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(54) **A forced discharge compressed-air operated device for sanitary fixtures**

Eine mit Druckluft bediente Abflussvorrichtung für Sanitäranlagen

Un dispositif d'évacuation actionné par air comprimé pour appareil sanitaire

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(73) Proprietor: **PRODUCTION S.R.L.**
81025 Marcianise (CE) (IT)

(72) Inventor: **GAGLIANO, Vitaliano**
6065 Passignano sul Trasimeno (PG) (IT)

(74) Representative: **Petruzziello, Aldo et al**
Racheli & C. S p A
Viale San Michele del Carso, 4
20144 Milano (IT)

(56) References cited:
FR-A- 1 566 133
FR-A- 2 256 292

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Description

[0001] The invention refers to the field of forced discharge sanitary fixtures, as are widely used, for example, on means of transport such as ships, airplanes or trains.

[0002] It is known that motorized systems, for evacuation of wastewater from sanitary fixtures for instance, have considerable drawbacks. For example, known systems that use a rotor are subject to breakage thereof when a hard object such as a fruit stone is accidentally thrown into the fixture.

[0003] FR-A-1566133 discloses a forced discharge device for feeding concrete, comprising a body defining an inner chamber, an inlet and an outlet, a hollow cup-shaped shutting element movable between an extended closure position and a retracted opening position, a piston element including a stem, a working head, a drive head, said piston element being axially slidable in the cup-shaped shutting element, driven by the respective working head. The document does not disclose any means for operating the piston element'drive head, nor the possibility to apply a vacuum to facilitate entry of the material (concrete) in the inner chamber. Furthermore, the arrangement shown in the drawings and described would not be suitable for use in sanitary fixtures due to unavoidable overall dimensions and insufficient sealing.

[0004] The vacuum systems currently in use in the sanitary field, which have been used for a long time in the shipping sector and more recently in the rail sector, have the drawback that reverse flow may occur when they are accidentally subjected to changes in the pressure situation.

[0005] An aim of the present invention is to exclude the possibility of accidents due to dangerous backflow that might involve the user. A further aim is to eliminate or drastically reduce the possibility of damage to the sanitary fixtures or downtime thereof.

[0006] A further aim is to achieve the above advantages with reduced water consumption and moderate power consumption.

[0007] A further aim is to provide such devices that can also be adapted to foldaway fixtures.

[0008] The above aims have been achieved with a device as stated in claim 1. Further characteristics of the device are stated in the subsequent claims.

[0009] In other words, the new device comprises a body that can be mounted on the sanitary fixture, the body being provided with an inlet opening for entry of wastewater and an outlet opening for discharge thereof and defining an inner chamber in which a cup-shaped shutting element can move between an extended position, in which it shuts the inlet opening, and a retracted position in which it leaves said opening free, a distributor element, being fixed to the body, or fixed to a cover thereof, provided with input and output ducts for a fluid, generally compressed air, and further comprises a twin piston element, movable inside the cup-shaped element between an extended position (with the cup-element extended) and a retracted position.

[0010] The new device achieves the above aims, and in particular it eliminates the possibility of backflow of expelled wastewater, it provides for a perfect separation, in a closed position, between the discharge network and the sanitary fixture; it can be adapted not only to fixed sanitary fixtures but also to foldaway sanitary fixtures; it requires reduced water consumption and reduced power consumption: its operation is efficient and reliable even in situations where the waste pipe has a very small section or an upward, long or winding course.

[0011] An exemplary unrestrictive embodiment of the invention will be described below with reference to the appended drawings, in which:

Figure 1 is an axial sectional view of the device according to the invention in a first embodiment; the plane of the sectional view is indicated by 1-1 in Figure 2;

Figure 2 is a top plan view of the device in Figure 1, with the cover removed to show underlying parts;

Figure 3 is an axial sectional of the distributor element of the device alone, taken along a plane indicated by line 3-3 in Figure 2;

Figure 4 is an axial sectional view of the distributor alone, taken along a plane indicated by line 4-4 in Figure 2;

Figure 5 is an axial sectional view of the distributor alone, taken along the plane indicated by line 5-5 in Figure 2;

Figure 6 shows the device fitted to a sanitary fixture of a traditional type;

Figure 7 shows the device fitted to a tip-up foldaway sanitary fixture shown positioned for use;

Figure 8 shows the fixture in Figure 7 in a raised idle position;

Figures 9 to 12 are schematic pictures of the device, shown in various purely illustrative sectional views, which show four stages of operation of the forced discharge device.

[0012] With reference first to Figures 1 to 5, a forced discharge device is indicated as a whole by reference number 10 and comprises a hollow body 11, generally but not necessarily cylindrical, that has an inlet opening 12 to let wastewater in and an outlet opening 13 to let wastewater out. Inside the body 11 a cup shaped element indicated as a whole by reference number 14 can slide axially (in a direction defined by the x axis of the

body). A twin piston element indicated as a whole by 15 can slide axially inside and with respect to the cup-shaped element 14. A distributor element 16 is fixed with respect to the body 11 and more precisely is supported by a cover 18 fixed to the body 11.

[0013] The above elements will now be described in detail.

[0014] The body 11 is formed with an internal a chamber 21, in which said inlet opening 12 opens. This opening is made in the side wall of body 11. The body 11 also has a lower flange 22 for attachment of an outlet part 23, in which said outlet opening 13 opens. The body 11 also has an upper flange 24 on which said cover 18 is screwed. The coupling and fixing screws are not drawn but simply indicated with their axes drawn with dashed and dotted lines.

[0015] At an end thereof towards part 23, the body 11 has an internal seat for an O-ring or sealing ring 26, whilst the part 23 itself has a seat for an abutment ring 25, thus allowing the cup-shaped shutting element 14 to seal the chamber 21 tightly.

