Feb. 28, 1939. E. C. DE STUBNER 2,148,608

DISPERSION APPARATUS

Filed Nov. 20, 1936 4 Sheets-Sheet 1

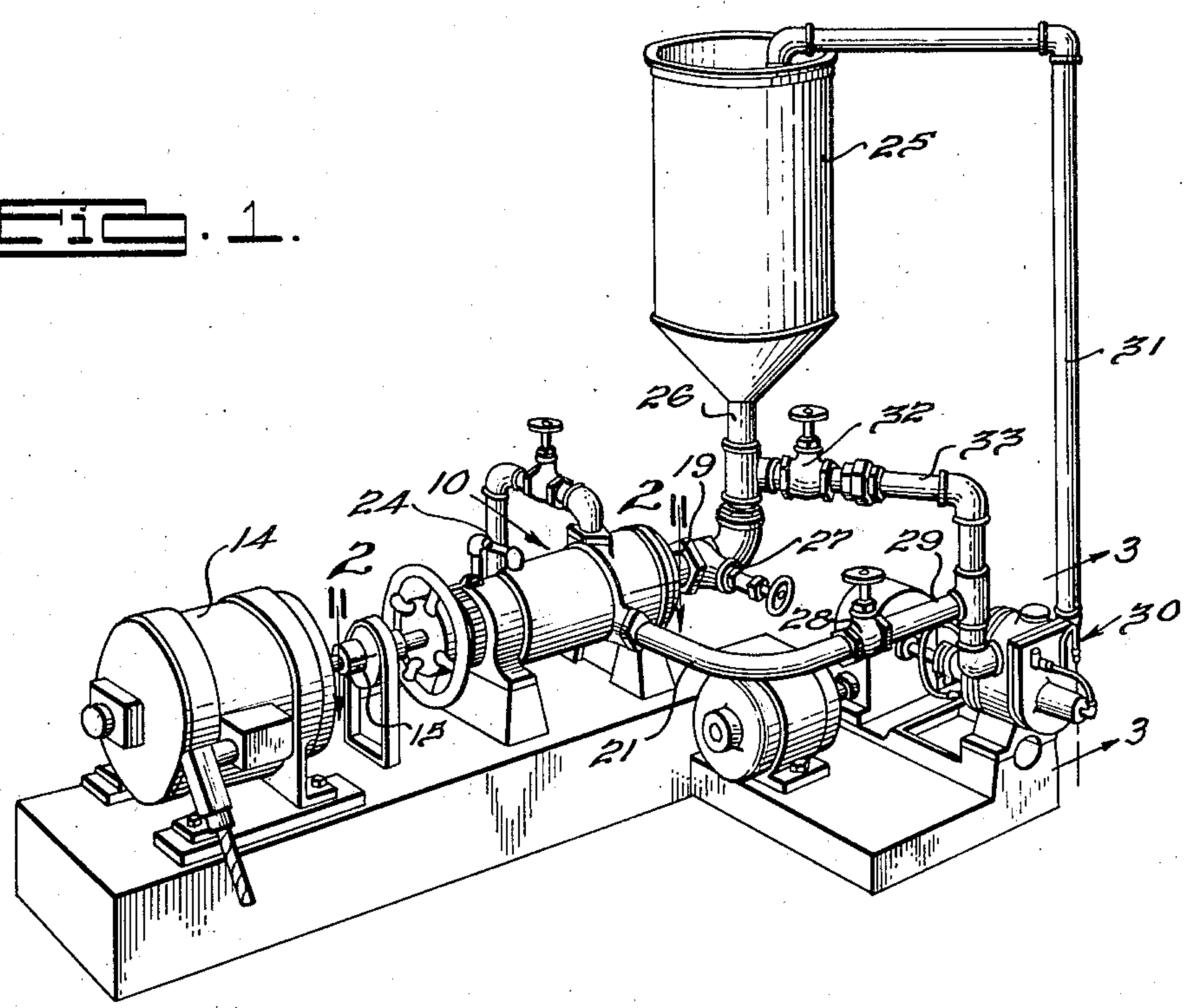

FIG. 1.

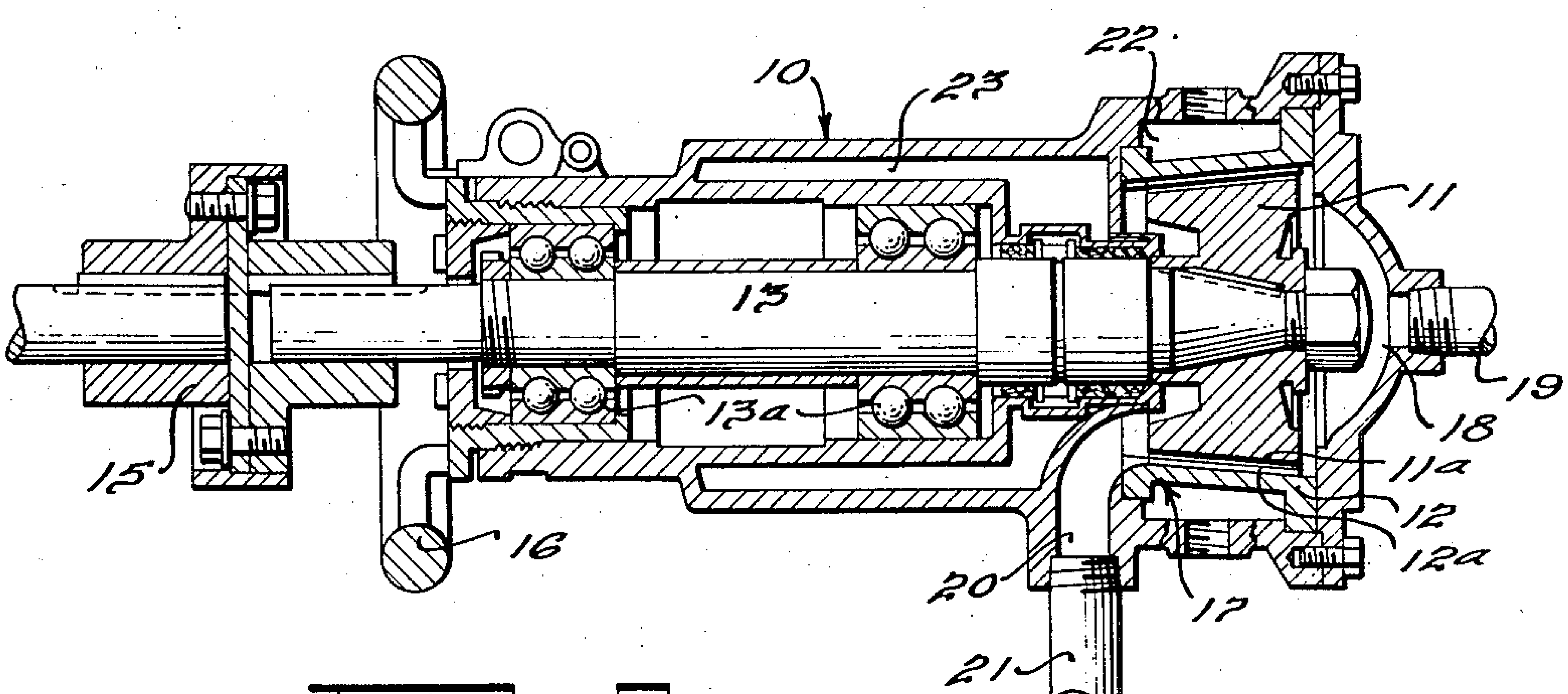

FIG. 2.

INVENTOR.
Emile C. de Stubner.
BY Duke, Calver and Gray
ATTORNEYS.

