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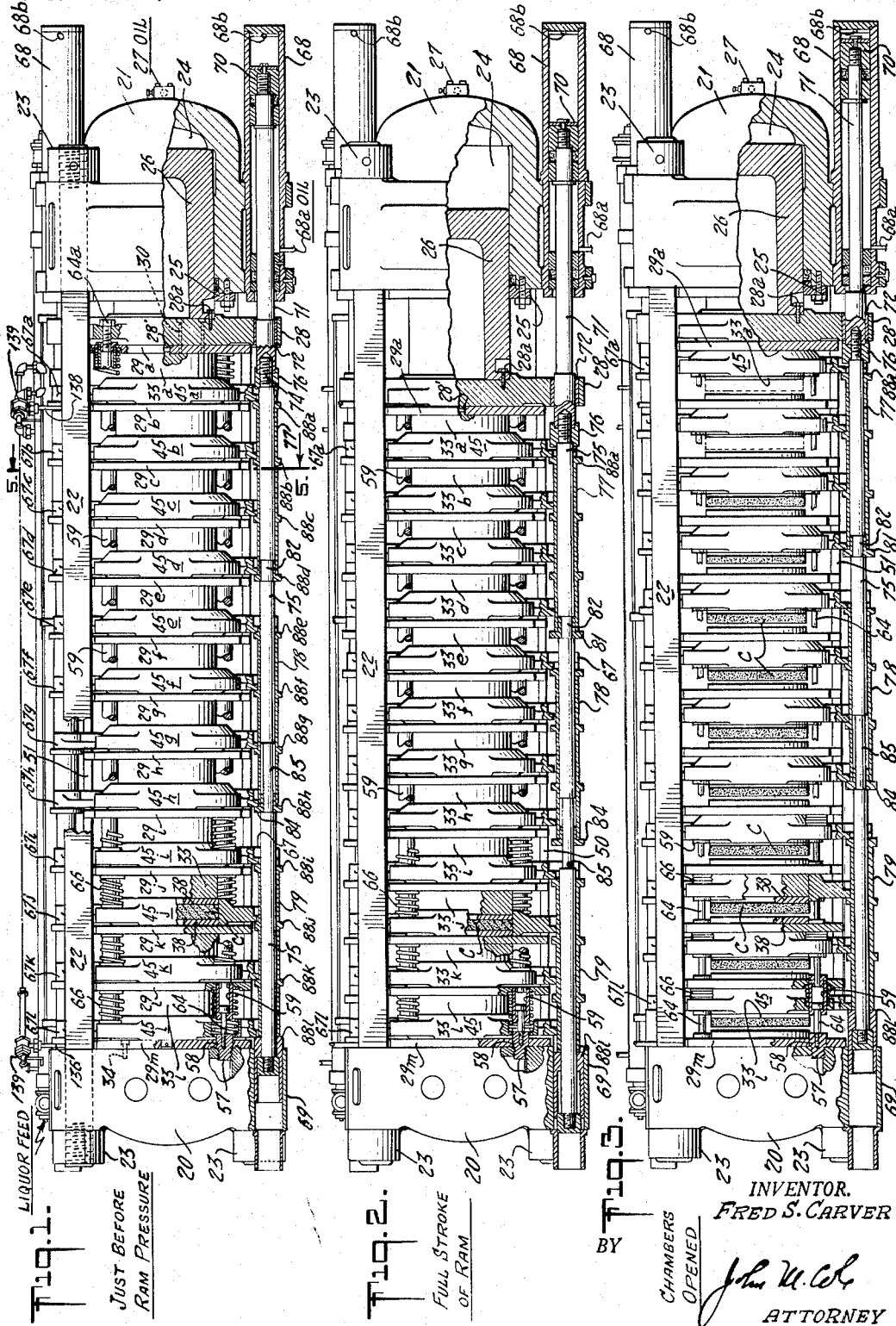
F. S. CARVER

2,714,849

MULTI-CHAMBER PRESS

Filed Oct. 8, 1949

6 Sheets-Sheet 1



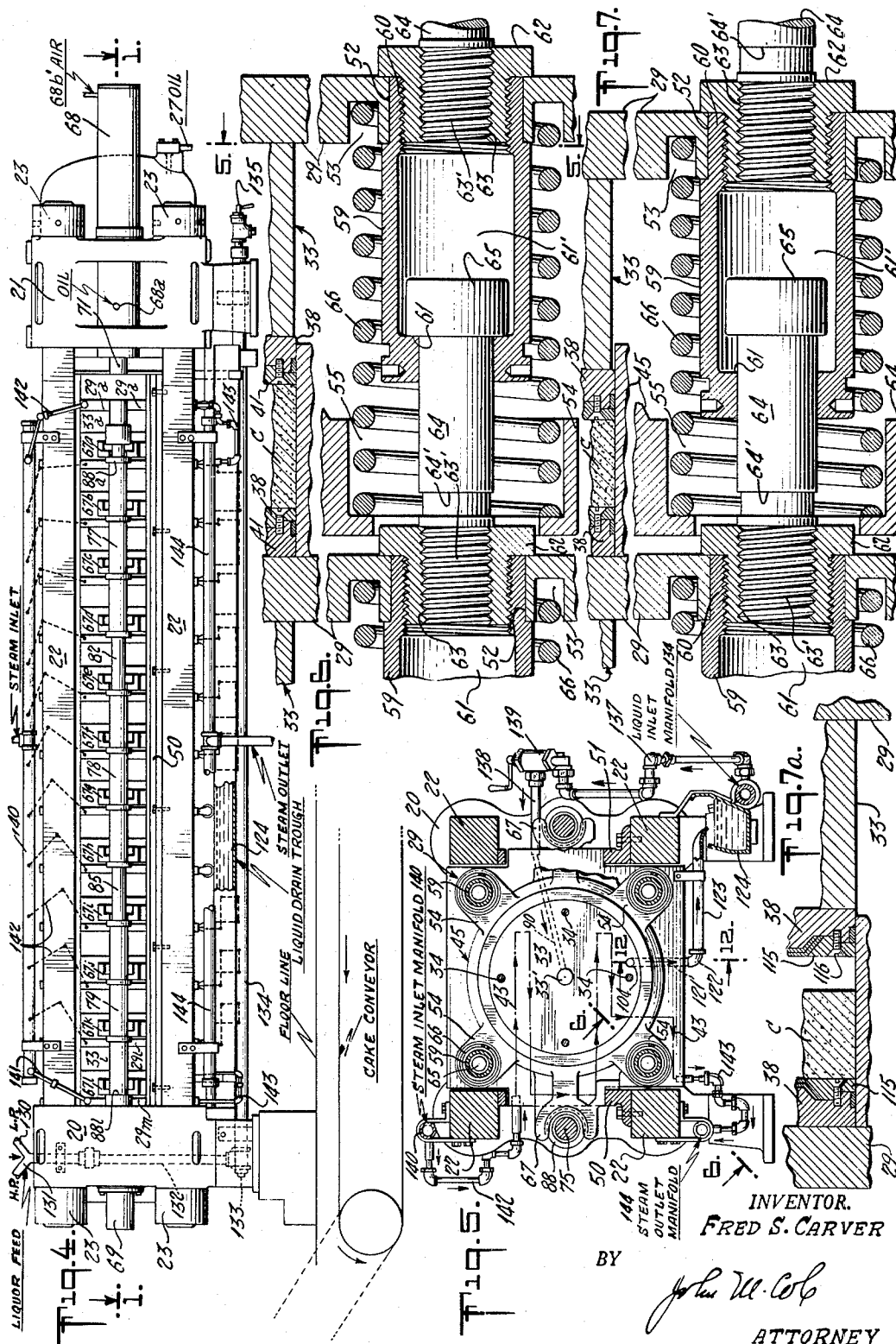
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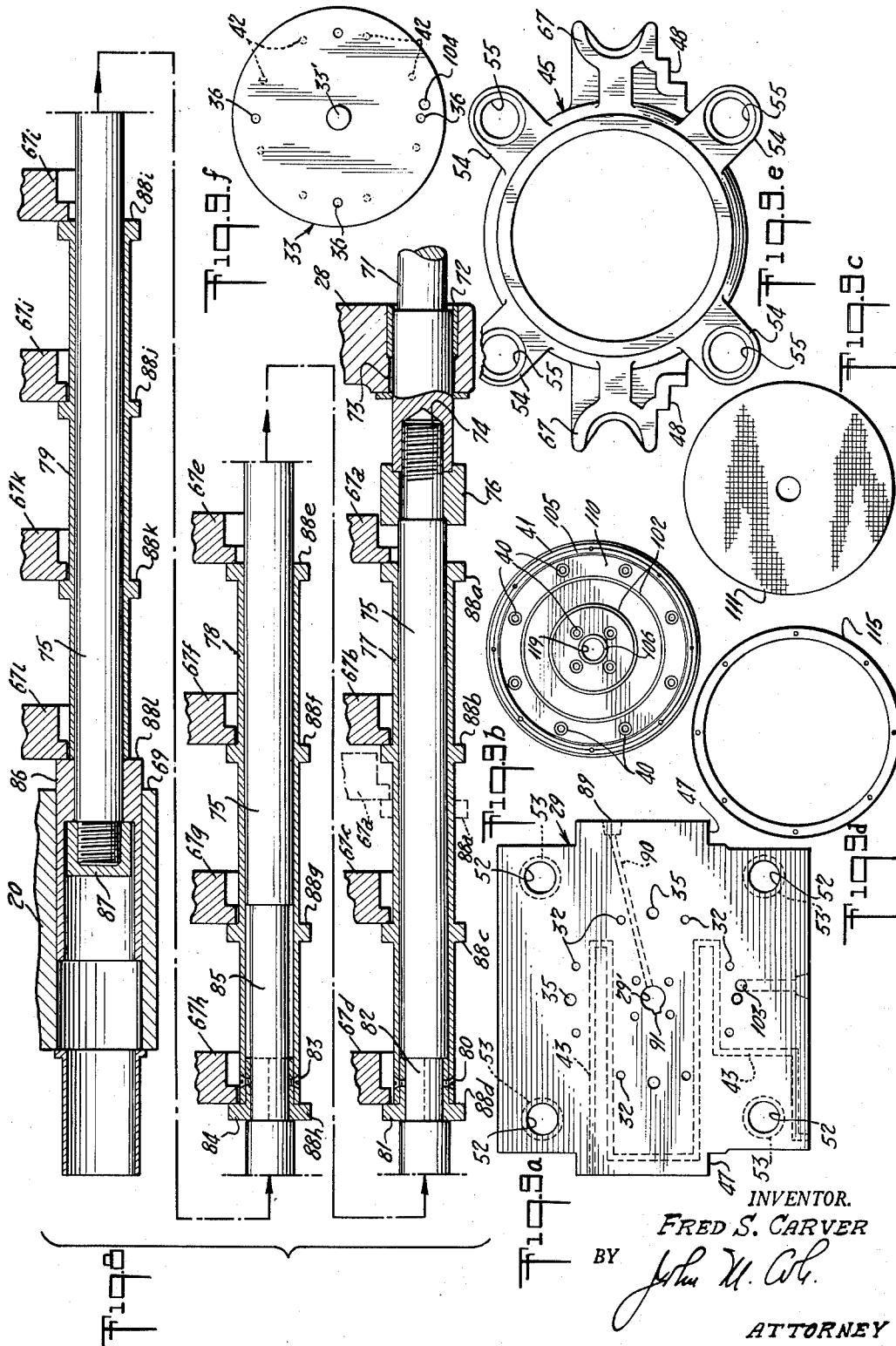
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Fig. 10.