[0016] The cup-shaped shutting element 14 has a cylindrical skirt part 28, of a suitable size and shape to be able to slide inside the chamber 21 of the body, and an upper (in fig. 1) flange part 30, extending inside from the skirt part. The skirt part is preferably thinner at one end 31; at the opposite end it has a seat 32 opening towards the outside for an O-ring 33, and a seat 34, facing inwards, for an O-ring 35.

[0017] The fixed distributor element 16 comprises a cylindrical portion 36, from which a lower (in fig. 1) plate portion 38 extends; it has a circumferential peripheral seat 40 for an O-ring 41 to provide a seal against the inner surface of the cup-shaped element 14 and a through hole 39 with seats for O-rings 42, 42, for a stem of piston 15. The cylindrical portion of distributor 16 has a plurality of ducts for an operating fluid, said ducts being circumferentially spaced apart and referenced respectively a, b, c and d as can be seen in the plan view in Figure 2. The operating fluid is preferably compressed air, supplied by a compressor or a special supply system (not illustrated). The ducts a, b, c and d have a threaded mouthpiece for connection to said supply system, by means of solenoid valves or opening and closing devices managed by an electronic, electrical or mechanical means.

[0018] The duct a, which can also be seen in Figure 3, extends with its axis parallel to the axis of the device and ends in the vicinity of plate 38 in a radial passage towards the outside, indicated by a', which opens into an annular chamber 45 defined between the distributor 16 and the cup-shaped element 14.

[0019] The duct b, which can also be seen in Figure 5, has a limited axial extension and opens outwards radially at the top into the annular chamber 43 through a hole b' defined between the cup-shaped element 30 and the cover 18.

[0020] The duct c, which can also be seen in Figure 1, extends in an axial direction, has a radial opening c' in a chamber 46 between the cover and the piston and an end opening c" in the outermost surface of the distributor, facing the piston 15; that is to say, the opening c" opens into a chamber 47 defined between plate 38 and piston 15.

[0021] The duct d, which can also be seen in Figure 4, extends in an axial direction and has a radial opening d' at an end near the plate 38, facing towards the chamber 44 of the distributor (that is, with the device assembled, towards the chamber defined between the distributor and the piston).

[0022] The piston 15 comprises a stem 51, a working head 52, a drive head 53 all integral with each other. The working head 52 slides inside the cup 14, forming a seal with O-ring 48; 49 is a stop on the cup. As the stem slides inside the plate 38 of the distributor, a seal is formed by the O-rings 42. The drive head slides along the inside wall of the distributor, a seal being formed by the upper O-ring 54 accommodated in the head 53. An axial duct for compressed air is defined inside the stem 51 and this duct is indicated as a whole by the letter e. A check valve 56 is situated on the bottom of the duct and indicated schematically by a spring-loaded ball.

[0023] The forced discharge device is mounted downstream of the bowl of a sanitary fixture as can be seen in Figure 6 or in Figures 7 and 8. In Figure 6, the sanitary fixture is indicated with the reference number 60 and is of a traditional type. The device 10 is mounted with the longitudinal axis x lying horizontally, with the opening 12 at the outlet of the bowl and the opening 13 connected to a per se known rotary exhaust valve 58 which will therefore not be described in detail.

[0024] The sanitary fixture of Figures 7 and 8 is a tip-up foldaway fixture, which is shown in the position of use in Figure 7. The device 10 is mounted with the x axis vertical and the opening 12 at the opening of the bowl of the sanitary fixture 70. In figure 8 the device 10 is shown tipped with the sanitary fixture in the resting position.

[0025] With reference now to Figures 9 to 12 various stages of operation of the device will be described.

[0026] At rest (Figure 9) the cup-shaped shutting element 14 is in a fully extended position, so that it completely covers the inlet opening 12, thus closing it tightly, that is to say forming a seal on O-ring 26, on O-ring 33 and on the abutment ring 25.

[0027] When the device 10 starts to operate (Fig. 9), compressed air is introduced through the duct d of the distributor and the opening d', between the plate part 38 of the distributor and the drive head 53 of the piston. Since the plate part 38 is fixed, the head 53 and the whole piston 15 rise, expelling air through the openings c' and c" and the duct c (Fig. 12).

[0028] A vacuum is created in the chamber 21.

[0029] Compressed air is then introduced through the duct a of the distributor and the opening a' between the plate part 38 of the distributor and the flange 30 of the

cup (Fig. 10).

[0030] Since the plate part 38 is fixed, the flange 30 and the whole cup 14 rise, expelling air through opening b' and duct b (which for simplicity's sake has been indicated in the scheme of Figures 9 to 12 as being connected directly to the body rather than made in the distributor, as is actually the case (Fig. 5)).

[0031] At the end of its stroke, the distributor is therefore in the position shown in Figure 11, with the cup-shaped shutting element completely retracted so as to free the opening 12.

[0032] Through it, the wastewater can fill the chamber 21.

[0033] Compressed air is then introduced through the duct b at the same time allowing air to evacuate through the duct a. The cup-shaped element 14 is thus again pushed into the extended position in Fig. 12, shutting the inlet opening 12 and preventing any return of wastewater or odors through the sanitary fixture.

[0034] At this point the piston 15 enters into operation and is pushed into the extended state (Fig. 9) to expel the wastewater through the discharge opening 13. Operation of the piston 15 is carried out by introducing compressed air through the duct c and the openings c' and c" (Fig. 12), so as to act simultaneously on the upper surfaces of the larger working head and of the smaller drive head of piston 15.

[0035] Compressed air may be introduced through the duct e at this stage to facilitate evacuation of the wastewater.

[0036] The cycle is ended, and in any case can be repeated, on the basis of a programmable logic, until the wastewater has been completely evacuated.

[0037] It will be understood that in this way a functional and efficient device has been provided to close the wastewater inflow opening completely and prevent any return of wastewater and odours.