DISPERSION APPARATUS

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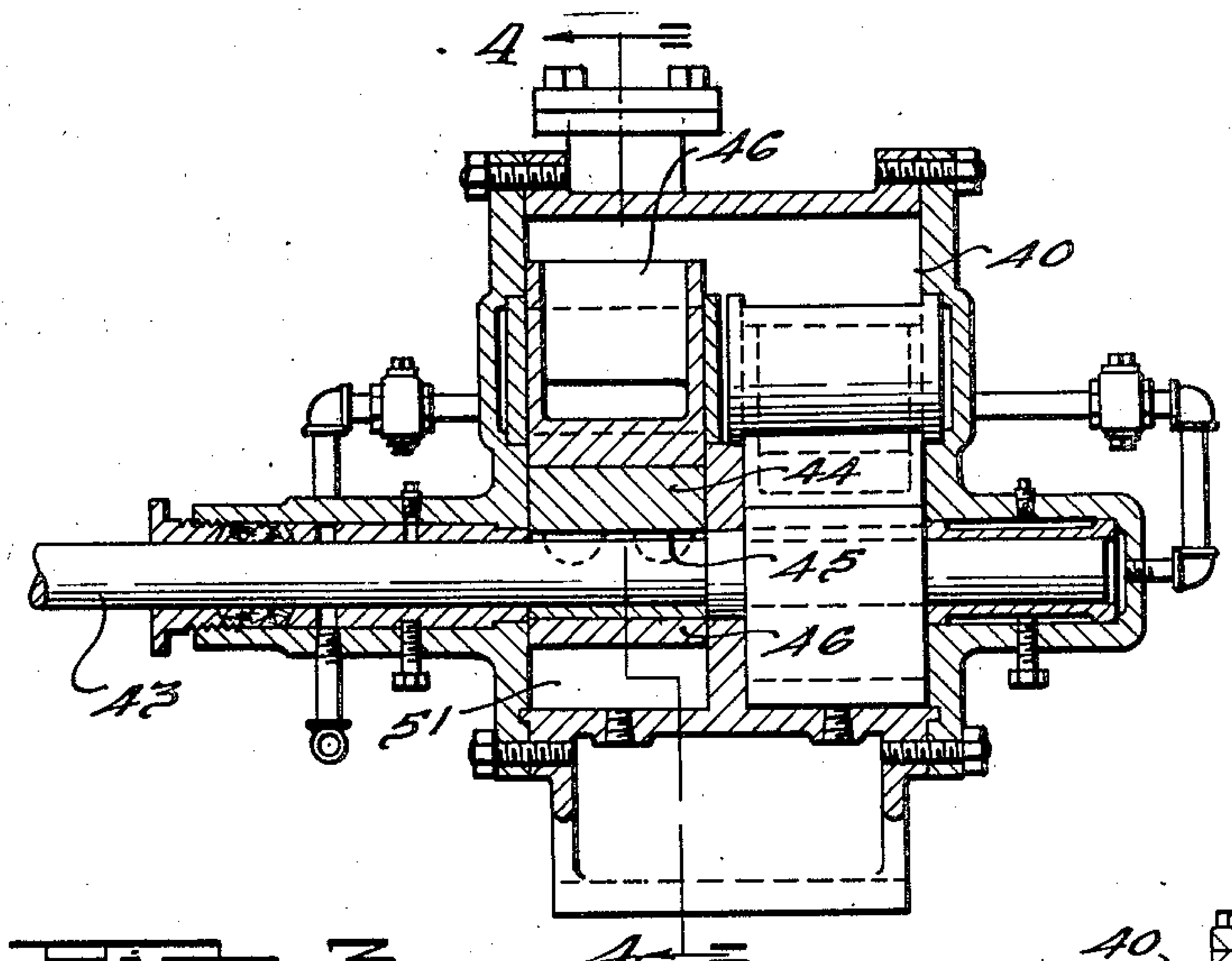


FIG. 3.

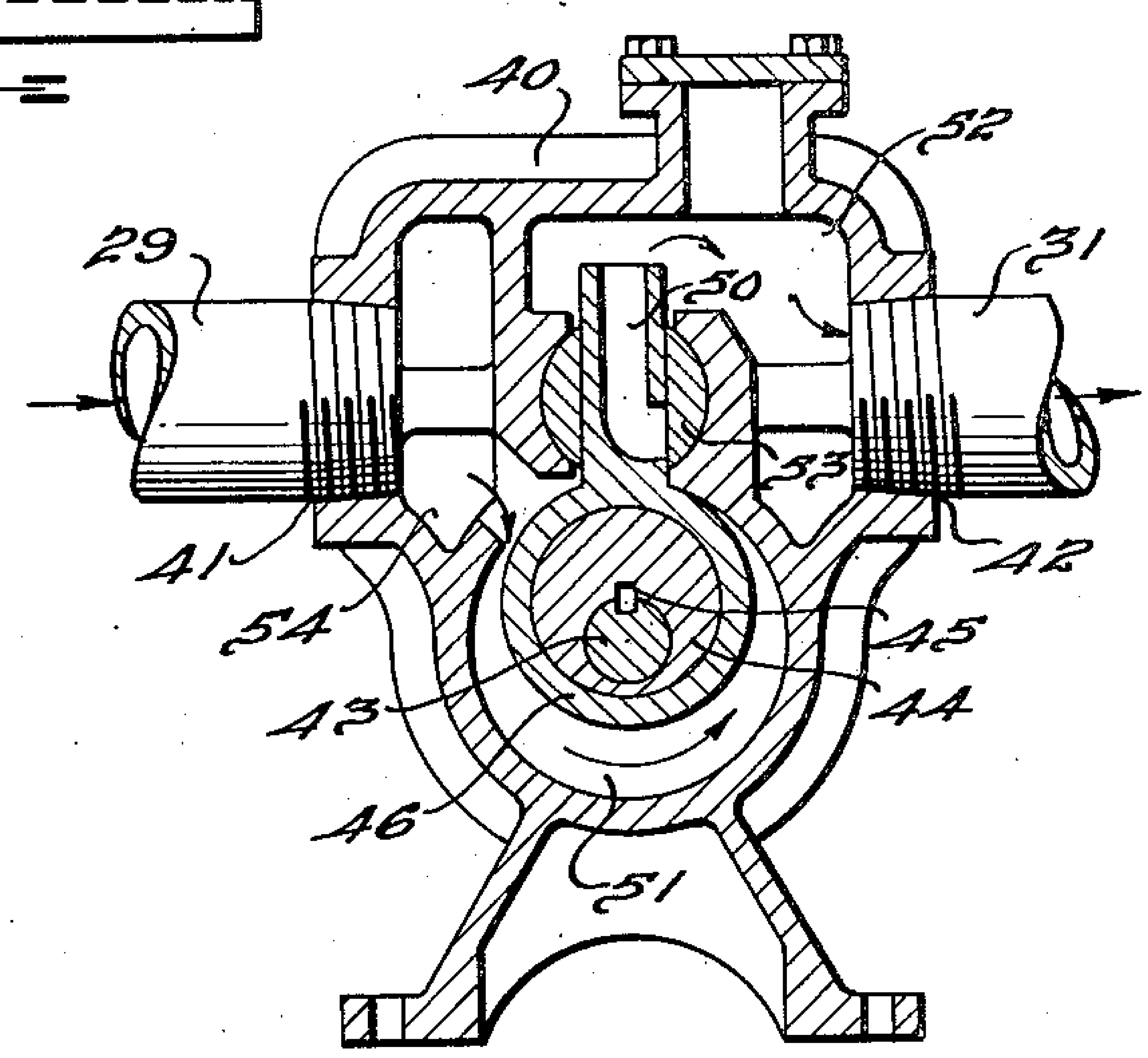
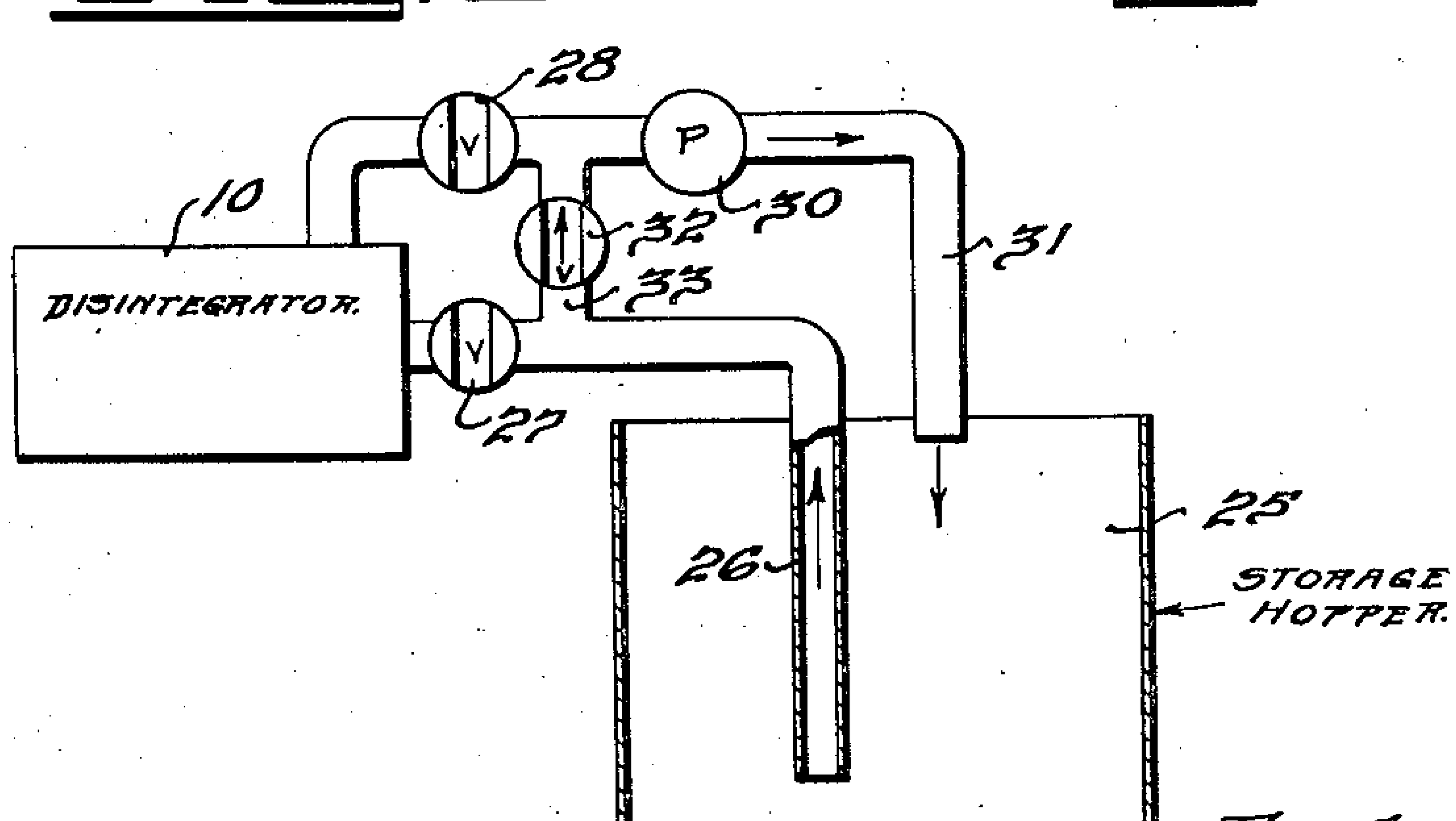


