Oct. 18, 1966

J. FARMER

JUICE PRESS

3,279,357

Filed Jan. 31, 1964

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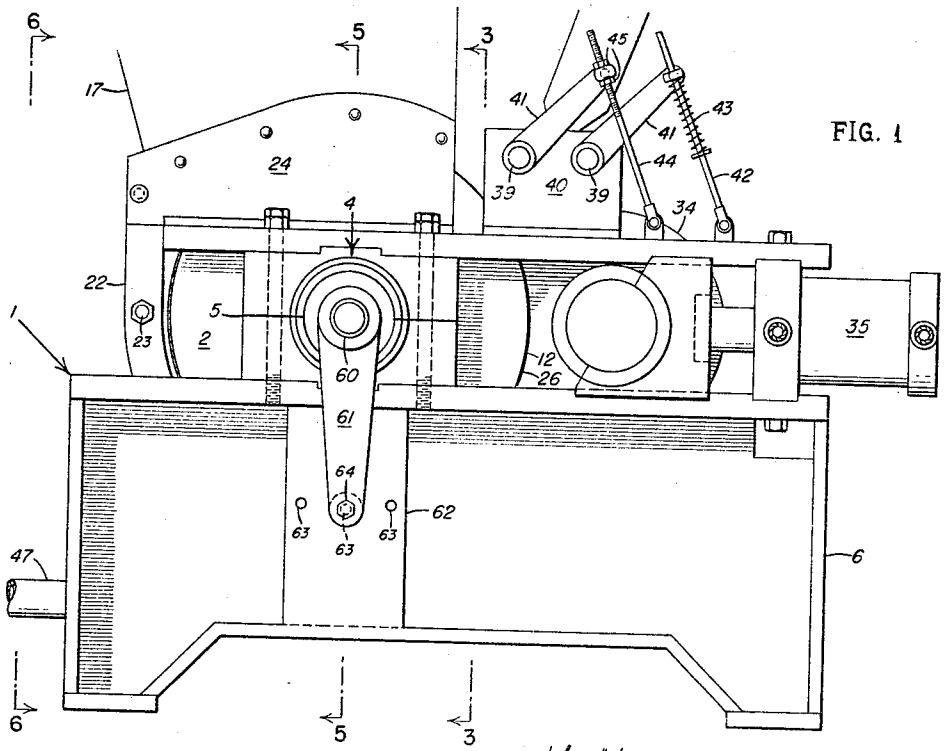


FIG. 1

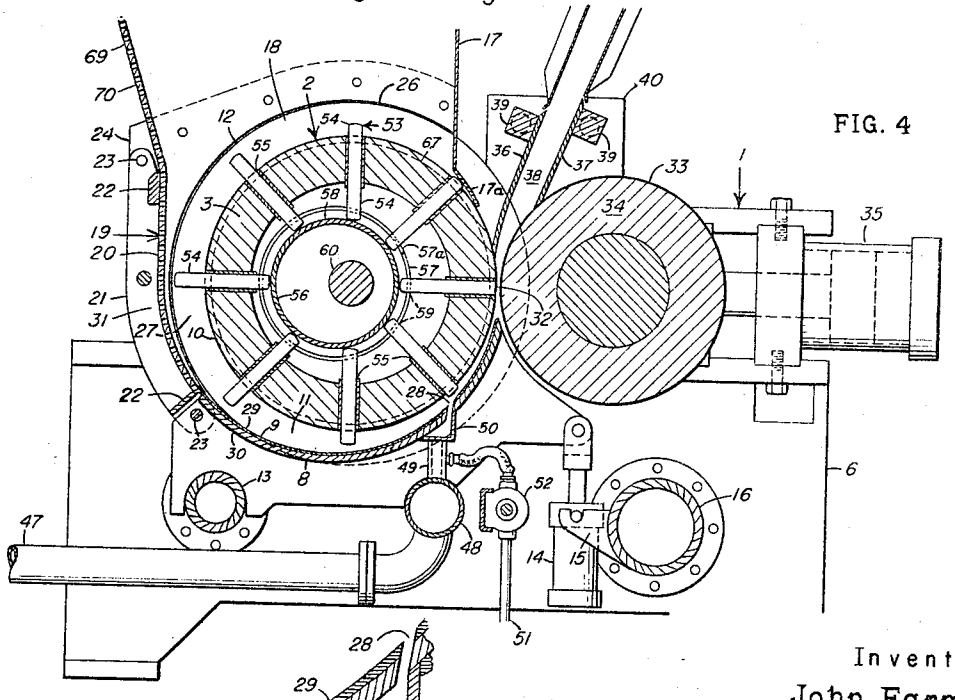


FIG. 4

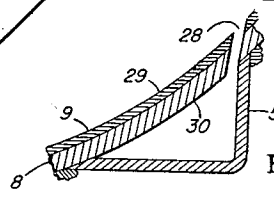


FIG. 7

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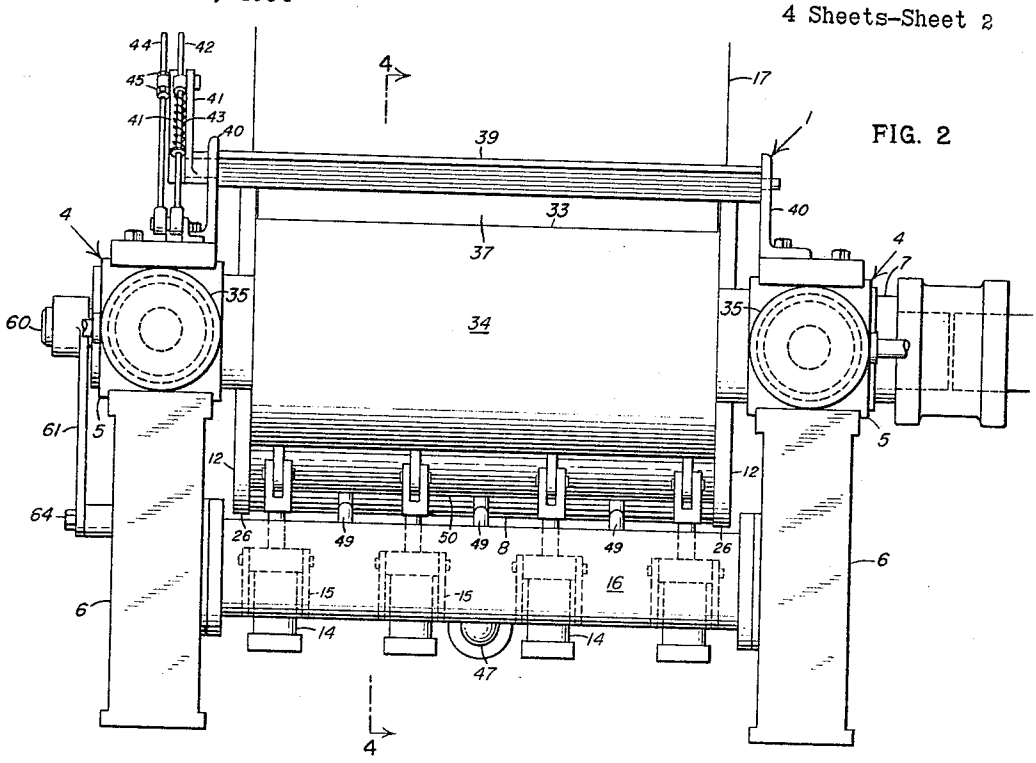


