

- [54] **LOCKING MEANS FOR FILTER PLATES IN A FILTER PRESS** 3,567,027 3/1971 Kurna 210/230
 3,598,240 8/1971 Abe 210/230
 3,624,778 11/1971 Weber 210/230
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 210/228, 229, 230

[56] **References Cited**

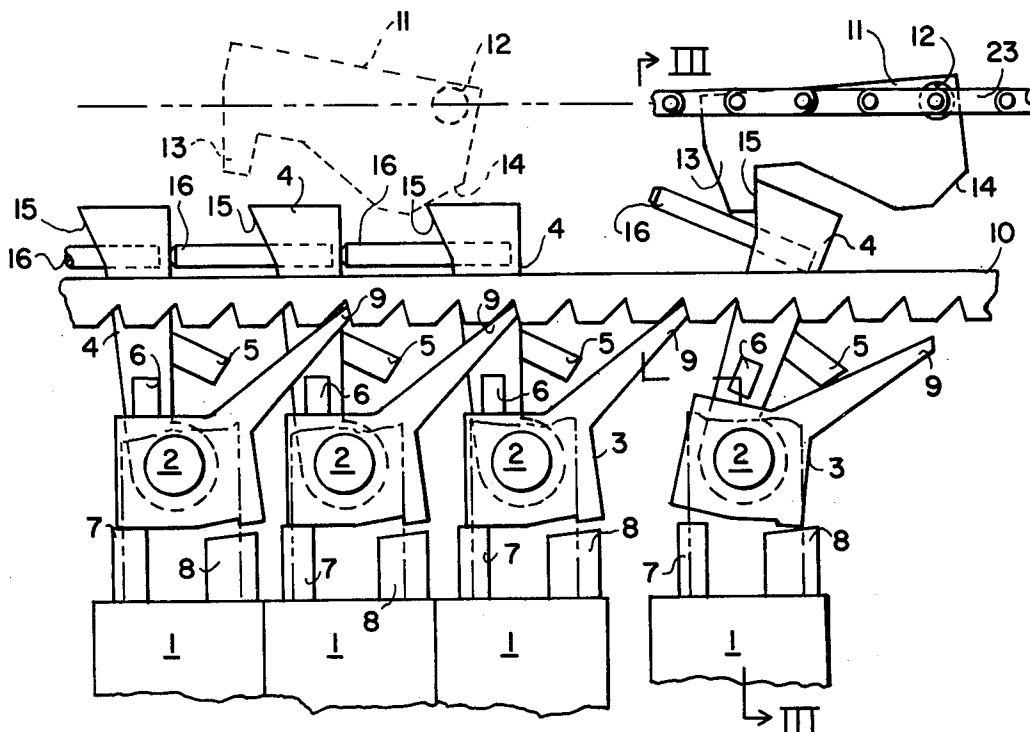
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[57] **ABSTRACT**

Apparatus for locking filter plates in a filter press embodying ratchet means extending longitudinally of the filter press with the plates being movable relative to the ratchet means. A movable actuating member is carried by each filter plate and is movable selectively to an operative position in engagement with the ratchet means and to an inoperative position out of engagement with the ratchet means.