FIG. 4.

FIG. 5.



INVENTOR.
Emile C. de Stubner.
BY
Dike, Calver and Gray
ATTORNEYS.

Feb. 28, 1939. E. C. DE STUBNER 2,148,608

DISPERSION APPARATUS

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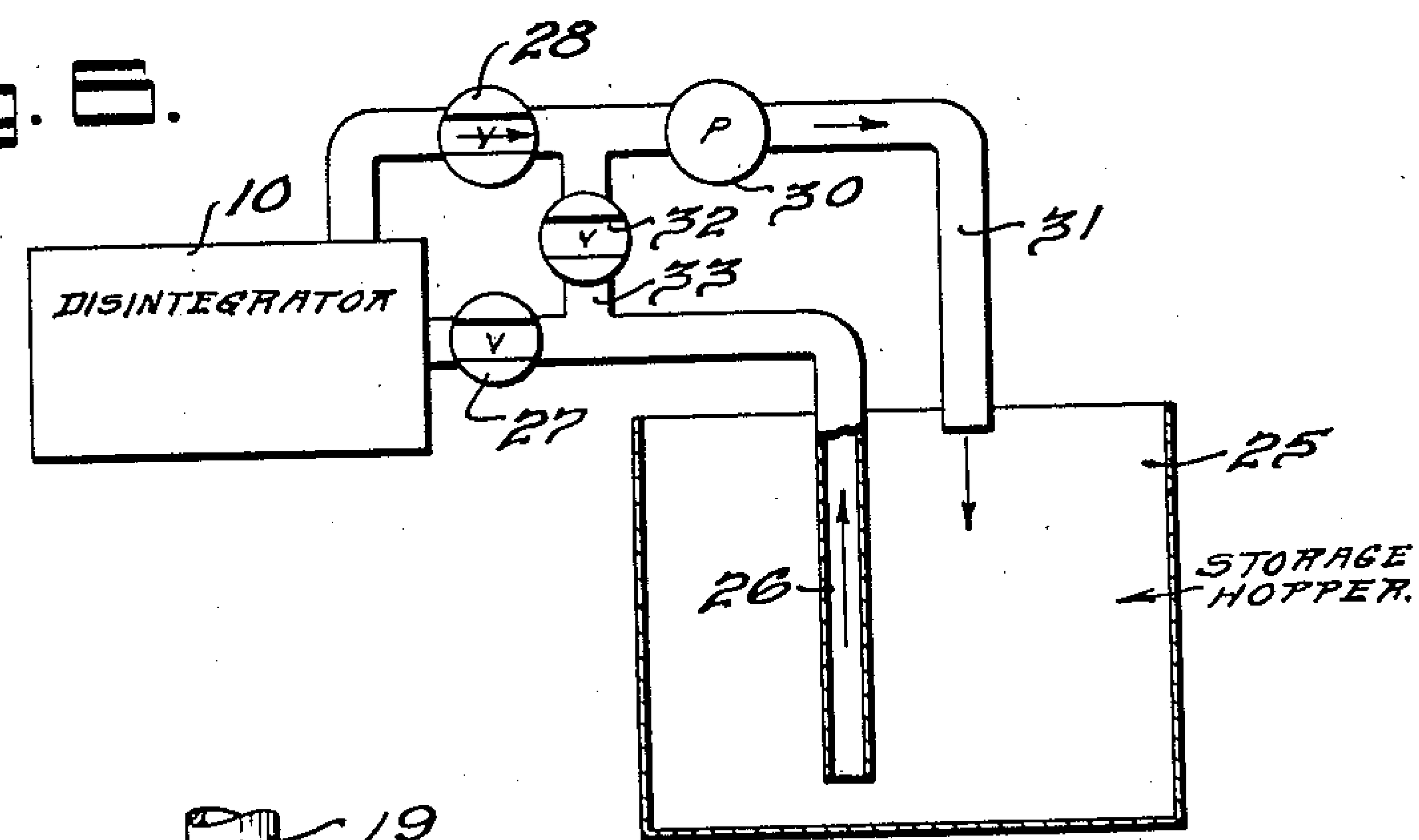
FIG. 6.