FIG. 2

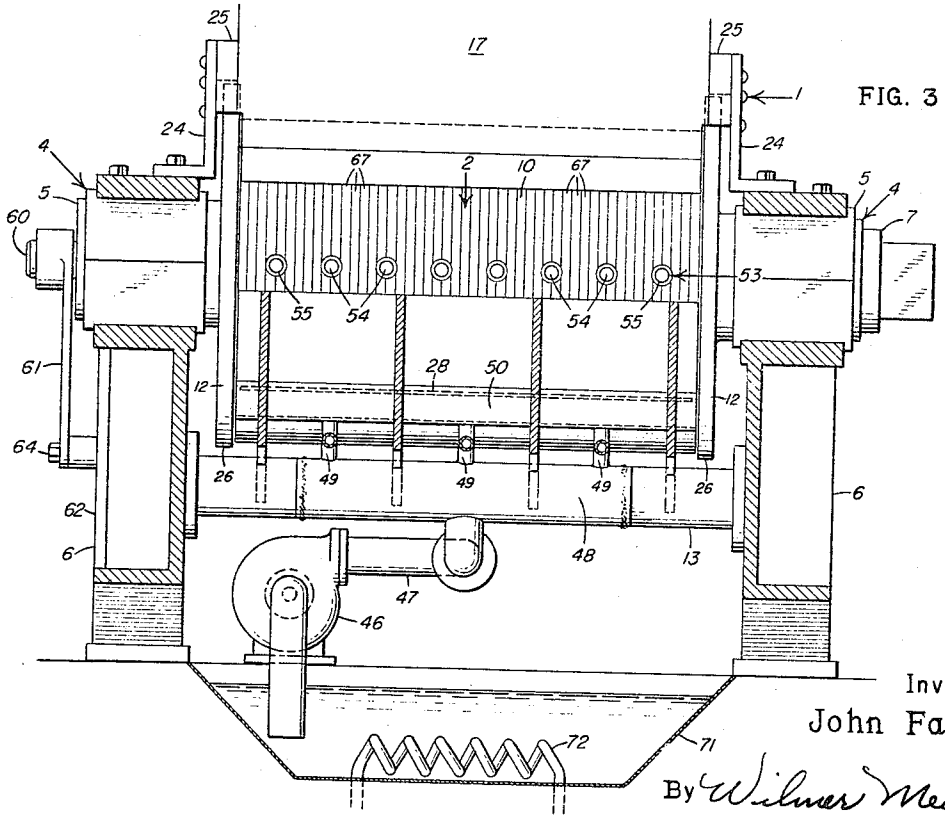


FIG. 3

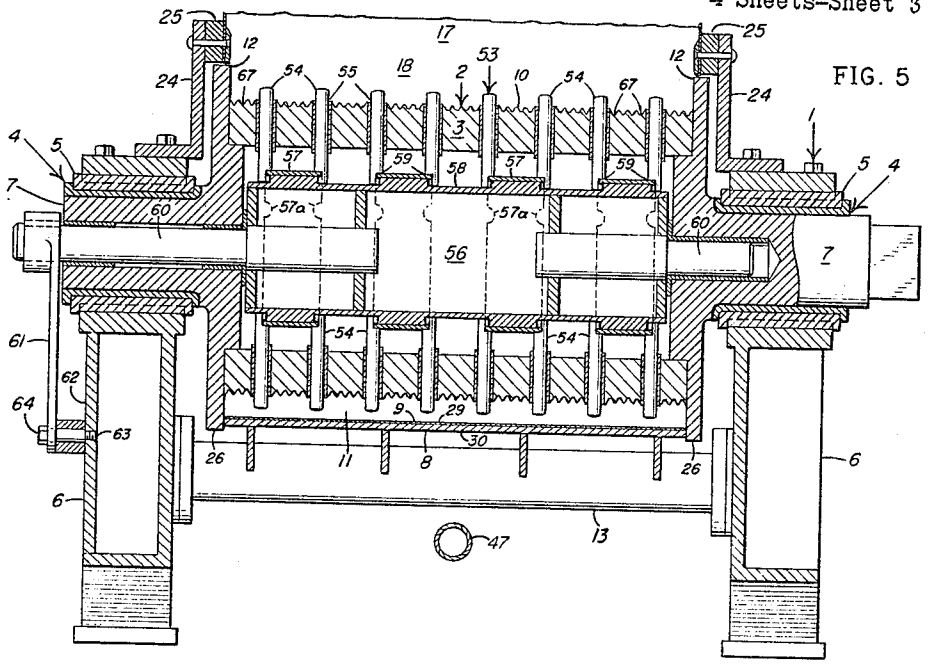
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FIG. 5



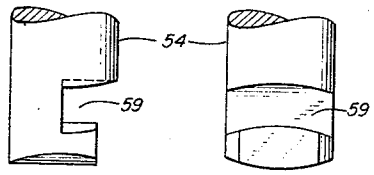


FIG. 8

FIG. 9

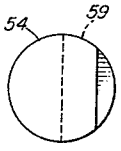


FIG. 10

FIG. 11

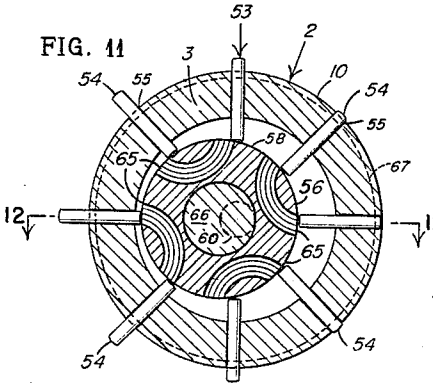
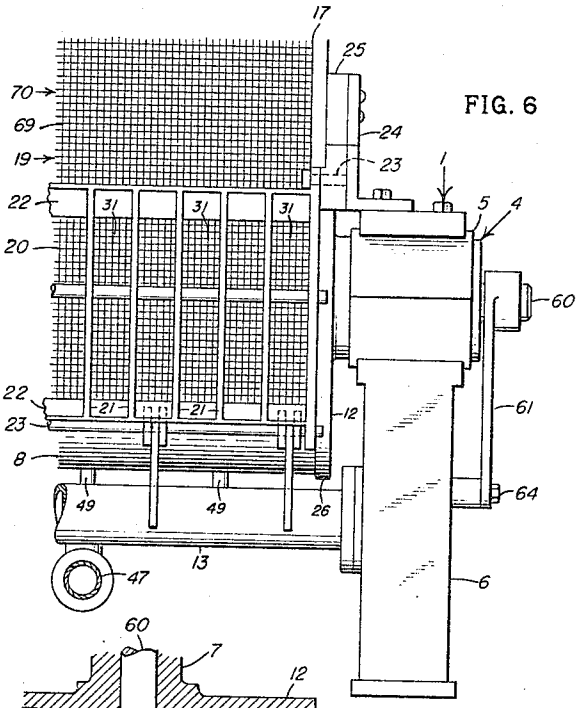


FIG. 6



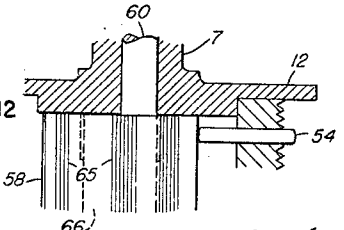


FIG. 12

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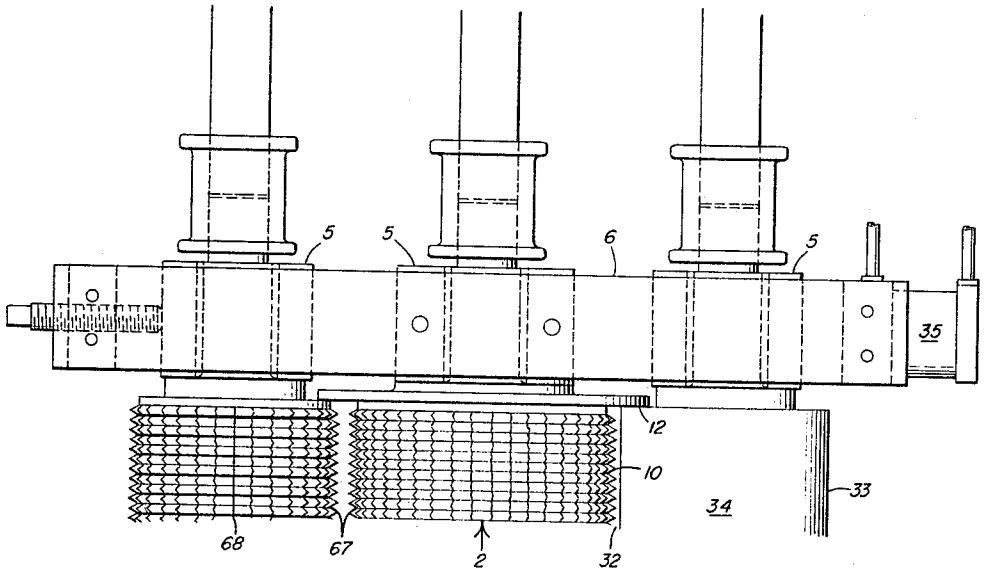


FIG. 14

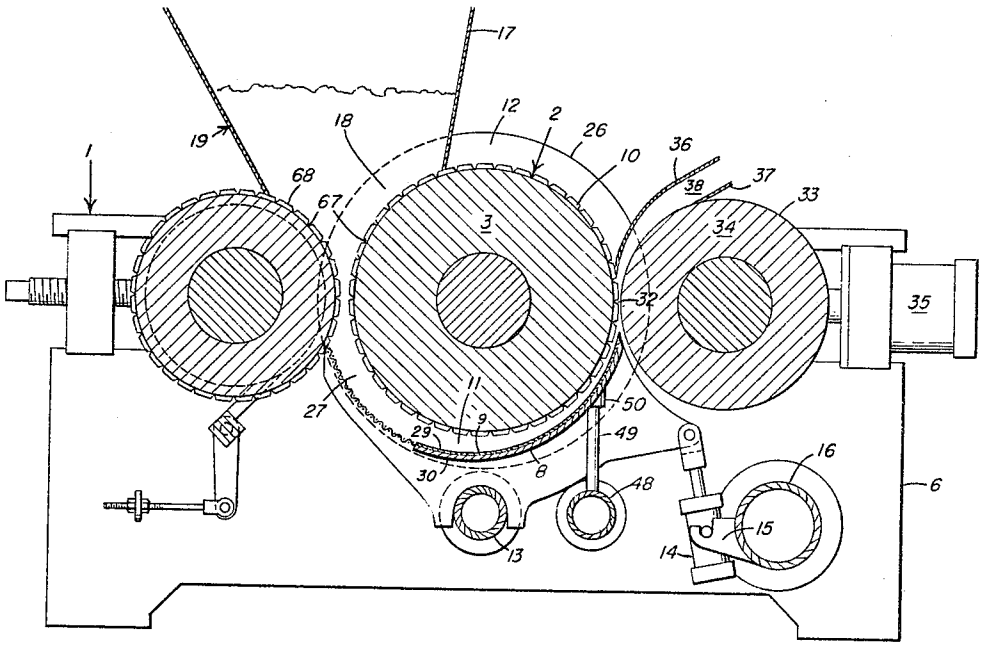


FIG. 13

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3,279,357

JUICE PRESS

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Filed Jan. 31, 1964, Ser. No. 341,659
26 Claims. (Cl. 100—74)

This invention relates to presses for extracting juice from sugar cane and other juice-containing materials.

