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(71) Applicant: **ALFA-LAVAL N.V.**
Stroombaan 4
NL-1181 VX Amstelveen(NL)

(72) Inventor: **van Vlaenderen, Johannes M. H.**
76 Parelvisserslaan
NL-1183 RN Amstelveen(NL)

(74) Representative: **Meijer, Cornelis Adrianus**
Octrooibureau Ir. C.A. Meijer Herengracht 317 Postbus 3690
NL-1016 AV Amsterdam(NL)

(54) **Installation for conveying milk over long distances through a piping system.**

(57) Such an installation is composed of a forwarding station (50), a receiving station (1) and an interposed pipeline (2, 3), which forwarding station (50) pumps milk (200) through the pipeline (2, 3) to the receiving station (1) in series with auxiliary liquids (300, 301, 400, 500) for keeping the pipeline clean, which milk (200) and auxiliary liquids (300, 301, 400, 500) are kept separated from each other during transportation by means of resilient balls (Fig. 29, 31; 60, 100-111). The incoming milk (200) in the receiving station (1) is discharged separately into a tank vehicle, the auxiliary liquids (300, 301, 400, 500) are first used for cleaning the receiving station (1) internally and thereafter stored in a storage station (Fig. 30; nr. 1000), from which they are, in a later stage, pumped back to the forwarding station (50) for repeated use with a next consignment of milk.

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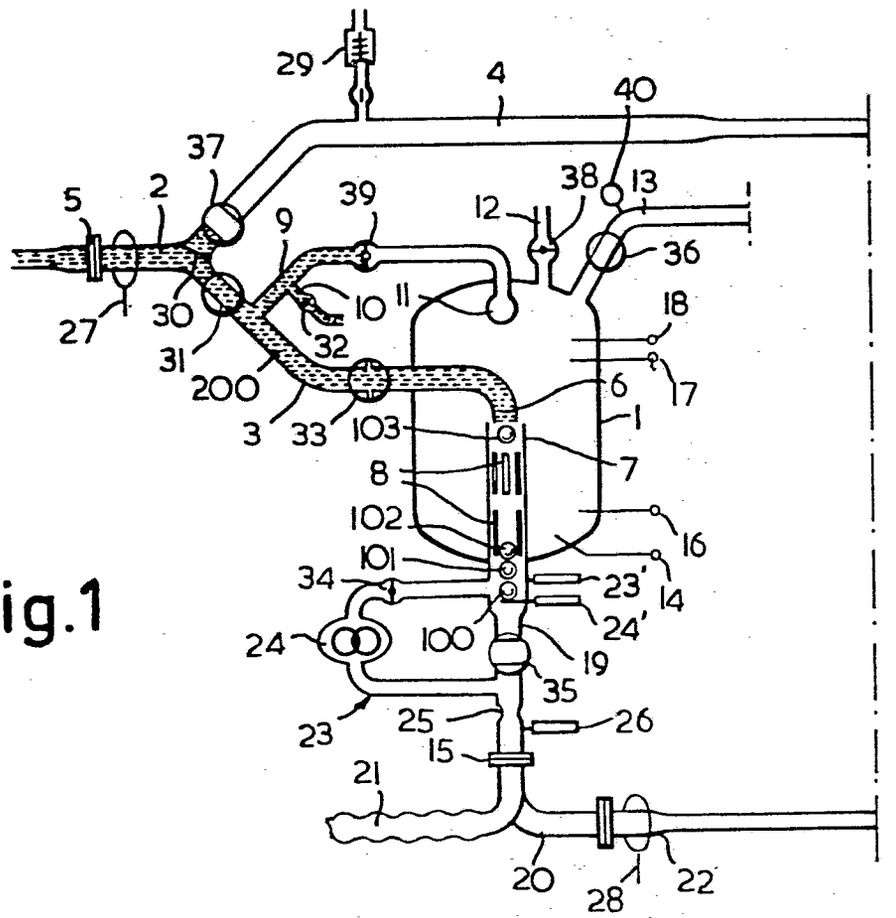
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Fig.1

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ALFA-LAVAL N.V., AMSTELVEEN, NETHERLANDS

INSTALLATION FOR CONVEYING MILK OVER LONG DISTANCES THROUGH A PIPING SYSTEM

The invention relates to an installation for conveying liquids, especially those intended for consumption, such as milk, over long distances through a piping system. Installations of this type are known, but efforts at using such installations for transportation over long distances, for instance amounting to 10 to 15 kilometers, have not as yet been crowned with success, specifically in those cases where a part is played by such problems as the deterioration of the quality of the milk and keeping the pipeline and the other equipment clean and free from infection.

The invention aims at providing an installation which can be used over the aforementioned and even longer ranges, while offering some additional advantages. To this end, an installation according to the invention is composed of a forwarding station, a receiving station and an interposed pipeline, which forwarding station possesses means for pumping milk through the pipeline to the receiving station in series with auxialiary liquids for keeping the pipeline clean, and also possesses means for keeping the milk separate from the auxiliary liquids and the auxiliary from each other during transportation, this being accomplished by means of separators which are caused to be carried along upon each change of liquid and which seal off the pipes of the piping system, which receiving station possesses means for receiving the incoming milk, the auxiliary liquids and the separators between them as well as means for delivering the milk separately from the auxiliary liquids to means for further transportation, such as a tank vehicle, furthermore means for pumping the auxialiary liquids, kept separate from each other by the separators, back to the forwarding station, as well as means for keeping the receiving station's own installation

clean, the receiving station comprising a reservoir into which the pipeline enters, near which point of entry two stop valves are arranged, and the end which protrudes into the reservoir being connected to a tube which protrudes vertically through the centre of the bottom of the reservoir, openings being provided in the wall of the part of the tube occurring inside the reservoir, the part of the tube projecting outside the reservoir being in engageable and disengageable flow communication with a branch point for connection to a tank vehicle, or with a connecting line which includes a storage circuit serving to store the auxiliary liquids, which connecting line leads to a point located upstream of the point of entry of the pipeline into the aforementioned reservoir, a fluid pump and a stop valve being provided in a bypass of the part of the vertical tube which protrudes outside the reservoir, the top of which reservoir is equipped with an inlet pipe, including a stop valve, for compressed air as well as with a discharge pipe, including a stop valve, for the evacuation of air, spraying means furthermore being provided for washing out the inside of the reservoir, which spraying means possess a connection, including a stop valve, to the pipeline at a point located between the aforementioned two stop valves near the entry of the pipeline into the reservoir, which connection is provided with a stop valve and a supply pipe for mains water between this stop valve and the point where the connection opens into the pipeline, the tube which protrudes into the reservoir being suitable for accommodating the separators that are leaving the pipeline, in such a way that they do not seal off this tube but allow liquid to continue to flow along them and trough it, which separators are supported on sluicing means arranged in the tube, which sluicing means are capable of releasing an individual separator so as to cause it to fall further into the tube and into the connecting line, while the tube in its part that is bridged by the bypass furthermore possesses a stop valve, which tube possesses at a point beyond the bypass, viewed in the direction of flow, a constriction upon which a separator can be hermetically supported, which constriction allows the separator to pass as the pump pressure is raised, the separatos being so designed that, in co-operation with detectors arranged near the pipes, they impart an impulse to these detectors as they

approach them, whereupon these detectors convey impulses to an automatic control system, the stop valves and sluicing means being provided with remotely controlled actuators that are energized by the automatic control system which is actuated by the aforementioned impulses from the detectors, while the reservoir is equipped with signal-emitting level probes, which signals determine in part the operation of the automatic control system.

For reliable cleaning of the reservoir after the milk has passed through it, it is proposed according to the invention to provide the internal valve member of the stop valve at the entry of the pipeline into the reservoir, in the position nearest to the reservoir, with a spraying duct, in such a way that, in the closed position, this valve member allows a spraying jet of auxiliary liquids to pass, as part of a method allowing the reservoir to be safeguarded against infection in a simple manner, use being made of auxiliary liquids which are already present.

According to the invention, the means of the forwarding station for causing the separators to be carried along in the pipeline upon each change of liquid are constituted by a length of pipe having a larger inside diameter than that of the separators, which pipe accomodates in longitudinal direction a number of bars which jointly form an elongate cage, which cage can accomodate a number of separators that are arranged in a row, the pipe containing sluicing means which can discharge one separator in each instance so that this separator is caused to be carried along with the flow, and which pipe contains near the sluicing means, upstream in the liquid, perturbing means for raising the flow resistance of the leading separator in the liquid, in such a way that only a minor inclination of the pipe is sufficient for causing this separator to be carried along by the liquid at the proper time after this separator has been released by the sluicing means.

A separator preferably consist of an at least substantially spherical wall of resiliently elastic material, the inside of which is completely filled up with an incompressible liquid such as water as well as with a diamagnetic substance which can co-operate with

detectors arranged on the outside of the pipes. The sealing power of this type of closing elements, being based on the resilient stretch of the enveloping wall, has been found to be extremely reliable without producing a high resistance inside the pipeline.

The installation according to the invention can thus convey milk over long distances, of the order of 15 to 30 kilometers and more, and, in other words, is capable of transporting milk over distances amounting to several times the length of the milk column which is pumped over. The installation works almost fully automatically and requires no return line for reconveying the auxiliary liquids to the forwarding station, since this can be accomplished through the same, single transmission line which is provided. Furthermore, the formation of foam is extensively prevented.

In order further to explain the invention, an example of embodiment of the invention wille be discribed, reference being made to the drawing, from which description a few additional particulars will become evident.

In the drawing,

Fig. 1 is a diagrammatic representation of the principal part of the receiving station, in the situation where the milk pumped from the forwarding station is just entering into the receiving station;

Fig. 2 through 28 are similar to Fig. 1, but show the succession of situations which follow the situation of Fig. 1;

Fig. 29 shows the pipe element of the forwarding station in which the separators are stored and from where they can in each instance be individually discharged with the aid of sluicing means;

Fig. 30 is a diagrammatic view of the storage circuit;

Fig. 31 is a sectional view of a substantially spherical embodiment of a separator according to the invention.

It is to be noted in general that the piping system of the receiving station to be discussed hereinafter, towards which the balls are pumped, is characterized by such a diameter that the balls fit with some clearance in the pipes, allowing the liquids to flow along them in some situations which will be described hereinafter. The pipeline which comes from the forwarding station, however, is narrower, and the balls, with their resilient pressure, fit in it in a manner which is virtually sealing. Similarly, the storage circuit only comprises the narrower pipes. The constrictions, or, if preferred, the expansions, are indicated in Figs. 2 through 28.

The receiving station which is shown diagrammatically in Fig. 1 comprises a reservoir 1, a pipe 2, which is connected at 5 to the long-distance transmission line which comes from the forwarding station (not shown) being bifurcated into a pipe 3 and a pipe 4. The pipe 3 opens centrally into the reservoir 1. The mouth 6 is located above a tube 7 which protrudes centrally and vertically through the bottom of the reservoir 1 and which is provided with open slots 8 along its part which protrudes into the reservoir 1. The pipe 3 has a branch 9 which leads to the upper part of the reservoir 1, inside which this branch 9 ends in a spherical nozzle 11. The branch 9 has an inlet stub 10 for the supply of mains water. The reservoir 1 possesses a supply pipe 12 for feeding compressed air, and is furthermore connected to a discharge pipe 13. The reservoir 1 is provided at four different heights with a level signaler which is capable of indicating the level reached by the milk or the auxiliary liquid, use being made of a signal imparted to the automatic control system (not shown). These four level signalers bear the reference numbers 14, 16, 17 and 18.

The tube 7 extends downwardly outside the reservoir in the form of the pipe 19, which ends in the coupling 15, which serves for connecting either the connecting hose 21 which connects to a milk tank vehicle (not shown), or the pipe bend 20 to the connection 22, which leads to a storage circuit (see Fig. 30) for the auxiliary liquids, which storage circuit opens at its other end into the pipe 4.

A bypass circuit 23 with an interposed pump 24 is connected to the pipe 19. Furthermore, sluicing means 23' and 24' are fitted at the tube 7, and are actuated by the automatic control system (not shown). They serve for controlling the passage of the separators, hereinafter referred to as balls, which control will be discussed in more detail in the course of the further description. The tube contains the balls 100, 101 and 102, while a ball 103, at the front of the incoming milk column 200, is just falling into the tube 7. The pipe 19 comprises a throat or constriction 25 and a finger stop 26. This arrangement will be further explained hereinafter.

The numbers 27 and 28 indicate annular detectors which convey an impulse to the automatic control system (not shown) when a ball passes in the pipe. The number 29 indicates a vent branch. The number 30 indicates an automatic switch which serves for guiding the balls.

The piping system of the receiving station is equipped with the stop valves 31, 32, 33, 34, 35, 36, 37, 38 and 39, which can be actuated by the automatic control system (not shown).

The receiving station as shown in Fig. 1 is marked by the situation where the milk column 200 has just entered the receiving station, preceded by a column of air from which the milk column 200 has been separated by the ball 103.