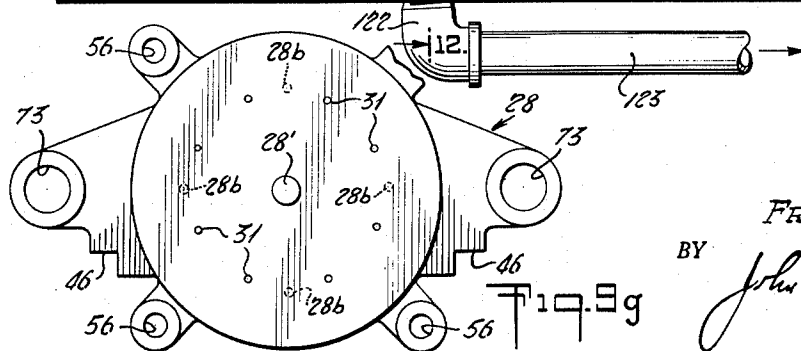
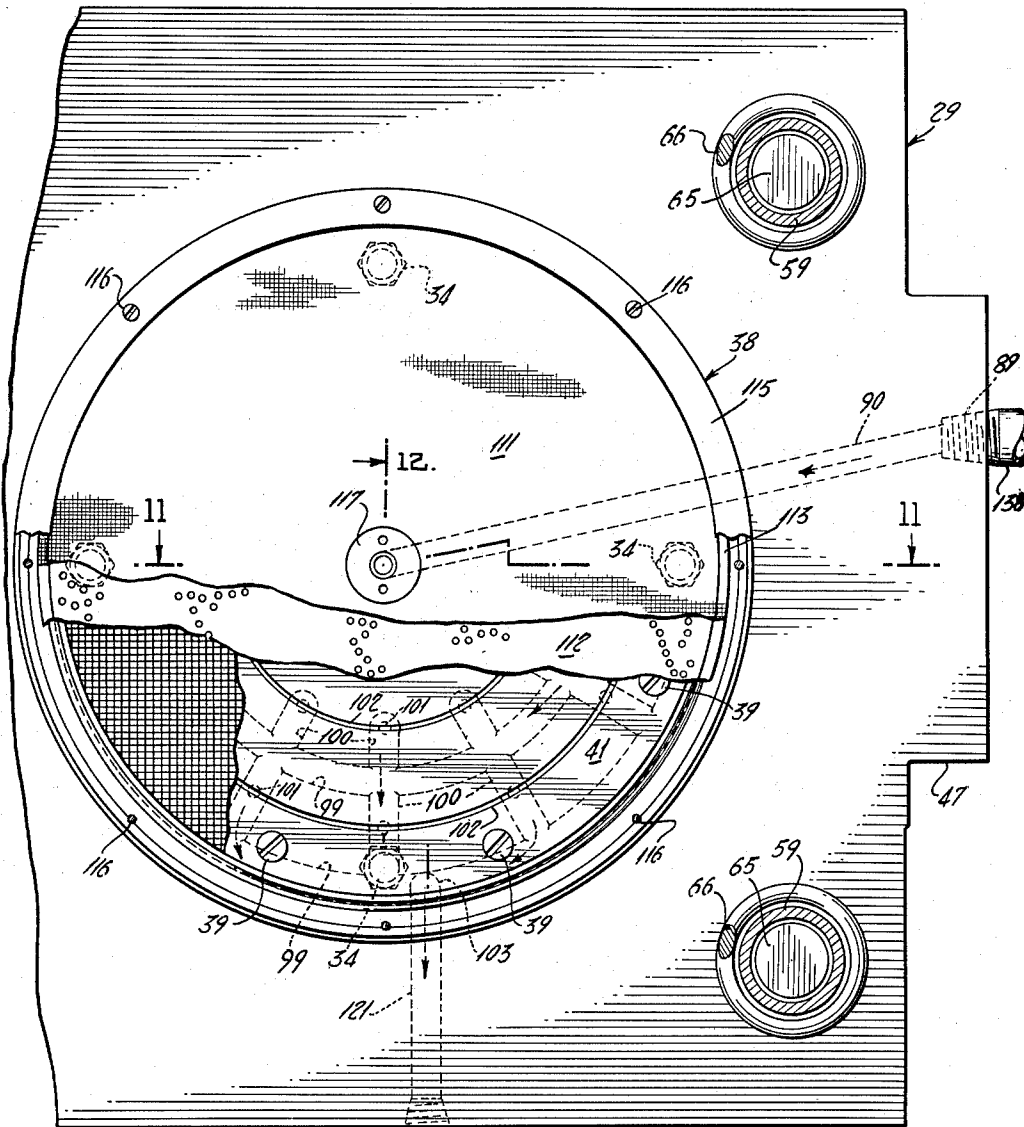
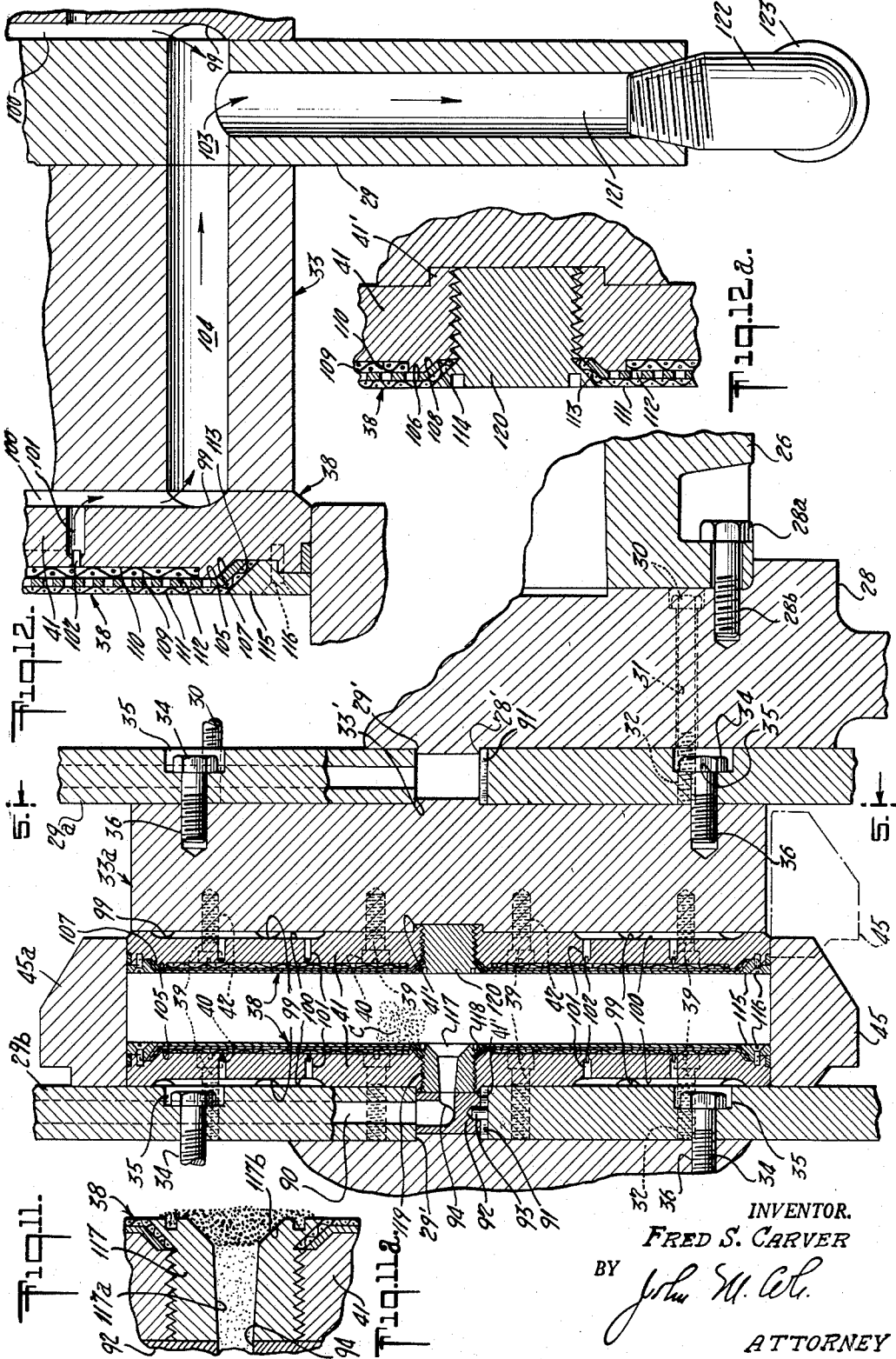


