Dec. 13, 1960 N. W. PIRIE ET AL 2,963,960

APPARATUS FOR THE EXPULSION OF LIQUID FROM FIBROUS MATERIALS

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Fig. 4

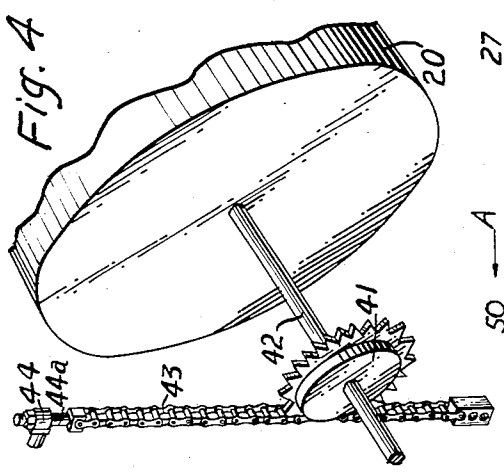


Fig. 1

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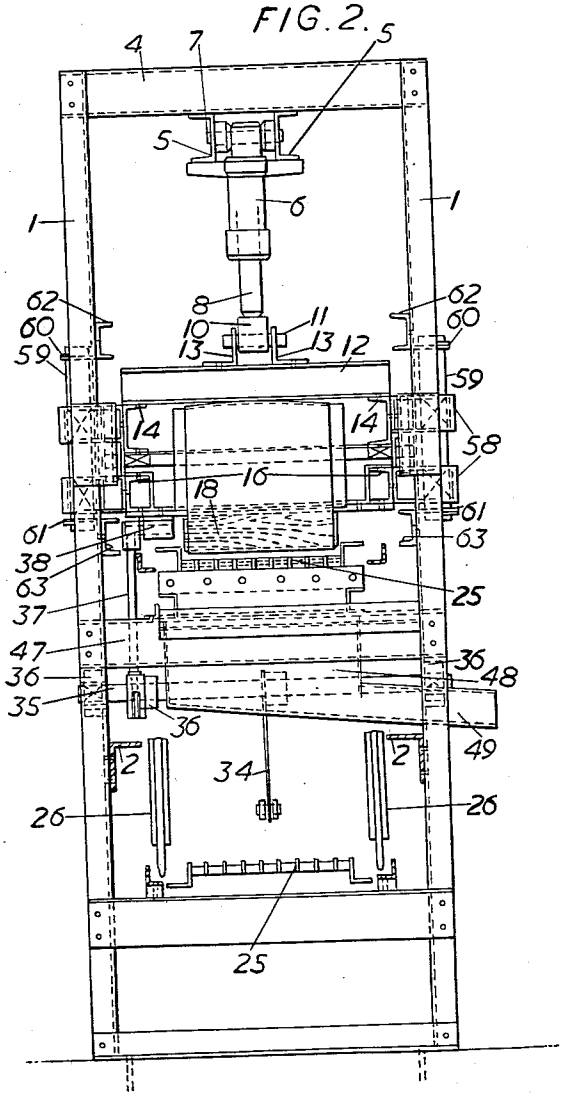
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APPARATUS FOR THE EXPULSION OF LIQUID FROM FIBROUS MATERIALS

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FIG. 2.