Claims

1. A forced discharge device for sanitary fixtures comprising

a body (11)defining an inner body chamber (21), an inlet opening (12) and an outlet opening (13),
a hollow cup-shaped shutting element (14) axially slidable in said body chamber between an extended position in which it closes said inlet opening and a retracted position in which it leaves said inlet opening at least partly free,
a piston element (15) including a stem (51), a working head (52), a drive head (53) integral to each other, said piston element being axially slidable with respect to said cup-shaped shutting element (14)

characterised in that it further comprises

- a distributor element (16) fixed with respect to the body (11) and comprising a plate portion (38) positioned between said working head and said driving head of the piston element, said distributor element (16) being in sealing engagement with said shutting element (14) and said piston element (15) and defining an annular chamber (45)with said shutting element (14), a distributor chamber (44) with the piston element (15), a further annular chamber (47) with the piston element and a further chamber (43) with the shutter element (14)

further comprising a plurality of ducts (a, b, c, d) for an operating fluid in said distributor element (16), said operating fluid being for sliding said shutting element (14) between an extended position and a retracted position and for sliding said piston element (15) between an extended position and a retracted position.

2. A device according to claim 1, **characterised in that** it comprises an additional duct (e) for an evacuation fluid in the piston stem, said additional duct having an opening to body chamber (21).

3. A device as said in claim 2, wherein said additional duct (e) comprises a check valve (56).

4. A device according to claim 1, wherein said distributor is fixed to a body cover (18).

5. A device according to claim 1, **characterised in that** said ducts for an operating or driving fluid comprise

- a first duct (a) extending between a duct end and said annular chamber (45) for supplying operating fluid for driving said cup shaped element (14) to its retracted position
- a second duct (b) extending between a duct end and said further chamber (43) for supplying operating fluid for driving cup-shaped element (14) to its extended position
- a third duct (c) extending between a duct end and said further chamber (47) for supplying operating fluid for driving the said piston element to the extended position -
- a fourth duct (d) extending between a duct end and said distribution chamber (44) for supplying operating fluid for driving the piston element to the retracted position.

6. A device according to claim 1, wherein the operating fluid is compressed air.

7. A device according to claim 1, that can be mounted on fixed sanitary fixtures or tip-up foldaway sanitary fixtures.

8. A device as said in claim 1, wherein
said duct (a) has a radial opening (a') in the vicinity of the distributor plate portion (38) for acting on a surface of the cup-shaped element which is part of annular chamber (45)
said duct (b) has an opening (b') at a position near the body cover (18)
said duct (c) has openings (c', c'') to act on surfaces of the piston heads (52,53)
said duct (d) has an opening (d') in the vicinity of the distributor plate and facing toward the piston stem (51) for acting on a surface of the piston head (53) which is part of chamber (44).

9. A device as said in claim 5 **characterised in that** vacuum is created in internal chamber (21) of the body when said piston element is moved to its retracted position; cup-shaped element (14) is in its extended position wherein it obstructs inlet opening (12) and rotary exhaust valve (58) connected to opening (13) is closed.

Patentansprüche

1. Eine Zwangsabflußvorrichtung für sanitäre Einrichtungen, die folgendes umfaßt:

einen Körper (11), der eine innere Körperkammer (21) umfaßt, eine Ein- (12) und eine Auslaßöffnung (13),
ein hohles, muffenförmiges Schieberelement (14), das axial in der genannten Körperkammer zwischen einer ausgestreckten Stellung, in der es die genannte Einlaßöffnung verschließt, und einer eingezogenen Stellung, in der es die genannte Einlaßöffnung zumindest teilweise freiläßt, verschoben werden kann,
ein Kolbenelement (15), das einen Schaft (51), einen Betriebskopf (52), und einen Steuerkopf (53) umfaßt, die jeweils einteilig sind, wobei das genannte Kolbenelement axial im Verhältnis zu dem genannten muffenförmigen Schieberelement (14) verschoben werden kann,

dadurch gekennzeichnet, daß sie desweiteren folgendes umfaßt:

- ein Verteilerelement (16), das im Verhältnis zum Körper (11) fest ist und einen Plattenabschnitt (38) umfaßt, der zwischen dem genannten Betriebs- und dem genannten Steuerkopf des Kolbenelements liegt, wobei das genannte Verteilerelement (16) dicht mit dem genannten Schieberelement (14) eingreift und das genannte Kolbenelement (15) eine ringförmige Kammer (45) mit dem genannten Schieberelement (14) bildet, eine Verteilerkammer (44) mit Kolbenelement (15), eine weitere ringförmige Kammer (47) mit Kolbenelement und eine weitere Kammer (43) mit Schieberelement (14),
- sowie desweiteren eine Vielzahl von Rohrleitungen (a, b, c, d) für ein Betriebsfluid in dem besagten Verteilerelement (16), wobei das genannte Betriebsfluid für die Verschiebung des genannten Schieberelements (14) zwischen einer ausgestreckten Stellung und einer eingezogenen Stellung und für die Verschiebung des genannten Kolbenelements (15) zwischen einer ausgestreckten Stellung und einer eingezogenen Stellung bestimmt ist.

2. Eine Vorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, daß** sie eine zusätzliche Rohrleitung (e) für ein Entleerungsfluid im Kolbenschaft umfaßt, wobei die genannte zusätzliche Rohrleitung eine Öffnung zur Körperkammer (21) aufweist.

3. Eine Vorrichtung gemäß Anspruch 2, wobei die genannte zusätzliche Rohrleitung (e) ein Rückschlagventil (56) umfaßt.

4. Eine Vorrichtung gemäß Anspruch 1, wobei der genannte Verteiler an einem Deckel (18) befestigt ist.

5. Eine Vorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, daß** die genannten Rohrleitungen für ein Betriebs- oder Steuerfluid folgendes umfassen:

- eine erste Rohrleitung (a), die sich zwischen einem Rohrleitungsende und der genannten ringförmigen Kammer (45) erstreckt, um das Betriebsfluid zu liefern, das das genannte muffenförmige Element (14) in seine ausgestreckte Stellung bringt
- eine zweite Rohrleitung (b), die sich zwischen einen Leitungsende und der genannten weiteren Kammer (43) zwecks Lieferung des Betriebsfluids erstreckt, das das muffenförmige Element in seine ausgestreckte Stellung bringt
- eine dritte Rohrleitung (c), die sich zwischen einem Leitungsende und der genannten weiteren Kammer (47) zwecks Lieferung des Betriebsfluids erstreckt, das das genannte Kolbenelement in die ausgestreckte Stellung bringt
- eine vierte Rohrleitung (d), die sich zwischen einem Rohrleitungsende und der genannten Verteilerkammer (44) für die Lieferung des Betriebsfluids erstreckt, das das genannte Kolbenelement in die eingezogene Stellung bringt.