Fig. 11.

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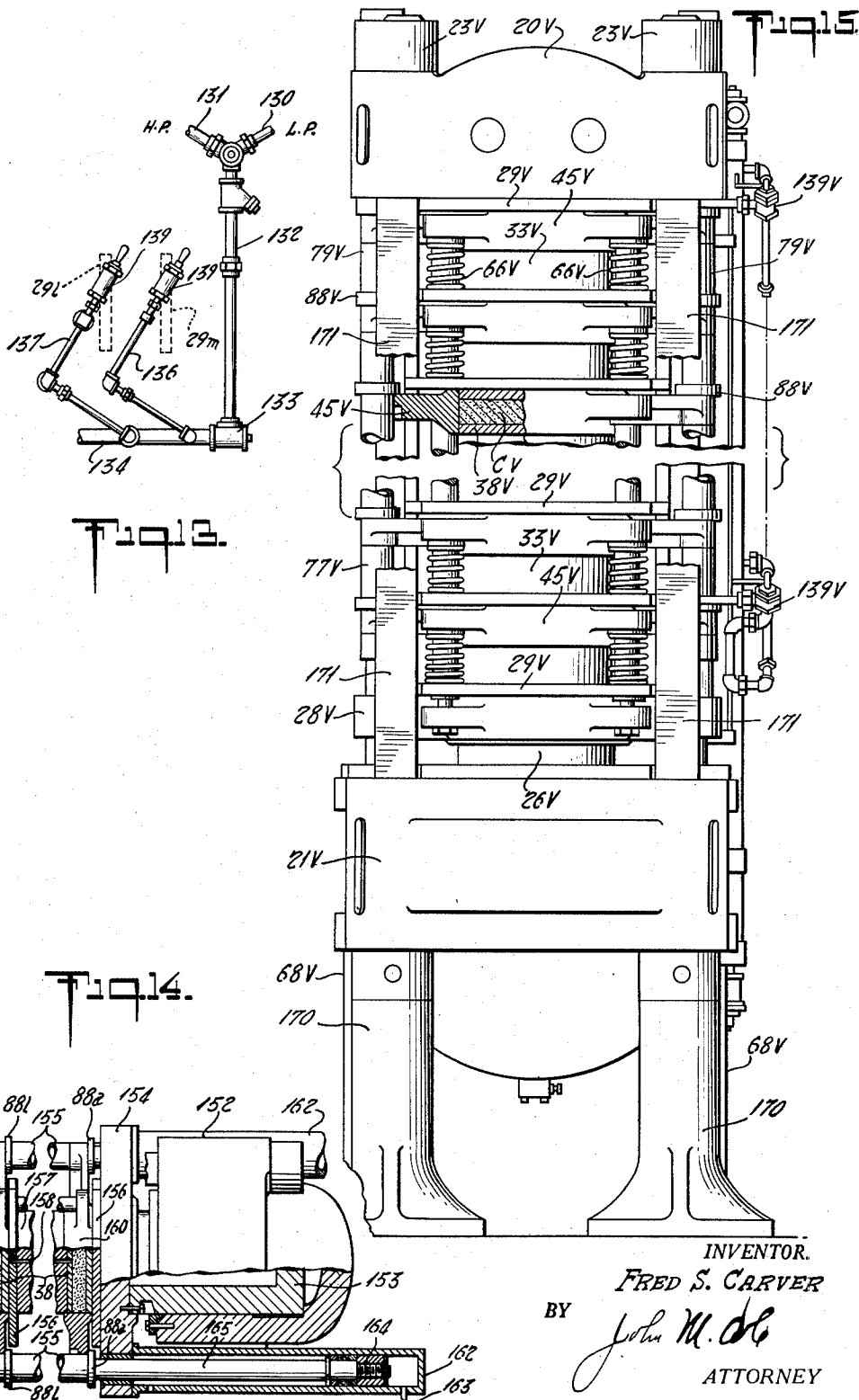
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2,714,849

MULTI-CHAMBER PRESS

Fred S. Carver, Short Hills, N. J., assignor to Fred S. Carver, Inc., Summit, N. J., a corporation of New York

Application October 8, 1949, Serial No. 120,381

20 Claims. (Cl. 100—113)

The present invention relates to presses for separating liquid constituents, such as oil or water, from the solid constituents of materials of various kinds, such as cocoa, copra, and other vegetable oil bearing materials, which are in, or have preliminarily been reduced to, substantially semi-liquid state slurries, mother liquors from crystallization, etc., all of which are adapted to be moved and put under pressure by a pumping operation.

With the press of the present invention, feeding is performed by pumping in the material in a more or less fluid state under pressure, the pumping pressure being relatively high, as 800 pounds per square inch, for example, and continued for some time after the press has been filled in order to cause an initial filtering; the press chambers are then shortened by application of external pressure, whereby a further expressing of liquid is performed, together with caking of residual solids; and further steps of operation include collecting the expressed liquid; elongating the press chambers to their original length; opening up the press chambers in such a way that in a horizontally arranged press the press cakes fall out from the opened chambers; reclosing the press chamber sides whereupon the press is ready for refeeding; and repeating these steps through repeated cycles of operation.

