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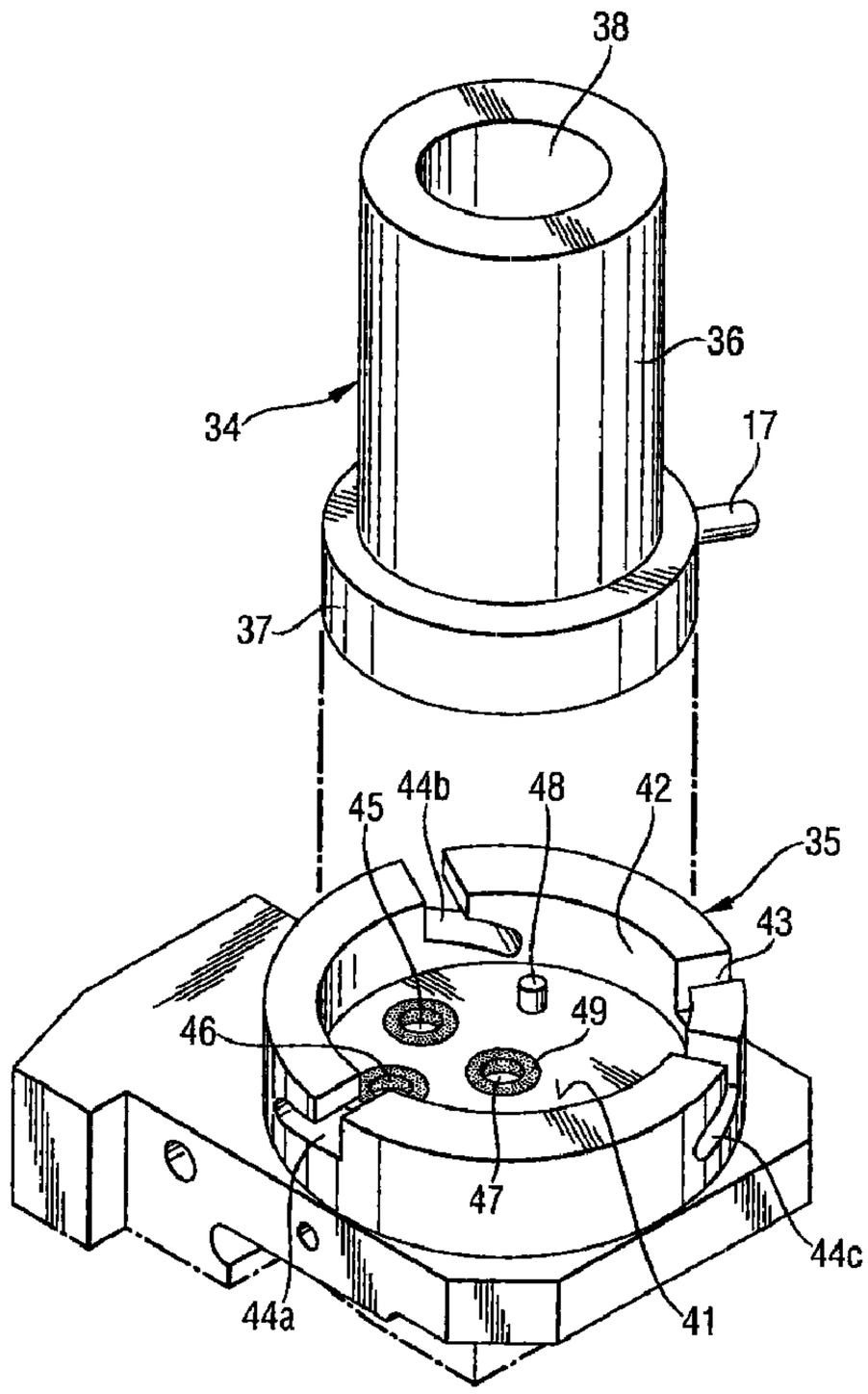
(54) Title: AUTOMATIC ANALYZER



(57) Abrégé/Abstract:
The automatic analyzer for the assay of liquid samples comprises an exchangeable mixing chamber unit (34) whose mixing chamber (14) is tapered toward the bottom and is provided with an outlet (18) which is followed by a bore (19) which connects the

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(57) Abrégé(suite)/Abstract(continued):
mixing chamber (14) to an outlet opening (20). An abrupt transition (13) is formed between said bore (19) and the outlet opening (20) for the analyzed liquid. Said abrupt transition (13) is a restriction which serves as a collecting trap for disturbing particles (23), e.g. coaguli, which might lead to undesirable obstructions elsewhere. Those particles which cannot be flushed away laterally by another outlet opening (17) are eliminated by removing the mixing chamber unit (34) from the base unit (35) in few operations and blowing it through. A sealing ring (49) serves for a tight seal between the plane bottom (41) of the mixing chamber unit (34) and the connection (47). A fluid sensor (50) is provided in order to detect the sample liquid flowing through this connection.