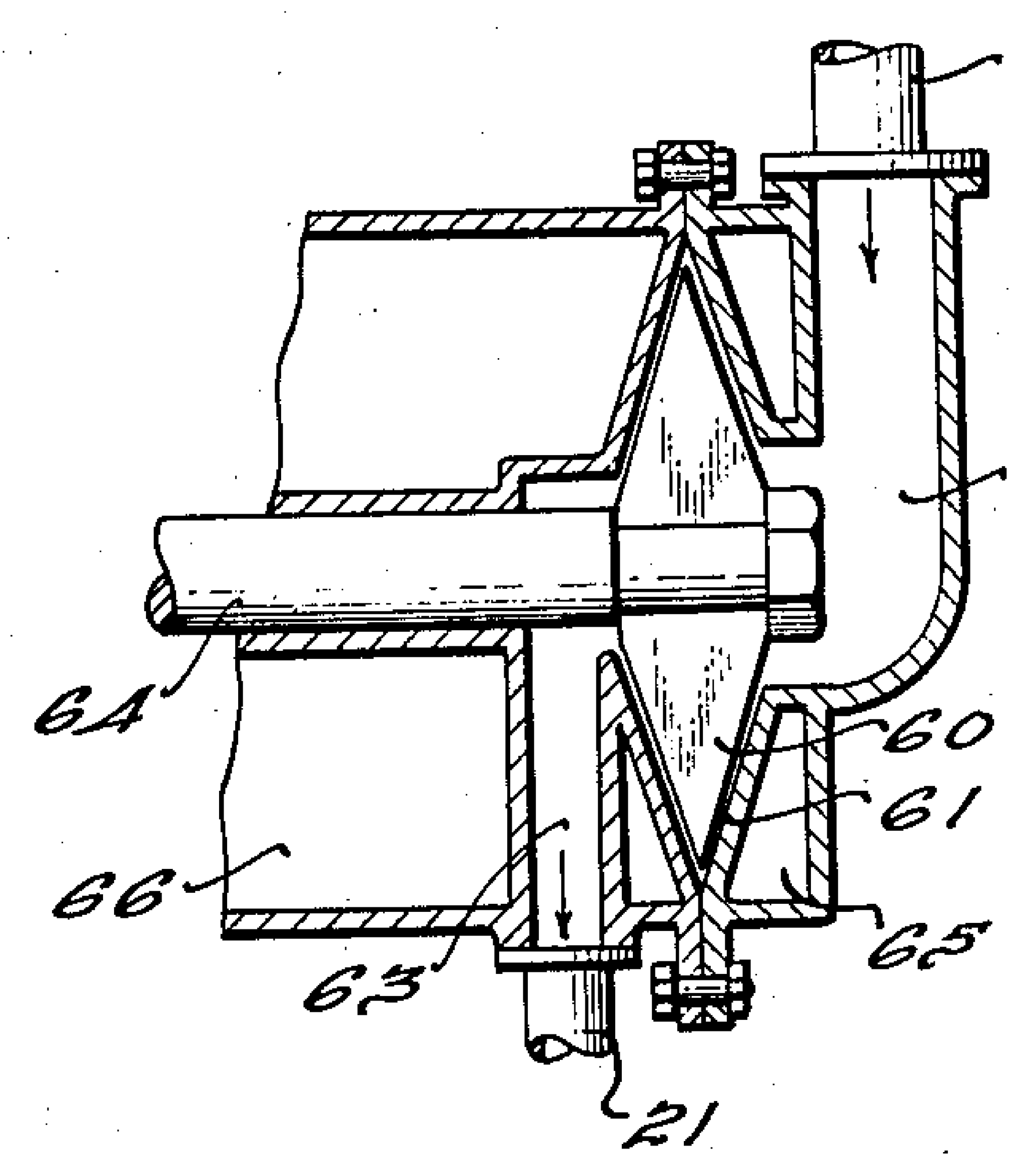
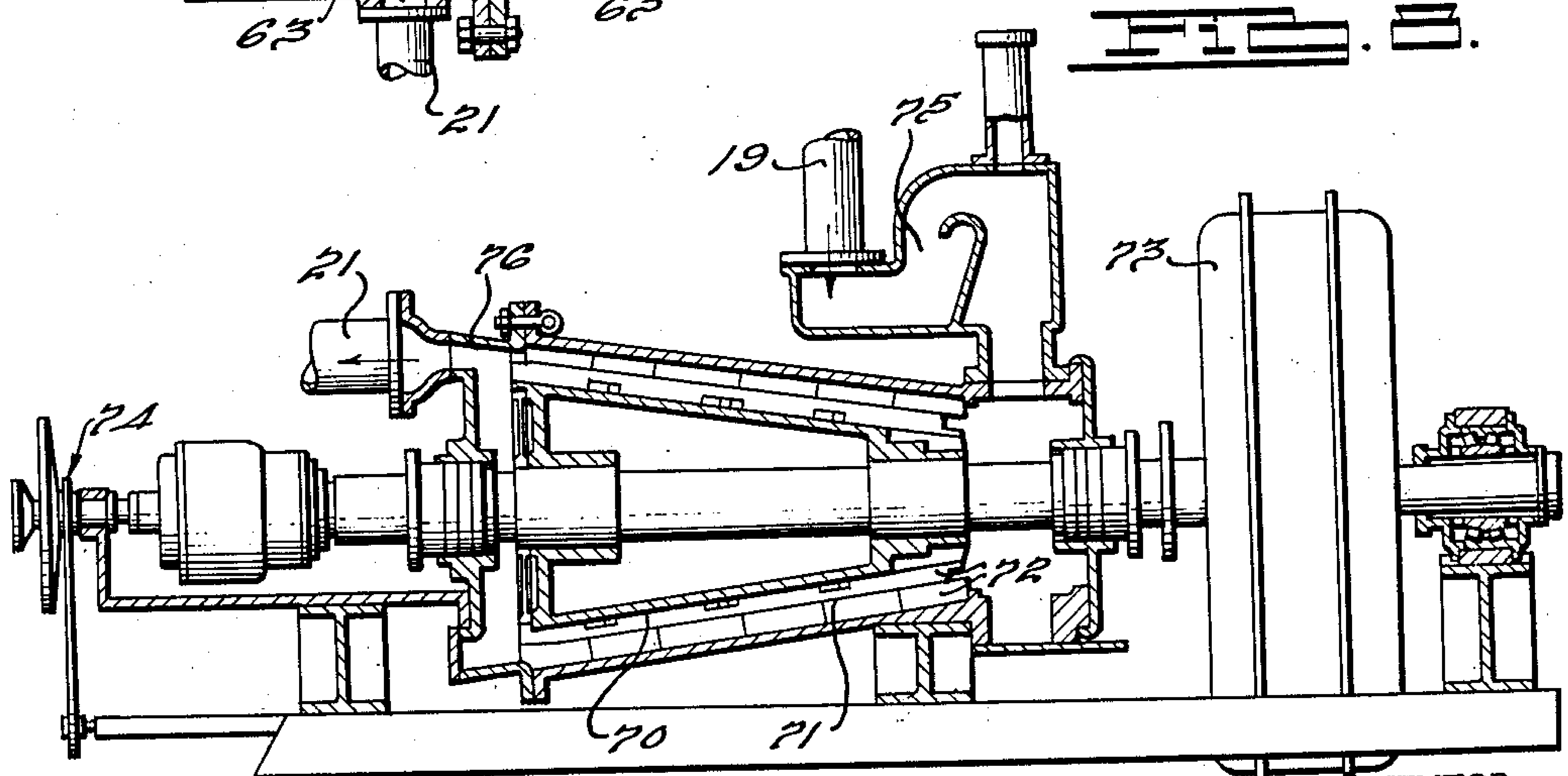


FIG. 7.

