July 14, 1964 R. M. WILLIAMS 3,140,652

DEWATERING PRESS CONE ADJUSTING DEVICE

Filed Feb. 2, 1962 3 Sheets-Sheet 1

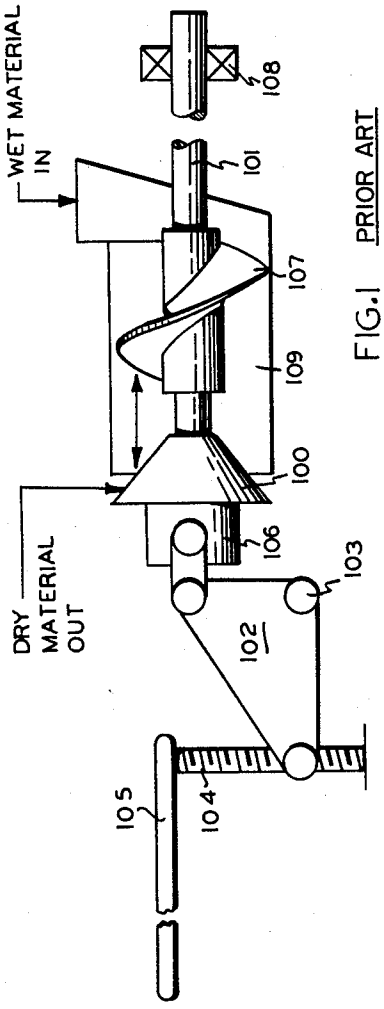


FIG.1 PRIOR ART

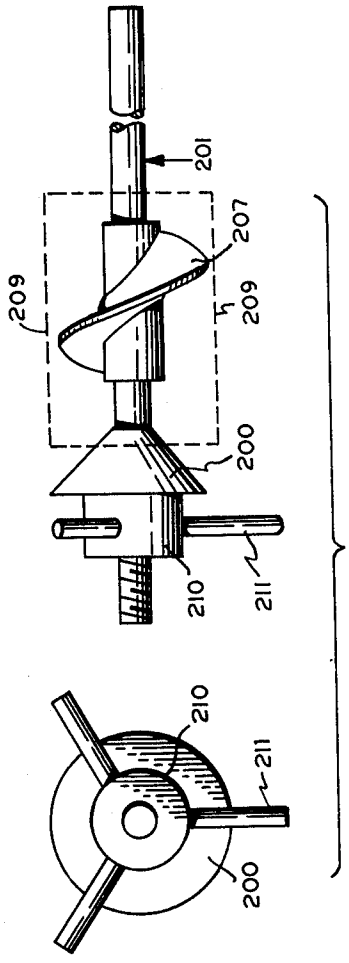


FIG.2 PRIOR ART

INVENTOR.
ROY MILTON WILLIAMS
BY Harry C. Braddock
ATTORNEY

July 14, 1964 R. M. WILLIAMS 3,140,652

DEWATERING PRESS CONE ADJUSTING DEVICE

Filed Feb. 2, 1962 3 Sheets-Sheet 2

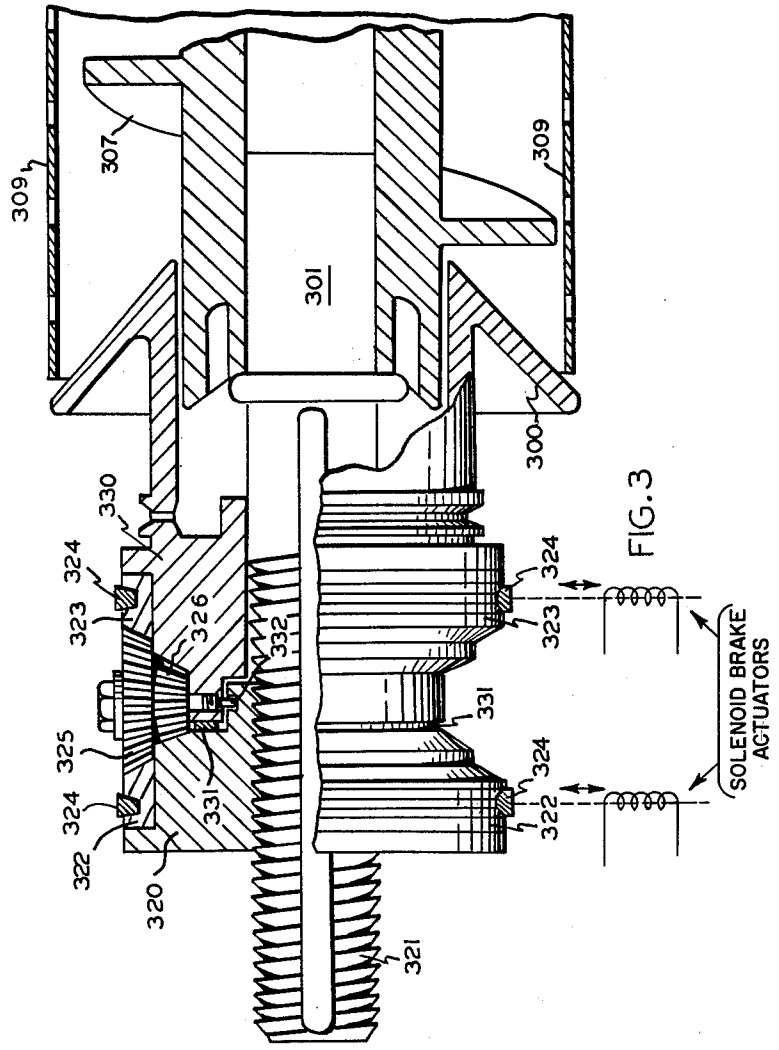


FIG. 3

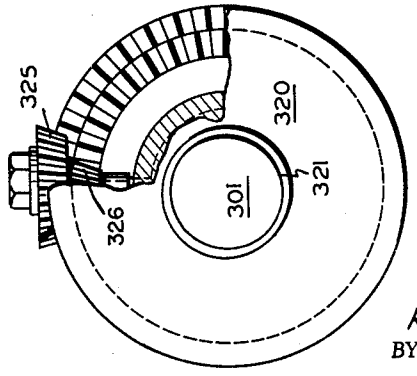


FIG. 4

INVENTOR.
ROY MILTON WILLIAMS
BY Harry E. Braddock
ATTORNEY

July 14, 1964 R. M. WILLIAMS 3,140,652

DEWATERING PRESS CONE ADJUSTING DEVICE

Filed Feb. 2, 1962 3 Sheets-Sheet 3

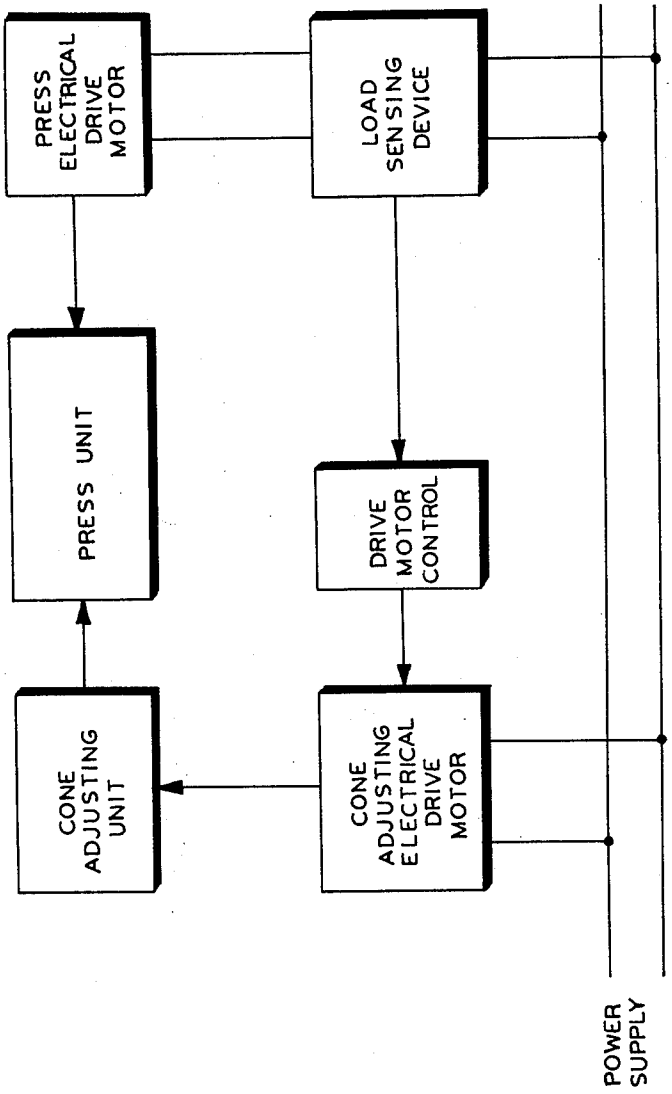


FIG. 5

INVENTOR.
ROY MILTON WILLIAMS
BY Harry C. Bradlock
ATTORNEY

United States Patent Office 3,140,652 Patented July 14, 1964

3,140,652

DEWATERING PRESS CONE ADJUSTING DEVICE

Roy Milton Williams, Waynesboro, Va., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

Filed Feb. 2, 1962, Ser. No. 170,557
2 Claims. (Cl. 100—148)

This invention relates generally to apparatus for extracting liquids from compressible masses containing liquids.

More specifically, this invention relates to an improved press apparatus for dewatering pulps, particularly to helical blade or screw type press apparatus having a mechanism for adjusting the clearance between the screw housing and the cone against which the pulp is pressed.

