33 is located on the circumference edge of opening 1020 as it was bent and pulled out so that it protruded outwards from the external surface area 23 of tubular conduit means 15.

In the illustrated example, the positioning of outlet tubule 33 is performed by leading the one end of outlet tubule 33 in the direction of arrow 1040 (see figure) over a leading pin 1050 (that was mounted in and as a continuation extension of cutting pin 1030), in a way such that the end of outlet tubule 33 finally encircles the protruding edge of opening 1020.

Any professional would understand that the stage of positioning outlet tubule 33 from the outside, wherein the end of is located on the circumference of the opening's edge, might also be performed by other piloting and transporting means or in a manner wherein the protruding edge of the opening is the one that would encircle the end of outlet tubule 33.

Illustrated in figure No. 10d is the stage of clasping the end of outlet tubule 33 and the protruding edge of opening 1020. This stage is accomplished using heat welding means 1060 that heat welding them together one to the other around their circumference.

In experiments that were conducted it was found. That heating while pressing, at 200 degrees centigrade and for duration of 20 seconds, is sufficient in order to form a durable soldering connection between an outlet tubule made from a sector of a typical drip irrigation extension and the edges of an opening made at a poly-pipe type of lay flat water conduit means.

In the illustrated example, heat welding means 1060 is made up from several clasping assemblies and heating (two – one 1060 and one 1060' are illustrated for the sake of providing the illustration), and it is driven in the direction of arrows 1070 and 1070' respectively, in order to provide complete circumferential clasping of the end of outlet tubule 33 and the protruding edge, versus the pins arrays 1030 and 1050 and bracket assembly 1010.

Any professional would understand that the clasping operation and the welding might of course be performed using other clasping means as well as different welding and supporting means.

Illustrated in Fig. 10e is the stage of releasing outlet tubule 33 from the clasping of the heat welding tool and the subsequent cooling of the welding area. In the illustrated example, cutting pin 1030 converges back into bracket assembly 1010 that is retreated from the welding soldering place and disconnected from the wall of the tubular conduit means while moving in the direction of arrow 1080. Leading pin 1050 is retreated in the direction of arrow 1085, and clasping and heating assemblies 1060 and 1060' respectively are also being retreated from the welding place in the directions of arrows 1090 and 1090' respectively.

Any professional in this field would understand that releasing the outlet tubule and cooling the welding place might also be accomplished by propelling other means and in other or different directions.

Any professional would understand as well that the method might include also an additional stage of welding the other second end of the outlet tubule and sealing it (and see

previous cited discussion when referring to figures No. 1 and No. 5 relating to the configuration of the tubular conduit means 15 combined with outlet tubules 33 as they were closed and sealed at their end tips 34 as illustrated there).

Any experienced professional would also understand that upon completing the continuous sequence of stages, it is feasible to implement them again and again in a cyclically run at the following place on the wall of tubular conduit means 15 that is intended for connecting one more outlet tubule on it.

Moreover, any experienced professional would also understand that the method is given to being implemented not only when the tubular conduit means 15 has already been completed to form a tubular profile, but even at an earlier stage, for example – implementing the method upon a sheet of flat film of material which only in the following stage, after the outlet tubules were heat welded to it, will be folded and soldered to provide a tubular conduit profile.

In addition, any professional would understand that the method is given to industrialized and mechanized implementation in a manner that its stages are performed in the course of the continuous production of tubular conduit means 15, for example using an extrusion process, or by a process of film blowing, or – as said, from a sheet that is folded later on in the proceedings and soldered to become the desired tubular conduit profile.

In such a case, any professional will understand that the implementation of the method dictates the propelling of the various means in a cyclic mode, at a velocity that is essentially equal to the velocity of the tubular conduit means 15's wall motion in the course of its production process and in the direction of its advance until the completion of heat welding of the outlet tubule to the wall.

Alternatively, it is also possible to implement the method at the stage that comes after completing the production of tubular conduit means 15 as a tubular profile and rolling it as required. In accordance with this alternative, the positioning by heat welding of the outlet tubules from the outside and along the tubular conduit means 15 on its external surface area 23, might also be performed by implementing the method whose stages were described when referring to figures No. 10a to No. 10e.

In such a case, the stages of the method are implemented in a cyclic procedure within the intervals between the deploying run on the one hand and rolling of the tubular conduit means on the other hand, or alternatively – in a continuous mode, within the repeated process

of deploying and rolling the tubular conduit means as said, and in a manner that requires a cyclic propulsion of the various means at a velocity that is essentially equal to the velocity of the wall of the tubular conduit means that is spread and rolled anew, and in the direction of movement of the wall, until the completion of the heat welding of outlet tubule (whose turn arrived now) to the wall.

Let's refer to **Figure No. 11**. Figure No. 11 constitutes a schematic illustration of a sample production layout, or in other words array 1101 for implementing the method whose stages are illustrated in figures No. 10a to No 10e above, shown to be implemented after completing the production of the tubular conduit means 15 as a tubular profile.

Manufacturing array 1101 is installed between deploying assembly 1102 to rolling anew assembly 1103. Deploying assembly 1102 spreads from it (in the illustrated example by rolling in the direction of arrow 1104), in every cycle, a sector of tubular conduit means 15 whose production as a tubular profile has already been completed (for example, by the film blowing process cited earlier). A rolling anew assembly 1103 operates in synchronization with deploying assembly 1102 (for example – controlled by controller 1105), in order to roll anew (by rolling in the direction of arrow 1106) of the sector from the tubular conduit means that was unloaded from the deploying assembly 1102.

Any professional would understand that the assemblies for deploying and for rolling anew, are illustrated only in a schematic fashion, and that they might include also rolling means for controlling the speed and tension of the tubular conduit means advancing on their surfaces.

Manufacturing array 1101 comprises bracket assembly 1110 that is located inside tubular conduit means 15 opposite the position of the intended coupling unto outlet tubule 33. Bracket assembly 1110 is adapted to the flow of the tubular conduit means 15 around it, relying on a cylinders setup 1112 that is installed on it.

The bracket assembly 1110 is bounded in its position inside tubular conduit means 15, between two assemblies of cylinder arrays 1114 and 1116, respectively. The assemblies of cylinder arrays 1114 and 1116 are adapted to the flow of tubular conduit means 15 through them, while maintaining the positioning of bracket assembly 1110 between them.

Bracket assembly 1110 includes a piercing tool 1130 in it, intended to open opening 1020 in the wall of tubular conduit means 15, in the lace designated for connecting to it an

outlet tubule 33, while biasing the edge of opening 1020 to bend and be pulled out so it protrudes outwards of the external surface area 23 of tubular conduit means 15.

For example, in accordance with the description relating to figure 10b, piercing mean 1130 might include cutting pin 1030 that – after attaching flush the wall of tubular conduit means15 to bracket assembly 1110, is protruded outwards from bracket assembly 1110, wherein on the opposite place, externally from tubular conduit means15, a support is located (that is not illustrated but see figure 10b).

Manufacturing array 1101 includes also feeding and leading means 1150. Means 1150 feeds – one at a time, one single outlet tubule 33 and leads it to its place upon the external surface area 23 of tubular conduit means 15, in a manner that one end of outlet tubule 33 eventually clasps the circumference of the protruding edge of opening 1020. Any professional would understand that such means might be operated either manually or automatically.

Manufacturing array 1101 includes also welding means 1060 for clasping the end of outlet tubule 33 and the protruding edge of opening 1020 and for heat welding them together on to the other around their circumferences. Any professional would understand that also the heat welding means might be mobile and operated either manually or automatically.

An additional soldering means 1161 is also included in the illustrated example, for soldering the other end of outlet tubule 33 and sealing it at its end 34.

