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APPARATUS FOR DRAINING FIBROUS MATERIAL

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4 Claims. (Cl. 100—157)

This invention relates in general to an apparatus for mechanically removing excess water from fluid mixtures of pulp fibres in water as commonly employed in the paper-making process. Machines of the class employed in removing a substantial percentage of water just prior to passing the pulp to a refining operation, are commonly referred to as "drainers." The nature of the draining operation may vary to a considerable extent depending upon the type of stock handled, the amount of stock to be processed, the consistency requirements in the material which is discharged from the drainer, and the degree of uniformity desired in the rate of discharge of drained material at any given time.

In Patent No. 2,483,200, issued to me Sept. 27, 1949, there is disclosed one typical form of drainer construction which comprises essentially a combination of revolving cylindrical screen, screw conveyor and press roll. The revolving screen component also includes a frusto-conical section which cooperates with the press roll to receive partly dewatered stock from the main body of the cylindrical screen and to provide a roll squeezing action.

Drainers of this type are ordinarily characterized by a heavy casting type of construction which is designed with bearing portions to support the weight of heavy rotating members and to withstand considerable stresses in carrying out continuous draining operations for long periods of time. Such a construction places certain cost limitations on the manufacture and sale of this class of drainer. For some types of work a much lighter type of construction is desired and especially one which can be so organized as to provide a much cheaper unit in which the revolving screen can be properly supported.

The performance characteristics of conventional drainers has also been unsatisfactory for some types of work. For example, processing with the heavier type of drainer construction described has resulted in reducing the water content of stock ordinarily down to a well-known point. Beyond this point, however, it has been found to be very difficult to reduce the water content of such stock. It will be apparent that there is thus present an undesirable limitation in conventional draining equipment. This limitation has become an important consideration for the reason that the present demand in paper-making is for removal of larger amounts of water just before the stock enters the steam digester for refining. The refiner also requires a relatively uniform feeding rate. A further problem may arise in this connection since there may develop a tendency for squeezed fibrous stock which is worked by a press roll of a drainer to clog and collect undesirably in the outlet end of the drainer. This may affect the feeding rate undesirably.

With the foregoing problems and limitations in mind with respect to conventional drainers, I have devised a basically new form of simplified drainer construction in which preformed steel components are combined in a unique manner to provide a machine which is characterized by light weight and strength achieved with a highly important reduction in manufacturing costs. This basic form of simplified drainer construction is of special design so that it may be used to deal with varying requirements for any one of a number of drainer operations of the class generally indicated above. Thus in one form the simplified drainer construction may be employed to

produce a low consistency stock. In another form the machine may include novel means for increasing the dewatering capabilities so as to produce a very high consistency stock. In still another form the machine may include means for overcoming clogging and providing a high degree of uniformity in the rate of feeding of drained material to a refiner unit.

For example, in removing a percentage of water signficantly higher than that ordinarily removed with conventional equipment, I provide an apparatus for subjecting stock to two successive roll squeezing steps which are carried out in a manner such that a layer of fibrous material in first compressed and almost immediately, while in the process of recovering from its compressed state, the layer is again compressed to thus provide a secondary extraction of water of a highly desirable nature.

I accomplish this by utilizing two press rolls in a rotary screen and by arranging the nip point for the secondary roll squeeze with the screen to occur closely adjacent to and slightly above the nip point of the first roll squeeze. In this way there is temporarily formed, in the layer of stock moving around the revolving screen, a narrow zone of shielded material from which water from adjacent masses of fibres tends to be excluded and the maximum effect of two successive squeezing operations may be fully realized to force moisture out through the screen apertures. Moreover, the squeezed stock, as it falls back from the screen periphery onto the lower press roll, after passing through the second nip point, is prevented from dropping between the press rolls but continues to work over the tops of both rolls and then goes back under both rolls at advanced positions with greater draining efficiency being realized.

In providing for a highly uniform rate of feeding stock to a refiner, I have further found that I may combine with the simplified form of machine of the invention, with or without press roll members, a novel screw dispensing apparatus by means of which a greatly improved uniform feeding of dewatered stock may be carried out at the discharge end of the drainer. This avoids clogging, as well as troublesome variation in the rate of discharge into the refiner apparatus.

The nature of the invention and its other objects and novel features will be more fully understood and appreciated from the following description of a preferred embodiment of the invention selected for purposes of illustration and shown in the accompanying drawings, in which:

FIG. 1 is a cross sectional view showing a fabricated drainer construction of the invention, together with supporting means and power driving mechanism;

FIG. 2 is a cross section taken centrally through the drainer construction of FIG. 1 approximately on the line 2—2 of FIG. 1;

FIG. 3 is a cross sectional view illustrating a screen member removed form the drainer of FIG. 1 and further illustrating the association of a helical screw member within this screen body;

FIG. 4 is a fragmentary cross sectional view of a drainer construction similar to that shown in FIG. 1 and further including a press roll mechanism which includes two separate press rolls arranged in close proximity to one another;

FIG. 5 is a view illustrating in elevation the structure shown at the right hand side of FIG. 4 and also indicating in cross section the drainer cylinder and screen member;