In pressing water and soluble by-products from pulps, such as cellulose or cellulose esters, it is usually desirable to remove as much of the liquid as possible. The final drying of the dewatered pulp by heating is made easier if most of the water is pressed out. Also, in many cases the water contains dissolved impurities, and if a large part of the water is removed by evaporation, these impurities are left in the product.

Presses of the helical blade or screw type have been used widely for such operations as pressing the juices from grapes and other fruits. These presses are used in continuous processes as contrasted to the batch operations of simple presses.

In the operation of a typical helical screw press the wet pulp is fed into one end of the press and is carried forward by a rotating helical blade toward a section of a right circular cone aligned with the axis of the blade and positioned adjacent one end of the blade with its projected vertex toward the helical blade. One of the conventional earlier types of presses is shown in FIGURE 1 on which the various parts of the press are identified.

In this press the cone **100** is keyed to the shaft **101** so that it rotates with the shaft, but it is free to slide axially along the shaft. It is held in position or moved forward or backward along the shaft by a strong lever **102** with its fulcrum at **103**. This lever is operated by turning the screw **104** by means of the hand lever **105**. The mechanical pressure against cone **100** is applied by means of a thrust bearing (not shown) in block **106** and in operation this thrust is opposed by the thrust of the pulp being pushed against the cone by the rotating helical blade **107**. The shaft **101** exerts an equal thrust against the thrust bearing **108**.

