Sept. 4, 1951 A. H. AMERY 2,567,045

CRUSHING MACHINE

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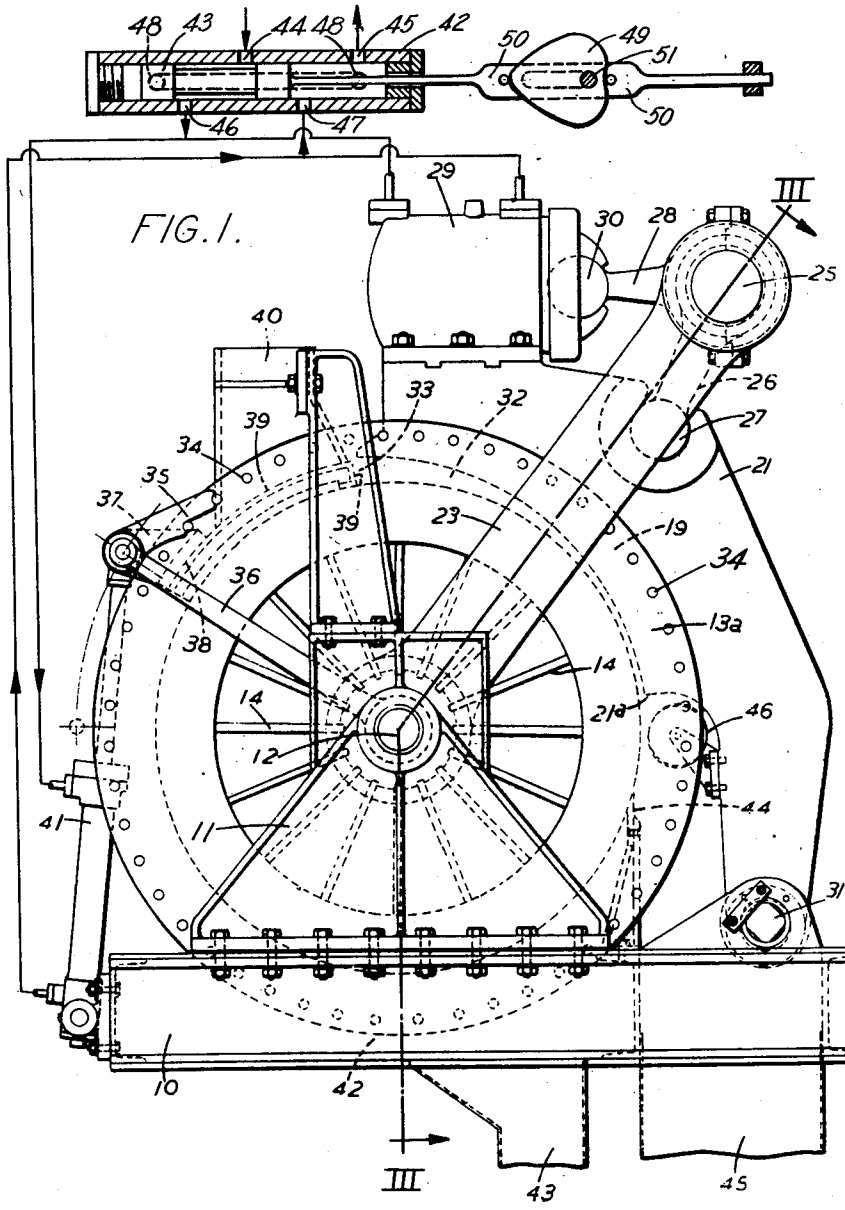
FIG. 1.



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CRUSHING MACHINE

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FIG.2.