Manufacturing array 1101 is operated in the time interval between the unloading of the would be next sector of the tubular conduit means from deploying assembly 1102 (while rolling the sector of which the heat welding of the outlet tubule on it has already been completed), and until the unloading of the next sector to be treated, namely – in the time interval in which the deploying and the rolling anew assemblies (1102 and 1103, respectively) are idle (not operating).

Any professional would understand that manufacturing layout 1101 might be operable in a cyclic mode even in the course of a continuous and non-stop process of spreading on the one hand and rolling a new on the other hand of tubular conduit means 15. In such an operating configuration, manufacturing array 1101 is of course in need of automation, and in consequence – of compatible control too – for example, through an interface 1169 to controller 1105. Moreover, as was explained above, when functioning in a cyclic mode as claimed, in the course of continuous unceasing unloading and rolling anew of tubular conduit means 15, array 1101 should be itself be propel. Array 1001 should be propelled to move in

the direction of arrow 1170, at a velocity that is essentially equal to the velocity of the advancing movement of the wall of tubular conduit means 15, and this until completing the hat welding of outlet tubule 33 whose turn arrived (and in the illustrated example – also of sealing it at its end). On the other hand, propelling manufacturing array 1101 and rending it back to its position anticipating an additional operation cycle (as the movement direction shown by arrow 1171) might be of course relatively fast. A viable propulsion means, that is known and recognized by any professional in this field of automation of manufacturing arrays, and that might fit the need for bi-directional and controlled propulsion as said and as it applies to array 1101, is a propelling screw motion (that is not illustrated).

Thus, considering all that was described above combined with referring to the accompanying figures, any professional would easily appreciate that irrigation system 10 in accordance with the present invention, is one that is convenient and easy to operate, requires only minimal maintenance and is user friendly. Simultaneously, it is a relative low cost system and enables it marketing at a reasonable price (as required by its target buyer's niche). The system is compatible with and easily fits installation with existing infrastructures, integrating completely with the existing infrastructure (for example, the particulars of the terrain and the systems existing in the area). The system is amenable to be connected to an existing water supply and does not require investment of energy nor added pumping activity or pressure build up. The system, being modular in its construction, is given to fast folding for transportation (in the field or elsewhere from site to site) – thus providing flexibility from the aspect of providing water flow to the desired areas and directions, and is potentially open for future expansion and adaptation to varying conditions of the agricultural areas intended for watering

Any professional would understand that the present invention was described above solely in a way of presenting examples, serving our descriptive needs and those changes or variants in the structure of the irrigation system, the method for connecting one tubular conduit means in series to another tubular conduit means or in means for hat welding outlet tubules to their locations were described only in a way of providing an example and while referring to the accompanying figures and would not exclude them from being part of the present invention.

In other words, it is possible to implement the invention as it was described above while referring to the accompanying figures, even with introduction of changes and additions that would not stray from the characteristics of the irrigation system in accordance with the

invention and the methods that are embodied in the manner of its functioning and operation as well as the methods required for manufacturing it, characteristics, methods and means that are claimed herein under.

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CLAIMS

1. An irrigation system, comprising:

a tubular conduit means, at least one, that has a thin wall, such that it is capable of being essentially flattened and is connectable to a water source, in a manner that water entrance into it results in its widening into a configuration that is not essentially flat;

a plurality of connector components located along the length of said tubular conduit means wherein they protrude from its external surface area and are adapted to selectively enable anchoring of irrigation extensions into them, in a manner that enables connecting said irrigation extensions for allowing water entrance into them from said tubular conduit means; and

a connector assembly, at least one, that enables connecting said tubular conduit means in series with an additional such tubular conduit means;

wherein said irrigation system is characterized in that said connector assembly enables a face to face connection of a portion of said tubular conduit means wall with another portion of said additional tubular conduit means wall in order to seal said connection against leakage of water.

2. An irrigation system in accordance with claim 1, wherein said tubular conduit means constitutes a lay flat poly-pipe type of hose.

3. An irrigation system in accordance with claim 1, wherein said tubular conduit means constitutes a multi layered pipe and wherein its innermost layer that faces said water flow when it enters said conduit is of a darker pigmentation relative to the pigmentation of the external layer of said conduit means.

4. An irrigation system in accordance with claim 1, wherein said connector components constitutes bendable outlet tubules located on said external surface of said tubular conduit means by heat welding.

5. An irrigation system in accordance with claim 4, wherein said outlet tubules are sealed and normally closed at their ends in a manner that they might be truncated in order to anchor to them after being truncated as said to irrigation extensions.

6. An irrigation system in accordance with claim 1, wherein said connector assembly comprises:

two flange components, each one of them formed with a circumferential bracket that enables folding and bending on its outer surface area a portion of said wall of said tubular conduit means in a direction from the inside and outwards; and

an array of fastening means locatable around each of those two flange components for fastening said flanges one towards the other and in a manner that said wall portion that is folded and bent over said circumferential bracket in the one flange component, would establish face to face contact with the wall portion that is folded and bent over said circumferential bracket in said second flange component, and this without limiting or reducing from said free passage flow cross section area within both said tubular conduit means.

7. An irrigation system in accordance with claim 6, wherein

said two flange components are formed – each one of them, with a circumferential array of through passing bores; and

said array of fastening means include a plurality of screws that are adapted for being installed in said circumferential array of through passing bores; and

a plurality of nuts adapted for being installed on said screws in order to fasten, as said, one towards said other and forming a dismountable connector.

8. An irrigation system in accordance with claim 6, wherein

said array of fastening means includes an array of eccentric fasteners.

9. An irrigation system in accordance with claim 6, wherein

said array of fastening means includes static screw heads that protrude from one of said cited flanges, and wherein it is possible to integrate them into said bores formed in said second flange.

10. An irrigation system in accordance with claim 6, wherein

at least one of said two flange components is formed with a bisecting groove in a manner that enables its installation as a bisected ring over said tubular conduit means from the side and alleviates the task of folding and bending said wall portion of said tubular conduit means, over said circumferential bracket formed in said flange component.

11. An irrigation system in accordance with claim 10, wherein said system further comprises a splitter means for splitting said flange component by installing it on said circumferential array of passing through bores on both flanks of said bisecting groove.

12. An irrigation system in accordance with claim 6, wherein said connector assembly further comprises an incandescent wire installed in at least one of said flange components, in order to solder said wall portions one to the other.

13. An irrigation system in accordance with claim 12, wherein said connector assembly further comprises a burst battery means installed in said flange component in order to generate a one time voltage as required by said incandescent wire for rendering it red hot and accomplish its soldering function.

14. An irrigation system in accordance with claim 1, wherein said system further comprises at least one anchoring means connectable to said connector's components.

15. An irrigation system in accordance with claim 14, wherein said system further comprises at least one branching component, anchorable to said anchoring means and enabling piloting said water flow from said connector component to a plurality of said irrigation extensions.

16. An irrigation system in accordance with claim 15, wherein

said branching component is formed from two flexible flat films, soldered one to the other while leaving a shaped flow passage between them.

17. An irrigation system in accordance with claim 1, wherein said system further comprises

a line termination end disc component connectable to said connector assembly in order to close the end of said tubular conduit means, and prevent water leaks from it.

18. An irrigation system in accordance with claim 17, wherein said system further comprises

a tap means installable in said disc for draining water from said tubular conduit means.

19. An irrigation system in accordance with claim 1, wherein said system further comprises

a passage means for bridging between one diameter of said tubular conduit means and a second and different diameter of another tubular conduit means.

20. An irrigation system in accordance with claim 19, wherein said passage means has a wall capable of being flattened enabling said passage means to being flattened to an essentially flat condition and connectable to said connector assembly for being connected in series to said tubular conduit means.