In the dewatering of pulps of cellulose acetate and similar materials the thrust against the bearing **108** and against the cone **100** and its thrust bearing may rise to 56,400 lbs. The shaft **101** in a typical press is about 4 inches in diameter and about 10 feet long. The helical blade is usually about 16 inches in diameter. The large thrust causes rapid wear on the thrust bearings with frequent shut downs for repair or replacement. Also the compressive force on the shaft sometimes causes this shaft to curve out of line and press the blade against the perforated housing **109** causing a flow of metal which closes the perforations and also frequently causing the shaft to break. This is especially likely to happen during a bearing failure.

The pulp fed to a press of this type often varies in water content and often in other respects as well. Its feed may sometimes be heavy and sometimes light so that it is necessary, if constant pressure is to be applied to the pulp, to vary the opening between the cone **100** and the end of housing **109** from time to time. If the load of pulp in the system is heavy and the opening between cone and housing is small, the pressure will become too great and damage to bearings and shaft are likely to occur. On

the other hand, if the opening between cone and housing is large with respect to the amount of pulp in the press, then the pressure on the pulp is low and it will retain a large amount of water. Therefore, for efficient operation of a press it is necessary to change the clearance between cone and housing from time to time without stopping the press. In the press shown in FIGURE 1 this is done by turning the screw **104** by use of hand lever **105**.