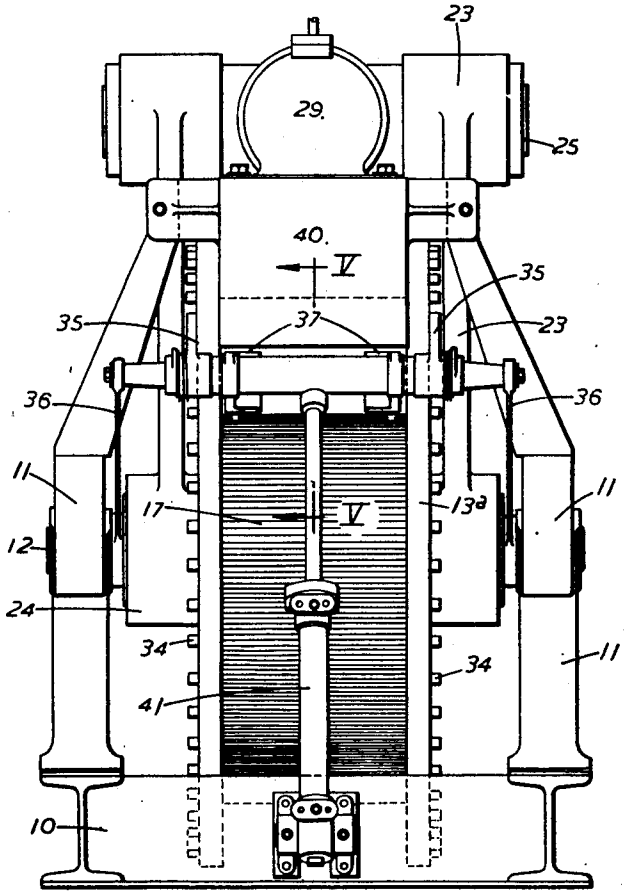

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FIG. 3.

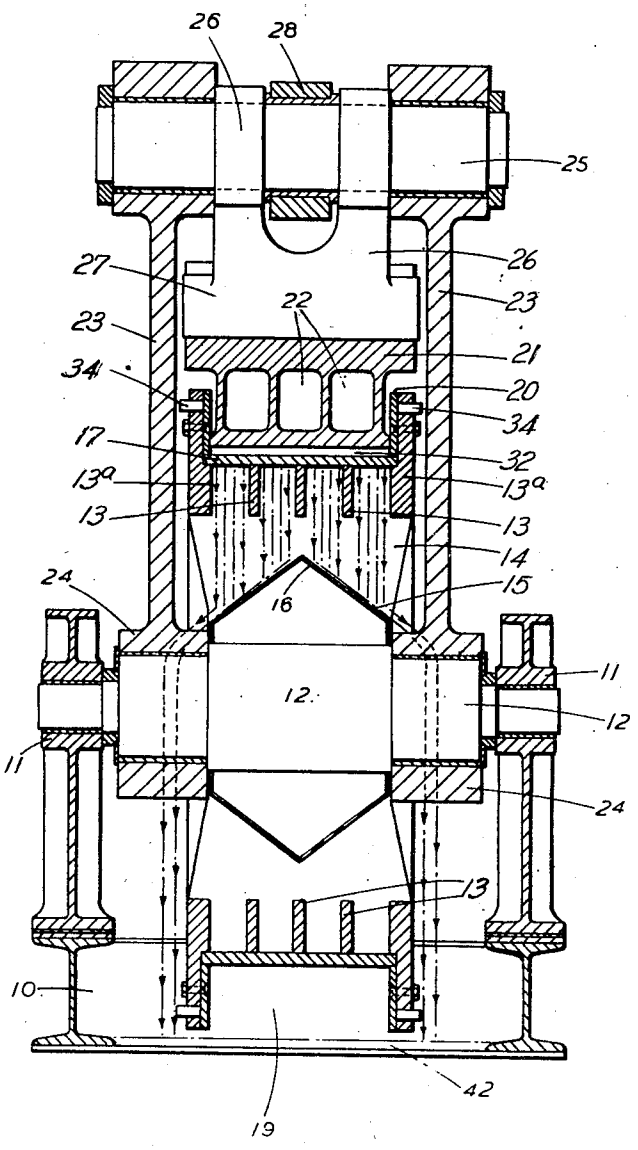

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FIG.4.