Abstract

The automatic analyzer for the assay of liquid samples comprises an exchangeable mixing chamber unit (34) whose mixing chamber (14) is tapered toward the bottom and is provided with an outlet (18) which is followed by a bore (19) which connects the mixing chamber (14) to an outlet opening (20). An abrupt transition (13) is formed between said bore (19) and the outlet opening (20) for the analyzed liquid. Said abrupt transition (13) is a restriction which serves as a collecting trap for disturbing particles (23), e.g. coaguli, which might lead to undesirable obstructions elsewhere. Those particles which cannot be flushed away laterally by another outlet opening (17) are eliminated by removing the mixing chamber unit (34) from the base unit (35) in few operations and blowing it through. A sealing ring (49) serves for a tight seal between the plane bottom (41) of the mixing chamber unit (34) and the connection (47). A fluid sensor (50) is provided in order to detect the sample liquid flowing through this connection.

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AUTOMATIC ANALYZER

The present invention refers to an automatic analyzer for the assay of liquid samples, said automatic analyzer comprising a mixing chamber which is followed by an analyzing block including an evaluating unit, said mixing chamber comprising at least one inlet opening for air respectively water and being connected to an outlet opening for the analyzed liquid.

Automatic analyzers of the mentioned kind are known.

As an example of the prior art, Fig. 1 illustrates the block diagram of an automatic analyzer 10 for the selective determination of ions, e.g. Li^+, K^+, Na^+, Cl^-, in liquid samples of biological substances such as blood or urine. The samples are placed on a sample platform 11 in separate containers. By means of an automatic pipette arm 12, small amounts of the samples are now serially supplied to a mixing chamber 14. Chamber 14 essentially consists of an upwardly open, cylindrical vessel having a continuously tapering bottom. Inlet openings 15, 16 for air and water, respectively, are laterally connected to the top of this vessel, and two outlet openings 17, 20 are connected to its bottom. The liquid samples delivered by the pipette needle are homogenized by means of an air vortex generated by opening 15, and supplied by outlet opening 20 and a connecting duct 21 to the measuring channel of an analyzing block 22, e.g. an electrode block. Second inlet opening 16 mainly serves for the supply of rinsing water and outlet opening 17 for the extraction of the latter and of possible excess liquid (waste).

The measuring channel of analyzing block 22 is e.g. provided with several ion-selective electrodes and a reference electrode connected thereto which measure the ion concentration e.g. of the above-mentioned ions and output the measuring results by means of an electronic evaluating system 24. Finally, the sample liquid is discharged into a collector 25 for disposal.

The operation of automatic analyzers of the represented kind should be as free of disturbances as possible. However, since the analyzed liquids come from a large number of sources, this aim can only be attained within certain limits. In particular, frequent problems are caused by small particles such as coaguli which may choke the analyzer, thereby resulting in incorrect analyses or even rendering the measurements impossible. In such cases, the critical components must be disassembled and cleaned, thereby causing complications and time losses.

Consequently, the aim of the invention is to provide an improvement of the known automatic analyzers which allows to prevent the described obstructions as largely as possible.

This aim is attained by an automatic analyzer wherein said mixing chamber is disposed in a dedicated, exchangeable unit, and wherein said outlet opening for the analyzed liquid is associated with a particle collecting trap. The dependent claims indicate developments and alternative embodiments of the invention.

In particular, the advantages obtained with the automatic analyzer of the invention consist in that the mixing chamber is easily exchangeable, so that impairments of the operation

of the automatic analyzer by an obstruction of the mixing chamber by a particle, e.g. a coagulum, are easily and quickly eliminated. Furthermore, the mixing chamber design of the invention allows quick and effective cleaning, so that possible particles in its outlet channel are easily removed.

The invention is described in more detail hereinafter with reference to the figures, where

FIG. 1 shows a block diagram of an automatic analyzer of the prior art as previously discussed above;

FIG. 2 shows a perspective view of a mixing chamber unit and of the associated base unit;

FIG. 3 shows a cross-section of the mixing chamber unit; and

FIG. 4 shows a cross-section of the mixing chamber unit and of the base unit.

