

June 29, 1965

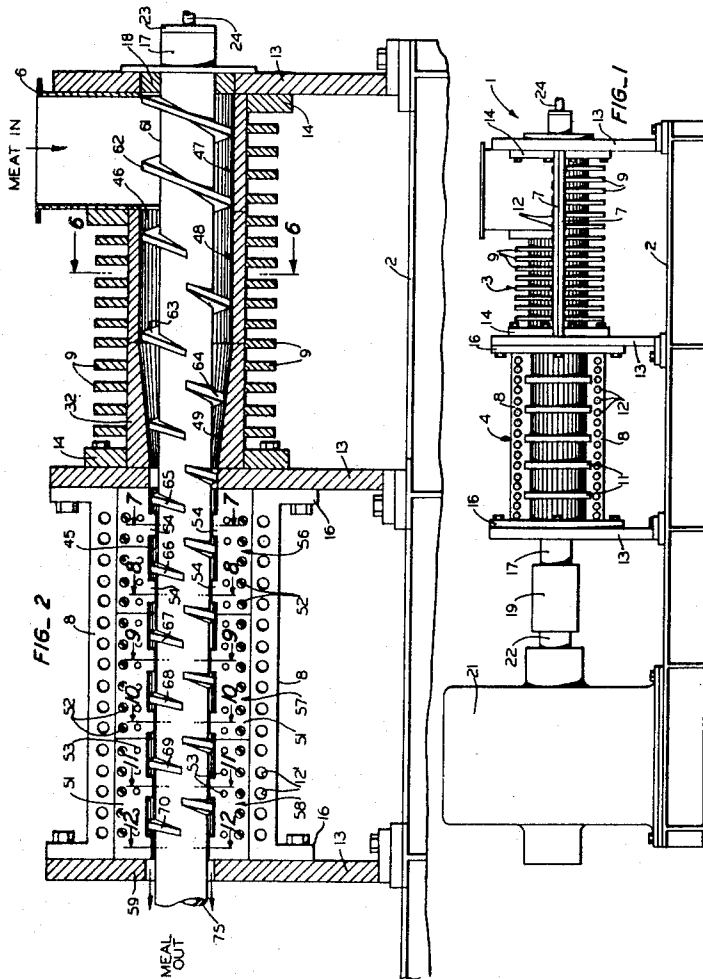
S. HILLER

3,191,521

FLUID EXPRESSING METHOD

Original Filed Aug. 24, 1959

3 Sheets-Sheet 1



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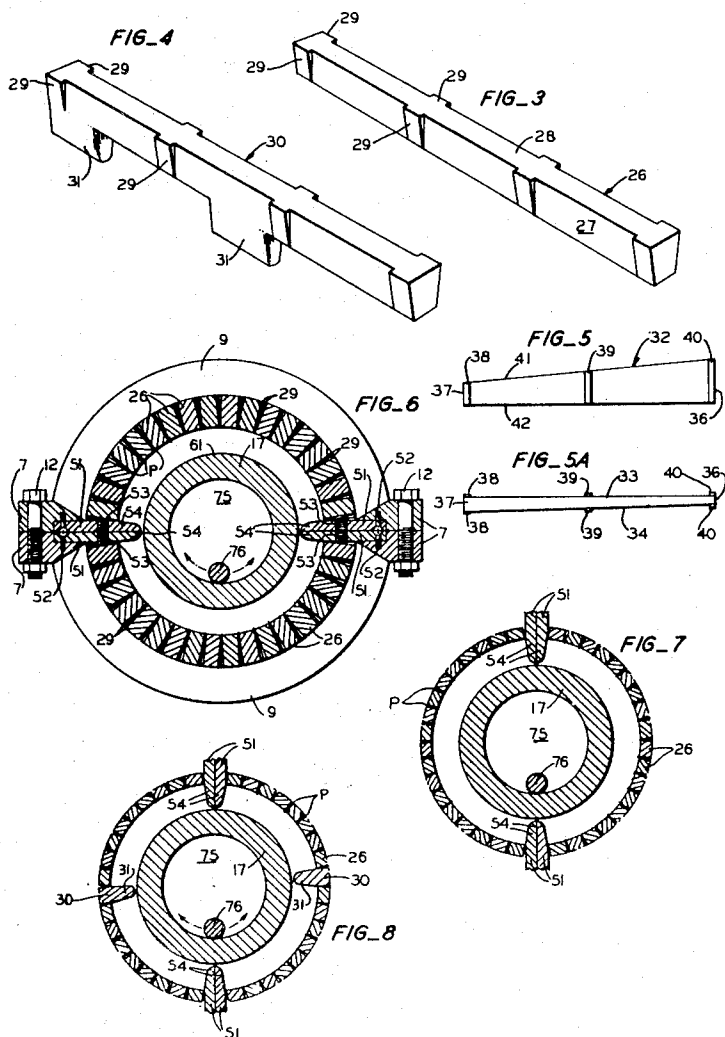
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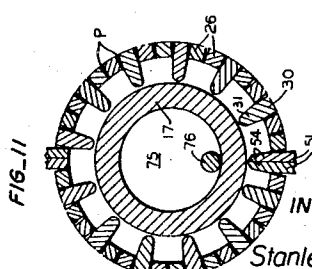
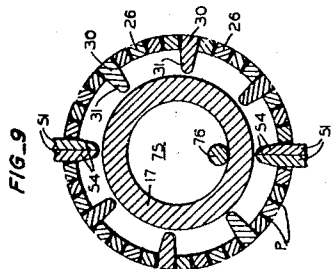
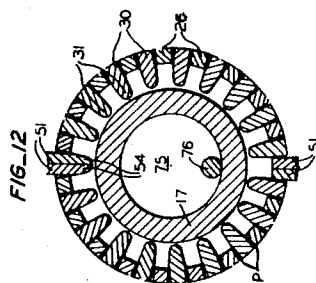
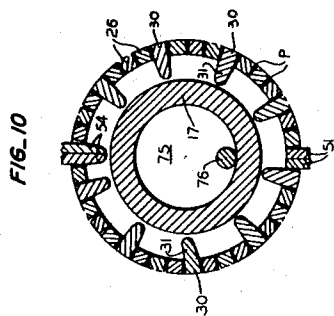
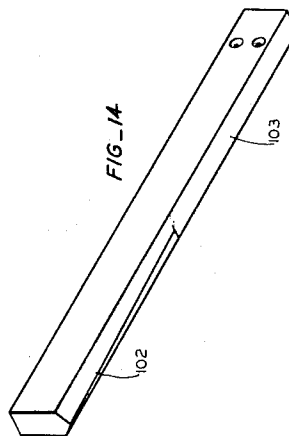
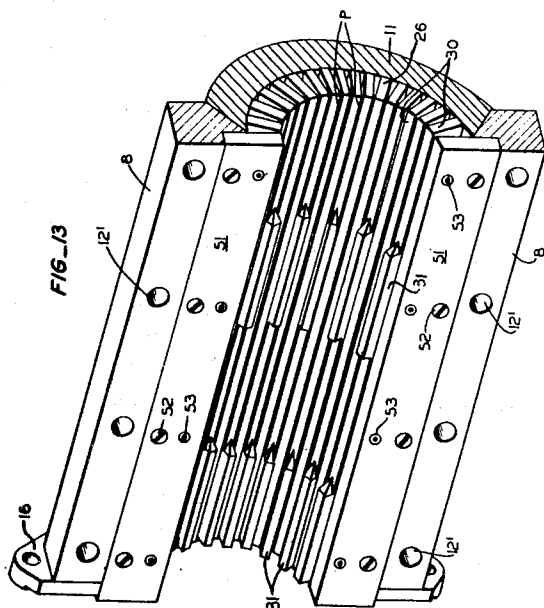
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FLUID EXPRESSING METHOD