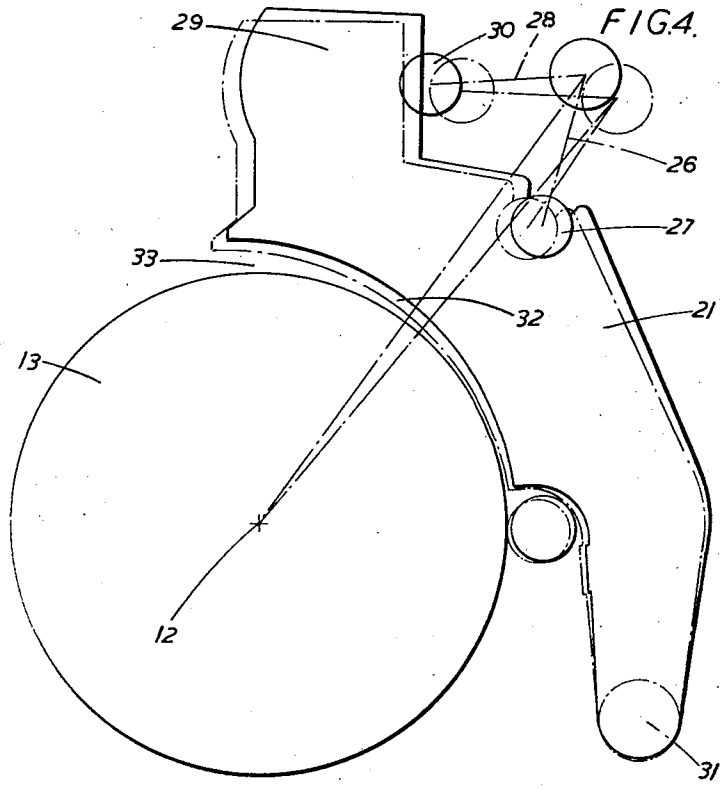
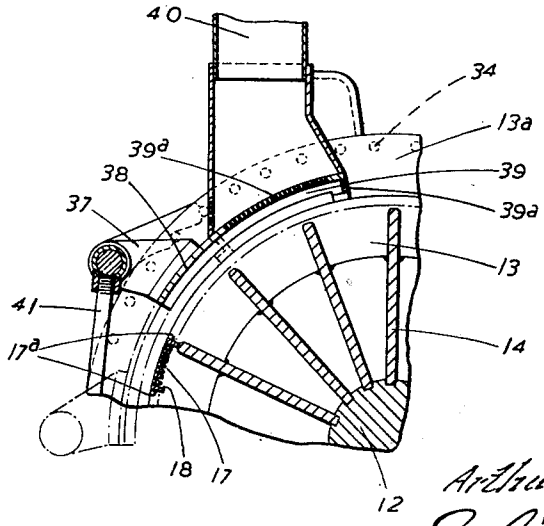


FIG.5.



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Patented Sept. 4, 1951 2,567,045

UNITED STATES PATENT OFFICE

2,567,045

CRUSHING MACHINE

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In Great Britain July 5, 1944

9 Claims. (Cl. 100—47)

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This invention is for improvements in or relating to crushing machines, expressing machines (i. e., machines for extracting liquids from solid or semi-solid matter) and the like (hereinafter generally referred to collectively as crushing machines). The invention is particularly concerned with a machine for expressing oil from nuts and seeds.

The well known worm-expeller type of expressing machine is open to the objection that friction on the worm and cage by the material being operated upon rapidly results in wear of said parts and entails frequent replacement thereof. This frictional wear cannot be avoided because a certain amount of friction between the worm and the material is necessary for the operation of the machine.

An object of the present invention is to provide a crushing machine in which there is little or no relative movement, between the crushing members and the material being treated, tending to cause serious and rapid wear of said members. A further object of the present invention is to provide a crushing machine in which a positive crushing pressure is exerted on the material to be treated which pressure is not dependent to any great extent, if at all, on the frictional properties of the material. A still further object of the invention is to provide an improved crushing machine of simple and robust construction. A still further object of the invention is to provide a machine in which the crushing pressure is applied to the material without an objectionable increase in the temperature thereof.

According to the present invention there is provided a crushing machine comprising two members which constitute opposite walls of a wedge-shaped or tapered space or chamber, a step-by-step mechanism for feeding material step-by-step through said space, and means for moving at least one of said members towards and away from the other during halts in the movement of the step-by-step mechanism so as to crush material in the wedge-shaped space or chamber.

According to a still further feature of the present invention there is provided a crushing machine comprising two members which constitute opposite walls of a wedge-shaped or tapered crushing space or chamber, a step-by-step mechanism for imparting intermittent movement to one of said members relatively to the other to feed material step-by-step through said space or chamber, and pressure applying means for moving at least one of said members towards and away from the other, during halts in said intermittent movement of one member, so as

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to crush the material in the wedge-shaped space or chamber.

