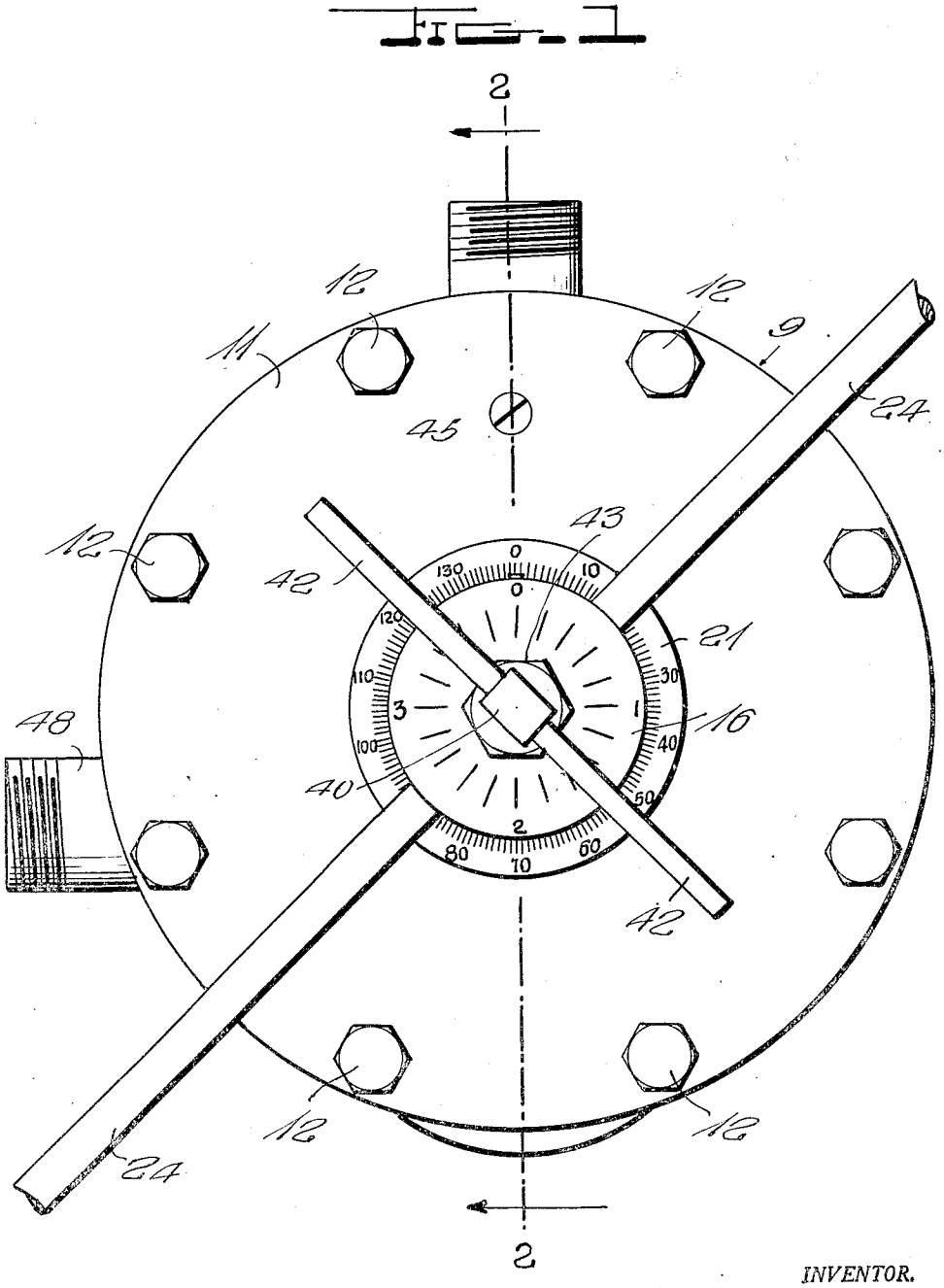
Sept. 4, 1951 J. MARCO 2,566,949

HYDRAULIC GRINDING CONTROL

Filed Oct. 17, 1946 3 Sheets-Sheet 1