Although not so limited in its purview, the particular concern of the present invention is the extraction of sugar juice from sugar cane. It has been the almost universal practice for many years to extract juice from the sugar cane by mill trains, which, in the usual arrangement, have two or more three-roll mills. With its massive mills and enormous appetite for power, a mill train extracts juice from cane mainly by brute force by passing the cane and, after the first crushing, the bagasse between the rolls of its succession of mills.

A mill train may depend either on its mills or in more modern installations on a preceding crushing or crushing and shredding device for rupturing the juice-containing cells of the cane. In either case, it extracts juice by forcing the bagasse through openings between the rolls of its mills that are too small to accept both the juice and the fiber and so cause the excess juice to be stripped off. Some 85% of the juice in the cane is loosely held in the large thin-walled parenchyma or main storage cells. The remaining 15% is tightly held within the tough pieces containing the rind and node tissue, in unbroken cells, in pockets in slightly broken cells, in the fibro-vascular bundles and to the pith and fiber. With the tremendous pressures of 10,000–15,000 p.s.i. exerted between the top and discharge rolls of its mills, a mill train can readily extract about 90% of the juice but the resilience of the fiber and its affinity for juice preclude the recovery of the remaining 10% by practically obtainable pressures. It therefore is customary to increase the effectiveness of a mill train by maceration or imbibition in which the bagasse in advance of at least the intermediate mills is sprayed with water, or, in compound maceration, dilute juice. This increases the liquid content of the bagasse presented to the mills and enables the latter to strip off a greater percentage of the residual or initial juice in the form of progressively more dilute juice. Even so, due largely to the impossibility of obtaining much more than superficial or surface mixing of the applied liquid and the residual juice within the total processing time of about 45 secs., entraining or trapping of air in the bagasse as it expands on release from the tremendous pressures after passing through each pair of rolls, and a phenomenon known as reabsorption which, at the speeds and pressures of the rolls, causes more liquid to pass or be squirted through them than their openings should accept, a mill train, with maceration, extracts usually no more than 93% of the residual juice, with 95% the practical limit. As a result, millions of tons of sugar are burned annually with the discharged bagasse and forever lost.

Recently, there has been considerable developmental work on adapting the diffusion process, used so successfully and now universally on sugar beets, for extracting juice from cane. In this process water introduced at the material discharge end of the diffuser, is circulated crosswise or transversely through succeeding sections of a moving mat of bagasse, flowing by gravity through each section and becoming increasing richer juice as it progresses countercurrent the bagasse to a point of liquid discharge adjacent the material infeed end of the diffuser.

The bagasse discharged from the diffuser is very wet and must be pressed to reduce its juice content before it can be used further. In the application of the diffusion process to sugar beets, the beets, before being introduced into the diffuser, are sliced into thin chips or cossettes and, as to them, the diffusion that takes place in the diffuser is a combination of diffusion in the physical chemistry sense of a spontaneous intermixing of the applied liquid or diluent and the residual juice from ruptured cells and osmosis or dialysis in which the sucrose is selectively extracted through the walls of the unbroken cells, leaving behind the impurities. However, the very different structure of sugar cane does not adapt it for such preparation and, as applied to it thus far, the diffusion process has been essentially a washing process, dependent for its effectiveness upon preliminary rupturing of cells to expose the juice for mixing with the water.

With the best of available devices, cane prepared by cutting, crushing and shredding will have around 94% of its cells ruptured and, as applied to such cane, the diffusion process has been able to extract at best about 96% of the juice, in part presumably by some osmotic action. Not only is the remaining 4% or so of the residual juice in the cane beyond its reach but the process is slow (about forty minutes), its equipment requires a disproportionately large space for its output and is ill-adapted to the washing action to which its extraction is primarily attributable and the liquid content of the bagasse from the diffuser is so high as to present a difficult and expensive problem in reducing that content to the point where the bagasse can be used either as fuel or for by-products.

The primary object of the present invention is to provide an improved press for extracting juice from juice-containing material whereby a mass of such material is driven through a point of maximum pressure to reduce its liquid content, while being subjected to a diluent liquid introduced in advance of that point and forced countercurrent through the material to wash out juice.

Another object of the invention is to provide a juice press whereby a mass of juice-containing material is moved within a confined space toward a maximum pressure point at which its liquid content is reduced, while being subjected to the washing action of a diluent liquid introduced under pressure into the space in advance of the pressure point.

An additional object of the invention is to provide a juice press whereby a mass of juice-containing material is compressed by being driven through a confined space of progressively decreasing cross-section to a point of maximum compression and, while being subjected to a diluent liquid introduced under pressure into the space in advance of the pressure point and forced countercurrent through the material by the composite of its own pressure and the pressure exerted upon the material.

A further object of the invention is to provide a rotary juice press which is capable of positively feeding a mass of juice-containing material into a confined space toward a pressure point without impeding the flow of a diluent liquid forced counter-current through the material within that space.

Another object of the invention is to provide a rotary juice press wherein a mass of juice-containing material is driven through a confined space between a stationary surface and a rotary drum by the coaction of a positive feed and the difference in the coefficients of friction of that surface and the surface of the drum.

Another object of the invention is to provide a rotary rake press for extracting juice from juice-containing material wherein a mass of such material is fed into a confined space of progressively decreasing cross-section between a stationary pressure plate and a rotary drum

mounted eccentrically relative to the plate by tines projectable radially from the drum, thereby enabling a diluent liquid to be introduced into the space adjacent a trailing end thereof and forced without interference counter-current through the material to a point of liquid discharge.

A further object of the invention is to provide a rotary press for extracting juice from juice-containing material wherein a mass of such material is positively fed into a confined space between a non-rotary pressure plate and a rotary drum against a counter-flowing liquid diluent and, as it leaves the space, is compressed between the drum and a squeeze roll for expressing part of its liquid, thereby reducing the liquid content of the discharged material below that of the entering material.

A further object of the invention is to provide a rotary press of the above-described character wherein the pressure plate and squeeze roll are adjustable relative to the drum for varying the pressures exerted therebetween upon the material and controlling the amount of liquid expressed therefrom.

Another object of the invention is to provide a press for extracting juice from juice-containing material wherein the material not only is subjected to a counter-flowing diluent liquid under pressure but the liquid is readily recirculated one or more times by regulating the driving force on it to increase the effectiveness of its action upon the material.

Another object of the invention is to provide a rotary rake press for extracting juice from juice-containing material which, by using tines on a rotor to feed a mass of such material into a confined space between a non-rotary surface and the rotor against a counter-flowing liquid diluent, enables the material to be presented to the press both soaking wet and hot, with benefit rather than detriment to the action of the press in extracting juice.

Another object of the invention is to provide a rotary rake press for extracting juice from juice-containing material wherein a mass of the material is fed into a confined space of progressively decreasing cross-section between a non-rotary pressure plate and a rotary drum eccentrically mounted relative to the plate by tines which project radially from the drum and are positively extended and retracted relative to its surface as the drum rotates.

A further object of the invention is to provide an improved feed for feeding juice-containing material to a point of maximum pressure which, by using as its feeding means tines carried by and projectable and retractable radially of a rotary drum, is enabled effectively to handle even material that, when presented for feeding, is either very wet with diluent or hot or both.

Other objects and advantages of the invention will appear hereinafter in the detailed description, be particularly pointed out in the appended claims and be illustrated in the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a preferred embodiment of the improved juice press of the present invention;

FIGURE 2 is an elevational view of the press of FIGURE 1 taken from its material discharge end;

FIGURE 3 is a vertical sectional view taken along lines **3—3** of FIGURE 1;

FIGURE 4 is a vertical sectional view taken along lines **4—4** of FIGURE 2;

FIGURE 5 is a vertical sectional view taken along lines **5—5** of FIGURE 1;

FIGURE 6 is a fragmentary elevational view taken along lines **6—6** of FIGURE 1;

FIGURE 7 is a fragmentary view on the section of FIGURE 4 and on an enlarged scale showing in detail the diluent inlet;

FIGURE 8 is a fragmentary front elevational view on an enlarged scale of the inner end portion of one of the tines;

FIGURE 9 is a side elevational view of the tine of FIGURE 8;

FIGURE 10 is an inner end view of the tine of FIGURE 8;

FIGURE 11 is a fragmentary view on the section of FIGURE 4 of an alternate positive drive for the tines;

FIGURE 12 is a fragmentary horizontal sectional view taken along lines **12—12** of FIGURE 11;

FIGURE 13 is a vertical sectional view on a section corresponding to that of FIGURE 4 of another embodiment of the press of this invention; and

FIGURE 14 is a fragmentary plan view of the press of FIGURE 13 with the hopper and scrapers removed.

Referring now in detail to the drawings in which like reference characters designate like parts, the improved juice press of the present invention, in its capability of extracting juice from juice-containing material and discharging the material in a relatively dry condition, can be used alone on some materials. However, as applied to a material such as sugar cane in which about 15% of the juice is tightly held and the objective is to render it commercially feasible to extract a higher percentage than that obtainable by a conventional mill train, the improved press is primarily designed for use in an improved process employing a plurality of such presses arranged to act successively upon the bagasse and including other devices for preparing and treating the cane for action by the presses so as to extract the desired high percentage of the juice.