FIG. 6 is a cross sectional view showing a modified form of drainer construction in which is included a special screw dispensing mechanism, together with a power driving means therefor;

FIG. 7 is an end elevational view taken approximately on the line 7—7 of FIG. 6;

FIG. 8 is an end elevational view taken approximately on the line 8—8 of FIG. 6;

FIG. 9 is a detail fragmentary view illustrating diagrammatically handling of stock by means of the screw dispensing arrangement of the invention;

FIG. 10 is a fragmentary cross sectional view of a modified form of drainer construction in which is included a novel two-roll arrangement for squeezing stock against a frusto-conical screen member; and

FIG. 11 is an end elevational view of the structure shown in FIG. 10 and indicating parts of the mechanism in cross section.

The basic form of simplified drainer construction of the invention, which may be employed independently of either press roll or dispensary screw arrangements, is illustrated in FIGS. 1, 2 and 3. As shown therein, I provide a special fabricated cylindrical casing and a revolving screen. These parts are preferably made up of light weight stainless steel designed to eliminate the more costly cast metal housings of drainers heretofore used. I further combine with the relatively lightweight casing externally located support members for rotatably receiving the revolving screen and conveyor mechanism in a manner such that the end walls of the cylindrical casing do not act as supporting members. It is pointed out that this simplified form of drainer machine is designed to provide a product of low consistency, i.e., in the 3–8% consistency range.

Considering in detail the special fabricated casing referred to, numerals 2 and 4 denote top and bottom casing sections of steel or other suitable material which may, for example, be constructed of flat steel plates rolled into the form of semicylindrical members. The section 2 is slightly smaller in diameter than the section 4 and is designed to nest inside the member 4 as shown in FIG. 2, so that a substantially sealed joint is obtained and fluid material can flow down around the inside of section 2 without escaping.

Flange members 2′ and 4′ are arranged as shown in FIG. 12 and provide for detachably securing the two sections together by suitable fastening means. The two ends of the cylindrical structure thus formed are partly closed by end walls 6 and 8 and the entire casing body is supported on base members 10 and 12 above which are located curved side brackets as 14 and 14*a*. The top casing section of sheet metal lends itself to the provision of work openings for checking on stock as it passes through the drainer, and these openings are indicated at 9 and 11 and are closed by sliding panels 9*a* and 11*a*. The bottom section 4 is also formed with an opening 4*a* through which drainer water may be discharged.

In accordance with the invention, I combine with these cylindrical sections 2 and 4 a screw conveyor and drain screen assembly which is supported in a manner such that its weight, to a very large degree, is received externally of the casing. Thus no heavy bearing structure is utilized at the end wall areas of the casing and substantial advantages are realized in manufacture and assembly.

In this arrangement I combine the parts noted with two elongated journals 16 and 18 which are rotatably mounted in externally located bearings 20 and 22 in turn received on end support members 24 and 26. The two journals are fitted into opposite ends of a hollow shaft 28 and are rotated by power driving means 27. This shaft is also constructed of a light-weight steel material and has secured therearound a helical flight which constitutes a screw conveyor generally indicated by the numeral 30. At the outer peripheral edges of the flights is located a screen member 32, better shown in FIG. 3. The screen member 32 may be in one preferred form fabricated from four sections which are secured to longitudinal bars 34, 36, 38 and 40 reinforced by angle brackets as 42, 44, 46 and 48. At the right hand end of the screen member 32, I further provide a frusto-conical screen member 50 which is secured to overhanging 52.

Communicating with the end wall 6 of the casing is an inlet port 54 which is located in concentric relationship around the journal 16 to provide for introduction of wet fibrous material into the drainer. At the opposite end of the frusto-conical screen section 50, I further provide an outlet port 56 through which drained stock may be discharged.

It will be observed that by means of the two-section construction, and the externally supported journals, a unique arrangement of parts is realized whereby stock may be fed into a rotating screw conveyor contained within an attached screen body and a draining operation may be carried out with no heavy bearing structure being included in the casing itself at any point. Important advantages are realized from this arrangement, both in connection with assembling and operating. Moreover, the expensive construction of older type machines is avoided.

In FIGS. 4 and 5, I have further combined with the simplified form of drainer construction of FIGS. 1, 2 and 3, a special multi-press roll arrangement in which a pair of cooperating press rollers of conical form are employed. Attention is drawn to the fact that this form of multi-press roll machine is designed to produce a stock of much higher consistency in a range of consistencies of from 14% to 20% and beyond. As shown in FIG. 4 the conical rollers are denoted by numerals 60 and 62 and are located within the frusto-conical screen section 50*a* of the drainer 2*a* at points between the drainage outlet 56*a* and the junction of screen 32*a* with member 50*a*.