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APPARATUS FOR THE EXPULSION OF LIQUID FROM FIBROUS MATERIALS

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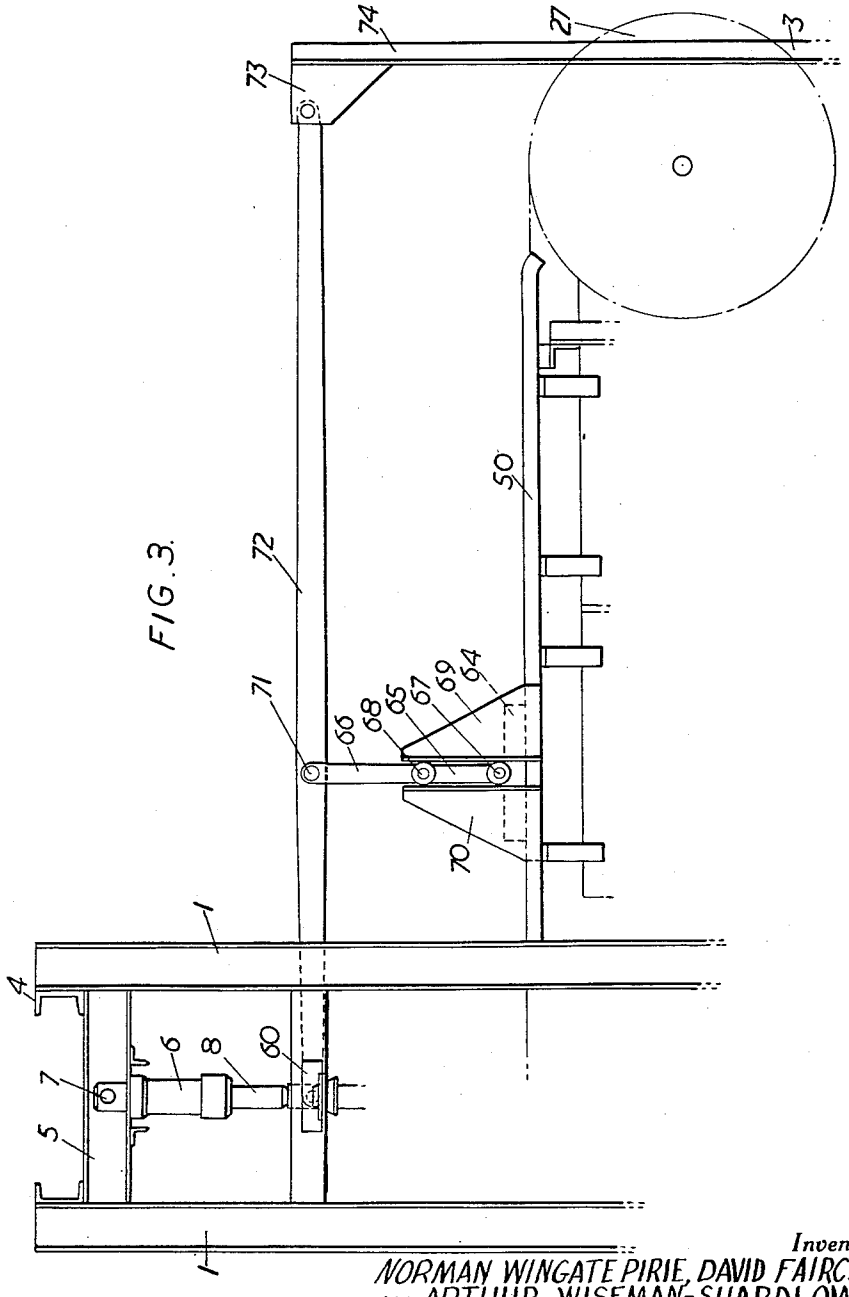


FIG. 3.

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APPARATUS FOR THE EXPULSION OF LIQUID FROM FIBROUS MATERIALS

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3 Claims. (Cl. 100—118)

For many purposes there is need for a press which will satisfactorily separate water and other fluids from fibrous materials, particularly vegetable matters such as leaves, grasses and certain kinds of fruits, on an industrial scale and without rubbing or churning. It is desirable that the fluid expulsion should be effected under such conditions that the bed of material being pressed is kept thin so that compacted fibre does not act as a very fine filter.

These conditions are particularly desirable in the expulsion of juices from fragments of vegetable matter that have been produced in a suitable mill, or for the expulsion of water from leaves that have been suitably preheated, for example, by steaming.