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3 Sheets-Sheet 3



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3,191,521

FLUID EXPRESSING METHOD

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Original application Aug. 24, 1959, Ser. No. 835,698, now Patent No. 3,130,666, dated Apr. 28, 1964. Divided and this application July 16, 1963, Ser. No. 301,227
8 Claims. (Cl. 100—37)

This invention relates generally to a method for mechanically expressing fluids from fluid bearing materials and this application is a division of application Serial No. 835,698, now Patent No. 3,130,666 dated April 28, 1964.

More particularly, this invention relates to a high pressure fluid expressing method for extracting fluids such as oil, fat or juice from fluid bearing material. The method of the present invention and the press and cage assembly illustrated herein for use in conjunction with carrying out said method are particularly well adapted for the processing of various fluid bearing materials, such as coconut meat, soya beans, fish, animal meat, cotton seeds, apples or other fruits, and the like. This invention may be employed, however, for treating other fluid bearing materials which are susceptible to fluid extraction upon the application of pressure thereto.

Summarizing this invention, its objects, among others, include the provision of a novel method for expressing fluid from fluid bearing materials; the provision of a fluid expressing method which employs a novel press and cage assembly during its performance; the provision of a fluid expressing method which utilizes the application of pressure, and in which such pressure is maintained on the material being treated by compensating for volume changes in such material as fluid is extracted therefrom; and the provision of a fluid expressing method which precludes burning of material being treated by preventing rotation of such material during extraction of fluid therefrom in a rotary type press and cage assembly. These and other objects of this invention will become evident from reading the following description.

The fluid expressing method of the present invention is an improvement over the press and method disclosed in Hiller et al. Patent No. 2,149,736 granted March 7, 1939. Similarly, the press of this invention is an improvement over the press and method disclosed in abandoned application, Serial No. 584,584 filed May 14, 1956, of which the aforementioned application No. 835,698 is a continuation-in-part. For a thorough discussion of the general principles of operation of rotary type screw presses and heretofore known methods of expressing fluid from fluid bearing materials, reference is directed to the just mentioned patent and abandoned application.

Fluid expressing presses and methods have been known in the art heretofore and commonly employ rotary compression screw shafts therein for treating material fed into such presses to express fluid therefrom by compressing the material between the screw shaft and the press cage. However, such prior art constructions consume large quantities of power in the pressing operation and fail to obtain uniformly high quality results in that fine particles of material being treated frequently are expressed from the press with the extracted fluid. The construction of a press desirably and effectively employed in carrying out the present method, however, permits generation of high pressures therein while requiring less power than

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heretofore and without discharging quantities of fine particles of material with the fluid which is extracted.

Surrounding the screw shaft in such a press suitable for performing the present method is a generally cylindrical annular press cage grid assembly comprised of a plurality of spaced elongated grid bars which are separated from each other by various spacer means to provide substantially radial discharge passages. Upon rotation of the screw shaft in the bore of the press, the material in the press is compressed between the screw and the grid assembly and fluid in the material is expressed therefrom and discharged generally radially through the discharge passages to the exterior of the press where it is collected for subsequent use. The material from which the fluid has been extracted (hereinafter called meal) is discharged from the end of the press. An important feature of the method embodied in this invention as will be pointed out fully hereinafter, resides in its preferred use of the novel construction of the grid cage assembly of the press described in detail in aforementioned Patent No. 3,130,666 which produces effective oil extraction to provide large quantities of free oil which are substantially unaccompanied by fine meal particles.

