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(54) Seal for pressurized equipments through which the material to be treated is conveyed

(57) The entry f1 into the pressure treatment space (11) of the equipment and the exit f3 therefrom consist of ducts (13,15), each duct having an intermediate portion (13A, 15A) of high hydraulic resistance; in points (25, 25A) between said intermediate portion and the treatment space (11) a liquid is introduced under the same or slightly higher pressure than that existing in the treatment space (11); the liquid under pressure prevents the aeriform substance from exiting the treatment space (11), whereas the flow of said liquid towards the outside is limited by the intermediate portion (13A; 15A).

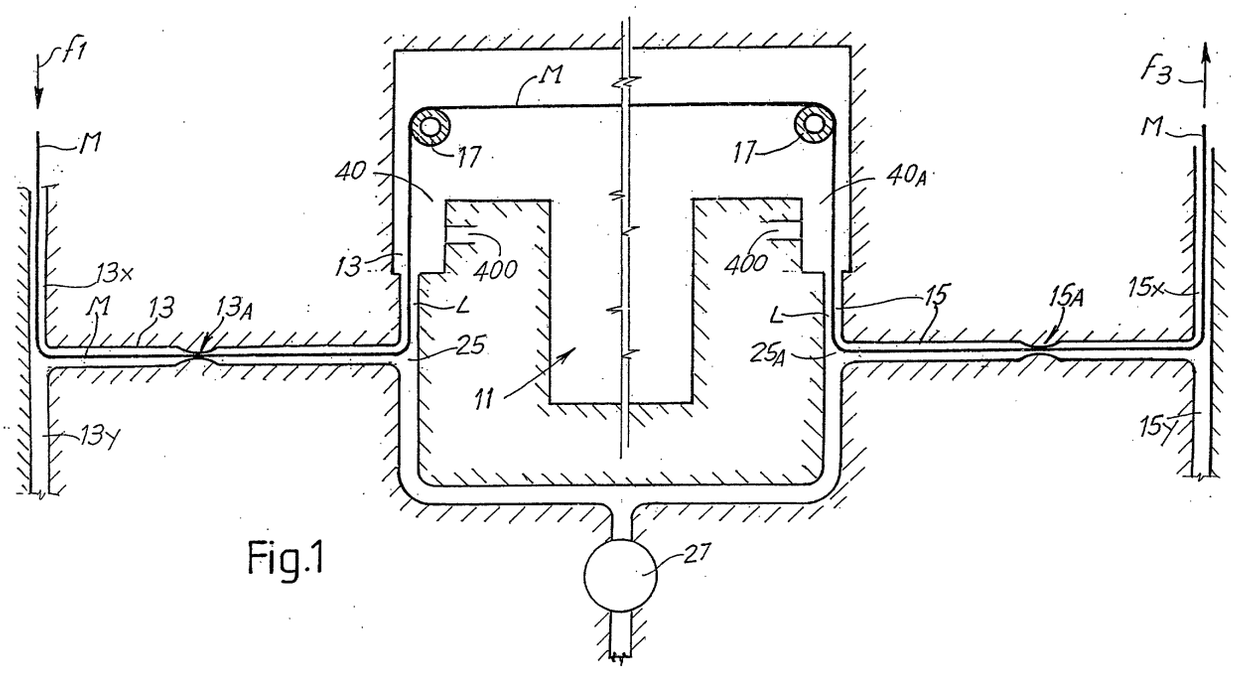


Fig.1

EP 1 325 974 A2

Description

[0001] The invention relates to a method and to the respective equipment for continuously submitting a material in rope or in width, such as fabric, any kind of sliver or other material, to a treatment at a higher pressure than atmospheric pressure, at a high temperature, also in the presence of vapor and gas to be kept insulated from the external environment.

[0002] To carry out the aforementioned treatments in a continuous way, different methods and devices have been proposed, but with the current solutions it is not possible to realize a perfect seal between the treatment space and the entry and the exit, respectively, of the material to be treated. Accordingly it is also possible to have a substantial output of gas and vapors - also hot - to the environment.

[0003] Such output means a waste of energy, problems in proximity of the device and often damage or corrosion of seal members, with an increase in operating and maintenance costs.

[0004] The purpose of the invention is to solve these problems and also to achieve further aims and benefits, which will be evident from the description hereinbelow.

[0005] The invention relates to a sealing device in pressure equipments through which material to be treated - such as fabrics, yarns, slivers or films- continuously flows, which presents at the entry into the pressure treatment space and/or at the exit of this space of the equipment a portion with reduced section or anyhow featuring high hydraulic resistance, in which there is a fluid, which can be gas or vapor at high viscosity or preferably a working fluid, which is fed into this treatment space with at least an equal or slightly higher pressure than the one prevailing in the treatment space, to circulate in this portion towards the outside, while being discharged between this portion and outside, and to keep a water head with respect to the treatment space.

[0006] For the sake of simplicity it will be referred to as a working fluid hereinbelow.

[0007] The working fluid can be introduced by a propelling device (such as pump or similar) or be drawn from one inlet tank at a level at which a water head is created, and can be discharged and collected in a collecting tank for its disposal and/or possible recovery. As an alternative, it is possible to make the working fluid circulate into a closed circuit through a re-circulation circuit using a pump, which draws the working fluid downstream of the high hydraulic resistance portion and reintroduces it again between this portion and the treatment space.

[0008] Each high hydraulic resistance portion of both the entry and the exit ducts can be comprised of a reduced section, namely an extended slit having a slightly larger section than that of the material to be treated, to enable the passage of the material in laminar mode, that is laid down. In this case each entry and exit duct can advantageously feature more connections along said extended slit section, to even out the flow along the path.

[0009] According to a possible alternative, each high hydraulic resistance portion can include: one set of reduced sections causing pressure drops in series; or one labyrinth arrangement, having a similar function; or also at least an even resiliently flexible obstacle, which adapts the reduced section depending on dimensional features of passing material, even when unequal; or, again, at least a dimensionally adjustable obstacle for example a pressure-controlled air chamber or alike.

[0010] In a further possible embodiment, at least one of these entry and exit ducts extends partially as an air gap between a rotor with horizontal axis, onto which the material to be treated is guided and its direction of motion reversed, and a mantle surrounding it; in the area of this air gap with which the material is provided the portion with reduced section is formed, while in the area of said air gap free from said material a seal shield between the rotor and the mantle is foreseen.

[0011] An inert gas supply may be provided at the inlet duct and/or at the outlet duct, between the inlet point of the liquid and the connection to the treatment area, to avoid the contact between the gas or the vapour contained of the treatment space and the working fluid contained in the inlet and outlet ducts; this inert gas can be renewed cyclically.

[0012] Means to recycle and/or replace and/or reintegrate cyclically the working fluid contained in the inlet and outlet ducts can be foreseen.

[0013] Said working fluid in each of the entry and exit ducts can be chosen so as to exercise a certain action onto the material passing by; the two working fluids can also be different.

[0014] If the two working fluids are different it is necessary to foresee a double system of liquid inlet and/or a double recycling system, while if the two working fluids are the same, and other needs are compatible, a common inlet system for the working fluid in the two inlet and outlet ducts can be foreseen.

[0015] Filtering and/or conditioning means of the working fluid which is fed can also be foreseen, especially when a recycle is foreseen.

[0016] The high hydraulic resistance portion may advantageously be provided with seals adapted to reduce the flow of the working fluid in said portion such as to limit the required capacity of the pump.

[0017] The finding will be better understood following the description and the attached drawing, which shows a non-limiting practical example of the finding itself. In the drawing:

- Fig. 1 to 4 show schematic and illustrative diagrams of possible embodiments of the invention;
- Fig. 5 to 7 show a vertical section of an embodiment following lines VI-VI and VII-VII of Fig.5;
- Fig. 8, 9 and 10 show a vertical section following lines IX-IX and X-X of Fig.8;
- Fig. 11 to 18 show possible system solutions to ob-

tain high hydraulic resistance.