It is an object of this invention to provide an apparatus adapted to separate fluids from solids simply, efficiently, rapidly, and substantially continuously, the operation whereof can be as nearly fully automatic as in practice is feasible.

The present invention is more particularly directed toward improvements in presses of the type shown in my United States Patents 2,247,988 of July 1, 1941, 2,072,942 of March 9, 1937, and 1,771,526 of July 29, 1930.

The present invention contemplates improvements in multi-chamber presses preferably of the horizontal type, wherein a movable ring is horizontally shifted relative to an associated pair of filtering elements for each chamber to either form a closed chamber or to open the chamber for discharge of the pressed cake formed in it, these improvements relating to the devices employed in spacing and retracting the chamber-forming rings at the close of the pressing operation, and having means which not only tie the platen for one unit of the press to the platen for adjacent units, whereby the expansion of each chamber is limited and controlled, but also during the compression stroke of the press permits over-travel of all parts toward the resistance head. In accomplishing this, it is contemplated that all the platens, filter parts, chamber-forming rings, pistons, platen tie connections, and springs of the units may be identical and interchangeable (except for minor differences at the ends of the press) so as to reduce the cost of manufacture, maintenance and servicing; also the ring retracting means is in the form of suitable similarly reciprocable power retractable shafts provided with abutments, certain of which are engageable by the rings during the compression stroke, and all of which are engageable with the rings when the shafts are

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retracted to open the press chambers. These parts are provided with suitable over-travel or lost motion so as to avoid interference of one part with the other when ram pressure is applied. When the travel of the ram exceeds the maximum length of an open chamber-forming unit with its associated parts, provision is made for additional over-travel or lost motion, whereby it is possible to provide a multi-chamber press in which the press unit nearest the ram travels during the compression stroke into a region partly occupied by the adjacent press unit when the press was open.

A further object of the present invention is to provide a multi-chamber press of the type having filter plates, screens and telescoping rings characterized by the absence of lateral projections so that the resulting cake produced by extracting the liquid materials is a flat disc, smooth on both faces. The elimination of projecting parts from the interior of the chamber, which tend to narrow the chamber in any way, makes it possible to secure greater cake thickness throughout, makes it impossible to overload the press so that it cannot be opened far enough to clear cakes from obstructions which had caused undercuts and facilitates the release of the compressed cake from the screen without having to clear any projecting surface.

In carrying out the present invention, the press has stationary heads connected together by tie members which maintain fixed spacing, one being a ram-carrying head, a plurality of platens carrying filtering elements, a plurality of pistons carrying filtering elements and alternating with the platens, each of the pistons being secured to an adjacent platen to form a pair of carriers which move as a unit, the other filtering element carriers being secured respectively to the ram and the remote head to form a series of filter chambers with influent passages and effluent passages, a series of tie connections which secure the ram, the remote head and each of the pairs of carriers together, these including elements having lost motion therebetween which limit the separation of the carriers of adjacent pairs but allow adjacent pairs to approach one another when the ram acts to move the filtering elements toward one another, a plurality of peripheral rings one for each chamber, spring means interposed between each ring and one of the carriers of a chamber to force the ring past the filtering elements and against the adjacent corresponding carrier to close the chamber, the spring means being compressible when the ram closes the press to form a cake, the expansion of the spring means on release of the ram pressure being effective to separate one of the filtering elements from the cake, this expansion being limited by the lost motion tie connections, and means acting on each of the rings to shift the ring to the chamber opening position and pull the cake away from the other filtering element against the resistance of the tie connections so as to free the cake so that in a horizontal press it may fall of its own weight.

Other and further objects of the invention will appear as the description proceeds.

The accompanying drawings show, for purposes of illustrating the present invention, three of the many embodiments in which the invention may take form, it being understood that the drawings are illustrative of the invention rather than limiting the same.

In the drawings:

Figure 1 is a top plan view of a horizontal press with parts broken away and showing the relation of the parts after the chambers have been filled by the extraneous pump with the solids compacted and before ram pressure is applied, the ring-retracting mechanism being shown along the line 1—1 of Fig. 4, other parts being broken away to show interior construction;

Figure 2 is a view similar to Figure 1 showing the posi-

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tion of the parts at the end of the compression stroke of the ram;

Figure 3 is a view similar to Figure 1, showing the position of the parts at the completion of the back or return stroke of the ring-return mechanism, the pressed cakes remote from the ram being shown in position prior to dropping free of the filter plates;

Figure 4 is a front elevational view of the press with the chambers closed and prior to application of ram pressure;

Figure 5 is a transverse sectional view on the line 5--5 of Figs. 1, 6 and 11;

Figure 6 is an enlarged sectional view on the line 6--6 of Figure 5, illustrating the inter-relation of two adjacent platens and interposed filter plates, chamber-closing rings, ring-operating springs, and lost-motion tie connections between platens, the parts being shown in the position assumed when the chamber is closed by the ring and when ram pressure is not applied;

Figures 7 and 7a are views similar to Fig. 6, respectively showing the position the parts assume when ram pressure has been applied to shorten the filter chamber, and when ram pressure is released and the initial break has been made between the filtering screen and cake;

Figure 8 is a view on a larger scale, showing in full lines the inter-relations of the pull-back mechanism and the chamber-closing rings when in the position of Fig. 1;

Figures 9a to 9g, inclusive, are elevational views taken from the right of Figs. 1 to 4, inclusive, showing the principal elements used in the press, Fig. 9a showing the platen, Fig. 9b showing one of the filter screen supporting plates, Fig. 9c showing the filter screen, Fig. 9d showing the filter screen-retaining ring, Fig. 9e showing the peripheral chamber-closing ring, Fig. 9f showing the piston, and Fig. 9g showing the cross-head;

Figure 10 is a still further enlarged view showing an assembly of a platen with associated filter plate, filter screen, and screen-securing ring, and showing influent and effluent passages;

Figure 11 is a cross-sectional view taken on the broken line 11--11 of Fig. 10, illustrating a complete press chamber unit with the closed chamber filled with material to be pressed;

Figure 11a is a fragmentary view illustrating the formation of a plug in the orifice when pressure is applied;

Figures 12 and 12a are enlarged sectional views on the broken line 12--12 of Figures 5 and 10, illustrating the effluent passages;

Figure 13 is a rear elevational view illustrating the feed piping arrangement leading to the chamber units;

Figure 14 is a fragmentary view of horizontal press in which certain of the parts are reversely arranged; and

Figure 15 is an elevational view illustrating a vertical press.

The horizontal press of Figures 1 to 13 has two stationary supports, namely, a resistance head 20 and a ram head 21, these heads being interconnected by four square tie members or strain rods 22 threaded on the ends and carrying nuts 23, as indicated more clearly in Figure 1. The ram head 21 has a cylindrical chamber 24, carries a gland ring 25, and receives a ram 26. It is connected at 27 to hydraulic mechanism (not shown) whereby oil may be pumped into the ram head under high pressure (say 6000 lbs. per square inch). The cylindrical portion of the ram 26 which travels in the ram cylinder 24 is secured to the ram cross-head 28 (Fig. 9g) by bolts 28a entering holes 28b.

Between the cross-head 28 and the resistance head 20, the press shown in the drawings has twelve chambers, forming units, which, except for terminal connections are duplicates of one another.

On the side of the cross-head 28 opposite the ram it is secured to the first of thirteen steam platens 29, all alike and marked 29a--29m, inclusive, Fig. 1 only (except as noted), by screws 30 passing through holes 31 in the

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cross-head and entering tapped openings 32 in the platen. The cross-head has a centering boss 28' to enter a central hole 29' in the platen and assist in aligning the parts.

The right platen 29a, before being secured to the cross-head is secured to one of twelve pistons 33 (marked 33a--33l, inclusive, Fig. 2) by screws indicated at 34 passing through counterbored holes 35 in the platen and threaded into tapped openings 36 in the rear face of the piston (see Fig. 11). The pistons have centering bosses 33' to enter the holes 29' in the platens.

The front or left faces of the pistons 33 carry filtering elements, designated generally as 38. These are secured by screws 39 passing through holes 40 in plates 41 and threaded into the pistons at 42, the parts being centered by boss and recess as indicated at 41', Fig. 11.

