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3,164,167

APPARATUS FOR HOMOGENIZING LIQUIDS AND PULPS

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3 Sheets-Sheet 1

Fig. 1

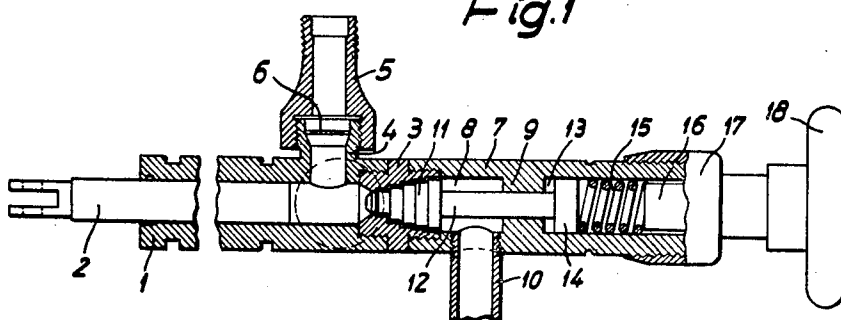


Fig. 2

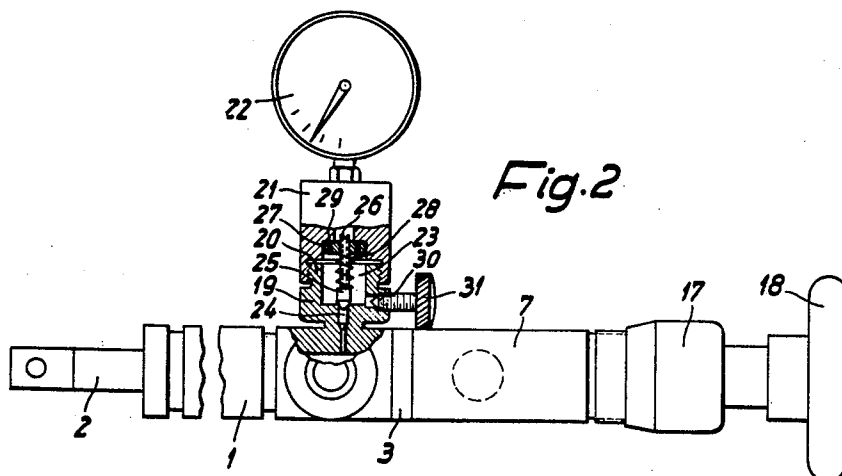
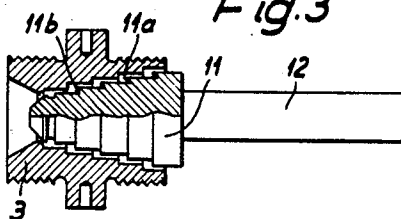