[0018] The same references indicate the same or similar elements in the different illustrated solutions.

[0019] According to what is shown in the diagram of Fig.1, 11 denotes the treatment space or chamber consisting of a chamber, through which the material M to be continuously treated flows. Said material may be fabric or a yarn assembly or rope structure or a continuous or discontinuous sliver or elements which are carried by a continuous transport base; such material M is introduced as indicated by arrow f1 and comes out as indicated by arrow f3 along paths which partially extend into two inlet (13) and outlet (15) ducts; in addition to these ducts the material is also further guided through chamber 11 by guiding means wholly denoted by 17 or alike, which may also be provided along said ducts 13 and 15; the outlets of the two ducts 13 and 15 into the treatment chamber 11 are denoted by 40 and 40A. Each of the two ducts 13 and 15 features a reduced section portion or an equally high hydraulic resistance portion denoted by 13A and 15A respectively, through which the material M passes anyway. In each of said ducts 13 and 15, in areas 25 and 25A respectively, a working fluid is fed, which can be "inert" or active, i.e. exercising a certain function onto the material passing by. Areas 25, 25A are located lower than outlets 40 and 40A.

[0020] In the diagram of Fig. 1 (and in that of Fig. 2) a working fluid L has been foreseen, which is the same in both ducts 13 and 15. The introduction of the working fluid can therefore be ensured by one device 27, such as a pump, which will be adjustable in order to set, at inlet points 25 and 25A, a pressure, which is equal to or slightly higher than that existing in the treatment space. Pump 27 will be adjusted to ensure at any time the correct setting of the working fluid L level in the portion of the duct 13 and/or 15 opening into chamber 11; this portion advantageously has a larger section to facilitate the control by sensors, which should control the pump operation to correct and keep the working fluid level within predetermined limits.

[0021] Due to pressure difference between the external environment, from which material M comes and to which material M returns as indicated by f1 and f3, and the internal environment of the treatment chamber 11 (and due to movement of the material in the outlet duct 15), the working fluid L tends to escape from the branch of ducts 13 and 15 which communicates with the treatment chamber 11 towards the outside both at the inlet and at the outlet of the material.

[0022] High hydraulic resistance portions 13A and 15A allow to limit the flow of such leakage, keeping the required pressure at points 25 and 25A, i.e. slightly higher than that existing in chamber 11.

[0023] In the diagram of Fig. 1 a splitting of ducts 13 and 15 is provided, a branch being orientated upwards for passage - in 13X and out 15X - of the material M, and a deviation 13Y and 15Y is provided to discharge the working fluid L. In the variation of Fig. 2 the two ducts 13 and 15 are not split. Other arrangements may be provided such as deflectors, spurt screens, channels or deviating pipes, section expansions, collecting vessels as indicated by a dash-dot line in Fig.2, or alike.

[0024] In the diagram of Fig.3 (and in that of Fig.4) an embodiment is indicated, in which there is a double inlet system of the working fluid, comprising two recycling pumps 27X and 27Y for working fluids which can be different or the same. With two pumps there are more possibilities for a selective adjustment of inflows into the two ducts 13 and 15.

[0025] In Fig. 3 and 4, closed circulations for the two working fluids L have been foreseen, with filtering 31 and conditioning 35 devices. The filtering and conditioning devices can be located at a different position than that indicated in the drawing, provided they are inserted in the recycle circuits.

[0026] Looking at the left part of Fig.4, an alternative embodiment is illustrated by means of stroke and point, in which the circuit of the liquid is open, with a discharge tank 36 and a feed tank 37 for pump 38 replacing the 27X one. The two tanks can be combined if the working fluid L is recycled; the working fluid can be integrated and its partial discharge will then be arranged for a progressive renewal of said working fluid L.

[0027] For the treatment of rope material, ducts 13 and 15, including portions 13A and 15A may have for example a circular section.

[0028] For fabric or sliver or film material or alike, when the treatment must be carried out with laid down material, i.e. laminar ("in width"), ducts must be developed with an extended section, that is in a slit form.

[0029] This type of solution is shown in Fig. 5 to 7. Herein, duct 113 (corresponding to inlet 13) is illustrated, with a high hydraulic resistance portion 113A corresponding to 13A and with a recycle circuit 123 corresponding to 23 and equipped with a pump 127 for the circulation of recycling working fluid L as indicated by arrow f17 from inlet branch (as indicated by arrow f1) to the branch opening into the treatment chamber 11. This arrangement features a section of the duct 113 (and accordingly of outlet conduit corresponding to 15) developed as a transversal slit; therefore, it is necessary to assure a regular intake by pump 127 in the intake portion 123A and also in the inlet portion 123B towards the branch of duct 113 that reaches chamber 11. To achieve this, the recycle circuit 123 is formed by a plurality of connections 123C suitably sized and distributed along the transversal extension between the reduced section 113A of duct 113, and the parts 123A and 123B of the recycle circuit 123; in this way the inflow and the withdrawal of the working fluid L are substantially regular along the slit transversal section of duct 113.

[0030] The recycle circuit 123 could include also in this case conditioning means for cooling and heating or alike. In the area of the reduced section 113A one system for adjusting one transfer slit or other similar ar-

rangements could be foreseen, to adjust the size of this slit according to the material to be treated, to get the max. hydraulic resistance compatibly with the need to ensure the passage of the material. This system can, if necessary, be replicated.

[0031] In fig. 8 to 10 a further embodiment is shown of either of the two ducts (that, in this case, can be U-shaped), in particular the inlet duct 213 equivalent to those numbered 13 or 113.

[0032] The feed of the material M according to arrow f1 occurs in a portion with elongated inlet section 213A, whereas numeral 213B denotes the branch - partially of widened section - opening into the schematically sketched treatment chamber 11. The intermediate portion between the two portions 213A and 213B of inlet duct 213 extends like an air gap 213C between a mantle 245 and a rotor 247 which is surrounded by said mantle; the material M passes through this air gap 213C and the connections 223C of the two parts 223A and 223B of duct 223, respectively, into which the working fluid pump 227 is inserted. The air gap 213C is closed by a diaphragm or a seal shield 249 lying between the mantle 245 and the rotor 247, in order to ensure the forming of the duct among portions 213A, 213C, 213B, partially defined from the air gap between the mantle 245 and the rotor 247. Also in this case the inlet of the working fluid and a recycle set can be foreseen including members and devices perfectly similar to those foreseen in other embodiments.

[0033] In the portion 213C with air gap at least one section 213X at high hydraulic resistance, equivalent to those of previous solutions, has been foreseen. The air gap 213C presents one or more narrowings 213X or other high hydraulic resistance portions in the arched portion where material M is provided and flows, whereas the diaphragm or seal shield 249 is located where said material is not provided, with an even different arrangement from the one illustrated, in which the two elements 213X and 249 are vertically aligned.

[0034] In this solution with rotors 247, measures can be taken to impinge both sides of the material with the working fluid, and not only or mainly that side which is not in contact with the rotor. When the material M is permeable to liquid, it is even possible to foresee the inlet and the exit of the working fluid with both connections 223C being provided close to the diaphragm with the seal shield 249, for example in the positions indicated by arrows fT in Fig.5.

[0035] The presence of one rotor like 247 promotes the regular flow of the laminar material i.e. laid-down, such as a fabric, a sliver-shaped film or others.

[0036] In some or all solutions it can be foreseen the dragging of the material by means of pliers or pins engaging the side edges of the material M and in particular as far as a fabric is concerned, the relative selvedges thereof. In such a way, the passage of the material in the equipment for the treatment under pressure in re, becomes very regular.