Novel features of the present invention over previously known fluid extracting methods will become evident from the following disclosure, reference being directed to the accompanying drawings in which:

FIG. 1 is a side elevational view of a press assembly and the power source therefor desirably employed in practicing the method of this invention;

FIG. 2 is a longitudinal vertical section of the press assembly of FIG. 1 on an enlarged scale relative thereto;

FIG. 3 is an isometric view of a grid bar employable in the press;

FIG. 4 is an isometric view of a modified grid bar having pressure maintaining and rotation preventing damping projections extending from one surface thereof;

FIG. 5 and 5A are side and plan views, respectively, of a tapered grid bar of the type employed in the feed section of the press;

FIG. 6 is a vertical section taken in the plane of line 6—6 of FIG. 2;

FIGS. 7 through 12 are vertical sections taken in the planes of lines 7—7 through 12—12, respectively, of the pressure section of the press of FIG. 2;

FIG. 13 is an isometric view of a grid body section of the press, the section illustrated being that employed at the discharge end of the press;

FIG. 14 is an isometric view of a modified grid bar construction.

As noted previously, the present invention relates to an improved method for mechanically extracting fluid, such as oil or fat, from materials such as dried fresh coconut meat, fish, soya beans, cotton seed or the like, and juices or other liquids from fruits or other liquid bearing material. A press construction well suited and designed for practicing the method of this invention is shown in FIG. 1 and comprises a press and cage assembly generally designated 1 which is mounted upon and bolted to a supporting frame or base 2 in the well known manner.

Press construction 1 is divided into a hollow feeder section 3 and a hollow pressure section 4, the bores of which desirably are longitudinally aligned with each other and which define a continuous internal passageway through the press through which material to be treated

is passed. Feeder section 3 includes a feed hopper 6 into which material to be treated is introduced manually or mechanically as desired.

Each of feeder section 3 and pressure section 4 is defined by opposite grid body sections each of which comprises a pair of longitudinally extending flange members 7 and 8 in the feeder and pressure sections, respectively. Extending between the respective flanges of the press sections are a series of arcuate ribs 9 in the feeder section and 11 in the pressure section. A series of bolt and nut fasteners 12 are employed to secure together opposite grid sections of the press by passing the same through appropriate bores 12' provided through flanges 7 and 8. The respective flanges and ribs of the respective press body sections may be formed as integral castings or the ribs may be welded or otherwise secured to the flanges. It is against the ribs 7 and 8 that outer portions of the series of grid bars which define the passageway through the press are engaged. Because of the arcuate configuration of the ribs, the grid bars define a generally annular press body when the various body sections are operatively assembled.

Extending upright from support base 2 of the press are a series of vertical standards 13 to which base plates 14 of the feeder section and 16 of the pressure section are bolted in the well known manner. By releasing certain of the securing bolts, opposite body sections which make up the press body may be separated from each other to gain access to the press interior for cleaning or for replacing or modifying the arrangement of the grid bars positioned therein.

Extending through the passageway or internal bore through feeder section 3 and pressure section 4 is an elongated hollow screw shaft 17 which, as shown in FIG. 2, is journaled at one end in bearing 18 for rotation. A coupling 19 of any conventional construction may be employed between the other end of the shaft and a power source 21 employed for driving the shaft. Such power source 21 may be of any suitable type but desirably a multi-horsepower electric motor is employed. Stub shaft 22 extends from power source 21 and is operatively connected to screw shaft 17 by coupling 19. Bearing means is employed in the housing of power source 21 for journaling stub shaft 22 so that screw shaft 17, through coupling 19, is properly supported for rotation.

Screw shaft 17 is provided with a longitudinal bore extending throughout its length and the end of shaft 17 remote from power source 21 is capped by a cover plate 23 which is fastened over the end of the shaft by bolts, screws or the like. Cover plate 23 is apertured and a connection 24 for connecting the shaft bore to a source of a suitable shaft cooling medium extends therethrough for a purpose to be described.

Described briefly, operation of the press is as follows: a quantity of fluid bearing material, such as fresh coconut meat dried to a moisture content of below 5%, is introduced mechanically or manually into feed hopper 6 at the bottom of which it is engaged by screw shaft 17, the screw flights of which urge the material longitudinally through the bore of the press and which apply pressure thereto until the majority of fluid (oil in the case of coconut meat) is expressed therefrom. Because the body of the press is provided with substantially radially extending fluid discharge passages each of which is defined by a pair of adjacent grid bars, fluid expressed from the material may pass from the press and can be collected in suitable containers (not shown) positioned on the support base 2 of the press in a well known manner. Because of the high pressures developed in the press, of the order of 10,000 to 30,000 pounds per square inch, the major part, if not all, of the fluid may be extracted from the material being treated. For example, in the case of coconut meat, the oil content thereof may be reduced to a level of 5 to 8% by weight; the oil content of soya beans and cottonseeds may be reduced to approximately

2½% and 3% respectively; and the oil content of meat scraps or fish may be reduced to from 6 to 10%. Lower oil contents also are obtainable but the above listed levels produce meals which are acceptable commercially.