6. Eine Vorrichtung gemäß Anspruch 1, wobei das Betriebsfluid Druckluft ist.

7. Eine Vorrichtung gemäß Anspruch 1, die an feste oder drehbare Klapp-Sanitäreinrichtungen montiert werden kann.

8. Eine Vorrichtung gemäß Anspruch 1, wobei die genannte Rohrleitung (a) eine radiale Öffnung (a') in der Nähe des Verteilerplattenabschnitts (38) aufweist, um auf eine Oberfläche des muffenförmigen Elements einzuwirken, das Teil der ringförmigen Kammer (45) ist,
die genannte Rohrleitung (b) eine Öffnung (b') in der Nähe des Deckels (18) aufweist, die genannte Rohrleitung (c) Öffnungen (c', c") aufweist, um auf Oberflächen des Kolbenkopfs (52, 53) einzuwirken, die genannte Rohrleitung (d) eine Öffnung (d') in der Nähe der Verteilerplatte und dem Kolbenschaft (51) zugewandt aufweist, um auf eine Oberfläche des Kolbenkopfs (53) einzuwirken, der Teil der Kammer (44) ist.

9. Eine Vorrichtung gemäß Anspruch 5, **dadurch gekennzeichnet, daß** ein Vakuum in der inneren Kammer
(21) des Körpers erzeugt wird, wenn das genannte Kolbenelement in seine eingezogene Stellung bewegt wird; das muffenförmige Element (14) sich in seiner ausgezogenen Stellung befindet, in der es die Einlaßöffnung (12) versperrt und das Dreh-Ablaßventil (58), das mit der Öffnung (13) verbunden ist, geschlossen ist.

Revendications

1. Dispositif d'évacuation forcée pour installations sanitaires comprenant un corps (11) formant une chambre interne (21), une ouverture d'entrée (12) et une ouverture de sortie (13), un élément d'obturation (14) en forme de coupelle, creux et mobile dans le sens axial dans ladite chambre, entre une position étendue dans laquelle, il ferme ladite ouverture d'entrée en l'obstruant et une position rétractée dans laquelle, il laisse libre au moins en partie ladite ouverture d'entrée, un élément à piston (15) comprenant une tige (51), une tête de travail (52), une tête de commande (53) intégral l'une à l'autre, ledit élément à piston étant mobile dans le sens axial par rapport audit élément d'obturation en forme de coupelle (14)
caractérisé par le fait qu'il comprend également

   - un élément de distribution (16) fixé par rapport au corps (11) et comprenant une partie à plaque (38) placée entre ladite tête de travail et ladite tête de commande de l'élément à piston, ledit élément de distribution (16) étant engagé de façon hermétique avec ledit élément d'obturation (14) et ledit élément à piston (15) et définissant une chambre annulaire (45) avec ledit élément d'obturation (14), une chambre de distribution (44) avec l'élément à piston (15), une autre chambre annulaire (47) avec l'élément à piston et une autre chambre (43) avec l'élément d'obturation (14) comprenant également une série de conduits (a, b, c, d) pour un fluide de commande dans ledit élément de distribution (16), ledit fluide de commande étant prévu pour faire coulisser ledit élément d'obturation (14) entre une position étendue et une position rétractée et pour faire coulisser ledit élément à piston (15) entre une position étendue et une position rétractée.

2. Dispositif selon la revendication 1, **caractérisé par le fait qu'**il comprend un autre conduit (e) pour un fluide d'évacuation dans la tige du piston, ledit autre conduit ayant une ouverture sur la chambre (21).

3. Dispositif selon la revendication 2, où ledit autre conduit (e) comprend une vanne de contrôle (56).

4. Dispositif selon la revendication 1, où ledit distributeur est fixé au couvercle (18).

5. Dispositif selon la revendication 1, **caractérisé par le fait que** lesdits conduits pour un fluide de commande ou de travail comprennent :

   - un premier conduit (a) s'étendant entre une extrémité de conduit et ladite chambre annulaire (45) pour alimenter le fluide de commande pour placer ledit élément en forme de coupelle (14) dans sa position rétractée
   - un deuxième conduit (b) s'étendant entre une extrémité de conduit et ladite autre chambre (43) pour alimenter le fluide de commande pour placer l'élément en forme de coupelle (14) dans sa position étendue
   - un troisième conduit (c) s'étendant entre une extrémité de conduit et ladite autre chambre (47) pour alimenter le fluide de commande pour placer ledit élément à piston dans la position étendue
   - un quatrième conduit (d) s'étendant entre une extrémité de conduit et ladite chambre de distribution (44) pour alimenter le fluide de commande pour placer l'élément à piston dans la position rétractée.