The externally located bearings of the machine of FIGS. 1, 2 and 3 are modified to include supports for the rollers 60 and 62. These members and their respective shafts 64 and 66 are mounted in opposite ends of a rocker bearing plate 70 which is pivotally contained between forked extremities 72 and 74 of an arm 76. At its upper portion the arm 76 is formed with a bearing 78 through which extends a shaft 80 in turn received through another bearing portion 82 in an extension bracket 84 better shown in FIG. 5. The arm 76 also includes a weight carrying bar 76′ on which is adjustably received a weight 76″. By varying the position of weight 76″ varying degrees of pressure may be transmitted through the forked extremities 72 and 74 to force the rolls 60 and 62 against the screen in balanced relationship with desired force.

The extension bracket 84 forms a part of the main bearing support 86 in which one journal 88 for the screen 32*a* is located. As may be more clearly seen in FIG. 5, the press rollers 60 and 62 are arranged to engage in rolling contact with the inner peripheral surface of the frusto-conical screen 50*a* and as the rollers occur in close proximity to one another, there is provided two nip points N1 and N2 which occur in relatively close proximity to one another.

With the screen 50*a* revolving in a clockwise direction, as viewed in FIG. 5, a layer of stock tends to advance towards the outlet 56*a* and will be compressed as it passes through the nip point N2. This first nip point N2 squeezes part of the remaining water out of the stock which almost instantly passes to the second nip point N1 while still in a compressed state so that a secondary squeezing action takes place which is highly effective in removing a further small but important percent of water out of the stock. Since the peripheries of the two press rolls are located in close proximity to one another as explained above they cooperate with the screen extension and one another in a novel manner in handling the stock. A layer of the stock ordinarily tends to adhere to roll 62 after passing nip point N2, to a greater or lesser extent, depending on the character of pulp being processed and the speed of rotation of the rolls. Such an adhering layer of stock, however, may be prevented from remaining on the periphery of the first press roll by reason of the fact that the periphery of roll 60 at points nearest the roll 62 operates to engage

the accumulation of stock carried by roll **62** and displaces or peels this stock away so that it is diverted to the screen extension and, therefore, is constantly advanced between the screen and roll **60** to provide the second squeezing action disclosed above.

It is also pointed out that the layer of stock leaving the second nip point N1 almost immediately starts to fall away from the rotary screen surface and tumbles over both of the rolls into a position to approach the discharge outlet **56***a* without coming into contact with further wet stock to any appreciable extent. Thus I am enabled to remove small amounts of moisture which cannot be displaced in a conventional machine using a single press roll and it will be seen that the two press rolls cooperate with one another and with the screen to provide a unique water extracting function.

In FIGS. 6–11 inclusive, I have illustrated two more important forms of my machine in which novel regulating screw means of the invention are employed. One of these forms is shown in FIGS. 6–9 inclusive, wherein I have shown the regulating screw means combined with a single press roll in my simplified drainer construction. This type of machine is designed to meet a requirement for an output of stock of medium high consistency, i.e., in a consistency range of from 8–14% consistency and at the same time afford a degree of uniformity not heretofore possible in the feeding rate of stock being delivered to a refiner apparatus.

As shown in FIG. 6, I provide the simplified form of drainer construction already described which is characterized by externally located bearing means for supplying the rotating parts. Numeral **2***b* denotes an outer cylinder casing of the sectional type earlier noted in which is located a conveyor screw **30***b* and screen **32***b* driven by a shaft **88***b* from a power driving unit **27***b*. Also provided is a frusto-conical screw section **50***b* having an outlet **56***b*.

Arranged to lie in rolling contact with the screen member **50***b* is a press roll **102** mounted on a shaft **104** in turn received in a bearing **106**. The latter member forms a lower end of an arm **108** which is mounted on a shaft **110** transversely disposed through a bearing portion **112** of a bearing stand **114**. At its upper end the arm **108** includes a bar **116** on which is slidably supported a weight **118**. Changing the position of the weight varies the pressure of roll **102** on the screen surface to develop a greater or lesser amount of squeeze.

In accordance with the invention, I combine a dispensing screw member **122** with the screen and roll construction above described. This screw member is arranged to extend angularly into the frusto-conical screen member **50***b* in a position slightly above and to one side of the roll member **102**, as is best shown in FIG. 9. The screw member **122** includes an extended shaft portion **124** which is rotatably supported in an inclined position in special angled bearing **126**. At the outer end of the shaft is a pulley **128** adapted to be belted to another pulley **130** on driver shaft **88***b*.

In operation the dispensing screw **122** functions to smooth out travel of drained material which ordinarily tends to be moved by the screw conveyor **30***b* in periodic advances so that batches are discharged. The exact manner in which this is accomplished is indicated somewhat diagrammatically in FIG. 9. Stock leaving the screen **32***b* is caused to move under the press roll **102** as suggested by the arrows. After the pressed layer thus worked passes away from the press roll, it is immediately engaged by the dispensing screw which revolves in an opposite direction to that of the main screw conveyor although the helical flight is in the opposite helical direction as the helical flight of the main screw conveyor. With this arrangement the stock is turned over by screw **122** and continuously advanced short distances so as to progressively drop over the press roll **102** onto an area slightly advanced toward the discharge end. Lastly the stock drops in front of a discharge shoe **130** which deflects the material out of the discharge outlet **56***b*.