Fig. 2 shows a mixing chamber unit 34 and an associated base unit 35 in a perspective view. Mixing chamber unit 34 is provided with an essentially cylindrical outer wall 36 which is seamlessly followed at the bottom by a base plate 37 of a larger diameter. The first outlet opening 17 laterally projects from plate 37 in the form of a connecting nipple which allows the connection of a drain water tube. Mixing chamber unit 34 is open at the top (sample opening 38) and comprises a plane bottom. The latter communicates with outlet opening 17, which is hidden in the illustration but

visible in FIG. 1. Furthermore, two risers lead up from the bottom into wall 36 of mixing chamber 34 and communicate with the inlet openings 15, 16 illustrated in FIG. 1.

The base unit 35 constitutes the counterpart of mixing chamber unit 34 in automatic analyzer 10. Accordingly, base unit 35 comprises a plane bottom 41 which is cylindrically surrounded by a cylindrical guide 42 adapted to insertable base plate 37. Cylindrical guide 42 is provided with an incision 43 for the reception of outlet opening 17 and with three locking slots 44a, 44b, 44c. Bottom 41 communicates with connection 45 of the air riser, with connection 46 of the water riser, and with connection 47 of the second outlet opening 20 for the analyzed liquid. Further provided is a pin 48 which cooperates with a non-represented blind bore of base plate 37 in order to allow a correct angular guidance of mixing chamber unit 34 while it is inserted into base unit 35.

Connections 45, 46, 47 are provided with (preferably exchangeable) sealing rings 49 (FIG. 4) which ensure a tight connection with openings 15, 16 respectively 20. Mixing chamber unit 34 is attached to base unit 35 by a non-represented coupling ring which is slipped over mixing chamber unit 34 from above and seizes the upper edge of base plate 37, and which is secured by a clockwise rotation by means of internal pins which engage in locking slots 44a, 44b, 44c.

FIG. 3 shows a central cross-section of mixing chamber unit 34 at a scale of approx. 2 : 1 with respect to its real size. Upwardly open mixing chamber 14 is cylindrical in shape while its wall surface is as smooth as possible and

e.g. conically tapered at the bottom. At the pointed end of mixing chamber 14, the wall of the mixing chamber comprises an outlet opening 18 which is followed by a vertical bore 19 whose diameter respectively clear width approximately corresponds to that of connecting duct 21 and of the measuring channel of analyzing block 22. This vertical bore 19 is horizontally connected to first outlet opening 17. At the bottom, bore 19 is followed by second outlet opening 20 whose diameter abruptly decreases at transition 13, said diameter being e.g. reduced to a third of the diameter of bore 19. Practical values are e.g. 0.3 to 0.4 mm for outlet opening 20 and 0.8 mm for bore 19. Restriction 13 serves as a trap for particles which are capable of causing the obstructions described in the introduction.

FIG. 4 shows another cross-section of mixing chamber unit 34 and of base unit 35 on a further enlarged scale. At the location of restriction 13 between bore 19 and second outlet opening 20, i.e. in the collecting trap, a particle 23 is shown whose travel in the direction of connection 47 is hindered. Particle 23 reduces or blocks the desired flow of the analyzed measuring liquid toward analyzing block 22. The occurrence of this condition is detected by a fluid sensor 50 at connection 47 which detects the absence of the expected liquid. In this case, the automatic analyzer can be stopped.

In order to eliminate such an obstruction, it may be attempted to flush the blocking particle by the supply of water from inlet opening 16 and its extraction by lateral outlet opening 17. Alternatively, the concerned mixing chamber unit 34 can be replaced in few operations by a spare unit, thereby restoring the operativeness of automatic

analyzer 10. The concerned mixing chamber unit 34 is also easily cleaned by flushing respectively blowing it through from outlet opening 20 to mixing chamber 14, so that the formerly concerned unit 34 is available as a new spare unit.

The described division of the automatic analyzer 10 into a basic apparatus comprising base unit 35 and into an easily exchangeable mixing chamber unit 34 comprising a particle trap is simple in construction and allows to avoid prolonged failures of analyzer 10. Fluid sensor 50 provides a safe detection of a possibly required exchange and cleaning of the mixing chamber unit. Those solid constituents of the analyzed liquid which pass second outlet opening 20 do not impair the measurements in analyzing block 22 and do not constitute a risk of obstructions of the hitherto usual kind. Standstill times of automatic analyzers 10 as well as the required maintenance are thus substantially reduced.