Many attempts have been made to effect fluid expulsion with conventional apparatus. However, experience has shown that the main disadvantage of the screw expeller is that there is so much internal friction that the material is disintegrated and an excessive amount of power is consumed; roller presses have the disadvantage that pressure is not maintained for a sufficiently long time on the material; hydraulic presses are unsatisfactory by reason of the labour required for charging and emptying the press when the thickness of material to be treated is small.

An object of the invention is to avoid the aforesaid disadvantages, and the invention accordingly provides a continuous press for the expulsion of liquid from fibrous materials such as vegetable matters, characterised by means for periodically advancing and immobilizing a relatively thin layer of said material, and means for applying pressure during each period of immobilization to successive, stationary portions of said material.

Preferably, the pressure is applied by hydraulic means so as to remain uniform notwithstanding decrease of depth of the layer of material undergoing pressure.

The layer of material may be periodically advanced and immobilized by an endless conveyor or grid-like or slatted construction, preferably made of a chain or series of substantially rigid elements, and operated in synchronism with the pressure-applying hydraulic ram or equivalent means; the conveyor may be advanced to an extent substantially equal to the dimension of the pressure-applying means in the longitudinal direction of the conveyor, so that each successive portion of the material is subjected to a single pressing, or to an extent which is a fraction of said dimension so that each successive portion of the material is subjected to a series of successive pressings. In the latter case, the pressure applying means may be rockable to distribute the pressure over several adjacent portions of material progressively reduced in thickness by the successive pressings.

For example, a tumbler or a sprocket system whereby such a conveyor is driven may be turned as the pressure-applying ram or other means moves to release the pressure. Thus, a ratchet wheel on the tumbler or sprocket shaft may be angularly displaceable by a pawl actuable by preferably adjustable lever-linkage means connected with the ram or equivalent.

Advantageously, the face of the pressure-applying ram or equivalent means (which for convenience of description will hereinafter be referred to as a ram) is covered with a movable endless band, arranged to be displaced substantially in synchronism with the means for advancing the layer of material, and in the same direction, during the periods when the ram is raised to relieve the material of pressure.

Preferably, the intermittent advancing of said band is effected automatically each time the ram is raised, and with a delayed action, so that the band is clear of the upper surface of the material before it is displaced.

For example, the band may be displaceable around at least two rollers mounted in bearings on extensions from the ram, one run of the band traversing the pressure face of the ram, and the intermittent advance may be effected by engagement of an angularly displaceable member with a fixed abutment on a frame in which the ram is mounted.

Such means may conveniently comprise a rack and pinion arrangement, more particularly a free-wheel sprocket and a length of roller chain secured in a fixed position under tension, and for adjusting the timing, the rack or equivalent roller chain may be adjustable in a direction parallel to the axis of the ram.

According to a further feature of the invention, the means for advancing the material towards the ram may be extended on the entry side and a preliminary pressing means associated with such extension, said pressing means being operated by a lever-linkage system actuable by the ram.

By such means not only is the material subjected to an initial pressing which expels the more easily removable portion of fluid contained in the material, but the layer of material is partially compressed and consequently the stroke of the ram, necessary to lift it above the upper surface of the material during displacement of the layer, is reduced.

The ram is preferably associated with known means for effecting independently (*a*) variation of the duration of the pressure stroke, (*b*) variation of the frequency of the strokes and (*c*) variation of the pressure applied.

The foregoing and other features of the invention will be better understood from the following description by way of example of an embodiment illustrated in the accompanying drawings, wherein:

Figure 1 is a side elevation of a press,

Figure 2 is a vertical section on the line II—II of Figure 1,

Figure 3 is a diagrammatic side elevation of a part of the press shown in Figures 1 and 2, illustrating a modification in which preliminary pressing means are included, and

Figure 4 is a detail of part of the mechanism of Figure 1.

The press as shown in the drawings has a main frame comprising four uprights **1** and two main longitudinal beams **2**, the ends of which are supported on legs **3**.