Fig. 3



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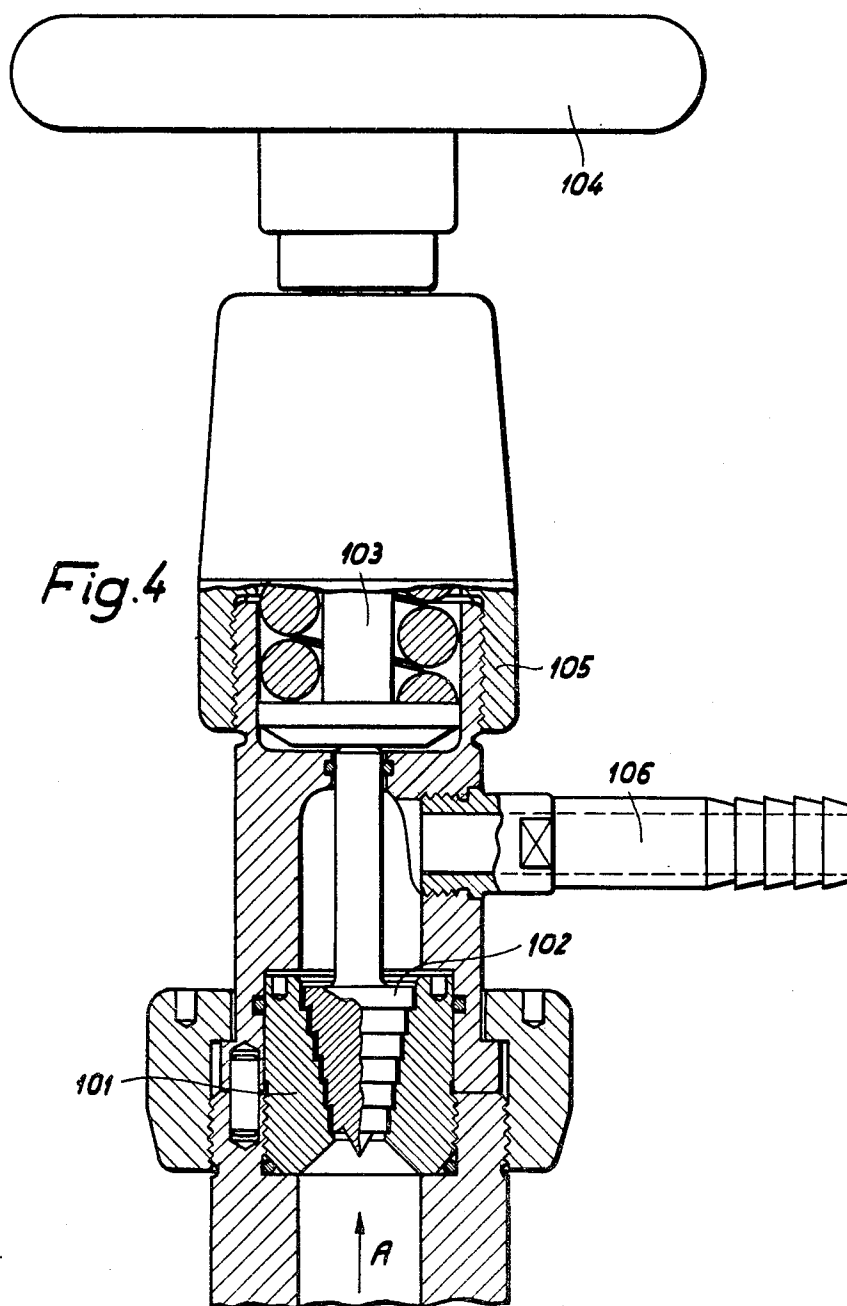
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*Fig. 5*

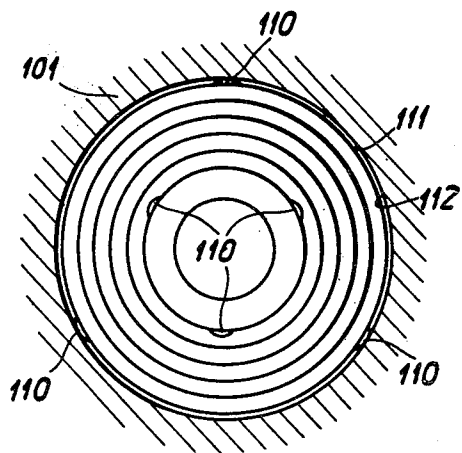
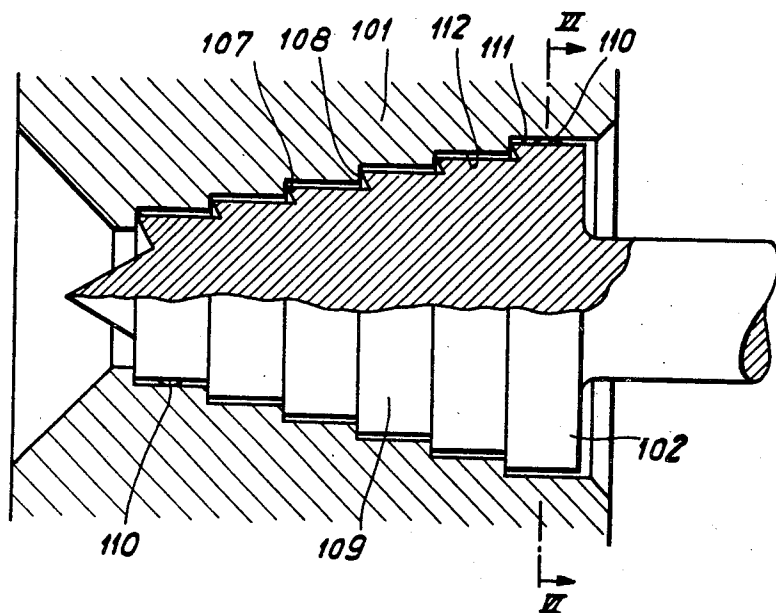


*Fig. 6*

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## 3,164,167 APPARATUS FOR HOMOGENIZING LIQUIDS AND PULPS

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This invention relates to apparatus for homogenizing liquids and pulps of the type having a homogenizing head including male and female parts, of which the female part has a stepped bore expanding towards the outlet side and into which the correspondingly stepped male part is inserted under adjustable pressure.