A large number of alternatives are possible within the scope of the invention, some of which are listed in particular herebelow.

- The shape of the mixing chamber does not necessarily have to be cylindrical. It may also be convex or have an oval cross-section, for example. However, the container walls should be smooth in order to avoid material deposits. Furthermore, a tapered zone must be provided at the bottom in order to ensure a perfect draining of the liquid.

- First outlet opening 17 for the drained liquid may be directed downwards instead of sideways.

- The attachment of mixing chamber unit 34 in base unit 35 may be obtained by different means, e.g. by a lever closure.

- Instead of bore 19 and outlet opening 20 whose cross-sections are both cylindrical, the particle trap may also be formed by non-cylindrical cross-sections, e.g. by a trefoil cross-section of outlet opening 20.

- The particle trap may be an integral part of mixing chamber unit 34, as described above. It is also possible, however, to obtain the reduction of the clear width of bore 19 by a separate part which is exchangeably disposed transversally or longitudinally in said bore, e.g. a nozzle screwed into bore 19.

The invention therefore refers to an automatic analyzer 10 for the assay of liquid samples, comprising at least a vertically extending mixing chamber 14 having at least one inlet opening 15, 16 for air and water, respectively, and an outlet opening 20 for the analyzed liquid, as well as an analyzing block 22 following mixing chamber 14 and including an evaluating unit 24, wherein mixing chamber 14 is disposed in a dedicated, exchangeable unit, and wherein outlet opening 20 for the analyzed liquid is associated with a collecting trap for particles 23.

Claims

1. An automatic analyzer for the assaying samples, said automatic analyzer comprising:

a chamber for mixing a liquid sample, said chamber having an outlet opening, and

an evaluation unit for receiving said liquid sample from said chamber through said outlet opening, said evaluation unit determining at least one characteristic of said sample, and wherein said chamber has a trap for collecting particles which are suspended in the liquid sample prior to evaluation by said evaluation unit, said trap being formed by a portion of the walls of said chamber and said opening, said portion of said walls and said opening being operative to separate said suspended particles from said liquid sample.

2. The automatic analyzer of claim 1, wherein the mixing chamber has an associated volume and said trap collects the particles which are suspended in the liquid sample in a localized region of said chamber, said localized region being substantially smaller than said volume.

3. The automatic analyzer of claim 1, wherein said mixing chamber has walls that taper to form a bore and then abruptly transition to form said outlet opening, said bore having a larger cross-section than that of said outlet opening and said trap being formed by the substantially abrupt transition between said bore and said outlet opening.

4. The automatic analyzer of claim 1 wherein said analyzer further includes a base disposed between said chamber and said evaluation unit, said chamber capable of being assembled to said base.

5. The automatic analyzer of claim 4 wherein said chamber is removable from said base.

6. The automatic analyzer of claim 1 wherein said chamber is disposed in a unit that includes two risers that provide inlet openings for said chamber.

7. The analyzer of claim 6 wherein said risers extend parallel to said chamber before turning toward and intersecting said chamber.

8. The automatic analyzer of claim 6 wherein said unit has a plane bottom which engages with said base and thereupon forms connections to said outlet opening and said risers.

9. The automatic analyzer of claim 8 wherein said connections are provided with exchangeable sealing means.

10. The automatic analyzer of claim 3 further including an additional outlet opening that intersects said bore and extends transversally therefrom.

11. The automatic analyzer of claim 1 further including a fluid sensor between said chamber and said evaluation unit for detecting the flow of passing liquid.

