

March 1, 1932.

A. H. ADAMS

1,847,159

EXTRACTOR

Filed Oct. 25, 1928

2 Sheets-Sheet 1

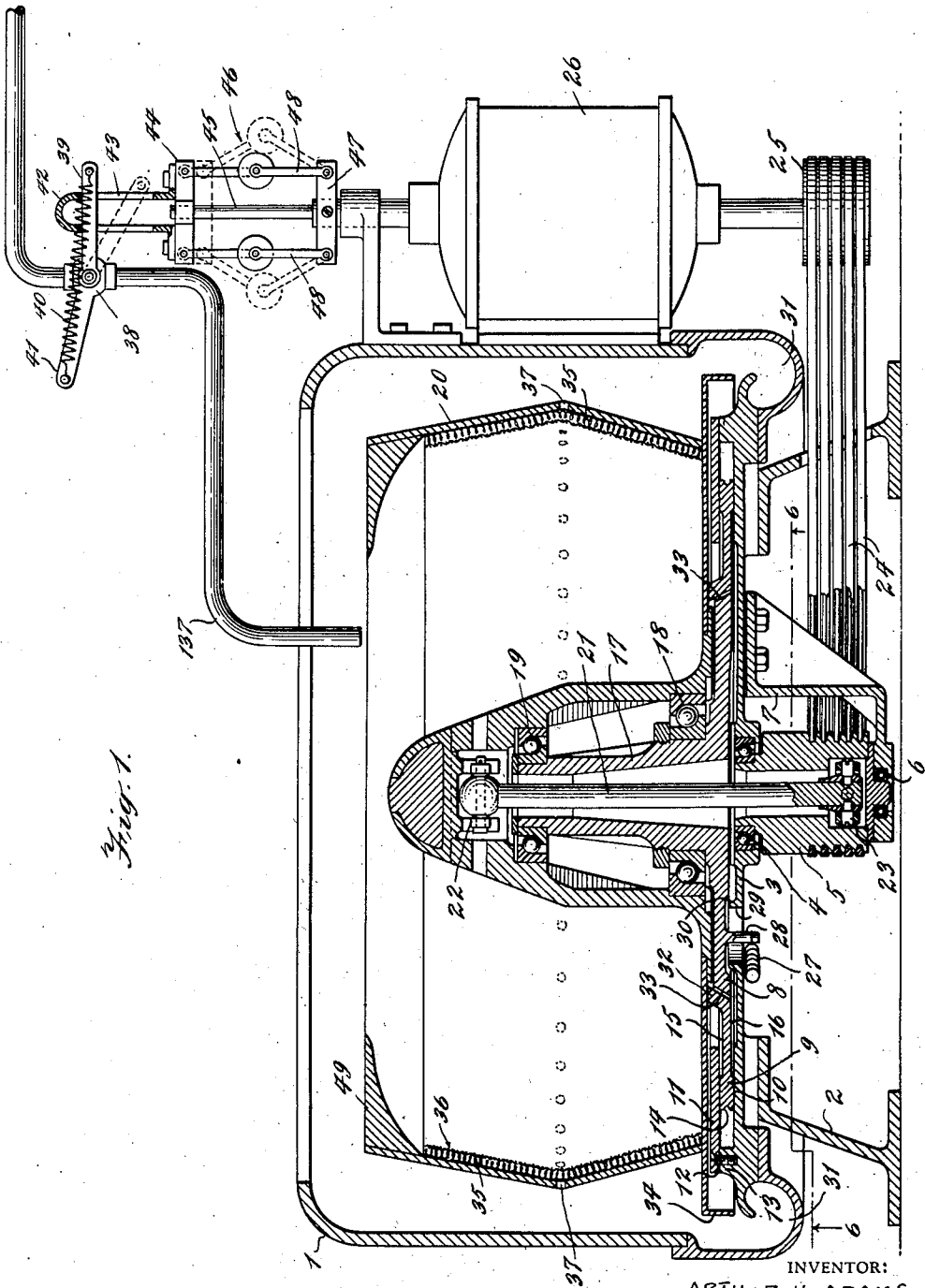


Fig. 1.