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HYDRAULIC GRINDING CONTROL

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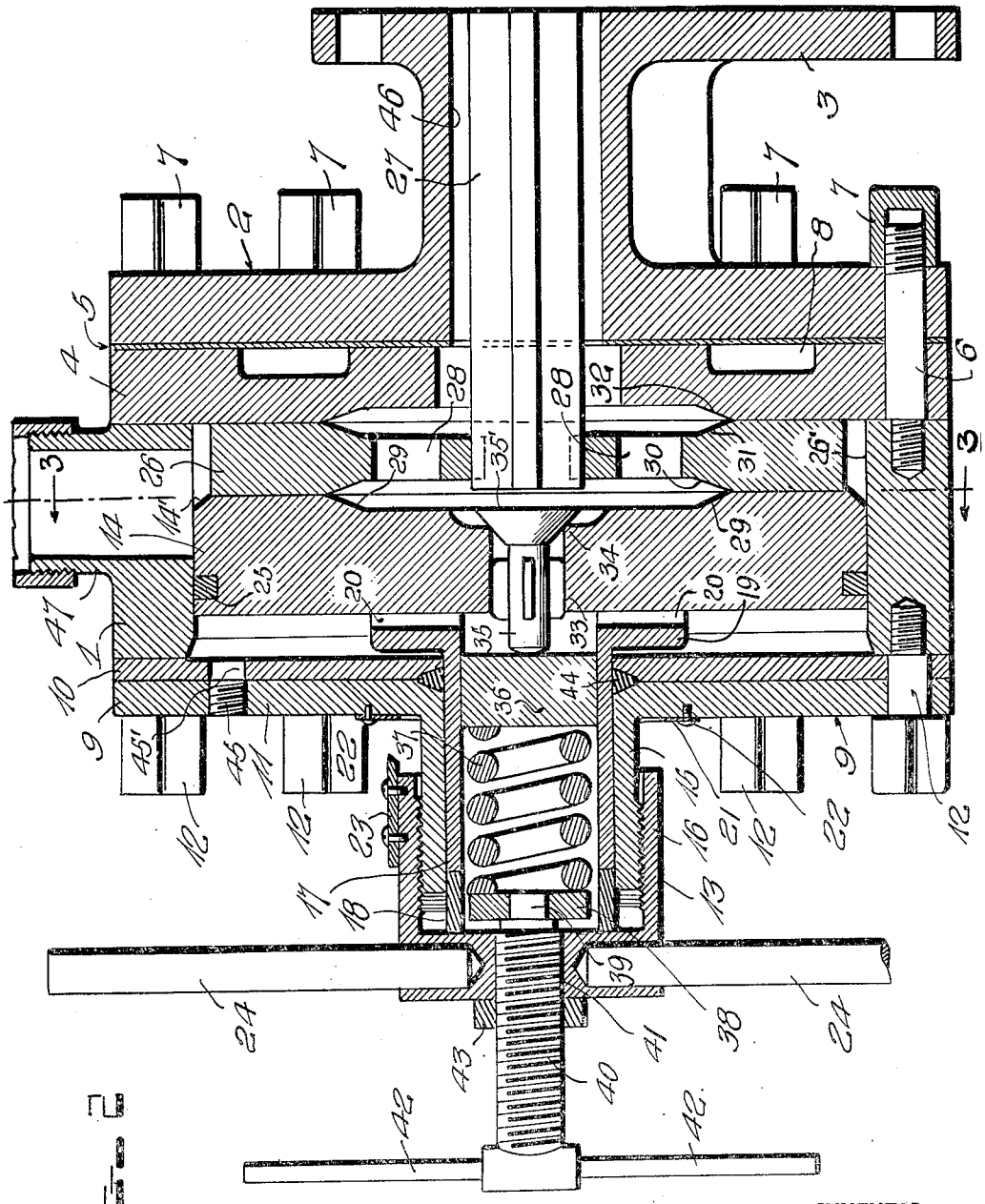