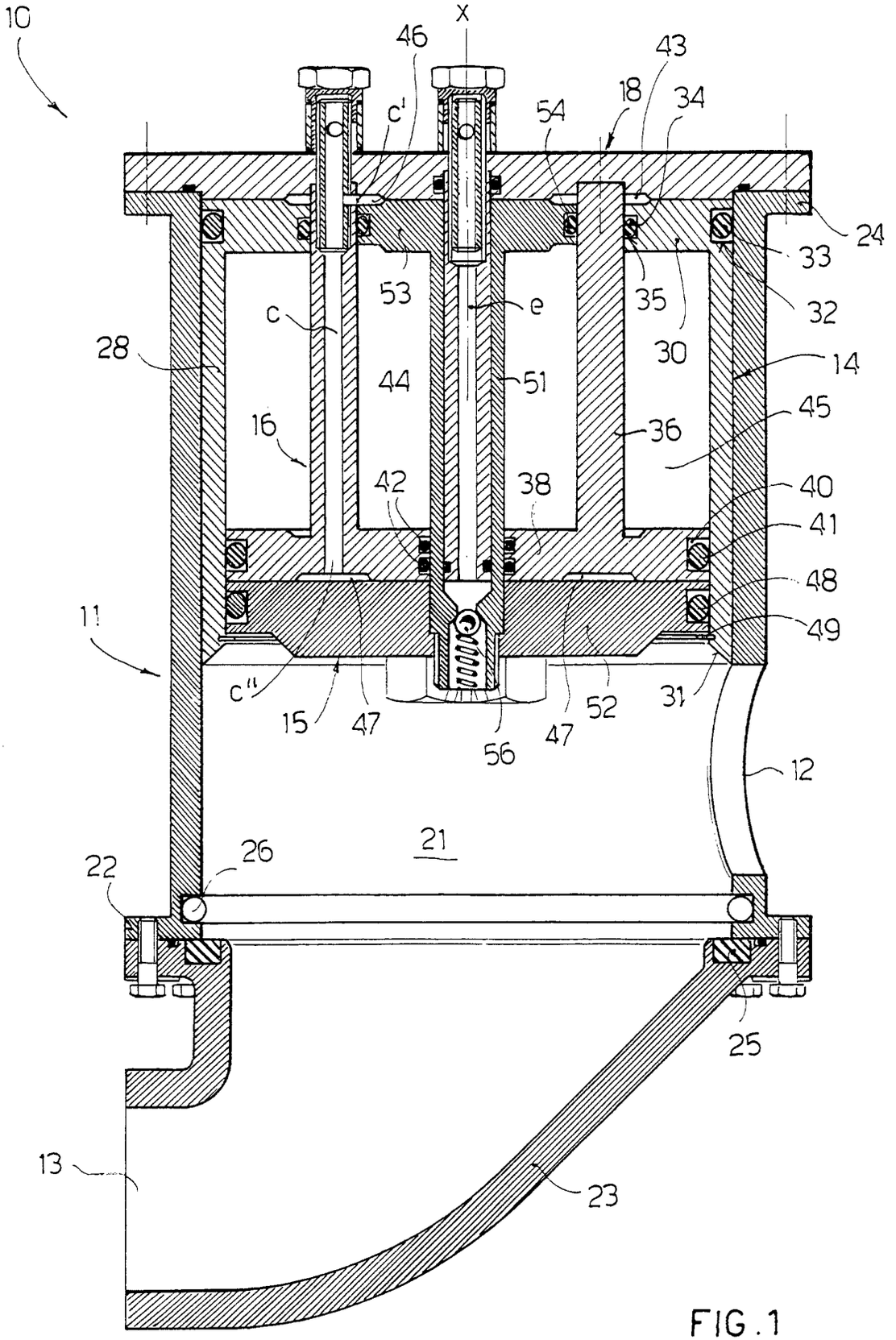
6. Dispositif selon la revendication 1, où le fluide de commande est de l'air comprimé.

7. Dispositif selon la revendication 1, pouvant être

monté sur des installations sanitaires fixes ou des équipements abattables et escamotables.

8. Dispositif selon la revendication 1, où ledit conduit (a) a une ouverture radiale (a') à proximité de la partie à plaque du distributeur (38) pour agir sur une face de l'élément en forme de coupelle qui est une partie de la chambre annulaire (45) ledit conduit (b) a une ouverture (b') dans une position proche du couvercle (18) ledit conduit (c) a des ouvertures (c', c") pour agir sur des faces des têtes du piston (52, 53) ledit conduit (d) a une ouverture (d') à proximité de la plaque du distributeur et tournée vers la tige du piston (51) pour agir sur une face de la tête du piston (53) qui est une partie de la chambre (44).

9. Dispositif selon la revendication 5, **caractérisé par le fait que** l'évacuation est créée dans la chambre interne (21) du corps quand ledit élément à piston est déplacé dans sa position rétractée ; l'élément en forme de coupelle (14) est dans sa position étendue où il obstrue l'ouverture d'entrée (12) et la vanne d'écoulement rotative (58) reliée à l'ouverture (13) est fermée.


10
X
46
43
18
34
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c'
24
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e
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38
40
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FIG.1