The immediate result of this operation is to provide for batches of material which are delivered from the main screw conveyor **30***b* being continuously broken up and fed over into the area of the discharge outlet so that a highly uniform rate of feeding is accomplished and this uniformity may be realized even though the speed of output is varied in various ways.

In FIGS. 10 and 11, I have further illustrated a dispensing screw in combination with a pair of press rolls. It is to be observed that this arrangement is designed to provide for a maximum water removal with a suitably high degree of uniformity being realized.

As noted in FIG. 11, a drainer casing of the class described is provided with a frusto-conical screen **50***c* in which is supported a pair of press rolls **60***c* and **60***d*. Located through the frusto-conical screen above the press rolls is a dispensing screw **140**. The mounting of this dispensing screw corresponds to that of dispensing screw **122** already described and these parts, together with the press roll bearings and drive are similar to the arrangement shown in FIGS. 6–9 inclusive, and are designated by similar but primed numerals. Likewise the operation and functioning of the dispensing screw **140** corresponds generally to that already described in connection with the description of dispensing screw **122**. However, it is found that the double roll and dispensing screw arrangement provides for high consistencies of very desirable nature while uniformities of discharge is preserved at all times.

It will be evident that in operating the machine, either independently or in conjunction with the press roll and dispensing screw, the speed of rotation of the regulating screw may be varied to exercise control over the number of passes the stock makes under the press rolls and consequently the consistency of the discharging stock. For instance, if it is desired to have a relatively thin layer of stock go under the press roll for more efficient pressing, the speed of the conveyor is increased. On the other hand, if a lower conveyor speed is employed, a heavier layer of material is passed under the press rolls. It will be apparent that the speed control functions to provide varying degrees of consistency and the additional press roll and dispensing screw combinations operate to significantly extend this control as well as affording a much sharper degree of processing along particular points desired.

While I have shown preferred embodiments of the invention, it will be understood that various other changes and modifications may be adopted in keeping with the scope of the invention as defined by the scope of the appended claims.

I claim:

1. In a pulp drainer construction of the class which includes a casing, a screw conveyor mounted for rotative movement in the casing, a screen drum secured around said screw conveyor, said drum including an outwardly flared annular screen extension having a stock outlet formed at the lower side thereof, the combination of a conical press roll mounted for rolling contact with the inner periphery of the screen extension, a second conical press roll also mounted for rolling contact with the screen extension and positioned slightly above the first press roll, said second press roll being arranged closely adjacent to the said first press roll to provide a nip point for the stock between said second press roll and said screen closely adjacent and above the nip point between the first roll and the screen, means for yieldably supporting said press rolls in normal spaced relation, and means for applying the same pressure to each of said rolls.

2. In a pulp machine for draining a fluid mass of pulp fibres, said machine including a casing, a screw conveyor mounted for rotation in the casing, and a screen drum secured around the conveyor, said screen drum having a screen extension and a stock outlet formed at the lower

side of the screen extension, the combination of a pair of cooperating press rolls having generally parallel outer adjacent faces mounted in rolling contact with the inner periphery of the screen drum extension, one of said press rolls being positioned in part above the other and in close proximity therewith, said press rolls and screen drum cooperating to provide two spaced-apart fibre-working regions along which the fibres may be subjected to successive compressive forces and their proximity to each other preventing the carrying of the pulp fibre mass therebetween.

3. In a pulp machine for draining a fluid mass of pulp fibres, said machine including a casing, a screw conveyor mounted for rotation in the casing, and a screen drum secured around the conveyor, said screen drum having a screen extension and a stock outlet formed at the lower side of the screen extension, the combination of a pair of cooperating press rolls mounted in rolling contact with the inner periphery of the screen drum extension, said press rolls and screen drum cooperating to provide two spaced-apart fibre-working regions along which the fibres may be subjected to successive compressive forces, and said press rolls being arranged in close proximity to one another whereby fibrous material passing through a first fibre-working region and collecting at an underside of a peripheral surface of one of the rolls in a mass greater in thickness than the distance between said press rolls

may be displaced by an adjacent peripheral surface of the other roll and advanced to the second fibre-working region.

4. A structure according to claim 3, in which the screen extension is provided with a regulating screw and a deflector blade mounted at the lower side of the screen extension and cooperating with the regulating screw and the press rolls to regulate advance of stock towards the said stock outlet in a controlled manner.