The operation of the receiving station according to the invention will now be explained on the basis of Figs. 2 through 28, which illustrate the succession of situation occurring in the receiving station. Reference will first be made to Fig. 1 as well.

A milk tank vehicle (not shown) is connected to the hose 21; the pipe bend 20 is disconnected. A detector (not shown), arranged at some distance upstream of the receiving station, has imparted a signal to the automatic control system that the milk has arrived. The "Receiving" button (not shown) is then depressed in the receiving station, whereupon the automatic control system causes the valves and sluicing means to assume the proper position for

receiving, as shown in Fig. 1. The milk in the pipeline, by way of a ball, pushes forward the air contained in the pipeline. This air escapes through the pipe 13 which (if required with the use of an interposed sound-deadening device) leads to the free atmosphere.

The balls 100, 101 and 102 are already in the tube 7, where they rest upon the sluicing means 24', their final position after the preceding reception of milk. The reason for the prior presence of these three balls 100, 101 and 102 will be discussed hereinafter. The passing if the ball 103 along the detector 27 is signalled through to the automatic control system (not shown).

Fig. 1 shows in its final situation that the milk 200 enters through the pipe 3 into the reservoir 1, and that the leading ball 103 is about to fall into the tube 7.

In Fig. 2, the reservoir 1 is filled with milk up to the level signaler 17. As a result, the valve 34 is opened, causing the pump 24 to be engaged. The milk flows into the tank vehicle.

In Fig. 3, the milk level in the reservoir 1 has dropped to the level signaler 16. As a result, the pump 24 is stopped and the valve 34 is closed. The milk starts rising again in the reservoir 1.

Fig. 4 shows the situation of the milk level rising up to the level signaler 18, which happens when the milk-feeding capacity becomes greater than the discharging capacity. This causes the valve 36 to be closed, so that the back pressure in the reservoir 1 keeps supply and discharge in equilibrium.

In Fig. 5, the milk column 200 has completely left the transmission line and the pipe 3. The separator between the milk column and the subsequent column of buffer water 300, the ball 104, is just falling into the tube 7. The passage of the ball 104 along the detector 27 causes the valves 31 and 33 to be closed.

In Fig. 6, the milk level has started to fall. As soon as it falls below the level signaler 17, the valve 36 is again opened, so that the milk level can continue to drop.

In Fig. 7, the milk level has dropped to the level signaler 14, causing the pump 24 to stop and the valve 34 to be closed.

In Fig. 8, the valves 31 and 39 are opened, causing the inside of the reservoir to be sprayed with buffer water 300. As soon as the water reaches the level signaler 16, valve 31 is closed and the spraying is interrupted. This front part of the column of buffer water still contains some milk, which milk now enters the tank vehicle. The amount of buffer water which gets into the tank vehicle along with this milk does not result in any obejctionable diluting of the milk. The tank vehicle is not shown in the drawing.

In Fig. 9, the mixture of milk and buffer water contained in the reservoir is pumped into the tank vehicle. The pump 24 stops when the level signaler 14 is passed. The tank vehicle can be disconnected from the connection 21.

In the situation acoording to Fig. 10, the hose 21 should be visualized as being disconnected, the pipe bend 20 being connected instead. The reservoir 1 can now be brought into flow communication with the storage circuit 1000 (see Fig. 30). This is furthermore accomplished by depressing a button (not shown), as a result of which the automatic control system receives the instruction of "Claening". This causes the valve 35 to be opened, and the ball 100 is sluiced with the aid of the fingers of the sluicing means 23' and 24'. This ball 100 now comes to rest sealingly upon the constriction 25. If necessary, the ball is prevented from slipping through, use being made of the finger stop 26.

In Fig. 11, the valve 35 is closed, and the valves 31 and 39 are open. The inside of the receiving station is now washed, use being made of the pressure in the transmission line. The buffer water 300 is followed by the ball 105, the passage of which is merely registered and counted by the automatic control system. The ball 105 is followed by the pre-rinsing water 301.

In Fig. 12, the water level has risen to the level signaler 17. This causes the valve 34 to be opened and the pump 24 to be started.

A pressure builds up in the bypass, as a result of which the ball 100 is forced through the constriction 25 and, by way of the pipe 22, towards the storage circuit 1000 (Fig. 30). The ball is followed by the water 300 and 301. When the level signaler 16 is passed, the pump 24 is stopped and the valve 34 closed, whereupon the water rise again, continuing to fall and rise alternately between the level signalers 16 and 17 in the same manner as had first been performed by the milk.

In Fig. 13, the valve 31 is closed as a result of the ball 106 -- which separates the pre-rinsing water 301 from the cleaning liquid 400 which is now flowing in -- having passed the detector 27.

In Fig. 14, the level of the pre-rinsing water 301 has fallen to the level signaler 14. As a result, the pump 24 is stopped and the valve 34 closed, the ball 101 being sluices to the constriction 25 through the valve 35, which has opened in the meantime, for which operation use is made of the sluicing means 23' and 24'.

In Fig. 15, the valve 31 is opened, and the cleaning liquid 400 flows again through the pipe 9 and the spherical spray nozzle 11, on the one hand, and through the spray duct 133 (also see Fig.7), on the other, into the reservoir 1. When the level signaler 17 is passed, the valve 34 is opened and the pump 24 started. The ball 101 has now come to separate the two liquids 301 and 400. At the same time, the level of the cleaning liquid 400 in the reservoir continuous alternating between the level signalers 16 and 17, as had first been the case with the milk and with the water.

Fig. 16 shows how, upon the cleaning liquid 400 reaching the level 16 for the first time, the pump 24 is stopped, the valve 31 is closed, and the ball 102 sluiced.

Fig. 17 shows that the valve 31 has been opened again and that the cleaning liquid 400 has again reached the level 17. As a result, the pump 24 is started. The procedure described with respect to Figs. 16 and 17 is repeated, and the ball 103 is sluices. The launching of additional balls into the cleaning liquid has the

purpose of attaining improved cleaning of the transmission line as a result of the sweeping action of the balls.

In Fig. 18, the cleaning liquid 400 has fully entered into the receiving installation, and the ball 107 -- which separates the cleaning liquid 400 from the post-rinsing water 500 -- has passed the detector 27. As a result, the valve 31 is closed. The level of the cleaning liquid 400 in the reservoir 1 continues to fall.

In Fig. 19, the cleaning liquid 400 has passed the level 14. As a result, the pump 24 is stopped, and the ball 104, having been sluiced past the sluicing means 23' and 24', continues on its way.

Fig. 20 shows a repetition of the preceding separation of liquids. The post-rinsing water 500 is now entering the reservoir 1 through the spraying devices.

In Fig. 21, the last ball 108, separating the rewashing water from the compressed air 600, has passed the detector 27. As a result, the valve 31 is closed.

In Fig. 22, the valve 33 is opened and subsequently, for five seconds, the valve 34 as well, causing the balls 105, 106, 107 and 108 to fall into the tube 7, having been pushed forward by the mains water 700.

In Fig. 23, the post-rinsing water 500 has reached the level 14, causing the ball 105 to be sluiced.

In Fig. 24, the ball 105 is pumped into the storage circuit (Fig. 30). As a result of the detector 28 having been passed, the pump 24 is stopped, and the valve 34 closed.

In Fig. 25, the valve 36 is opened, and the compressed air 600 is blown off into the free atmosphere through the pipe 13, if required with the use of a sound-deadening device (not whown). The absence of excess pressure in the transmission line is signalled by the pressure switch 40 to the automatic control system.

In Fig. 26, compressed air 800 is blown in, at the instruction of the pressure switch 40, through the valve 38 which has been opened in the meantime, the valve 35 and 37 being opened as well. The switch 30 is shifted while the valve 37 is being opened. The auxiliary liquids and the separators are now pressed back from the storage circuit 1000 (Fig. 30), through the valve 37, towards the forwarding station (not shown). Fig. 26 shows the moment in which the separator of cleaning liquid 400 and post-rinsing water 500 is passing the valve 37.

Fig. 27 shows the situation after arrival of the return dispatch at the forwarding station (not shown). Upon expiration of the maximum of time required for the return dispatch, the valve 38 is closed, and the valves 31 and 36 are opened. The compressed air for the return dispatch is now likewise blown off through the pipe 13.

Fig. 28 shows the valves, balls, etc. restored to the situation as represented in Fig.1, the installation thus being ready for receiving the next dispatch of milk.

If two consignments of milk are forwarded in rapid succession,there is no need to clean the transmission line after the first consignment. It will the be sufficient to use buffer water. This buffer water is stored in the storage circuit with three balls and returned simultaneously with the next complete consignment of auxiliary means as described hereinabove. It is for this reason that the forwarding station will have to be capable of accomodating at leat nine balls.

Fig. 29 shows the delivery mechanism, or output part, of the forwarding station, which is not shown itself, which output part consists of a pipe 50 which is sufficiently wide for accomodating, inside a cage 51 constituted by bars, the balls 103 through 111, in such a way that the milk and the auxiliary liquids which are to leave the forwarding station at the point 52 will be capable of flowing readily along them. The cage of bars is closed on the rear side with the stop 70 so as to allow the balls to be collected on

their way back from the receiving station. The numbers 53 and 54 indicate sluicing means, and the number 55 indicates a sight glass for checking whether all balls are present after the arrival of a return consignment as well as for observing the entry of the milk and of the auxiliary liquids. During the inflow of milk, the sluicing means 53 and 54 are actuated, and the first ball 103 starts functioning as separator between the column of air in the transmission line 56 and the milk. Each change of liquid is accompanied by the sluicing of another ball.

It has been found that when the pipe connection is arranged at a small angle of inclination, which arrangement constitutes a preferred design, the negative flow resistance of the ball to be sluices causes it to remain in its position, despite the withdrawal of the finger 57 of the sluicing means 53. According to the invention, a flow perturber 58, for example in the form of a ring, is provided slightly upstream from the position of the leading ball. This causes the pure flow around the ball to be disturbed, thus inducing a positive resistance of the ball of sufficient magnitude to allow it to be reliably carried along by the flow of liquid even at the aforementioned minor angle of inclination of the pipe 50.

Fig. 30 diagrammatically represents the storage circuit, which assembly is constituted by tubing in which the balls are a sealing fit.

Fig. 31 is a sectional view of a ball 60. It consists of a wall 61 of resiliently elastic material such as rubber, in which wall 61 a valve 62 is provided. The inside is occupied by a steel ball 63. The remaining space is filled (virtually) complete with water 64.

C L A I M S

1. Installation for conveying milk over long distances through a piping system, characterized by a forwarding station, a receiving station and an interposed pipeline, which forwarding station possesses means for pumping milk (200) through the pipeline (2, 3) to the receiving station in series with auxiliary liquids (300,301, 400, 500) for keeping the pipeline (2, 3) clean, and also possesses means for keeping the milk (200) separate from the auxiliary liquids (300, 301, 400, 500) and the auxiliary liquids from each other during transportation, this being accomplished by means of separators (60, 100-111) which are caused to be carried along upon each change of liquid and which seal off the pipes of the piping system, which receiving station possesses means for receiving the incoming milk (200), the auxiliary liquids (300, 301, 400, 500) and the separators between them as well as means for delivering the milk (200) separately from the auxiliary liquids (300, 301, 400, 500) to means for further transportation, such as a tank vehicle, furthermore means for pumping the auxiliary liquids (300, 301,400, 500), kept separate from each other by the separators (60, 100-111) back to the forwarding station, as well as means for keeping the receiving station's own installation clean, the receiving station comprising a reservoir (1) into which the pipeline (3) enters, near which point of entry two stop valves (31, 33) are arranged and the end (6) which protrudes into the reservoir (1) being connected to a tube which protrudes vertically through the centre of the bottom of the reservoir (1), openings (8) being provided in the wall of the part of the tube (7)occurring inside the reservoir (1), the part (19) of the tube (7) projecting outside the reservoir being in engageable and disengageable flow communication with a branch point for connection (21) to a tank vehicle, or with a connecting line (20,22) which includes a storage circuit (1000) serving to store the auxiliary liquids (300, 301, 400, 500), which connecting line (22) leads to a point located upstream of the point of entry of the pipeline (3) into the aforementioned reservoir, a fluid pump (24) and a stop valve (34) being provided in a bypass (23) of the part (19) of the vertical tube (7) which protrudes outside the reservoir (1), the top of which reservoir (1) is equipped

with an inlet pipe (12), including a stop valve (38), for compressed air (800) as well as with a discharge pipe (13), including a stop valve (36), for the evacuation of air, spraying means (11) furthermore being provided for washing out the inside of the reservoir (1), which spraying means (11) possess a connection (9), including a stop valve (39), to the pipeline (3) at the point located between the aforementioned two stop valves (31, 33) near the entry of the pipeline (3) into the reservoir (1), which connection (9) is provided with a supply pipe (10) with a stop valve (32) for mains water between the aforementioned stop valve (39) and the point where the connection opens into the pipeline (3), the tube (7) which protrudes into the reservoir being suitable for accommodating the separators (60, 100 -111) that are leaving the pipeline (3), in such a way that they do not seal off this tube but allow liquid to continue to flow along them and through it, which separators (60, 100- 111) are supported on sluicing means (23', 24', 26) arranged in the tube (7), which sluicing means (23', 24', 26) are capable of releasing an individual separator so as to cause it to fall further into the tube (7, 19) and into the connecting line (20), while the tube (7) in its part (19) that is bridged by the bypass (23) furthermore possesses a stop valve (35), which tube (19) possesses at a point beyond the bypass (23), viewed in the direction of flowm a constriction (25) upon which a separator can be hermetically supported, which constriction (25) allows the separator to pass as the pump pressure is raised, the separators (60, 100- 111) being so designed that, in co-operation with detectors (27, 28) arranged near the pipes, they impart an impulse to these detectors (27, 28) as they approach them, whereupon these detectors (27, 28) convey impulses to an automatic control system, the stop valves (31, 39) and sluicing means (23', 24', 26) being provided with remotely controlled actuators that are energized by the automatic control system which is actuated by the aforementioned impulses from the detectors (27, 28), while the reservoir (1) is equipped with signal-emitting level probes (14, 16, 17, 18), which signals determine in part the operation of the automatic control system.