While, as noted previously, rotary type screw presses have been known in the art heretofore, the constructions thereof do not produce results that are all that could be desired. It has long been a problem with rotary screw presses that material moved by the screw tends to rotate therewith. This condition detracts from the build-up of pressure necessary to obtain effective fluid extraction. Also, rotation of material with the screw under high pressure results in burning of material due to the high frictional heat produced. Similarly, rotatable damming restrictions or mechanical ring-like stops have been provided on the screw shafts of the prior art presses, as disclosed in aforementioned Patent 2,149,736, for the purpose of periodically restricting movement of material through the press and to cause the same to back up so that substantial pressure in the press can be produced. Such damming rings increase the tendency of the material to rotate with the screw and also force the material outwardly radially so that fine particles of meal are extracted with the fluid. Likewise, adjustable rings, orifices or like complicated mechanisms have been provided at the discharge end of prior art presses for restricting the discharge opening so that a final pressing operation can be effected before the material is discharged from the press. These features as noted have not produced entirely satisfactory results in the final product and require the use of unnecessary amounts of power and unnecessary expense in operation.

Similarly, although attempts have been made with prior art devices to prevent rotation of material with the rotary screw by providing so-called knife bars on the grid bar retaining plates of the press as disclosed in aforementioned Patent 2,149,736, the number of such knife bars usable and their effectiveness is limited. This is so because only two diametrically opposite retaining plates are used in each semi-cylindrical press body section. As a result, the total number of knife bars at any given cross-section of the press is limited to two.

With the present invention, however, press body grid bars are provided which employ immovable damming projections thereon which perform the dual function of precluding rotation of material as it passes through the press so that damage due to frictional heat is minimized and which also compensate for changes in volume of material as fluid is expressed from the material so that pressure may be maintained at least constant throughout the press section or may be progressively increased there-through so that most effective fluid extraction can be produced. Because such projections are provided directly on the grid bars, their position, location and number may be modified as desired to compensate for change and decrease in material volume during the fluid extraction process. That is, the number of such projections at any given press cross-section can be progressively increased from the infeed end of the press to the discharge end so that compensation for decrease in material volume can be made by decreasing the volume of the passageway through the press through which the material is movable.

Furthermore, because the damming projections of the present described press extend generally radially into the press passageway from the body thereof, rather than extending radially outwardly from the screw shaft as was true of the prior art constructions, movement of material through the press in a straight path is effected and tendency of the material to be forced radially outwardly also is prevented. As a result, the forcing of fine particles of material radially outwardly with the expressed fluid is greatly minimized. Therefore, highly satisfactory results are provided with this press and the fluid expressing method employed thereby. In addition, no expensive and complicated adjustable rings, orifices or like mechanisms

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are required at the discharge end of the press as was heretofore common.

Referring to one embodiment of grid bar employable with a press for carrying out the method of this invention, reference is directed to FIG. 3 in which a grid bar 26 having a substantially rectangular cross-section defined by opposite side faces 27 and opposite surfaces 28 extending between such side faces 27 is disclosed. Spacer means in the form of wedge shaped spacer elements 29 project laterally from opposite side faces 27. The function of the spacer elements 29 is to maintain separation of adjacent grid bars so that a substantially radial fluid discharge passage may be provided between adjacent bars when the bars are positioned in a press body. Because the spacer elements 29 are wedge shape, each fluid discharge passage (designated P in the drawings) is imparted with a flaring configuration which widens from the interior to the exterior of the press cage body so that fluid flow may be easily effected. Furthermore, because spacer elements 29 are of very narrow width compared to the overall length of the bar and because such elements are widely spaced along the length of the bar, each fluid passage defined between adjacent bars is substantially unrestricted adjacent the press body interior so that fluid flow is substantially unrestricted. Because the spacer elements desirably are arranged uniformly on the respective grid bars, the spacers of one bar provide seats for the spacers of the adjacent contacting bar.

While in the embodiment illustrated in FIG. 3 spacer elements are provided on each of the opposite faces 27, it should be understood that, as an alternative construction, spacer elements could be formed on only one of the side faces of the bar. With such construction, a discharge passage would be effected between a pair of bars by the spacer elements of one bar engaging a planar face of the other bar.

FIG. 4 illustrates a grid bar 30 of the general type shown in FIG. 3, but which includes damming means thereon for performing the dual purpose of maintaining pressure in the press by compensating for changes in volume of material being pressed and precluding rotation thereof. Such means is in the form of spaced damming projections 31 which project from one surface of the grid bar and extend in a direction generally parallel to the opposite side faces of the bar from which spacer elements 29 project. The height of the projections may be varied depending upon press size, the material being pressed, etc. With the exception of projections 31, the bars shown in FIGS. 3 and 4 desirably are the same and the location of the spacer elements thereon identical. In this manner, bars of the type shown in FIGS. 3 and 4 may be alternated in any arrangement desired in an assembled press cage. While in FIG. 4, two damming projections are shown on the bar, it should be understood that the number and location of such projections on a bar may be modified as desired to produce the desired results in an assembled press. The leading end of the projections may be rounded, as shown in FIG. 4, or pointed or tapered as shown in FIG. 13.

Because of the simple construction of these bars, the same may be cast in the configuration shown in FIGS. 3 and 4 from any suitable hard, strong material, such as alloy steel or the like. Thereafter the only machining which may prove desirable is a grinding operation in which all wedge shaped projections 29 may be finished off simultaneously to insure that the same all have their outer faces lying in the same plane so that rigid seats are provided for spacers of adjacent bars.