FIG. 2

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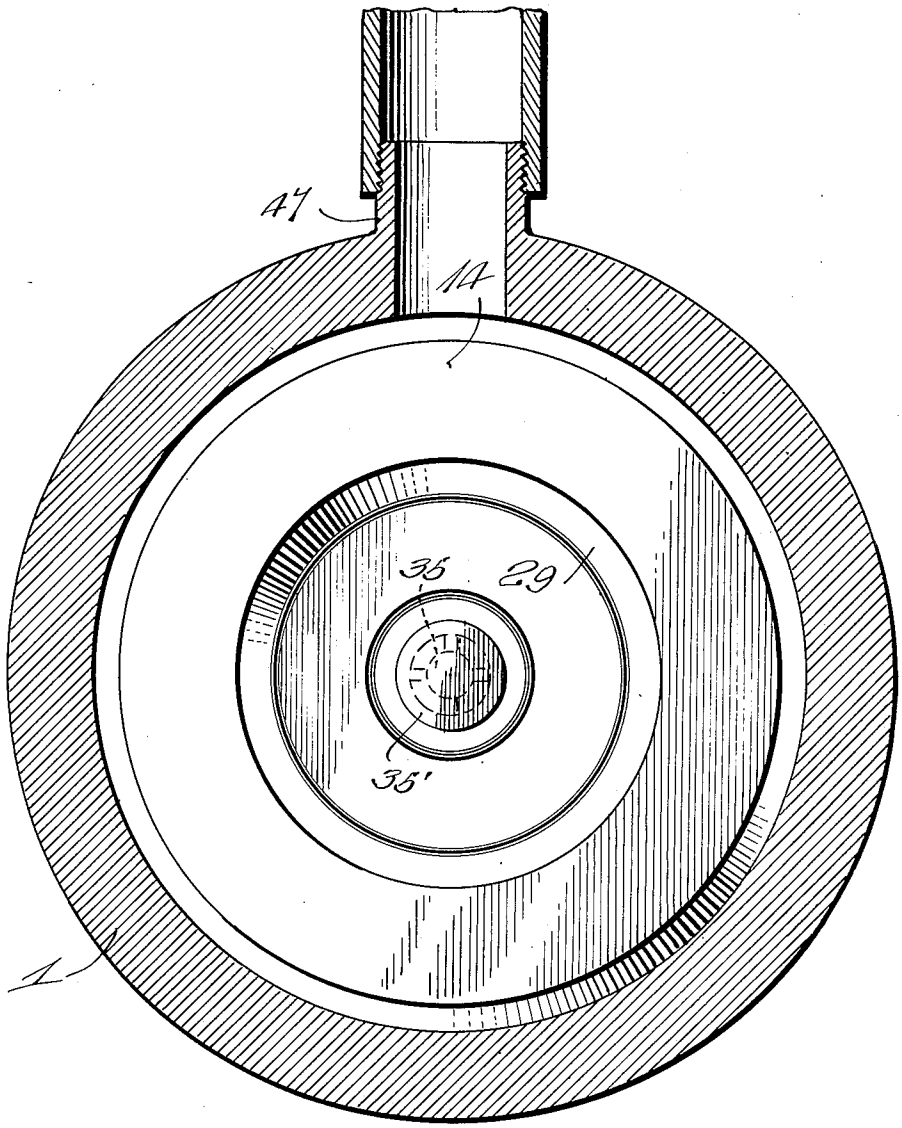


FIG. 3

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UNITED STATES PATENT OFFICE

2,566,949

HYDRAULIC GRINDING CONTROL

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Application October 17, 1946, Serial No. 703,837

15 Claims. (Cl. 241—37)

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My invention relates to the grinding of solids in a liquid medium. I have provided a machine or apparatus in which hydraulic pressure means is adjustable to maintain substantially constant grinding clearances automatically, regardless of normal wear, whereby products processed may have a uniform consistency.

