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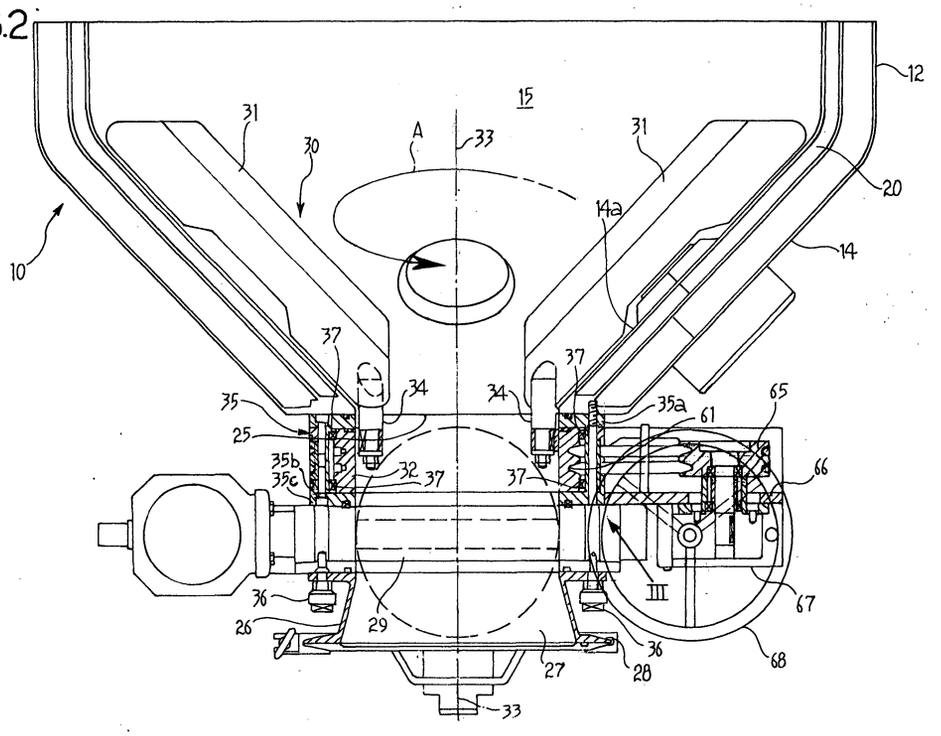
(54) A device for removing material from the internal walls of a container and apparatus provided with such a device

(57) A device (30) for removing material from the internal walls (14a) of a container (10). The container comprises at least one duct (27) communicating with the exterior and extending from a corresponding opening (25) in the container. The device comprises at least one blade element (31) which can be disposed inside the container (10) in the vicinity of the walls (14a), and a collar-like element (32) which has a radially inner face (32a) and can be arranged rotatably around the duct (27) in a manner such that the radially inner face (32a) faces the duct (27). The blade element (31) is fixed to the inner face (32a) of the collar element (32) by means of a connection element (34) which can be arranged through the opening (25) so that the rotation of the collar element (32) brings about rotation of the blade element (31) so as to remove the material that has accumulated on the walls.

FIG.2



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Description

[0001] The present invention relates to a device for removing material from the internal walls of containers such as those that are used in apparatus for drying material in the chemical, pharmaceutical, and food industries, and the like.

[0002] Apparatus of this type in fact comprises a casing which defines a chamber for holding material and which may be stationary or movable, for example, rotatable about a substantially horizontal axis. Moreover, at least one opening is formed in the casing and is provided with selective closure means for allowing the material treated to be discharged into further storage containers.

[0003] The materials treated often have a consistency which is floury or in any case such as to facilitate undesirable adhesion of the materials to the internal surface of the container. In this event, the materials may accumulate on the walls so that it is necessary to remove the deposits by means of scraping devices so that they can drop and flow out through the discharge opening. Known scraping devices generally have a rotary shaft which is inserted in the container coaxially through the discharge opening. The blades for scraping the internal walls of the container extend radially from the shaft. A scraping device of the above-mentioned type, which is used in a stationary drier, is described, for example in the document US-A-4 515 483.