21. An irrigation system in accordance with claim 1, wherein said system further comprises

flow narrowing assembly for regulating the water pressure in the system.

22. An irrigation system in accordance with claim 21, wherein said flow narrowing assembly includes:

two passage means in accordance with claim 19; and

two rigid pipe components each one of them connectable to the smaller diameter from said two diameters of said passage means; and

a valve connectable on its both sides to said rigid pipe components in order to regulate said water pressure in the system.

23. An irrigation system in accordance with claim 21, wherein said flow narrowing assembly includes

a middle sector capable of being flattened of said tubular conduit means having an inner space and adapted to be connected on its two ends in series to said tubular conduit means as said above by employing said connector assemblies; and

a flow narrowing means formed as a flattenable sector of a tubular means and affixed around its circumference on its one end to the internal wall of said middle sector and converging in its dimensions to form a spout that is located inside said inner space that is bound in said middle sector of said flattened tubular conduit means.

24. An irrigation system in accordance with claim 1, wherein said system further comprises

a direction changing means in order to vary the direction of water flow in the system.

25. An irrigation system in accordance with claim 24, wherein said direction changing means has a flattenable wall and which is connectable to said connector assembly in order to be connected in series to said tubular conduit means.

26. An irrigation system in accordance with claim 25, wherein said direction changing means has a shape similar to the letter L.

27. An irrigation system in accordance with claim 25, wherein said direction changing means has a shape similar to the letter T.

28. An irrigation system in accordance with claim 1, wherein said system further comprises a field repairs kit for mending holes in said tubular conduit means, that includes –

a holes piercing means for forming said hole in a smooth fashion; and

a spongy means that can be forced into said hole in order to seal it.

29. A method for connecting one of said tubular conduit means in series to a second tubular conduit means in an irrigation system in accordance with claim 6, wherein said method includes the stages of

installing said two flange components, each one of them on his specific tubular conduit means; and

folding and bending in an outwards direction said wall portion from an end of each one of said tubular conduit means, over all their circumferences; and

inserting and including said circumferential brackets of each of said flange components, inside said fold that has been formed at one end of said tubular conduit means; and

fastening said two flange components one towards the other, using said fastening means array and in a manner as said, so that said wall portion that is folded and bent over said circumferential bracket in one flange component would form face to face contact with said wall portion that is folded and bent over said circumferential bracket in said second flange component but without diminishing flow's cross section area inside those said two tubular conduit means.

30. A method in accordance with claim. 29, wherein said method includes in addition a stage of

parting at least one of said two flange components that are formed as a bisected ring in order to install it on said tubular conduit means from the side and alleviating said folding and bending of said wall portion of said tubular conduit means over said circumferential bracket formed in said flange component.

31. A method in accordance with claim 29, wherein said method includes in addition a stage of

soldering said portions of said walls one to the other.

32. A method for positioning by heat welding said outlet tubules from the outside, along said tubular conduit means serving in said irrigation system in accordance with claim 4, wherein said method includes the stages of

establishing the location at the wall of said tubular conduit intended for connecting said outlet tubule; and

creating an opening at said wall of said tubular conduit means in a selected site intended for connecting said outlet tubule while biasing the edge of said opening to bend and be pulled so that it protrudes beyond the external surface area of said tubular conduit means; and

positioning said outlet tubule from the outside, wherein an end of said outlet tubule is encircle the protruding edge of said opening; and

clasping the end of said outlet tubule and said protruding edge of said opening and heat welding them one to the other around their entire circumference; and

releasing said outlet tubule from the clasp of the heat welding tool and cooling said welding area.

33. A method in accordance with claim 32, wherein said method includes in addition a stage of welding the other second end of said outlet tubule and sealing it.

34. A method in accordance with claim 32, wherein it is characterized in that

said method stages are implemented while said tubular conduit means has already been formed as a tubular profile.

35. A method in accordance with claim 34, wherein it is characterized in that

said method stages are implemented within the time interval between deploying on one hand and rolling on other hand of sector of said tubular conduit means.

36. A method in accordance with claim 34, wherein it is characterized in that

Said method stages are implemented in a cyclical manner concurrently with a process of continuously deploying on one hand and rolling on an other hand of said tubular conduit means, and said method further comprises a stage of

propelling bracket assembly and heat welding tool in a velocity that is essentially equal to the speed of the wall of said tubular conduit means while it is spreading on a one hand and rolling anew on a second hand and moving in said direction of said wall until heat welding of said outlet tubule to said wall is completed.

37. A manufacturing array for positioning by heat welding of said outlet tubules from the outside, along said tubular conduit serving in an irrigation system in accordance with claim. 4, wherein said array includes a bracket assembly that is

amenable to be located within said tubular conduit means, wherein it is - bounded at its location between a deploying assembly from which said tubular conduit means is unloaded to said rolling anew assembly that on it said tubular conduit means is rolled anew; and

adapted to carry the flow of said wall of said tubular conduit means on it surface; and

includes a piercing tool in order to open an opening in said wall of said tubular conduit means at the location intended for connecting said outlet tubule, while biasing said edge of said opening to bend and be pulled so that it protrudes outwards from said external surface area of said tubular conduit means; and

it is amenable to be located opposite the intended location for connecting said outlet tubule; and

feeding and leading means for poisoning said outlet tubule upon said external surface area of said tubular conduit means in a manner that said end of said outlet tubule clasps said protruding edge of said opening; and

heat welding means for clasping said end of said outlet tubule and said protruding edge of said opening and heat welding one to another around their circumferences.

38. A manufacturing array in accordance with claim. 37, wherein it includes in addition–

an additional soldering means for soldering the second end of said outlet tubule and sealing it at its end tip.

39. A manufacturing array in accordance with claim 37 wherein said bracket assembly is bounded as said between said deploying assemblies and said rolling anew assembly by two assemblies of cylinder arrays.

40. A manufacturing array in accordance with claim 37, wherein said bracket assembly is adapted to the flow of said wall of said tubular conduit means on its surface by using a cylinders setup that is installed on it.

41. A manufacturing array in accordance with claim. 37, wherein said array is operated cyclically, through deploying on the one hand and rolling on the other hand in a continuous run of said tubular conduit means, and said array further comprises

propulsion means for moving said production array in a velocity that is essentially equal to the speed of the movement of the wall of said tubular conduit means while it is deploying on a one hand and rolling anew on the other and continues in said direction of said wall movement until heat welding of said outlet tubule unto said wall is completed.

42. A method for repairing holes in a tubular conduit means of an irrigation system in accordance with claim 1 that includes the stages of forming said hole into an essentially smooth shape at its circumference; and

forcing a spongy material into said hole.

43. An irrigation system in accordance with any of claims 1 to 28 as was exemplified herein above with reference to the accompanying figures.

44. A method for connecting one tubular conduit means in series to a second tubular conduit means in an irrigation system in accordance with any of claims. 29 to 31, as exemplified hereinabove with reference to the accompanying figures.

45. A method for positioning by heat welding outlet tubules from the outside, along a tubular conduit means in accordance with any of claims 32 to 36, as exemplified hereinabove with reference to the accompanying figures.

46. A manufacturing array for positioning by heat welding outlet tubules from the outside, along a tubular conduit means, in accordance with any of claims 37 to 41, as exemplified hereinabove with reference to the accompanying figures.