It is an object of my invention to provide in a substantially constant speed grinder an equilibration means or by-pass whereby the filament of material, carrying solid particles, may be made thinner so that the solid particles may be reduced by a condition of close physical proximity of the grinding and shearing surfaces.

It is also an object of my invention to provide a dual adjustment means whereby a hydraulic adjustment and a subsequent mechanical adjustment may be made substantially equal to the hydraulic adjustment whereby a failure of the hydraulic adjustment will not prevent the successful operation of my grinder.

It is also an object of my invention to provide a hydraulic pressure means using the liquid pressure of the material being processed as the material is forced into my novel grinding machine for the processing thereof.

It is a further object of my invention to provide a temperature control means for my grinding machine.

Other objects and advantages will be revealed in the detailed description of my drawings which constitute a part of my specification.

In the drawings:

Figure 1 is a front end elevational view of my new grinding machine showing more particularly both the hydraulic and mechanical adjustments;

Figure 2 is a longitudinal vertical sectional view taken substantially on the line 2—2 of Figure 1, looking in the direction of the arrows; and

Figure 3 is a transverse vertical sectional view taken substantially on the line 3—3 of Figure 2, looking in the direction of the arrows.

The drawings are merely illustrative of a preferred form of my invention and not definitive thereof except as claimed herein.

The reference characters identify the principal parts and details in both the drawings and specification.

In the drawings, the casing 1 is provided with a rear supporting head 2 which is adapted to be secured on a pump (not shown) by means of bolts passing through a flange 3. Interposed between casing 1 and the rear head 2 is a grinder plate or stationary stator 4 and a gasket plate

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5. Both of these plates are secured to the casing 1 by bolts 6 passing through both plates, the rear head and engaging the casing and cap nuts 7. The stator 4 is provided with an annular cavity 8 to receive a temperature control fluid to be circulated therethrough by means (not shown).

The opposite end of the casing 1 is provided with a front head 9 comprising an inner plate 10 and an outer plate 11 secured to the casing 1 by bolts 12 passing through both plates 10 and 11 and engaging the casing.

The front head 9 carries a dual control means 13 for a floating stator 14 within the casing 1. The plate 11 is provided with a tubular support 15 preferably integral therewith and centrally located thereon. The support 15 is externally screw threaded to receive an internally screw threaded cap or pressure member 16. The tubular support 15 is provided with adjustable tubular elements 17 and 18 telescopically slidable therein. The element 17 extends to a position within the casing 1 and is provided with a laterally extending disc 19 preferably integral therewith. The disc 19 is provided with projections 20 which engage the floating stator 14. The element 17 may be made of steel or stainless steel or other suitable material while the element 18 is made of softer material such as bronze or any other suitable alloy or even plastic material. The element 18 serves as a thrust bearing. The head 9 is provided with an indicating dial 21 secured thereto by any suitable means such as bolts 22. The cap 16 is provided with a pointer 23 to cooperate with the dial 22 to indicate the amount of adjustment which has been made. In order to make minute adjustments easily the cap 16 is provided with handles 24.

The floating stator 14 slidably fits closely within the casing 1 but in order to provide a nearly perfect fluid seal the stator is provided with, at at least, one piston ring 25. All of the four physically contacting faces of the stator 14, the rotor 26 and the stationary stator 4 are grinding surfaces provided with a series of concentrically arranged indentations or cavities such as disclosed in Figures 3, 4, 5 and 10 of my Patent No. 2,255,071, granted September 9, 1941.

In order to maintain sufficient hydraulic pressure back of the floating stator 14, the forward surface portion has been made smaller or reduced in area by cutting away or beveling the forward edge 14^1. The pressure in the annular channel 26^1, about the rotary stator 26, is only slightly greater, because of the force of gravity,

than the pressure in the exit tube 47. Since the pressure is directly proportional to the area, it is conclusive, therefore, that the stator 14 will be maintained and controlled in comminuting or grinding contact with the rotor 26 automatically by the fluid pressure in the machine, in that, the hydraulic pressure area on the larger side of the floating stator 14 is greater than the hydraulic pressure area on the smaller side thereof.