12. The automatic analyzer of claim 2 wherein said chamber is made of a transparent material.

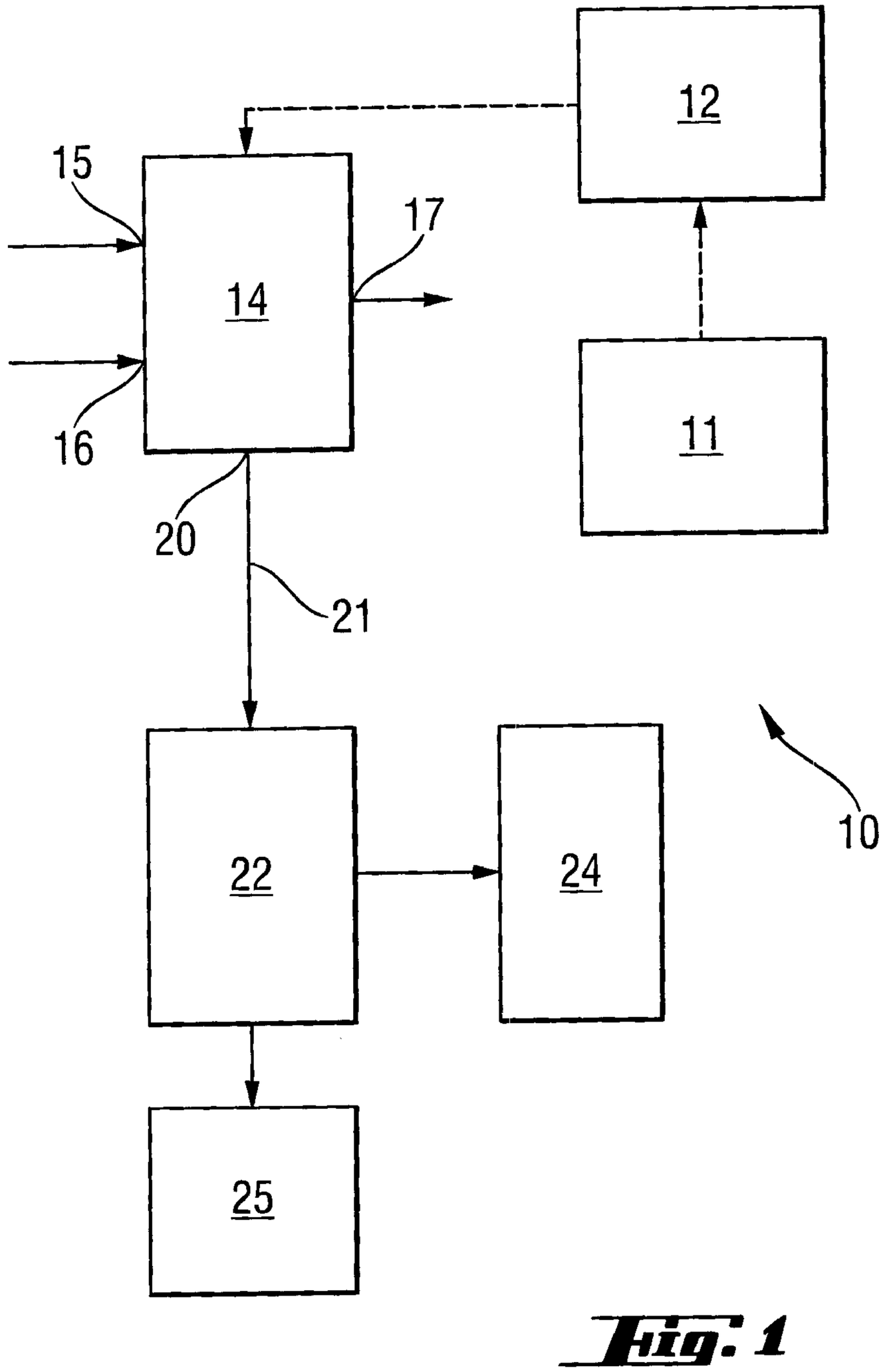


Fig. 1

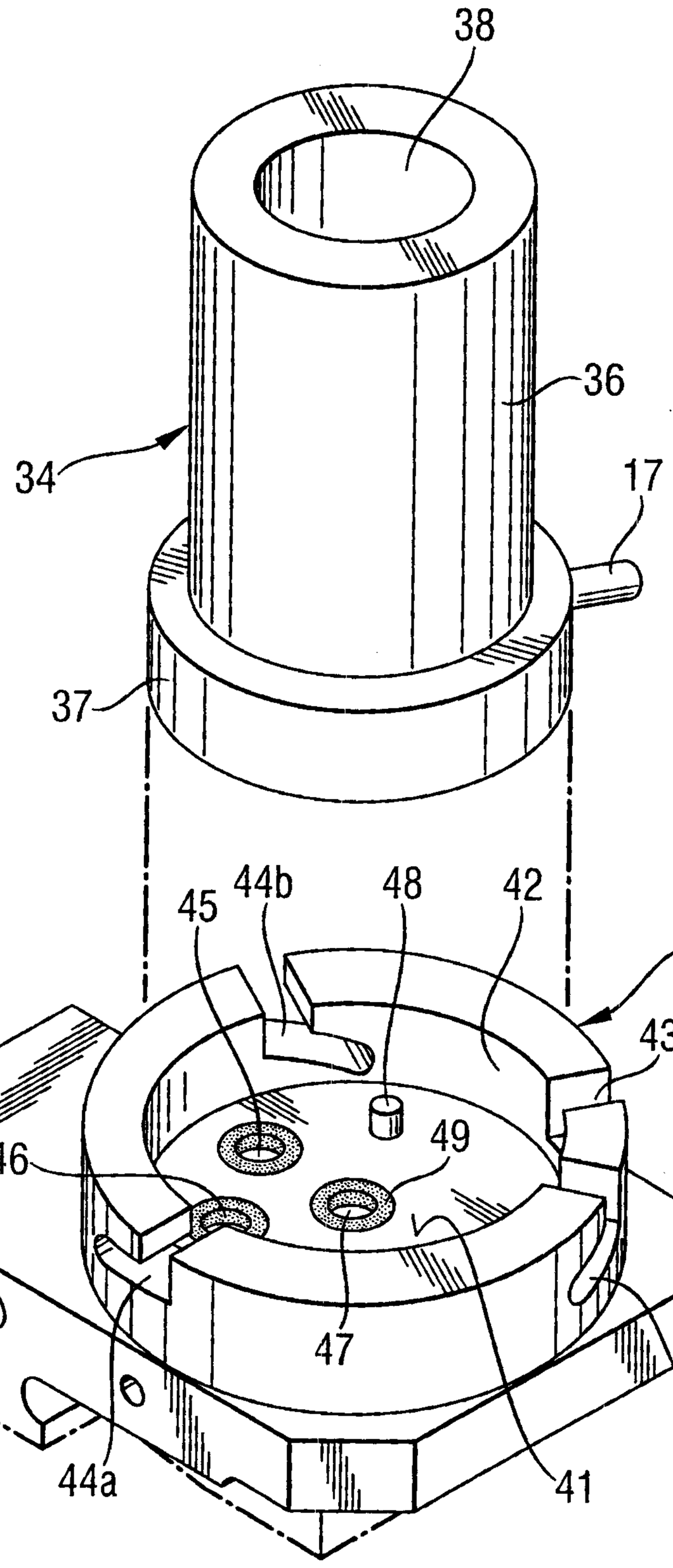


Fig. 2