[0037] In all illustrated different solutions it is possible to adopt the arrangement indicated in Fig.4 with discharge of the working fluid into a storage tank 36, for the disposal and/or recovery with regeneration and/or settling and/or filtering, and with an inlet pump 38 for the working fluid, drawing it from a tank 37 and which is still controlled to ensure the maintenance of the level of said working fluid in the inlet and exit ducts like 13 and 15. The liquid from tank 36 can be recycled into tank 37, after settling and/or filtering and/or regeneration and/or replenishing.

[0038] The working fluid L, that - as a same liquid or as two or more different ones - is provided in either duct such as 13 and 15 or 113 and the not illustrated equivalent or as 213 and the not illustrated equivalent, can advantageously be a liquid of comparatively high viscosity to reduce at most the flow through the reduced sections such as 13A and 15A or to the equivalent ones of the following examples. In areas of reduced section guiding and sealing members can be foreseen such as more or less flexible rims, small apertures, labyrinths, pressure rollers in contact with the material and others, in order to reduce the flow section of the liquid L during the continuous passage of material M. On the other hand the liquid L in each of the inlet and exit ducts can be replenished either cyclically or systematically replaced by foreseeing an inlet and optionally a withdrawal by means for example of a overflow, as this overflow can be provided on the inlet respectively exit branch and on the branch in communication with the treatment chamber like 11, in order to gain the possibility of replenishing or cyclical or continuous replacement of said liquid L in each of the entry and exit ducts such as 13 and 15 of Fig.1 and those of the following examples.

[0039] A gas cushion - wherein the gas is preferably heavier than those gases or vapors which are provided in space 11 - can be foreseen in the inner branch of at least one of the ducts, such as 13 or 15, which is in communication with the treatment space 11, to avoid any contact of the liquid of said ducts with said gases or vapors. This inert gas can be fed with a supply referred to with 400 in fig. 1 to 4.

[0040] In the illustrated diagrams, where the treatment of the flat sliver-shaped material M has been foreseen, it connections 123C, 223C are foreseen and alike for an even distribution of the working fluid flow; this will also be followed by other measures or replaced by them to get an as much as possible homogeneous flow along the sections for the passage of the material, which can also extend through a very elongated slit.

[0041] Fig.11 to 18 show many possible solutions of arrangements permitting the pressure drop and the reduction of flow in the high hydraulic resistance points and forming seals, such as 13A and 15A and those equivalent in all different solutions, to limit the quantity of working fluid escaping to the atmosphere.

[0042] In Fig. 11 and 13 arrangements are foreseen with one or more resiliantly flexible metal sheets. In Fig.

14 and 15 suitable baffles are foreseen to create labyrinths or subsequent sections. In Fig. 16 and 17 the use is foreseen of one or more deviating and/or pressure rollers. Fig. 18 shows one solution with blisters provided with a flexible or even elastic wall, which can be adjusted with the variation of the fluid pressure inside them.

[0043] It shall be understood that the drawing is just an illustrative representation of the finding, without any limiting purposes, as it can vary in form and arrangement without going beyond the scope of the inventive concept of the finding itself. The possible presence of reference numbers in the enclosed claims has the purpose to make the reading of the claims with reference to the description and to the drawing easy, and does not limit the scope of protection set by the claims.

Claims

1. Sealing device in pressure equipments through which material to be treated - such as fabrics, yarns, slivers or films- continuously flows, **characterized in that** it comprises an inlet duct (13) in the pressurized treatment space (11) and an exit duct (15) from said treatment space, wherein each of such ducts has one area at high hydraulic resistance (13A; 15A), in form of a reduced section, and a fluid and in particular a working fluid fed into an inlet area (25, 25A) arranged between the treatment space (11) and the respective high hydraulic resistance area (13A, 15A), being provided in each of the ducts, a feed (27) of said working fluid being foreseen which sets in said inflow area at least an equal or lightly higher pressure than the one which is present in the treatment space (11), so the working fluid circulates in said high hydraulic resistance area towards outside, with discharge between said area and outside.

2. Device according to claim 1, **characterized in that** said inlet areas (25, 25A), are arranged at a lower level with respect to the outlets (40 and 40A) of said ducts (13, 15) in the treatment space (11).

3. Device according to claim 1 or 2, **characterized in that** the end part towards outside of each inlet (13) and outlet (15) ducts respectively into and out of the treatment space splits into two portions, a preferably rising one through which the material is made enter and exit and a preferably descending one from which the working fluid exits.

4. Device according to at least claim 1 or 2, **characterized in that** said feed is carried out through a pump drawing the working fluid from a tank (37) and **in that** the working fluid is discharged and collected in a storage tank (36) for disposal and/or possible recovery.

5. Device according to claim 1 or 4, **characterized in that** the working fluid discharged is recycled through a circulation in a closed circuit by means of a ricirculation pump (27).

6. Device according to claim at least 1 or 5, **characterized in that** the recycle circuits are two, one for the inlet (13) and the other for the outlet (15) ducts, each ducht being provied with a respective ricirculation pump.

7. Sealing device according to at least claim 1, **characterized in that** the high hydraulic resistance areas of the inlet and outlet ducts extend with an elongated slit, for the passage of material (M) according to a laminar prifile i.e. laid down.

8. Device according to claim 7, **characterized in that** each of inlet and outlet ducts has a plurality of connections (123C, 223C) along said elongated slit, for the distribution of the working fluid in the elongated slits.

9. Device according to at least claim 1, **characterized in that** at least one of said inlet and outlet ducts partially extends as an air gap (213) between a rotor (247) having horizontal axis and a mantle (245) surrounding it, the area with reduced section (213X) being foreseen in a part of said air gap where the product passes through and a sealing shield (249) between the rotor (247) and the mantle (245)being foreseen in the remaining part of said air gap.

10. Device according to at least one of the previous claims, **characterized in that** it comprises a feed of a gas (400) above the internal level of the working fluid, to avoid the contact between the gas or the vapor contained in the treatment space and the working fluid contained in the inlet and outlet ducts (13, 15), said gas being renewed cyclically.

11. Device according to claim 1, **characterized in that** it comprises means (300) to recycle and/or replace and replenish cyclically the working fluid contained in the inlet and outlet ducts.

12. Device according to at least claim 1, **characterized in that** it comprises filtering and/or conditioning means of the working fluids, in the pumped recycle circuit.

13. Device according to at least claim 1, **characterized in that** the area with reduced section (13A; 213X) is provided with sealing devices, suitable for reducing the flow of the working fluid in said area.

14. Device according to claim 13, **characterized in that** said sealing devices comprise elastic mem-

bers.

15. Device according to at least claim 13, **characterized in that** said sealing devices comprise enhancing the material to slide.