The homogenizing or emulsifying action in apparatus of this type is obtained by the liquid being pressed through relatively narrow slits under periodically alternating pressure in repeatedly reversing directions.

An object of the invention is to produce homogenizing apparatus in which the annular duct or channel lies exactly concentrically in any cross-sectional plane at any setting so that the cross-sectional area of the annular slit is identical at all points in a transverse plane and the flow of liquid or pulp being treated is uniformly and properly homogenized.

Homogenizing apparatus of the type aforesaid is constructed according to the invention so that the front annular faces of the male part form tapered or conical surfaces, the cone apices lying on the axis in the direction of flow behind the particular step formed by it and so that the male part of the head is guided axially and secured against tilting.

By means of this non-tilting arrangement, concentricity of the two parts of the homogenizing head is ensured and the tapered construction has the effect that the pulp being homogenized is deflected at each step by more than 90° and is pressed through the annular cutting edges thus formed, whereby the microscopic particles are divided, broken up, swirled and thoroughly mixed between sharp edges of the cone and the step of the outer homogenizing head.

By this means, it is possible, with a relatively low pressure to attain an exceptionally high average dispersion.

In accordance with a preferred embodiment of the invention, the inner part of the homogenizing head has a shaft extending through the discharge chamber which is guided, secured against tilting, in an axial bore provided on the expansion side of the homogenizing head, to the part of the guide containing the discharge chamber.

The outer part of the homogenizing head may be constructed in the form of a double nozzle member, the nozzle arranged on the pressure side being connected directly with the cylinder and the nozzle on the expansion side being connected indirectly to the guiding component. This design ensures simple assembly and dismantling of the homogenizing head.

To obtain concentric guiding which ensures under all working conditions, that the width of the annular slit remains constant along the periphery in any transverse plane the cylindrical annular slits of one or more steps, between the two parts of the homogenizing head, in the peripheral direction, may contain a number of cams, offset with reference to each other, the depth of which corresponds to the radial width of the slit. These cams thus fix the width of the annular slit and also ensure that there is always concentricity between the inner and outer components of the homogenizing head.

The cams may be arranged on the inner part of the homogenized head, at the outer rim i.e., on the cylindrical stepped surface and slide along the corresponding

cylindrical stepped surface of the outer part of the homogenizing head.

The guiding cams are preferably staggered peripherally in each case through 120° so that guiding is performed by 3 cams in each step.

Preferably, the guiding cams are arranged in each case on the cylindrical annular faces of the inner and outer steps.

The guiding cams may be arranged in the outer or female part of the homogenizing head, but for practical working considerations, it is advisable, however, to fit the cams on the inner or male part.

Further advantages and features of the invention will be apparent from the following description of an exemplary form of embodiment and the drawing, in which

FIG. 1 is a side elevation, partially in section, of apparatus for homogenizing fluids and pulps, in which the housing components and the driving device are not shown,

FIG. 2 is a plan view corresponding to FIG. 1 and partially in section,

FIG. 3 is an enlarged axial section through the homogenizing head of the apparatus,

FIG. 4 is a section through the head assembly of another embodiment of homogenizing head according to the invention,

FIG. 5 is an enlarged sectional view of a homogenizing head according to the invention, and

FIG. 6 is a section along the line VI—VI of FIG. 5.

The apparatus shown in FIGS. 1 to 3 for homogenizing liquids and pulps has a cylinder 1 which is attached in a horizontal position to a casing, not shown, in which a driving motor is arranged. In the cylinder 1, a piston 2 moves, to which a reciprocating motion is imparted by a crank transmission or other form of gear, not shown, from the driving motor. The cylinder 1 has at its end facing away from the piston 2 an internal screw thread in which an outer part 3, shaped like a double nozzle with a collar, of a homogenizing head, is screwed. The cylinder 1 has on its upper side, near the end equipped with the internal thread, a branch 4 having an outer thread on which a pipe connection 5 is screwed, to which a stock tank or suction pipe for the substance to be homogenized, not shown in the drawing, may be attached. In the branch 4, a plate valve 6 is fitted which has notches on its rim through which the substance to be homogenized passes when drawn in by the piston 2 and which rises during the compression stroke of the piston owing to the action of the substance flowing back through the branch 4 and bears on a shoulder of the intake pipe 5 so that the bore of the intake pipe 5 is closed and a reflux of the substance to be homogenized through the said intake pipe 5 is prevented.