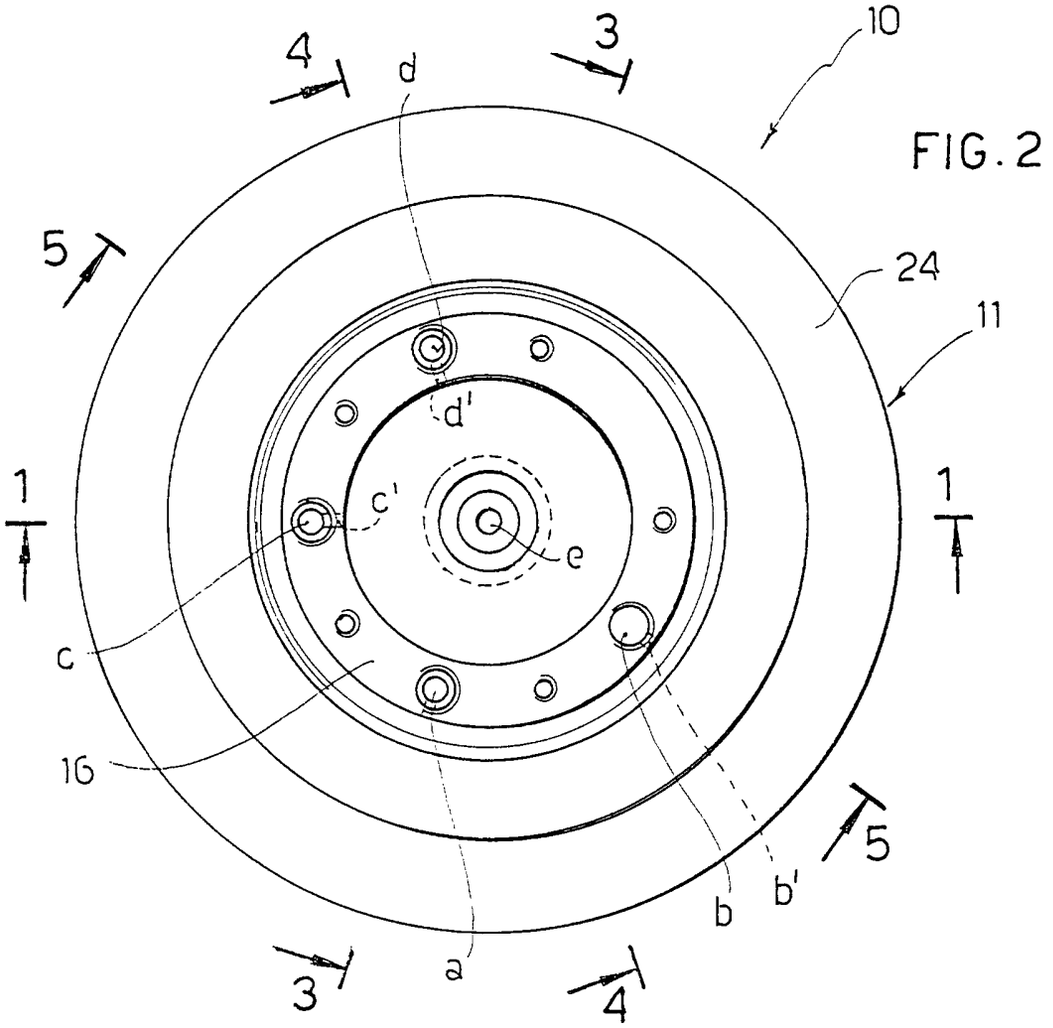


FIG. 2

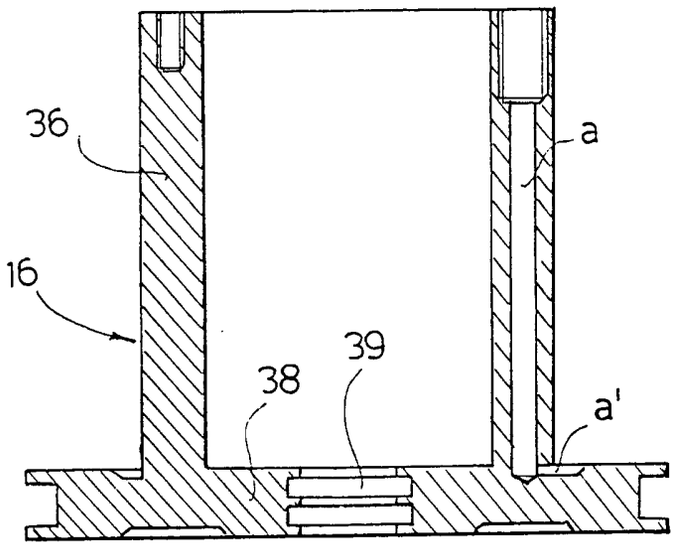


FIG. 3

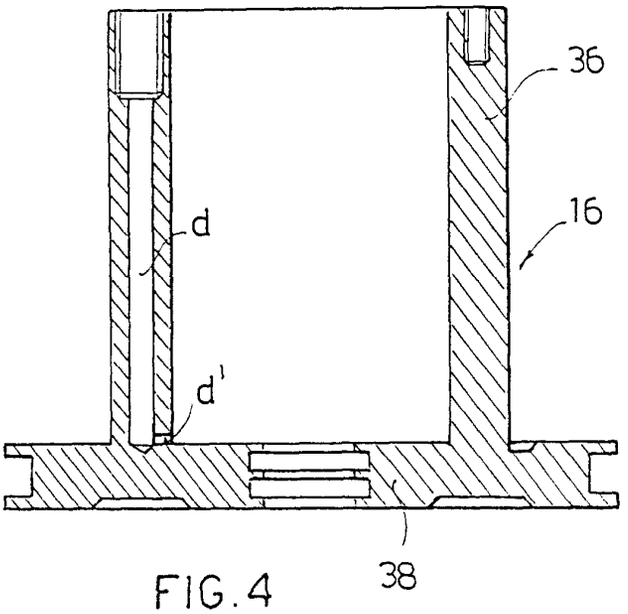
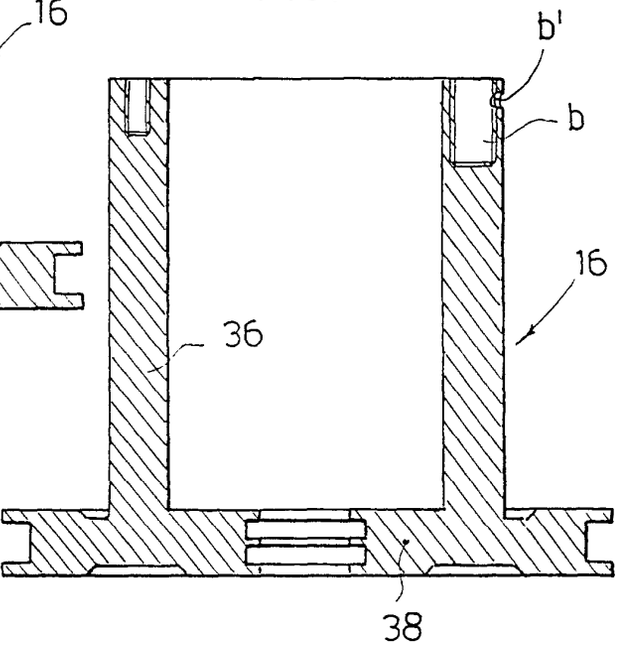