2. Installation according to claim 1, characterized in that the

means of the forwarding station for causing the separators (60, 100 -111) to be carried along in the pipeline upon each change of liquid are constituted by a lenght of pipe (50) having a larger inside diameter than that of the separators (60, 100 -111), which pipe (50) accommodates in longitudinal direction a number of bars which jointly form an elongate cage (51), which cage (51) can accommodate a number of separators (60, 100- 111) that are arranged in a row, and which pipe (50) contains near its sluicing means (53, 54), upstream in the liquid, perturbing means (58) for raising the flow resistance of the leading separator (103) in the liquid.

3. Installation according to claim 1 or 2, characterized in that the internal valve member of the stop valve (33) at the entry of the pipeline (3) into the reservoir (1), in the position nearest to the reservoir, is equipped with a spraying duct (133), in such a way that, in the closed position of this valve member, a spraying jet of the auxiliary liquids is allowed to pass.

4. Installation according to any one of the preceding claim, characterized in that a separator (60) is constituted by an at least substantially spherical wall (61) of resiliently elastic material, the inside of which is completely filled up with an incompressible liquid (64) such as water, a mass of diamagnetic material (63) furthermore having been introduced which can co-operate with a detector (27, 28) that is arranged on the outside of the pipes (2, 22).

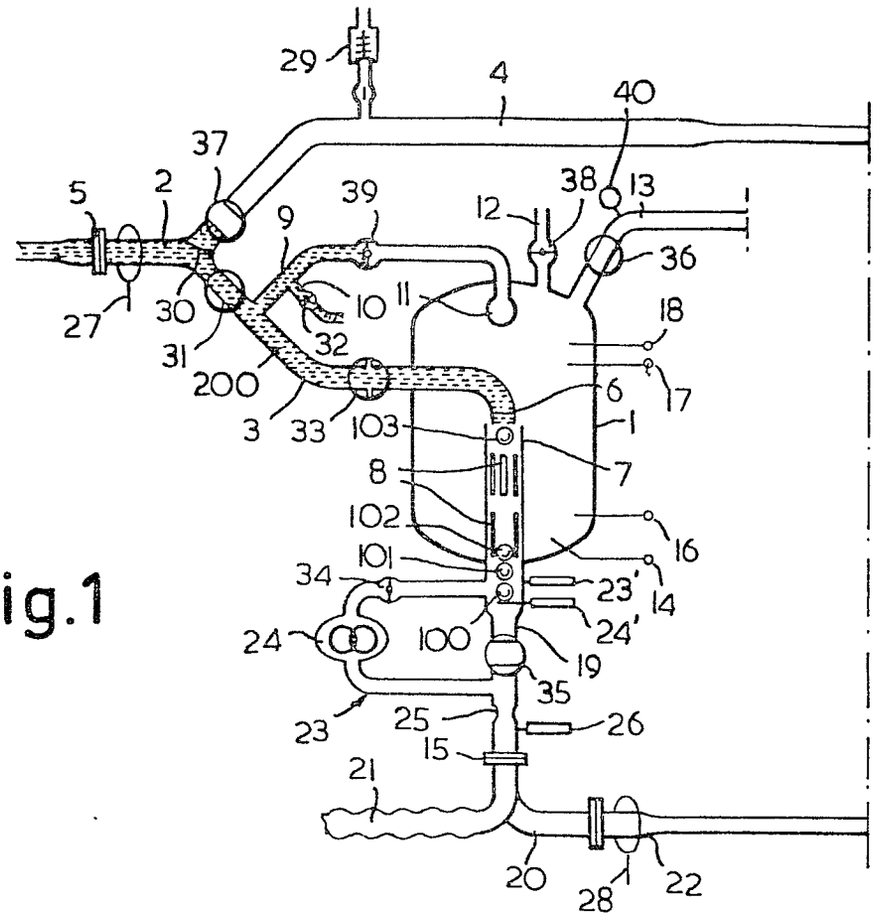
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Fig.1

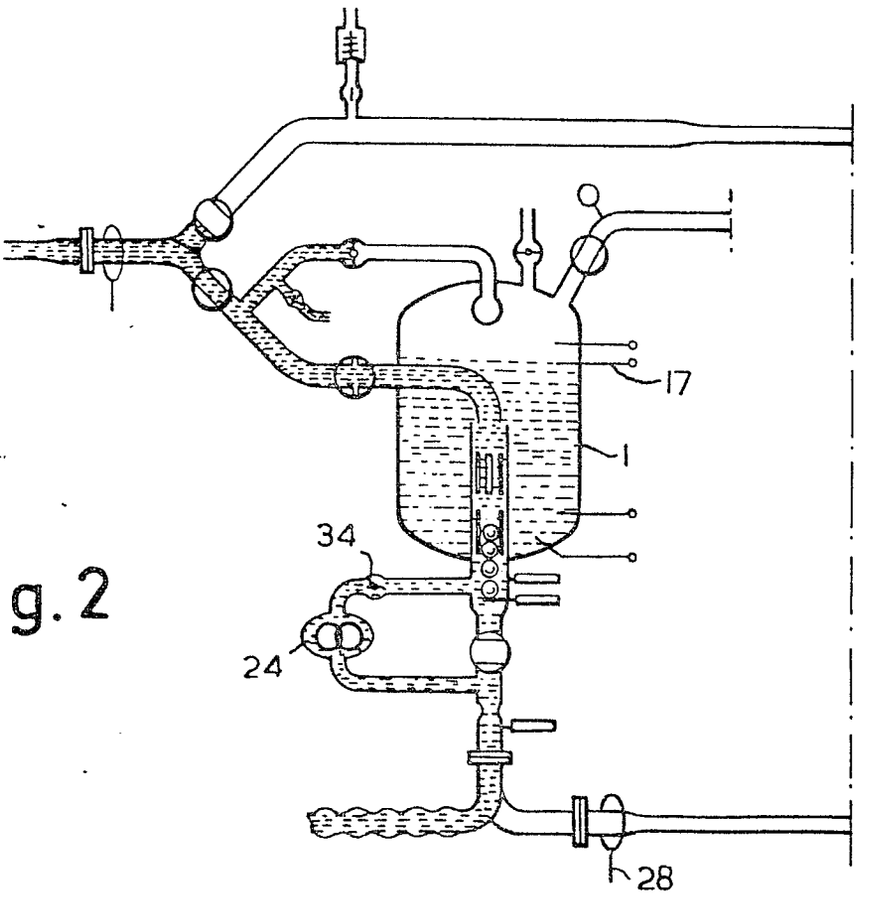
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Fig.2