Another type of press is shown in FIGURE 2 with housing **209** and bearings (not shown). In this press also the cone **200** is keyed to the shaft **201** and rotates with the shaft, but is free to slide axially along the shaft. In this case the cone **200** is moved forward to backward along the shaft by the threaded nut **210** having radial spokes **211** mounted therein. In normal operation this nut **210** also rotates with the shaft **201** and remains at the same position on the shaft. However, since the shaft **201** rotates at a low speed of about 5 r.p.m., it is possible to turn the nut **210** by striking the spokes **211** with a sledge hammer, driving the nut **210** either forward or backward to decrease or increase the clearance between cone **200** and housing **209**.

The press shown schematically in FIGURE 2 has some advantages over that shown in FIGURE 1. The greatest advantage is that practically no thrust is transmitted to the bearings. The thrust is borne by the shaft which is subjected to tension between the nut **210** supporting the cone **200** and the helical blade **207**. Bearings in this press will last for long periods and since the shaft is subjected only to tension, there is less tendency for it to bend and damage the housing, or to break.

The disadvantage of this press is that it is inconvenient and somewhat hazardous to change the clearance between cone and helical blade or housing. The spokes must be struck while they are rotating and serious accidents have happened during this somewhat difficult procedure. Furthermore, the adjustment cannot be made quickly since the nut **210** can be turned only a fraction of a revolution with each hammer blow and the press may be damaged before a correction can be made. Because of the hazards and inconvenience of this type of press, the press of FIGURE 1 replaced the press of FIGURE 2, but was still unsatisfactory as explained above. It was somewhat easier to adjust than the press of FIGURE 2 but the wear and tear on bearings, shaft and housing made its operation uneconomical. There was, therefore, a definite need for an improved dewatering device that would not have the deficiencies of either of these two prior art presses.

The object of the present invention is to provide an improved mechanism for quickly, safely, and accurately adjusting the clearance between a press cone and its housing in a helical blade press while the press is operating. A further object is to develop such a cone adjusting mechanism which will eliminate the tremendous thrust on the shaft bearings in a helical blade press. A still further object is the provision of such a cone adjusting mechanism which will automatically change the cone clearance in response to variations of current through an electrical drive motor.

Further objects and advantages will be apparent from a consideration of the following specification and claims in conjunction with the accompanying drawings in which:

FIGURE 1 is a schematic illustration of one form of prior art helical blade pulp dewatering press,

FIGURE 2 is a schematic illustration of another form of prior art helical blade pulp dewatering press,

FIGURE 3 is a partial side elevational view partly in section of a liquid separating press embodying features of the present invention,

FIGURE 4 is an end view of the press of FIGURE 3 with certain parts broken away, and

FIGURE 5 is a block diagram schematic presentation

of a system embodying features of this invention for automatically adjusting the cone position in accordance with the electrical load on the press unit electrical drive motor.

The above objects are accomplished in the present invention by the apparatus depicted in FIGURE 3 which comprises a threaded nut **320** on a threaded portion **321** of the shaft **301** of a helical press, two ring gears **322** and **323** each having a brake band **324**, a chuck type pair of gears **325** and **326** meshed respectively with the two ring gears **322**, **323** and with the threaded nut **320**; the structure so arranged that when the brake band **324** on one ring gear **322** is tightened the nut **320** will be rotated in one direction with respect to the shaft **301**, and when the brake band **324** on the other ring gear **323** is tightened, the nut **320** will rotate in the opposite direction with respect to the shaft **301**, causing the press cone **300** to move in one direction or the other along the shaft.