FIG.4

FIG.5



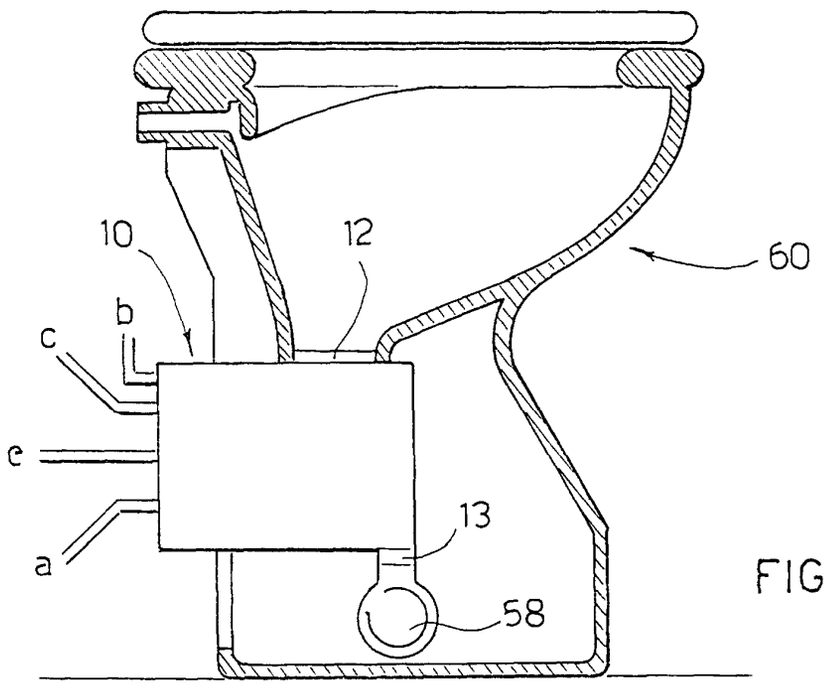
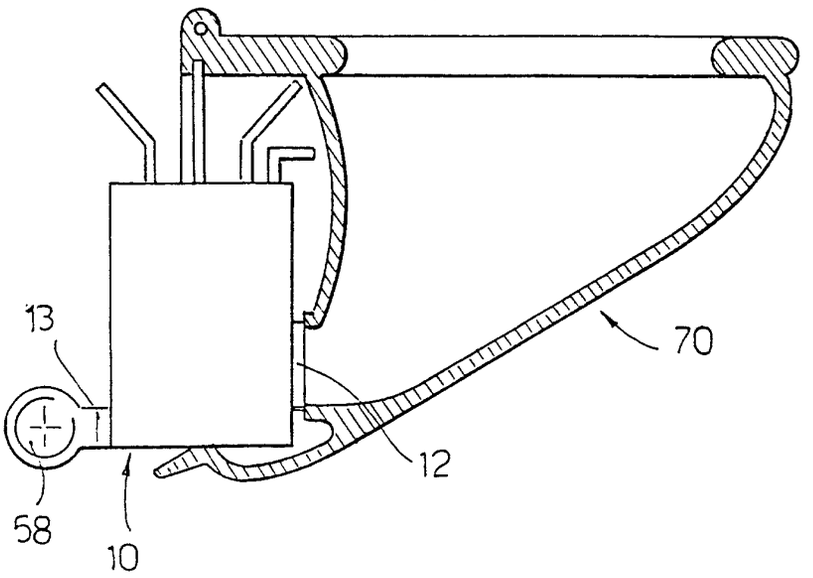