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APPARATUS FOR DRAINING FIBROUS MATERIAL

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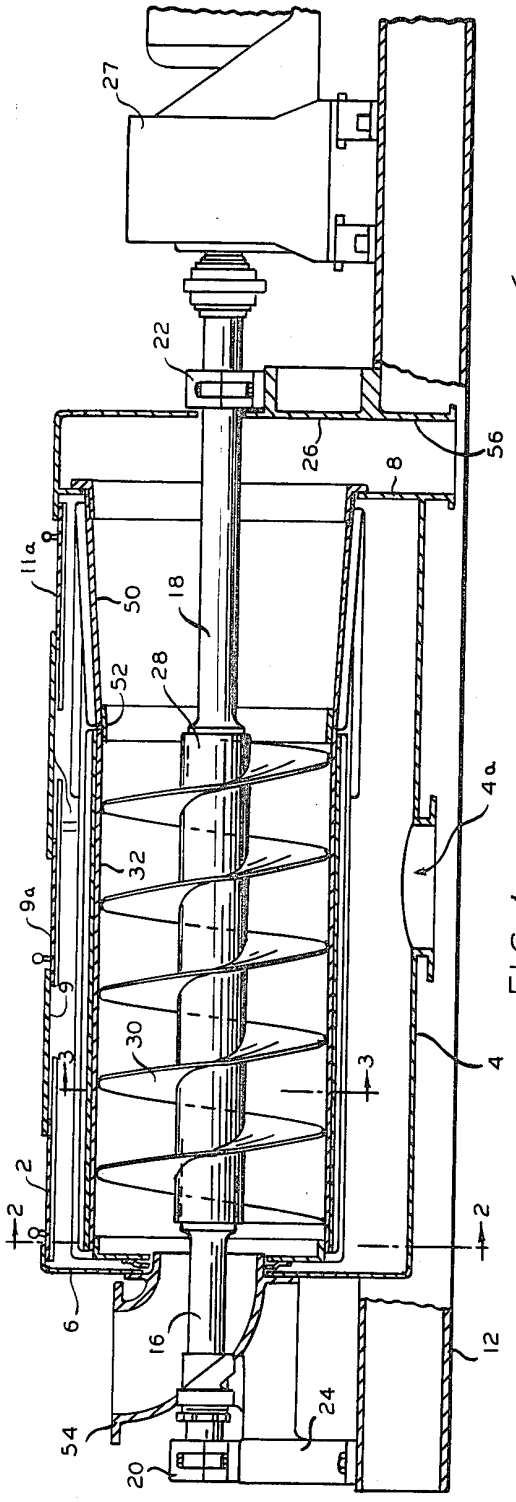

FIG. 1.

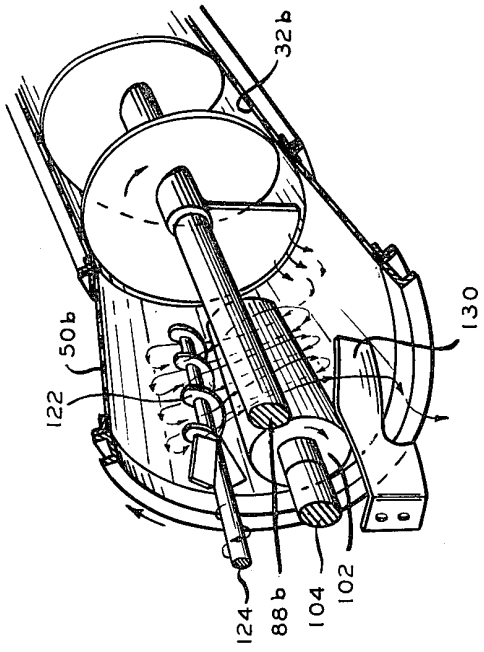

FIG. 9

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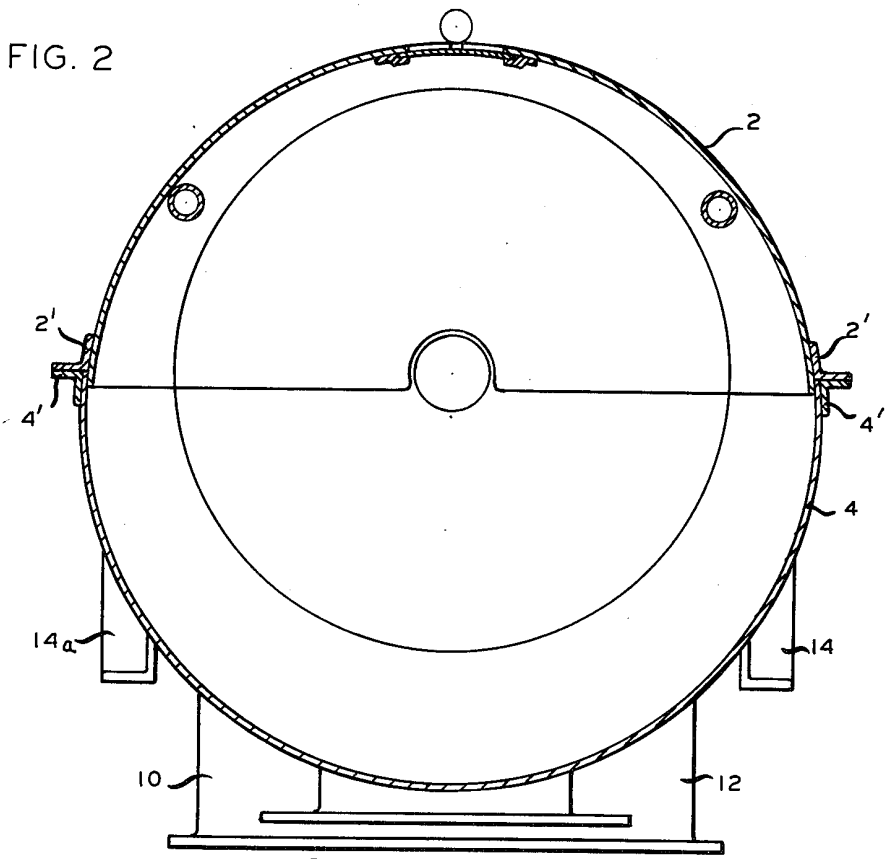
FIG. 2