On the thread of the outer part 3 of the homogenizing head, which is on the outside of the cylinder 1, a tubular guiding member 7 is screwed in the part of which lying opposite the part 3, a cylindrical chamber 8 is provided which is closed or the end remote from the part 3 by an intermediate web or partition 9. The chamber 8 has at its end adjacent the intermediate web 9, a discharge outlet in which a discharge pipe 10 is inserted. The inner component 11 of the homogenizing head has the shape of a stepped cone and is arranged in the chamber 8 seated on one end of a shaft 12 which is guided in a bore in the web 9.

In the member 7, on the other side of the web 9 a cylindrical chamber 13 is provided, in which a pressure element 14 acting on the adjacent end of the shaft 12 is guided. The element 14 is acted upon by one end of a cylindrical helical spring 15, of which the other end bears on a cylindrical projection 16 of a screw cap 17 which fits over the end of the member 7 and is screwed on a

thread on the latter. The screw cap 17 is provided with a handwheel 18.

The cylinder 1 has at its end adjacent the inner part 3 of the homogenizing head a side fitting 19 which is provided with a threaded spigot 20 on which a connecting piece 21 of a pressure gauge 22 is screwed. In the fitting 19, a chamber 23 is provided which is connected by a duct 24 with the interior of the cylinder 1. The opening of the duct 24 into the chamber 23 is designed as a valve seating for a tapered valve head 25. The valve head 25 is slidably guided on a rod 26 which is screwed into a bearing plate 27 which bears on a shoulder in the connecting piece or base 21 of the pressure gauge 22. On the guide rod 26 is fitted a compression spring 28 bearing on the bearing plate 27 and acting on the valve head 25. The bearing plate 27 is provided with openings 29. The valve head 25 and the compression spring 28 form a non-return valve assembly which ensures that the needle of the pressure gauge 22 does not respond to the reciprocating motion of the piston 2 but indicates continuously the maximum pressure attained. In order to prevent the substance to be homogenized penetrating inside the pressure gauge 22, the bore of the connecting element 21 of the pressure gauge 22 contains a displaceable piston, not shown in the drawings, on which the pressure of the substance to be homogenized acts.

The outer part 3 of the homogenizing head has a stepped bore, expanding outwardly, in which the correspondingly stepped inner part 11 of the homogenizing head with tapered annular faces 11a engages, a small intermediate clearance being left between the cylindrical surface of the bore of the outer part 3 and the cylindrical surfaces of the inner part 11 of the homogenizing head. The inner part 11 of the homogenizing head is pressed by the screw-controlled spring 15 acting through the element 14 and the guiding rod 12 into the stepped bore of the outer part 3 of the homogenizing head, so that its annular stepped faces, i.e. the annular cutting edge 11b are pressed against the annular front faces of the bore of the outer part 3. The initial tightening of the spring 15 and also the degree of pressure of the said annular stepped surfaces of the inner part 11 of the homogenizing head against the annular stepped faces of the bore of the outer part of the homogenizing head can be varied by means of the screw cap 17. Advantageously, a scale is provided on the outer face of the guide tube 7, over which the inner edge of the screw cap 17 moves, and on which the particular setting of the tension of the spring 15 can be read and which enables changes to be made in the tension of the spring 15 to selected fixed values.

When the piston is moved to and fro by the driving device above mentioned, then during the outward stroke of the said piston 2, the substance to be homogenized is drawn in through the branch 4 from the tank into the cylinder 1. During the return stroke of the piston, the plate valve 6 is pressed by the substance to be homogenized against the shoulder of the connecting pipe 5 so that a reflux of the substance contained in the cylinder 1 into the tank or the suction pipe is prevented. The substance contained in the cylinder 1 is compressed by the piston 2 and is discharged in a particularly thin layer between the outer part 3 of the homogenizing head and its inner part 11, which yields a little against the action of the spring 15, and with repeated deflection through 90° and by this means is homogenized, whereupon it passes into the chamber 8 from which it issues through the discharge pipe 10.

The outer part of the homogenizing head may be constructed in such manner that the front faces of the steps are coned, the apex of the cone lying on the same side as the apices of the annular conical faces of the inner part of the homogenizing head. The construction is preferably so arranged that the apex angle of the annular step of the outer part of the homogenizing head is greater than the apex angle of the annular surface of the inner part of

the homogenizing head. In FIGS. 1 to 3 of the drawings, the angle of taper in the steps of the outer part of the homogenizing head is 180°, i.e., step faces are provided lying in a plane perpendicular to the axis.