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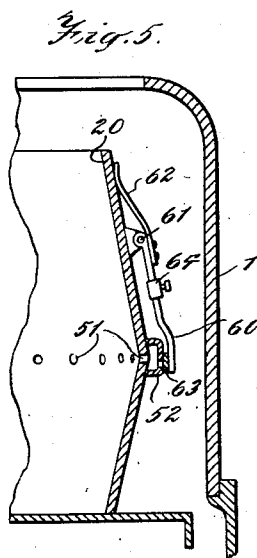
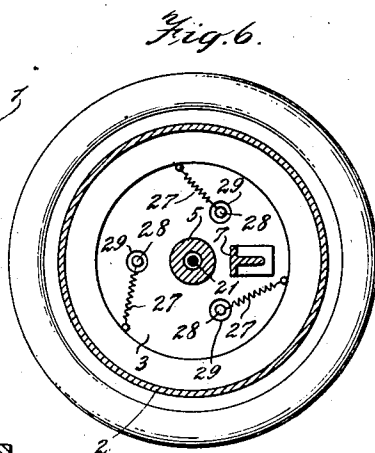
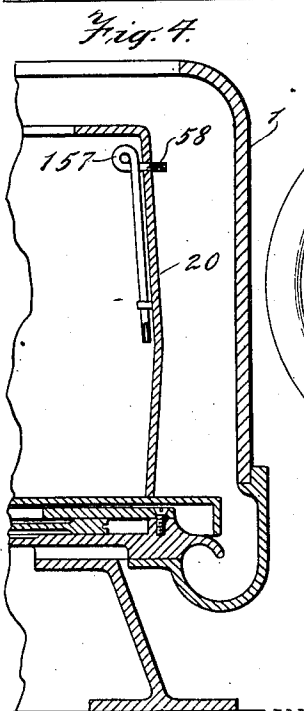
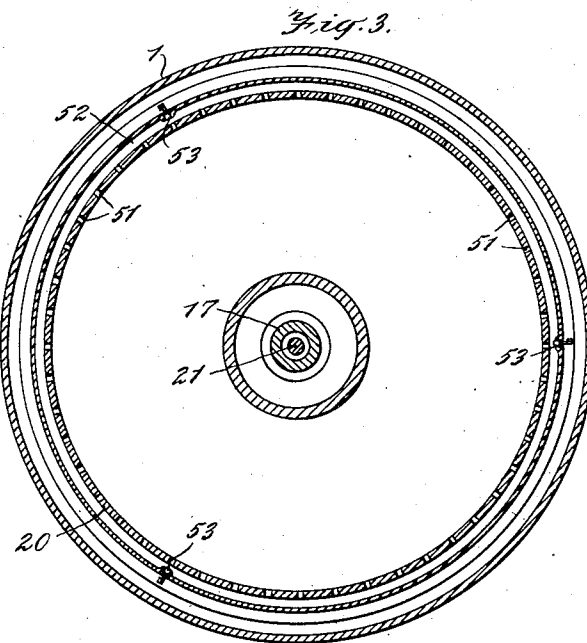
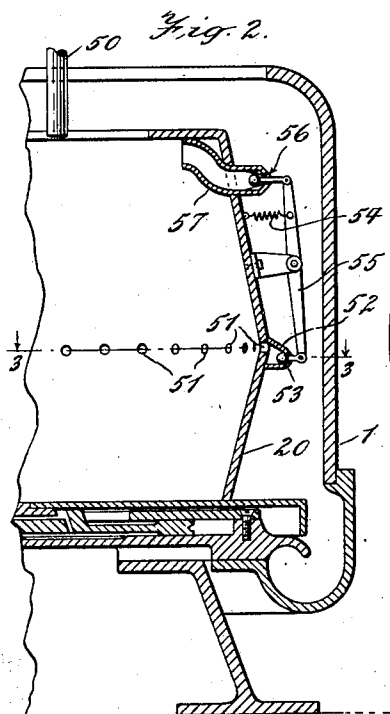
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EXTRACTOR

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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EXTRACTOR

Application filed October 25, 1928. Serial No. 314,921.