Mounted on two transverse members **4** at the top of the uprights **1** are two longitudinal beams **5** to which the upper end of a hydraulic cylinder **6** is secured in a suitable manner, e.g., on a pivot pin **7** as shown.

The lower end of the hydraulic piston rod **8** is secured by an adjustable screw threaded means **9** (Figure 1) to a cross-head member **10** connected by a pivot pin **11** to a ram structure. The latter comprises a cross member **12** mounted on the pin **11** by means of angle brackets **13**, and having secured below it a pair of longitudinal beams **14** which in turn carry two transverse beams **15** to the outer ends of which are in turn connected a further pair of longitudinal beams **16**.

Secured below the beams **16** is a group of hardwood blocks, of which the middle block **17** is cuboid in form

and constitutes the pressure applying member of the ram assembly, while the two outer blocks **18** are wedge shaped and serve as guides for a shrouding endless band **19** of rubber, plastic or other suitable sheet material. The band **19** is mounted on a driving roller **20** and a tension roller **21**, both these rollers being mounted in bearings carried by the beams **16**. The bearings for the tension roller **21** are indirectly supported by the beams **16** upon a plate **22** which is adjustable by screw and nut means **23** engageable with an abutment member **24** fixed to the beam **16**.

The ram assembly is vertically guided by brackets **58** secured to the members **14** and **16** of said assembly. These brackets are slidable upon fixed, vertical guides **59** mounted in upper and lower angle members **60** and **61** secured to beams **62** and **63** extending longitudinally between the uprights **1**.

A conveyor for the material to be treated, which consists of an endless chain of links **25**, each comprising a rigid frame enclosing a grid-like structure, is mounted on a pair of driving sprocket wheels **26** and a pair of tension sprocket wheels **27**, the shafts **28** and **29** of which are supported in bearings adjacent the ends of the longitudinal beams **2**.

On the shaft **28** of the driving sprockets **26** is secured a ratchet wheel **30**. Loosely mounted on said shaft is a lever **31** carrying a pawl **32** which is resiliently urged into engagement with the ratchet wheel **30**.

Articulated to the end of the lever **31** is a rod **33**, the other end of which is in turn articulated to a depending lever **34** secured to a transverse shaft **35** mounted in bearings **36** on two of the uprights **1**. As shown these lever-linkage elements **31—34** are mounted at the middle of the frame, and towards one side of the frame there is secured to the shaft **35** a lever **36** which oscillates about the horizontal. To the end of this lever is articulated a vertical rod **37**, the upper end of which is secured to a pivot member **38** located below one of the longitudinal beams **16**.

For facilitating adjustment of the displacement of the driving sprockets **26**, the rods **33** and **37** are shown articulated to the levers **31**, **34** and **36** by means of clevises **39**, each of which is adjustable on a screw-threaded portion of the rod. Furthermore, the articulation of the rod **33** to the lever **31** is preferably adjustable by the engagement of a pin **40** (which is engaged by the associated clevis **39**), in a selected one of a series of holes (not shown) in the lever **31**, so that notwithstanding a substantially constant stroke of the ram the pawl-and-ratchet means may be displaced to advance the conveyor chain **25** at each operation to an extent substantially equal to the longitudinal dimension of the block **17**, or by a fraction of the dimension as required.

Mounted at the top of the uprights **1**, for example on a plate carried by the beams **4**, is an electrically driven pump and operating gear (not shown) of known kind for the hydraulic cylinder **6**, which is of double acting type, having both downward and upward strokes positively effected.

The operating gear preferably includes a reservoir for hydraulic fluid with which is associated control means for the pump whereby the pressure created in the reservoir is adjustable. There is preferably mounted on the press a pressure indicator calibrated to show both the pressure in the cylinder and the pressure applied in pounds per square inch upon the material pressed beneath the ram face of the block **17**.