According to a preferred embodiment of the present invention there is provided a crushing machine comprising a wheel and a crushing member, the rim of the wheel and the crushing member constituting opposite walls of a wedge-shaped or tapered crushing space or chamber, a step-by-step mechanism for imparting intermittent movement to the wheel relatively to the crushing member to feed material step-by-step through said space or chamber, and pressure applying means for moving the crushing member towards and away from the rim of the wheel during halts in the intermittent movement thereof so as to crush the material in the wedge-shaped space or chamber. Conveniently the crushing member is pivoted to the machine frame, for movement towards and away from the rim of the wheel, and said pivot is arranged, with respect to the wheel, so that the space between the rim and the crushing member is of the required wedge form, said space decreasing in a direction from the feeding to the pivoted end of the crushing member. The material is fed, into the space between the rim of the wheel and the crushing member, by a feeding member and during the crushing operation is confined in said space by the feeding member. The wheel takes several step-by-step movements in traversing the complete span of the crushing member so that each charge of material is subjected to several crushing operations. Thus, due to the wedge shape of the space between the wheel rim and the crushing member the crushing operation will be of increasing severity so that thorough extraction of the liquid will be obtained without an excessive and objectionable "squirting-out" in the initial stages.

Conveniently the crushing member is operated, at least during its operative stroke, when it applies the crushing pressure, by one or more hydraulic ram devices, The wheel may also be rotated step-by-step by means of a hydraulic ram device, preferably through a pawl and ratchet mechanism.

A further advantage of the present invention is that the crushing member may be made of hollow or cavity construction so that a heating or cooling fluid can be introduced into it in cases where temperature control of the material being treated is advantageous.

The permeable rim of the wheel or the permeable part of the crushing member may comprise a series of bars clamped together with shims or narrow spacing pieces between them so that a plurality of interstices are formed,

through which the liquid exudes, this construction being somewhat similar to the construction of the cage of the well known worm-expeller type of expressing machine.

According to a further feature of the present invention there is provided a method of crushing materials (e. g. to express liquids from solid or semi-solid material) which comprises the steps of feeding material mechanically, by a conveyor having a permeable support for the material, through a wedge-shaped or tapering contractible crusing chamber, halting said material intermittently in said crushing space and applying pressure to express the liquid by contracting the crushing space during such halts, whereby the material is subjected to a series of crushing operations of increasing severity.

One specific embodiment of an expressing machine, according to the present invention, will now be described by way of example with reference to the accompanying semi-diagrammatic drawings.

On the drawings:

Figure 1 is a side elevation of the machine and also shows diagramatically a known form of cam mechanism for controlling the operating sequence of the moving parts of the machine,

Figure 2 is a front elevation,

Figure 3 is a sectional view on line III—III of Figure 1,

Figure 4 is a diagram showing the movement of the working parts of the machine when it effects a crushing operation, and

Figure 5 is a fragmentary sectional view on line V—V of Figure 2.

The machine comprises a base frame **10** having bearings **11** at opposite sides which carry a shaft **12** supporting a wheel located between the bearings. The wheel has a rim comprising a number of axilally spaced annular rings **13** mounted on spokes **14** radiating from the shaft **12**. The rim of the wheel also includes a series of circumferentially arranged cross-bars **17** which are assembled around the rim with shims or spacing pieces (not shown) between them so as to form a multiplicity of interstices **18** (see Figure 5) for the draining of expressed oil as hereinafter described. The cross-bars **17** are supported on the above mentioned annular rings **13** and extend between the two outermost rings **13***a* which project beyond the plane of the bars so as to form a kind of circumferential trough **19**. Every so often, around the rim, a key-bar **17***a* is located between the cross-bars **17**. The bars are secured in position by locking members **20** which bear on the ends of said bars and are secured to the projecting outer annular rings **13***a*.