The other platens 29b--29m, inclusive, carry, on the right face (toward the ram) identical filtering elements secured to them by similar screws 39 threaded into holes 32. The last platen 29m is secured to the resistance-head by another set of screws 34, indicated at the upper left of Fig. 1. It will thus be seen that, except at the ends, the intermediate platens 29b--29l, inclusive, carry on one side a piston 33 and filtering element 38 and on the other side a filtering element 38. Each of the platens has a steam passage indicated in dotted lines 43, Fig. 9a, so that the chambers may be heated from both sides.

Peripheral ring members 45 (shown in outline in Fig. 9e and also called chamber rings) are received between adjacent platens 29 and are adapted to fit about the filtering elements 38, when in the chamber closing position of Figs. 1, 2 and 11, or to be retracted about the pistons 33 as shown in Fig. 3 and in dotted lines in Fig. 11. Twelve of these rings are used here and are marked 45a--45l, inclusive.

The cross-head 28, platens 29 and rings 45 have bearing surfaces (indicated at 46, 47 and 48, Figs. 9g, 9a, 9e, respectively), which surfaces rest on guides 50 and 51 carried by the lower tie or strain members 22 (see Fig. 5). The platens 29 have four holes 52 at the corners, each hole being surrounded by an annular recess 53 (see Figs. 6 and 7). The peripheral rings 45 have lugs 54 internally counterbored at 55 (see Figs. 6 and 7), spaced the same as the holes 52 in the platen. The cross-head, Fig. 9g, has four similarly aligned holes 56 of smaller diameter.

The resistance head 20 carries four shouldered bushings 57 threaded into it and having heads 58 which extend through the holes 52 in the adjacent platen 29m. Each of the other platens 29, as shown more clearly in Figs. 6 and 7 carries sleeves 59 on the same spacing as the holes 52. The sleeves have reduced ends 60 to fit the holes 52 and reducing shoulders 61 at the other end to provide elongated recesses 61'. The sleeves 59 are secured to the platens (except the one fastened to the resistance head) by bushings 62 internally threaded as indicated at 63. The sleeves 59 receive bolts 64 having heads 65 in the recesses 61' and threaded as indicated at 63'. The bolts 64 are threaded into the bushings 62 and at the resistance head end of the press another set of these bolts is threaded into the bushings 57. The cross-head 28 is, as shown in Fig. 1, connected to the bushings 62 on the adjacent platen by similar bolts 64a in holes 56 so that four aligned lost-motion-tie-connections interconnect the ram with the resistance head and each platen.

Coiled springs 66 are received in the recesses 53 in the platens and bear against the flanges at the bottom of the counterbored holes 55 of the peripheral rings. When the press is assembled, these springs are placed under initial compression by blocking the rings behind horseshoe-shaped clips (not shown) adapted to fit into the undercuts 64' on the bolts 64. Each set of springs for a peripheral ring acts to push the peripheral ring toward the platen to its left, so as to place the ring in

chamber-closing position as shown in Figs. 1, 4, 6, 7 and 11. The reaction of the springs in the left chamber is toward the platen to its right. This carries the corresponding piston with it to spread the filtering elements apart. The cumulative action of the springs insures that all the peripheral rings are in the chamber-closing position, the chambers spread, and that the ram is pushed toward the ram head. The extent of this expanding operation is controlled by the take-up of the lost-motion connections including the sleeves 59 and bolts 64. The ram movement to the right is stopped by its engagement with the end wall of the ram head.

The ring retracting mechanism is carried at the front and rear of the machine and at the level of the center line of the press. The rings 45 are provided with forked lugs 67 opposite one another, as more clearly shown in Fig. 9e. The ram head carries hydraulic cylinders 68, 68. The resistance head 20 carries guide cylinders 69, 69 at the same level. The cylinders 68 carry pistons 70, hydraulically operated when ram pressure is released, and connected to piston rods 71 extending through guide bushings 72 carried in openings 73 in the cross-head 28. The rods 71 are drilled and tapped as indicated at 74 (Fig. 8) to receive the reduced threaded ends of shafts 75. The shafts 75 are long enough to reach over to the resistance head and enter the guide cylinders 69. Near the ram head end, the shafts 75 carry collars 76. Each shaft receives three sleeves 77, 78 and 79. These sleeves are alike. The sleeve 77 at the right is secured by screws 80 to a split ring 81 received in a reduced diameter portion 82 of the shaft. The sleeve 78 is secured by screws 83 to a similar split ring 84 received in an elongated reduced diameter portion 85 of the shaft 75. The sleeve 79 is held on the shaft by collar 86 and nut 87. The sleeve 77 carries three collars 88a, 88b and 88c; the split ring 81 carries a collar 88d. The sleeve 78 and split ring 84 similarly carry collars 88e, 88f, 88g and 88h. The sleeve 79 similarly carries collars 88i, 88j, 88k, and the collar 86 provides an abutment or stop 88l. These collars 88a-88l are each to the left of the corresponding rings 45a-45l, respectively.

When the springs 66 have moved the peripheral rings to chamber-closing position (as shown in Figs. 1 and 8), the lugs 67a to 67l engage with the corresponding collars 88a to 88l, inclusive, carried by the shafts 75, and the parts carried by the shafts 75 are connected so that any leftward movement of the ram will cause the shafts 75 to move to the left pulling the piston rods 71 and pistons 70 to the left.

Inasmuch as all the units shorten simultaneously under ram pressure, there is greater travel of the ram and units at the right than of the units at the left. The parts shift after the fashion of an accordion or camera bellows. The present press is designed to permit the amount of this travel for the extreme right unit to exceed the overall spacing between two adjacent units. This requires that all parts of the second unit and succeeding units be moved beyond the region into which parts of the first unit and succeeding units may move. As soon as the press starts to close, the lugs 67a engage the collars 88a, and this causes a corresponding shifting of the shafts 75 and the collars 88b, 88c and 88d. Due to the lost-motion connection provided by the long reduced portion 85 of the shaft, the rate of movement of the sleeve 78 will be controlled by the engagement of lugs 67e and collars 88e. Similarly, the movement of the left sleeve 79 will be controlled by the engagement of the lugs 67i and collars 88i. When the press is completely closed by the ram, the parts assume the position shown in Fig. 2, and the shafts 75 and all movable parts associated with them are to the left of the position shown in Figs. 1 and 8, lug 67a having moved to some such position as indicated in dotted lines in Fig. 8.

As soon as ram pressure is relieved, the springs 66 act to expand the assemblage, moving the parts from the posi-

tion in Fig. 2 to substantially the position of Fig. 1. This movement has caused each piston and filtering element to shift from the closed position shown in Fig. 7, where it is against cake C, to the position shown in Fig. 7a, where it has pulled the right-hand (or piston carried) filtering element 38 away from cake C.

When high pressure liquid is admitted through ports 68a to the left ends of cylinders 68, the pistons 70 will be shifted from the position of Fig. 2 to the position of Fig. 3. This shifting has, at least in part, been accomplished by the expansion of the springs 66 and is positively completed by the pistons 70. When the shafts 75 move to the right, they first bring the collars 76 against the cross-head 28 so as to apply ample power to return the ram. The ram is accurately aligned in the cylinder and this insures lining up of all the parts. At the same time, the collars 88a, 88b, 88c and 88d move as a unit and successively pick up the lugs 67a, 67b, 67c, 67d on four rings 45a-45d inclusive toward the ram end of the machine. When sufficient lost motion is taken up by this movement, the collars 88e, 88f, 88g, 88h pick up the next four rings and move them to the right; and in the same manner the collars 88i, 88j, 88k and 88l pick up or bring the other four peripheral rings to the extreme right position as shown in Fig. 3. In this power stroke of the pistons 70, the rings 45 are all moved to the extreme right position, so that the rings are beyond the filtering elements. The power stroke of the shafts 75 successively takes up the lost motion, shifts the rings 45 against spring pressure, separates the cake C from the left filtering elements 38, and brings the free surfaces of the cakes against the right filtering elements 38 which arrest movement of the cakes. Continued movement of the rings causes them to slide past the cakes so that at the full return stroke of the rings the cakes are all free to fall out of the press.

Figure 5 and Figures 9a to 13, inclusive, illustrate the component parts of the press unit in greater detail. Each platen 29 is tapped at the inlet 89 and has an obliquely sloping drilling 90 leading to the center opening 29' having a keyway slot cut at 91 opposite the passage 90. The openings 29' receive plugs 92 with keys 93 and angled passages 94 connecting to passage 90.

The rear face of each pressure plate 41 has annular grooves 99, Figs. 10 and 12, forming passages and radial grooves 100 communicating with drillings 101, which in turn communicate with annular grooves 102 on the front face. The outer annular groove 99 on the back face of the pressure plate drains into drillings 103 and 104 in the platen and piston, respectively, as shown more clearly in Fig. 12.