FIG. 8.



INVENTOR.

Emile C. de Stubner.

BY Dike, Calver and Gray

ATTORNEYS.

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DISPERSION APPARATUS

Filed Nov. 20, 1936 4 Sheets-Sheet 4

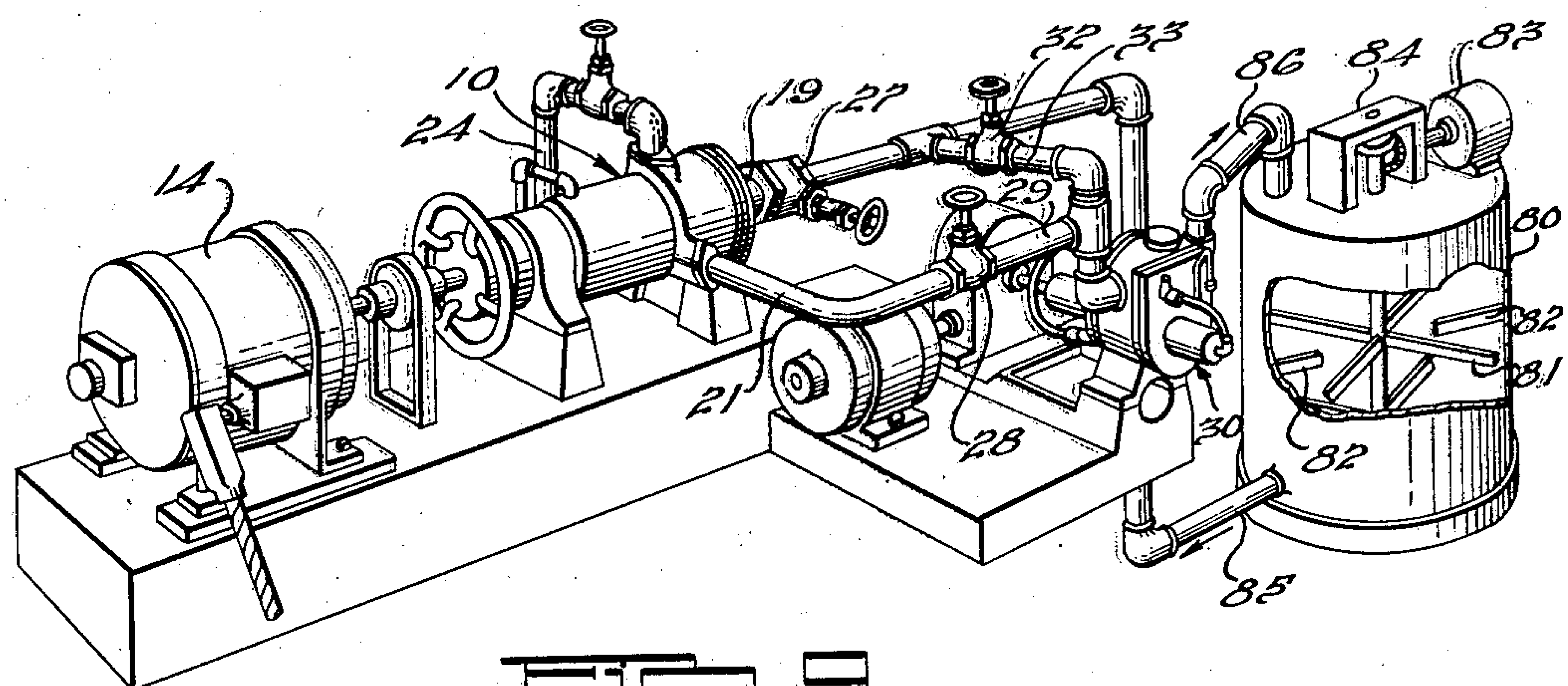

FIG. 9.

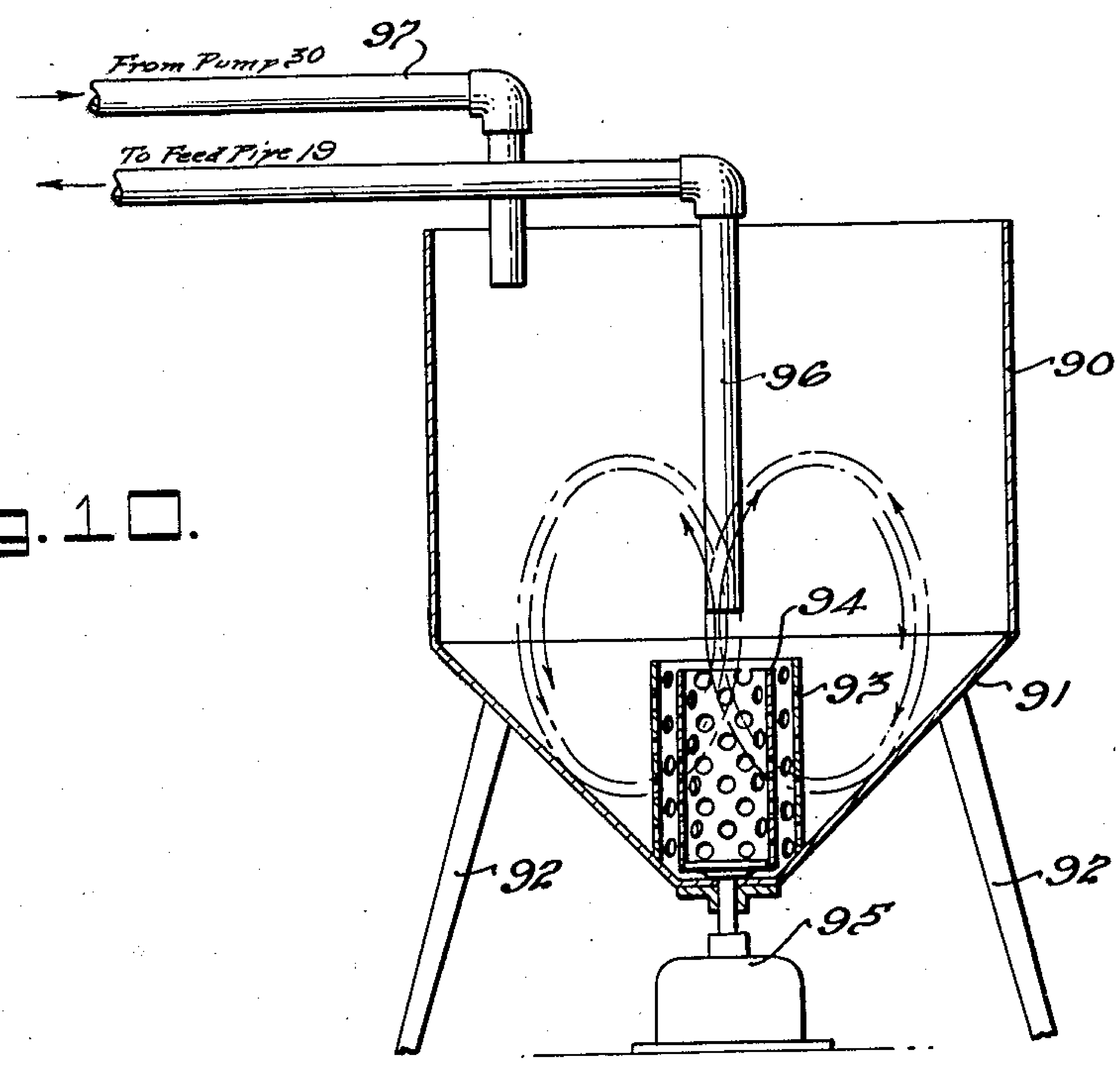

FIG. 10.

INVENTOR.

Emile C. de Stubner.

BY Dike, Calver and Gray

ATTORNEYS.