[0004] The fact that the rotary shaft occupies the discharge opening centrally leads to significant blockage thereof which obstructs the outward flow of the materials. The arrangement of the operating mechanism of the scraping device on the rotary shaft may also lead to problems of axial bulkiness.

[0005] The object of the present invention is to overcome the above-described disadvantages of the prior art whilst advantageously also maintaining a sealed condition of the apparatus even during operations to transfer the material through the discharge opening.

[0006] According to the invention, this object is achieved by means of a device for removing material from the internal walls of a container having the characteristics claimed specifically in appended Claim 1. Preferred embodiments of the invention are described in the appended dependent claims.

[0007] A further subject of the present invention is apparatus having the characteristics defined in appended Claims 11 to 14.

[0008] Advantages and characteristics of the present invention will become clear from the following detailed description which is given by way of non-limiting example with reference to the appended drawings, in which:

Figure 1 is a side elevational view of process apparatus provided with a device for removing deposits of material according to the invention;

Figure 2 shows, in section and on an enlarged scale, the scraping device for the removal of deposits of material according to the invention;

Figure 3 shows, on an enlarged scale, a detail indicated by the arrow III in Figure 2; and

Figure 4 shows, on an enlarged scale, a detail indicated by the arrow IV in Figure 3.

[0009] Process apparatus such as a biconical drier (Figure 1) comprises an outer casing or container 10 having a central cylindrical portion 12 and frustoconical end portions 14 and defining in its interior a chamber 15 for holding the material to be dried. The casing of the drier 10 is provided, in known manner not described in detail herein, with a support structure 16, with a motor 18 which enables the casing to be rotated about a substantially horizontal axis 19, with a jacket 20 for containing a diathermic fluid, and with suction means 22 for keeping the internal chamber 15 under reduced pressure.

[0010] At the distal end of one of the frustoconical portions 14 there is an opening 25 around which is fixed a discharge mouth element 26 which defines a discharge duct 27 connected to the opening 25. The discharge mouth element 26 has, at a distal end, a flange 28 which is intended, in a normal operating condition of the drier, for the optional fixing of a cover and, in a material-discharge condition, for the leaktight connection to a storage container (not shown). Selective closure means such as a butterfly valve 29 are mounted in the discharge duct 27.

[0011] With reference now to Figure 2, a scraping device 30 according to the invention comprises one or more blades 31 suitable for removing the deposits of dried material which adhere to the internal wall 14a of the frustoconical portion 14 adjacent the discharge mouth element 26 and a driven collar 32 coaxial with the opening 25 and surrounding the proximal portion of the discharge duct 27.

[0012] The blades 31, which are disposed inside the holding chamber 15 in the vicinity of the walls of the frustoconical portion 14, are fixed firmly to the collar 32 by means of respective support arms 34 which are fixed at one end to the internal surface 32a of the collar 32, thereby extending axially through the discharge opening 25, and at their end inside the holding chamber 15 are fixed to the blades 31. The driven collar 32 can rotate about the common axis 33 of the opening 25 and of the discharge duct 27, consequently bringing about rotation of the blades 31 fixed thereto.

[0013] The collar 32 is arranged axially between the opening 25 and the butterfly valve 29 in a manner such that the valve shutter cannot interfere with the arms 34 of the blades 31. The arms 34 are also arranged in the vicinity of the internal wall 32a of the collar element 32, that is, at the edge of the opening 25, so as to reduce their radial dimensions. The collar 32 is housed inside

a box 35 comprising an upper annular plate 35a fixed around the opening 25 in the casing 10 of the drier, an intermediate shell structure 35b fixed to the upper annular plate 35a and arranged so as to extend around the driven collar 32, and a lower annular plate 35c fixed to the covering shell 35b. The components of the box 35 are provided with through-holes arranged in a manner such as to enable the box 35, the butterfly-valve unit 29, and the mouth element 26 to be mounted on the casing 10 of the drier by means of the same bolts 36. As will be appreciated, the box 35 constitutes a modular unit so that it can be mounted between a pre-existing drier 10 and butterfly valve 29, without the need for substantial structural modification thereof.