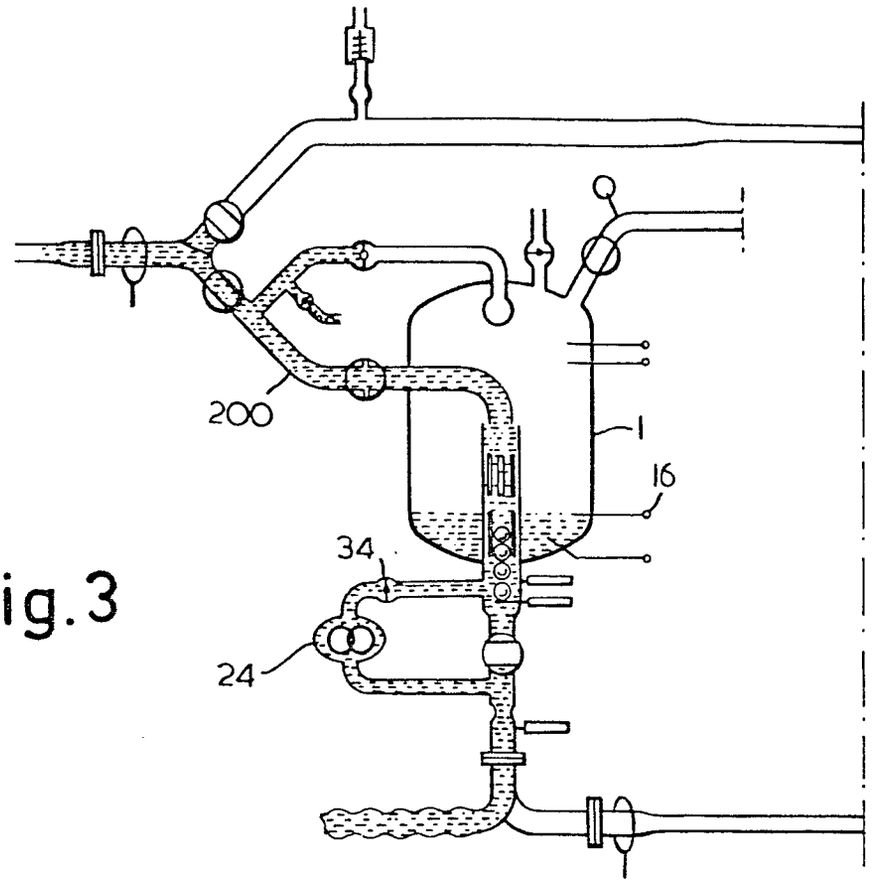


Fig.3

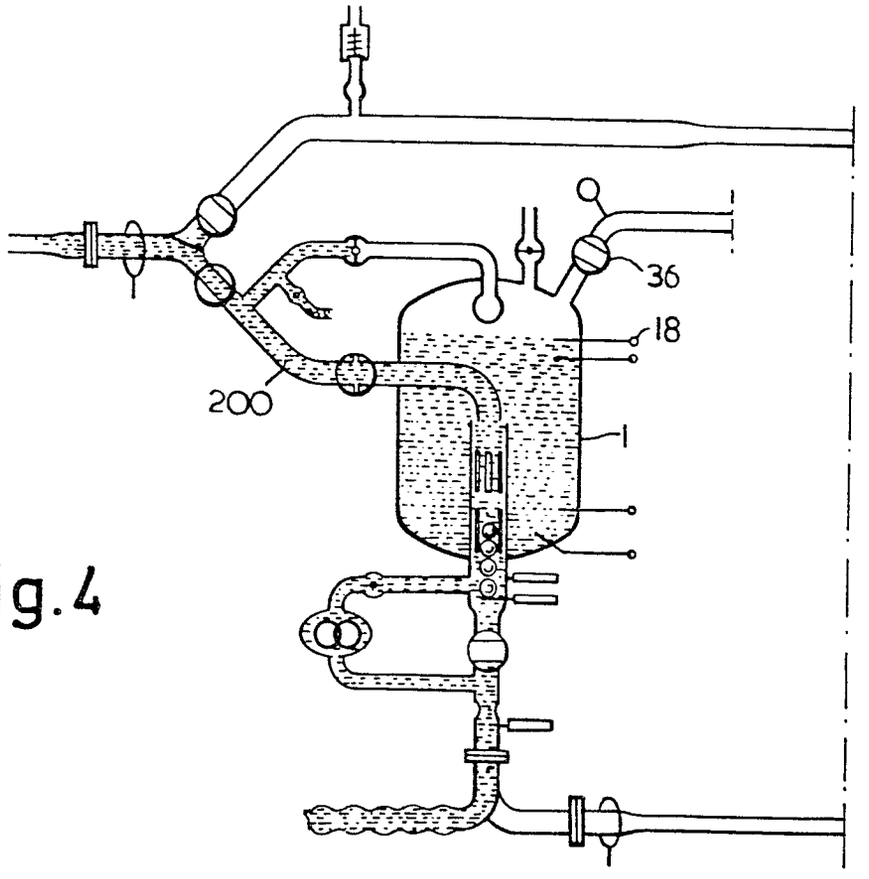


Fig.4

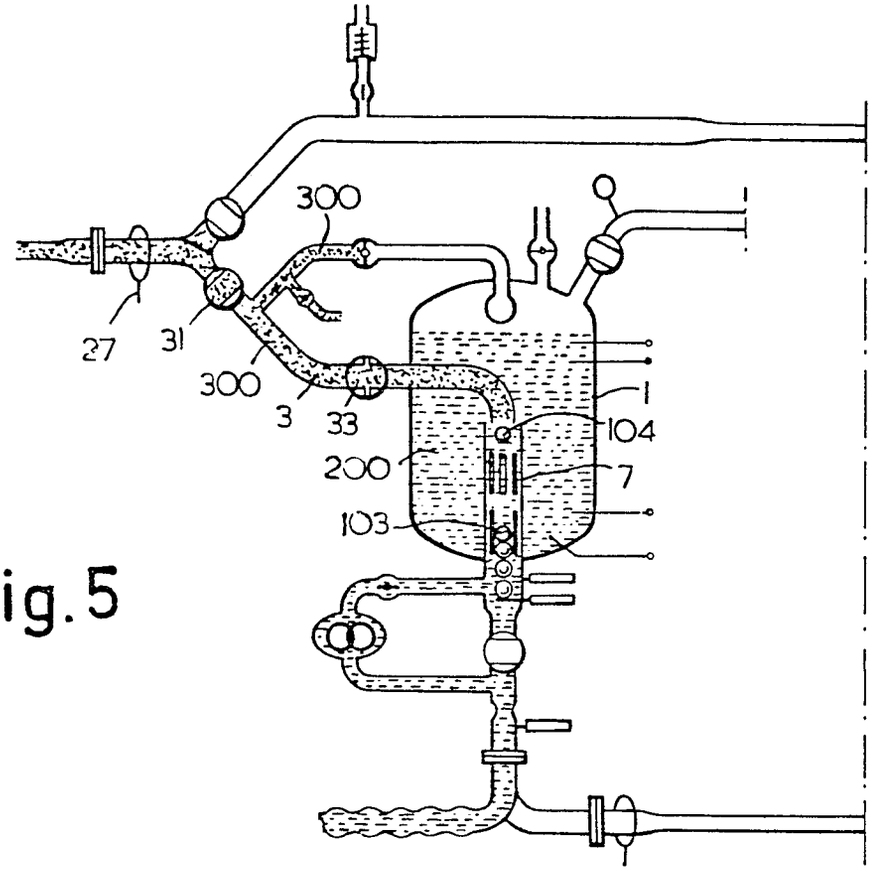


Fig.5

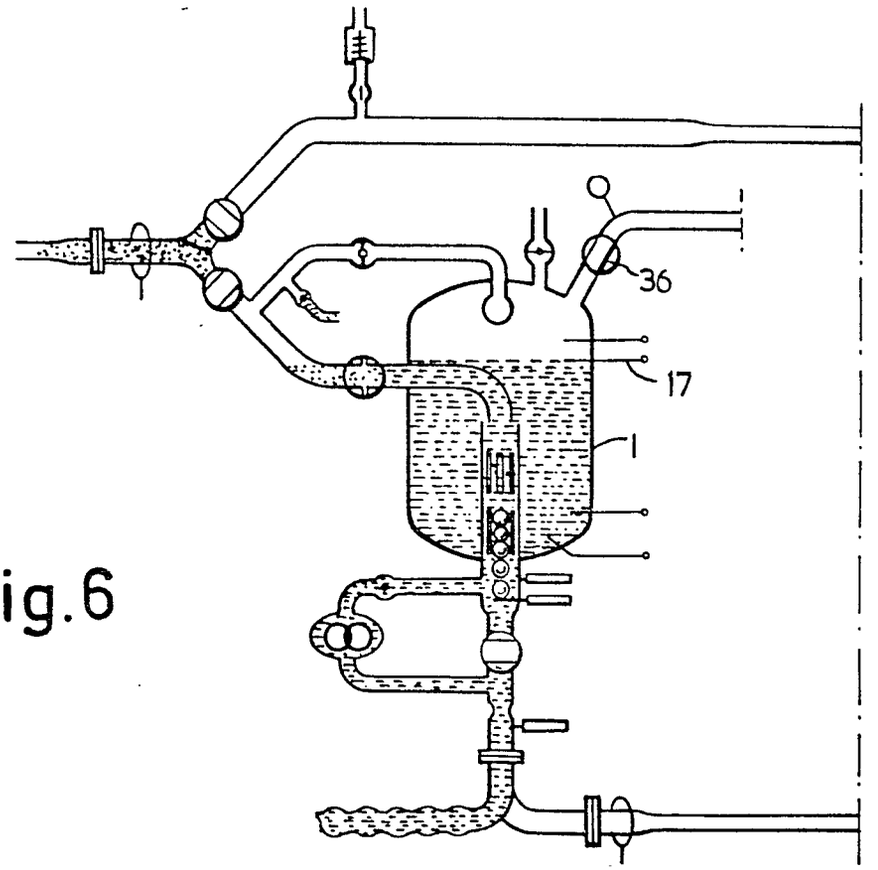


Fig.6

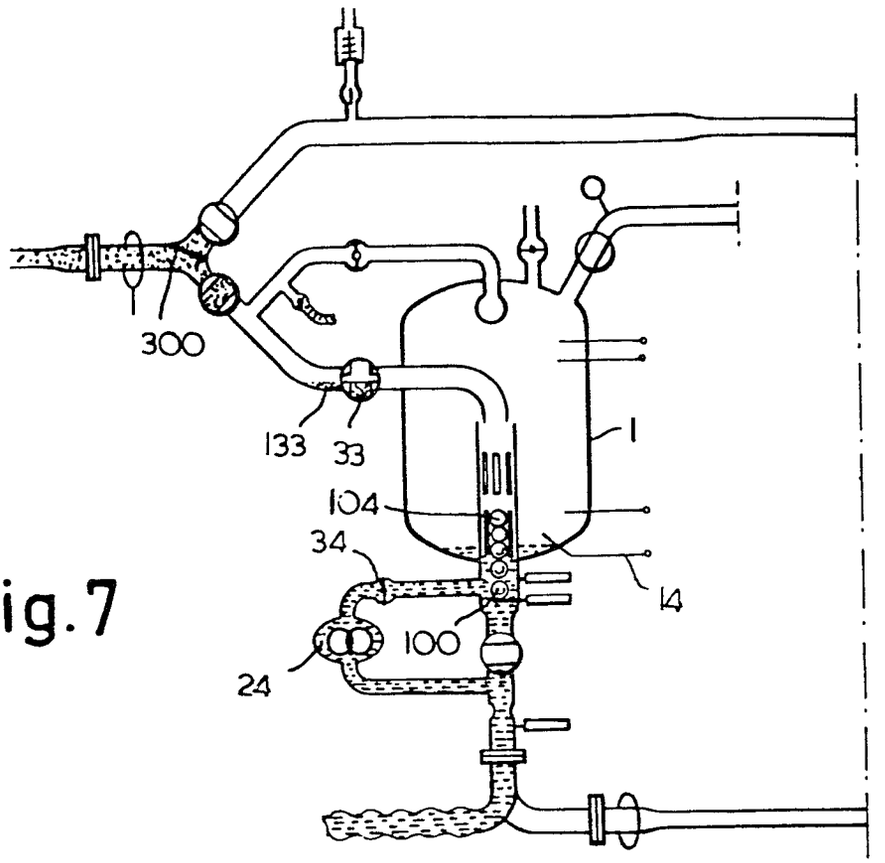


Fig.7

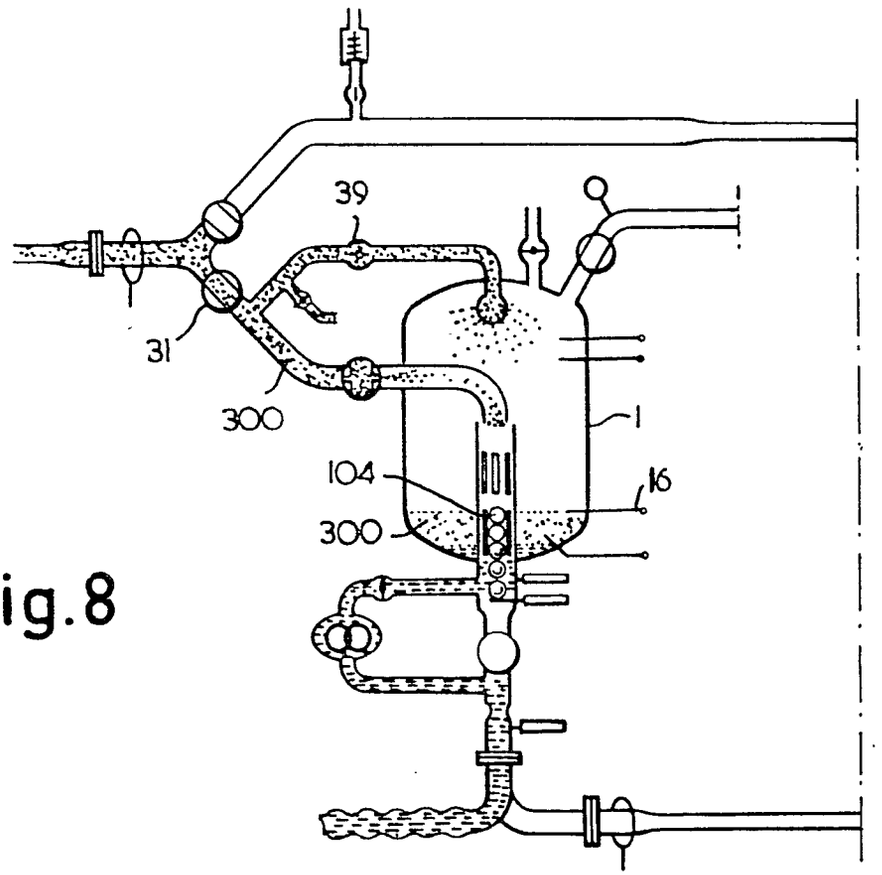
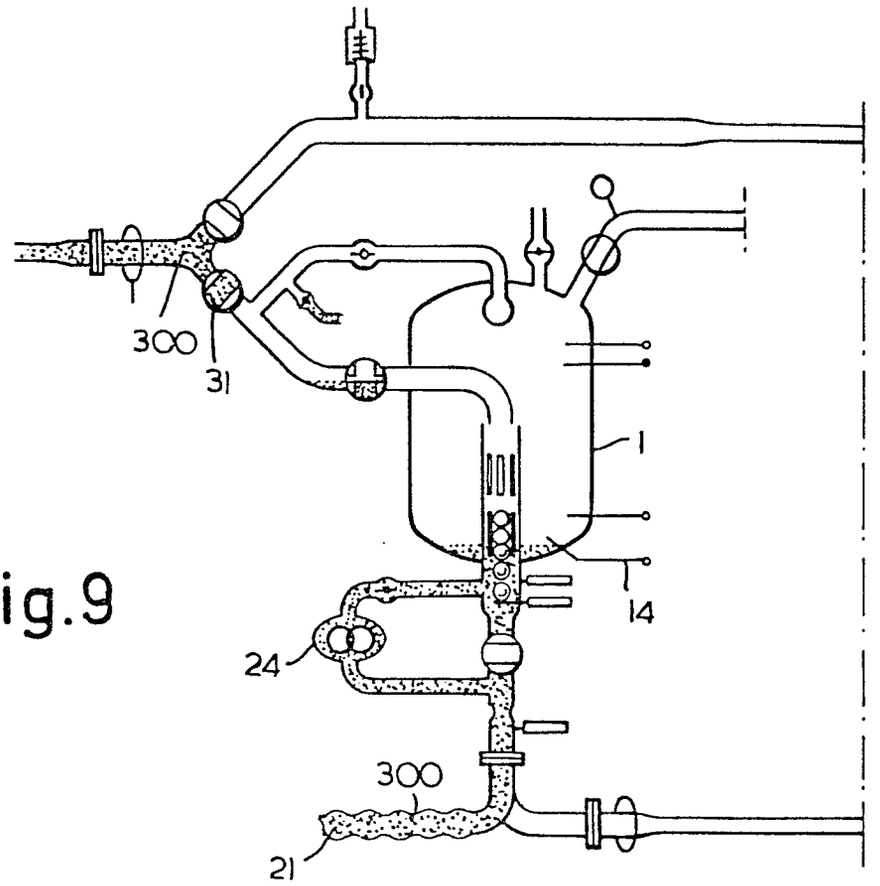