This invention relates to machines for centrifugally treating materials, especially to machines for centrifugally extracting fluid from fibrous material such as clothes.

5 An object of the invention is to provide an improved method and apparatus for balancing centrifugal extractor baskets.

Another object is the provision of a method of extracting fluid from a fibrous mass, 10 whereby the time of extracting is lessened and the draining of fluid from the mass is made more complete.

In accordance with my invention a centrifugal machine is provided with a rotor or basket which is so supported as to permit both translational and rotational motion. It is rotated by the application, through a flexible transmission, of a substantially pure torque. As is well known, pure torque applied to a 20 body free to move as described will cause the body to turn about its center of mass and not necessarily about the place where the torque is applied. A difficulty arises from the fact that the flexible transmission does not always transmit pure torque, but sometimes transmits a translational force tend- 25 ing to make the rotor revolve about the fixed shaft to which the transmission is coupled. By mounting the rotor, through anti-friction bearings, on a support which slides on a table, the resistance to turning is cut down. This reduces the torque necessary to overcome friction, which must be transmitted through the flexible transmission; and this in 35 turn reduces the objectionable translational forces transmitted by said transmission.

In order to reduce the dynamic unbalance of the rotor so that it may more easily be caused to turn about its center of mass, provision is made for holding in the rotor until full speed is attained, sufficient fluid to maintain the mass of material somewhat more than thoroughly saturated, and for there- 40 after allowing it to recede slowly. The effect of this condition of excessive saturation or flooding is twofold as it not only "floats" the clothes sufficiently to cause more or less even distribution but also, upon the slow recession of the fluid from the rotor, tends to draw 45 moisture from the clothes or other fibrous ma-

terial by capillary attraction, cohesion, or other phenomenon, thereby making the clothes appreciably drier in a shorter interval of time, than possible with arrangements of the prior art, wherein no flooding is done and the fluid is drained from the mass to be dried as quickly as possible. 55

The above mentioned and other objects and advantages, and the manner of attaining them will be made clear in the following description taken in conjunction with the accompanying drawings. 60

In the drawings Fig. 1 illustrates in vertical section a centrifugal machine constructed in accordance with my invention. 65

Fig. 2 is a sectional view of a centrifugal machine having a modified form of drainage valve.

Fig. 3 is a sectional view of the machine shown in Fig. 2 taken along section lines 3—3. 70

Figs. 4 and 5 are views in vertical section of extractors having other forms of drainage valves.

Fig. 6 is a sectional view taken along lines 6—6 of Fig. 1. 75

Referring more particularly to the drawings, reference numeral 1 indicates the housing of a centrifugal extractor. The housing 1 is supported by pedestal 2 and carries centrally positioned with respect to the base portion 3 a bearing 4. This bearing serves to support one end of a pulley 5, the other end of which is supported by another bearing 6 positioned in a bracket arm 7 attached 85 to the base plate. Placed above the base portion 3 is a supporting plate 8 which is slidably supported on the base portion by means of a flat projecting ring bearing member 9. This bearing member is provided with a smooth bearing surface 10 which co-operates with a corresponding smooth bearing surface on the base portion 3. For holding the supporting plate in its proper position and preventing vertical movement thereof, a holding 95 ring 11 is provided. This ring is secured by screws 12 to a raised annular ring portion 13 of the base plate. The entire supporting plate 8 is intended freely to move with respect to the base portion 3 and hence 100