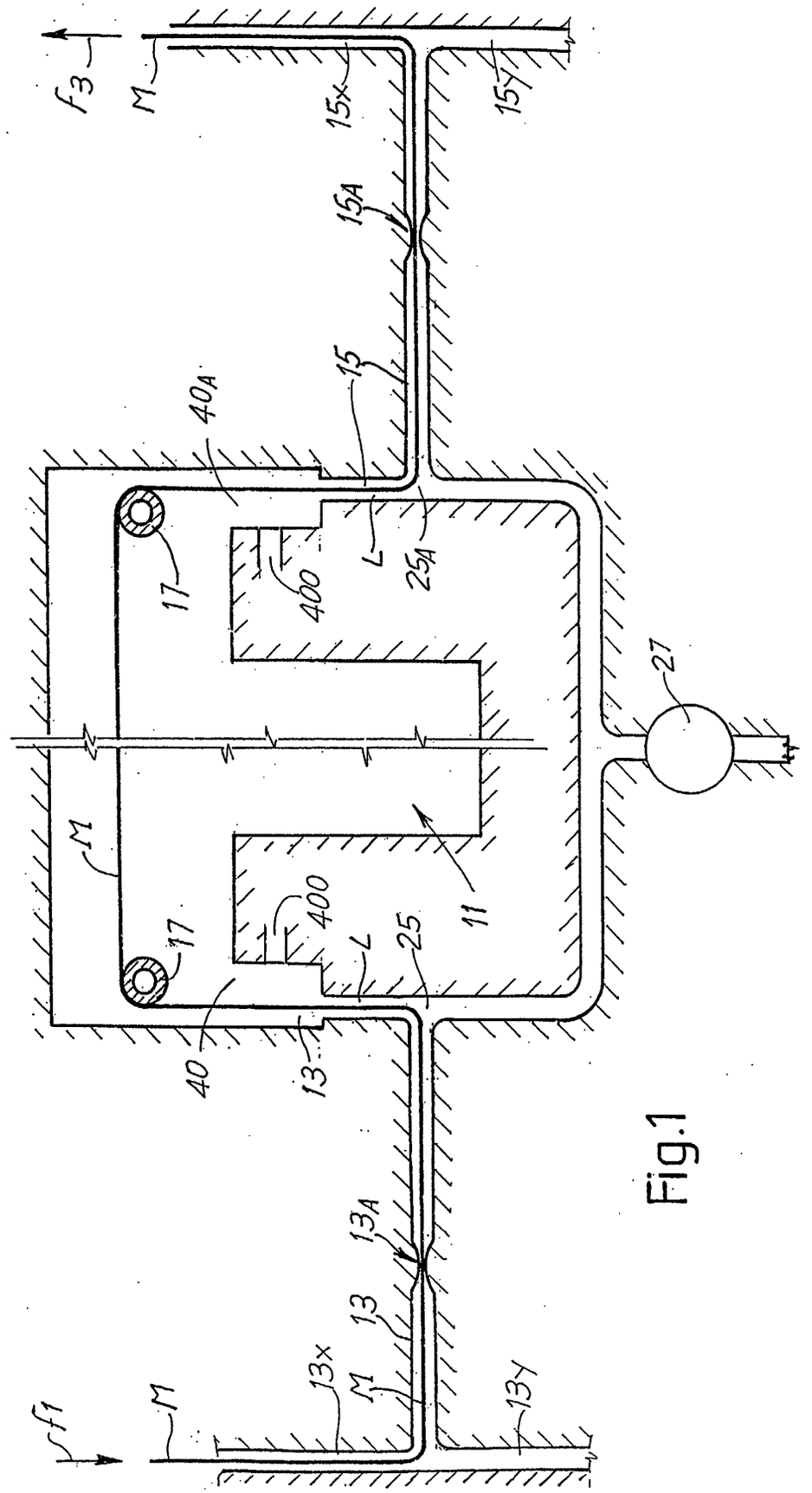
16. Device according to at least claim 1, **characterized in that** the working fluid is selected to obtain a certain action on the material passing through.

17. Device according to at least claims 1 to 4, **characterized in that** it comprises control means of the pump(s), to keep the level of the working fluid in the inlet area of said liquid, through level sensors or alike, in corrispondence with a possible widening in corrispondence with the level of the working fluid.

18. Device according to at least one of the previous claims, **characterized in that** it comprises one gas or vapor feed in the ducts over the meniscus of the working fluid, to achieve insulation with respect to the treatment chamber.

19. Device according to at least one of the previous claims, **characterized in that** the working fluid can be a vapor or a gas with high viscosity.

20. Sealing device in pressure equipments through which material to be treated flows; all as described, represented in the attached tables of drawings for exemplicative purposes.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15Y
15A
15
40A
17
400
L
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27
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13A
13
13x
M
M
F1
13Y