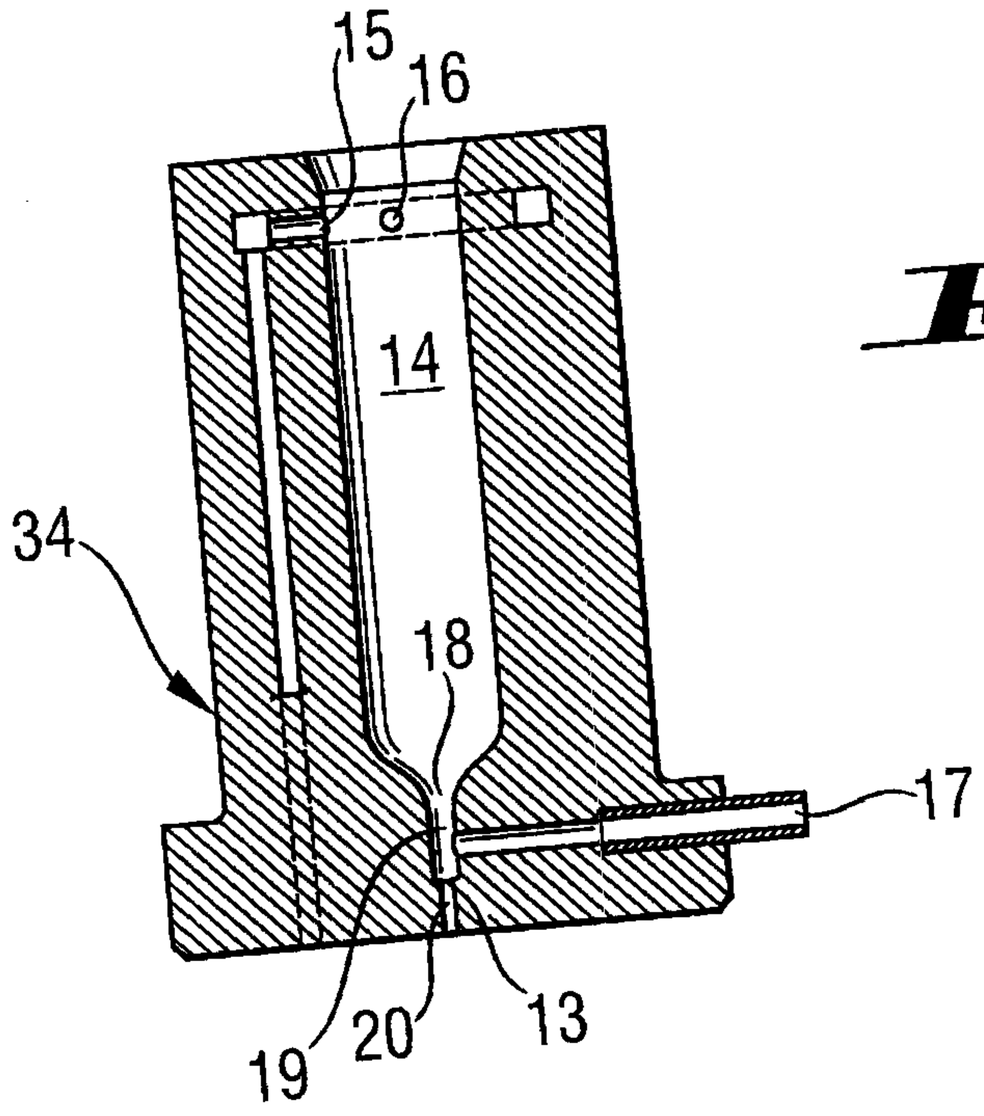


Fig. 3

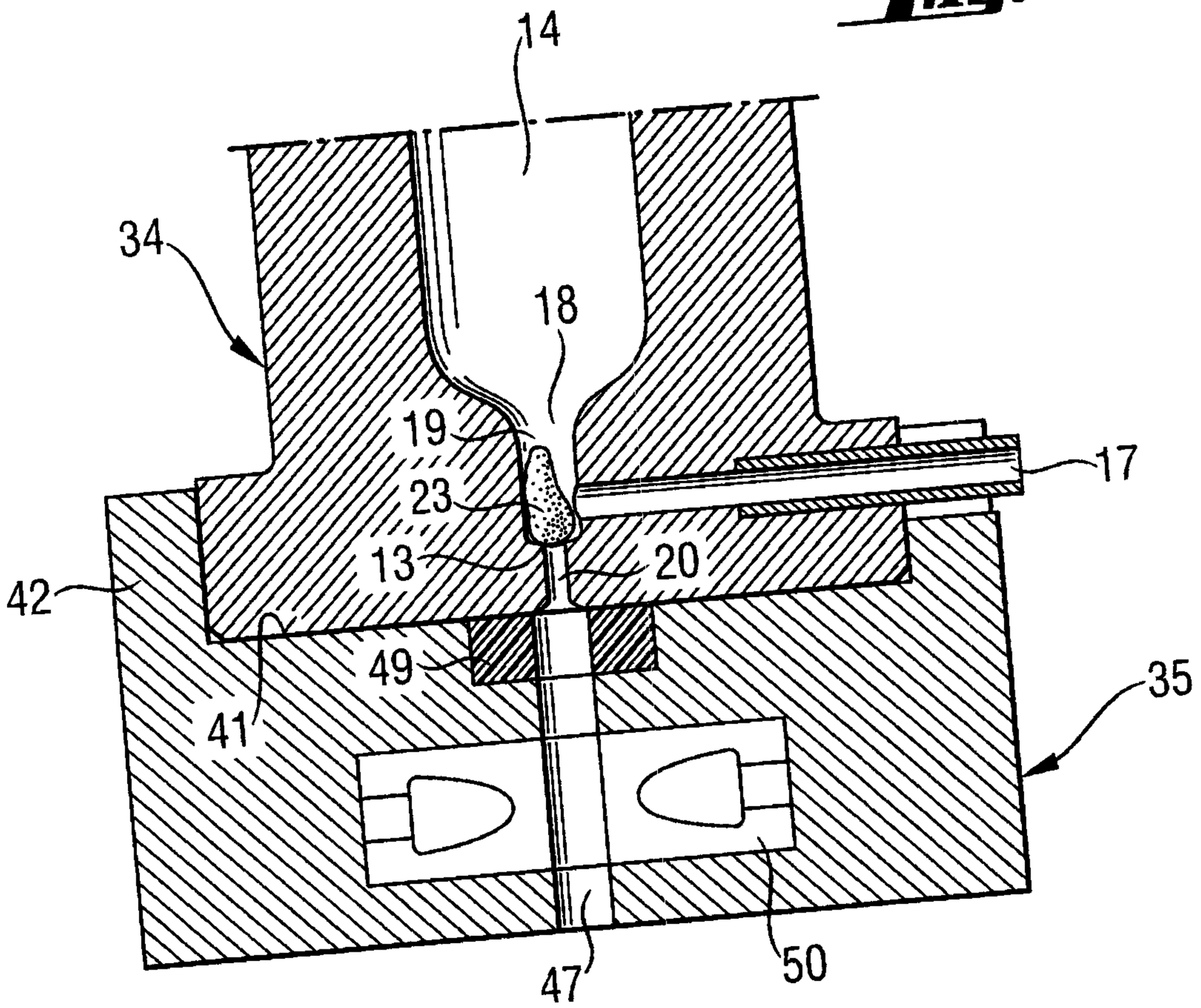