[0014] With reference to Figure 3, the box 35 defines a substantially cylindrical central cavity 35d, which is open at the top and at the bottom and coaxial with the driven collar 32, and on the side wall 35e of which radial ball bearings 37 are mounted. The radially inner sides of these bearings 37 are fixed firmly to the driven collar 32 so as to allow it to rotate about the axis 33 inside the box 35.

[0015] The upper and lower faces 41, 41' of the driven collar 32 have respective circumferential grooves 42, 42'. The radially inner side wall 43, 43' of each groove 42, 42' projects from the base of the respective groove 42, 42' to a lesser extent than the radially outer side wall 44, 44' which extends so as to be almost in contact with the respective surface 35f, 35g of the upper/lower plate 35a, 35c.

[0016] To allow the driven collar 32 to rotate and at the same time to maintain an optimal leaktight condition (see Figure 4), a sealing ring 51 of material which has good sealing characteristics and low friction relative to the surface 35f of the upper plate 35a, and which is compatible with the material treated in the drier, is fitted on the inner side wall 43 of the groove 42. To reduce friction with the surface of the upper plate 35a, the upper surface 51a of the sealing ring 51 has a circumferential groove 52 and a taper 53 in a radially outward direction. To improve the seal, there is an O-ring 55 in the groove 42 and the outer side wall 44 of the groove has a further groove 56 which houses a second O-ring 57. To further reduce friction, the spaces between the sealing ring 51, the O-rings 55, 57, and the surfaces of the upper plate 35a and of the driven collar 32 are filled with a lubricant compatible with the material treated in the drier.

[0017] The arrangement of the components on the lower face 41' is identical to that just described and will not therefore be described below. Naturally, the configuration and shape of the sealing means described above may vary without thereby departing from the scope of the invention.

[0018] With further reference to Figures 2 and 3, the radially outer side surface 32b of the driven collar 32 has circumferential races 61 which, in the embodiment shown, can be engaged by drive belts 63 which extend through slots in the shell structure 35b. The belts 63 are driven by a pulley 65 which is mounted rotatably on a plate 66 fixed firmly to the box 35 of the driven collar 32 and can be driven by a handwheel 68 via a reduction unit 67 (as shown in Figure 2), or possibly by a small electric motor (not shown).

[0019] Naturally, the drive may alternatively be transmitted from the pulley 65 to the driven collar 32 by means of a toothed belt, a chain, gears, or similar means.

[0020] During normal operation, the drier rotates about the axis 19 with the butterfly valve 29 and the discharge mouth element 26 closed until the desired moisture content of the material contained in the chamber 15 is reached.

[0021] At this point, the rotation is stopped, care being taken that the opening 25 is facing downwards. The container into which the dried material is to be transferred is then fixed to the flange 28 of the discharge mouth element 26.

[0022] Once the butterfly valve 29 has been opened, the dried material falls by gravity from the holding chamber 15 into the container.

[0023] If some of the material remains on the internal wall 14a of the holding chamber 15, the handwheel 68 is operated briefly to bring about movement of the driven collar 32 and hence of the blades 31 (in the direction of the arrow A), which remove the material, causing it to fall through the discharge opening 25.

[0024] As will be appreciated, the obstruction of the discharge opening 25 is reduced to merely the space occupied by the arms 34 of the blades 31, since the movement of the blades 31 is brought about by the driven collar 32 which has a central duct having a cross-section which can be the same as or larger than the discharge opening 25, and not by a shaft introduced through the opening.