FIG.6

FIG. 7



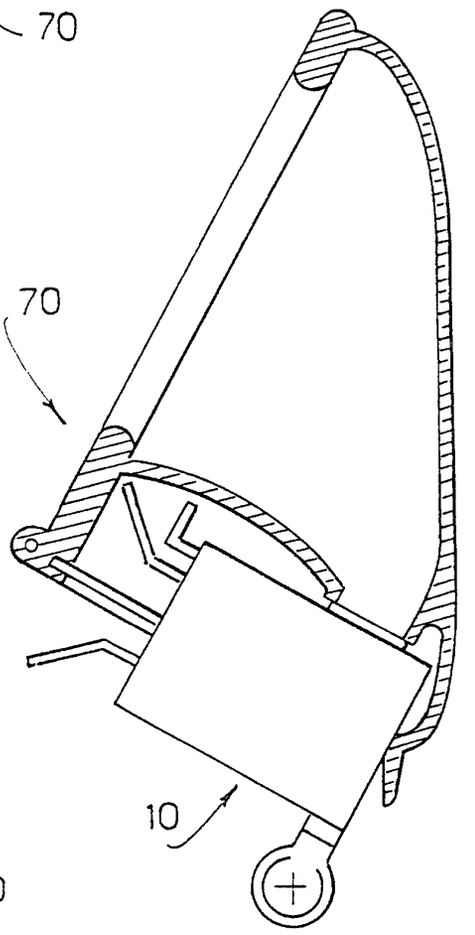


FIG. 8

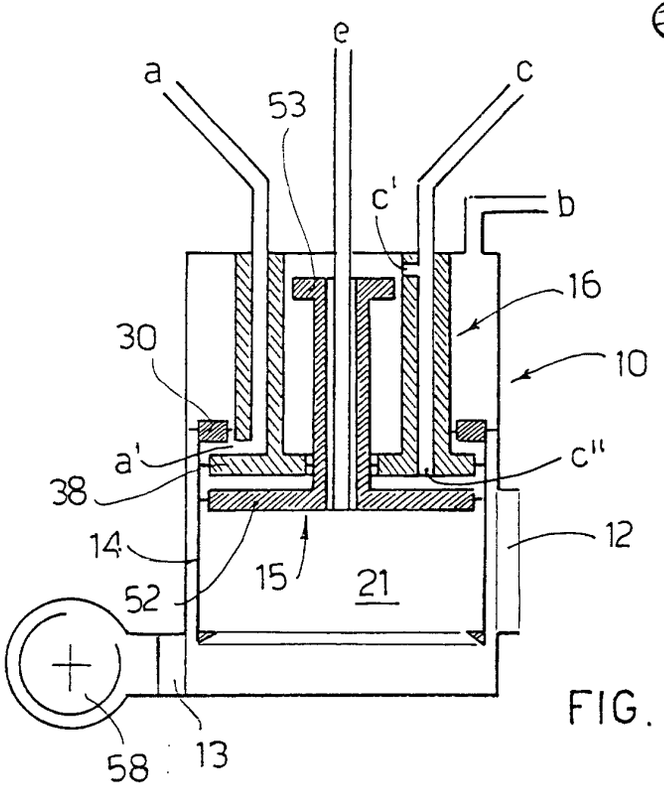


FIG. 10

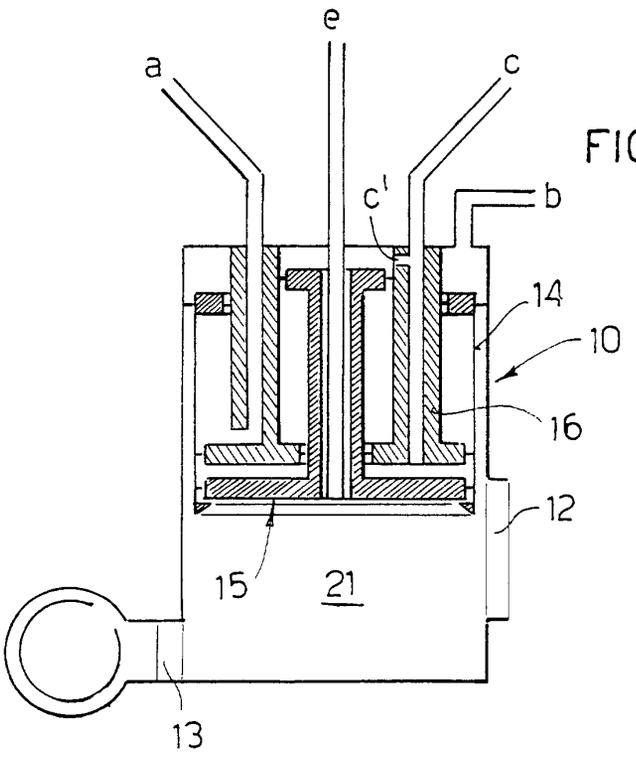


FIG.11

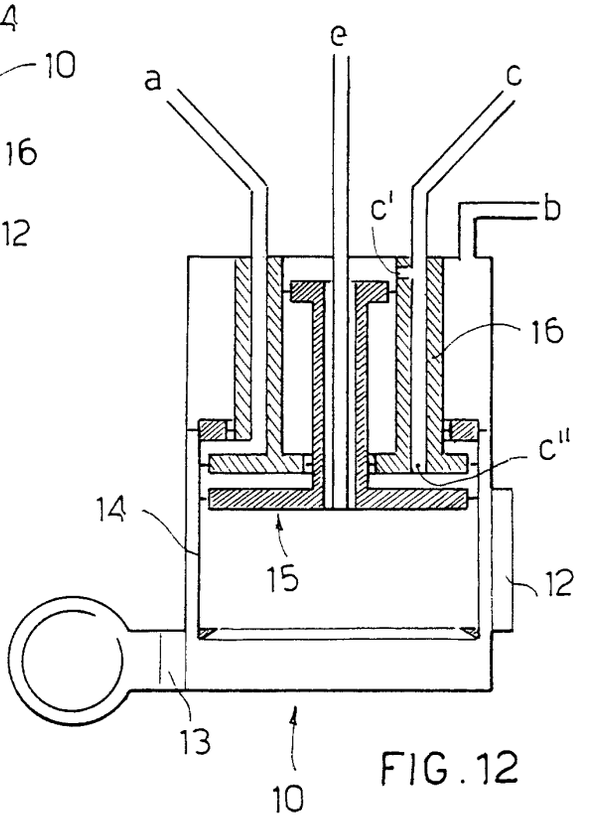


FIG.12

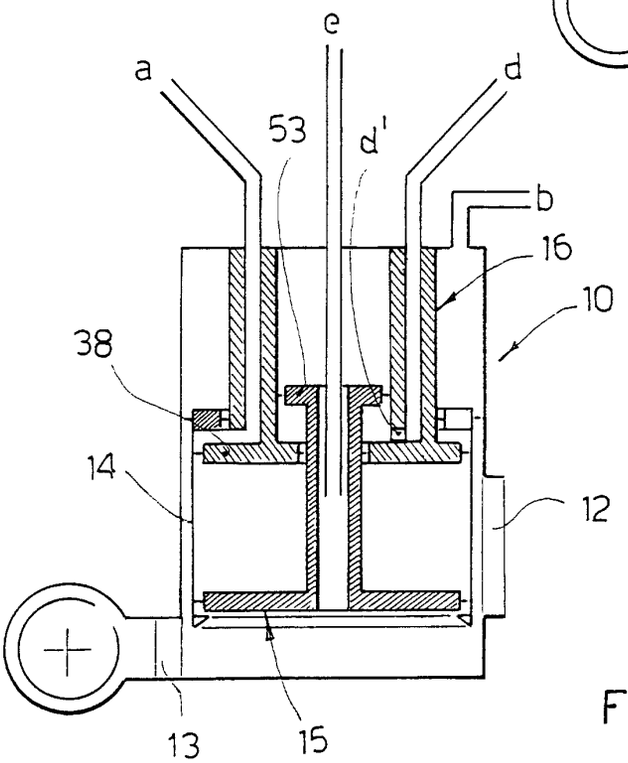


FIG.9