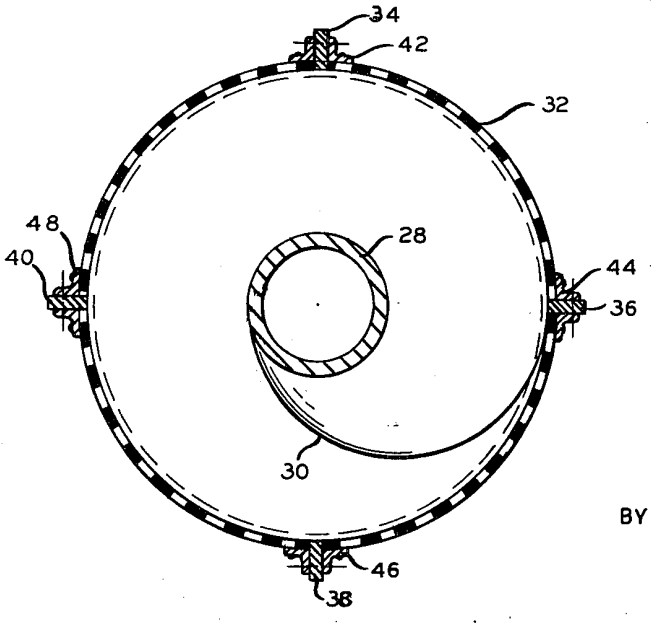


FIG. 3

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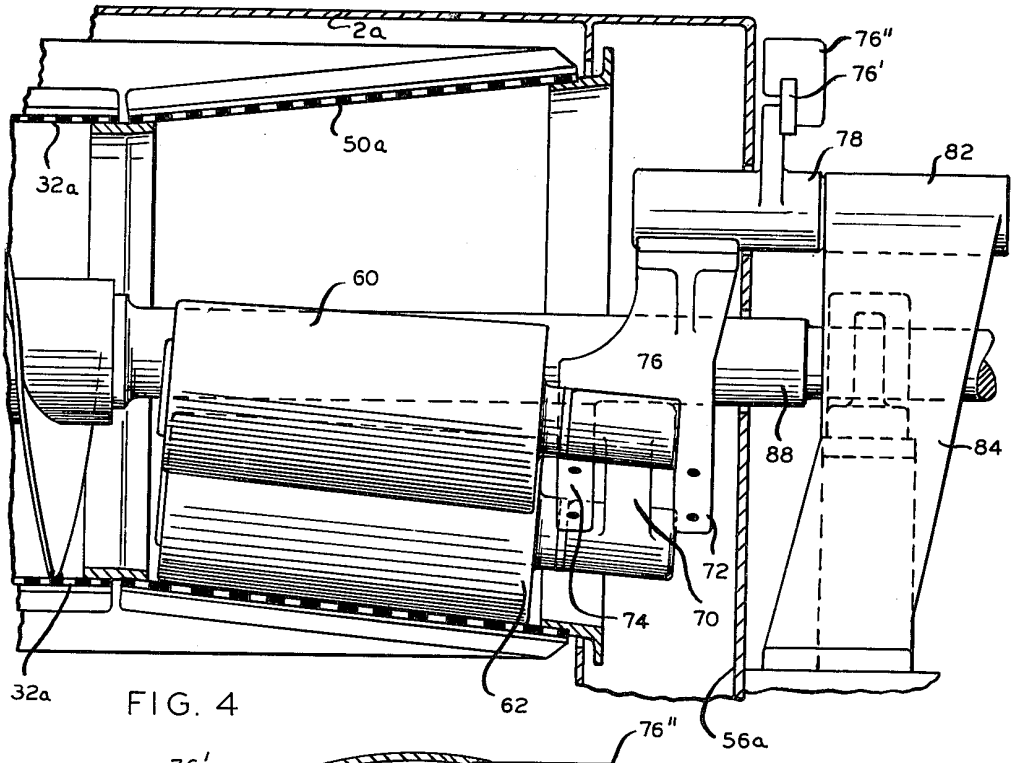