Fig.8



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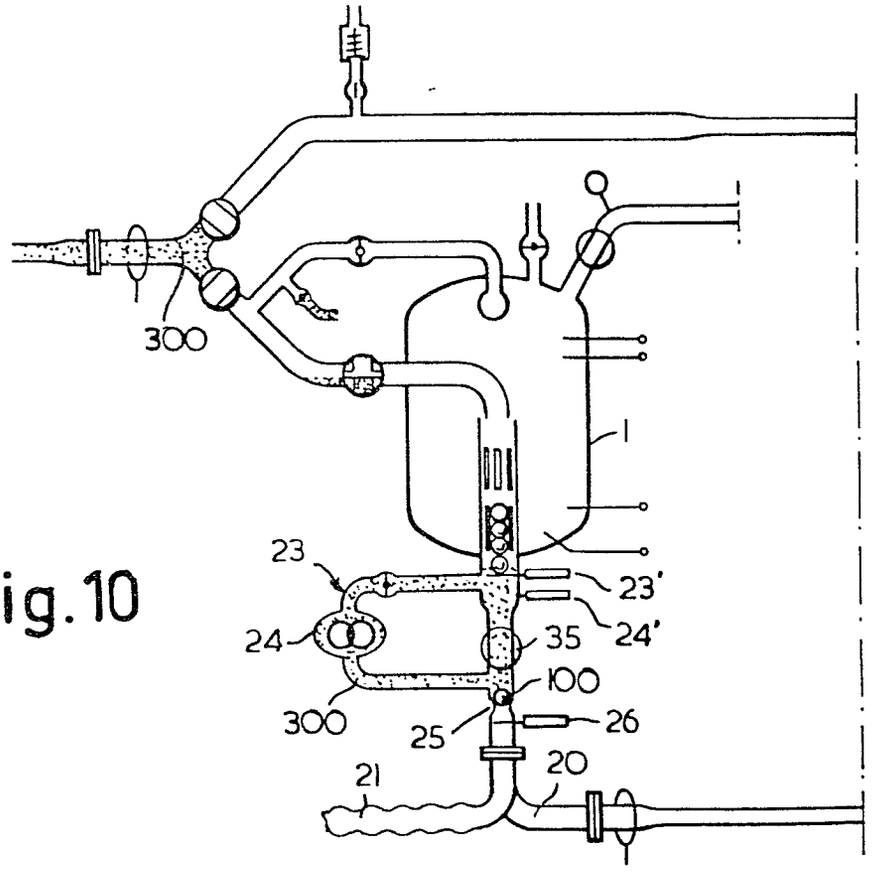
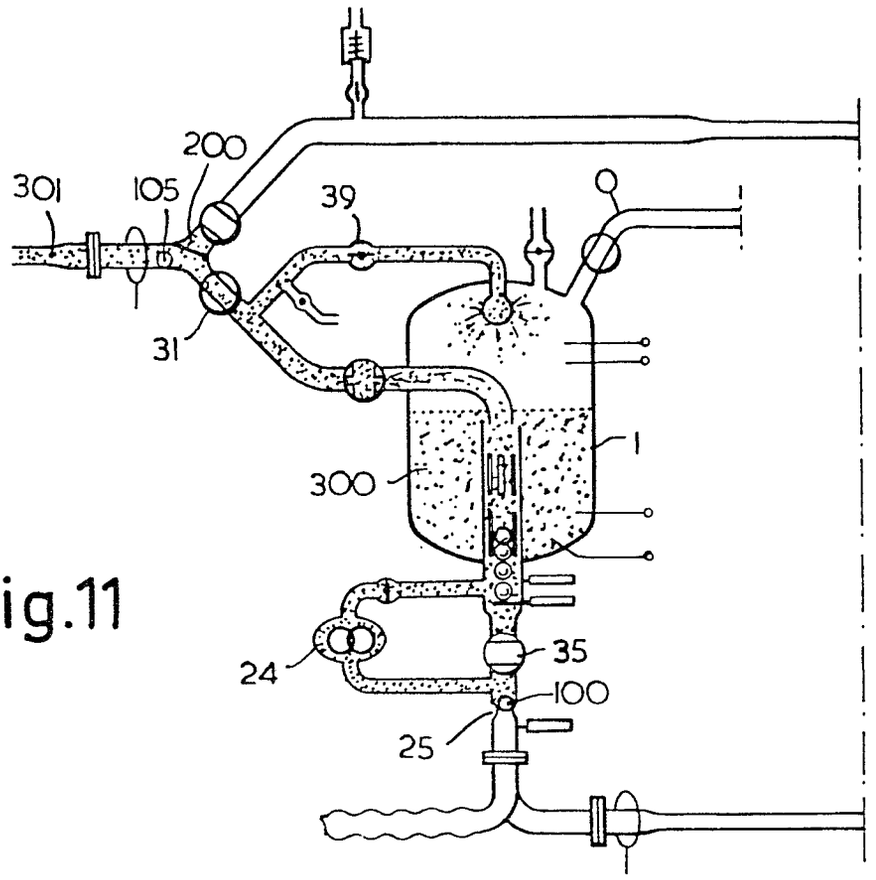


Fig.10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105
200
39
31
1
300
24
35
100
25

Fig.11

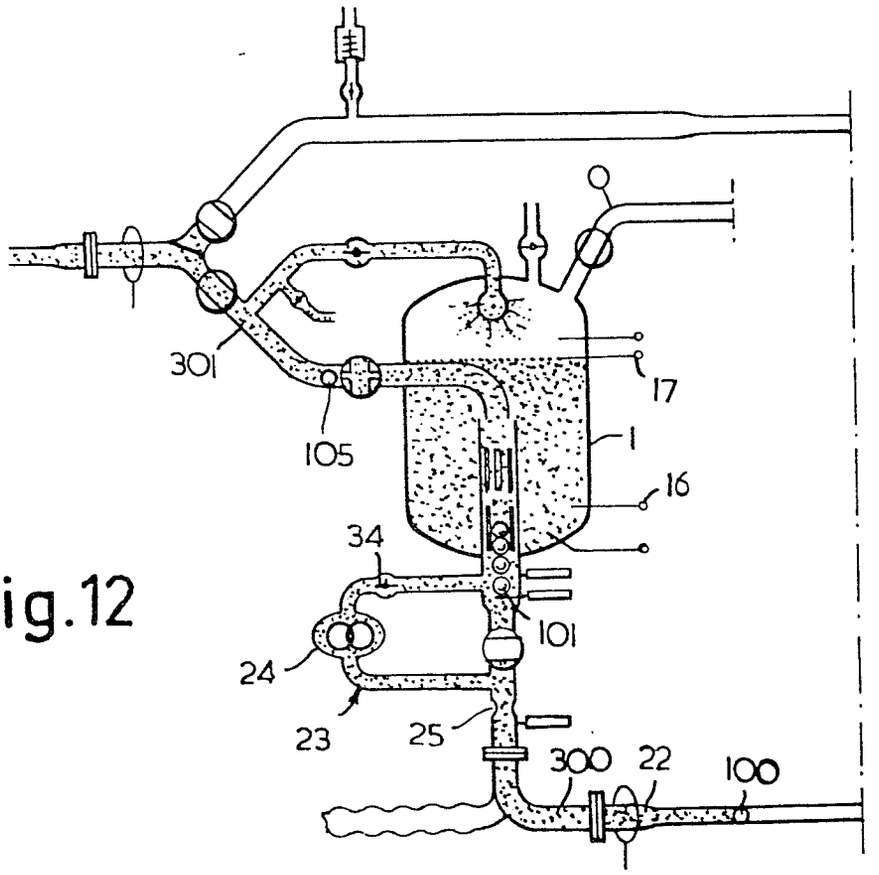
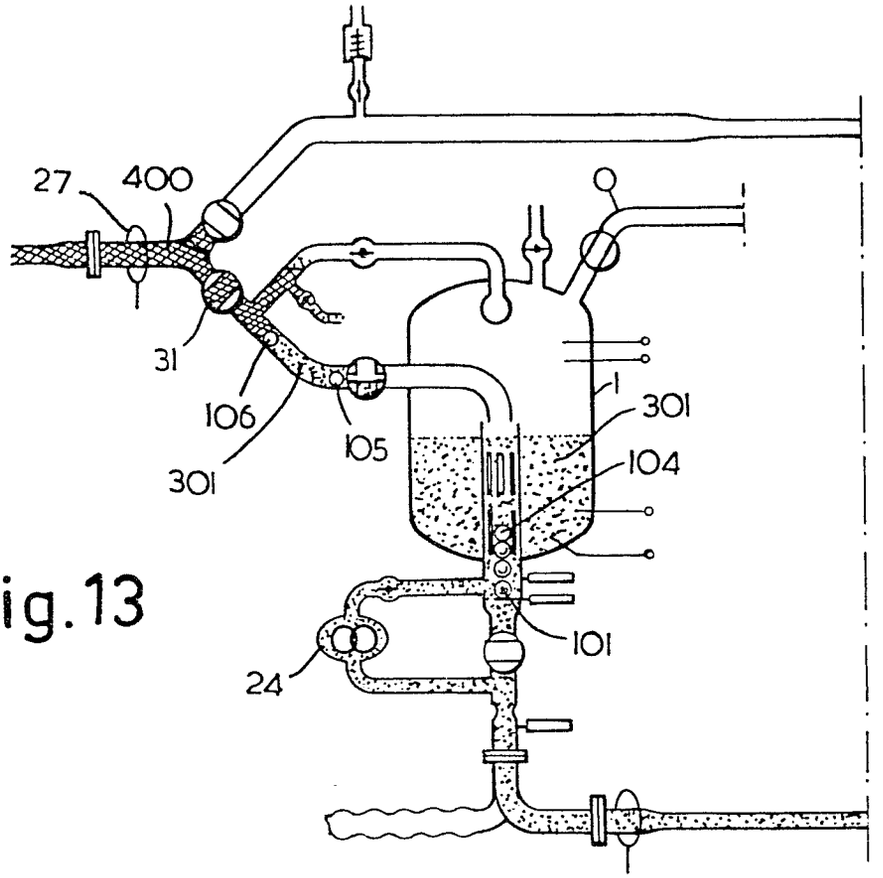

301
105
17
1
16
34
101
24
23
25
300
22
100

Fig.12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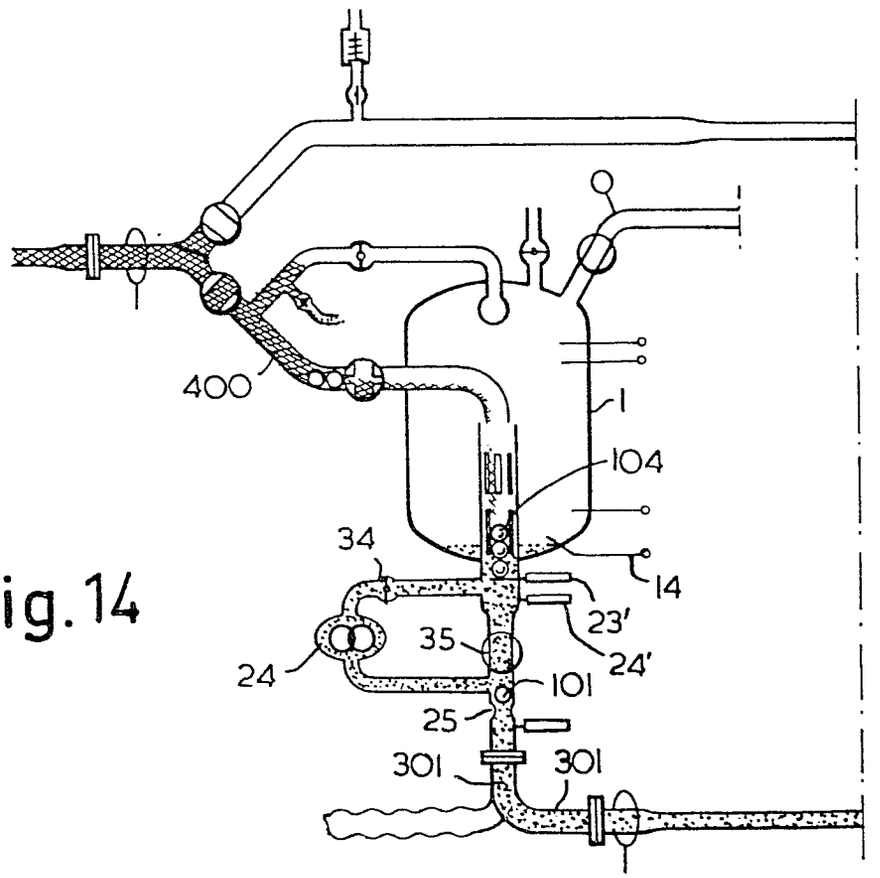
31
106
105
301
301
1
104
101
24