An arcuate crushing member **21** spans approximately one upper quarter of the wheel and has a sliding fit in the above mentioned trough **19** of the rim. The crushing member is of fairly massive construction and has cavities **22** in its interior for the introduction of, for example, steam so that both heat and pressure can be supplied to the material to be crushed. A tension arm or tie **23** is pivoted at **24** to the shaft **12** on either side of the wheel. The free ends of the two arms are connected to a common cross-shaft **25**. The cross-shaft **25** carries a toggle element **26** and a connecting member **28** which are journalled on the shaft. The toggle element **26** has a knuckle joint connection at **27** to the crushing member **21**, and the member **28** has a similar connection at **30** to the ram proper of a double-acting hydraulically operated ram **29**. At its lower end the crushing member **21** is pivoted to the base frame of the machine as indicated at **31**. The toggle-like mechanism just described is designed to give considerable mechanical advantage for the operation of the crushing member **21** and at the same time a favourable disposition of the stresses to which the machine is subjected when the crushing pressure is applied. The arrangement is also such that the space **32** between the crushing member **21** and the rim bars **17**, **17***a* of the wheel is of wedge form having its greatest cross-sectional area at the upper or feeding end **33** of the crushing member. The pivot **31** connecting the crushing member to the base frame **10** is of eccentric form so as to allow the crushing member to be adjusted, if desired, relatively to the rim of the wheel.

The rim of the wheel is provided with ratchet teeth in the form of spaced pins **34** and pawls **35** are carried on a rocking frame **36** pivoted on the shaft **12**, said pawls **35** engaging the ratchet teeth **34** to effect a step-by-step rotation of the wheel. In addition to carrying the pawls **35**, the rocking frame **36** also carries arms or brackets **37** connected at **38** to an arcuate feeding member **39** resting on the rim-bars, **17**, **17***a* of the wheel and adapted to be reciprocated by the rocking frame **36** below a feeding chute **40** for the machine. The walls of the feeding member **39** are perforated as indicated at **39***a* so that any free oil at the lower part of the chute **40** can exude and flow down the rim of the wheel to be collected with the expressed oil. The extremity of the rocking frame **36** is also coupled to a double-acting hydraulically operated ram **41**. It will be noted that the driving mechanism, for the wheel, just described is located very conveniently on the opposite end of the machine to the mechanism **23**—**29** operating the crushing member **21**.

A collecting reservoir **42** for oil is located below the wheel and is provided with a discharge conduit **43**. Guide plates **16** having conical surfaces **15** may be provided around the shaft **12** to direct the oil to the reservoir. A scraper **44** and discharge chute **45** are also located in proximity to the lower end of the crushing member **21** for removing and discharging exhausted material, generally called cake, from the wheel and discharging it from the machine. Prior to being scraped from the wheel the cake may be cut by a rotatable knife **46** mounted on the crushing member.

The operation of the machine above described is as follows:

Assuming that the crushing member **21** has just completed a crushing operation and has been moved by the reverse operation of the ram **29** away from the rim of the wheel into the position shown in full lines in Figure 4, and also that the pawl **35** and feeding member **39** have been moved back, from the position shown in Figure 1, by the operation of their ram **41**, ready to move the wheel one step forward and cause further charge of material to be fed between the rim-bars **17**, **17***a* of the wheel and the crushing member **21**; hydraulic pressure is applied to the ram **41** and initially the wheel is moved one step forward into the position shown in Figure 1, and material which, due to the previous backward movement of the feeding member **39**, has dropped from the chute **40** onto the rim of the wheel, is carried by the combined movement of the wheel and feeding member into the space **32** between the crushing member **21** and the rim of the wheel,

which space has been made available by the rotation of the wheel. The hydraulic ram **29** then operates through the toggle element **26** and connecting member **28** to apply the crushing member **21**, as shown in Figure 1 and in broken lines in Figure 4, with crushing force to the material between it and the rim of the wheel. The charge of material last fed in is given an initial crushing and is crushed with increasing severity each time the wheel is stepped forward until it is eventually discharged at the lower end **21***a* of the crushing member. It will be appreciated that each time the wheel is stepped around a new charge is fed to the crushing member and an exhausted charge is discharged but inasmuch as the span of the crushing member is say six times a single step of the wheel each charge of material will be crushed six times and each time with increasing severity due to the wedge or tapered shape of the space **32** between the crushing member and the rim of the wheel. The majority of the expressed oil percolates between the rim bars **17**, **17***a* of the wheel into the interior thereof, from which it subsequently drains to the reservoir **42** as indicated by the broken lines and arrows in Figure 3.