[0025] Moreover, the scraping device according to the invention has a compact structure with limited axial dimensions (that is, in the direction in which the discharge mouth element extends) which structure is particularly suitable for a rotary drier of the type described and enables the operation to remove deposits from the walls of the holding chamber to be performed without the need to disturb its leaktight condition. Naturally, the device according to the invention can be used in stationary driers, in storage containers, or in other structures of similar type.

[0026] Naturally, the principle of the invention remaining the same, the details of construction and forms of embodiment may be varied widely with respect to those described purely by way of example, without thereby departing from its scope.

Claims

1. A device (30) for removing material from the internal walls (14a) of a container (10), the container com-

prising at least one duct (27) communicating with the exterior and extending from a corresponding opening (25) in the container, **characterized in that** it comprises:

- at least one blade element (31) which can be disposed inside the container (10) in the vicinity of the walls (14a), and

- a collar-like element (32) which has a radially inner face (32a) and can be arranged rotatably around the duct (27) in a manner such that the radially inner face (32a) faces the duct (27),

the blade element (31) being fixed to the inner face (32a) of the collar element (32) by means of a connection element (34) which can be arranged through the opening (25) so that the rotation of the collar element (32) brings about rotation of the blade element (31) so as to remove the material that has accumulated on the walls.

2. A device according to Claim 1, **characterized in that** the connection element (34) is arranged in the vicinity of the radially inner face (32a) of the collar element (32) .

3. A device according to any one of the preceding claims, **characterized in that** the collar element (32) has a radially outer face (32b) provided with formations (61) for engaging drive transmission means (63).

4. A device according to Claim 3 in which the outer face (32b) of the collar element (32) is provided with circumferential races (61) for engagement by belt transmission means (63) which can be driven by a pulley (65) disposed in a radial plane, relative to the collar element (32) .

5. A device according to any one of the preceding claims in which the driven collar is housed in a box (35) which can be fixed to the container (10) and which defines a substantially cylindrical cavity (35d) which is open at the top and at the bottom and is coaxial with the driven collar (32) .

6. A device according to Claim 5 in which the driven collar (32) is rotatable relative to the box (35) by virtue of radial bearings (37) mounted on the side wall (35e) of the cavity (35d) of the box (35).

7. A device according to Claim 5 or Claim 6 in which the driven collar (32) has an upper face (41) and a lower face (41') facing an upper wall (35f) and a lower wall (35g) of the cavity (35d) of the box (35), respectively, sealing means (51, 55, 57) being interposed between each face (41, 41') and the corresponding wall (35f, 35g).

8. A device according to Claim 7 in which each of the upper and lower faces (41, 41') of the driven collar (32) has at least one circumferential groove (42, 56; 42') which can house the sealing means.

9. A device according to Claim 8 in which the radially inner side wall (43, 43') of each groove (42, 42') projects from the base of the respective groove (42, 42') to a lesser extent than the radially outer side wall (44, 44').

10. A device according to Claim 9 in which the radially inner side wall (43, 43') of the groove (42, 42') faces the duct (27) and the sealing means (51, 55, 57) comprise a ring (51) of resilient material fitted on the said side wall (43, 43').

11. Apparatus comprising a casing (10) which delimits a chamber (15) for holding material, the casing (10) having at least one opening (25) and at least one duct (27) communicating with the exterior and extending from the opening (25), **characterized in that** it comprises a device according to any one of the preceding claims.

12. Apparatus according to Claim 11, **characterized in that** it is process apparatus in which the casing (10) can rotate about a substantially horizontal axis (19).

13. Apparatus according to Claim 12, **characterized in that** it is a biconical drier the casing (10) of which has a central cylindrical portion (12) and frustoconical end portions (14).

14. Apparatus according to Claim 13 in which the duct (27) is a material discharge duct disposed at a distal end of a frustoconical portion (14).