is thoroughly lubricated by oil or grease. In order to insure thorough lubrication of the bearing surfaces the outer edge of the supporting plate is provided with an oil groove 14 and the sides of the supporting plate are cut away at 15 and 16 in order to insure free access of the lubricant to the bearing surface. Secured to the supporting plate 8 is an upstanding hub 17 which carries at its lower part next to the plate proper, a ball bearing 18 and at its upper end a ball bearing 19. Supported by these two ball bearings is a rotor or basket 20 which serves to hold the mass of material to be treated by the machine. In order to drive the rotor a short shaft 21 is connected with the basket 20 by means of a universal joint 22 and with the pulley 5 by means of a universal joint 23. The pulley 5 is rotated through a series of belts 24 passing around a pulley 25 attached to the shaft of an electric motor 26, which motor is fastened to the housing 1. In order to prevent rotation of the supporting plate 8 during the driving of the rotor by the electric motor, a plurality of holding springs 27 is provided. These springs are secured at one end to the base portion 3 and at the other end to a projection 28 joined to the plate 8. The projection 28 passes down through an opening 29 in the base portion 3 which is made large enough to permit the maximum movement in all directions, of the supporting plate 8 with respect to the base portion 3, which is encountered during normal operation. The upper side of this opening has an annular rim 30 which prevents oil from leaking out. In order to carry off fluid expelled from the extractor basket a gutter 31 is provided. This gutter is provided with a drainage opening in the usual manner. In order to prevent oil that may drop from the bearings 18 and 19 from being thrown out of the machine the supporting plate 8 is furnished with an upstanding inclined annular rim 32 which has adjacent the inside thereof a series of oil ducts 33. Any oil dropping down from the bearings travels out over the top of the plate until it strikes the rim 32 which deflects the oil downwardly through the ducts 33, from whence the oil passes outwardly underneath the plate to the bearing surface 10.

Secured to the supporting plate 8 is an annular guard ring 34 which serves to prevent water from splashing into the bearings of the machine during operation thereof.

The inside walls of the rotor or extractor basket 20 are lined with a spring-like mat or mesh 35 which is in turn covered by a wire screen of relatively small mesh, 36. The function of the mat and screen is to hold the material in the basket away from the side walls thereof and thereby permit easy drainage of the fluid to the outlet openings. The side walls of the basket, it will be noted, are inclined outwardly toward the center in bar-

rel fashion. At the point of the largest diameter a series of small holes 37 is provided. Fluid is supplied to the inside of the basket through a pipe 137 which has interconnected therein a shutoff valve 38. This valve is of the automatic type and is arranged to be shut off responsive to the attainment by the electric motor of full driving speed. The mechanism for operating the valve comprises a control arm 39 having a snap-by spring 40 which is secured at its other end to a stationary finger 41. The valve 38 is open when the arm 39 is in the position shown in full lines in Fig. 1. Slidably positioned around the control arm 39 is a link 42. This link has a lost motion slot 43 therein within which the arm 39 can act. The link is attached at its lower end to a cross head 44 slidably mounted on a rod 45 and forming part of a fly ball governor arrangement 46. The cross head 44 is linked to an arm 47 secured to the shaft of the motor by means of links 48 which carry the governor balls.

In operation when the motor 26 has attained its full operating speed the cross head 44 is drawn down toward the arm 47 through the action of the fly balls sufficiently to snap the valve operating arm 39 to its closed position as shown in dotted lines in Fig. 1. Due to the action of the snap by spring 40 the closing of the valve 38 is made to occur substantially instantaneously upon the attainment of the proper rotor speed. When the motor is stopped, because of the lost motion slot 43 the valve arm 39 will remain in its closed position until it is manually reset to its open position shown by the full lines in Fig. 1.

The operation of the machine is as follows:

Wet clothes or other similar materials are placed in the extractor basket 20 and the valve 38 opened to admit a quantity of water to the basket through the pipe 37. The water is allowed to flow into the basket until it slightly more than thoroughly saturates the clothes, the supply of water furnished by the pipe 37 being sufficient to fulfill this requirement regardless of the amount of water flowing out through the drainage holes 37. The electric motor 26 is then started, which causes the basket, through the action of the shaft 21, to start rotating. The basket, due to the fact that it contains a fairly homogenous mass, will be substantially in balance and will therefore rotate substantially on its geometric center, which is at the point of connection of the shaft 21 with the universal joint 22. However, it probably will not be exactly in balance and therefore will rotate around its center of mass, as it is substantially free from lateral restraint, which is at a point slightly distant from the geometric center. Due to the supporting of the basket by the ball bearings 18 and 19 very little friction resistance to rotation will be encountered. The slight gyratory movement of the basket because of