It is realized and appreciated that to every force there always exists a corresponding force which is equal and oppositely directed. All of the four approximately and substantially contacting faces of the stators 4 and 14 and the rotor 26 are maintained under substantially the same pressure or force either automatically by fluid pressure or by mechanical pressure or both.

It is contemplated that the floating stator 14 may be provided with temperature control means whereby either hot or cold fluid may be circulated therethrough to provide any temperature that conditions require.

The rotor 26 has a splined connection with the shaft 27. The shaft 27 is connected directly to a pump (not shown) whereby the shaft 27 and the rotor 26 are propelled. The shaft 27 is preferably cross-shaped in contour in a transverse section thereof. This particular contour provides for the flow of a liquid medium containing solids into the grinding stators. The rotor 26 is provided with spaced apertures 28 to allow free flow of the material being treated. Confronting side faces of the stator and the rotors are provided with recesses 29, 30, 31 and 32 centrally located therein. Each recess is provided with an inclined portion merging into the grinding surface. The inclined portions guide the material being treated to the grinding surfaces. Furthermore, by the use of inclined portions, the collection of material in sharp corners or crevices is prevented thereby affording the self clearing and sanitary quality.

The floating stator 14 is provided with a central aperture 33 defining a valve seat 34 and a guiding surface for a winged valve stem 35 on the valve 35^1. This valve construction provides for the flow of the liquid material being treated to the hydraulic chamber to the larger side of the floating stator 14, thereby placing said floating stator under hydraulic pressure urging the grinding surfaces into intimate physical contact. This hydraulic control of the floating stator 14 insures a uniform pressure between the grinding surfaces and consequently a uniform treatment of the material being processed. Therefore, the final product of the process is of uniform consistency or texture, resulting from the uniform pressure applied to the floating stator.

The control of the stator valve 35^1 is effected by the movement of the piston 36 in the sleeve 17. The piston 36 is cushioned by a spring 37 located between the piston 36 and an adjustable seat member 38 preferably swiveled on the end 39 of an adjustable screw threaded element 40. The element 40 engages a screw-threaded bore 41 located centrally in the cap end of the cap or sleeve 16. The element 40 is provided with handles 42 and with a lock nut 43. The closed end of the sleeve 16 is provided with dial indicating marks to indicate in conjunction with the handles 42 the amount of adjustment given to the stator valve 35^1.

In order to prevent leakage from the hydraulic chamber about the tubular element 17, the plates 10 and 11 are provided with opposed beveled annular recesses to receive a packing 44 which is a circular ring or annulus having when in use a triangular cross section. When these plates 10 and 11 are forced together the packing 44 is forced into intimate physical contact with the element 17 and thereby prevents leakage. The plates 10 and 11 are provided with aligned apertures 45^1 adapted to receive a detachable sealing plug 45. The sealing plug 45 is preferably provided with screw threads engaging complementary threads in the aperture 45^1 of plate 11.

The entrance for the material fed to the grinder is through the head 2 as indicated by the reference character 46. The exit for the processed material extends through the casing 1 as indicated by the numeral 47. Exit 47 guides or conducts the material processed outwardly as the product is directed to pass forward from the pump section through space about the shaft 27 and there forced between stators 4, 14 and rotor 26. To that end the uniform thickness of the material being treated is forced to pass between the stators 4 and 14 and the rotating shear or rotor 26. The thickness of the film of material being treated is controlled automatically by the hydraulic pressure on the stator 14 or by mechanical adjustments of the mechanism 13, 15, 16, 17, 18, 19, 20, 24 or by both control means used simultaneously. The exit 47 is connected to an outlet tube or pipe leading to a suitable tank or receptacle (not shown).