Patented Feb. 28, 1939

2,148,608

UNITED STATES PATENT OFFICE

2,148,608

DISPERSION APPARATUS

Emile C. de Stubner, Charleston, W. Va.

Application November 20, 1936, Serial No. 111,853

2 Claims. (Cl. 83—93)

The present invention relates to a dispersion apparatus, and particularly to such apparatus which may be utilized for the formation or stabilization of emulsions or suspensions, for the blending either of colors or of flavors with masses to be colored or flavored, for the improvement of textures of materials passed therethrough, for the disintegration and dispersion of solids in liquid or plastic mediums, for the grinding and extraction of fibrous materials, or for other like or similar purposes.

In a preferred embodiment of the invention herein disclosed by way of example, and hereinafter referred to as a "transperser", a member in the nature of a colloid mill is employed as one unit thereof. Such a mill is preferably of the rotating type and comprises in general a rotary member, hereinafter termed the "rotor", mounted for rotation within a fixed or stationary member, hereinafter termed the "stator". Upon rotation of the rotor relative to the stator, materials fed to the space between such members are subjected to shearing and other stresses as may be required to accomplish the desired processing thereof. In other of such mills a plurality of rotor members may be employed.

In part, the present invention provides a method of increasing the efficiency of such a member and the production of superior results therefrom by providing means for operating such a member under a diminished atmospheric pressure, i. e. a partial vacuum.

In using rotary disintegrating members of which a colloid mill is an example, the rotor speed is an important factor in the satisfactory operation thereof. In using such devices there frequently is a reduction in rotor speed of as much as 50% when the material to be processed is introduced into the spaces between the rotor and the stator, which space is hereinafter referred to as the disintegrating chamber. In using such devices, particularly where the rotors are intended for operation at high rotor speeds, this reduction of rotor speed is very serious and greatly impairs the efficiency of the machine and the satisfactory nature of its operation. Variable rotor speeds due to load conditions in the machine also cause considerable variation in the quality of the product processed thereby. Mills which may be used satisfactorily as a unit of the transperser of this invention may have rotor speeds as high as approximately 6000 to 7000 R. P. M. or higher, or such speeds may be approximately 3600 R. P. M., depending on the design and construction of the particular mill selected.

Some of the reasons for variations in the rotor speed are (1) internal friction of the material in the disintegrating chamber; (2) inertia of the processed mass and back pressure on the discharge side of the chamber; and (3) variations in quantity and character of the materials fed to the inlet of the machine.

In conventional types of such disintegrating equipment the power utilized in driving the rotor is also utilized to convey the materials to be acted upon to the disintegrating chamber and to carry away the processed mass of such materials after their passage between the rotor and the stator. This utilization of the same power source for both conveying the materials and for operation of the rotor requires under certain circumstances excessive power application on the rotor so that the rotor tends to "race" without properly acting on the materials to be processed. Under other load conditions so much of the power is absorbed in conveying the materials that sufficient power is not available to cause the rotor to operate at the required speed to produce the desired result.

Under certain conditions, the materials to be processed are a mass which is not of uniform consistency, density or size. The power requirements to convey such materials, therefore, will vary considerably. Also, the load imposed on the rotor will vary with variations in the consistency, density or size of the materials to be processed.

In processing many types of materials in such devices, gas pressures also may be built up within the disintegrating chamber and such pressures are undesirable and may lead to unsatisfactory results in the finished product, due undoubtedly to variations of pressures in the chamber causing variations in rotor speeds.

In certain uses of such equipment it is also desirable to reduce oxidation in the chamber of the materials being processed. The present invention in one of its aspects makes possible the control of such oxidation reactions occurring within the disintegrating chamber.

It is, therefore, an object of the present invention to provide a method of creating dispersions or similar states of matter under reduced atmospheric pressures.

A further object of the invention is to provide a device for creating dispersions or similar states of matter wherein a rotor member is employed and wherein the rotor speeds are maintained under varying load conditions with a greater degree of uniformity than is possible with presently known devices of this type.

Another object of the invention is to provide a device utilizing a rotor member for creating dispersions or similar states of matter and wherein a substantially uniform flow of pre-mixed materials to be further processed is effected.

Another object of the invention is to provide a device for creating dispersions or similar states of matter in which back pressures occurring within the disintegrating chamber are reduced.

Another object of the invention is to provide a device for creating dispersions or similar states of matter in which a power source, subject to separate control, performs the function of material handling and another power source also independently controlled drives the disintegrating device within the disintegrating chamber.

Another object of the invention is to provide a device for creating dispersions or similar states of matter in which a rotor and a stator are utilized and wherein heating of the materials in the disintegrating chamber is reduced.

Another object of the invention is to provide a device for creating dispersions or similar states of matter by utilizing a rotor moving within a stator in a chamber under reduced atmospheric pressures whereby pressures within the chamber are controlled and gases or vapors generated by processing of the materials in the disintegrating chamber are continuously removed therefrom.

Another object of the present invention is to provide a method of creating dispersions or similar states of matter and apparatus for use with such method whereby there is assured a controlled flow to the processing chamber of the materials to be processed in the state of a preliminary admixture of predetermined and controlled flow characteristics.

Other objects and advantages of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein a preferred embodiment of the present invention is illustrated.

In the drawings, wherein like reference characters designate corresponding parts in the several views,

Fig. 1 is a view in perspective of a device embodying the present invention;

Fig. 2 is a fragmentary section of a form of the disintegrating equipment shown in Fig. 1 taken substantially on the line 2—2 of Fig. 1 in the direction of the arrows;

Fig. 3 is a fragmentary section of the conveying and vacuum creating pump taken substantially on the line 3—3 of Fig. 1 in the direction of the arrows;

Fig. 4 is a sectional view taken substantially on the line 4—4 of Fig. 3 in the direction of the arrows;

Figs. 5 and 6 are diagrammatic views illustrating the first and second stages respectively, of a dispersion method embodying the present invention;

Figs. 7 and 8 are fragmentary sectional views of modified types of disintegrating equipment which may be used in carrying out the present invention;

Fig. 9 is a view in perspective having a part broken away showing a device similar to that shown in Fig. 1 but having a modified form of material chamber and a modified form of connection therewith; and

Fig. 10 is a fragmentary sectional view of a modified type of material chamber adapted for use with a device embodying the present invention.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and that it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

Referring to the drawings and particularly to Fig. 1, a preferred form of device embodying the present invention comprises a disintegrating device indicated generally by the numeral 10 which may be of any type of colloid mill, Jordan engine, emulsifier, homogenizer, or similar equipment, which may include a rotor 11 and a stator 12 (Fig. 2). The details of construction of the device 10 do not form a part of the present invention and therefore the invention is not to be limited thereto. In place of a single rotor as here shown, a plurality of rotors may be utilized, and such rotors may be smooth surfaced or grooved, and may rotate in a stator or not.

In the particular embodiment here shown the rotor 11 is surrounded by and revolves within the stator 12 and both the rotor 11 and the stator 12 are provided with grooved portions 11*a* and 12*a* on adjacent mating surfaces. The rotor 11 is fixed to a power driven rotary shaft 13 mounted on bearings 13*a* and is suitably coupled with a source of power 14. In the embodiment here shown the shaft 13 is directly coupled with an electric motor through a flexible coupling 15 of any preferred type. In other instances the rotor is connected with the source of power through suitable gear mechanisms.

The adjustment of the rotor 11 relative to the stator 12 may be effected by an adjusting member 16 which is movable longitudinally of the device so as to increase or decrease the spacing between the adjacent mating surfaces of the rotor 11 and the stator 12. This adjustment permits control of the device for operation for various purposes and for effecting various changes in the individual particle sizes of the materials being processed. Various types of adjustments are provided in various types of devices which may be utilized in carrying out the present invention.