The improvement in this press apparatus of FIGURES 3 and 4 primarily involves the mechanism for adjusting the cone **300** to vary the clearance between cone **300** and housing **309**. The bearings are not shown in these figures of the drawing. In normal operation cone **300**, block **330** and nut **320** all rotate with the shaft **301** at about 5 r.p.m. It will be noted that block **330** is keyed to the shaft, but free to slide along the shaft along with cone **300**. Nut **320** is threaded and screwed onto the threaded portion **321** of the shaft **301**. The ring gears **322** and **323**, rotate freely and independently of block **330** and nut **320** respectively. Brake bands **324** do not rotate. The ring gears **322** and **323** are meshed with gear **325** which is rigidly connected with gear **326** which is meshed with the gears on nut **320**, but is not in contact with block **330**.

The end of shaft **301** is threaded with beveled threaded portion **321** which matches the threads in nut **320**. These threads withstand the full thrust of the press.

In normal operation the helical blade **307** of the press, the cone **300**, block **330**, nut **320** and ring gears **322** and **323**, all rotate together and gears **325** and **326** are rotationally still about their own axes, but revolve bodily around the shaft **301** with the other parts. The shaft **301** rotates in the direction such that the top of the shaft comes toward the viewer. Now if the brake band **324**, on the right as viewed in FIGURE 3, is tightened on ring gear **323**, the latter will be slowed down or stopped so that it will no longer rotate with the remainder of the assembly. This will cause gears **325** and **326** to rotate about their axes as they continue to revolve around the shaft. The rotation of gear **326** will drive nut **320** to the right as seen in FIGURE 3 so that it rotates faster than shaft **301** and the entire assembly, including cone **300** will move to the right along the shaft and will decrease the clearance between cone **300** and housing **309**.

If the other, or left band in FIGURE 3, is tightened on ring gear **322**, then the reverse will happen. As ring gear **322** slows down or stops, gears **325** and **326** will be caused to move to the left in FIGURE 3 and gear **326** will cause nut **320** to rotate slower than shaft **301** and the entire assembly will move to the left increasing the clearance between cone **300** and housing **309**. When the assembly moves to the right the nut **320** presses against the thrust washer **331** which contacts block **330** which in turn contacts cone **300**. When the control assembly moves to the left, it pulls the cone **300** along with it by means of the pin **332** which is an extension of the axle of the gears **325** and **326**. The pin **332** is firmly held in block **330** and the end of pin **332** slides in an annular groove in the nut **320**.

The adjustment by means of brake bands **324** as described above may be slow or rapid depending on whether the ring gear involved is merely slowed down or stopped. Thus, the clearance between cone **300** and housing **309** can be varied quickly before trouble develops or before wet pulp is allowed to escape. Or the adjustment can be slow, if desired, but accurately controlled to give the correct desired pressure on the pulp. In one embodiment of this invention the electrical motor driving the shaft ordinarily requires or draws about 20 amperes of current which is continuously shown on an ammeter and registered on a time chart. Variations in the drive motor load as reflected in the reading of the ammeter will indicate a need for changing the clearance between cone and housing. A higher current will show that the pressure against the helical blade **307** is abnormally high calling for more power from the motor. The clearance should be increased to prevent damage to the equipment and possibly to the pulp being processed. If the current is low, the pulp is going through under too low a pressure and will carry too much water and impurities. Accordingly, decreasing the clearance would be desirable.

The operation of brake bands **324** can, if desired and with ordinary skills, be made entirely automatic by the use of solenoids activated by changes in the shaft drive motor current.

It will be obvious that in this press there will be no thrust upon the shaft bearings, hence bearing replacement is no longer a factor in maintenance cost. The shaft is now under only stretch tension, instead of the compression that occurs in the press of FIGURE 1. There is no tendency for the shaft to bend and damage the housing and shaft breakage has been substantially eliminated by apparatus embodying this invention.

The power savings achieved by the elimination of shaft deflection and heavy thrust loads on bearings is converted to useful work resulting in a pressed pulp with an average moisture content 5% lower than that of pulp processed through presses as shown in FIGURE 1. This means a corresponding reduction in the heat required to dry the pulp.

The improved press of this invention also operates more safely than either of the earlier presses.

As an illustrative indication of the advantages and utility of the present invention the following comparison was made.