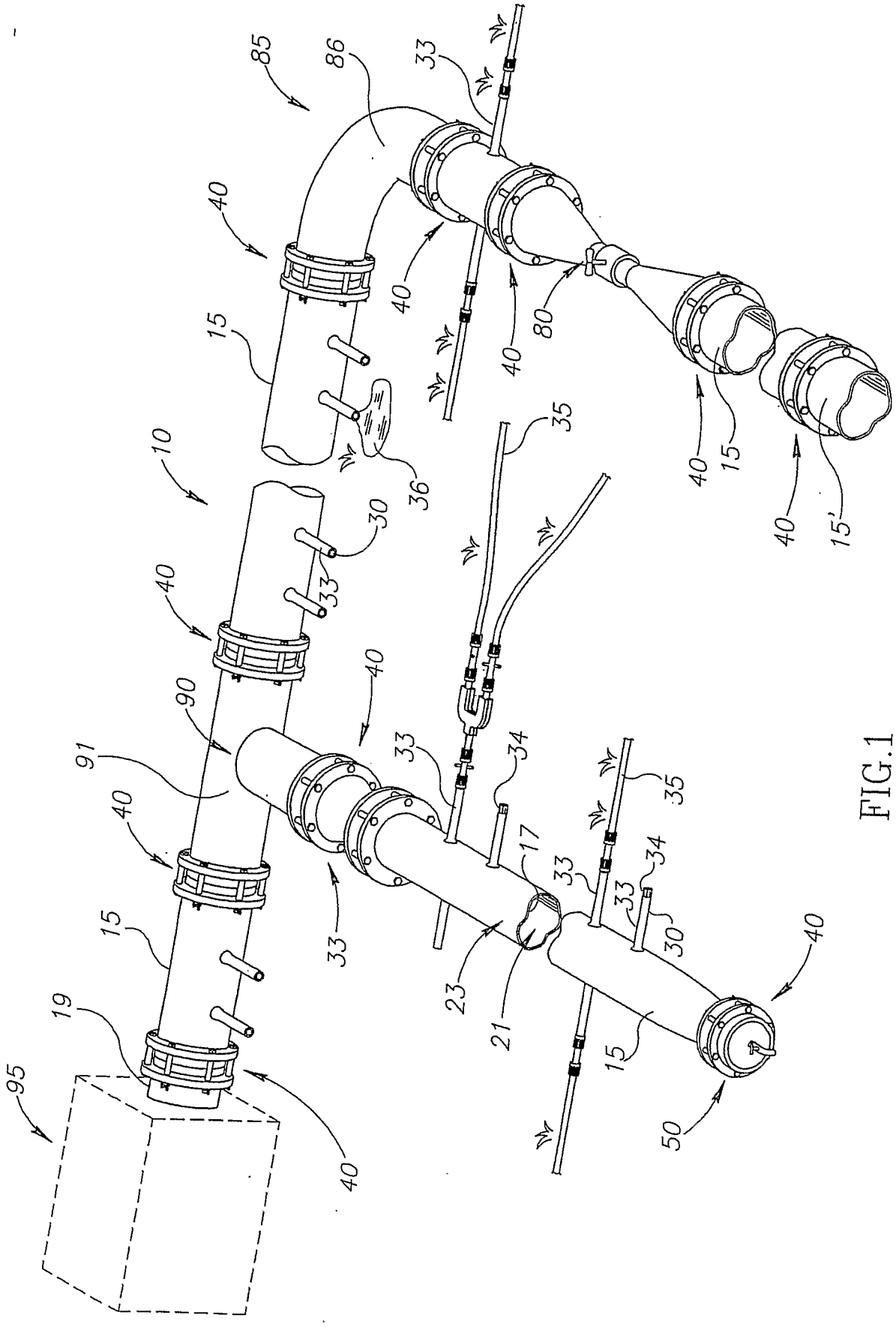

FIG.1

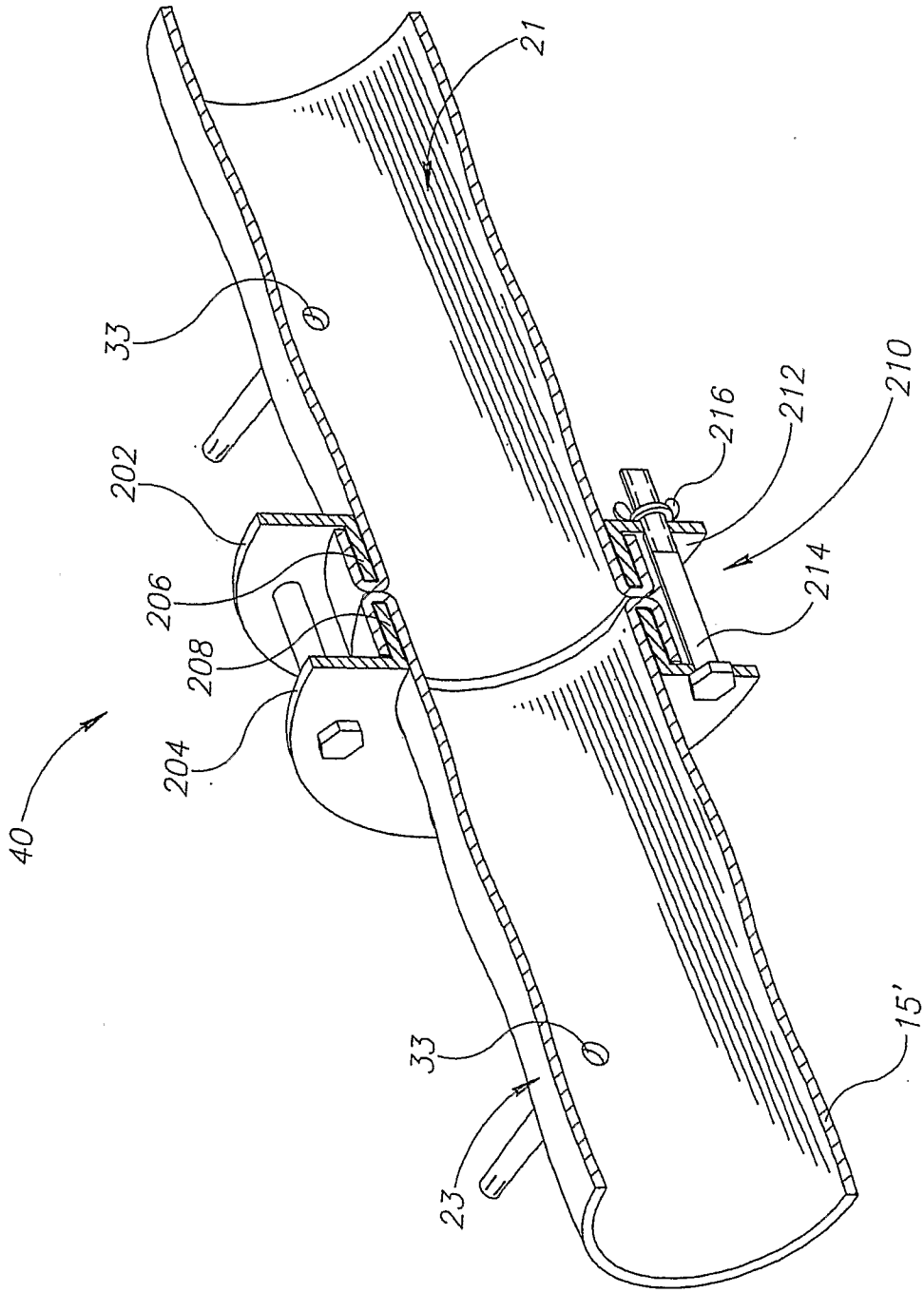

FIG.2

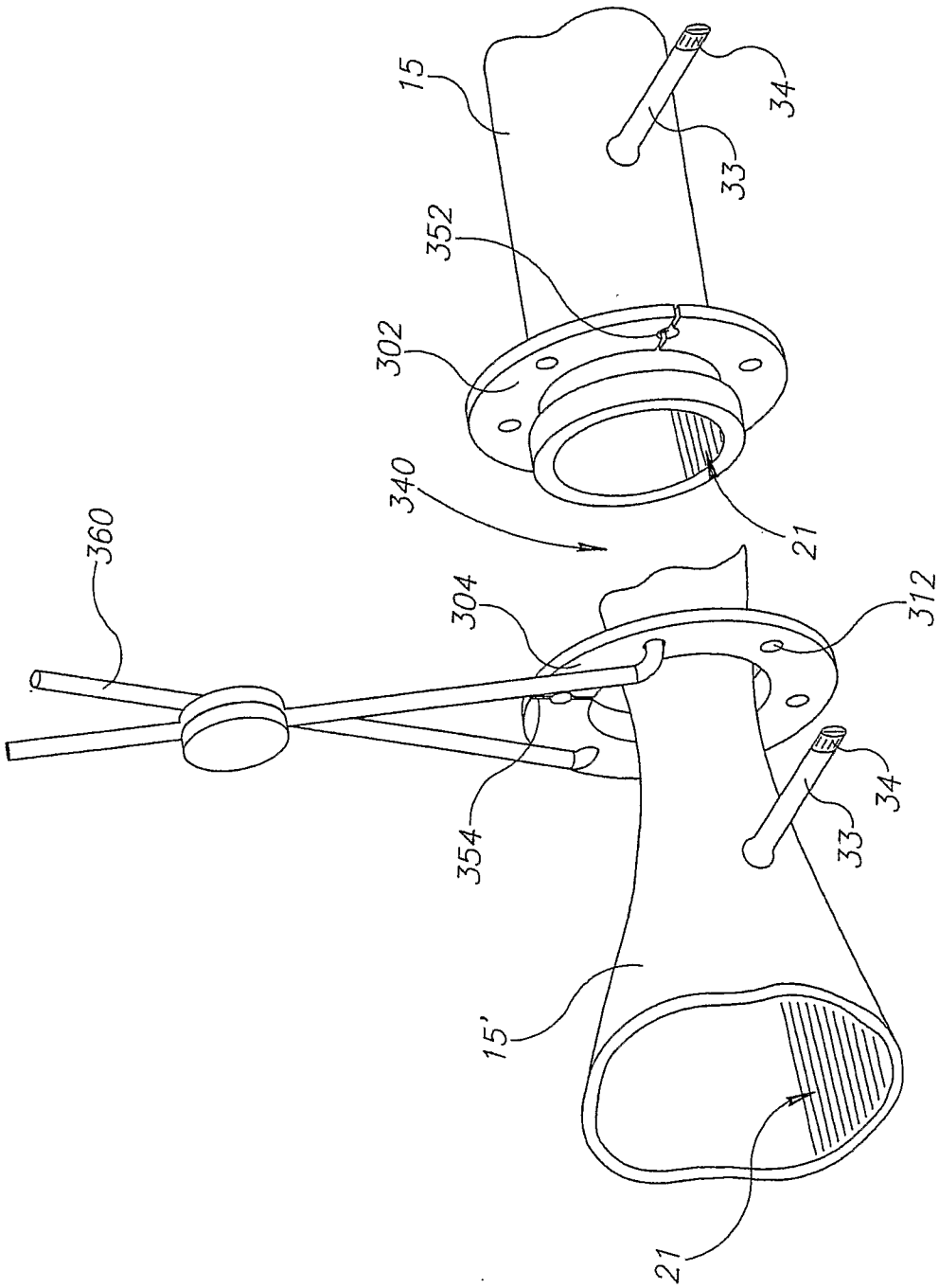

FIG.3