In the conventional milling process, juice is extracted from sugar cane initially as rich juice and in later stages, after the addition of water or dilute juice, as progressively more dilute juice, by compressing the cane or bagasse to the maximum practical extent so as to strip off the excess liquid. Considering the term "cells" in accordance with industry practice to include both the cells and the tubes within the cane or stalk in which its juice is contained, the juice extracted by milling is derived entirely from ruptured cells. Now recognized as essentially washing, diffusion, too, as applied to sugar cane, derives the extracted juice practically entirely from ruptured cells. It, therefore, is essential to the effectiveness of both processes that as large as possible a percent of the cells be ruptured. In diffusion, cells can only be ruptured by preparing the cane before it is introduced into the diffuser, usually by successive cutting, crushing and shredding operations. Milling may also include similar preparation of the cane, or in some installations, the mills themselves may be entirely responsible for rupturing cells.

Mixing of the diluent liquid and the residual juice from ruptured cells is recognized as desirable in both processes and is obtained to a large degree in diffusion by the long period in which the bagasse is exposed to the diluent, but cell rupture alone will not ensure that all the juice from the ruptured cells will be extracted by either process. Even after a cell has been ruptured, part of the juice it contained is bound by molecular attraction to its walls and this bond is not readily broken either by the pressures exerted in milling or by the low energy diluent flowing under only gravitational forces through the bagasse in diffusion. In milling, tests have indicated that good mixing would enable the pressures to be reduced without reduction in the effectiveness of the extraction, but such mixing of the diluent liquid and the residual juice from the ruptured cells is not practically obtainable. The milling process is of too short duration and the fiber has the capacity to absorb about ten times its weight of moisture, as a result of which liquid sprayed upon the mat of bagasse in the brief interval of its passage between successive mills is largely absorbed by the fiber adjacent the mat's surface. Too, even were good mixing obtainable in milling, the liquid content of bagasse that a mill can handle is quite limited.

Temperature is another of the factors that can affect the extraction of juice from sugar cane. Temperatures as high as 140–158° F. are ineffective except over a long period, but higher temperatures of from 175–185° F. will

act quickly and both soften the fiber and kill or destroy the walls of the living cells so that they become fully permeable to counter-migration of the juice and the diluent by diffusion without dependence upon dialysis. This effect can be obtained in diffusion by applying heat to the diluent as it is circulated through the bagasse but in milling the heating of the bagasse by increasing its slipperiness tends to choke the mills.

Not only is a mill ill-suited to handle very wet or hot material but, as briefly mentioned earlier, the tremendous pressures on which it relies for extracting juice are in part self-defeating due to reabsorption. These same pressures also have an adverse effect upon mixing by imbibition between mills. The resilience of the fiber is such that on release of the pressure the bagasse springs back substantially to its initial volume and in process draws air into its interstices including the ruptured cells from which juice has been expressed. The air so entrapped, to the extent that it is interposed between the residual juice and the applied diluent, impairs the miscibility of the liquids.

The improved juice press of the present invention is more akin to a diffuser than to a mill but differs from and has advantages over both. Whatever its form, the improved press has a laterally confined space or zone of progressively increasing pressure through which juice-containing material is moved, means for driving the material through the space, a point, area or zone of maximum pressure adjacent the material discharge end of the space, and means for introducing dilute juice or other liquid diluent into the space in advance of the maximum pressure point and forcing it under positive pressure through the space longitudinally of and counter-current to the material to a point, area or zone of liquid discharge adjacent the material infeed end of the press. Depending on its form, the press may drive the juice-containing material through the laterally confined space by a rotor or rotary member contained partly or wholly in a stationary member defining an opposite side of the space, endless belts at opposite sides of the space or other drive means suitable for the particular form.

Possessing the foregoing characteristics the preferred, illustrated form of the juice press, designated as **1**, is a rotary press which has as its driving, propelling, progressing or forcing member a rotary drum or rotor **2** having a cylindrical shell or side wall **3** of cast steel, iron or like material. A hub or end assembly **4** is bolted or otherwise releasably secured to each end of the preferred drum **2** and the latter is rotatably mounted in a pair of split ball or other suitable anti-friction bearings **5**, each of which is attached, as by bolting, to and supported on one of a pair of preferably cast side frames **6** and journals the hub, stub axle, or journal **7** of the adjoining or related assembly. Partly containing the drum **2** and in the illustrated embodiment covering or including about 120° of the circumference of the shell **3**, is a pressure plate **8** desirably disposed below and co-extensive laterally or axially with the shell and having an arcuately concave, preferably cylindrical inner face or surface **9** confronting and of somewhat greater radius than the confronting outer or peripheral surface or side **10** of the shell. Between their surfaces **9** and **10**, the shell **3** and the pressure plate **8**, together bound or define the vertical or upper and lower extremities or limits of a laterally or transversely confined space, compartment or chamber **11** which conveniently is contained or bounded at the sides by peripheral flanges **12** rigid or integral with and projecting or extending radially from the hubs **7** of the hub assemblies **4** beyond at least the surface of the pressure plate.

While non-rotatable and permissively fixed, the preferred pressure plate **8** is hingedly, pivotably or swingably mounted adjacent one end on a hinge bar **13** extending laterally between and connected at its ends to the side frames **6**. The opposite end of the preferred hinged pressure plate **8** is supported on one or preferably a plurality of hydraulic or fluid-actuated cylinders **14** pivotably connected to the pressure plate and themselves supported on brackets **15** rigid with and radially outstanding from a cross bar **16** which is fixed at its ends to the side frames **6** and spaced longitudinally thereof from the hinge bar **13**.

If, as is preferred in extracting juice from sugar cane, the juice-containing material is fed by gravity to the press **1**, the latter may be surmounted by a feed hopper or bin **17** which opens downwardly onto the rotary drum **2** through a top opening **18** in the press. With such a gravity feed, the juice-containing material conveniently is led or fed around the drum **2** to the space **11** past a perforate or foraminous outer wall **19** which in the preferred press **1** is suitably formed by a perforated plate **20** backed by a plurality of sections of grate bars **21** extending circumferentially of the drum, the sections being arranged side by side and having their frames **22** pinned or secured, as by hinge pins **23**, at their lower or trailing ends to the leading or hinged end of the pressure plate **8** and at their upper or leading ends to side plates or closure members **24** fixed to and upstanding from the side frames **6**. Conveniently mounting the hopper **17** at the sides, the side plates **24** enclose or cover at the sides the portions of the end flanges **12** of the drums **2** which project above the side frames **6** and have instanding lips **25** that partly overlie and approach closely the adjoining portions of the rims **26** of the flanges.

Unlike the feed zone or inlet passage **27** between the perforate outer wall **19** and the shell **3** of the drum **2** which leads to and forms an upward or forward extension of the space **11**, the latter has in the inner face **9** of the pressure plate **8** an outer wall which preferably is smooth and imperforate or closed except that it is slotted or apertured laterally or transversely over substantially its full width adjacent its trailing end, suitably by a slot, aperture or opening **28**. To minimize resistance to movement or passage of the juice-containing material through the space **11** over the pressure plate **8**, the latter's inner face **9** should be smooth and, rather than being metal, preferably is formed by a facing or lining **29** of "Teflon," "Gatke," "Kel-F" or like lubricious or low frictional coefficient material which is bonded to a rigid metal backing **30** making up the bulk of the plate.

The perforate wall **19** and the pressure plate **8** are both non-rotary and stationary except for the preferred adjustability of the spacing between the confronting surfaces **9** and **10** of the pressure plate and the shell **3** of the drum **2** obtained by the hinged mounting of the pressure plate, and the space **11** is bounded laterally by the end flanges **12** on the drum **2**, which with the side plates **24** also laterally bound the inlet passage **27** preferred. The press **1** thus has in the space **11**, a laterally or transversely confined space and in perforate outer wall **19** formed by the screen **20** and openings **31** between the slots or grate bars, a liquid outlet or discharge area or point adjacent the material infeed or leading end of the space. As illustrated, the lower part of the perforate outer wall **19** of the inlet passage **27**, backed by the laterally spaced grate bars **21** and their frames **22**, may be substantially concentric with the inner face **9** of the pressure plate **8**. The outer surface **10** of the shell **3** of the drum **2** may also be concentric with the inner face **9** of the pressure plate **8**, in which case the inlet passage **27**, downwardly or rearwardly from the point concentricity of its outer wall **19** and the space **11**, will be of uniform cross-section. In such case, the point or area of maximum pressure, rather than being located or positioned between a movable driving member and a stationary member fully or, as illustrated, partly containing the driving member, will ordinarily be located beyond the trailing or material discharge end of the pressure plate **8** and may be the opening or nip **32** between the surface **10** of the shell **3** and the surface **33** of a counter-rotating squeeze roll **34** rotatably mounted on the side frames **6** at the discharge side of the drum **2** and shiftable radially relative to the drum by suitable means, such as illustrated hydraulic cylinders **35**. However, as

in the illustrated embodiment, it is preferred to mount the drum 2 eccentrically of the inner face 9 of the pressure plate 8, with the drum's axis shifted toward the trailing end of the pressure plate, so as to make the space 11 and at least the adjoining part of the inlet passage 27 volute or crescent-shaped, with a decrease in cross-sectional area, here progressive, toward the trailing end of the pressure plate. With this preferred construction, the juice-containing material fed into the press will be progressively compressed or compacted as it approaches the trailing or material outlet end of the space 11 and that end or a point within the space adjacent thereto, may be the point or area of maximum pressure. Even when the space 11 is made volute so that it is not only a confined space but a pressure space or chamber, as well, it, nonetheless, is preferred to include the squeeze roll 34 as part of the press 30 as to drive the material through this area of maximum pressure by the co-action of the drum and the squeeze roll, rather than by the drum alone.