Fig.13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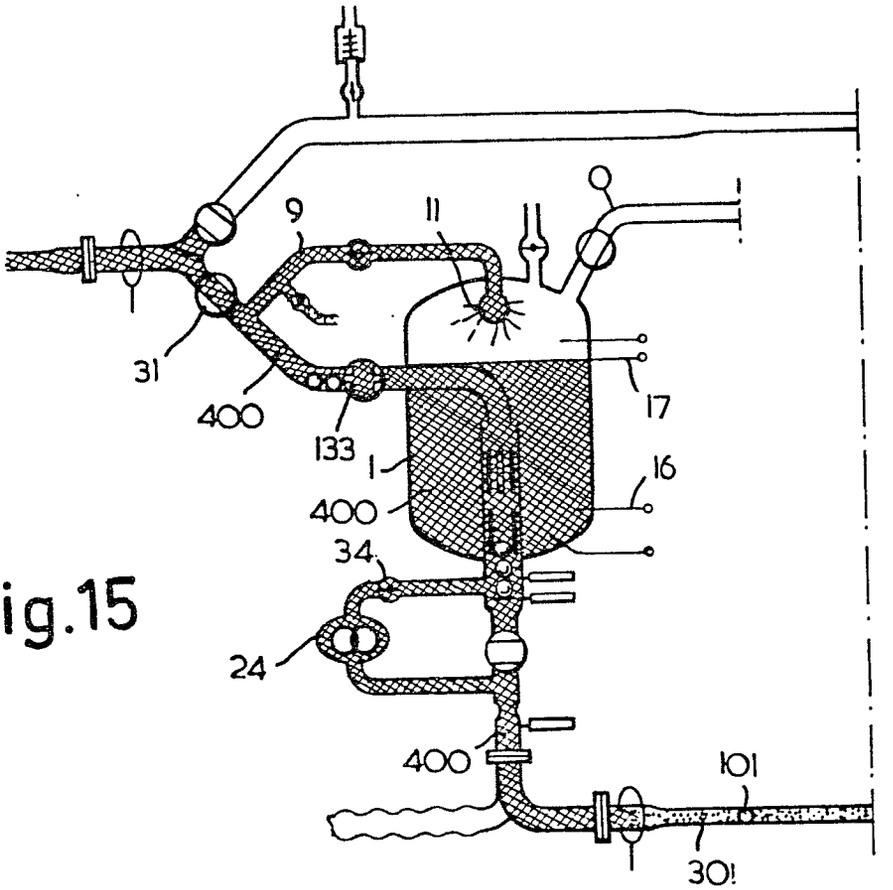
104
34
14
23'
35
24'
24
101
25
301
301

Fig.14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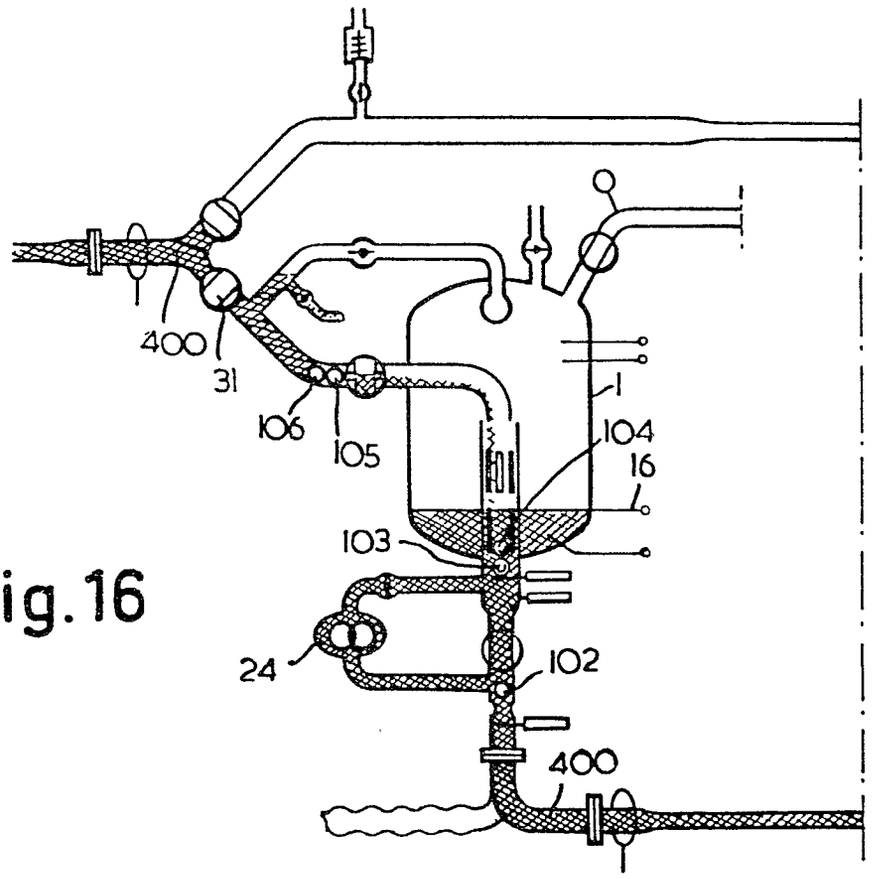
17
16
400
34
24
400
101
301

Fig.15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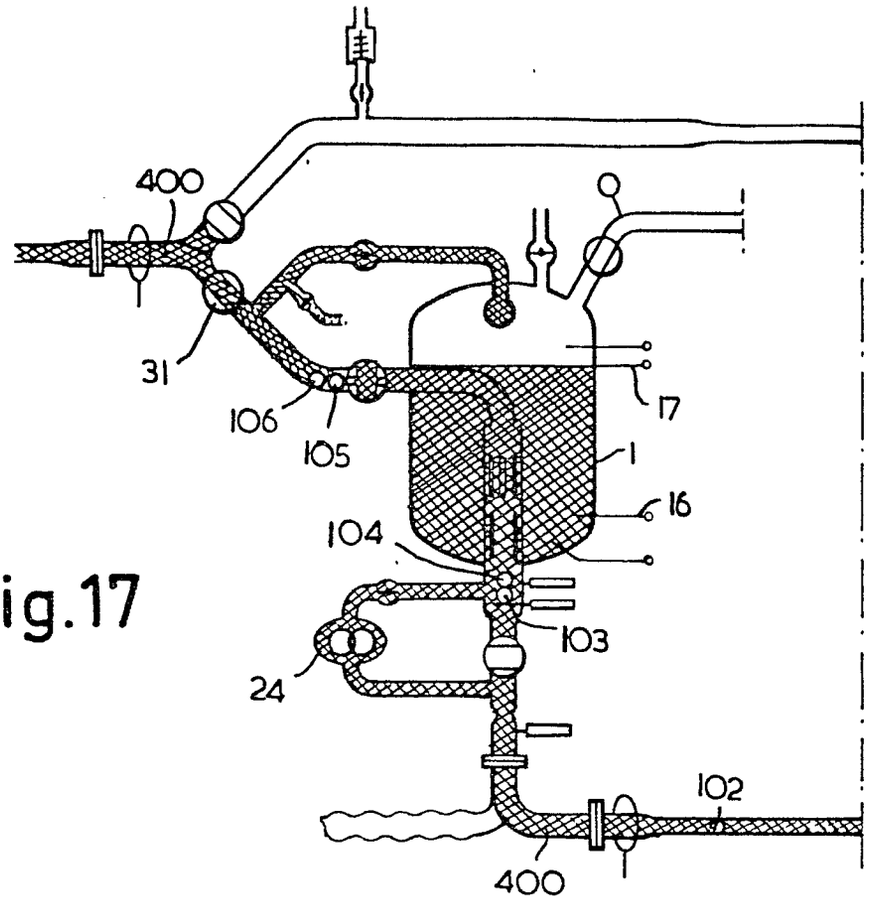
31
106
105
1
104
16
103
24
102
400

Fig.16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31
106
105
17
1
16
104
103
24
102
400