The rotor 11 and the stator 12 operate in what is herein termed the disintegrating chamber, which is designated generally by the numeral 17. The disintegrating chamber 17 communicates with an inlet port 18 to which is suitably connected an inlet conduit 19. A discharge port 20 communicates with the disintegrating chamber 17 and connects with a discharging conduit 21. The rotor 11 and the stator 12 are interposed in the chamber 17 between the inlet port 18 and the discharge port 20 so that materials flowing from the inlet port 18 will pass between the rotor and the stator before passing to the discharge port 20.

In order to insure the maintenance of proper temperatures within the disintegrating chamber 17, a jacketed portion 22 may be provided through which may be circulated either a heating fluid or a cooling fluid as may be desired. A jacketed housing 23 is also provided surrounding the shaft 13 through which a suitable cooling medium may be circulated to carry away the heat of friction due to operation of the shaft 13.

The circulating medium may be fed into the housing 23 through a conduit 24 (Fig. 1) and may be continuously withdrawn from the jacket through suitable conduits (not shown). Materials to be processed may be supplied to the disintegrating chamber 17 through the conduit 19 (Fig. 1) as from a hopper 25 or other storage chamber which is suitably connected with the conduit 19 through a conduit 26 and a valve portion 27.

The discharge conduit 21 is connected through a valve 28 and a conduit 29 with the suction side of a pump 30. On the discharge side of the pump 30 a conduit 31 communicates with the hopper 25. A by-pass is provided between the hopper 25 and the pump 30, this by-pass comprising a valve 32 and a conduit 33 which connects with the suction side of the pump 30.

Any preferred type of pump capable of creating the desired amount of suction may be used as the pump 30. One type which I have found to be satisfactory is a rotary plunger type of pump as shown in greater detail in Figs. 3 and 4. Such a pump comprises a cylinder casting 40 provided with openings 41 and 42 on the suction and discharge sides respectively of the piston 46. A drive shaft 43 serves to operate the pump and a cam or eccentric 44 is secured thereon as by the key 45. A rotating piston member 46 is connected with the cam or eccentric 44 and is driven thereby.

In the embodiment here shown by way of example, two of the rotating pistons 46 are provided. The pistons 46 each have a sliding valve portion 50 which serves as a conduit between the chamber 51 and the upper chamber 52. Upon rotation of the shaft 43 the pistons 46 slide in the slide valve 53 and due to the motion of the cam or eccentric 44, a portion of the piston 46 contacts with a portion of the wall of the chamber 51 and serves to compress the material ahead of the piston and to exert a force on the material causing it to flow through the conduit 50 when it reaches a point where the intake opening therein communicates with the chamber 51. During this motion a suction is created in the suction chamber 54 to which the conduit 29 is connected.

While the pump which has just been described is generally known as a rotating plunger type of suction pump, any other suitable type of pump may be employed which has both a suction and discharge opening therein and I do not desire to be limited by the foregoing description to the use of any particular type of pump in connection with the invention herein described and claimed.

In place of the disintegrating equipment previously described, I may utilize in a modification the type of disintegrator shown in Fig. 7 which will connect with the inlet conduit 19 and the discharge conduit 21 and which comprises a rotor 60 and a stator 61 interposed between the inlet chamber 62 and the discharge chamber 63, the rotor being mounted on the shaft 64 and being power driven. The chamber in which the rotor and stator are mounted is surrounded with jacketed portions 65 and 66 through which may circulate any suitable type of fluid heat controlling medium. In some instances this will be for the purpose of cooling the device and in other instances for the purpose of heating the material passing therethrough. In using the modified device shown in Fig. 7 the inlet conduit 19 is connected with the inlet chamber 62 and materials to be processed by the disintegrator are fed therethrough. The suction side of the pump 30 is connected through suitable conduits with the discharge conduit 21 which communicates with the discharge chamber.

In the modification shown in Fig. 8 the disintegrator which is employed may be of the type known in the paper industry as a "Jordan engine". Such a device includes a rotary plug 70 and a stationary shell 71, both of which are provided with disintegrating knives 72. The plug 70 is driven by a suitable motor 73 and the clearance between the plug 70 and the shell 71 is controlled by the adjusting mechanism indicated generally by the numeral 74.

The material to be processed is fed in through the inlet conduit 19 to an inlet chamber 75. The material then passes between the knives 72 carried by the shell 71 and the plug 70 and is discharged into the discharge chamber 76 and then is carried away through the discharge conduit 21 connected with the suction side of the pump 30.

While I have illustrated and described generally three different types of disintegrating devices which may be used in connection with the present invention, the invention is not limited to any particular type of such devices nor, as previously stated, is it limited to any particular type of pump equipment. My invention, therefore, is not limited to any particular structures either of the disintegrator or of the pump equipment.

In certain instances it may be desirable to provide for agitating and admixing the materials in the feed tank or chamber. Two types of devices adapted for this purpose are shown in Figs. 9 and 10. In Fig. 9 the device is of the type known generally as a "pony mixer" in the paint and allied industries and may comprise a tank 80 in which a suitable agitating or stirring device is provided, such for example as the power driven arms or rakes 81. Stationary arms 82 may be secured inside the tank 80 and extend between the power driven arms or rakes 81 to break up the circular flow of the materials inside the tank 80. The arms or rakes 81 are driven by a suitable power source 83 and power transmission device 84. In this instance, the feed line 19 is connected through the valve 27 with a supply line 85 which terminates inside the tank 80 and at a point adjacent the bottom thereof. This permits constant withdrawal from the tank 80 of the heavier portions of the materials therein which drop into the lower levels in the tank 80. The suction exerted on the line 85 through the disintegrating device 10 by the pump 30 is sufficient in the normal case to raise the materials from the lower levels of the tank 80 to the higher level of the feed inlet 19.

The materials after passing through the disintegrator 10 are returned to the tank 80 through the pipe 86, which terminates at a point adjacent the top thereof.

If desired, instead of the feed tank or chamber shown in Fig. 9, a modified form as shown in Fig. 10 may be employed. This device is of the type known commercially as a "Vissolver" and comprises a tank 90 having a conical or hopper-shaped bottom 91. Suitable supports 92 maintain the tank in an upright position so that materials fed into the tank drop or flow into the bottom 91. In the bottom portion 91 a stationary baffle element 93 is provided, which in the instance here shown is formed of a perforated metal sheet. Inside the baffle element 93 a rotary member 94 is provided, which in this instance is also formed of perforated sheet metal. The rotary member 94 is power driven from a suitable power source such as the motor 95. Upon rotation of the member 94, the material in the bottom 91 will flow through the baffle member 93 and be subjected to working and shearing between the baffle 93 and the rotary member 94. The material then flows through the member 94 and is discharged upwardly through the open top thereof. By this action, the materials inside the tank 90 are constantly circulated in the direction indicated diagrammatically by the direction of the arrows. The feed pipe 19 of the device 10 is connected in this instance with supply pipe 96 which draws materials from a point adjacent the top of the member 94. Materials which have passed through the device 10 are discharged through the pipe 97 which communicates with the discharge port of the pump 30 and discharges within the tank 90 at a point adjacent the top and at one side thereof.