11 Claims, 5 Drawing Figures



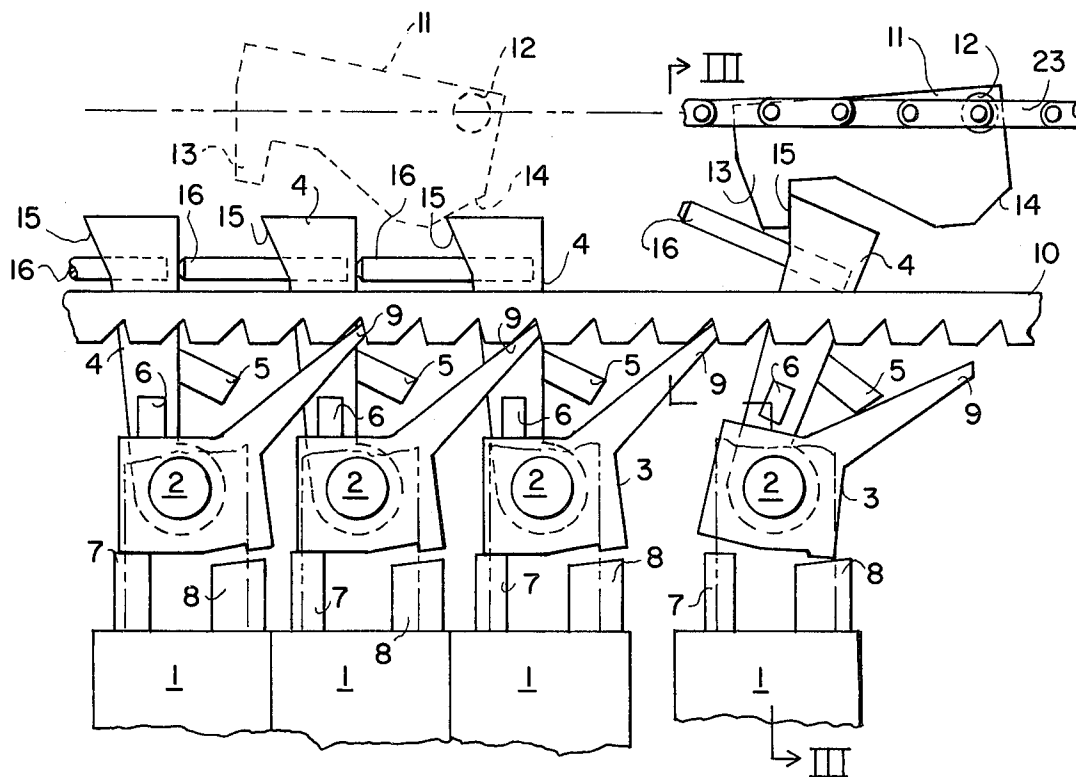


Fig. 1

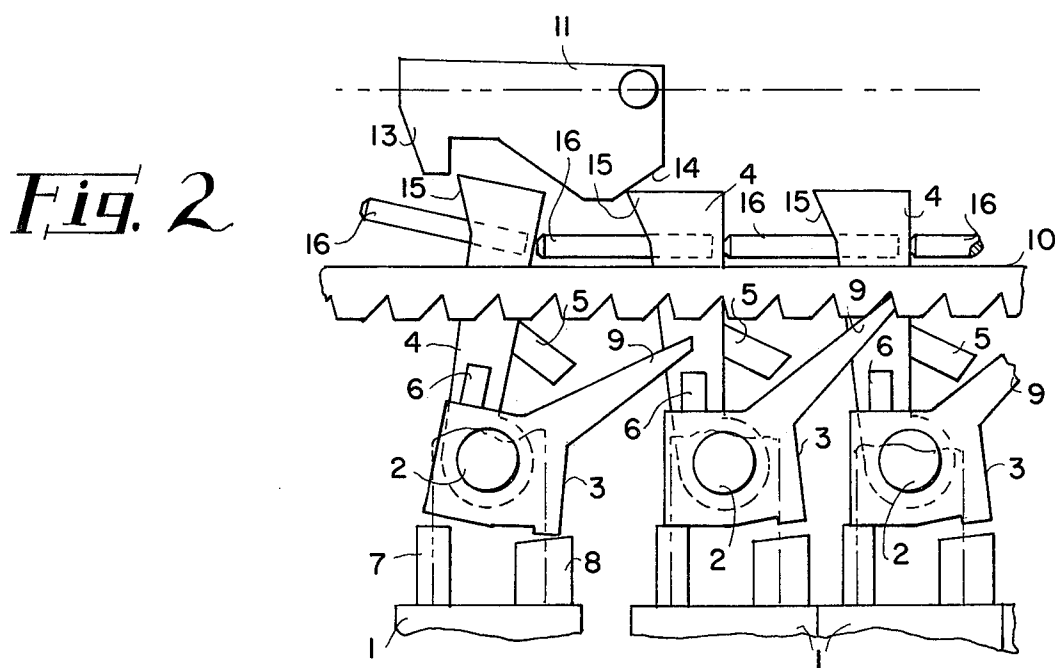


Fig. 2

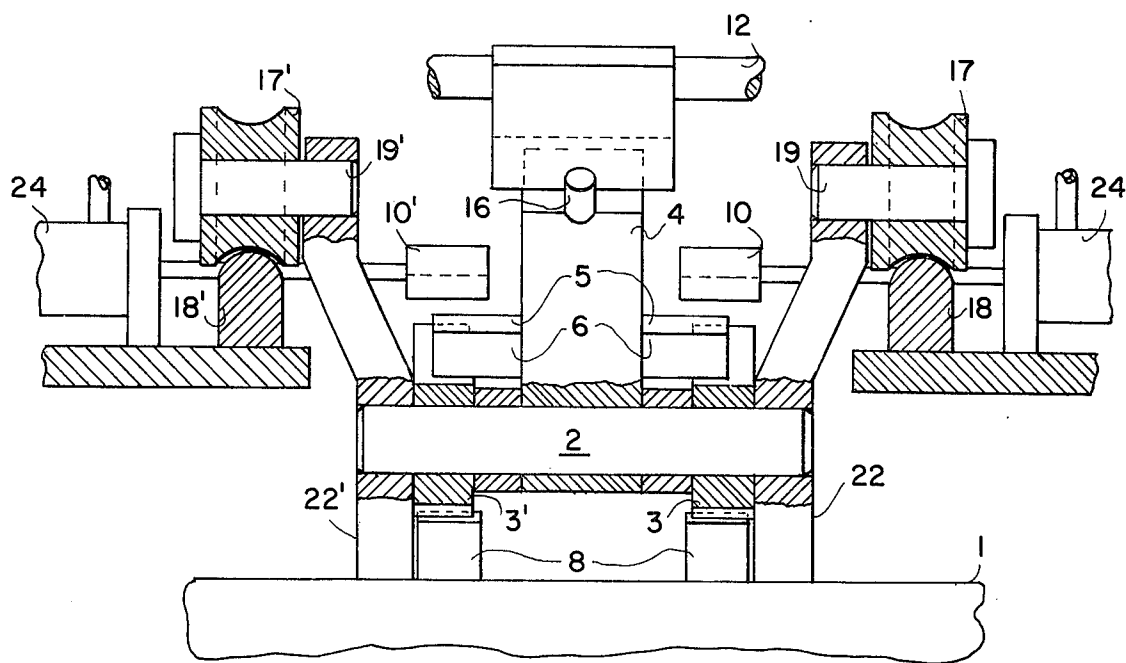


Fig. 3

Fig. 4

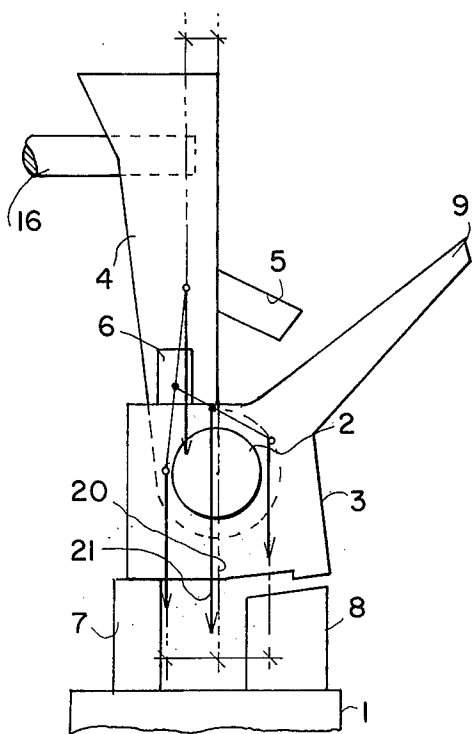
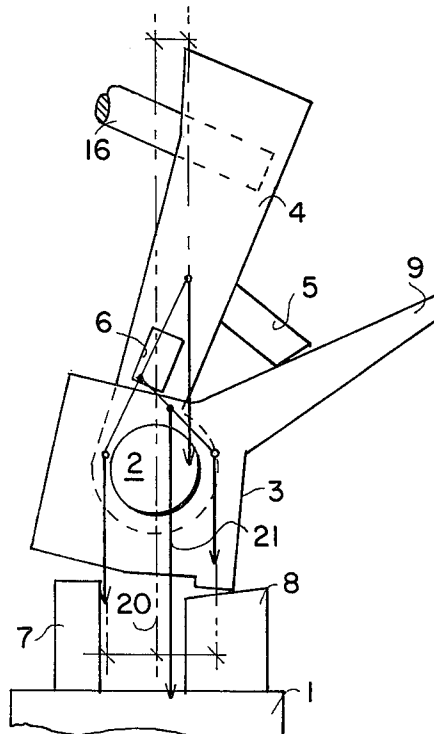


Fig. 5



LOCKING MEANS FOR FILTER PLATES IN A FILTER PRESS

BACKGROUND OF THE INVENTION

This invention relates to locking means for filter plates in a filter press wherein actuating members provided on the plates are movable to an operative and an inoperative position for engagement and disengagement, respectively, with ratchet means. The locking means prevents several plates from sticking to each other, from being shifted together when the press is opened and insures that only one plate is moved at a time, so that the cake may drop out and be disposed of.

Heretofore in the art to which our invention relates, locking means for filter plates have employed a conventional pawl type element on a filter plate which engages a ratchet element on an adjacent filter plate so that all plates are interlocked. To open the press, the lock of the frontmost plate is automatically sprung open or opened by cam means moving in the direction in which the press is opened.