The front face of the plate has inner and outer annular, flat, coplanar surfaces 105, 106. Outside the flat surface 105 is a beveled surface 107, and on the inside of surface 106 is another beveled surface 108. A spacer 109 in the form of a relatively coarse, rolled, cross-wire-mesh screen, calendered to flatness, is received in the recess 110 in the front face extending between the flat surfaces 105, 106. A filtering screen 111 (Fig. 9c) made of fine wire (as more fully described in my copending application Serial No. 188,371, filed October 4, 1950), and a backing plate 112 of perforated sheet metal, are flanged at the periphery and near the center, as indicated at 113 and 114 (Figs. 12 and 12a) so as to fit about the beveled surfaces 107 and 108. A filter screen securing ring 115 (Fig. 9d) is detachably held against the periphery of the filtering screen by screws 116.

The inner flanges of the filter screens secured to plates 41 (carried by platens 29b-29m, inclusive) are secured in place by inlet nozzles 117 having conical heads 118 and threaded into central holes 119 in the plates 41, thereby connecting inlet passage 90 to the chamber. The nozzle is reamed at 117a to have a slight taper and is provided with a taper of about 45° at 117b. The screens on the filtering elements carried by pistons are secured in place by plugs 120. Instead of supplying material to be filtered

to the chambers by inlets communicating directly to the platen, it is obvious that the feed could be from a platen through a piston and nozzle, as indicated in Figure 14.

It will be noted that the filtering elements 38 are characterized by the absence of any projections which obstruct or hinder the lateral movement of the cake. When the initial break is made between the filtering element and the right-hand side of the cake C, the cake C has a smooth vertical surface free of undercuts, and when the cake C is broken away from the left filtering element, it has a similar smooth face except for the plug of material hereafter referred to. These faces are vertical in the horizontal press of Figures 1 to 13. As soon as the rings 45 are withdrawn far enough to release the cakes, the cakes fall out of the machine onto a cake conveyor, chute or the like, without any hindrance or need for longitudinal movement whatever.

This contour of cake face makes it impossible to overload the machine in such a way that the cake might be formed too thick to clear horizontal projections. The overall capacity of the machine is thus greatly increased over that of the former machine of the same size, wherein the cakes produced necessarily had undercuts which interfered with the cake falling freely out of the open press chambers if filled beyond a certain capacity.

The liquid expressed through the filtering elements 38 enters holes 103 in the platens and 104 in the pistons, which are aligned (Fig. 12), and the liquid received in these passages drains down through a passage 121 leading to the bottom of the platen. The effluent passages 121 are connected by elbows 122 to drain pipe 123, which carry expressed liquor across to a trough 124 extending longitudinally of the machine.

Influent material to be filtered is received from pumps extraneous of the machine through a low pressure line indicated in Figs. 4 and 13 at 130, or through a high pressure line indicated at 131. It passes downwardly through suitable piping indicated at 132, to a T 133, where it is connected to a liquor supply pipe 134 extending from the resistance head to the ram head of the machine, and provided with a drain valve at 135. As seen more clearly in Figs. 1, 5 and 13, the liquor supply pipe 134 is connected through stationary piping 136 to platen 29m and to a series of eleven walking pipes 137 connected to platens 29b-29l, inclusive, said piping including valves 139 so that it is possible to cut off supply to all but one platen and apply pressure to dislodge clogging material. Platen 29a is plugged at its inlet 89.

Steam enters a manifold 140 on the upper front part of the machine, Fig. 4, and passes through a stationary pipe 141 connected to platen 29m and twelve walking pipes 142 connected to platens 29a to 29l, inclusive, so as to supply the platen steam passages 43. Steam and condensate pass from the lower ends of passages 43 into pipes 143 similarly connected to outlet manifold 144.

While the outer ends of cylinders 68 are normally vented as indicated at 68b (Figs. 1, 2 and 3), they may be connected (especially in larger presses) to a continuous source of air under pressure as indicated at 68b' (Fig. 4). Compressed air in these cylinders will assist in expelling the hydraulic fluid through ports 68a and in shifting the shafts 75 and parts carried thereby back to the position of Fig. 1, thereby relieving springs 66 of this load.

Operation

The press parts are normally in the position shown in Figures 1, 4, 5, 6 and 11, the filter elements 38, 38 being spaced the maximum and the peripheral rings 45 closing the chambers. Liquid to be filtered is supplied to the platens, except 29a, and through the passages in these platens and orifices 117 enters the chambers at the center. While liquid may be pumped into smaller presses at moderately high pump pressures of 500 lbs. per square inch, it is preferable with larger presses and where higher

pump pressures of 800 lbs. per square inch are attained, to preliminarily fill the press at a pressure of about 300 lbs. per square inch, as through a low pressure line 130, before applying the higher pressure through line 131. The forces are better balanced by first employing the lower pressure.

The pumping operation fills all chambers with the filterable material and a substantial portion of the liquid content is forced through the screens so as to create deposits in the form of semi-solid cakes which completely fill the chambers. The supply pumps for the material to be filtered are then shut down. High pressure fluid is admitted to the cylinder in the ram head. This fluid pressure, which may be of the order of 6000 pounds per square inch, presses the cross-head and all the pistons, rings, platens and interconnected parts toward the stationary elements carried by the head. This shortens the chambers, as indicated by comparing the positions of the parts in Figures 1 and 2, and presses the available residual liquid from the cakes through the screens and drainage passages. It also tends to push some of the solids back into the nozzle 117, which forms a lug of caked material to plug the nozzle. This action is indicated in Figure 11a by the density of the stippling. Some of the highly compacted material in the chamber will tend to escape by flowing backwardly in the nozzle, but it meets the smoothly polished sloping surfaces 117b of the nozzle and compacts in a manner to effectively pinch off further flow. The plug acts as a check valve. This plug is only about 3/4" in diameter at its inner end and is readily sheared off when the press is open and the cake drops.

After ram pressure has been applied in sufficient extent and time to press sufficient residual liquid from the cakes, ram pressure is released, whereupon the expansion springs 66 force all the parts between the fixed platen and filtering element and the ram toward the right, forcing the ram back into the ram head and separating the right filtering screens from the cakes. Concurrently with the release of the pressure in the ram cylinder, fluid pressure is applied to the left faces of the pistons 70 in cylinders 68. The first movement of these pistons brings the collars 76 against the cross-head and as the ram has large bearing areas in the cylinder wall of the ram head, these parts are shifted back accurately in line. This insures that the rods 75 with collars attached will operate in unison and engage the lugs on each peripheral ring and pull the rings back, this action taking place successively from ring 45a to 45l. The shifting of the rings 45 to the right will break the left faces of the cakes away from the left filtering elements and as each ring passes clear of the corresponding right filtering element (Figs. 3 and 11), the cakes fall clear of the machine onto a conveyor or chute so that the cakes may drop without any resistance being offered by undercuts and projections which would occur in the press without flat, parallel filtering elements. By avoiding interference with cake removal due to obstructions arising from cake contour, it is possible to fill the chambers to maximum capacity and after pressing, remove the cakes. It is impossible to overfill the chambers.

As soon as the cakes are freed from the chambers, pressure is released in hydraulic cylinders 68 and the springs 66 return the rings 45 to the position of Fig. 1 and carry the pistons 70 and rods 75 carried thereby from the extreme right position of Fig. 3 to the intermediate position of Fig. 1. Parts have thereby been restored to the position first discussed and the press is ready for another cycle of operations.

Figure 14 shows a horizontal press generally similar to the horizontal press above described in detail, but having a reversed arrangement of certain of the parts and operations. The resistance and ram heads are indicated at 151 and 152. The ram head carries a ram 153 connected to a ram cross-head 154 as previously described and this cross-head is interconnected with the resistance head

through lost motion tie connections 155 generally the same as those previously described. Here similar platens 156 may be employed but instead of having the faces of the platens toward the ram directly carry filtering elements, as previously described, these faces of the platens carry pistons 157. The pistons and other faces of all the platens carry filtering elements 38 as above described. The pistons 157 are like the pistons previously described, except that they have a central opening 158 to carry the influent from the platens to the nozzle. The expressed liquor drains through the platens and pistons as previously described. Each unit is provided with a chamber forming or peripheral ring 160 similar to the ring 45 but urged toward the ram by springs 161. The pistons are steam heated as before and the pressing operation is carried out in the same way by applying pressure to the ram 153. On release of the ram pressure, the springs will expand, forcing the ram back into the ram head. In the construction of Figure 14, however, the cross-head 154 carries cylinders 162 which extend back alongside the ram head. These cylinders are connected to suitable hydraulic mechanism through ports 163 to the right of the pistons 164. The pistons 164 operate shafts 165 similar to the shafts 75 but move them toward the resistance head instead of being pulled toward the ram head as above described. Similar lost motion connections between the shafts 165 and various collars (like 88a—88f) adapted to cooperate with the rings would be employed. With this arrangement reaction to the pressure applied in the cylinders 162 forces the ram into the ram head and insures the spacing of the filter chamber walls while the peripheral rings are being pressed back over the pistons to open the chambers and allow removal of the cake.