In the embodiment shown in FIGS. 4 to 6, the homogenizing head consists of an outer female part 101 and an inner male part 102. The outer part 101 and the inner part 102, as in the embodiment shown in FIGS. 1 and 2, have several steps, the front faces of the steps of the inner component being tapered. The setting of the inner component 102 is effected by means of a shaft 103 and a handwheel 104 and a screw-controlled spring 105. The substance to be homogenized enters in the direction of the arrow A, FIG. 4, into the homogenizing head and is discharged through a pipe 106 after passing through the homogenizing head.

By altering the setting, i.e. rotating the handwheel 104 the inner part 102 of the homogenizing head is moved axially and is urged with more or less force with its annular cutting edges 107 against the series of steps 108 of the female part 101.

The cylindrical faces 109 of the inner part 102 have guide cams 110, of which the depth corresponds to the radial gap 111 between the two cylindrical boundaries of the inner and outer parts. In the embodiment shown in FIGS. 4 to 6, the guide cams are arranged on the inner end and outer end steps. It may suffice to provide the guide cams on one step only, for instance, on the middle step. On the other hand, all the steps may have guiding cams.

As may be seen from FIG. 6, on the casing 109, three guiding cams are arranged at angular intervals of 120°.

In the embodiment shown in FIGS. 4 to 6, three cams offset by 120°, are arranged on one annular step. It is also possible to provide only a single cam on each step and to offset the cams circumferentially with reference to the adjacent step.

By means of the guiding cams 110 which slide with a very small clearance over the stepped faces of the female part, an exceptionally accurate centering is obtained, i.e. concentric guiding, and thus the required uniformity of the width of the gap is ensured.

I claim:

1. Apparatus for homogenizing liquids and pulps having a homogenizing head adapted for being passed by said liquid and said pulps, respectively, in one direction of flow, said apparatus comprising a male part and a female part cooperating with each other, the female part comprising a bore having steps, the male part comprising a valve member having corresponding steps, adjustable resilient pressure means forcing said male part into said female part, the diameter of said steps of said male part and of said female part increasing in said direction of flow, the front annular faces of the steps of said male part being conically inclined towards the axis of the male part in the direction of increasing diameter of said male part, said inclined face of each step extending to the diameter of the respective step, thereby producing annular linear cutting edges and deflecting said liquids and pulps at each step by an angle of more than 90°; the cone apices lying on the longitudinal axis of the male part behind the respective steps in said direction of flow, and means guiding the male part in the female part so that it is movable axially but remains centered relative to said female part and free from tilting.

2. Apparatus as claimed in claim 1, in which the discharge chamber of the guiding component is sealed airtight from a second chamber by the guide for the shaft, the guide being constructed as an intermediate web or partition.

3. Apparatus as claimed in claim 2, in which a helical spring acts through a pressure element on the shaft of said male part and bears against a cylindrical collar entering the chamber of the guide and carried by a screw cap equipped with a hand wheel which is screwed on a thread

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at the end of the guide tube remote from the homogenizing head in such manner that by rotation of said screw cap tensioning of the helical spring may be varied.

4. Apparatus as claimed in claim 2, in which the female part of the homogenizing head is constructed in the form of a double nozzle; the nozzle at the upstream side being connected directly to said cylinder, and the nozzle at the downstream and discharge side being connected indirectly to said guiding web.

5. Apparatus as claimed in claim 1 comprising a shaft on said valve member and as said guiding means a cylinder containing a discharge chamber and a guide bore for said shaft.

6. Apparatus as claimed in claim 1, comprising cams arranged in the radial gap between the cylindrical stepped faces of at least one step of said male and female parts, said cams effecting axial concentric guiding of the male and female parts and the height of said cams corresponding to the width of said gap.

7. Apparatus as claimed in claim 6, wherein said cams are provided in a plurality of steps, the cams of different steps being staggered circumferentially.

8. Apparatus as claimed in claim 6, in which the guide cams are located on the outer surfaces of the male part.

9. Apparatus as claimed in claim 8, in which the guide cams are mutually offset by 120°.

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10. Apparatus as claimed in claim 9, in which the guide cams are arranged on the inner end and outer end steps of the male part.

11. Apparatus as claimed in claim 6, in which three cams are displaced at intervals of 120° around the cylindrical periphery and are arranged on at least one step of the male part.

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