The grid bars thus described are usable throughout the pressure section 4 of the press and also may be employed closely adjacent the infeed end of the feeder section 3 of the press. However, a particular type of inclined grid bar of the type shown in FIGS. 5 and 5A is employed in one portion of the feeder section where the bore of the feeder section is reduced in diameter to produce an initial

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stuffing or fluid expressing operation. Such inclined bars are designated 32 and have opposite side faces 33 and 34 which are inclined relative to each other and which converge towards one end 36 of the bar and diverge toward opposite end 37. Spacer elements 38, 39 and 40 are provided which project from each of such opposite side faces and such spacer elements extend from the respective side faces a distance which increases progressively towards end 36 of the bar.

Inclined bar 32 also includes opposite surfaces 41 and 42 which extend between side faces 33 and 34. These opposite surfaces 41 and 42 also are inclined relative to each other and converge towards end 37 of the bar and diverge toward end 36 as shown in FIG. 5. In this manner bar 32 is imparted with a dual inclined construction by means of which the bore of the press in the feeder section may be transformed from a larger diameter to a progressively smaller diameter.

The construction of the press cage body is illustrated in FIGS. 2 and 6-13. The filler section 3 of the press comprises upper and lower grid body sections in the upper of which the feed hopper 6 mentioned previously is positioned. The flanges 7 of the respective upper and lower sections between which are arcuate ribs 9 extend are generally horizontally arranged so that the upper section and the attached feed hopper may be withdrawn from the lower section so that access may be gained to the press interior. This is in distinction to the arrangement of the flanges 8 of the pressure section 4 which are arranged generally vertically so that the opposite cage sections thereof may be separated from each other by removing all but the two bottom retaining bolts securing the same to upright standards 13 and pivoting the opposite cage sections outwardly relative to each other about such bolts to expose the interior thereof. The construction illustrated in FIG. 1 with the flanges 7 of the feeder section being aligned generally in the same horizontal plane is preferred so that the feed hopper 6 may be positioned at one end of the upper half of the cage body of the feeder section so that cutting away of flanges 7 is not necessary as would be the case if such flanges were positioned in the same vertical plane as is true of the flanges 8 in the pressure section.

The grid body of the feeder section desirably is defined into three series of circumferentially arranged grid bars having side faces of adjacent bars opposing each other and spaced from each other by spacer elements interposed therebetween to define fluid flow passages P. (See FIG. 6.) In this manner the body of the feeder section is provided with an annular bore 46 which extends through the feeder section and communicates with and is axially aligned with an annular bore 45 in the pressure section 4 of the press as shown in FIG. 2. While grid bars of long, one piece construction could be used, desirably shorter grid bars which may be more easily produced and heat treated when necessary without attendant distortion are employed. In the feed section illustrated, three lengths of longitudinally arranged bars positioned in abutting end to end relationship are employed to define the grid body thereof. The bars in the first two series 47 and 48 desirably are of the construction shown in FIG. 3 which are free of radial damming projections so that the bore 46 in the areas of these bars has a substantially circular inner periphery as shown in FIG. 6. However, in section 49 of the feeder section, tapered bars 32 of the type illustrated in FIGS. 5 and 5A are employed to impart a tapered or conical configuration to the bore 46 to reduce the diameter thereof to the same size as that to be employed in the pressure section of the press.

As shown in FIG. 6, the face to face flanges 7 are horizontally arranged and grid bar retaining plates 51 extend generally radially from each of such flanges and are removably secured thereto by screw connectors 52 or the like which pass through appropriate holes provided in the retainer plates and which are threaded into tapped holes provided in arcuate ribs 9. The retaining plates employed

in the feed section are of the type illustrated in FIGS. 2 and 8 and used in the pressure section of the press. Desirably such retaining plates, while the same could be of single elongated construction, are of a length substantially equal to the lengths of the grid bars which they maintain in position.

The retaining plates are provided with means for adjustably urging the respective grid bars into engagement with each other and with the arcuate ribs of the cage body so that the cage body is capable of withstanding the tremendous torsional forces produced when screw shaft 17 rotates during the fluid expressing operation. Such means comprises a series of set screws 53 which extend through threaded bores in the retaining plates 51 and engage the side surfaces of the grid bar positioned adjacent the respective retaining plates. Any suitable number of such set screws may be employed with a retaining plate, but desirably four or five such screws are used for each retaining plate.

Set screws 53 are particularly effective in that they preclude the need for accurate tolerances being maintained during manufacturing of the grid bars; furthermore the set screws allow the grid bars to be adjustably urged toward each other to compensate for wear in the grid bars as the same are eroded or worn due to the passage of fluid from the press under the high pressure generated therein. In addition, the set screws are effective to provide additional fluid drainage passages in that the grid bars positioned adjacent the respective retaining plates can be spaced therefrom a predetermined distance so that fluid may flow between the retaining plate and the adjacent grid bar.

Desirably the retaining plates 51 also are provided with radially projecting knife bars 54 as shown in FIGS. 2 and 6. Such knife bars have been known broadly in the art heretofore as disclosed in the aforementioned Hiller et al. Patent 2,149,736. However, the use of such bars heretofore has been limited solely to attempts to preclude rotation of material carried through the press. Because the number of such bars heretofore usable was limited, the results obtained have not been highly successful. In the embodiment shown in FIG. 6, each of the adjacent retaining plates 51 is provided with longitudinally spaced series of knife bars arranged face to face to provide series of material rotation preventing projections.