The form shown in Figure 15 is a vertical press which may be substantially identical with the horizontal presses above described. The parts are in general the same, and in Figure 15 corresponding reference characters with the letter V added are applied. Instead of having the entire press supported by feet carried by the ram head and resistance head as shown in Figure 4, here the ram head of the press is carried on legs 170. Instead of having the platens, peripheral rings and cross-heads supported by gravity on horizontal tie members, here the tie members 171 act as guides for these parts. Gravity aids in opening the press and suitable mechanism, not shown, would be provided to laterally remove the cakes from the smooth filter screens provided by the construction shown in detail in the earlier figures.

Since it is obvious that the invention may be embodied in other forms and constructions within the scope of the claims, I wish it to be understood that the particular forms shown are but three of these forms, and various modifications and changes being possible, I do not otherwise limit myself in any way with respect thereto.

What is claimed is:

1. A press having stationary heads connected together by tie members to maintain fixed spacing, one head carrying a ram, a plurality of filtering element-carrying platens, a plurality of filtering element-carrying pistons alternating with the platens, each of the pistons being secured to the adjacent platen to form a pair of carriers which move as a unit, the other filter element carrying parts being secured respectively to the ram and the remote head, whereby a series of filter chambers is formed between the filtering elements, an influent passage for each chamber, effluent passages for each filtering element, a series of tie connections slidably secured to the ram and to the remote head, the tie connections being also slidably secured to each pair of carriers, and including elements having lost motion therebetween which limits the separation of the pairs of carriers but allows carriers of adjacent pairs to approach one another when the ram acts to move the filtering elements toward one another, a plurality of peripheral rings one for each chamber, spring means interposed between each ring and one of the carriers of a cham-

ber to force the ring past the filtering elements and against the adjacent corresponding carrier to close the chamber, the spring means being compressible when the ram closes the press to form a cake, the expansion of the spring means on release of the ram pressure being effective to separate one of the filtering elements from the cake, the expansion being limited by the lost-motion tie connections, and means including the tie connections acting on each of the rings to shift the ring to the chamber-opening position to pull the cake away from the other filtering element and thereafter free the cake so that it may be removed from the chamber.

2. A press as claimed in claim 1, wherein the piston-platen units have the platens thereof disposed toward the ram, the springs push the peripheral rings away from the ram, and the ring-shifting means includes tension elements pulled toward the ram head and freely slidable away from the ram head when ram pressure is applied.

3. A press as claimed in claim 1, wherein the ring shifting means includes reciprocable shafts guided by the fixed heads, and each shaft has an abutment engageable with each peripheral ring to shift it to chamber-opening position.

4. A press as claimed in claim 1, wherein the ring shifting means includes reciprocable shafts guided by the fixed heads, and each shaft has an abutment engageable with each peripheral ring to shift it to chamber-opening position, the abutments being arranged in groups having lost-motion connections between the groups whereby the group nearer the ram may shift relative to the more remote group when the ram is closing the press.

5. A press as claimed in claim 1, wherein the ring shifting means includes reciprocable shafts guided by the fixed heads, and each shaft has an abutment engageable with each peripheral ring to shift it to chamber-opening position, wherein certain of the abutments are carried on a sleeve having limited sliding movement on the shaft to permit over-travel when the ram closes the press.

6. A press as claimed in claim 1, wherein the lost motion connections include headed bolts carried by the platens and extending in one direction, and tubular bolt-receiving members carried by the platens and extending in the other direction, the tubular members having enlarged chambers to accommodate the bolt heads and reducing shoulders to engage said bolt heads.

7. A press as claimed in claim 1, wherein the press is horizontal, and filtering elements have flat faces in vertical planes, whereby the cakes formed therebetween are characterized by the absence of undercuts so that they fall without having to clear the projections.

8. A multi-chamber press having a resistance head, a ram head interconnected with the resistance head to maintain a fixed horizontal spacing, a ram in the ram head, a ram carried platen, a stationary resistance head carried platen, a plurality of pairs of vertical filtering elements, one element of one pair being connected to the ram platen, the other of another pair being connected to the resistance head platen, the elements of each pair facing one another to form filter chamber walls, a platen and a piston connected together and interposed between the filtering elements of adjacent pairs and secured thereto to form a plurality of bodily movable units spaced between the respective ram-head-connected and the resistance-head-connected filtering elements, a series of lost motion connections between the successive platens and the ram and resistance head which allow reduction of the spacing of the respective platens from one another and of the resistance head from the ram when the ram is forced out of the ram head toward the resistance head, and limit the corresponding spacings when force is applied to any or all the movable platens to separate the chamber forming filtering elements, peripheral chamber forming rings one for each member, and of a length to cover the chamber when the platen spacings are the maximum springs biasing the rings to chamber closing position and the pairs of filter-

ing elements away from one another, and means acting on the respective rings and against the extended lost motion connections to shift the respective rings clear of the corresponding chambers to free the cakes formed in the chambers for removal from the press.

9. In a filter press, a resistance head, a ram, a ram head, head interconnecting tie members, a series of platens with interposed pressing chambers, each formed by two circular filtering elements face to face, and a peripheral ring normally overlapping both elements, a platen carrying one filtering element, a piston intermediate the other filtering element and the next platen, spring means between said next platen and the peripheral ring for moving the ring to chamber-forming position, means to feed the material which is to be pressed into the chambers when the platens are in extended relation and the peripheral rings are in chamber-forming position, means for leading off expressed fluids from the filtering elements so that the residues in the chambers form cakes, the springs being compressed when the filtering elements are moved toward one another by the pistons and acting in the absence of ram pressure to bodily shift each piston and adjacent filtering element away from the cake, the peripheral rings having laterally extending, aligned lugs, shafts carried by the resistance and ram heads, power-operated toward the ram head and freely movable toward the resistance head and having abutments on the resistance head side of the ring-carried lugs engageable with the lugs to retract the rings when power-operated, the abutment spacings during the power-operated stroke being uniform and sufficient to shift each ring beyond the opening between the filtering elements so that the cake is free for removal from the chamber certain of the abutments being engageable by the resistance head side of corresponding ring carried lugs to shift the same and the remaining abutments toward the resistance head under the influence of ram pressure.

10. In a filter press, a resistance head, a ram, a ram head, head interconnecting tie members, a series of platens with interposed pressing chambers, each formed by two circular filtering elements face to face, and a peripheral ring normally overlapping both elements, a platen carrying one filtering element, a piston intermediate the other filtering element and the next platen, spring means between said next platen and the peripheral ring for moving the ring to chamber-forming position, lost-motion tie connections interconnecting the ram head with the successive platens and the resistance head which limit the separation of the platens and insure full opening of all the chambers, means to feed the material which is to be pressed into the chambers when the platens are in extended relation and the peripheral rings are in chamber-forming position, means for leading off expressed fluids from the filtering elements so that the residues in the chambers form cakes, the springs being compressed when the filtering elements are moved toward one another by the pistons and acting in the absence of ram pressure to bodily shift each piston and adjacent filtering element away from the cake, the peripheral rings having aligned lugs, shafts carried by the resistance and ram heads, power-operated toward the ram head and freely movable toward the resistance head and having abutments on the resistance head side of the ring-carried lugs engageable with the lugs to retract the rings when power-operated, the abutment spacings during the power-operated stroke being uniform and sufficient to shift each ring beyond the opening between the filtering elements so that the cake is free to drop out of the chamber certain of the abutments being engageable by the resistance head side of corresponding ring carried lugs to shift the same and the remaining abutments toward the resistance head under the influence of ram pressure.