It appears to be selfevident that there is no need to vary the speed of the grinder when it is desired to reduce the flow rate of material being sheared or ground. It has been my experience, in grinding and dispersing various pigmented materials, that the rate of flow control means is a most desirable feature, since the operator can better treat the various physical and chemical elements involved to produce the best results. Very fine and minute solid particles of matter, if the liquid body is too thick, can easily find their exit without even coming in contact with the grinding or shearing faces. Under these conditions, the by-pass of some of the material being processed will result in making the film of material passing between the grinding surfaces thinner so that the solid particles can be reduced as desired. When the apertures 45^1 are open the mechanical adjustment is used to maintain the grinding faces or surfaces in close relation to operate successfully on the mixture being treated.

My invention is operated to grind solids contained in a liquid medium. The grinding and mixing of paint ingredients can be thoroughly accomplished in my novel grinder.

When grinding and mixing of paint ingredients, it may be found desirable to have the valve 35, 35^1 closed and depend entirely on the mechanical adjusting means of the dual adjustment mechanism so as to prevent the paint ingredients from entering the hydraulic chamber, so that the grinder may be more readily cleansed in preparation for the subsequent treatment of food products. Furthermore, the paint ingredients, because of their adhesive qualities, may form a film of gum on the peripheral wall of the hydraulic chamber which could interfere with the intended operation of the floating stator 14. It appears to be self-evident that it would be extremely difficult to remove a paint or gum film from the peripheral wall of the hydraulic chamber.

Whenever it is desirable to prevent the material being treated from entering the hydraulic

chamber, the valve 35, 35¹ may be conditioned to close.

It may be desirable to provide means (not shown) for positively closing the valve 35, 35¹ when desired. On the other hand, if the grinder or emulsifier is to be used only for a selected variety of food products, then it is possible to omit the valve element 35, 35¹ and also its controlling means. The part 33, in such a case, would admit the liquid to the hydraulic chamber.

To facilitate the substantially universal use of my emulsifier and the cleansing thereof, I prefer to use the valve to control the valve part to the hydraulic chamber.

The operation of the machine appears to be easily understood from the foregoing description. The ingredients enter the machine through the feed tube 48 which leads to a pump (not shown). From the pump, the ingredients are forced along by the pump through the inlet 46 into the machine where it is received between the grinding stators 4 and 14 and the rotor 26. Initially some of the mixture of ingredients enters the hydraulic chamber to produce pressure on the floating stator 14 and urge all of the grinding surfaces into intimate physical contact with the solids in the liquid mixture to crush them into the minutest particles possible in such a mixture.

In order to obtain the desired hydraulic pressure initially the valve 35¹ must be open sufficiently to receive the liquid mixture. The opening of the valve 35¹ is obtained by adjusting the screw 40, spring 37 and piston 36 inwardly to open the valve 35¹ to provide for the free flow of the liquid mixture into the hydraulic chamber in front of stator 14. When all of the grinding surfaces are in the most intimate contact for the successful grinding and mixing operation then the mechanical adjustment is made by turning the cap 16 forwardly while the screw 40 is held against turning. In this mechanical adjustment, the lock nut must be loosened and turned backwardly, the screw cap 16 must advance at the same speed on the tube 15 as it does on the screw 40. When the final adjustment has been made to produce the desired product then the readings on the dials can be noted and recorded for future use so that a readjustment for the same kind of material may be accurately and expeditiously made by the operator.

The finished product finds its exit through the necks 47. The necks 47 have a tubular connection leading to a tank or receptacle (not shown). The rotor or grinder 26 is propelled by the shaft 27 which is connected directly to the pump shaft (not shown).

It will be observed that I have provided a novel machine for grinding and mixing that can readily be assembled and disassembled whenever conditions may require disassemblage for the replacement of worn parts, etc.

The machine can be cleansed and sterilized by forcing suitable fluids through the machine preferably alternately from the feed end and then through the front end by way of the apertures 45¹ and the hydraulic chamber, etc. The repeated alternate treatment thoroughly cleanses and sterilizes the machine.

From the foregoing description of the construction of my improved device, the operation thereof and the method of applying same to use will be readily understood and it will be seen that I have provided a comparatively simple and inexpensive means for carrying out the various objects of the invention.