A method embodying the present invention and adapted for use with any suitable kind of the previously described classes of equipment is shown best by the diagrammatic sketches of Figs. 5 and 6. In Fig. 5 is shown the method of the present invention during the first stage of its operation for the purpose of creating a preliminary admixture of the materials to be processed. The materials to be processed are charged into the storage hopper 25, which may be in any desired plane relative to the plane of the disintegrator. The materials are drawn from the hopper 25 through the feeding conduit 26. The valves 27 and 28 are in the closed position as shown in this sketch and the disintegrator 10 is not utilized in this stage of the operation. During this stage of the method, the valve 32 is open so that the by-pass 33 is open and the charged materials flowing from the feeding hopper pass through the by-pass 33 and the valve 32 to the suction side of the pump 30. The action of the pump 30 then serves to create a further preliminary admixture of the materials charged in the hopper and to return such admixture continuously through the conduit 31 to the hopper. This flow of materials is indicated by the arrows in Fig. 5 and may be continued as a continuous cycle until such time as the materials have attained the state of a satisfactory preliminary admixture. This stage of the process actually produces a preliminary admixture of the materials whose fluidity or flow characteristics can be thus definitely controlled. This produces a substantially uniform mix of the materials which are subsequently to be acted upon by the disintegrating equipment. During this stage of the operation the only part of the equipment which is operating is that of the conveying devices which in this use create the desired preliminary admixture of the charged materials. In this manner there is assured a uniformity of flow of pre-mixed materials to the disintegrating equipment.

In Fig. 6 the second step of the method is shown. Here the valve 32 is closed so that the by-pass 33 no longer acts to convey the materials to the pump 30. The materials from the hopper 25 are now in the condition of preliminarily admixed bodies of predetermined fluidity or flow characteristics so that when the valves 27 and 28 are opened the material is drawn from the storage hupper 25 through the conduit 26 and then through the disintegrator 10. The disintegrator 10 is connected with the suction side of the pump 30 through the discharge conduit 21, so that the difference in pressures in the hopper 25 and in the disintegrator 10 causes the materials to flow through the disintegrator and be discharged through the discharge conduit 21 without substantial demands on the power on the rotor. The materials then flow through the valve 28 to the pump 30, from which they are returned continuously through the conduit 31 to the feeding hopper 25. The materials may be circulated through the disintegrating equipment as many times as is desired for the purpose of completing the processing of the materials and adjustments can be made in the disintegrator to secure successively greater action on the materials. During this operation the pump 30 thus is acting not only to convey the materials from the feeding hopper through the disintegrator but also to convey the processed materials from the disintegrator to the feeding hopper. Also, during this time a suction is being created by the pump 30 in the disintegrator so that the operation of the disintegrator on the materials passing therethrough is carried out while a diminished atmospheric pressure is maintained therein.

From the foregoing it is obvious that the combination of the conveying system with the disintegrator will achieve a desirable result in the operation of the disintegrator since it eliminates a great deal of load from the power source of the disintegrator due to the conveying of the materials to be processed and of the finished materials through the pump 30. Also, a superior operation is assured because of the provision of the pump 30 and the cycle of operation shown diagrammatically in Fig. 5 wherein the pump acts to form a preliminary uniform admixture of the raw materials having controlled flow characteristics. Also, in the event any gas or vapor is created in the disintegrator, such gas or vapor is continuously carried away by operation of the pump 30.

The processed materials may be returned to the hopper 25 and stored, or if desired the materials can be discharged directly into containers or other packages therefor.

It is known that the action of a disintegrating device as herein described imparts high speed rotary movements to the individual particles in the materials being processed. In the case of dispersions of finely divided solids in fluid dispersion mediums, it is my belief that centrifugal forces are built up in the solid particles which tend to throw the particles from the dispersion and thus tend to counteract the action of the disintegrating device in stabilizing the dispersion. I have found that the action of the pump 30 on the mass passing from the disintegrator exerts compression forces on the mass which neutralizes the centrifugal forces in the solid particles and stabilizes the dispersion to a considerable extent.

The present invention is particularly useful in creating or stabilizing dispersions of finely divided solid particles in fluid dispersion mediums, such for example as dispersions of pigment in paints, varnishes, lacquers, printing inks, and the like, as well as in other types of manufacturing wherein dispersions, emulsions, and homogenized masses are produced from the component ingredients. Such ingredients may be charged in the hopper and the preliminary admixture is created either in the hopper, as shown in Figs. 9 and 10, or by the operation of the pump 30 in circulating and admixing the materials.

It is to be understood that the method herein disclosed may be operated in accordance with production manufacturing conditions, in which event the relative sizes of the constituent units of the device herein disclosed will differ from those shown in the drawings. For example, the unit designated as the storage hopper may be of room size to hold the required amounts of materials. It also is to be understood that the return line may be modified so as to discharge the finished product at any desired point.

In addition to the use of the device and method herein disclosed for the purposes and uses hereinbefore set forth, I have found that the device and method of this invention is very useful in carrying out processes wherein a uniform precipitation of a constituent element is desired. For example, nitrocellulose dissolved in acetone forms a solution which is circulated through the first stage of the operation herein set forth. In the disintegrating chamber of the disintegrator, water is introduced and when the nitrocellulose solution is passed through the disintegrator, the water in the disintegrating chamber precipitates the dissolved nitrocellulose. Since the mass then is directly acted upon by the disintegrator, the uniform precipitate form of the nitrocellulose is preserved. Instead of the nitrocellulose-acetone solution, an alcoholic-resin solution or a benzol-wax solution may be utilized. The resin or the wax may be precipitated from the solution by the addition of suitable precipitating agents to the solution in the disintegrating chamber.

Among the materials satisfactorily processed by this method are dispersions of carbon black or other finely divided solids into dispersion mediums of aqueous nature, waxes, oils, resins and synthetic plastic bodies. Also various types of emulsions may be formed and various materials may be homogenized or fibrous or pastic masses disintegrated and their individual solid particles reduced in size.

The term "disintegrator" or "disintegrating device" as used herein refers to any type of device wherein materials acted upon by the device are subjected to forces either to deform the individual particles thereof or to break up such particles or tear apart flocculates or agglomerates thereof. This includes the concept of devices for the reduction of coarser particles to finer particles but is not limited solely to such devices. Such devices may deform plastic masses without in a strict sense causing disintegration thereof. However, some disintegration of solid particles may result from deformation of plastic masses containing such particles. In the use of such devices for homogenization of mixtures, fluids, or stabilization of emulsions, the deformation of the masses may result in a change in size of the globules of the mixtures. In this instance there is no disintegration of solid particles but there is a disintegration of globular masses.

I claim:

1. In an apparatus for forming a uniform and stable dispersion from a mixture of finely divided solids and fluid media, the combination which comprises a feed tank, a centrifugally acting disintegrating device, and a vacuum pump of the rotary plunger type, said disintegrating device and pump each having an inlet port and a discharge port, a conduit connecting said tank with the inlet port of said disintegrating device, a conduit connecting the discharge port of said disintegrating device with the inlet port of said pump, a conduit connecting the discharge port of said pump and adapted to discharge materials into said tank, a by-pass connecting said first mentioned conduit and said pump, and control members associated with said conduits and said by-pass for regulating the flow of materials through said apparatus, said pump being capable of producing suction in said disintegrating device and having a reciprocating plunger element adapted to forcibly straighten the rotary path of movement of the particles of dispersed material as said material passes therethrough.

2. In an apparatus for forming a uniform and stable dispersion from a mixture of finely divided solids and fluid media, the combination which comprises a feed tank, a disintegrating device operatively connected with a source of power and a vacuum pump operatively connected with a separate source of power, said disintegrating device and said pump each having an inlet port and a discharge port, a conduit connecting said tank and the inlet port of said disintegrating device, a conduit connecting the discharge port of said disintegrating device and the suction port of said pump to permit said pump to create a controlled amount of suction in said disintegrating device, a conduit connecting the discharge port of said pump and said tank, a by-pass connecting said first mentioned conduit and said pump, and valve means for directing said mixture alternately into said by-pass and into said disintegrating device, said pump being capable of creating a mixture of uniform and predetermined flow characteristics when said mixture is directed by said valve means through said by-pass and having a reciprocating plunger element adapted to forcibly straighten the rotary path of movement of the particles of dispersed material emanating from said disintegrating device.

EMILE C. DE STUBNER.