Fig.1

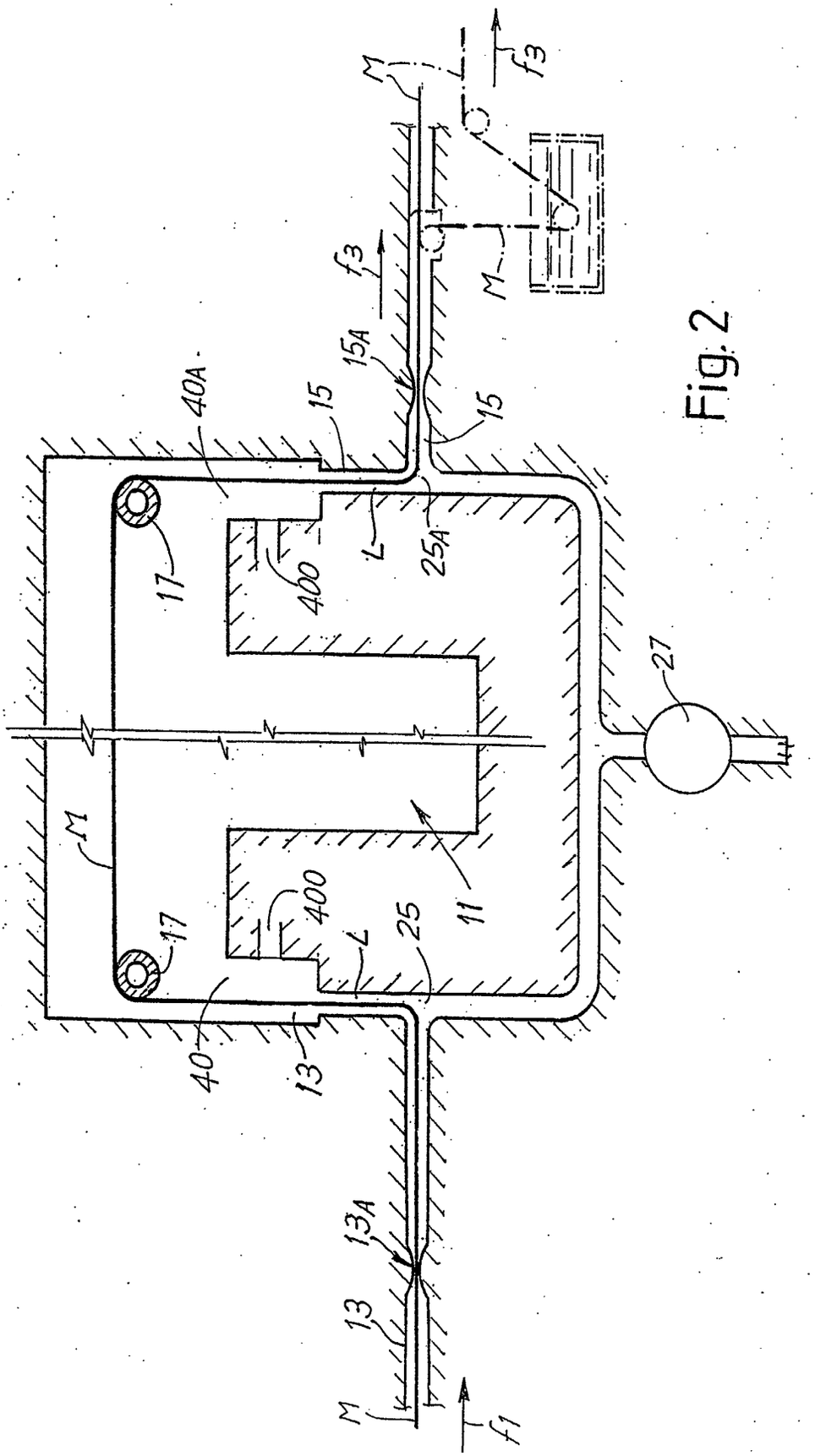

Fig. 2

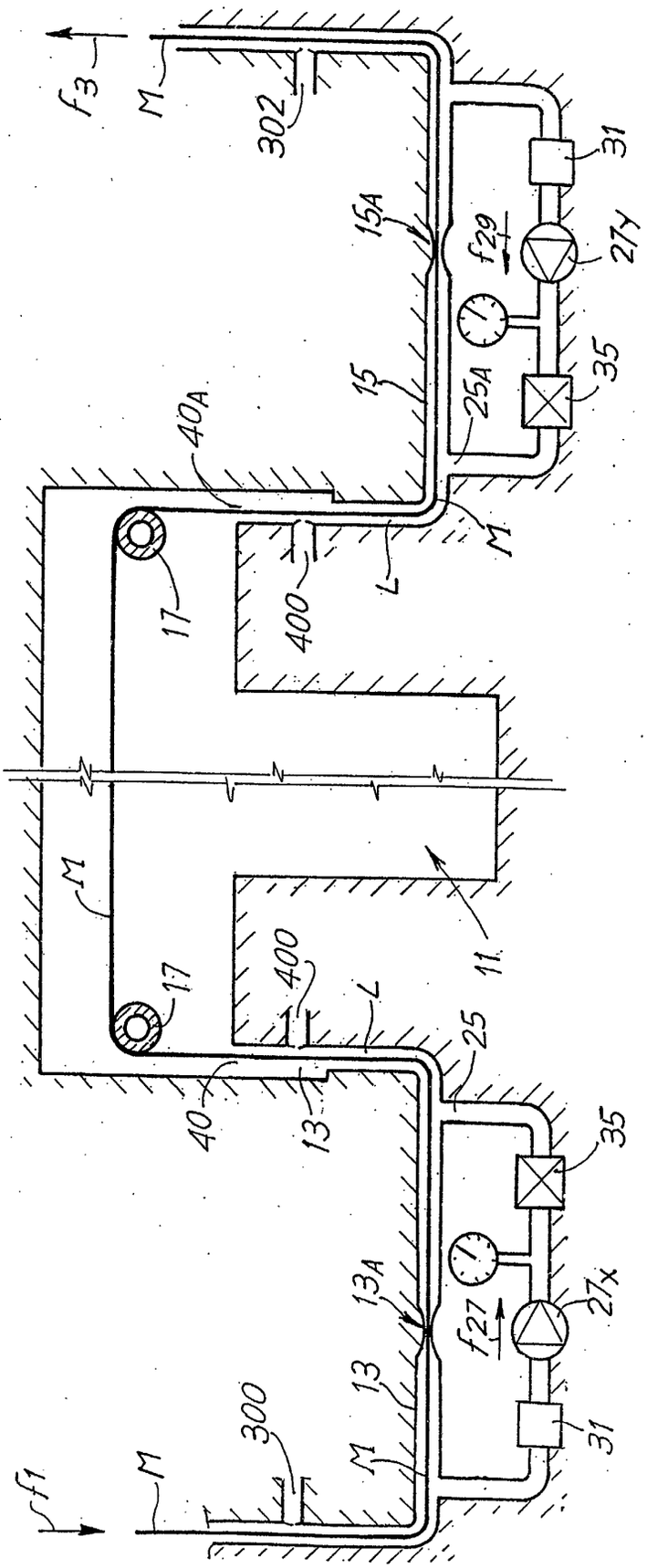
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Fig.3