While I have particularly described the elements best adapted to perform the functions set forth, it is apparent that various changes in form, proportion and in the minor details of construction may be resorted to, without departing from the spirit or sacrificing any of the principles of the invention.

Having fully shown and described my novel machine, what I claim is:

1. In a grinding and mixing machine for solid particles in a liquid medium, said machine comprising a casing containing a shaft, a rotor and a plurality of stators therein surrounding the shaft and disposed at opposite sides of the rotor, said rotor being splined on said shaft and being rotatable and propelled by the shaft splined therein, said shaft entering the casing through an opening of a diameter adapting it to form an inlet about the shaft for material to be treated, the stator at the opposite side of the rotor from the inlet being slidably and non-rotatably mounted in said casing and defining the movable wall of a hydraulic chamber within the casing the stator confronting the inlet being stationary and formed with an opening registering with the inlet and through which said shaft passes, said rotor being formed with transverse openings establishing communication between spaces formed by recesses in confronting side faces of the rotor and the stators, said chamber having direct communication through an apertured portion of said slidable stator with the solid particles and liquid mixture being treated, whereby a continuing pressure may be maintained on the rotor and stators notwithstanding normal wear thereof.

2. The construction set forth in claim 1, in which the apertured portion of the slidable stator is provided with a valve having a winged valve stem guided by the apertured portion, in combination with means abutting against said valve stem to open the same.

3. The construction set forth in claim 1, in which the apertured portion of the slidable stator is provided with a valve, said valve having a winged valve stem guided by the apertured portion, in combination with a dual control means, one element of which is adjustably movable to engage the valve stem and open the valve, the other element of said control means having a concentric relation to the first named element, said other element having a sleeve extending through the casing and into the hydraulic chamber, said sleeve having a disc thereon within the chamber, said disc engaging said slidable stator when said element is in working adjustment with said slidable stator.

4. In a grinding and mixing machine, said machine comprising a casing having heads detachably secured thereon, said casing also having a shaft, a rotor and a plurality of stators therein, one of said stators being stationary, said rotor being splined on said shaft and adapted to be driven by the shaft, one of said stators being slidably and adjustably movable but being nonrotatable, one of said heads being a rear head and having a tubular opening to receive the material being treated, said tubular opening constituting both an inlet opening and a housing for the shaft located therein and extending therethrough, said shaft having one end splined to said rotor to propel the same, the other end of said shaft being adapted for direct connection with a feeding means, the other head constituting a front head comprising one stationary

wall of a hydraulic chamber and also comprising a support for a dual control means for said machine, said slidable stator constituting a movable wall of said hydraulic chamber, and having a valved aperture therein, in combination with said dual control means, said support constituting a cylindrical sleeve extending outwardly and centrally from said front head, said dual control means comprising an internally screw threaded cap, an internal cylindrical sleeve and a ring aligned with said internal sleeve, a threaded stem, a piston, a washer and a spring, said cylindrical sleeve being externally screw threaded to receive said cap, the washer being swivelly connected to said screw threaded stem within said internal sleeve and ring, said internal sleeve being telescopically mounted within said cylindrical sleeve, said internal sleeve having a flange on the inside of said front head, said flange being provided with radial ribs co-extensive with said flange, said piston being slidably mounted in said internal sleeve adjacent its flange, said spring being helical and compressibly located in the internal sleeve between said washer and said piston and engaging both washer and piston, thereby urging them apart, pointer and dial means located on said cap and front head respectively to indicate the amount of adjustment of said flange, both said cap and said stem being provided with radial handles to facilitate manipulation thereof when making adjustments, said cap having dial marks thereon to indicate the amount of adjustment of said piston as compared with the radial handles of said stem.

5. The construction set forth in claim 4, in which said front head constitutes a composite structure comprising two plates secured together in superposed relation, said plates having concentric, opposed but adjacent reduced portions defining an annular recess receiving a sealing gland, said gland engaging the circumference of the internal sleeve of the mechanical adjustment element.

6. The construction set forth in claim 4, in which one of said stators is provided with an annular cavity comprising part of a temperature control means.