Furthermore, there is preferably provided on the frame control means of known kind which determines the frequency of the strokes of the hydraulic piston **8**, and also independently the dwell of said piston in its lower, protruded position during which pressure is maintained upon the material.

As the ram effects each upward stroke, the pawl **32** engages and turns the ratchet wheel **30** on the shaft of the driving sprockets **26**, under actuation of the lever-linkage means **31, 33, 34, 36, 37**, so that as the ram rises the link conveyor **25** is displaced in the direction of the arrow A to bring a fresh charge of material below the effective surface of the block **17**, or a part of said surface.

The band **19** is provided to prevent adherence of the pressed material to the block **17**, and the press includes means for displacing this band in substantial synchronism with, and in the same direction as, the conveyor **25**. That is to say, the upper run of the conveyor **25** and the lower run of the band **19** are moved simultaneously to the left as seen in Figure 1, and preferably to a substantially equal extent. Movement of the band **19** is however delayed until the lifting of the ram has proceeded to such an extent that the band is displaced from contact with the material on the conveyor **25**, including the material entering the ram area which has not been pressed.

To this end, movement of the band **19** is effected by means of the rack and pinion type, the position of the rack or equivalent being such that effective engagement does not commence until the ram has lifted to a predetermined extent. As shown, the rack and pinion means consists of a free-wheel chain sprocket **41** mounted on one or each end of the shaft **42** carrying the driving drum **20** for the band **19**, and a length of roller chain **43** held in tension in a vertical attitude upon a bracket **44** secured to one of the uprights **1**. The chain **43** is preferably held in tension by screw thread means **44*a***, whereby the vertical location of the chain may be suitably adjusted. Evidently as the ram rises, and when the teeth of the sprocket **41** engage the chain **43**, the sprocket is turned clockwise as seen in Figure 1, and turns the drum **20** likewise so that the lower run of the band **19** is displaced to the left in the direction of the arrow A.

In case any of the pressed material might adhere to the band **19**, a scraper **45** is disposed to bear lightly upon the band, transversely below the pair of beams **16**.

During each successive pressing operation the portion of the conveyor links **25** located below the ram block **17** is supported by a fixed grid structure **46** carried by a pair of transverse beams **47**. Below this fixed grid is a collecting pan **48** the base of which is inclined and from which extends discharge channel or duct **49**.

The chains (not shown) by which the links **25** of the conveyor are interconnected and mounted on the sprockets **26** and **27** are supported, in the upper run, by a pair of angle members **50** carried by uprights **51** from the longitudinal members **2**, and in the lower run by a pair of angle members **52** supported on the lower parts of the uprights **1** and by the legs **3**. Towards the left-hand end of the members **50**, as seen in Figure 1, is mounted a scraper **53** for cleaning material adhering to the conveyor links **25** after the greater part of such material has been discharged from these links as they pass round the driving sprockets **26**.

Below the feed or right-hand portion of the upper run of the conveyor, and suspended from the angle members **50**, are two pans or trays **54** and **55** for collecting any fluid which may drain naturally from the material or may be expelled therefrom by an initial pressing as will be described. These pans have discharge channels or ducts **56** and **57** respectively which project from the side of the press in the same direction as the discharge duct **49** of the pan **48**, so that all the expelled fluid may be collected, for example, in a channel, on one side of the machine.

It has been found by experiment that a press as described by reason of the application of uniform pressure for a controlled duration on successive portions of the material to be treated, effects expulsion of fluids from fibrous materials, particularly vegetable matters such as

leaves, in a more satisfactory and efficient manner than has hitherto been possible, with apparatus of known types.

In a development of the invention (see Figure 3), auxiliary pressing means are provided above the conveyor and before the main pressure means. These serve to remove some of the more easily expellable fluid from the material and at the same time serve to effect an initial compression of the material prior to the main pressing operation.