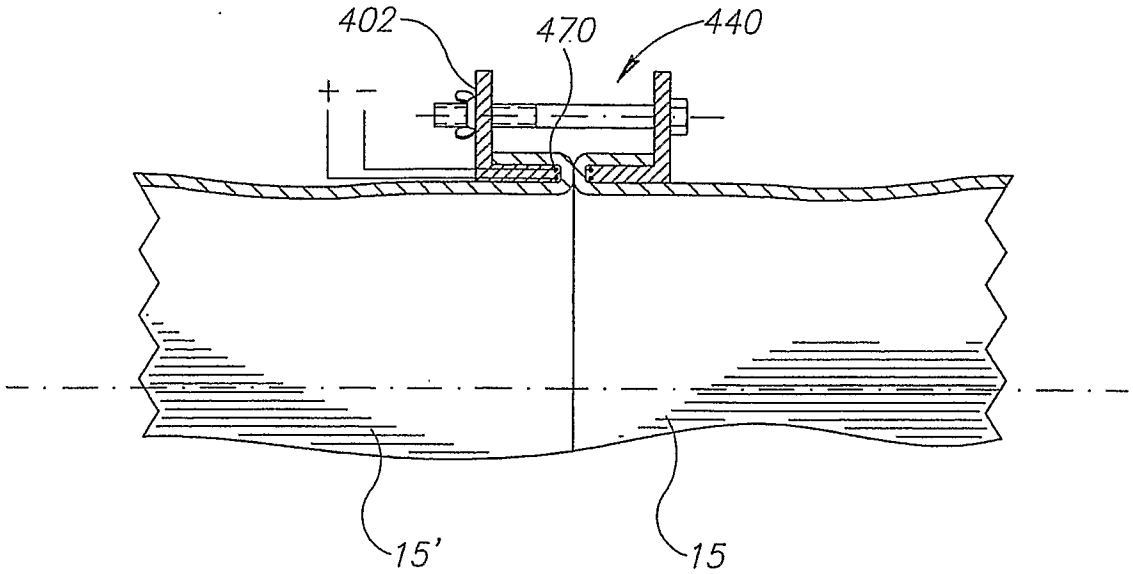

FIG.4

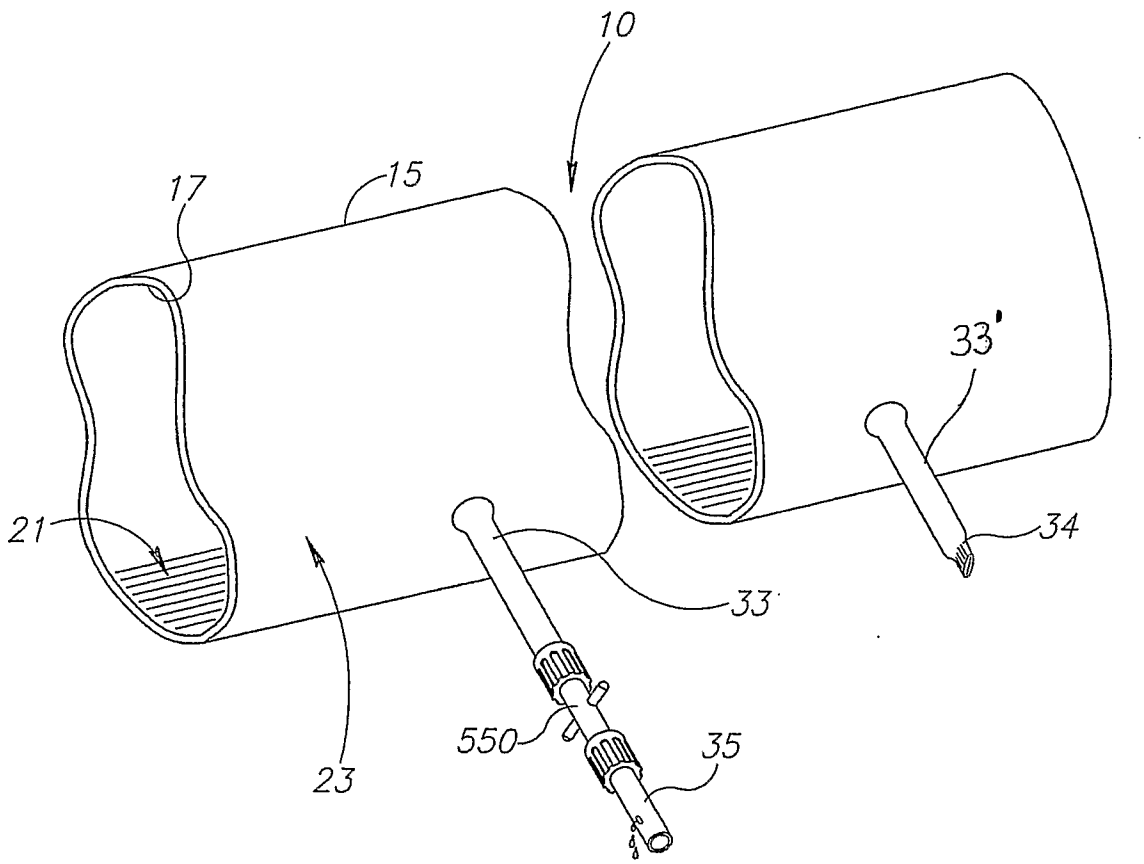

FIG.5

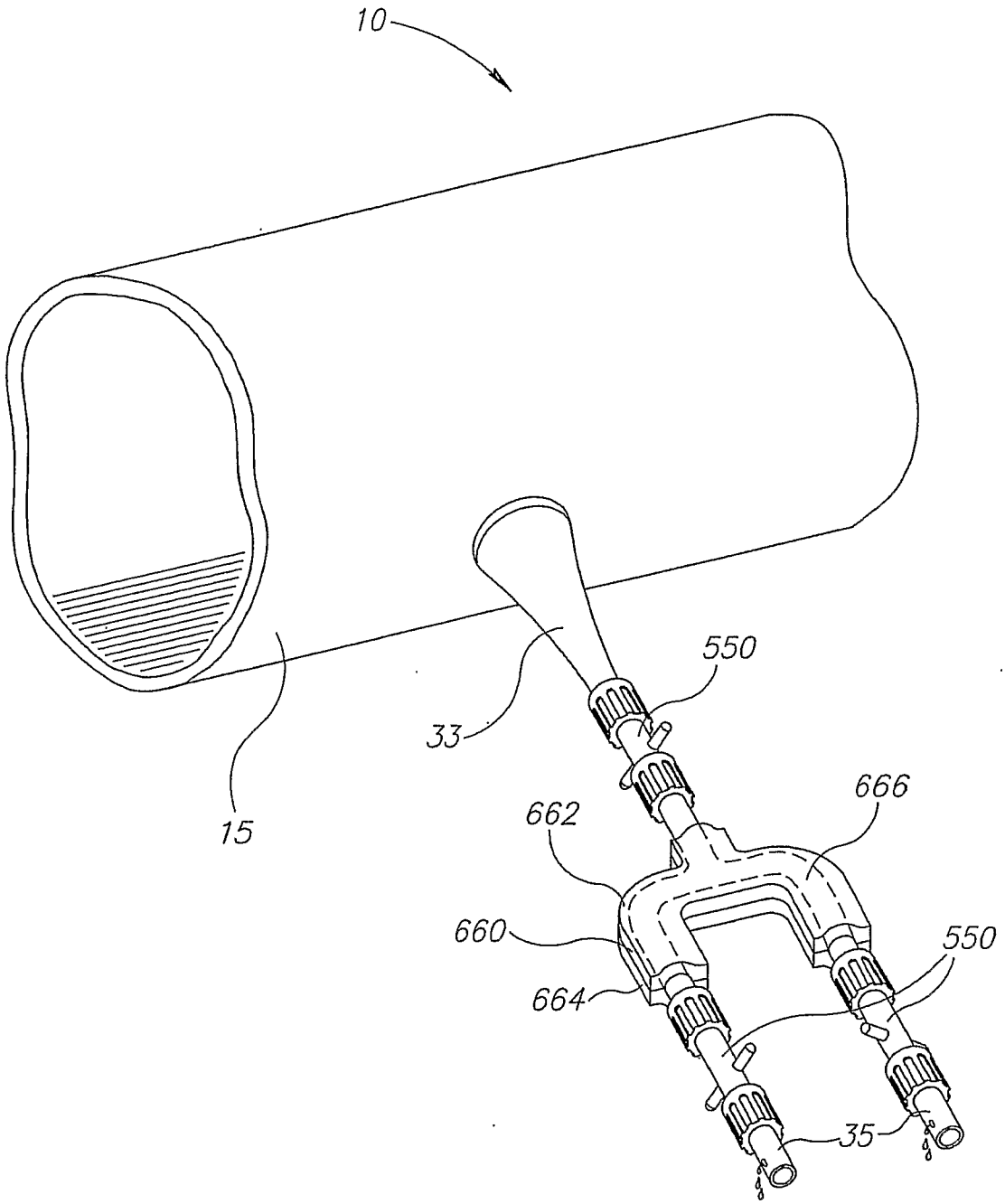

FIG.6

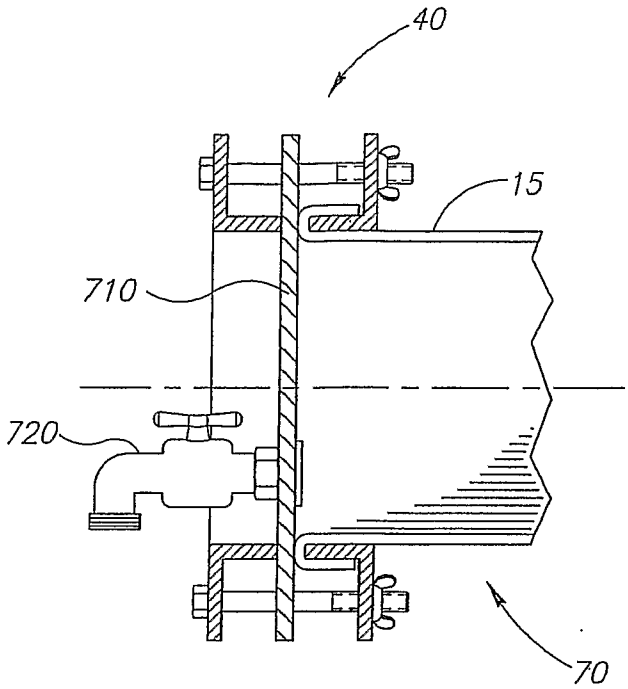