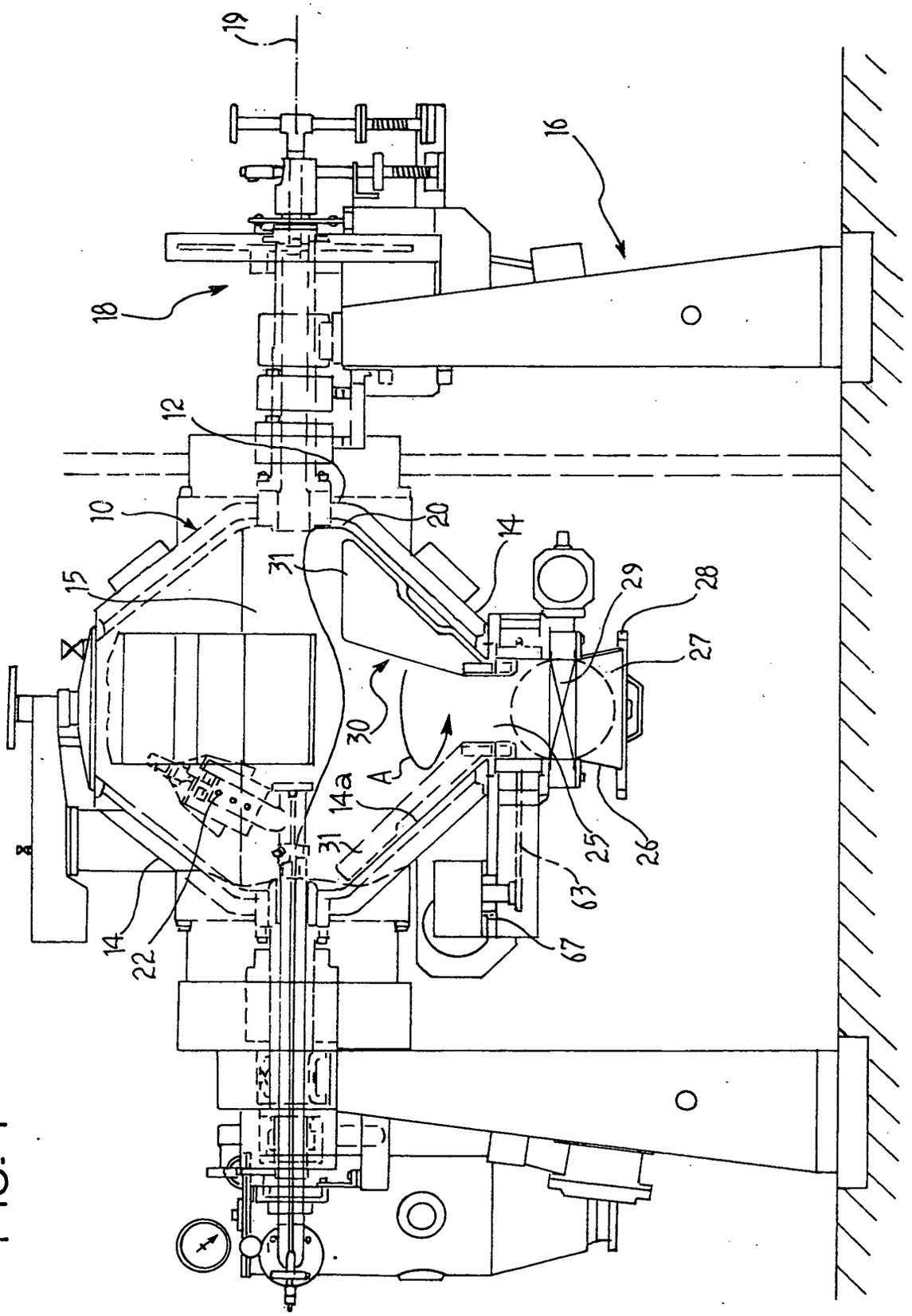

FIG. 1

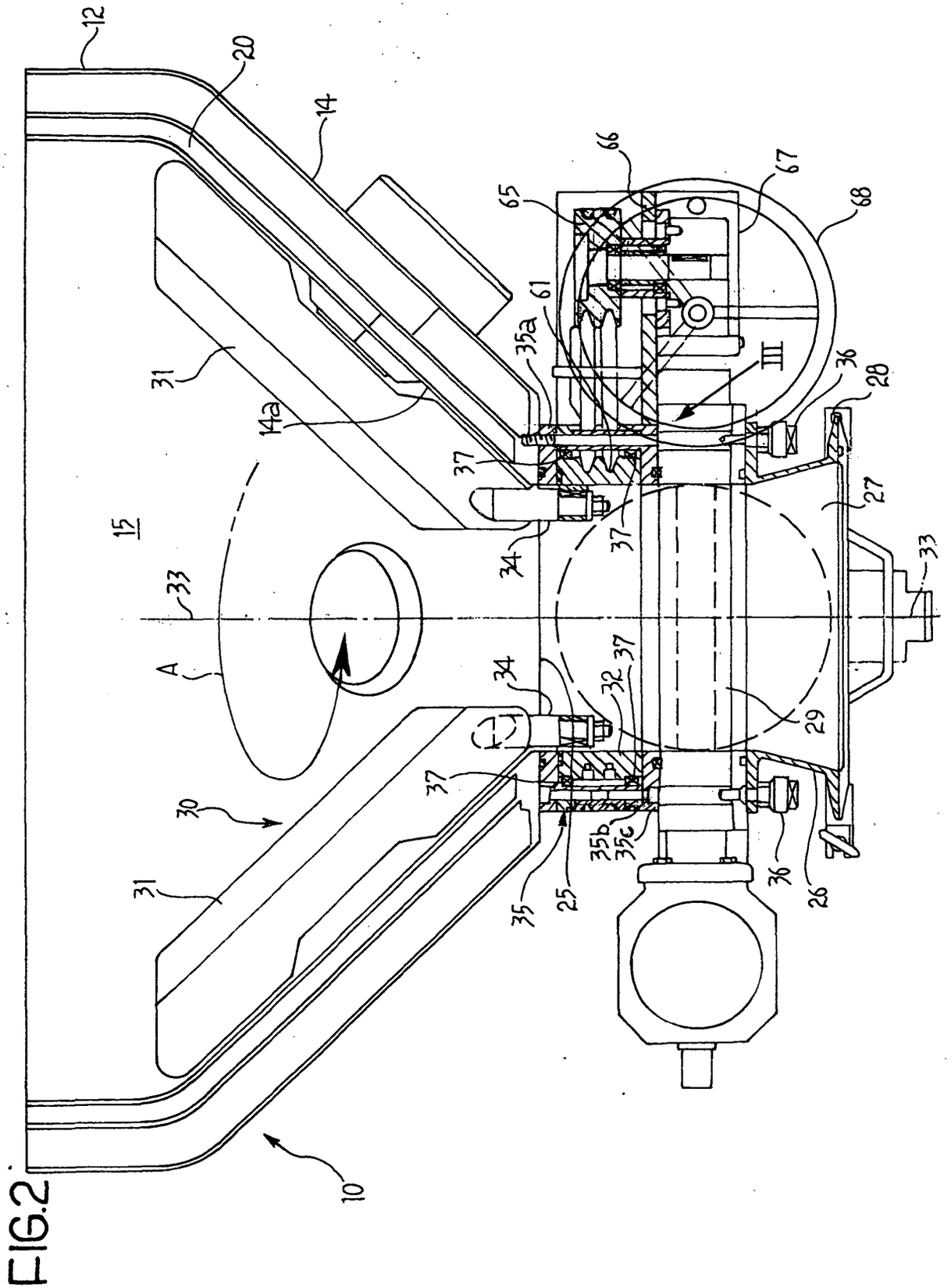
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FIG.2