The press shown in part in FIGURE 3 was used to extract water from a pulp containing 3% cellulose acetate. This press rotating at 5 r.p.m. continuously reduced the pulp to a product containing 60% cellulose acetate and 40% water. It was found that on the average 5% more water was removed from similar pulp than when operating with the press shown in FIGURE 1. Furthermore, over a period of several months, there was no bearing failure since with the improved apparatus bearing thrust was eliminated. Since no force was acting to deflect the shaft, there was no shaft breakage and no erosion of housing by the helical blades. With the old type of press the holes in the housing were frequently closed by such abrasion and had to be drilled out. In the new equipment a small part of the shaft is subjected to tension and none of it to compression. This is believed to contribute to the improved results. A significant reduction in operating accidents occurred with the press of this invention as compared with the frequent accidents occurring with the conventional press shown in FIGURE 2 where a sledge hammer is used to adjust the press cone.

Various types of automatic controls or actuating devices, as discussed herein, can be incorporated to obtain instantaneous response of the cone adjuster mechanism to changes in the current requirements of the electrical press drive motor.

While a preferred embodiment of this invention has been described in detail, many variations and modifications within the spirit of this invention will occur to those skilled in the art. All such variations and modifications are considered to fall within the scope of the following claims.

What is claimed is:

1. An improved press apparatus for extracting liquid from a compressible mass containing a liquid, said apparatus comprising in combination, a hollow foraminous cylindrical casing having a central axis, a rotating assem-

bly mounted for rotation about the axis of said casing and positioned adjacent one end of said casing, said assembly comprising a first rotating element positioned within said casing and having a material forwarding surface, said element and said material forwarding surface constructed and arranged to positively displace a mass of material positioned within the casing in a given axial direction toward said one end of the casing, said assembly, further comprising a second element mounted for rotation with said assembly positioned adjacent said one end of said casing, said second element constructed and arranged to oppose movement of material displaced toward said end of said casing to compress the same during rotation of said assembly, said second element cooperating with said one end of the casing to form a restricted discharge passageway for exit of the compressed material during rotation of said assembly, said second element mounted for limited axial movement along the casing axis with respect to the casing during rotation of said assembly, said assembly further comprising a planetary gear means directly physically engaged with said second element, and braking means cooperating with said planetary gear means, said braking means actuatable for positively rapidly smoothly selectively adjusting the axial position of said second element with respect to said one end of said casing in an infinitely variable and reversible manner during rotation of said assembly to thus vary the size of the restricted discharge passageway.

2. The improved apparatus of claim 1 in which said assembly further comprises a cam means for causing axial movement of said second element and said planetary gear means comprises a third element rotatably mounted on said assembly, said third element positioned in operative engagement with said cam means of said assembly such that rotation of said third element relative to said assembly causes axial movement of said third element relative to said assembly, said third element operatively coupled to said second element to transmit bidirectional axial movement thereto, a first annular bevel gear member freely rotatably mounted on said second element for rotation about an axis coincident with said casing axis, a second opposed annular bevel gear member freely rotatably mounted on said third element for rotation about an axis coincident with said other bevel gear axis, a third annular bevel gear member rigidly connected to said third element and in axial alignment with said other gear members, at least one planetary bevel spur gear member operatively engaged with said first and second bevel gear members for rotation about its own axis perpendicular to the axis of the other bevel gear members and supported in said second element for rotation, therewith and for revolution about the axis of said other bevel gear members, said planetary bevel spur gear provided with another aligned planetary bevel spur gear rigidly attached thereto and in operative engagement with said third annular bevel gear member, said braking means cooperating with said annular bevel gear members for selectively causing relative rotation between said first bevel gear member and the second element and between the second bevel gear and the third element to vary the position of the third and second element axially with respect to the casing.

References Cited in the file of this patent

UNITED STATES PATENTS

2,178,714	Anderson	Nov. 7, 1939
2,340,009	Meakin	Jan. 25, 1944
2,609,744	Rietz	Sept. 9, 1952
2,901,967	Ornulf Dahl	Sept. 1, 1959

FOREIGN PATENTS

1,227,735	France	Mar. 7, 1960