the fact that it is not rotating around its geometric center, but around its center of mass is easily accommodated by movement of the supporting plate 8 on its bearing surface 10, the plate 8 being prevented from rotating with the basket by means of the holding springs 27. As the basket continues to rotate, gradually approaching its normal operating speed, the clothes or other material within the basket, due to the presence of the water which floods the basket are partially suspended and therefore do not pack down in one position, but rather move around gradually and distribute themselves fairly regularly. There will be but little centrifugal force acting to force the clothes against the basket wall because of the hydrostatic pressure existing on both sides of them caused by the water which is under pressure due to the centrifugal force of rotation thereof. The basket, of course, attains its operating speed rather slowly and during the time interval the clothes or other material within the basket will have arranged themselves due to partial floatation in the water in a fairly well distributed manner. As soon as normal operating speed is attained the fly ball governor 46 draws the cross head 44 down far enough to snap the valve control arm 39 to its closed position, thereby stopping the flow of water in the basket. The basket will now be filled with a sort of annulus of water and clothes, the width of which is dependent on the width of the rim 49 forming part of the basket 20.

As rotation of the basket is continued water is forced out through the holes 37 in the basket and carried away into the gutter 31 and thence to the drainage pipe. As the holes 37 are made relatively small the water will not pass very quickly from the machine but the level of it will rather recede slowly. This slow recession of the water through the clothes or other mass of material causes the clothes to be not only more quickly dried but also more thoroughly dried. The more thorough drying may be the result of several actions. For one thing, the clothes are not packed solidly against the side of the basket because of the hydrostatic pressure of the water which serves to float the clothes and keep them away from forcible contact with the side walls. The water has therefore a fairly free passage through the clothes and does not have to pass through a filter comprising a solidly packed mass of damp clothes. As the water recedes from the inside of the mass of clothes to the outside, because of the relatively small size of the holes 37, all the water that leaves the clothes will leave them through a mass of wet material and therefore will leave comparatively freely. The clothes will therefore be dried from the inside of the machine outwardly, rather than in the opposite manner as in an ordinary machine.

In supplying the extra fluid to the damp

clothes before the machine is started care should be taken not to supply too great a surplus. This is for the reason that, as is well known, a plain centrifugal extractor basket when filled with water and accelerated in speed rapidly has a tendency to vibrate strongly due to the surging of the mass of water from side to side in the basket. In carrying out my invention it is preferable to supply just sufficient water to slightly more than saturate the clothes. The clothes should be thoroughly wet and the water should cover the mass of them to a slight depth when they are fairly well distributed and compacted. This slightly more than saturated condition insures that the clothes will be fairly well "floated" by the water and that the mass of clothes and water will not be sufficiently fluid to cause violent surging and consequent vibration when the basket is accelerated rapidly. Of course where the length of time necessary to bring the basket up to full speed is not important, any amount of water could be used in relation to the mass of clothes as vibration could easily be avoided by bringing the basket up to speed very slowly.

In the ordinary machine where the basket is made with an extremely large number of holes, water leaves the outer layer of clothes first because the moisture in the outer layer of clothes is subjected to a greater centrifugal force than those on the inside. Those on the inside, because they are traveling in a circle of smaller radius, will be subject to less centrifugal force. In the ordinary machine, therefore, the layer of clothes next to the inside wall of the basket tend to be dried first, then wet again by water coming from layers of clothes nearer to the axis of rotation of the basket. Water from the layers of clothes nearer the axis must therefore pass through a filter comprising a tight packed and relatively dry layer of clothes. This fact retards the drying speed of the operation. Another reason for the quicker drying of clothes in a machine constructed in accordance with my invention appears to be that as the level of the main body of water recedes relatively slowly through the clothes it tends to draw with it by capillary attraction or cohesion, water droplets or films from the fibres forming the clothes, thereby producing a sort of stripping action. Hence, it is necessary in order to secure optimum results to adjust the speed of recession of the water through the clothes or other material to agree with the type of material acted on.

During the draining operation the mat 35 and screen 36 keep the material within the basket away from the basket walls proper and thereby permit free drainage of fluid from the machine. This is a rather important feature as, if no mat is provided, the flow of water along the side walls of the basket

will be greatly retarded and the best results therefore not obtained. Good results can be had by making the angle of the basket side walls in the neighborhood 10° with the vertical.