FIG. 4

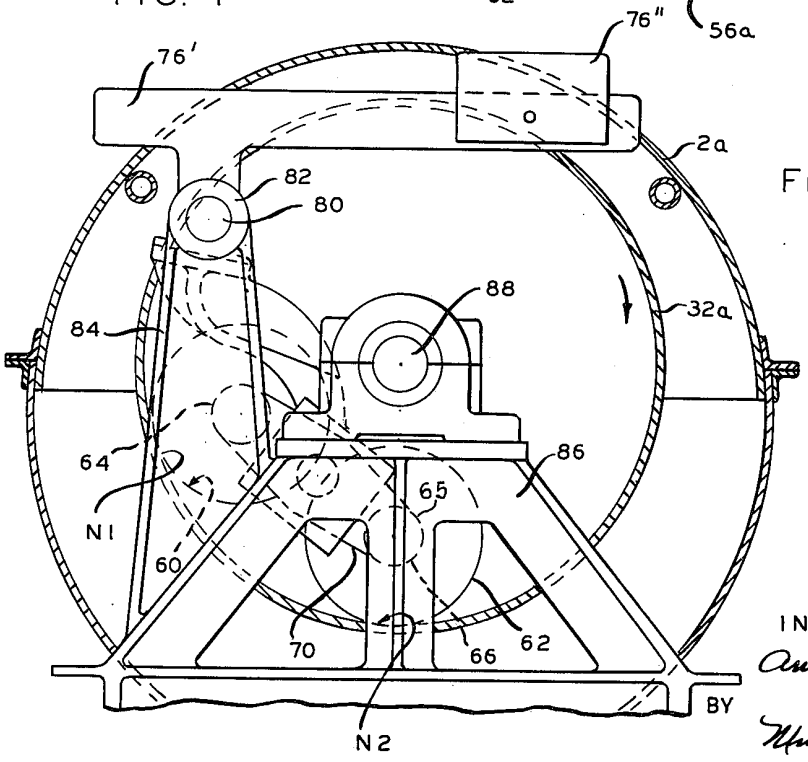

FIG. 5

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FIG. 6

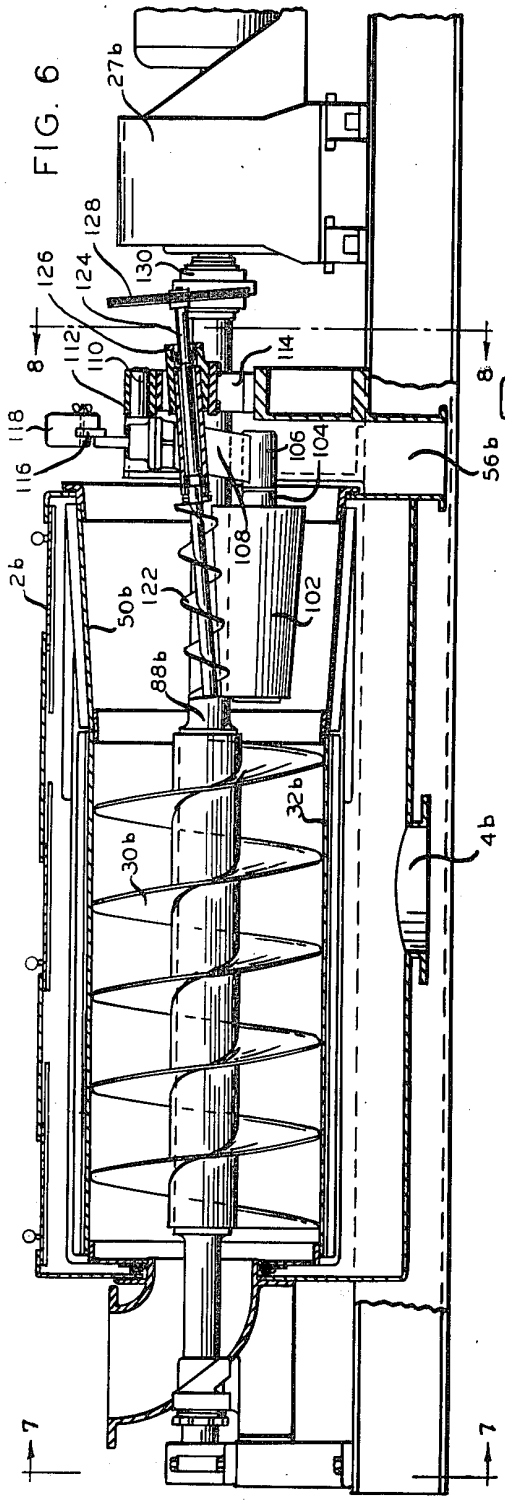

FIG. 8

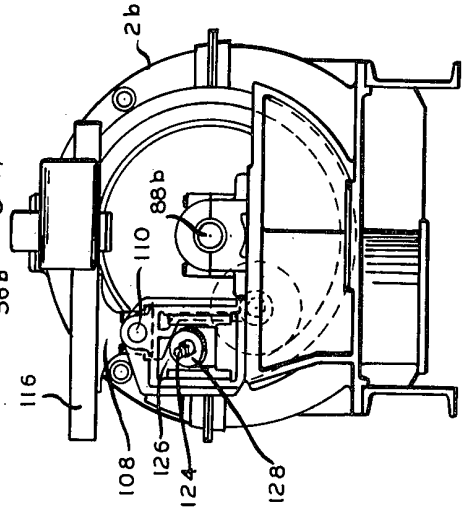

FIG. 7