Fig.17

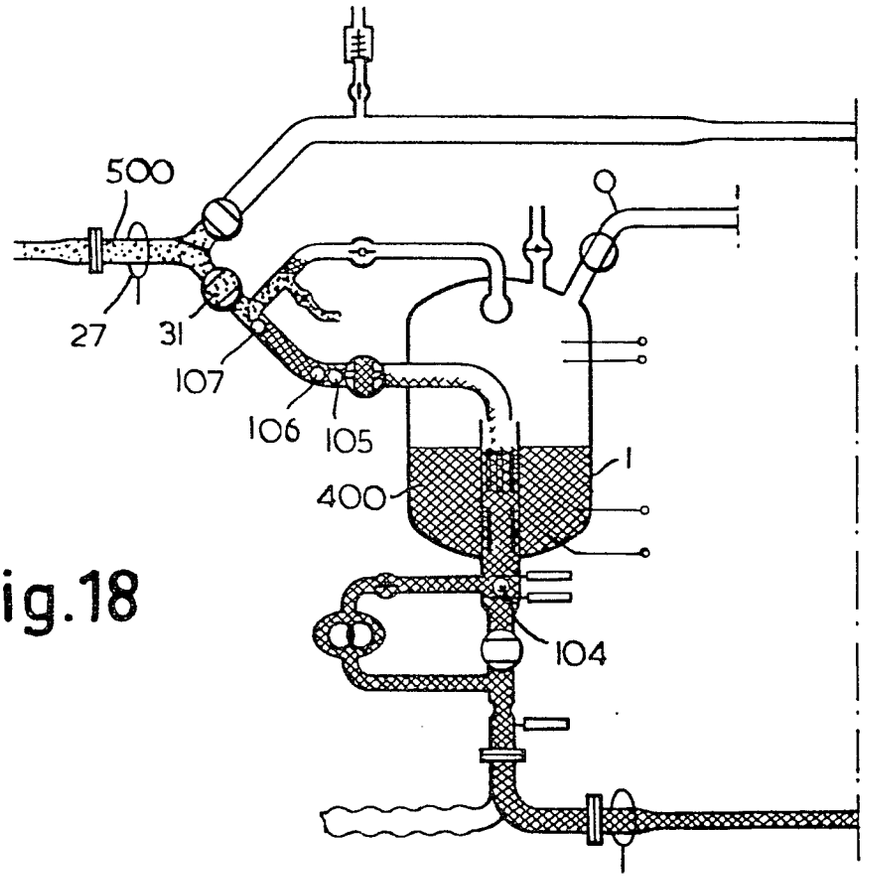

500
27
31
107
106
105
1
400
104

Fig.18

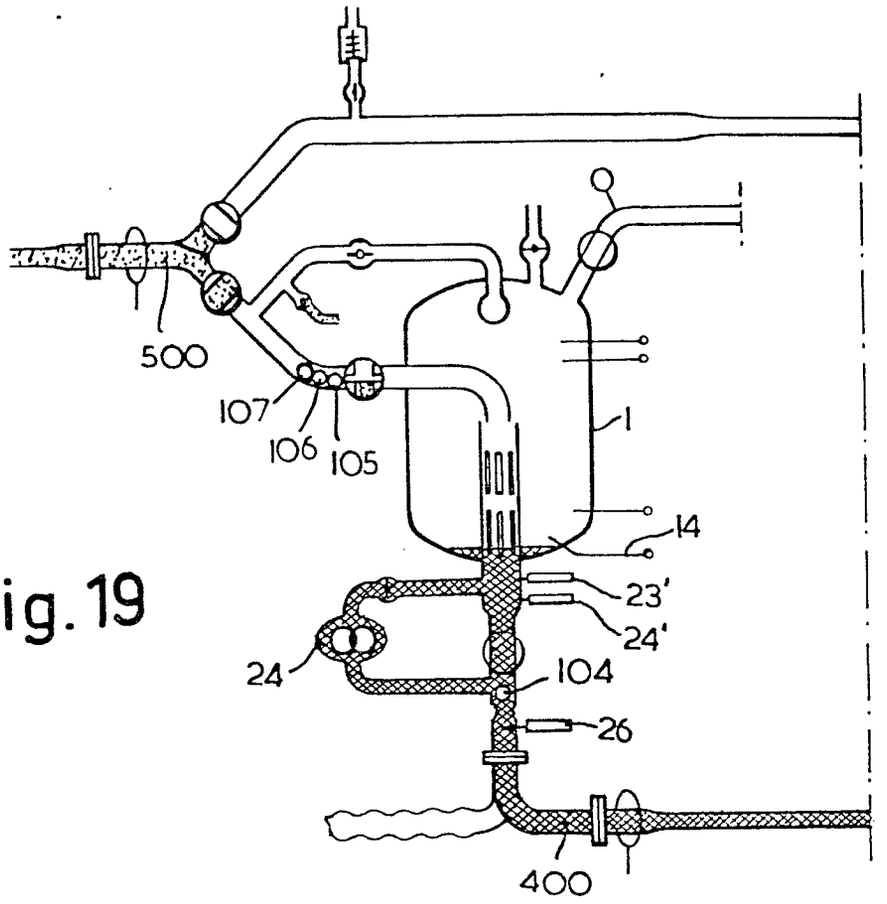


Fig.19

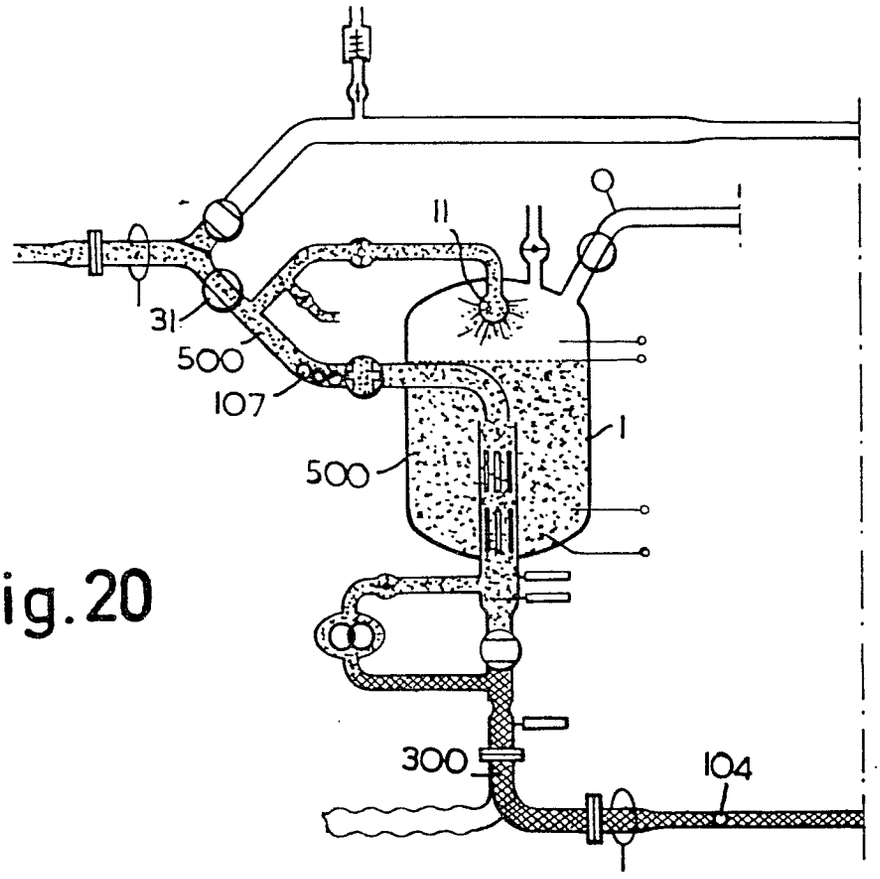


Fig.20

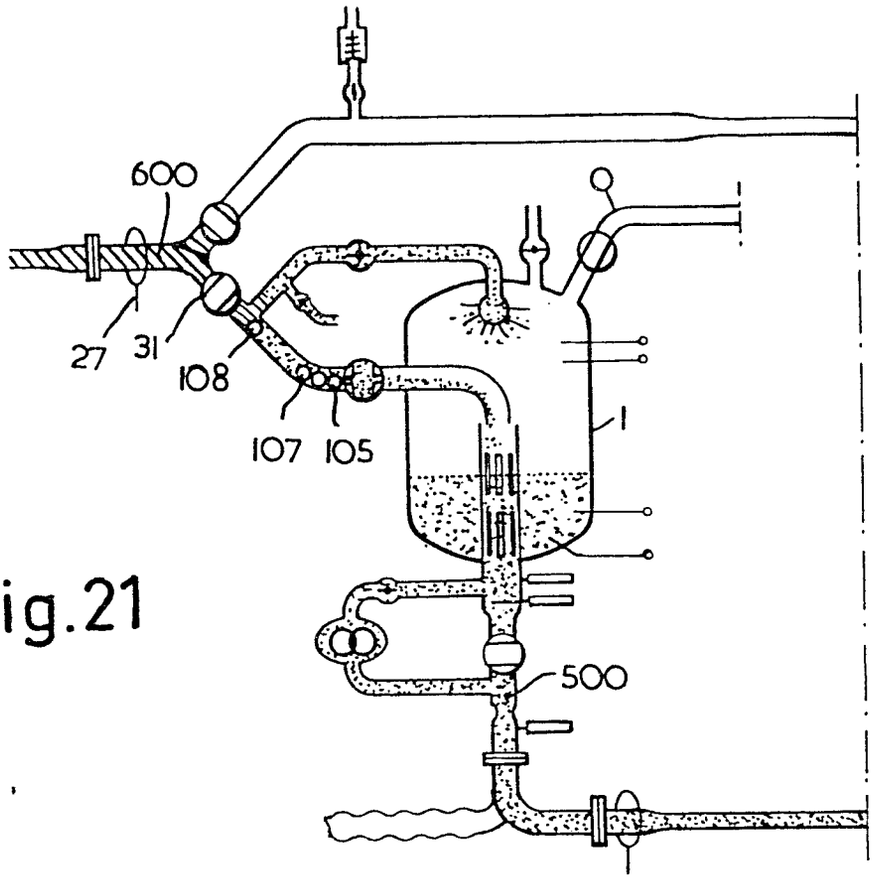


Fig.21

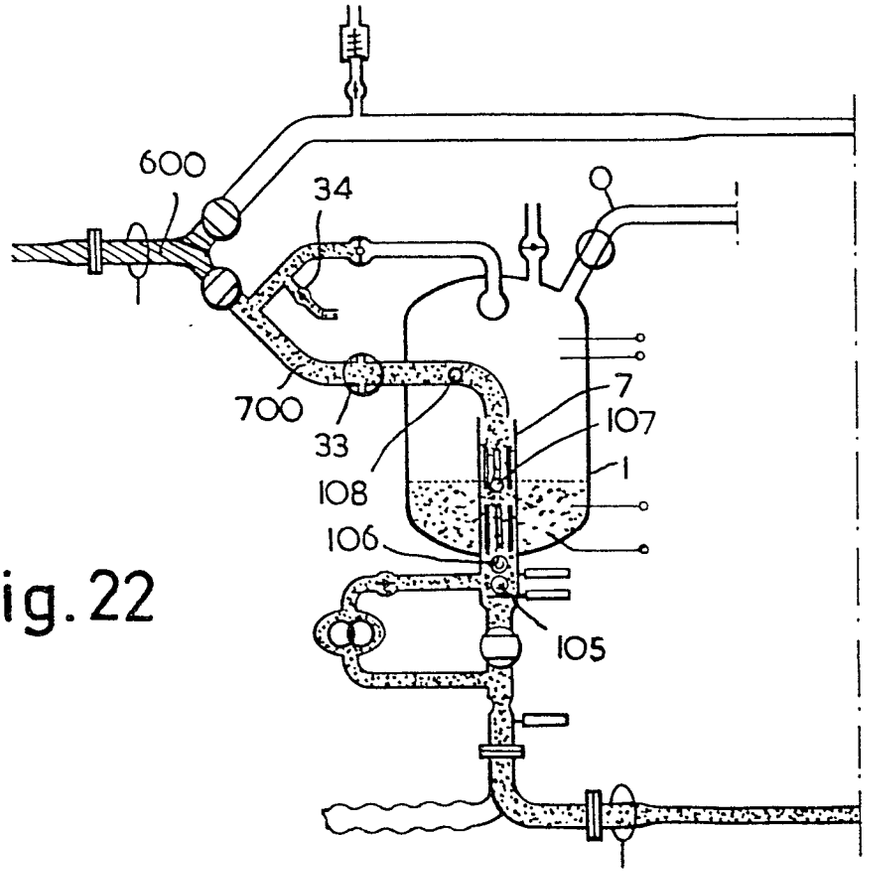


Fig.22

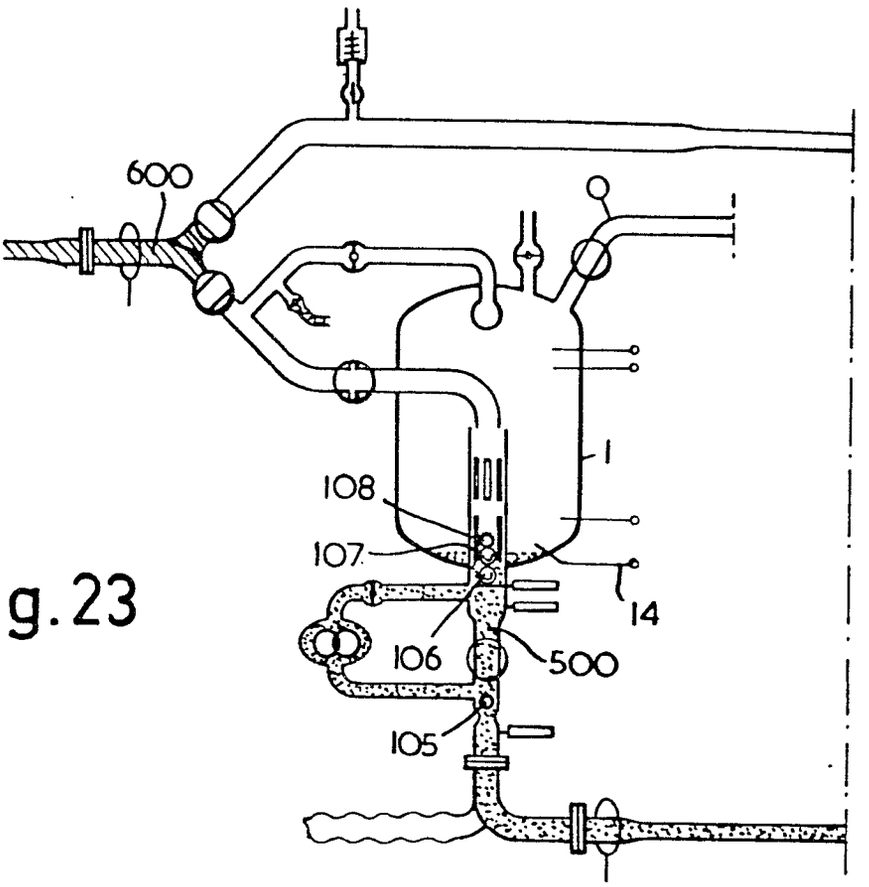


Fig.23

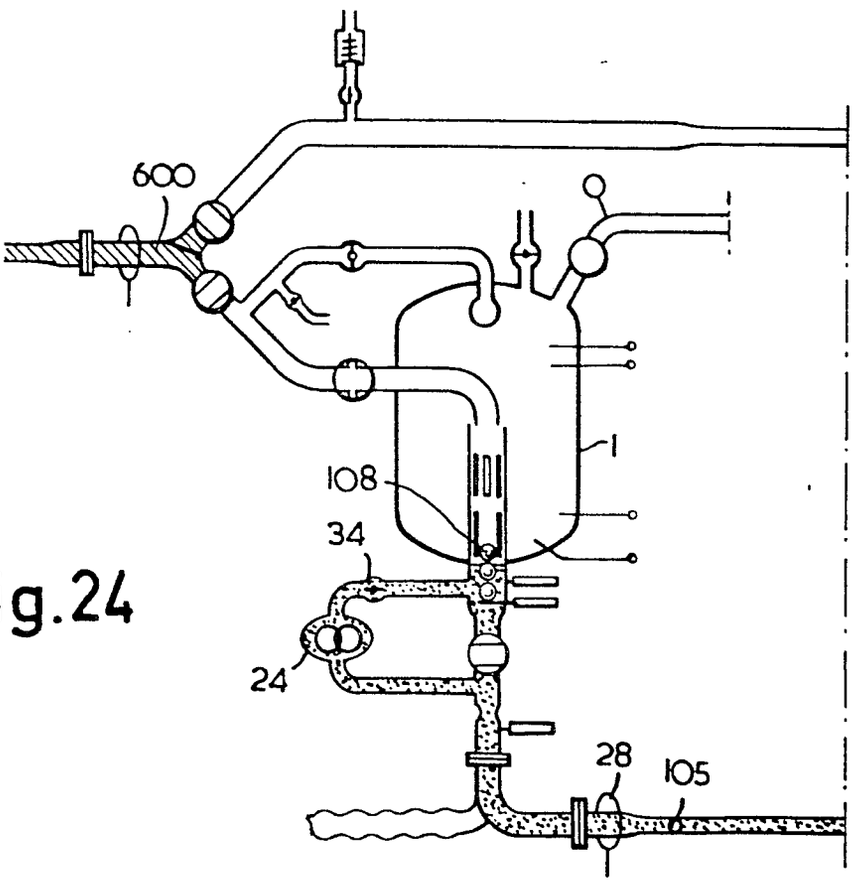


Fig.24

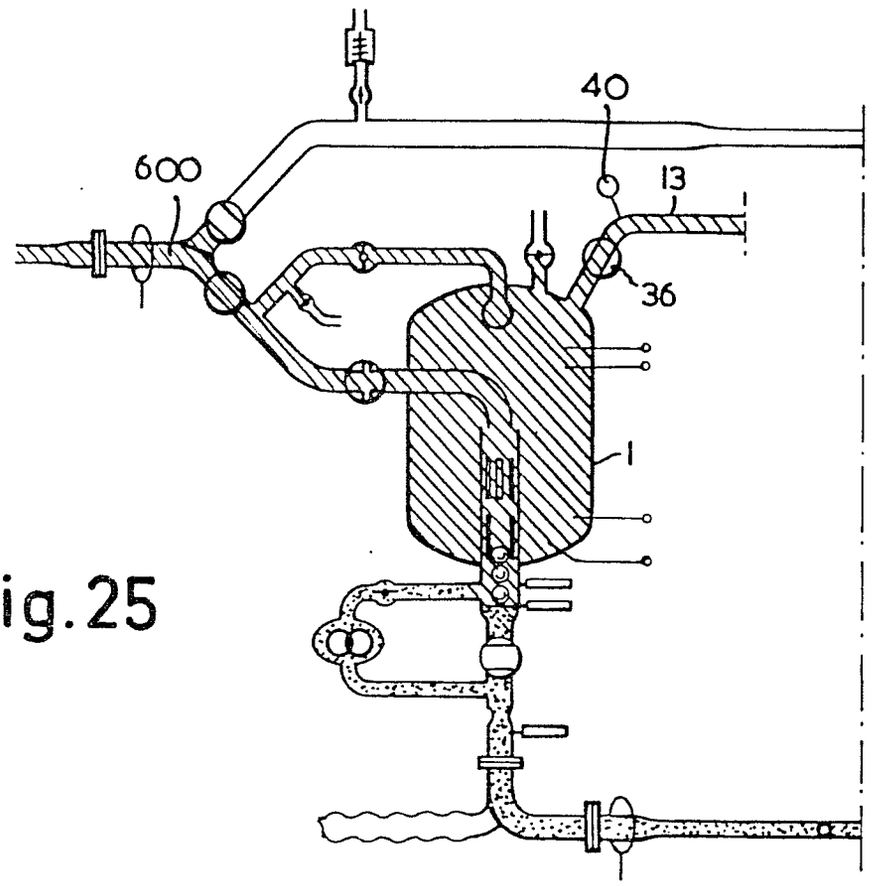


Fig.25

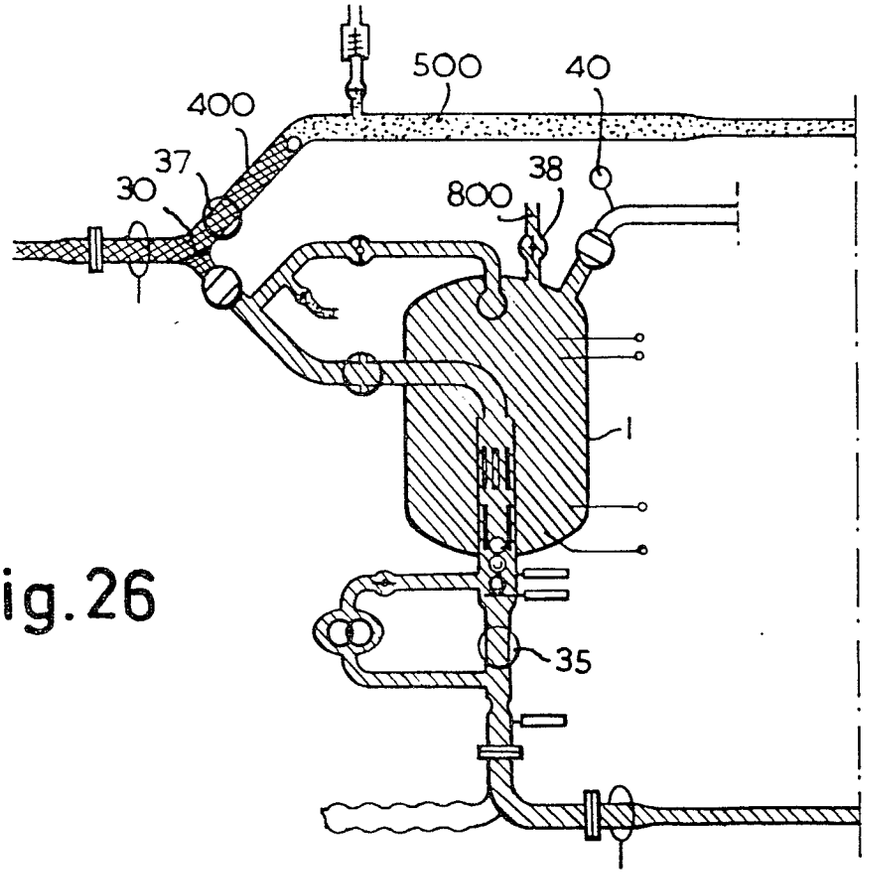


Fig.26

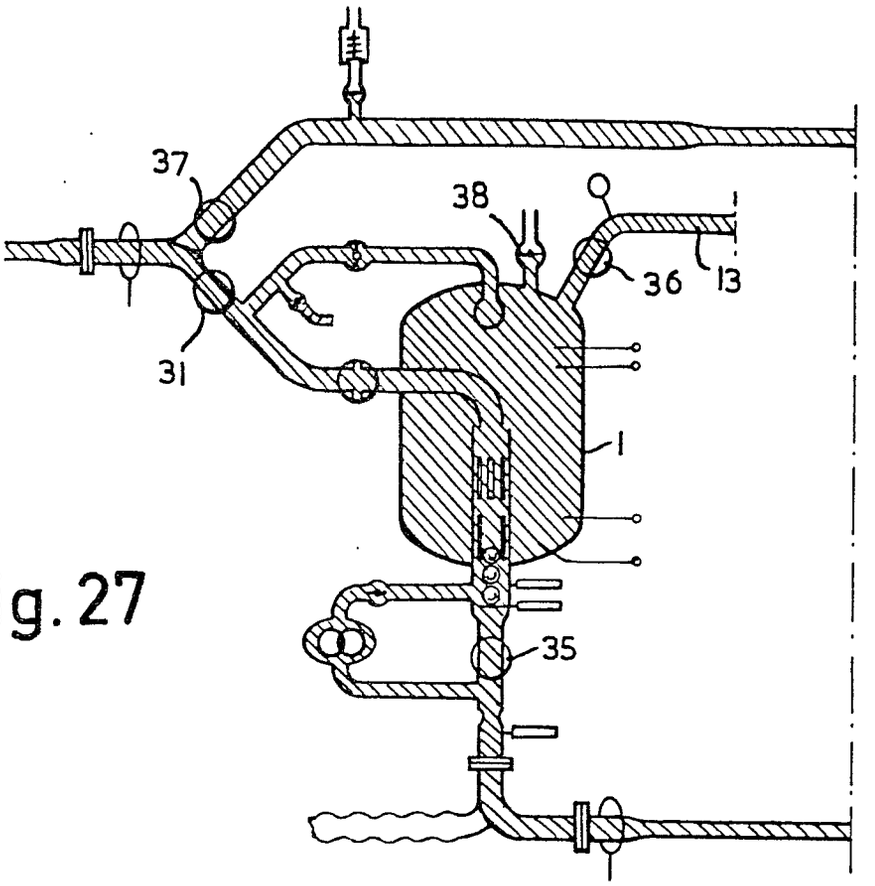


Fig. 27

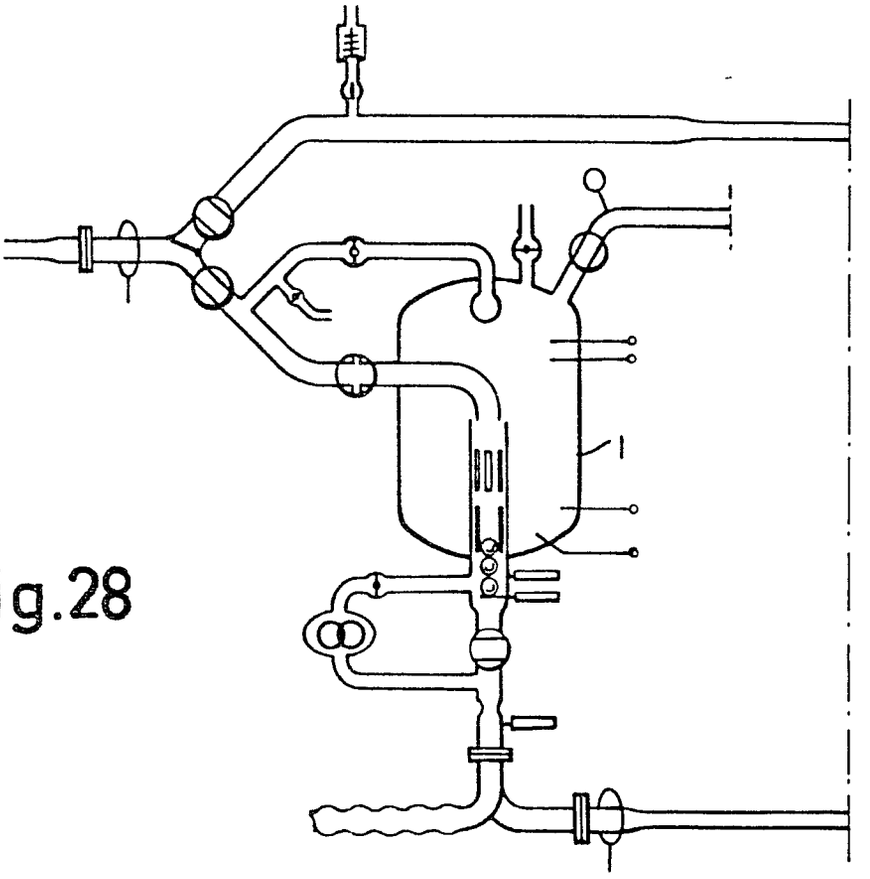
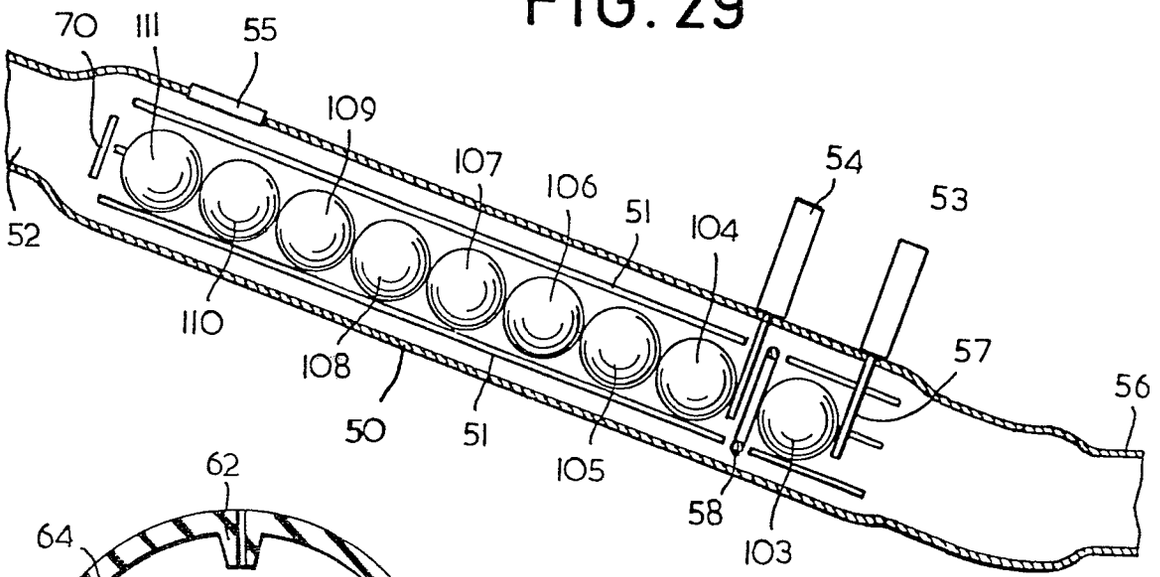


Fig. 28

15/15

FIG. 29