FIG.7

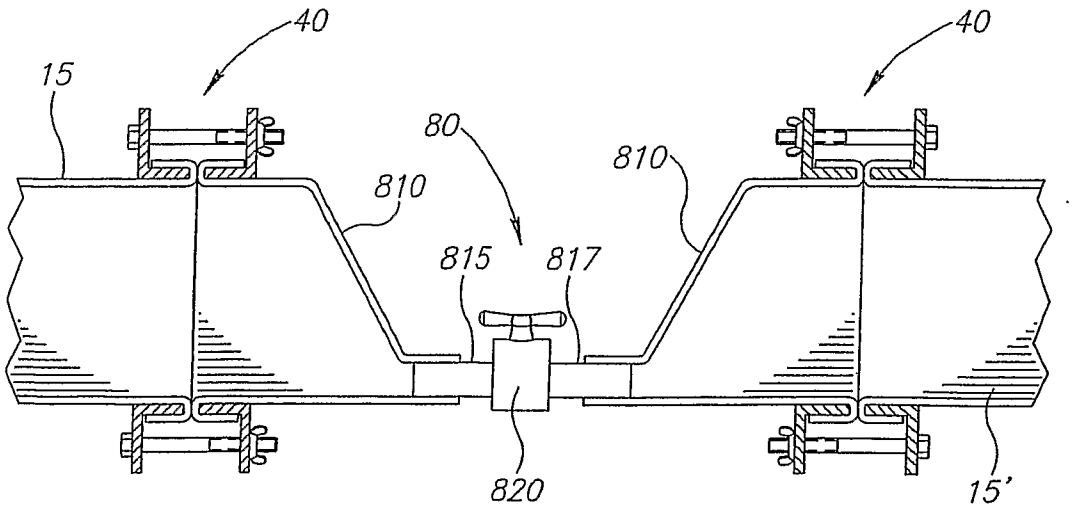

FIG.8

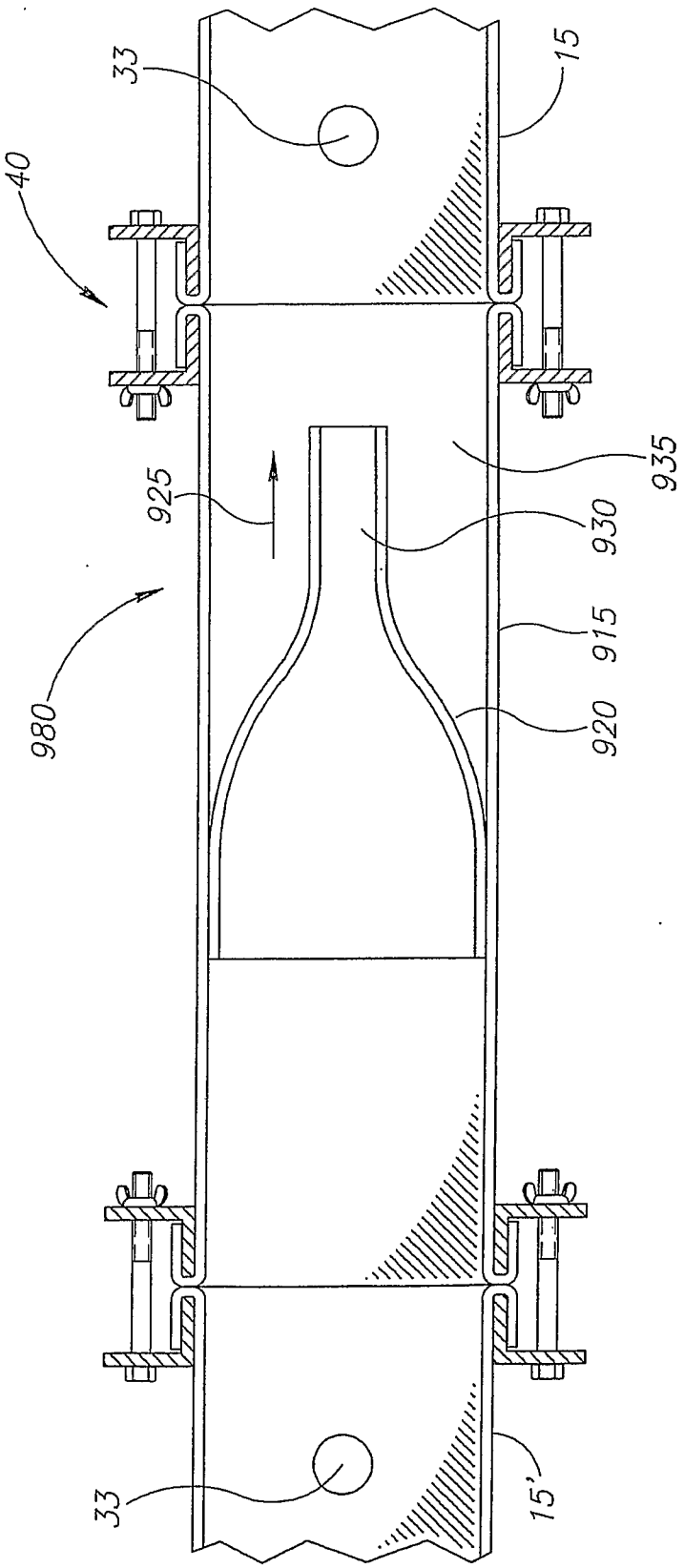

FIG.9

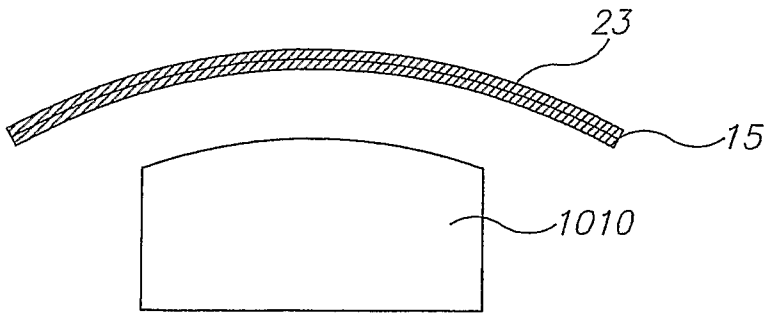