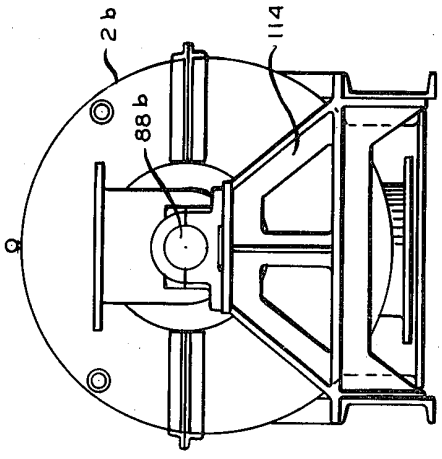

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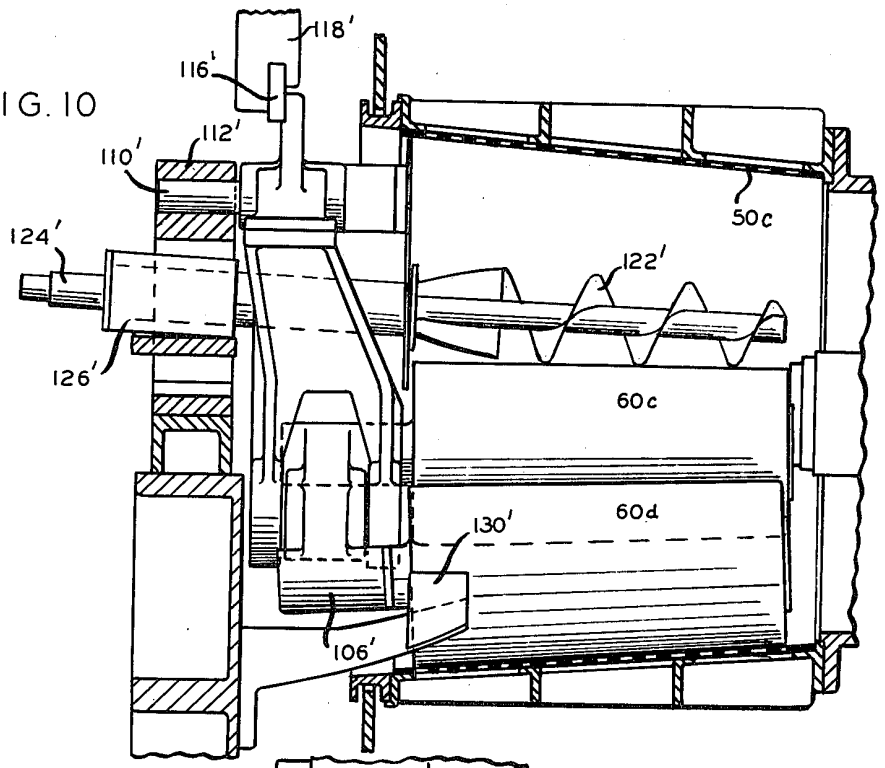
FIG. 10



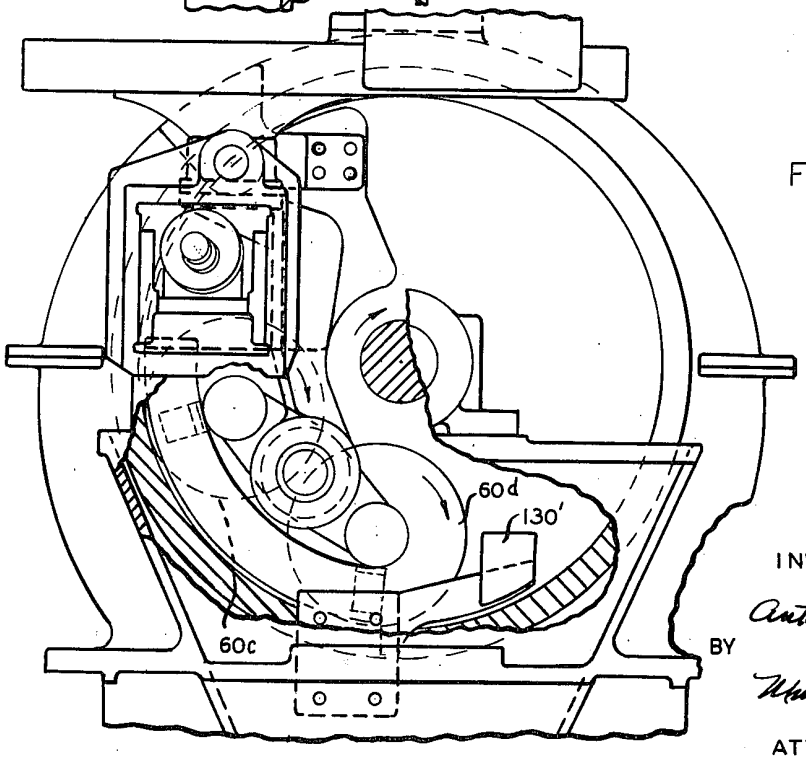


FIG. 11

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