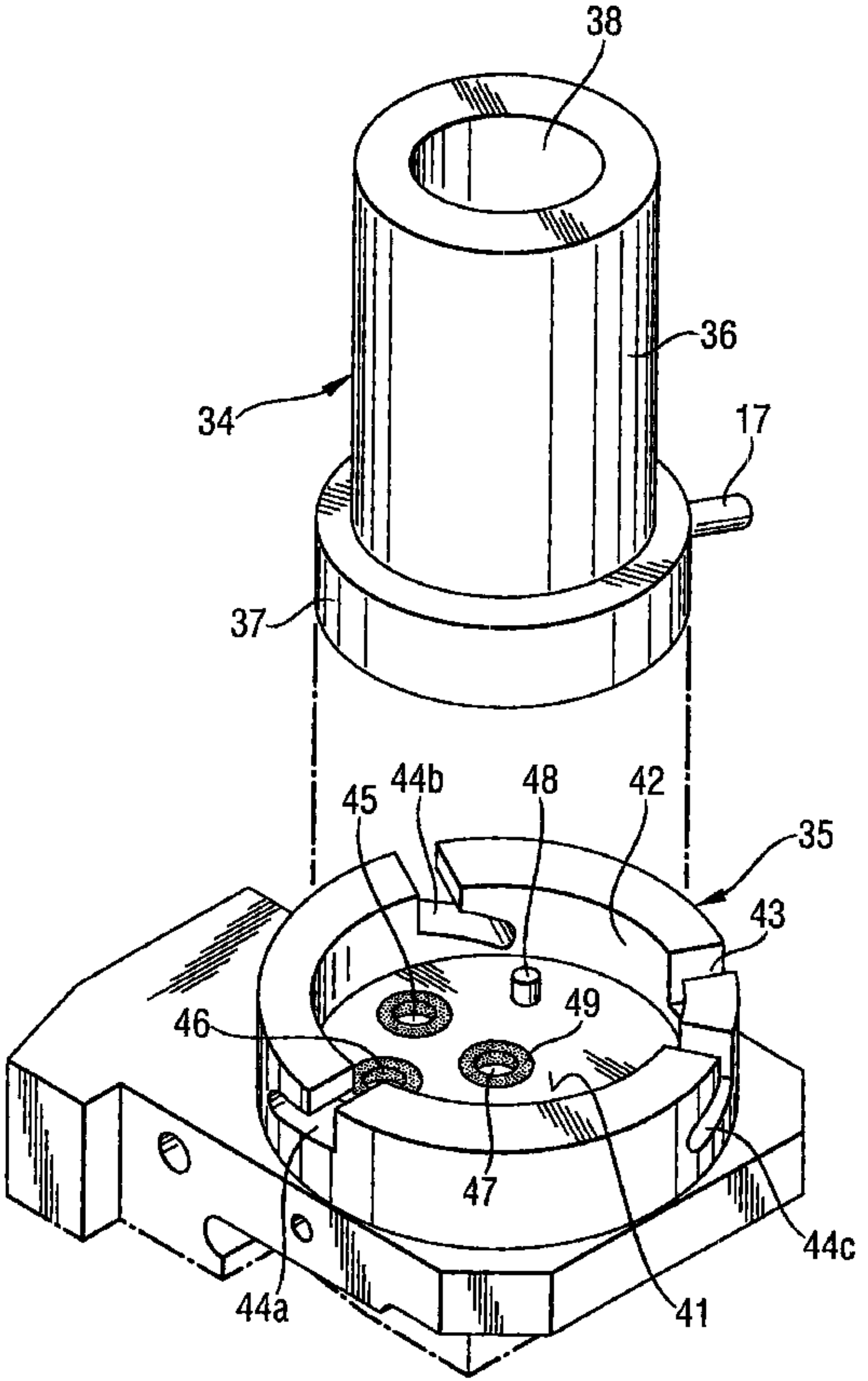


Fig. 4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