The operation of the hydraulic devices to obtain the correct sequence of movements of the wheel, feeding member and crushing member may be controlled by a cam mechanism or other known timing device such as is shown diagrammatically in Figure 1. One well-known form of timing mechanism for supplying pressure fluid alternately to opposite ends of the cylinders of the hydraulic rams **29** and **41** is shown in Figure 1. This timing mechanism comprises a valve having a cylinder part **42** in which works a piston valve proper **43**. The cylinder is provided with an inlet port **44**, for hydraulic pressure fluid, and a return port **45** for said pressure fluid. The cylinder **42** also has a port **46** connected to one end of each of the cylinders of the hydraulic rams **29** and **41** and a port **47** connected to the opposite end of each of said cylinders. There is also a transfer passage **48** extending from one end of the valve cylinder **42** to the other. Movement of the piston valve **43** is effected by a cam **49** operatively connected to the piston valve by a connecting rod **50**. The cam **49** is rotated by means of a shaft **51** driven at an appropriate speed by, say, an electric motor.

The timing device above described operates as follows: When the piston valve is in the position shown, pressure fluid is being supplied via port **46** to the left hand end of the hydraulic ram **29** and to the upper end of the hydraulic ram **41** and pressure fluid is being discharged from the opposite ends of these rams via the port **47** and return port **45**. At the appropriate time, i. e. when the piston of the ram **29** has reached the end of its outward stroke and the piston of the ram **41** has reached the end of its downward stroke, the cam **49** has moved the piston valve **43** over to the right. This places the inlet port **44** in communication with the port **47** and the port **46** in communication with the return port **45** via the transfer passage **48**. As a result, the pressure fluid is now supplied to the right-hand end of the ram **29** and is discharged from the left-hand end and is supplied to the lower end of the ram **41** and is discharged from the upper end thereof. In other words, the direction of flow is now opposite to that indicated by the arrows. It will be understood that so long as the cam **49** rotates, this alternate movement, in opposite directions, of the pistons of the rams **29** and **41** will continue to take place so as to effect the required movement of the crushing member **21**, rocking frame **36** and feeding member **39**.

By subjecting the material to a series of pressing operations of increasing severity, each pressing operation may be of relatively short duration, the machine operating quickly and several times on a relatively small amount of material so that such material is drained effectively of its liquid content through the large draining areas available compared to the small mass of material. It is believed that this is more efficient than the existing practice of using a large press and operating on a considerable bulk of material for a prolonged period, the time of operation being necessarily long due to the large amount of liquid to be expressed and the limited draining surface available.

The crushing member or means may have a pintled or other irregular surface, e. g., a corrugated surface in which the corrugations are of a varying pitch, so as to impart a kneading action to the material at each crushing operation.

I claim:

1. A crushing machine for expressing liquids from solids or semi-solids comprising a wheel and a crushing member, the rim of the wheel and the crushing member constituting opposite walls of a tapered crushing chamber, at least one of said walls having openings therein, a step-by-step mechanism for imparting intermittent movement to the wheel relatively to the crushing member to feed material step-by-step through said chamber, pressure applying means for moving the crushing member towards and away from the rim of the wheel during halts in the intermittent movement thereof, so as to crush the material in the tapered chamber, and means for collecting liquid expressed from such material and exuded through the openings in the wall of the crushing chamber.

2. A crushing machine as claimed in claim 1, wherein the rim of the wheel comprises a series of bars spaced apart to provide the openings in the wall of the crushing chamber.

3. A crushing machine for expressing liquids from solids or semi-solids comprising a wheel and an arcuate crushing member which spans a part of the rim of the wheel, said rim and the crushing member constituting opposite walls of a tapered crushing chamber, at least one of said walls having openings therein, a pivotal support for the arcuate crushing member located at one end thereof, a step-by-step mechanism for imparting intermittent movement to the wheel relatively to the crushing member to feed material step-by-step through said chamber, pressure applying means for moving the crushing member about its pivotal support towards and away from the rim of the wheel during halts in the intermittent movement thereof, so as to crush the material in the tapered chamber, and means for collecting liquid expressed from the material in the chamber and exuded through the openings in the wall thereof.

4. A crushing machine for expressing liquids from solids or semi-solids comprising a wheel and an arcuate crushing member which spans a part of the rim of the wheel, the said rim and the crushing member constituting opposite walls of a tapered crushing chamber, at least one of said walls having openings therein, a pivotal support for the crushing member located at one end

thereof, a step-by-step mechanism for imparting intermittent movement to the wheel relatively to the crushing member, a feeding member supported on the rim of the wheel in front of the inlet end of the tapered crushing chamber and movable with the wheel in one direction for feeding material step-by-step through the crushing chamber, means for retracting said feeding member, a pressure applying means for moving the crushing member about its pivotal support and towards and away from the rim of the wheel during halts in the intermittent movement thereof, so as to crush the material in the tapered chamber, and means for collecting liquid expressed from such material and exuded through the openings in the wall of the chamber.