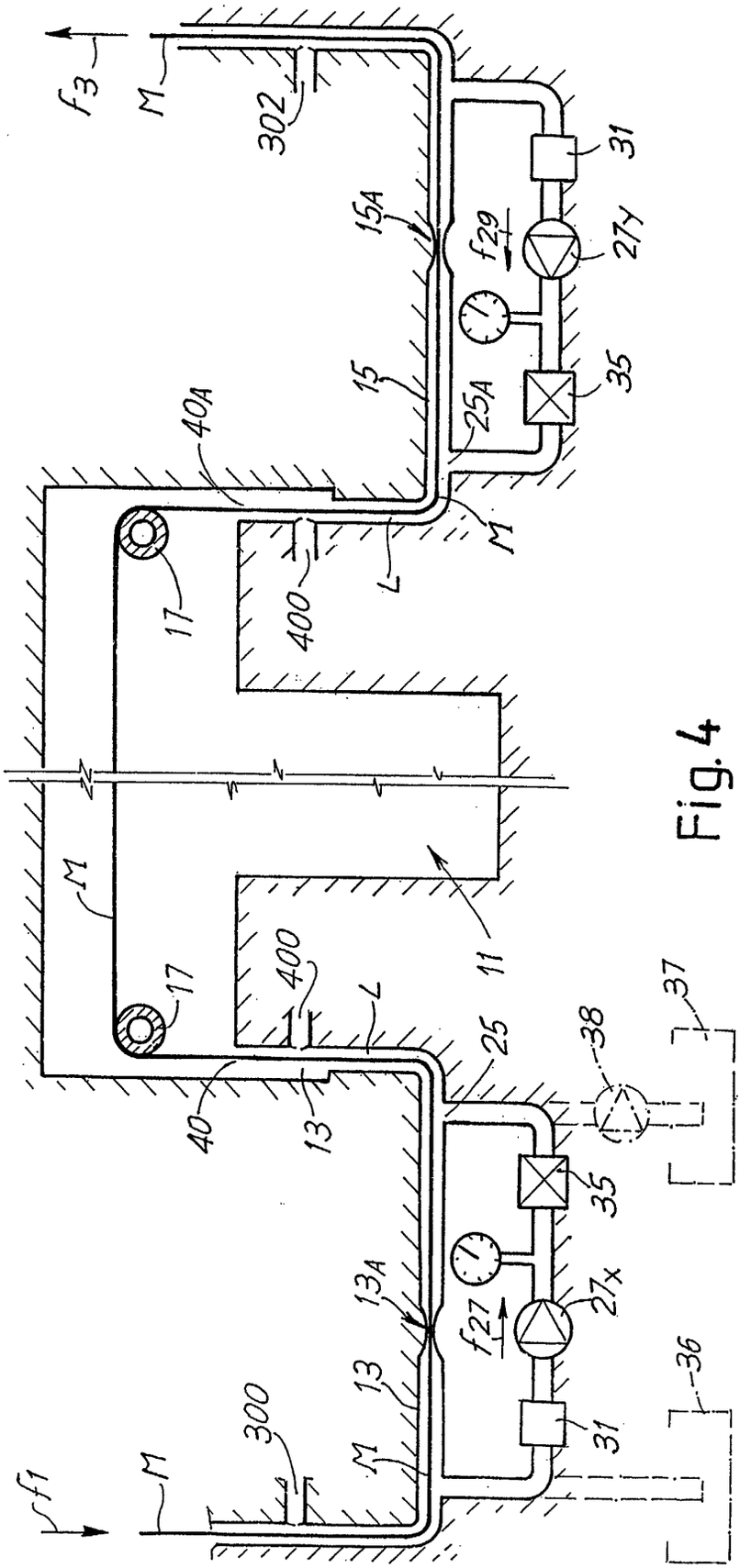
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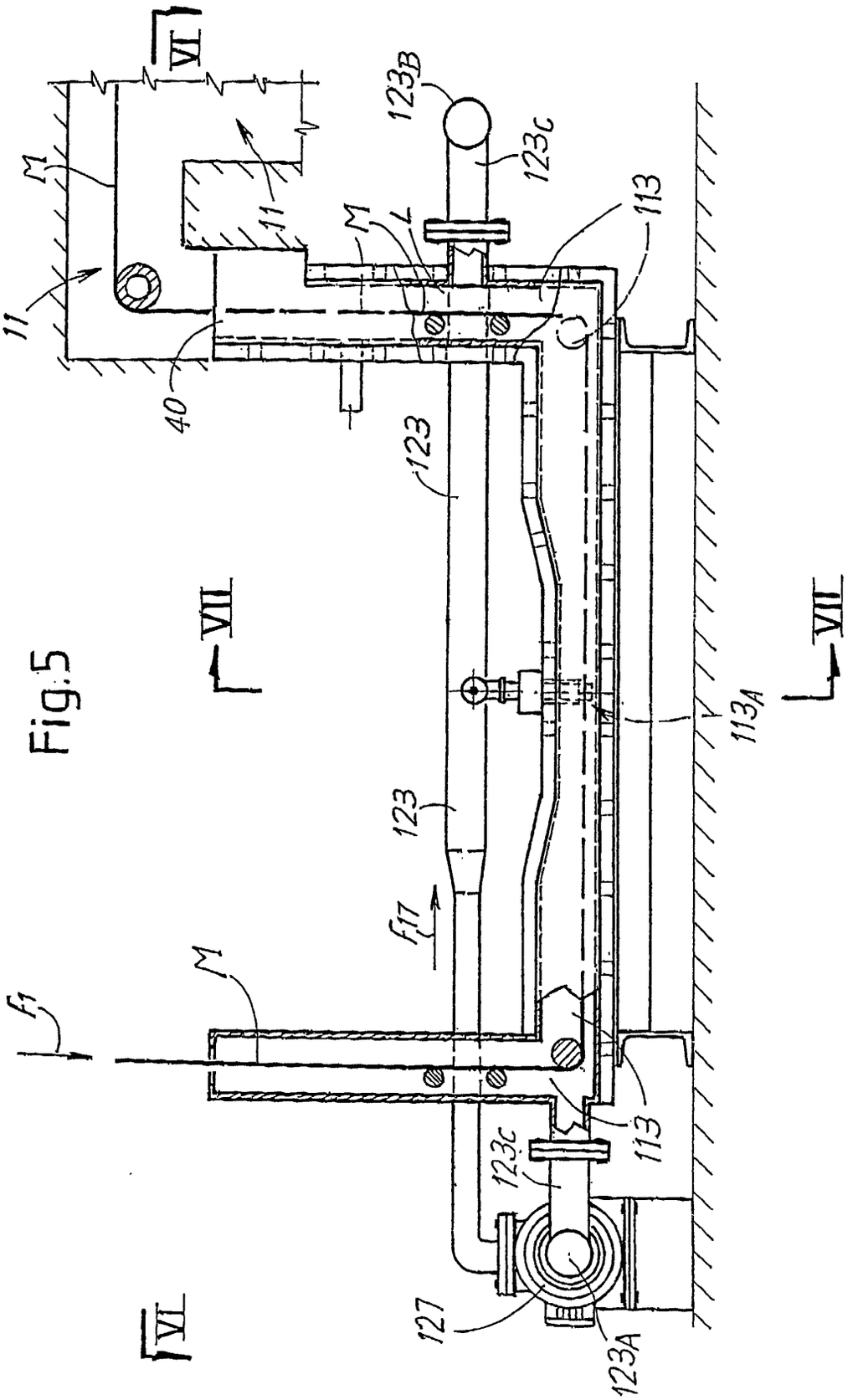
Fig. 4