FIG.10A

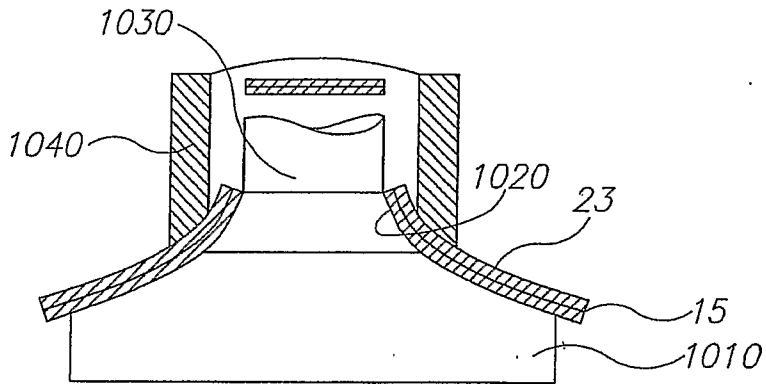

FIG.10B

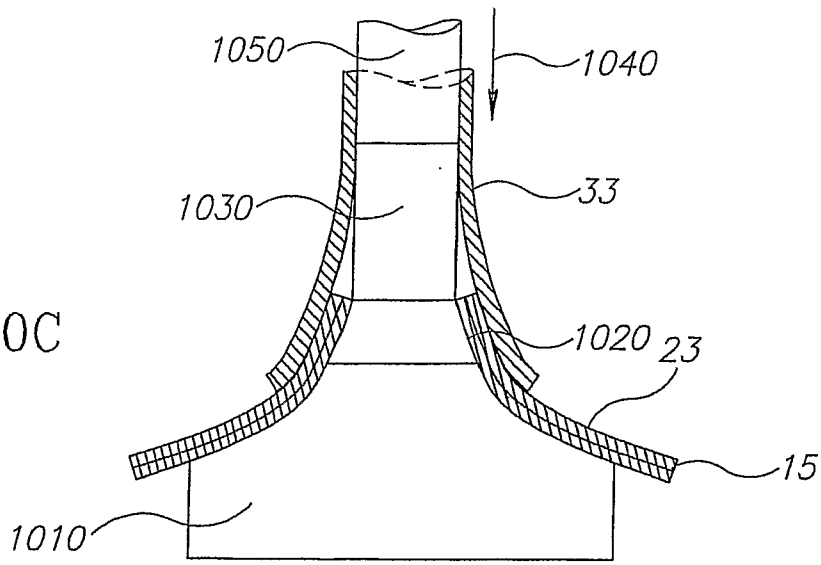

FIG.10C

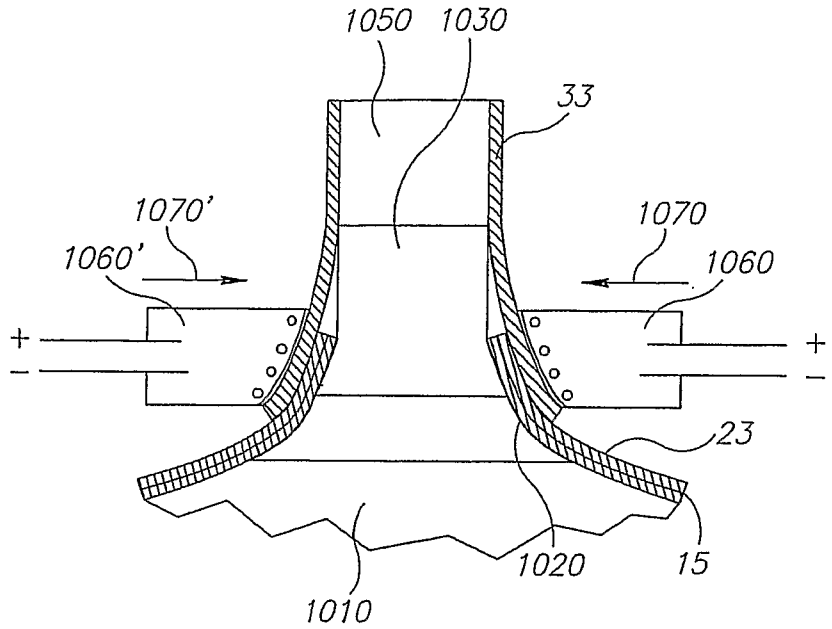