5. A crushing machine as claimed in claim 1, wherein the operating mechanism for the crushing member comprises an arm pivoted on the axis of the wheel, a hydraulic ram, a connecting member operatively connecting said ram to the free end of said arm, and a toggle element operatively connecting the free end of the arm to the crushing member.

6. A crushing machine for expressing liquids from solids or semi-solids comprising a wheel and an arcuate crushing member which spans a part of the rim of the wheel, the said rim and the crushing member constituting opposite walls of a tapered crushing chamber, at least one of said walls having openings therein, a pivotal support for the crushing member located at one end thereof, a step-by-step mechanism for imparting intermittent movement to the wheel relatively to the crushing member, a feeding member supported on the rim of the wheel in front of the inlet end of the tapered crushing chamber and movable with the wheel in one direction for feeding material step-by-step through the crushing chamber, means for retracting said feeding member, a hydraulic ram, an arm pivoted on the axis of the wheel, a connecting member operatively connecting said ram to the free end of said arm, a toggle element operatively connecting the free end of the arm to the crushing member, whereby the ram moves the crushing member about its pivotal support and towards and away from the rim of the wheel during halts in the intermittent movement thereof, so as to crush the material in the tapered chamber, and means for collecting liquid expressed from such material and exuded through the openings in the wall of the chamber.

7. A crushing machine for expressing liquids from solids or semi-solids comprising a wheel and an arcuate crushing member which spans a part of the rim of the wheel, said rim and the crushing member constituting opposite walls of a tapered crushing chamber, at least one of said walls having openings therein, a pivotal support for the crushing member located at one end thereof, a hydraulic ram device, a pawl and ratchet mechanism operated by said hydraulic ram device, and acting on the wheel to impart intermittent movement thereto relatively to the crushing member, a feeding member supported on the rim of the wheel in front of the inlet end of the tapered crushing chamber and movable with the wheel in one direction for feeding material step-by-step through the crushing chamber, means for retracting said feeding member, a hydraulic ram, an arm pivoted on the axis of the wheel, a connecting member operatively connecting said ram to the free end of said arm, a

toggle element operatively connecting the free end of the arm to the crushing member, whereby the ram moves the crushing member about its pivotal support and towards and away from the rim of the wheel during halts in the intermittent movement thereof, so as to crush the material in the tapered chamber, and means for collecting liquid expressed from such material and exuded through the openings in the wall of the chamber.

8. A crushing machine for expressing liquids from solids or semi-solids comprising a wheel having a rim of slightly spaced transverse bars defining openings therebetween, an arcuate crushing member which spans a part of the rim of the wheel, the said rim and the crushing member constituting opposite walls of a tapered crushing chamber, a pivotal support for the crushing member located at one end thereof, a hydraulic ram device, a pawl and ratchet mechanism operated by said hydraulic ram device and acting on the wheel to impart intermittent movement thereto relatively to the crushing member, a feeding member supported on the rim of the wheel in front of the inlet end of the tapered crushing chamber, and movable with the wheel in one direction for feeding material step-by-step through the crushing member, means for retracting said feeding member, a hydraulic ram, an arm pivoted on the axis of the wheel, a connecting member operatively connecting said ram to the free end of said arm, a toggle element operatively connecting the free end of the arm to the crushing member, whereby the last mentioned ram moves the crushing member about its pivotal support and towards and away from the rim of the wheel during halts in the intermittent movement thereof, so as to crush the material in the tapered chamber, and means for collecting liquid expressed from such material and exuded through the openings in the rim of the wheel.

9. A crushing machine comprising a wheel, and a crushing member, the rim of the wheel and the crushing member constituting opposite walls of a tapered crushing chamber, at least one of said walls having openings therein, a step by step mechanism for imparting intermittent movement to the wheel relatively to the crushing member to feed material step by step through said chamber, and pressure applying means for moving the crushing member towards and away from the rim of the wheel during halts in the intermittent movement thereof so as to crush the material in the tapered chamber.

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