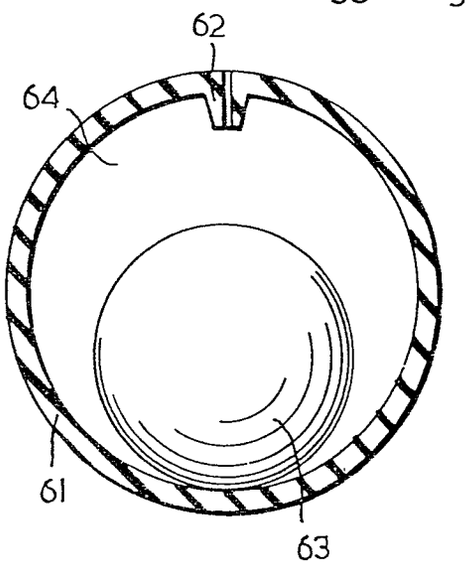


FIG. 31

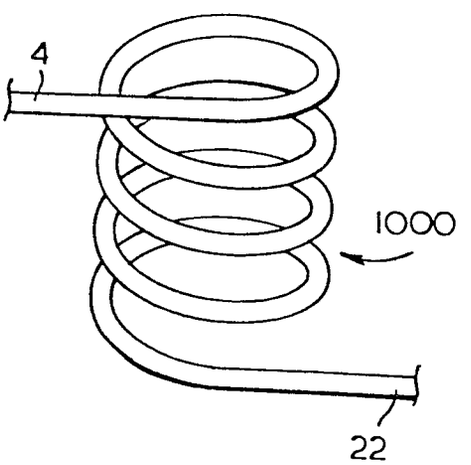


FIG. 30

European Patent Office

0022276

Application number

EP 80 20 0107

EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	BE - A - 633 550 (VAN RIET-SCHOTEN & HOUWENS) * Page 2, first paragraph; figures *	
A	DE - A - 2 525 937 (ECKART) * Claim 1; figure *	
A	US - A - 3 779 270 (DAVIS) * Abstract; figures *	
A	US - A - 2 951 255 (VER NOOY) * Claim 1; figures *	

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

F 17 D 3/08
B 08 B 9/04

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

F 17 D
B 08 B
B 67 C

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24-09-1980	V. REETH