To prevent any of the material from adhering or clinging to the surfaces 10 and 33 of the drum 2 and, if used, the squeeze roll 34, there should be scrapers or scraper plates 36 and 37 positioned about them beyond the nip 32 to scrape off any such material. In the illustrated embodiment the scraper plates 36 and 37 of the drum 2 and the roll 34, respectively, are spaced in substantially parallel relation and serve not only as scrapers but to bound opposite sides of a material discharge or outlet passage 38 through which the partly dried discharged material is directed toward a succeeding processing stage. In part to compensate for wear, the scrapers 36 and 37 should be movable rather than fixed and to this end each of the scrapers may be fixed to one of a pair of blocks or bars 39, both journalled in the same uprights 40 fixed to and upstanding from the side frames 6 and each having fixed to one or each end a swing arm 41, the free end of which is connected to the adjoining side frame. The swing arms 41 of both scrapers 36 and 37 may be connected by rods to one or both side frames 6, but, whether the squeeze roll 34 is smooth or rough-surfaced, its scraper 37 preferably is spring-urged against it to compensate for its movement against the pressure of the hydraulic cylinders 35, while the drum scraper 36 may be fixable at a selected spacing from the drum. In keeping, the rod 42 connecting one or each swing arm 41 of the roll scraper 37 to the adjoining side frame 6, carries a compression spring 43 acting between the arm and the side frame, while each connecting rod 44 for the drum scraper 36 carries adjusting nuts 45 on opposite sides of the associated swing arm.

The transverse slot or aperture 28 interrupting the inner face 9 of the pressure plate 8, is purposed to admit dilute juice or other liquid diluent into the space 11 for washing juice out of a mass of juice-containing material moving through the space by flowing counter-current through the material to the liquid discharge or outlet 19 adjacent, or in advance or ahead of the leading end of this space. The liquid diluent is admitted to or introduced or injected into the space 11 at positive or super-atmospheric pressure through the transverse slot 28 and, as admitted, preferably is distributed substantially uniformly across or over the width of the space. For the latter purpose, the diluent, pumped or driven by a suitable pump 46, is led through an inlet pipe 47 to a header 48 and thence through connecting pipes 49 to a distributing chamber 50 of V- or other suitable shape in the pressure plate 8 below or outwardly of the latter's inner surface 9 and opening upwardly or inwardly through the slot 28 onto the space 11. If, as in the case of sugar cane, some of the juice released from ruptured cells is molecularly bonded or otherwise clings or is held tightly to the fiber or other material, the press 1 preferably is provided with an air inlet line 51 branched for connection to the connecting pipes 49 and supplied from a suitable source (not shown) with compressed air, the supply of which is interrupted intermittently by suitable means, such as the illustrative interrupter 52. So supplied, the liquid diluent, as introduced into the space 11, will contain slugs of air which, by the friction engendered at their interfaces with the residual juice, will enable the diluent as it is subsequently forced through the material, to make use of the Dupre effect in wiping or rubbing exposed but tightly held juice from the material.

The juice press 1 of the main embodiment in which the juice-containing material is both fed into the inlet passage 27 and driven through that passage and the preferred volute pressure space 11 by the drum 2, can best be described as a rotary rake press. Capable, contrary to a mill, of handling even hot, soaking or sopping wet material, the press employs, to feed juice-containing material from the hopper 17 or other supply into the inlet passage 27, a plurality of rakes 53 mounted on, in or carried by and arranged in circumferentially spaced relation about the shell 3 and each formed of a row of tines 54 extending substantially across the shell. The tines of each rake or row 53 may be aligned or staggered, but whether the overall arrangement is the illustrated column of straight parallel rows or of chevron or other suitable pattern, the rows should be uniformly spaced about the shell, with the spacing between adjoining rows suited to the particular material being processed, so that the force applied by the rakes will be substantially uniformly distributed over the mass of the material.

To adapt them to pass the point or zone of maximum pressure, here the nip 32 of the shell 3 and the counter-rotating squeeze roll 34, the individual tines 54 are disposed or directed radially of the shell and are slidably mounted therein in preferably lined apertures 55 extending radially therethrough, so as to be projectable or extendable and retractable or radially reciprocable relative to the shell's surface 10. At the speed of from 3–10 r.p.m. at which the drum 2 will ordinarily be rotated, centrifugal force will not be sufficient to project the tines 54. Also, it is preferred that the projection of the tines stop short of the surface 9 of the pressure plate, about 1 in. in the illustrated press, so that they will be fully retracted into the shell 3 as they reach the trailing end of the pressure space 11. Thus, at least the projection of the tines will be under a controlled positive force. Such a force can be obtained by stationarily mounting in the drum 2 a hollow cylindrical core, pulley or cylinder 56 concentric with the inner face 9 of the pressure plate 8, against which the inner ends of the tines 54 press, with the counter pressure of the juice-containing material and finally the squeeze roll 34 relied upon for retraction. However, the resultant impositive control of retraction has drawbacks and it usually will be preferable for the tines 54 to be positively driven both outwardly and inwardly relative to the surface 10 of the shell 3.

The core 56 is adaptable for positive projection and retraction by drivably connecting or interlocking it with the tines 54. In the main embodiment, this is accomplished by mounting on the core 56 a plurality of axially spaced annular tracks, bands or rings 57 raised or upstanding from the peripheral surface 58 of the core and each slidably fitting or received at the sides in radial slots 59 in adjoining pairs of the tines 54 of each rake 53. The core 56 in this case is stationarily mounted in the shell 3 of the rotary drum 2 by providing it at either end with a stub shaft 60 eccentric to it but concentric with the drum and extending into the hub 7 at the adjoining end of the drum. For holding the core against rotation, one or either of the shafts 60 has fixed to its outer end outwardly of the adjoining hub 7 a radial arm 61, the end of which is secured to the adjoining side frame 6. In the illustrated press the point of maximum projection of the tines 54 is within the limits of the inlet passage 27 and diametrically opposite the squeeze roll 34. If, in the op-

eration of the press, angular shifting, movement or adjustment of this point appears desirable, it is obtainable by providing for each radial arm **61** an anchor plate **62** on a side of the adjoining side frame **6**, to which the outer end of the arm is selectively securable in any of a plurality of annularly related positions, as by providing in the plate a series of circumferentially spaced holes **63** for receiving a bolt **64** on the end of the arm. Since assembly and disassembly of the drum **2** and core **56** and individual insertion and removal of the tines **54** for replacement or other purpose would otherwise be impossible, it is necessary that the tongue-and-slot interlock between the tines and the tracks **57** be releasable. This is readily accomplishable without interference with the drive of the tines **54** by interrupting the tracks **67** by transverse notches, interruptions or breaks **57***a* through which the associated tines can pass. These notches **57***a* preferably are laterally aligned and conveniently located in the area along the path of movement of the tines **54** beyond the squeeze roll **34** and radial movement of the tines as they cross the notches sufficient to misalign their slots **59** with the tracks normally is prevented by a removable retainer or cover plate **17***a* covering the outer ends of the tines over that area.

In the alternative arrangement shown in FIGURES 11 and 12, the positive force for retracting the tines **54** is magnetic and, as well could be done with the interlocking tracks and tines of the main arrangement, the core **56** is free to turn or rotate with the tines and thus minimize wear due to sliding friction. In this alternative arrangement, the magnetic force is supplied by horseshoe magnets **65** of "Alnico" or similar permanently magnetized material. The magnets **65** extend longitudinally across the core **56** and are embedded therein so that their ends are flush with its surface **58**. With the spacing of adjoining magnets roughly approximating the gap between the poles of each magnet, there is obtained over the surface **58** of the core **56** a permanent magnetic field which suffices to hold the tines to the surface and thus provide the desired positive retraction. As the resistance to relative turning of the tines **54** and the core **56** will be somewhat greater than if only sliding friction were involved, it usually will be beneficial to minimize this effect by mounting the magnetic core for free rotation with the tines. To accomplish this, without precluding angular adjustability of the point of maximum projection of the tines **54**, the illustrated magnetic core **56** is supported on the shafts **60** which, as in the main arrangement, are concentric with the hubs **7** of the drum **2** and the required offset of the core **56** relative to the drum to make it concentric with the inner face **9** of the pressure plate **8**, is obtained by forming the shafts as eccentric or radially offset extensions of a central shaft **66** on which the core is rotatably mounted.

With its tines **54** so positively projectable and retractable and the point of maximum projection, if desired, adjustable, the drum **2** of the main embodiment preferably has the surface **10** of its shell **3** interrupted not only by the radial tine-receiving apertures **55** but also by at least circumferential grooves **67** for increasing the frictional resistance between the surface and the material and thus enabling the surface, as well as the tines, to apply a substantial driving force in moving the material through the press.