The grid body section 49 adjacent the pressure section of the press as described previously is defined by a series of tapered bars 32 of the type shown in FIGS. 5 and 5a. Bars of this character also are arranged side by side and separated from each other by spacer elements provided to define a series of substantially radial discharge passages P therebetween. Because the bars are arranged with their opposite inner and outer surfaces 41 and 42 diverging in the direction toward the pressure section 4 of the press, the bore 46 through the feed section is progressively decreased in diameter and a conical restriction is provided. Because the side faces 33 and 34 of the bars 32 longitudinally converge in the direction toward the pressure section of the press, substantially uniform dimension discharge passages may be maintained about the periphery of the grid body in the section 49 thereof.

As material is fed into the press through the feed hopper and fed toward the pressure section 4 by screw shaft 17, the restricted conical section 49 effects an initial compression of the material so that voids in the material are filled and the material is more or less stuffed to compact the material to facilitate subsequent fluid extraction. In this manner, air introduced into the press with the material may be driven off and also an initial fluid extraction may be effected.

The bore 47 in the pressure section 4 of the press is defined by three separate annular series 56, 57 and 58 of grid bars which are arranged to maintain bore 47 of substantially constant internal diameter throughout its full length. That is, with the exception of volume com-

pensating and rotation preventing damming projections provided on the bars as will be described, the periphery of bore 47 takes the form of a right circular cylinder. In the pressure section, grid bars of both types shown in FIGS. 3 and 4 are employed in varying arrangements starting from the end of bore 45 adjacent to feeder section 3 of the press and varying toward the discharge end 59 of the press. That is, as shown in FIGS. 7 through 12, the grid bars of the body of the pressure section are arranged so that damming projections are positioned to extend substantially radially inwardly from the periphery of the bore 47 to fill up the passageway and to restrict the passage of material through the passageway to compensate for changes in volume of the material as fluid is extracted from the material progressively during its travel through the pressure section.

In the infeed end of the pressure section, such projections may be defined by diametrically opposite knife bar projections 54 provided on retaining plates 51 as described previously if so desired. Thereafter, however, grid bars of the type shown in FIG. 4 are alternately interposed in varying arrangements between the retainer plates, desirably in a regular pattern, so that the number of such projections progressively increases toward the discharge end of the press. In this manner the volume of the bore 45 in the pressure section is progressively decreased so that pressure in the pressure section may be maintained at least substantially constant and desirably is progressively increased toward the discharge end. That is, the projections 31 on the grid bars and 54 on the retaining plates compensate for the loss of volume of the material as a result of fluid expressed radially through the discharge passages of the press and progressively fill up the spaces between adjacent screw flights on the rotatable screw shaft 17 passing therethrough.

Initially as shown in FIG. 7, only two diametrically opposite projections are employed at the entering end of the pressure section, while, referring to FIG. 12 which is a section taken immediately adjacent the discharge end 59 of the press through which the low content oil meal is discharged, substantially every other grid bar in the press is provided with such projections so that the volume of the bore 47 in this location is substantially reduced to about 50% of the volume at the entering end of the pressure section.

While in FIGS. 7 to 12 the arrangement of the projections has been illustrated as being varied in a generally regular manner from a projection extending inwardly from between each eighteenth grid bar at the entering end to a projection on every other grid bar at the discharge end as shown in FIG. 12, the exact arrangement and number of projections employed may be varied depending upon the material being treated and its fluid content. The arrangement illustrated, however, has proved satisfactory for expressing oil from coconut meat, which in the fresh, wet condition contains up to 30% oil. After the majority of the water is dried from the meat in any suitable manner, in which dried condition the meat is introduced into the press, the expressible oil content thereof is about 62% by weight, which is reduced in the press to an acceptable level of from 5 to 8%.

In this manner it should be understood that the projections employed serve as dams which fill the gaps between adjacent screw flights of the screw shaft. However, such dams are in distinction to prior art arrangements in which rotatable conical rings or the like were provided directly on the screw shaft for rotation therewith which produced undesirable rotation of the material and forced the same radially outwardly with oil expressed from the material. With the present construction, however, because the damming projections are stationary and extend inwardly from the periphery of the bore 45 of the pressure section of the press, the same do not effect undesirable rotation or radial outward movement of the material, but serve as stoppers to compensate for volume changes in the material

as fluid is expressed and to maintain pressure in the press. Furthermore, the projections thus employed insure that the material moved by the screw shaft cannot rotate therewith, but rather force the material to travel in a straight path through the press.

The screw shaft 17 employed with the press, as a result of the use therein of volume compensating projections as described, need not have an expensive tapered or like modified construction. As shown in FIG. 2, desirably the shaft has a uniform root diameter 61 throughout its length. As a result the shaft does not require expensive machining operations or the like which heretofore have been employed in providing screw shafts of varying root diameters or those having damming cones or the like along their length. The screw flight on shaft 17 desirably is of a discontinuous nature which divides the flight into a series of separate flight sections numbered 62 through 70 extending from the infeed end to the discharge end of the press respectively. In the feeder section 3 of the press the first screw flight 62 is defined by several convolutions which have uniform crest diameter and uniform pitch. However, the succeeding discontinuous screw flights 63 and 64 progressively decrease in crest diameter and pitch to correspond to the conical configuration imparted by tapered bars 32 to converging conical section 49 of the press body. This construction results in the initial stuffing action and fluid extraction mentioned previously.