VI
VII
VII
VI
11
11
40
M
M
M
123B
123C
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123
123C
113
113A
127
123A
F1
F17

Fig.5

Fig. 6

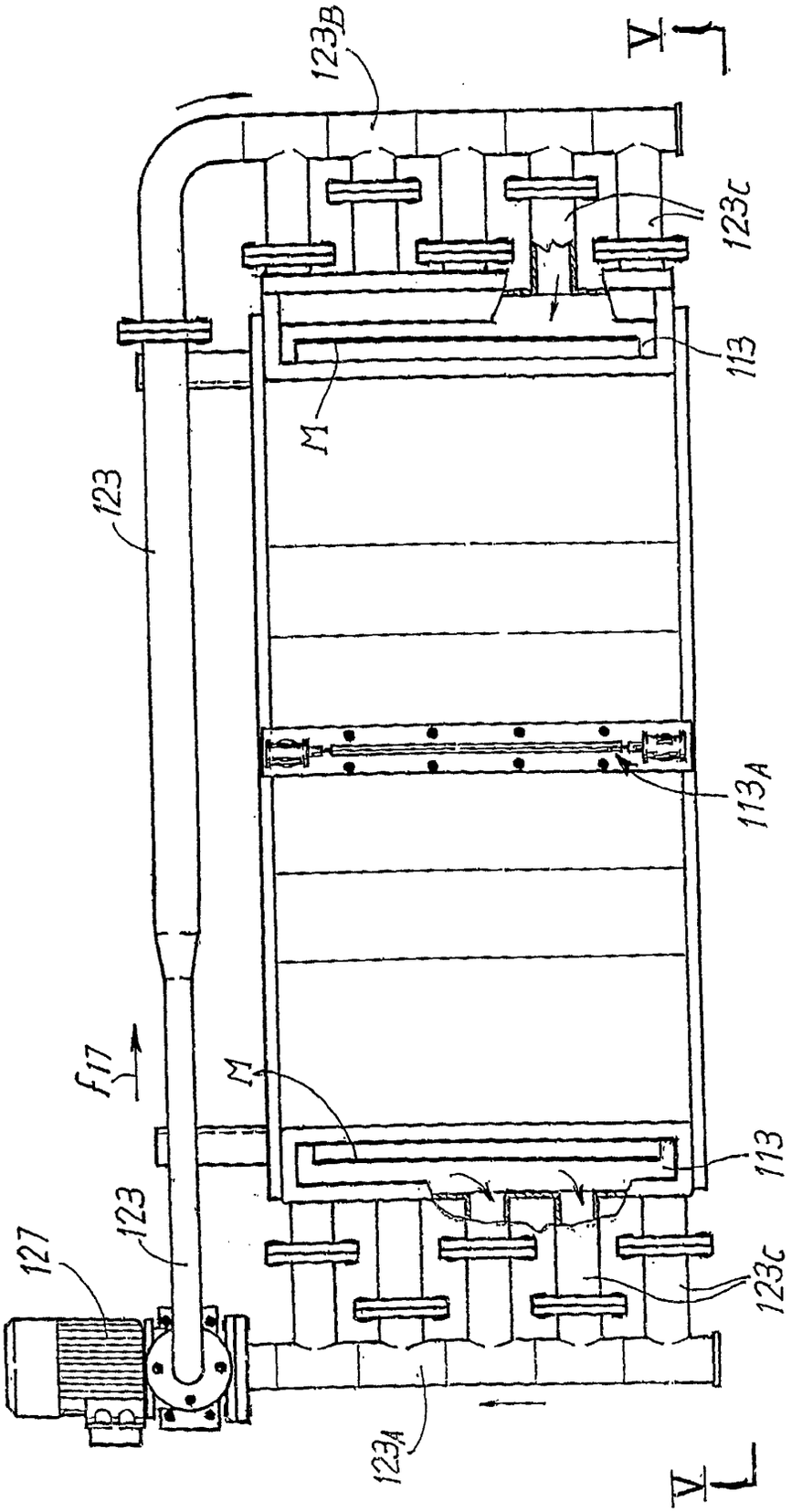
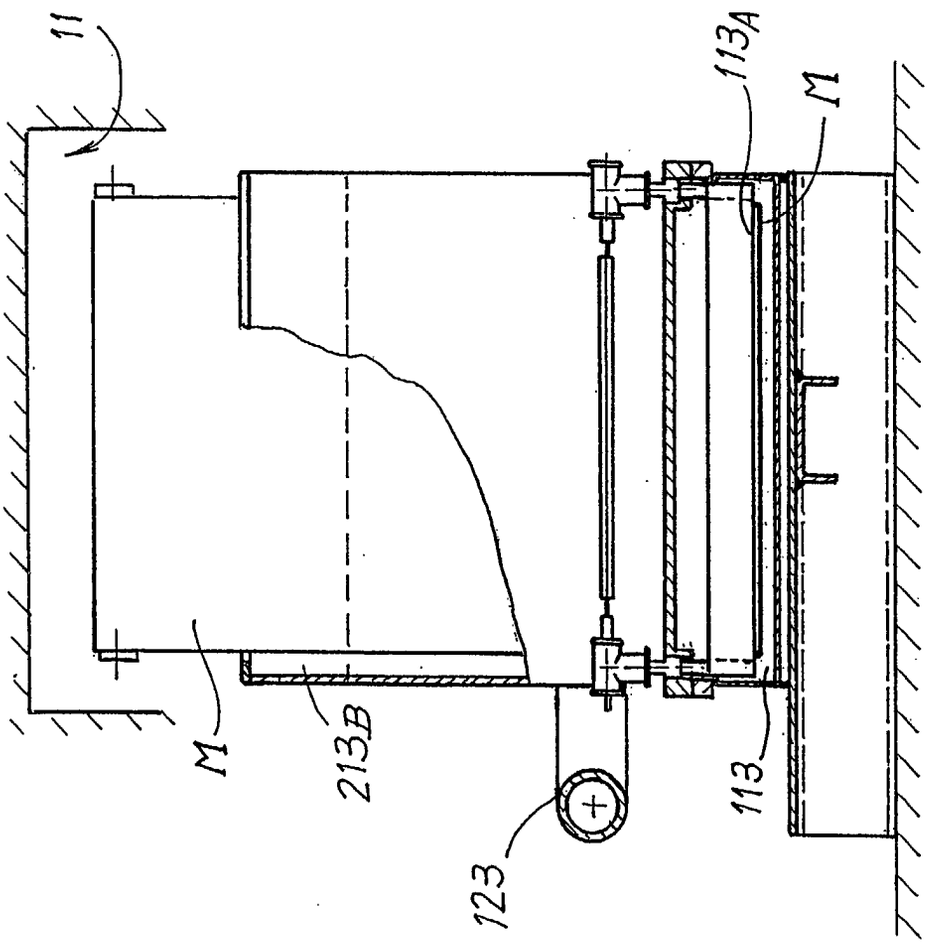
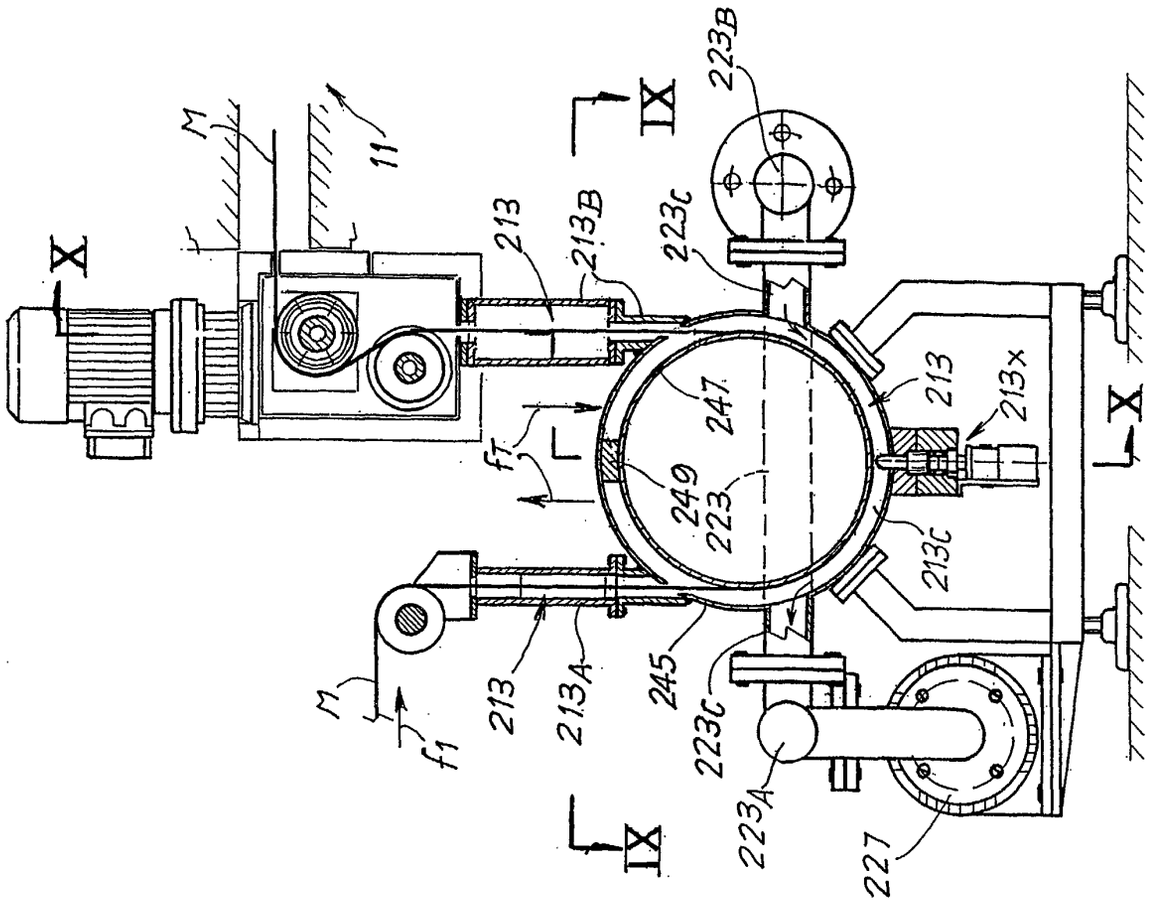


Fig. 7

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M
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213
213B
223B
IX
223c
213
213x
247
f1
249
223
213c
X
M
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213
213A
245
223c
223A
227
IX