FIG. 3

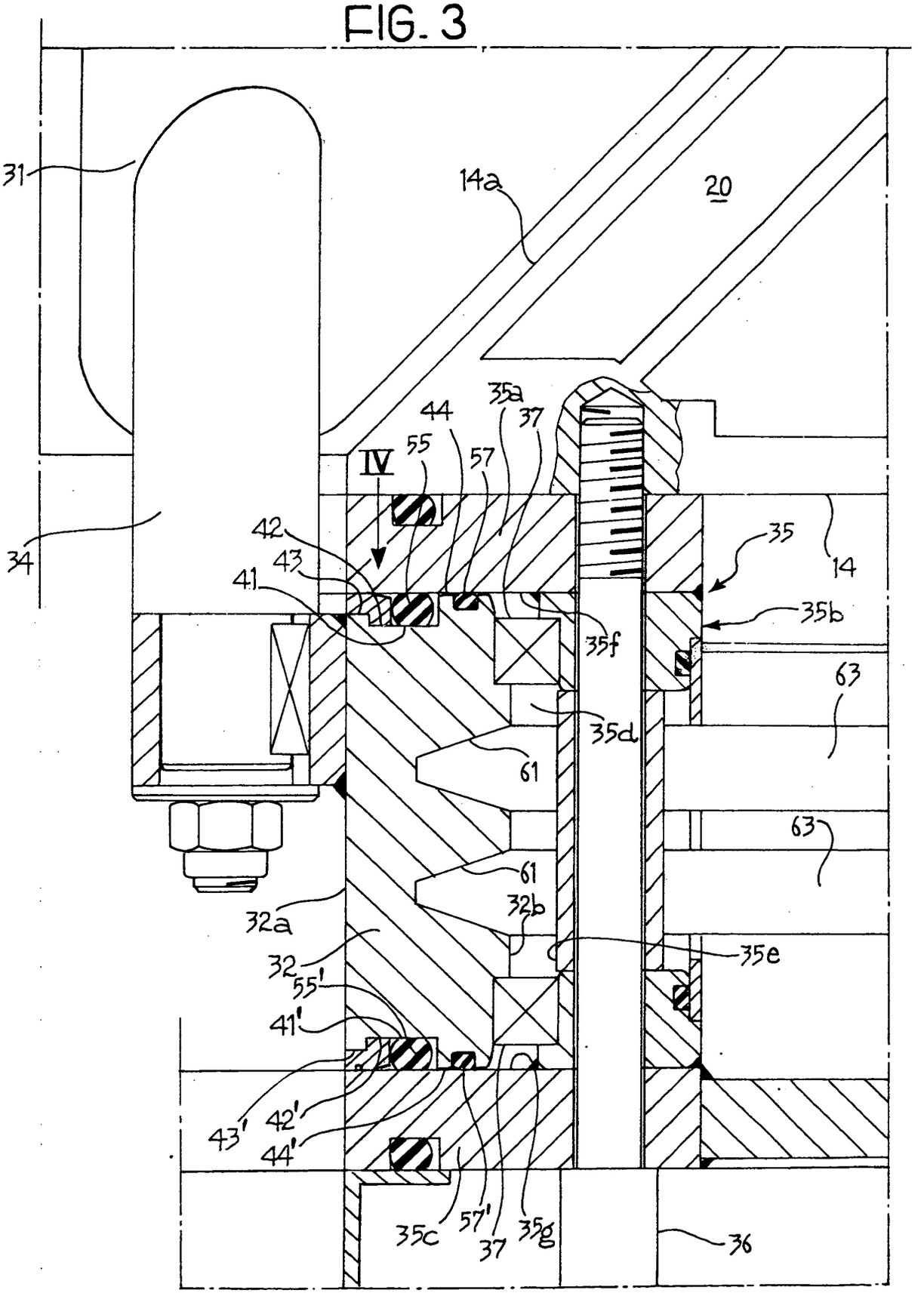
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FIG. 4