In Fig. 2 I have shown a modified form of machine wherein the basket is first filled half or thereabouts full with water from a pipe 50. No water can leave the machine until the correct speed of rotation has been obtained as there is no drainage opening from the basket until the proper speed has been obtained. The basket is provided with a plurality of holes 51 around the point of greatest diameter thereof. These holes open into an annular channel or conduit 52 which is provided with a plurality of drain valves 53. These drain valves are maintained closed by a spring 54 interconnected with a lever arm 55 pivotally secured to the valves. Pivotally connected to the opposite end of the lever arm 55 is a valve arrangement 56 which controls the flow of fluid from a pipe 57 communicating with the inside of the basket. The valve 56 when in the position shown in Fig. 2, which is its position when the machine is at rest, partially throttles the opening in the pipe 57. As soon as the basket 20 is set into rotation water gradually rises up the side wall of the basket due to centrifugal force and finally rises high enough to flow into the pipe 57 through which it is thrown by centrifugal force against the valve 56. In passing by this valve, due to the throttling action thereof, sufficient pressure is exerted to rock the lever arm 55 against the action of the spring 54 and close the valve 56 firmly on its seat preventing further flow of the water therethrough, while at the same time opening valve 53 and permitting water slowly to flow from the basket. The operation of the machine then continues in exactly the same manner as set forth in connection with the machine shown in Fig. 1. As soon as the machine is stopped, the spring 54 rocks the lever arm 55 closing the valve 53 and opening the valve 56. The valve 56 now being open, water therein flows out leaving the pipe 57 empty, ready for another cycle of operations.

In Fig. 4 I have shown a machine having a plurality of siphon pipes 57 which serves to withdraw water from the basket. With this machine the basket is filled about half full of water, then started rotating. As soon as the desired speed is reached the water rises over the bend in the siphon, thereby filling the pipe full and causing water to be ejected from the discharge portion 58 of the siphon under the influence of the centrifugal force of rotation of the basket. The siphon action will continue until all of the water has been drained from the basket. When a centrifugal extractor basket is furnished with a siphon draining arrangement such as shown

in this figure care must be used properly to correlate the height through which the water must be lifted by the siphon, with the centrifugal force due to rotation of the basket. It will readily be seen that the force against which air pressure has to lift the body of water is not that of gravity, but centrifugal force resulting from the rotation of the basket. Therefore, the height through which this water must be lifted, or in other words, the size of the loop in the siphon, must be made small enough to permit water to be siphoned out under atmosphere pressure.

It will be seen that in order to fix the speed at which the draining operation in either one of the machines illustrated in Figs. 2 and 4 starts, it is necessary merely to regulate the level to which the basket is initially loaded, the higher the level, the lower the rotational speed at which the drainage operation will commence. If it is desired to start draining only when a high speed is attained, a relatively small load should be placed in the basket.

In Fig. 5 I have shown a centrifugally operated valve mechanism in conjunction with a basket 20 provided with an annular channel 52 similarly to the basket shown in Fig. 2. This annular conduit has spaced around the periphery thereof a plurality of valves 59. These valves are of the centrifugally operated type and comprise an arm 60 pivoted to the basket at 61 and forced against openings in the conduit 52 by a spring 62. The end of the arm 60 is provided with a gasket 63 of rubber or the like, which fits tightly against the conduit 52 and prevents leakage of fluid. When the speed of rotation of the basket has increased up to a certain point the centrifugal force is sufficient to rock the arm 60 around the pivot 61 against the action of the spring 62 and remove the gasket 63 from the opening in the conduit, thereby permitting fluid to escape. In order that the speed at which the valves open may be adjusted, an adjustable weight 64 is applied to the lever arm 60. This weight can be moved to any desired position along the arm 60 so as to cause the valve to open at a lower or higher speed, as desired. In order that the valve may be dependent for its operation upon a given rotational speed of the basket without regard to the pressure of the water against the gasket 63, the size of the discharge openings in the conduit 52 should be made relatively small. However, if the speed of the basket is increased slightly after the valves 59 open the slight decrease in water pressure against the gaskets will not be sufficient to cause the valves to close when the basket becomes nearly dry.