Difficulties have been encountered with such prior art locking means due to the fact that the distance between adjacent plates is determined by the size of the locking means. Accordingly, the stack of plates cannot be pulled apart far enough to allow the plates to "breathe", which is essential because the cake tends to expand and increase in volume once the press is opened and pressure is released. Filter plates rigidly connected by the usual pawl type locking means remain under tension after pressure has been released, so that a considerable force is required to disengage them. This causes premature and excess wear of the locking means. Also, control of the locking means cannot be varied or adapted easily to meet individual requirements. For example, it is very difficult to open all locks simultaneously even if this should be desirable for maintenance and servicing purposes. Also, if one locking means for the plates does not function correctly all following plates will be unlocked due to the fact that all plates are interlocked. Furthermore, several sets of differently dimensioned locking mechanisms are required to accommodate various plate and/or cake sizes, which increases production and storage cost of the components.

BRIEF SUMMARY OF THE INVENTION

In accordance with our present invention we provide novel locking mechanism for filter plates which operates in an improved manner and is constructed so as to insure improved shifting and control conditions for the plates and above all increases the distance between adjacent plates when pressure is released so as to enable the plates to expand.

In accordance with our present invention pawl type locking elements cooperate with a common ratchet element which is not an integral part of the filter plates and extends longitudinally of the filter press. Accordingly, adjacent filter plates are not linked to each other since all plates are independently connected to the common ratchet element. Due to this arrangement, improper operation of one filter plate pawl does not impair that of any of the preceding or following pawls so that the filter plates remain locked properly. To insure proper "breathing" an expansion of the plates, the ratchet element is movable into an open or inoperable position in which it is not engaged by the pawls and into

a closed or operating position for engagement with the pawls.

DESCRIPTION OF THE DRAWINGS

Apparatus embodying features of our invention is illustrated in the accompanying drawings, forming a part of this application, in which:

FIG. 1 is a diagrammatic, side elevational view showing the upper parts of filter plates and the locking and opening means as viewed from one end of the stack of plates to be pulled apart;

FIG. 2 is a side elevational view showing the stack of plates after they have been shifted;

FIG. 3 is a view taken generally along the line III—III of FIG. 1 partly in section and showing the suspension means for a filter plate; and

FIGS. 4 and 5 are side elevational views showing details of the locking means in two different positions so as to show the centers of gravity under different conditions.