FIG.10D

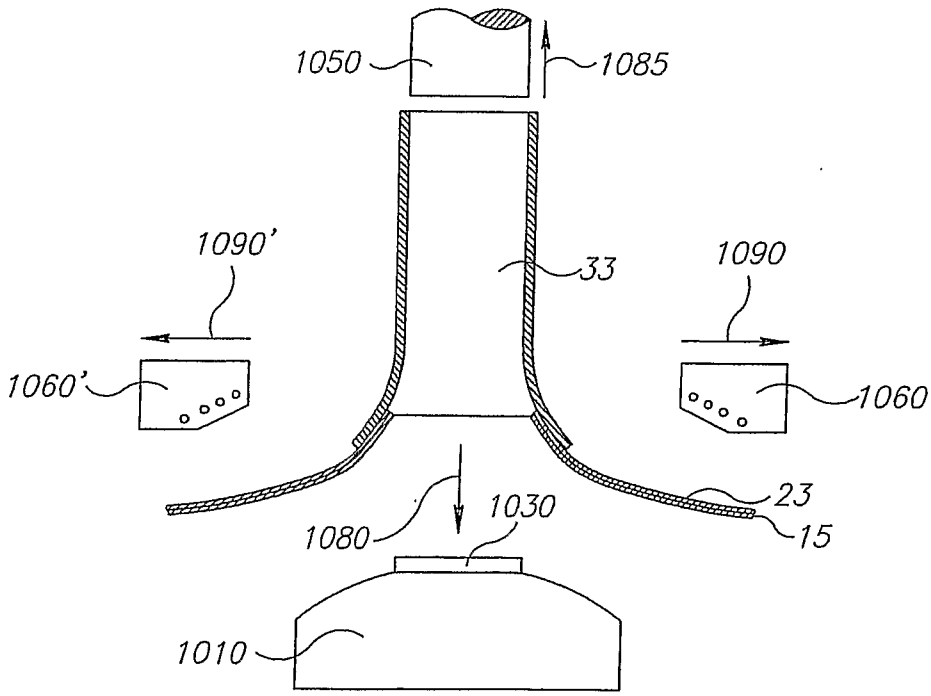

FIG.10E

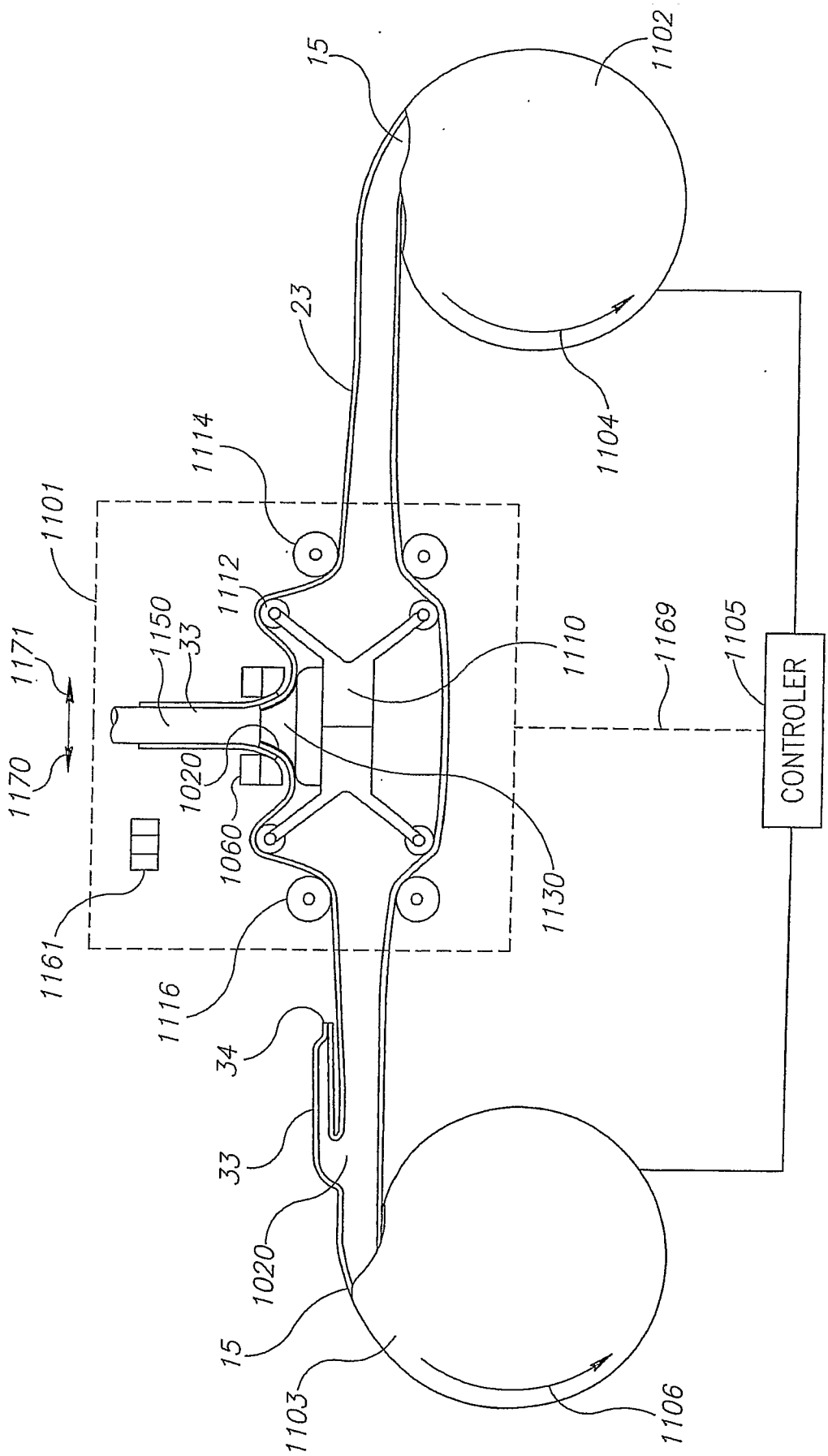
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FIG.11