The auxiliary pressure means comprise a pressure member which desirably is of similar construction to the means **17**, **18**, **19** hereinbefore described but is shown as a plate **64** carried by a shank **65** to which are articulated a pair of links **66**. Extending laterally at the upper and lower ends of the shanks **65** are rollers **67** and **68**, which run in a guideway formed between angle brackets **69** and **70** mounted on the angle irons **50**.

The links **66** are pivotally connected at **71** to a lever **72**, one end of which is articulated to the ram assembly and the other end of which is pivotally mounted between brackets **73** provided on extensions **74** of the uprights **3**. The means **64**—**70** may be located at any suitable position in relation to the feed portion of the conveyor. As shown, the location of the pivot **71** is selected, for example, so that its distance from the articulation to the ram assembly is half that of its distance from the pivotal connection to the brackets **73**, whereby the material is subjected to a preliminary compression equal to two-thirds of that effected by the hydraulic ram assembly.

It will be seen that the auxiliary pressing means will exert pressure on the material simultaneously with the pressing action of the main assembly. The provision of the guideway between the plates **69** and **70** ensures that the pressure plate **64** exerts an evenly distributed pressure on the material on the conveyor.

Alternatively, the plate **64** or equivalent pressure member may be rockable, for example, about the axis of the rollers **67**, particularly when the displacement of the conveyor is a fraction of the longitudinal dimension of said means, so as to distribute the pressure thereby applied over several adjacent portions of material progressively reduced in thickness by the successive preliminary pressings.

Evidently the mode and details of construction of a press and the details and modes of operation of the several elements and assemblies therein may be modified considerably without departing from the scope of the invention.

We claim:

1. A press for the expulsion of liquid from fibrous material comprising an endless conveyor of grid-like construction for the material, means for periodically advancing and immobilising said conveyor, a supporting frame, a hydraulically displaceable platen mounted on said frame for applying pressure to fibrous material on said conveyor during immobilisation thereof, a movable endless band covering the face of said platen, means for advancing said movable endless band in synchronism with the means for advancing said conveyor when said platen is in a non-pressing position, a fixed abutment on said frame in which said platen is mounted, an angularly displaceable member engaging said fixed abutment for actuating said band displacing means, means for supporting said conveyor beneath said platen and means for collecting the expressed liquid located beneath said supporting means, said means for supporting the conveyor permitting free passage of liquid expressed from the material into said collecting means.

2. A press for the expulsion of liquid from fibrous material comprising an endless conveyor of grid-like construction for the material, means for periodically advancing and immobilising said conveyor, a hydraulically displaceable platen for applying pressure to fibrous material on said conveyor during immobilisation thereof, a movable endless band covering the face of said platen, means for advancing said movable endless band in synchronism with said means for advancing the conveyor when the platen is in a non-pressing position which band displacing means comprises a length of chain serving as a rack under tension and adjustable for timing the displacements of said band, in a direction parallel to the axis of the platen and a free-wheel sprocket mounted to engage said chain, means for supporting said conveyor beneath said platen and means for collecting the expressed liquid located beneath said supporting means, said means for supporting the conveyor permitting free passage of liquid expressed from the material into said collecting means.

3. A press for the expulsion of liquid from fibrous material having in combination a frame, an endless conveyor for the material movably supported on said frame, means operably associated with said conveyor for periodically advancing and immobilizing said conveyor, a hydraulically displaceable platen positioned over said conveyor for applying pressure to fibrous material on said conveyor during immobilization thereof, an endless band movably supported by said platen and covering the face thereof, means operably associated with said movable endless band for advancing it in synchronism with the means for advancing said conveyor only when said platen is in a non-pressing position, support means connected to said frame and positioned under said conveyor for supporting said conveyor, a collecting pan connected to said frame and positioned under said support means, said conveyor being in the form of a chain of links each comprising a rigid frame of grid-like structure, and said support means being a fixed grid-like structure, whereby liquid expressed from the material by pressure of said platen and said endless band has free passage into said collecting pan through openings in both said structures.

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