The other embodiment shown in FIGURES 13 and 14 is like the main embodiment except that it relies for feeding the juice-containing material into the inlet passage **27** upon a fed roll **68** instead of the tines. Rotating counter to the drum **2**, the feed roll **68** co-acts with the drum in feeding material into the inlet passage **27** and, to improve this action, both the feed roll and the shell **3** of the drum in this embodiment are circumferentially and longitudinally or cross-grooved for better grip of the material. Even so, this feed is not capable of handling as wet material as the tines **64** but is usable in place of the latter upon drier material.

The various rotary members of the press of each embodiment, the drum **2** and squeeze roll **34** of the first and the additional feed roll **68** of the second, can be driven by a single motor (not shown) coupled through reduction gearing (not shown) to the drum with the auxiliary roll or rolls driven off the drum. Some flexibility in the relative peripheral speeds of the drum and roll or rolls can be obtained with such a single motor by use of a V-belt and vari-pulley driving connection rather than gearing between the rotary members and, if more flexibility is desired, the rotary members can be driven by separate, independently controllable motors.

Whether constructed in the preferred manner or otherwise, the improved press **1** of this invention is like unto mill and diffusion in being dependent for efficient extraction of juice upon prior preparation of the material. In the case of sugar cane, the prior or initial physical preparation of the cane may involve shredding it by a Searby or like shredder in which it is passed between rotor-mounted swing hammers and fixed anvils to distintegrate the cane into fibers, or both crushing and shredding it, as by a Maxwell crusher and shredder, in which it is first crushed between crushing rolls and then combed by a sharp-toothed roll into fine shreds. Alternatively, the cane can be cut into short lengths and then crushed and shredded, as in preparing it for diffusion, or even passed through a two or three-roll mill. In any case the objective is to rupture a high percentage of the cells. This physical preparation may be and, with the ability of either form of the press **1** to handle wetter material than a mill, preferably is supplemented by subjecting the bagasse before it reaches the press to dilute juice or other liquid diluent which preferably is hot so that, when circulated through the bagasse, it can both wash out loose juice and heat the bagasse to the critical range of 175–185° F. at which the fibers are softened and the living cells killed. The use of the feed hopper **17** surmounting the press **1** for this purpose has the additional advantage of compacting the bagasse in the bottom of the hopper by the pressure of the column of bagasse and diluent to facilitate feeding and mixing and ensure against gaps in the supply, and the hopper can readily be adapted for re-circulation of the diluent by providing a screened opening **69** in the bottom portion of its sloping side wall **70** through which the diluent and any of the rich juice it has picked up can pass to a sump or tank **71** below the press.

Picked up by the tines **54** of the main embodiment or between the circumferentially and cross-grooved shell **3** and feed roll **63** of the alternate feed FIGURES 13 and 14, the prepared bagasse is fed thereby into the inlet passage **27** from whence it moves into the space **11** and finally between the shell **3** and the squeeze roll **34**, and, so long as the supply is uninterrupted, the bagasse with either feed will move within the press as a continuous mass, mat or blanket. Studies of the coefficient friction of bagasse on a smooth steel plate and a grooved rotor have shown that on a stationary smooth plate the dynamic coefficient decreases with increase in pressure from about .4 at 20 p.s.i. to about .15 at 2000 p.s.i., while on a grooved rotor moving with the bagasse the static coefficient increases with increase in pressure from about .5 at 20 p.s.i. to over .7 beyond 100 p.s.i. These studies further showed that the addition of moisture decreased the dynamic coefficient on the plate but had little effect upon the static coefficient on the rotor. From these studies it is apparent that, even at the low pressures contemplated in the contained spaces **11** and **27** in the press, ranging from around 5 p.s.i. in the upper or leading part of the inlet passage **27** to around 35 p.s.i. and not over 100 p.s.i. at the trailing end of the pressure space **11**, and with no moisture added beforehand, there will be a difference in the coefficients of friction of the bagasse in favor of that on the shell surface **11** of about .1. The use of the preferred "Teflon" or like lubricious lining **29** on the pressure plate **8** will decrease the coefficient on the plate's inner face **9** to less than .1, with a corresponding increase of the difference

in favor of the shell surface to more than .4, and this difference will be further increased if the bagasse is wet with diluent when presented to the press. This difference in the coefficients on the two surfaces **9** and **10**, with the usual entrance angle therebetween only around 5°, is more than enough to enable the grooved or roughened surface **10** of the shell to apply a positive driving force to the bagasse greater than the opposing forces applied by the counter-flowing diluent introduced through the slot **28** and the pressure exerted upon the bagasse first by the decrease in the cross-sections of the spaces **27** and **11** and later by the squeeze roll **34**. Thus, once the bagasse has reached the smooth face **9** of the pressure plate **10**, the drum **2**, by the friction engendered between it and the bagasse, can drvie the latter the rest of the way without any assistance but will be assisted almost to the end by the force applied by the tines **54** of the main form and, so long as there are no gaps in the supply and the bagasse moves within the press as a continuous blanket, by the force applied earlier by the feed roll **68** of the other form.

For the press to operate as intended, it is of course necessary that the counter-flowing liquid introduced through the slot **28** into the laterally confined space **11**, be free to pass longitudinally through the bagasse to the liquid outlet **19** beyond or ahead of the leading end of the pressure plate **8**. In the second form of FIGURES 13 and 14 in which the bagasse is fed by the feed roll **68**, there is nothing to interfere with the required passage of the diluent except the bagasse itself and tests have established that the permeability of bagasse under pressure in the direction of the applied pressure is as little as one-tenth that in the transverse direction. The direction of the pressure exerted on the bagasse both by the pressure plate **8** and by the squeeze roll **34** being forward toward the leading end of the space **11**, the applied pressure thus will apply a force causing the diluent to flow in exactly the direction desired and this force will be increased by the pressure at which the liquid is introduced.

In the main form, counter-flowing diluent will be deflected by and pass between the laterally spaced tines **54** of each rake or row **53** and be but little affected in its flow under the applied forces. Moreover, any adverse effect of the tines upon flow of the diluent is more than compensated for by the gaps in the bagasse formed behind the tines, which, by being filled with the diluent as it passes the tines, aid in distributing the diluent uniformly over the area of the blanket on any given cross-section.

The preferred progressive decrease in the cross-sectional area of the space **11** accompanying an increase in the pressure applied by the pressure plate **8** from somewhat more than 5 p.s.i. at the leading end to from 35 to 100 p.s.i. at the trailing end of the space, will compress the bagasse mat in a direction radial of the drum **2** from about 4" to about 1". Since a mat of bagasse of the thickness of that entering the space **11** at the pressure there applied, even when subjected to a pressure on the order of 6,000 p.s.i., will be compressed only to about ¼", the 1" thick mat at the trailing end of the space will be only about one-fourth fiber. Thus, the density of the fiber at any point in the pressure space **11** will not be sufficient to prevent the required counter-flow of the diluent under the applied pressure.

The subjection of the bagasse in the pressure space **11** and at least in part in the inlet passage **27** to the action of diluent flowing longitudinally through it under positive or superatmospheric pressure, alone is much more effective in washing out or carrying away residual juice than diluent flowing only under gravity, as in the diffusion process, and, as mentioned earlier, the washing action of the diluent under pressure can be rendered even more efficient by introducing slugs of air with the diluent to take advantage of the Dupre effect, in rubbing off any exposed residual juice clinging tightly to the fiber. Too, wetting or other beneficial chemical agents can be introduced with the diluent and within the space **11** it is possible to increase further the kinetic energy of the diluent, derived from its rate of flow and the preferred heat, by subjecting the contents of the space to ultra-sonic or other suitable agitation.

A particular advantage of the improved press over a diffuser is that, by regulating the pressure at which it is introduced, the diluent can be circulated not once but a plurality of times through a given section of the bagasse mat as it passes through the pressure space **11**. The maximum length of the path over which the bagasse is exposed to the diluent is that of the pressure space **12** and the inlet passage **27** to the point of exit of the diluent and considerably shorter than that in a diffuser. However, as opposed to the cross-wise and intermittent path in a diffuser, the length-wise path in the press **1** affords continuous contact between the bagasse and the diluent. Too, with the drum turning at only around 3–10 r.p.m., the movement of the bagasse will be slow and in the illustrated arrangement in which the space **11** and inlet passage together span about 215° of the circumference of the shell **3**, the path for each circulation of diluent will be approximately between ⅓ and ⅜ of that circumference. Thus, for a press of convenient size capable of handling around 100 tons of cane per hour and for a pressure space **11** decreasing from around 4 in. to around 1 in. in height, a shell about 5 ft. wide and 3 ft. in diameter, the maximum path will be almost 6 ft. While this path is short compared with that in a diffuser, the contact over it of the residual juice and diluent is uninterrupted and it suffices for the accelerated action of the diluent under the pressure at which it is applied to produce the mixing or diffusion required for washing or rinsing residual juice from the fiber. Too, further acceleration of the action of the diluent is readily obtained by conducting the washing under heat and any of the other of the beneficial conditions previously mentioned. Both residual and applied juice are pressed from the bagasse mat or blanket, prior to its discharge from the press **1**, by the squeeze roll **34** and a pressure between the roll and the drum **2** on the preferred order of from 1,000 to 2,500 p.s.i., and far below that of a mill, will have the salutary effect of rupturing and releasing juice from cells that were missed in preparing the cane. The juice so extracted can also be drained into the tank **71**. Another important purpose of the squeeze roll **34** is to reduce the juice content of the discharged bagasse to a point where it is readily handleable for further processing and a pressure of the preferred order will accomplish this by reducing the juice content to less than 70%. So reduced, the discharged bagasse will contain about 28 parts of juice to 12 parts of fiber, far below the juice content of the initial cane which for the same twelve parts of fibers is about eighty-eight parts juice. Even were the bagasse delivered to the press of the same fiber and juice composition as cane, there therefore would be an overall reduction in its juice content as it passed through the press and this reduction is the greater if, as preferred, the bagasse, when introduced, is wet with diluent.