Fig. 8

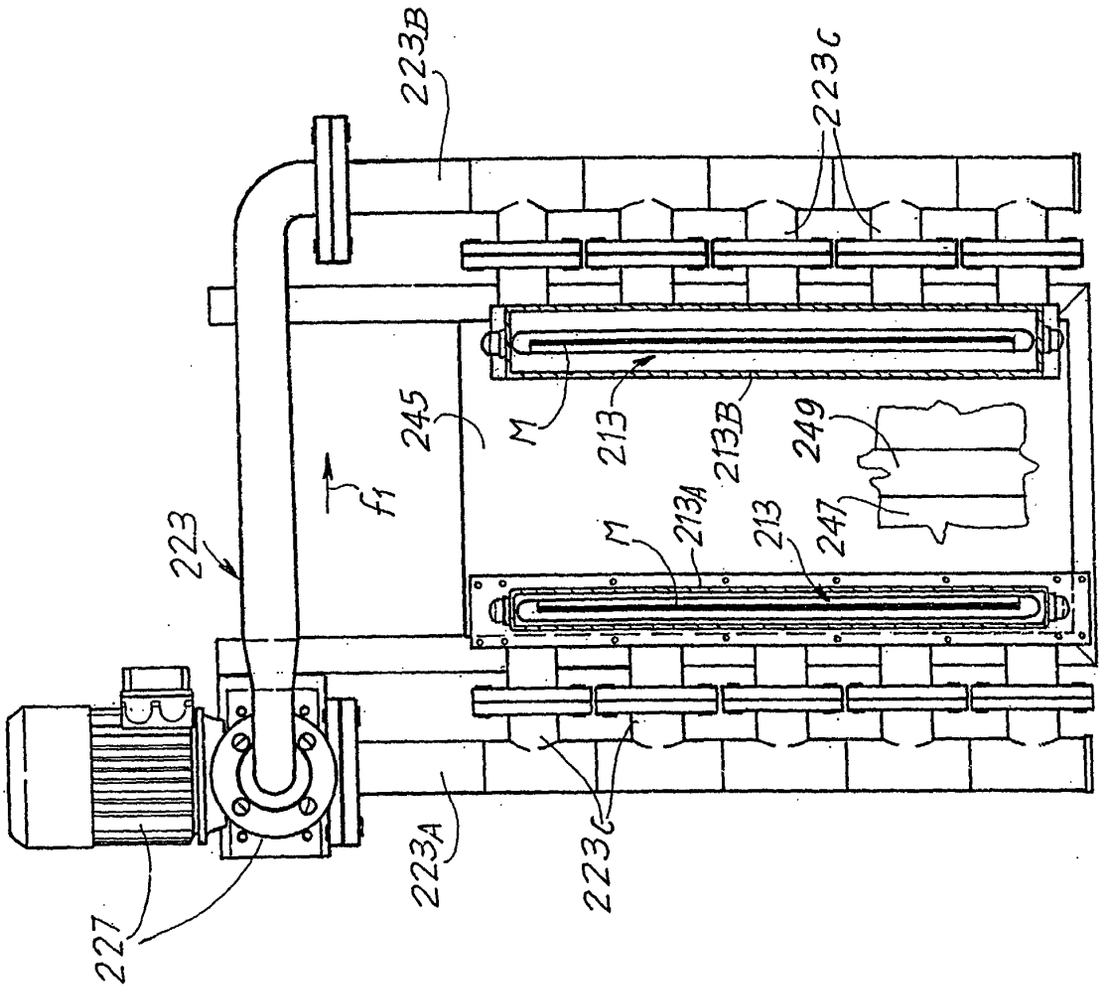
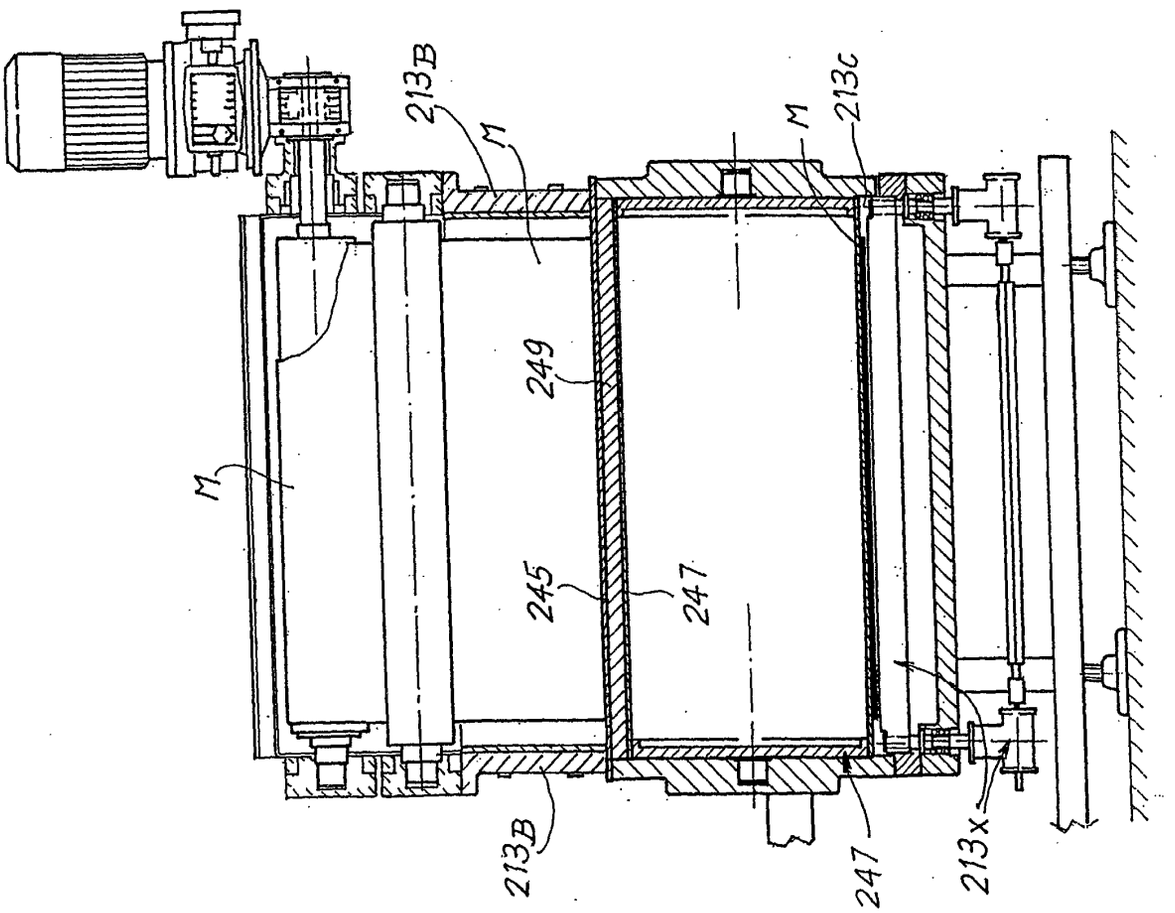


Fig.9

Fig. 10



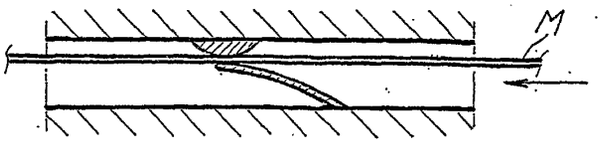


Fig.11

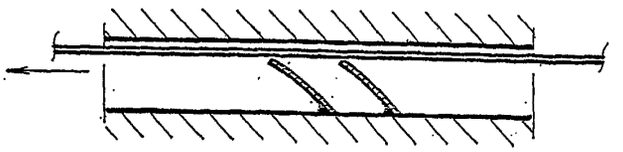


Fig.12

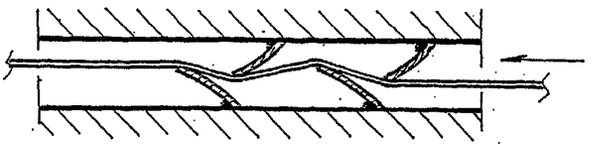


Fig.13

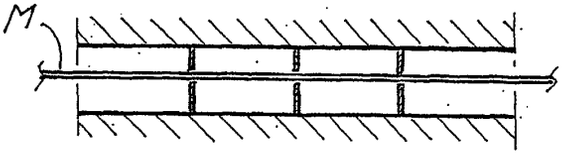


Fig.14

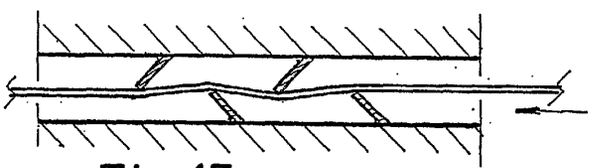


Fig.15

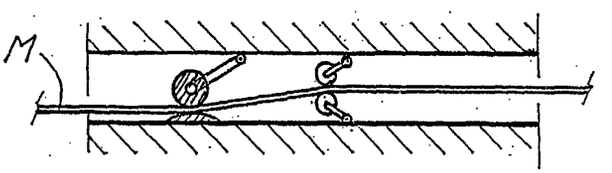


Fig.16

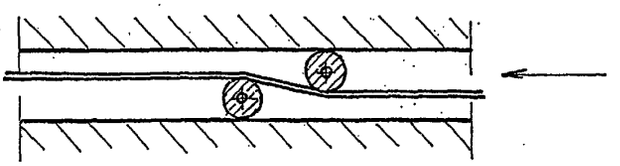


Fig.17

Fig.18