In constructing the type of relief valve shown in this figure it may be found desirable in certain cases to make the valve in such manner that once it is opened at a given speed

of rotation it will remain open even if the speed of rotation is greatly reduced. This may be accomplished by replacing the spring 62 with a spring, the resistance of which decreases with an increase in deflection resulting from the swinging of the arm 16.

The extractor basket of this machine is mounted for free rotation around its center of mass in substantially the same manner as set forth in my copending application Serial No. 269,851 filed April 13, 1928. In constructing an extractor of this type it is necessary to avoid as largely as possible any frictional drag on the basket, leaving it free to turn as it will. Provided there is no frictional retarding force present, the basket will rotate around its center of mass, which will be determined by the distribution of the clothes in the basket. The frictional forces tend to cause the basket to rotate around a point other than its center of mass, thereby producing harmful vibrations which may increase in amplitude sufficiently to cause damage to the machine. I reduce the frictional forces to a low value in a machine constructed in accordance with my present invention by mounting the rotating basket on ball bearings or other bearings of the anti-friction type, on a hub supported by a plate slidably positioned on a table or base portion, forming a part of the machine housing. The plate to which the hub is attached is permitted a small amount of movement sufficient to accommodate it to the eccentric movement of the basket rotating around its center of mass, and is retained in a normal position against the frictional drag of the bearings which tend to rotate it, by holding springs. I reduce frictional resistance in the universal joints connecting the driving pulley with the basket by making the shaft interconnecting the pulley with the basket relatively long so that the universal joints will have to turn through only a small angle during operation of the machine. When the basket is rotating, as the ball bearings are relatively small in diameter and located near to the axis of rotation but little frictional resistance would be encountered when the basket is rotating on its geometrical center, especially when this center is in line with the center of the driving pulley.

When the basket is rotating in a slightly unbalanced condition the rotation will take place around its center of mass which will be at a point off center with respect to the geometrical center of the basket and this will cause an oscillatory movement of the plate to which the hub supporting the basket is attached. This movement will be relatively small, however, and hence the frictional forces produced thereby will be also relatively small. A machine of this type will work satisfactorily even when damp clothes or other material are thrown into the basket promiscuously. It sometimes happens that while the

machine will take care of lateral unbalance of the load, at high speeds sufficient vertical unbalance may be present to cause vertical vibration of the basket, which may become great enough to be detrimental to the operation of the machine. By flooding the loaded basket with water or other fluid sufficient thoroughly to saturate the load, more perfect vertical balance, as well as lateral balance is obtained. The clothes are in a sense floated in the water and therefore are prevented from packing tightly in a given position and are enabled to move about sufficiently to distribute themselves relatively evenly around the inside of the basket. This is especially true if the flooding water is held in the basket until normal operating speed is attained. As the basket accelerates the clothes distribute themselves more or less evenly around the inside of the basket, thereby perfecting the balance. The water being under the influence of centrifugal force caused by rotation of the basket, will equalize hydrostatically the pressure on all sides of the clothes, or other load in the basket, thereby preventing the same from packing tightly against the wall of the basket. This condition will obtain even if the water is permitted to leave the basket as described above. The level of the water, or tide, will go down gradually, thereby drying the layers of clothes next to the center of the basket first, at the same time preventing the outer layers from packing, thereby permitting free egress of water from the machine.

I have found that by controlling the speed at which the water flows from the basket so that the flow is relatively slow, that the drying operation as a whole can be speeded up and that the clothes in this shorter interval of time will be drier than when the machine is operated in accordance with the prior practice. The water should be caused to flow from the basket slowly enough so that the tide or water level recedes relatively slowly through the clothes. If this speed is selected properly the inside layers of clothes will be dried first. As I have stated heretofore, the action appears to be a combination of plain centrifugal extraction of water from the fibers, with a stripping action resulting from the capillarity or surface tension of the fluid, which seems to cause the receding water to draw with it droplets of water, or moisture films in the clothes. There is always, of course, a force of adhesion causing a water film or water droplets to adhere to the fibres in wet clothes or other fibrous material. This force of adhesion is normally sufficient to hold these water films or droplets on the fibres during the extracting operation. However, if the speed of recession of the water level is made sufficiently slow the force of cohesion existing between the receding water body and the films or water droplets on the fibres may be great enough to overcome the