Aptly termed from its functions, a pressure rinse and squeeze press, and designed to act upon bagasse from which a large percentage of the initial rich juice has previously been extracted incident to the preparation of the cane, the improved juice press, mainly by its pressure washing or rinsing action, is capable of extracting some 75–80% of the residual juice from such bagasse, particularly if the latter is delivered to it both wet and hot. The pressure at which the diluent is applied makes use for extraction of tightly held juice of far more kinetic energy than is available in the gentle washing of the diffusion process and the preferred prior heating of the bagasse augments this energy in addition to softening the fibers and killing living cells. By driving the bagasse through a point of maximum pressure before discharge, the press discharges the bagasse in a relatively dry, readily handleable condition, as opposed to the diffusion process, and its power requirements relative to a mill are exceedingly small. Thus, a press of the previous-

ly mentioned size, capable of handling around 100 tons of cane per hour, will actually use only about 50 H.P.

From the above detailed description it will be apparent that there has been provided an improved press for extracting juice from juice-containing material, which is both highly efficient and low in its power requirements. It should be understood that the described and disclosed embodiments are merely exemplary of the invention and that all modifications are intended to be included that do not depart from the spirit of the invention or the scope of the appended claims.

Having described my invention, I claim:

1. A press assembly for extracting juice from juice-containing material comprising a laterally confined space, a point of maximum pressure adjacent a material outlet end of said space, means for moving a mass of juice-containing material through said space and past said pressure point, said space being of such shape as with said moving means to subject said mass to progressively increasing pressure as it moves therethrough, and means for introducing liquid diluent into said space in advance of said pressure point for flow under positive pressure counter-current through said mass to a liquid outlet adjacent an opposite end of said space.

2. A press assembly for extracting juice from juice-containing material comprising a laterally confied space, a point of maximum pressure beyond a material outlet end of said space, rotary means for moving a mass of juice-containing material through said space and past said pressure point, said space being of such shape as with said moving means to subject said mass to progressively increasing pressure as it moves therethrough, and means for injecting liquid diluent under pressure into said space in advance of said pressure point for flow counter-current through said mass to a liquid outlet adjacent and opposite end of said space under a positive pressure in part produced by the progressively increasing pressure to which said mass is subjected.

3. A press assembly for extracting juice from juice-containing material comprising a laterally confined space, a point of maximum pressure adjacent a material outlet end of said space, non-rotary means at a side of said space, a rotary member for moving a mass of juice-containing material through said space over said non-rotary means and past said pressure point, said space being of such shape as with said rotary member to subject said mass to progressively increasing pressure as it moves therethrough, a liquid outlet in a side of said space adjacent an end thereof opposite said outlet end, and means for introducing liquid diluent into said space in advance of said pressure point for flow counter-current through said mass to said liquid outlet under a positive pressure in part produced by the progressively increasing pressure to which said mass is subjected.

4. A press assembly for extracting juice from juice-containing material comprising a laterally confined space progresively decreasing in cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved therethrough to progressively increasing pressure, a point of maximum pressure adjacent said end of said space, rotary means for moving said mass through said space and past said pressure point, and means for introducing liquid diluent into said space in advance of said pressure point for flow counter-current through said mass to a liquid outlet adjacent an opposite end of said space under a positive pressure in part produced by the progressively increasing pressure to which said mass is subjected.

5. A rotary press for extracting juice from juice-containing material comprising a rotary member, a non-rotary member confronting and spaced from a side of said rotary member and with said side partly defining a laterally confined space of progressively decreasing cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved through said space to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, means on said rotary member for moving said mass through said space over said non-rotary member and past said pressure point, and means for introducing a liquid diluent into said space in advance of said pressure point for flow counter-current through said mass to a liquid outlet adjacent an opposite end of said space under a positive pressure produced in part by the progressively increasing pressure to which said mass is subjected.

6. A rotary press for extracting juice from juice-containing material comprising a rotary drum, a non-rotary pressure member confronting and spaced from a side of said rotary drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved through said space to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, means on said rotary drum for moving said mass through said space over said non-rotary member and past said pressure point, and means for introducing a liquid diluent into said space in advance of said pressure point for flow counter-current through said mass to a liquid outlet adjacent an opposite end of said space under a positive pressure produced in part by the progressively increasing pressure to which said mass is subjected.

7. A rotary press for extracting juice from juice-containing material comprising a rotary drum having a roughened side, a non-rotary pressure member having a lubricious surface confronting and spaced from said side of said drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section toward a material outlet and thereof for subjecting a mass of juice-containing material moved through said space to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, means on said drum and cooperating with said side thereof for moving said mass through said space over said non-rotary member and past said pressure point, and means for introducing a liquid diluent into said space through said surface of said non-rotary member in advance of said pressure point for flow counter-current through said mass to a liquid outlet adjacent an opposite end of said space under a positive pressure produced in part by the progressively increasing pressure to which said mass is subjected.

8. A rotary press for extracting juice from juice-containing material comprising a rotary drum, a pressure plate movable relative to having a smooth surface confronting and spaced from a side of said drum and defining with said side vertical limits of a laterally confined pressure space of progressively decreasing cross-section for subjecting a mass of juice-containing material moved through said space to progressively increasing pressure, a point of maximum pressure adjacent a material outlet end of said space, means for moving said plate and thereby varying a vertical dimension of said space, means on said drum for moving said mass through said space over said surface and past said pressure point, and means for introducing a liquid diluent through said surface into and substantially across said space in advance of said pressure point for flow counter-current through said mass to a liquid outlet adjacent an opposite end of said space under a positive pressure produced in part by the progressively increasing pressure to which said mass is subjected.

9. A rotary press for extracting juice from juice-containing material comprising a rotary drum, a non-rotary pressure plate having a surface confronting and spaced from a side of said drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section for subjecting a mass of juice-containing material move therethrough to progressively increasing pressure, a squeeze roll positioned beyond a material discharge end of said space for engaging and

with said drum side squeezing liquid from material discharged from said space, means on said drum for moving said mass through said space to said squeeze roll, and means for introducing a liquid diluent under positive pressure into said space in advance of said squeeze roll and with the progressively increasing pressure applied to said material forcing said diluent under positive pressure counter-current through said mass to a liquid outlet adjacent an opposite end of said space.

10. A rotary press for extracting juice from juice-containing material comprising a rotary drum having a roughened side, a stationary pressure member having a smooth surface confronting and spaced from said side of said drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved therethrough to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, means coacting with said drum side for moving a mass of juice-containing material to and through said space over said smooth surface and past said pressure point, and means for introducing a liquid diluent into said space in advance of said pressure point for flow counter-current through said mass to a liquid outlet adjacent an opposite end of said space under a positive pressure produced in part by said progressively increasing pressure on said mass.

11. A rotary press for extracting juice from juice-containing material comprising a rotary drum having a roughened side, a stationary pressure member having a smooth surface confronting and spaced from said side of said drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved through said space to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, a plurality of tines having inner ends contained in said drum and arranged in circumferentially and laterally spaced relation about and projectable and retractable relative to said side, said tines co-acting with said side for moving said mass to and through said space over said smooth surface and past said pressure point, and means for introducing a liquid diluent into said space in advance of said pressure point for flow under positive pressure counter-current through said mass to a liquid outlet adjacent an opposite end of said space in response to a force thereon produced in part by the progressively increasing pressure on said mass.

12. A rotary press for extracting juice from juice-containing material comprising a rotary drum having a grooved side, a stationary pressure member having a smooth surface confronting and spaced from said side of said drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved through said space to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, a plurality of tines having inner ends contained in said drum and arranged in laterally and circumferentially spaced relation about said side and mounted therein for radial reciprocation relative thereto, means for projecting said tines beyond said side over a part of the path of rotary movement thereof, said tines co-acting with the grooving of said side for moving said mass to and through said space over said smooth surface and past said pressure point, and means for introducing a liquid diluent into said space in advance of said pressure point for flow under positive pressure counter-current through said mass to a liquid outlet adjacent an opposite end of said space in response to a force thereon in part produced by the progressively increasing pressure on said mass.

13. A rotary press for extracting juice from juice-containing material comprising a rotary drum, a stationary pressure member having a smooth surface confronting and spaced from a side of said drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved through said space to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, a plurality of tines having inner ends contained in said drum and arranged in laterally and circumferentially spaced relation about said side and mounted therein for radial reciprocation relative thereto, means for projecting said tines beyond said side over a part of the path of rotary movement thereof, said tines on projection being engageable with juice-containing material for moving said mass thereof through said space over said smooth surface and past said pressure point, and means for introducing a liquid diluent into said space in advance of said pressure point for flow under positive pressure counter-current through said mass to a liquid outlet adjacent an opposite end of said space in response to a force thereon in part produced by said progressively increasing pressure on said mass.