In the pressure section 4 of the press, screw flights 65 through 70, while discontinuous, all are of the same pitch and crest diameter. As a result, heretofore employed methods of tapering the root diameter or employing tapered flights on the screw shaft to effect compression of material is precluded in that pressure maintenance is assured as noted previously by the damming projections extending into the bore 47 of the pressure section and progressively increasing in number along the length thereof towards the discharge end.

As shown in FIGS. 2 and 7 to 12, projections 31 and 54 employed for this purpose have their radial inner ends positioned closely adjacent to the root 61 of the shaft with normal operating clearance being all that is necessary.

Because substantial pressures are developed in the press as noted previously, large amounts of heat are generated during the fluid expressing operation. As a result it is desirable to cool the screw shaft during its use. For this purpose shaft 17 is provided with a longitudinal bore 75 throughout its length into which a cooling medium is introducible through the connection 24 described previously. The cooling medium may be withdrawn from adjacent the opposite end of the shaft in any well known manner so that flow through the shaft may be continuous for most effective cooling.

The cooling medium chosen may be any suitable fluid and desirably water is employed. While water has been used heretofore for cooling screw shafts, a problem results from use of water in that natural materials such as lime, iron particles and the like which are introduced into the shaft with the water tend to build up on the periphery of the shaft bore as hard deposits. Upon continued use of the shaft, such deposits gain substantial thickness and the heat conduction from the shaft to the bore thereof is materially reduced. Accordingly, in conjunction with a press of the type disclosed herein desirably employed for practicing the method of the present invention, means is provided for precluding the building up of such deposits so that the water used to cool the shaft need not be pure. For example, fresh or salt water direct from rivers or the ocean may be employed.

Such deposit precluding means desirably comprises a rollable member or members 76 positioned in the bore 75 of the shaft and movable about the periphery thereof as the shaft is rotated. While the rollable member or members may take various forms, in the embodiment illustrated an elongated rod which extends substantially

the full length of the shaft is employed. Such rod is illustrated as being circular in cross-section but the same may be polygonal in cross-section so that more of a tumbling effect will be produced when the screw shaft rotates.

Also, series of metal balls or the like may be employed in the shaft for this purpose also. Upon rotation of the shaft the rod 76 periodically engages the entire surface of the inner periphery of the shaft and any deposits which tend to form thereon are dislodged and may be flushed from the shaft bore with the cooling medium when the same is removed therefrom.

While grid bars of the type shown in FIGS. 3 and 4 are highly effective and satisfactory for their intended purpose, other modified spacer elements also may be employed. In this regard attention is directed to aforementioned Patent No. 3,130,666 which discloses other improved spacer elements which may be utilized, if preferred, in a press capable of performing the novel fluid expressing method disclosed and claimed herein.

A further modification of a cage bar is shown in FIG. 14. This arrangement employs a triangular shaped damming projection 102 which extends from one surface 103 thereof. Projection 102 increases in height towards the end of the bar from adjacent the middle thereof so that the blocking effect produced by the projection increases progressively toward the end of the bar. Bars of the type shown in FIG. 14 are primarily intended for use immediately adjacent the discharge end 59 of the press (such as in a grid section of the type shown in FIG. 13) so that a final compression of material just before it is discharged from the press may be effected. The number of such bars placed about the periphery of the bore of the press may be varied as desired depending upon the material being treated.

For purposes of illustration a press assembly embodying the various features disclosed herein will be described with respect to operation of the same for performing the method of this invention in conjunction with treating an oil bearing material, such as coconut meat, for extracting oil in fluid form therefrom. For treating such material the length of the press illustrated in FIG. 2 is approximately 68 inches with the screw shaft extending longitudinally therethrough in the manner described. The feed section of the press desirably comprises approximately half or 34 inches of the total press length with the pressure section taking up the remaining 34 inches. The shaft itself has a 5 inch root diameter with a 4 inch diameter bore extending longitudinally therethrough. The diameter of the bore 46 in the feeder section of the press adjacent the feed hopper is 8 inches and decreases due to tapered bars 32 to a 6 inch diameter adjacent the infeed end of the pressure section. Screw flight 62 has substantially an 8 inch crest diameter with a 6 inch pitch. The succeeding screw flights 63 and 64 progressively decrease from an 8 inch crest diameter to a 6 inch crest diameter. Screw flights 63 and 64 also decrease progressively in pitch from 5 inches in flight 63 to 4½ inches in flight 64. Screw flights 65 through 70 in the pressure section all have a 3½ inch pitch with substantially a 6 inch crest diameter to operatively correspond to the 6 inch diameter of bore 47.

In the press embodiment illustrated, 38 grid bars are employed and the number of damming projections used progressively increases toward the discharge end of the pressure section from two at section 7—7 to nineteen at section 12—12. In this manner the volume in the bore 47 of the pressure section of the press is progressively decreased in proportion to the decrease in volume of material treated in the press as fluid is extracted therefrom. Under ideal conditions, if the pressure produced in the press at various sections thereof were plotted against decrease in volume of material being treated, the resulting graph would be defined by a generally straight line.

With this arrangement, the pressure increases proportionally from zero at the hopper end to 12,000 p.s.i. at

the discharge end of the press. As noted previously, the pressure produced may be varied by modifying the arrangement of the projections extending into the cage assembly. With this construction the oil content of coconut meat may be decreased, as noted previously, to an acceptable level of from 5 to 8% by weight in the meal particles discharged from the press.