force of adhesion of these water films or drop-
lets to the fibres, and thereby causing a great-
er total amount of water to be removed. In
any event, whatever this action may be, I
have found that by controlling the rate of
flow of water from a mass of fibrous material,
so that level of the water recedes rather slow-
ly, that not only is time of complete drying
reduced but also that the drying is made more
perfect. This method of drying is workable
not only with a centrifugal machine but also
with any straight draining process where the
clothes are placed in a sieve-like container
and the water allowed to drain from them by
gravity. If the holes in the container are
made small enough so that the water level
recedes rather slowly the time of drying to
a given degree of dryness is greatly reduced,
and conversely, if the time of drying is held
the same, the degrees of dryness will be ap-
preciably increased.

While I have described a preferred embodi-
ment of my invention as adapted for the dry-
ing of clothes or other fibrous materials, I
believe that it is capable of advantageous
use in the removal of fluid from other mois-
ture retaining materials.

I have described a particular embodiment
of my invention for the purpose of illustra-
tion, but it will be understood that various
modifications and adaptations such as would
occur to one skilled in the art may be made
without a departure from the spirit of the
invention, as set forth in the appended claims.

What I claim is:

1. The method of separating fluid from
moist absorbent material which comprises
flooding said material with an added amount
of said fluid, centrifuging said material for
a time while maintaining the level of said
fluid, and then draining said fluid from said
material centrifugally at a predetermined
rate.

2. In a centrifugal drying machine com-
prising a basket having perforations therein,
means for conducting fluid into said basket,
and means responsive to the attainment by
said basket of normal extracting speed, for
stopping the flow of fluid from said means
first mentioned.

3. A centrifugal extractor for laundry pur-
poses, comprising a perforated basket, a con-
duit for conducting fluid to said basket, a
valve for controlling the flow of fluid through
said conduit, and means responsive to the at-
tainment by said basket of a certain prede-
termined speed for closing said valve.

4. A centrifugal extractor according to
claim 3 wherein the size of the perforations
in the basket is so selected with respect to the
fluid output capacity of the conduit that the
water introduced through the conduit is suf-
ficient to fill the basket to the desired level
and to maintain that fluid level until the clos-
ing of the valve.

5. A centrifugal extractor according to
claim 3 wherein the means for closing the
valve comprises a centrifugally operated
mechanism.

6. The method of balancing a centrifugal
extractor having a load of fibrous material
in the basket thereof, which comprises partly
filling said basket with a liquid and substan-
tially maintaining the level of said liquid dur-
ing an initial period of the rotation of the
basket.

7. The method of evenly distributing a load
of material in a centrifugal extractor basket
which comprises submerging said material
in a liquid in the basket and maintaining
it so submerged until the extractor attains
its normal operating speed.

8. The method of evenly distributing
fibrous material in the basket of a centrifugal
extractor, which comprises flooding said bas-
ket with a liquid to support the material and
preventing said liquid from leaving said
basket until the said basket has been rotated
sufficiently to establish the desired balance.

9. In a centrifugal extractor, a rotatable
basket having a plurality of small holes
therein, a conduit for supplying water to said
basket at a rate at least equal to that at which
it can escape through said holes, a valve for
controlling the flow of said water and means
responsive to the attainment by said basket
of a certain predetermined speed, for clos-
ing said valve.

10. In a centrifugal extractor, a rotatable
basket having a lining of relatively thick
spring material, said basket being formed
with side walls which increase in diameter
towards the center of the basket, the portions
of the walls upon either side of the center
of the basket being substantially symmetrical
and said walls being provided with a plural-
ity of holes disposed about the zone of largest
diameter.

In testimony whereof, I have signed my
name to this specification this 20th day of
October, 1928.

ARTHUR H. ADAMS.