14. A rotary press for extracting juice from juice-containing material comprising a rotary drum, a stationary pressure member having a smooth surface confronting and spaced from a side of said drum and with said side defining vertical limits of a laterally confined space of progressively decreasing cross-section toward a material outlet end thereof for subjecting a mass of juice-containing material moved therethrough to progressively increasing pressure, a point of maximum pressure adjacent said outlet end of said space, a plurality of tines having inner ends contained in said drum and arranged in laterally and circumferentially spaced relation about said side and mounted therein for radial reciprocation relative thereto, means for projecting said tines beyond said side over a part of the path of rotary movement thereof, said tines on projection being engageable with wet juice-containing material for moving said mass thereof to said space and toward said pressure point, and means for introducing a liquid diluent into said space in advance of said pressure point for flow under positive pressure counter-current through said mass to a liquid outlet adjacent an opposite end of said space in response to a force thereon in part produced by the progressively increasing pressure on said mass.

15. In a press assembly for extracting juice from juice-containing material, a rotary member, a stationary partly perforate wall confronting a side of said rotary member and therewith defining opposite sides of a laterally confined space, a pressure point adjacent a material outlet end of said space, a plurality of separate tines having inner ends contained in said member and spaced laterally and circumferentially about and mounted for radial reciprocation in said side of said member, and means to which said tines are individually releasably connected for progressively projecting and retracting said tines relative to said member side over the path of rotary movement thereof respectively for engaging and disengaging juice-containing material and on engagement feeding a wet mass of said material into said space past said perforate part of said wall toward said pressure point.

16. In a press assembly for extracting juice from juice-containing material, a rotary drum, a wall having a perforate leading part and a smooth cylindrically concave trailing part confronting a side of said drum and defining therewith opposite sides of a laterally confined space, a pressure point adjacent a trailing end of said space, a plurality of separate tines having inner ends contained in said drum and arranged in laterally and circumferentially spaced relation about and mounted for radial reciprocation in said drum side, drive means in said drum to which said tines are individually releasably connected for progressively projecting and retracting said tines relative to

said drum side over the path of rotary movement thereof respectively for engaging and disengaging juice-containing material and on engagement feeding a mass of said material into said space past said perforate part of said wall toward said pressure point.

17. In a press assembly for extracting juice from juice-containing material, a rotary drum, a wall having a perforate leading part and a smooth cylindrically concave trailing part confronting a side of said drum and defining therewith opposite sides of a laterally confined space, a pressure point adjacent a trailing end of said space, a plurality of separate tines having inner ends contained in said drum and arranged in laterally spaced relation in each of a plurality of circumferentially spaced rows about and mounted for radial reciprocation in said drum side, a cylindrical member mounted in said drum eccentric thereto and substantially concentric with said trailing part of said wall, and a driving connection between said cylindrical member and said inner end of said tines for individually releasably connecting said tines thereto and progressively projecting and retracting said tines relative to said drum side over the path of rotary movement thereof respectively for engaging and disengaging juice-containing material and on engagement feeding a mass of said material into said space past said perforate part of said wall toward said pressure point.

18. In a press assembly for extracting juice from juice-containing material, a rotary drum, a wall having a perforate leading part and a smooth cylindrically concave trailing part confronting a side of said drum and defining therewith opposite sides of a laterally confined space, a pressure point adjacent a trailing end of said space, a plurality of separate tines having inner ends contained in said drum and arranged in laterally spaced relation in each of a plurality of circumferentially spaced rows about and mounted for radial reciprocation in said drum side, a cylindrical member mounted in said drum eccentric thereto and substantially concentric with said cylindrical part of said wall, and a plurality of laterally spaced annular tracks fixed to and extending around a side of said cylindrical member and each releasably interlocking individually with inner ends of circumferentially spaced and aligned tines for progressively projecting and retracting said tines relative to said drum side over the path of rotary movement thereof respectively for engaging and disengaging juice-containing material and on engagement feeding a mass of said material into said space past said perforate part of said wall toward said pressure point.

19. In a press assembly for extracting juice from juice-containing material, a rotary drum, a wall having a perforate leading part and a smooth cylindrically concave trailing part confronting a side of said drum and defining therewith opposite sides of a laterally confined space, a pressure point adjacent a trailing end of said space, a plurality of spaced tines arranged about and mounted for radial reciprocation in said drum side, a cylindrical member mounted in said drum eccentric thereto and substantially concentric with said cylindrical part of said wall, and magnetic means carried by said cylindrical member for holding inner ends of said tines against a surface thereof and enabling said member progressively to project and retract said tines relative to said drum side over the path of rotary movement thereof respectively for engaging and disengaging juice-containing material and on engagement feeding a mass of said material into said space past said perforate part of said wall toward said pressure point.

20. In a press assembly for extracting juice from juice-containing material, a rotary drum, a wall having a perforate leading part and a smooth cylindrically concave trailing part confronting a side of said drum and defining therewith opposite sides of a laterally confined space, a pressure point adjacent a trailing end of said space, a plurality of spaced tines arranged about and mounted for radial reciprocation in said drum side, a cylindrical member mounted for independent rotation in said drum eccentric thereto and substantially concentric with said cylindrical part of said wall, and a plurality of permanent magnets embedded in said cylindrical member and each positioned to act on certain of said tines for holding inner ends thereof substantially immovably against a surface of said member and enabling said member to rotate with and progressively project and retract said tines relative to said drum side over the path of rotary movement thereof respectively for engaging and disengaging juice-containing material and on engagement feeding a mass of said material into said space past said perforate part of said wall toward said pressure point.

21. In a press assembly for extracting juice from juice-containing material, a rotary drum, a wall having a perforate leading part and a smooth cylindrically concave trailing part confronting a side of said drum and defining therewith opposite sides of a laterally confined space, a pressure point adjacent a trailing end of said space, a plurality of tines having inner ends contained in said drum and arranged about in laterally and circumferentially spaced relation and mounted for radial reciprocation in said drum side, a cylindrical member rotatably mounted in said drum eccentric thereto and substantially concentric with said trailing part of said wall, and a driving connection between said cylindrical member and said tines for causing said cylindrical member to rotate substantially with said tines and said tines to progressively project and retract relative to said wall over the path of rotary movement respectively for engaging and disengaging juice-containing material and on engagement feeding a mass of said material into said space past said perforate part of said wall toward said pressure point.

22. In a press assembly for extracting juice from juice-containing material, a rotary drum, a wall having a perforate leading part and a smooth cylindrically concave trailing part confronting a side of said drum and defining therewith opposite sides of a laterally confined space, a pressure point adjacent a trailing end of said space, a plurality of tines having inner ends contained in said drum and arranged in laterally and circumferentially spaced relation about and mounted for radial reciprocation in said drum side, a cylindrical member rotatably mounted in said drum eccentric thereto and substantially concentric with said trailing part of said wall, a driving connection between said cylindrical member and said tines for causing said cylindrical member to rotate substantially with said tines and said tines to progressively project and retract relative to said wall over the path of rotary movement respectively for engaging and disengaging juice-containing material and on engagement feeding a mass of said material into said space past said perforate part of said wall toward said pressure point, and means for selectively shifting the axis of said cylindrical member and thereby varying the point of maximum projection of said tines relative to said drum side.

23. A juice press comprising a rotary drum having a roughened side, a wall having a perforate leading part and a smooth trailing part confronting said side of said drum and therewith defining opposite sides of a laterally confined space, a point of maximum pressure adjacent a material outlet end of said space, a feed roll having a roughened surface facing and co-acting with said roughened side of said drum for feeding a mass of juice-containing material into said space past said perforate part of said wall, and means for introducing a liquid diluent into said space in advance of said pressure point, said diluent in response to force thereon flowing under positive pressure counter-current through said mass of material to said perforate part of said wall.

24. A juice press comprising a rotary drum having a circumferentially and cross-grooved side, a wall having a perforate leading part and a smooth trailing part confronting said side of said drum and therewith defining opposite sides of a laterally confined space, a point of maximum pressure adjacent a material outlet end of said

space, a feed roll having a circumferentially and cross-grooved surface facing and co-acting with said side of said drum for feeding a mass of juice-containing material into said space past said perforate part of said wall, and means for introducing a liquid diluent into said space in advance of said pressure point, said diluent in response to force thereon flowing under positive pressure counter-current through said mass of material to said perforate part of said wall.

25. A press assembly for extracting juice from juice-containing material comprising a laterally confined space, a point of maximum pressure adjacent a material outlet end of said space, means for moving a mass of juice-containing material through said space and past said pressure point, means for introducing liquid diluent into said space in advance of said pressure point for flow under positive pressure counter-current through said mass to a liquid outlet adjacent an opposite end of said space, and means for introducing individual slugs of air into said diluent in advance of introduction thereof into said space.

26. A press assembly for extracting juice from juice-containing material comprising a rotary drum having a grooved side, a wall having a perforate leading part and a smooth trailing part confronting said side of said drum and therewith defining opposite sides of a laterally confined space, a squeeze roll confronting said grooved side beyond a material discharge end of said space for expressing liquid from material discharged from said space,

means cooperating with said grooved side for moving a mass of juice-containing material through said space to said squeeze roll, and means for introducing a liquid diluent into said space in advance of said squeeze roll, said diluent in response to force thereon flowing under positive pressure counter-current through said mass of material to said perforate part of said wall.

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