The grid bars employed herewith desirably are of 11 inch lengths, are one-half inch thick and one inch wide. However, because of the high torsional strength of the press $\frac{3}{8}$ inch bars also may be used, thereby providing more discharge passages about the press periphery and increased fluid flow. Such bars desirably are of a hardness of from 55 to 65 on the Rockwell C hardness scale and may be carburized or cast directly from a material having the acceptable hardness. The power source 21 employed with the machine is a 50 horsepower electric motor which has more than sufficient power to rotate the screw and produce the desired pressures. Because of the novel construction of the cage assembly which precludes the forcing of fine particles of meal radially with the oil expressed from the material, it has been found that a savings of up to one-third in power result with this construction thereby permitting the use of a smaller essential power source than has been used heretofore.

While the capacity of the press described may vary depending upon the speed of rotation of the screw shaft 17, dried coconut meat having a moisture content of below 5% desirably is fed to the press at the rate of 3000 lbs. per hour, with shaft 17 rotating at approximately 40 r.p.m. On the average dried meat fed into the press contains approximately 62% expressible oil and the oil content of the discharged material is 7% by weight, meaning that approximately 90% of the oil is removed from the material in the press. If higher pressures were employed, obviously a greater percentage of the expressible oil could be extracted from the material, but the removal of oil to the 7% level has been found suitable in that a commercial meal is produced and damage to the meal and expressed oil by burning or the like as a result of excessive pressure is precluded.

While one embodiment of a press and cage assembly well suited for use in practicing the method of this invention has been specifically described herein for purposes of illustration, the disclosure herein is not intended to be in any way limiting upon the scope of protection afforded to the method of this invention and the same should be interpreted in light of the appended claims.

I claim:

1. A method of expressing fluid from fluid bearing material comprising urging a quantity of said material through a generally cylindrical confined passageway having fluid flow passages through the wall thereof, simultaneously applying pressure to said material as the same is moved from one end of said passageway toward the other end thereof to extract fluid from said material, and maintaining pressure on said material as the volume of said material decreases as fluid is extracted therefrom by partially and progressively increasingly blocking said passageway from said wall thereof in an inwardly direction to restrict and decrease the volume of said passageway in predetermined proportion to the quantity of fluid extracted from said material.

2. The method of claim 1 in which said material is moved through said passageway in a generally straight non-rotary path as pressure is applied thereto.

3. A method of treating a fluid bearing material to effect extraction of fluid therefrom without resultant burning of said material during such fluid extraction, comprising applying pressure to a quantity of said material while moving the same in a confined path defined by a passageway having a generally regular contour and generally constant dimensions through its length and fluid

flow passages through the wall thereof, and as said material is moved through said confined path progressively blocking said path in an inward direction from said passageway wall without altering the generally regular contour of said passageway to decrease the volume of said passageway in direct proportion to the decrease in volume of material due to loss of fluid extracted therefrom so that pressure on said material may be maintained at least generally constant throughout its travel through said path.

4. The method of claim 3 in which said passageway is generally right circular cylindrical in cross section, and which comprises applying pressure to said material with a rotary screw member rotating within said passageway to force fluid from said material outwardly through the passages in the wall of said passageway, and simultaneously precluding rotation of said material with said screw member while maintaining said pressure thereon by progressively blocking said passageway by inserting a series of non-rotatable stationary damming projections which project into said passageway inwardly from said wall thereof, said projections guiding said material in a generally straight path through said passageway while at the same time progressively increasingly blocking said passageway along its length.

5. The method of claim 4 which includes preliminarily applying compacting pressure to said material in a conically tapered infeed passageway of decreasing dimension which communicates with said cylindrical passageway prior to introducing said material into such cylindrical passageway.

6. A method of expressing fluid from fluid bearing material comprising providing a passageway having an infeed end and a discharge end, positioning a series of non-rotatable stationary material blocking projections in said passageway about the periphery thereof which extend inwardly from the wall of said passageway, locating said projections in said passageway so that the number of said projections about said passageway periphery progressively increases from said infeed end toward said discharge end to thereby progressively decrease the volume of said passageway, and moving said material through said passageway and into contact with said projections while simultaneously applying pressure thereto to extract fluid therefrom, the pressure applied to said material being maintained thereon as said material moves through said passageway due to said projections progressively blocking said passageway and flow of said material therethrough.

7. A method of expressing fluid from fluid bearing material comprising providing a generally cylindrical passageway having an infeed end and a discharge end with a substantially uniform internal dimension therebetween defined by an apertured wall, providing a rotary screw member having a generally uniform root diameter throughout its length with discontinuous screw flights thereon, positioning said screw member in said passageway with the crests of said screw flights closely adjacent said wall thereof and rotating said screw member in said passageway, providing a series of non-rotating stationary material blocking projections on said passageway wall extending inwardly from said wall to closely adjacent said screw member root, positioning said blocking projections in progressively increasing numbers about said passageway wall toward said discharge end between the respective screw flights on said screw member and at spaced peripheral locations on said wall, introducing a quantity of fluid bearing material into said passage, and moving said material through said passageway with said screw member into contact with said projections while simultaneously applying pressure to said material to extract fluid therefrom, the increasing number of said projections employed being selected to decrease the volume of said passageway toward said discharge end in predetermined proportion to the loss of volume of said material as fluid is expressed therefrom by pressure applied thereto by said screw member.

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8. The method of claim 7 which includes compacting said material preliminarily prior to introducing the same into said passageway.

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