11. In a filter press, a resistance head, a ram head, a ram, head interconnecting tie members, and a series of pressing units between the heads, each unit of the

series including a platen, one carried by the resistance head, the others slidably guided by the tie members, a platen carried filtering element, a piston, one piston being secured to the ram head, each of the others to the adjacent platens, a piston carried filtering element, a peripheral ring slidably guided by the tie members and of a size to fit about the filtering elements and form a closed pressing chamber, each platen having an influent passage opening through a filtering element, effluent passages in the filtering elements for expressed fluids, coil spring means acting on each peripheral ring to push it to chamber-closing position where it bears against the corresponding platen, the spring means reacting against the platen of the adjacent unit, except the spring means adjacent the ram which reacts against the ram, whereby the spring means acting singly closes the chamber and acting collectively expands the units to separate the filtering elements, and a series of lost motion connections between the ram and the platens limiting the expansion of the spring means and the spacing of the filtering elements, and including telescoping members within the springs.

12. In a filter press, a resistance head, a ram, a ram head, head interconnecting tie members, a series of pressing chambers between the two heads, each formed by two circular filtering elements face to face, one being toward the resistance head and the other toward the ram head, each element carrying a filter screen and a screen securing ring about the edges of the screen and coplanar with the screen, the screens and rings having exposed faces in parallel vertical planes, and a peripheral ring normally overlapping both filtering elements and screen-securing rings; means to guide the filtering elements for relative reciprocatory movement, a series of pistons, spring means between the pistons and peripheral rings for moving the rings to chamber-forming positions, means to feed the material which is to be pressed into the chambers when the filtering elements are in extended relation and the peripheral rings are in chamber-forming position, means for leading off expressed fluids from the filtering elements so that the residue in the chambers forms cakes with flat parallel faces free of undercuts, the springs being compressed when the filtering elements are moved toward one another by the pistons and acting on release of ram pressure to bodily shift them beyond the relatively movable filtering elements so that the cakes are freed from engagement with projecting surfaces, and means comprising power-operated reciprocable shafts lateral of the chambers, and having abutments engageable with the peripheral rings to so shift them in the absence of ram pressure, at least one of said abutments remote from the press head being engageable by a peripheral ring to shift the shaft toward the resistance head, the intermediate abutments having over-travel with respect to the intermediate rings.

13. A filter press such as claimed in claim 12, having lost-motion tie connections from the resistance head to the adjacent piston, from piston to piston and to the ram whereby the maximum opening of each chamber is fixed and all the chambers are opened to the fullest extend upon return of the ram.

14. In a filter press, a resistance head, a ram, a ram head, head interconnecting tie members, a horizontal series of pressing chambers between the two heads, each formed by two circular filtering elements side by side, one being toward the resistance head and the other toward the ram head, and a peripheral ring normally overlapping both filtering elements, means to guide the filtering elements for relative reciprocatory movement horizontally, a series of pistons, spring means between the pistons and peripheral rings for moving the rings to chamber-forming positions, means to feed the material which is to be pressed into the chambers when the filtering elements are in extended relation and the peripheral rings are in chamber-forming position, means for

leading off expressed fluids from the filtering elements so that the residue in the chambers forms cakes, the springs being compressed when the filtering elements are moved toward one another by the pistons and acting on release of ram pressure to bodily shift each piston and adjacent filtering element away from the corresponding cake, and means acting on the peripheral rings to shift them in this same direction to separate the cakes from the fixed filtering elements and then to shift them beyond the relatively movable filtering elements so that the cakes are free to drop out of the chambers, and means comprising horizontal, power operated reciprocable shafts lateral of the chambers, and having abutments engageable with the peripheral rings to so shift them in the absence of ram pressure, at least one of said abutments remote from the press head being engageable by a peripheral ring to shift the shaft toward the resistance head, the intermediate abutments having over-travel with respect to the intermediate rings.

15. In a filter press, a pressing unit having a pressing chamber formed by two circular filtering elements face to face, one relatively fixed, the other relatively movable, each filtering element including a flat screen with a perforated backing member, and each screen and backing member having their outer edge portions in inclined relation to the remainder thereof, a pressure plate having a beveled surface to fit the backing member, and a screen securing ring detachably secured to the pressure plate and having a beveled surface to engage the inclined portion of the screen and an outer face coplanar with the screen, the screens and rings having exposed faces in parallel planes, a peripheral ring normally overlapping both elements and screen-securing rings, means to guide the filtering elements for relative reciprocatory movement, a piston acting on the movable element, spring means between the piston and peripheral ring for moving the ring to chamber-forming position, means to feed the material which is to be pressed into the chamber when the filtering elements are in extended relation and the peripheral ring is in chamber-forming position, means for leading off expressed fluids from the filtering elements so that the residue in the chamber forms a cake with flat parallel faces free of undercuts, the springs being compressed when the filtering elements are moved toward one another by the piston and acting on release of piston pressure to bodily shift the piston and adjacent filtering element away from the cake, and means acting on the peripheral ring to shift it in the same direction to break the cake from the fixed filtering element and then to shift it beyond the relatively movable filtering element so that the cake is freed from engagement with projecting surfaces.

16. A multi-chamber filter press having a resistance head, a ram head, head interconnecting tie members, a ram, a plurality of press units between the ram and resistance head and guided by the tie members, each press unit including a pair of filtering elements, each provided with effluent passages, and one having a central inlet opening, a platen carrying one filtering element and having an influent passage extending to the platen, a piston carrying the other filtering element, there being an axially extending passage from the influent passage to the inlet opening, the filtering element carrier adjacent the resistance head and ram head being secured thereto and the other platens to the adjacent pistons, a peripheral ring slidable with respect to the piston and filter plates, coil spring means between each ring and the platen of the adjacent unit to urge the ring into chamber-forming position, lost-motion tie connections between adjacent platens and inside the springs which limit the spacing of the filtering elements when subjected to internal pressure by the influent or when the springs expand, and which allow the filtering elements to approach one another when ram pressure is applied.

17. A multiple unit press having a series of pressing units each with a platen, a piston, platen carried and

piston carried filtering elements, a chamber closing ring, means biasing the ring to chamber-closing position, and the filtering elements away from one another, a resistance head against which one of the carriers of a filtering element bears, a ram head, tie members interconnecting the resistance and ram heads, a ram for applying pressure to all the units toward the resistance head, to shorten the chambers, and aligned telescoping lost motion connections between the ram, the resistance head and the intermediate platens which limit the spacings of these parts when ram pressure is absent and which slide past one another when ram pressure is applied.

18. A multiple unit press having a series of pressing units each with a platen, a piston, platen carried and piston carried filtering elements, a chamber-closing ring, means biasing the ring to chamber-closing position, and the filtering elements away from one another, a resistance head against which one of the carriers of a filtering element bears, a ram head, tie members interconnecting the resistance and ram heads, a ram for applying pressure to all the units toward the resistance head, to shorten the chambers, connections between the ram, the resistance head and the intermediate platens which limit the spacings of these parts when ram pressure is absent and which slide past one another when ram pressure is applied, and hydraulically operated shafts slidably carried by the resistance and ram heads and having an element engageable with the ram head to insure its return, and shoulders engageable with each of the rings to move them against the biasing means past the filtering elements to release the cakes formed in the chambers.

19. A press having a ram head, a resistance head, a plurality of aligned pressing chambers each including a peripheral ring biased to chamber-closing position, a ram acting on all the chambers to compress them and express fluid content, each ring having pull back lugs, shafts adjacent the pull back lugs and freely slidable thereby when the press is being closed, and hydraulic shaft-reciprocating means alongside the ram head, each shaft carrying a plurality of relatively non-movable collars engageable with the lugs on a predetermined number of rings near the ram head so as to be shifted by the ring nearest the ram head in accordance with piston travel in closing direction, a first sleeve having limited lost-motion sliding connection with the shaft and carrying collars engageable with the lugs on a plurality of rings further from the ram head so as to be shifted thereby, and a second similar sleeve having greater lost motion with respect to the shaft, whereby the overall travel of the shafts may exceed the maximum spacing of the lugs of adjacent rings.

20. A multi-chamber press having a series of platens, pistons, filtering elements and chamber-closing rings normally biased to position to spread the filtering elements and form a closed chamber for receipt of influent and retention of cake, a ram for applying pressure to all the platens, filtering elements and pistons, and ring retracting means comprising lugs in the rings, and reciprocable power-operated shafts having collars engageable with the lugs to overcome the ring biasing means and open the chambers for discharge of the cakes formed therein, certain of the collars having over-travel with respect to the shaft when the press is being closed.

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