7. The construction set forth in claim 4, in which the machine is provided with a flow control means, said means comprising a screw threaded apertured portion in said front head, said portion having a screw threaded removable plug.

8. In a grinding and mixing machine for particles of solid material in a liquid, said particles and liquid constituting a feed mixture, said machine comprising a tubular casing having a feed head, a front head, and a tubular exit for the treated mixture, said casing containing a plurality of stators and a rotor, one stator being stationary, and one being slidable but non-rotary, in combination with a propelling shaft, said propelling shaft having a splined connection with said rotor, said slidable stator constituting one movable wall of a hydraulic chamber, said front head constituting a stationary wall of said chamber, said slidable stator having an apertured portion slidably supporting a valve in said aperture, in still further combination with a dual control means having sealed connection with said front head, one element of said dual control being in engagement with said valve to open the same and thereby place the hydraulic chamber in direct communication with the feed mixture, the other element of said dual control means engaging the slidable stator and constituting a mechanical adjusting means for said slidable stator whereby the grinding and mixing machine may be operated with the automatic hydraulic control, or with the mechanical control adjustment or with both of them.

9. The construction set forth in claim 8, in which the rotor is less in diameter than the sliding stator whereby a substantially annular channel is provided for the exit of treated material, said tubular exit being in direct communication with said channel.

10. The construction set forth in claim 8, in which the stationary stator is of substantially the same area as a cross section of the tubular casing whereby said stator may be bolted against the end edge of the wall of the casing opposite the front end of the casing.

11. The construction set forth in claim 8, in which each stator and the rotor is provided with, at least, one recessed portion, said recessed portions being circular in contour and extending radially away from the axial centers of said stators and rotor, each recessed portion terminating in beveled guiding portion leading to the treating portions of said stators and rotor.

12. The construction set forth in claim 8, in which the slidable stator is provided with, at least, one sealing ring projecting from an annular groove thereof into sealing contact with the tubular casing.

13. The construction set forth in claim 8, in which the front head is provided with a plugged aperture in direct communication with the hydraulic chamber.

14. In a grinding and mixing machine for a mixture, said mixture comprising solid particles in a liquid, the sub-combination comprising a head carrying and supporting a dual control mechanism, said head having a tubular extension projecting centrally therefrom and adjustably engaging portions of said dual control mechanism, said dual control mechanism comprising a sleeve telescopically received within said tubular extension an internally screw threaded cap member, a screw threaded stem, a washer, a piston, and a cushion, said sleeve extending in a sealed condition through said head said sleeve having a flange thereon on the inner side of said head, said flange being provided with radial ribs, said extension having external screw threads which engage complemental internal screw threads of said cap member, whereby a mechanical adjustment of the sleeve may be made, in combination with a valve opening means comprising said threaded stem extending through said cap and into said sleeve and being concentric therewith, said stem having said washer swiveled on one end thereof and located within the sleeve and against the cushion said cushion and piston being located within the sleeve and being in contact with each other, said piston being adapted to engage a valve stem to actuate the same.

15. In a grinding and mixing machine for treating a mixture of small particles and a liquid, the subcombination comprising a head having a tubular support thereon, said support extending outwardly and centrally from said head in combination with a dual control means mounted on said support, said support being externally screw threaded, said control means comprising an internally screw threaded cap member, an internal cylindrical sleeve and a bearing ring in alignment with said internal sleeve, a screw

threaded stem, a washer, a helical compression spring and a piston, said cap member being fitted over said threaded support and engaging said bearing ring, said threaded stem axially engaging said cap member and extending therethrough, said washer being swiveled on one end of said stem and located in said bearing ring, said sleeve extending through said head and having a flange thereon, said flange having ribs thereon, said piston being slidably fitted in said sleeve adjacent the flange of said sleeve, said spring being located in said sleeve and engaging both said washer and said piston and normally urging them apart, both said cap member and said stem being provided with handles extending radially therefrom, whereby adjustments may be easily and readily made by the operator of the machine.

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