DETAILED DESCRIPTION

Referring now to the drawings for a better understanding of our invention, we show the upper ends of a plurality of filter plates 1. As shown in FIG. 3, each filter plate 1 is mounted for shifting by suitable means, such as by rollers 17 and 17' mounted for rotation adjacent the upper ends of support brackets 22 and 22' carried by each plate 1. The rollers 17 and 17' travel along stationary tracks 18 and 18' mounted above the filter plates 1, as shown. Each filter plate 1 is provided with spaced apart actuating members 3, 3' which are movable about a common shaft 2 which is supported by brackets 22, 22'. Mounted for pivotal movement about each shaft 2 between the actuating members 3 and 3' is an upstanding lever arm 4. Each member 3 and 3' carries an extension in the form of a pawl 9. The actuating members 3 and 3' and the lever arm 4 may be moved independently of each other a predetermined angular distance which is determined by the positions of two cams 5, 6 carried by and projecting from both sides of the lever arm 4 in position to engage the actuating members 3 and 3', as shown. Accordingly, after the lever arm 4 has passed through a short idle phase the cam 5 or 6, as the case may be, engages the members 3 and 3' thus moving them in either of two directions. Stops 7 and 8 mounted on the filter plates 1 limit angular movement of the members 3 and 3' and the lever arm 4 to determine their extreme positions. One of the extreme positions is the operative or locking position, as shown by the three plates 1 on the left side of FIG. 1 in which each of the actuating members 3 and 3' with its pawl 9 engages a serration on laterally spaced toothed racks 10 and 10' which extend above the actuating members 3 and 3' and over the entire length of the filter press with the racks being located on opposite sides of a vertical plane passing through the center of the press. In the opposite extreme position, as determined by the stop 8, the actuating members 3 and 3' are in a neutral position with the pawls 9 disengaged from the toothed racks 10 and 10'.

As shown in FIG. 1, the frontmost filter plate 1 of a stack is disengaged and shifted from left to right away from the other filter plates by one of several movable hook-like members 11 which are carried by suitable means, such as an endless chain 23 rotating in a vertical plane. The hook-like members 11 of the lower flight of

the chain move in position to engage the lever arms 4 and in the same direction in which the press is opened. The hook-like members 11 of the return run or upper flight of the chain move out of reach of the lever arms 4. Each hook-like member 11 is mounted for rotation about a pivot shaft 12 and has a catch member 13 adapted to engage lever arms 4 and also has a sloped cam portion 14. As indicated by dotted lines in FIG. 1, when the sloped cam portion 14 contacts the lever arm 4 of a filter plate 1 it lifts the catch member 13 over the lever arm 4 of an adjacent filter plate on the left as viewed in FIG. 1. Only on reaching the frontmost filter plate 1 of the stack does the sloped cam portion 14 no longer contact a lever arm 4 so that the catch member 13 can engage only the last lever arm 4 which has not been rotated and rotate it in a clockwise direction about its axis, as viewed in FIG. 1. When cam 5 engages actuating members 3 and 3' it turns the latter against stop 8 so that the instant each of the actuating members 3 and 3' is turned to the right, as viewed in FIG. 1, its pawl 9 is released from its rack 10 whereby the plate can then be shifted without hinderance. Accordingly, movement of the actuating members 3 and 3' and lever arm 4 is limited while the hook-like member 11 continues to pull, thus shifting the entire plate 1 to the right, as viewed in FIG. 1.

As each plate 1 is being shifted, the sloped cam portion 14 of a hook-like member 11 moves against the lever arm 4 of the preceding filter plate 1 of a stack whereby the catch member 13 is lifted off the lever arm 4 of the filter plate 1 it has just shifted. In order to facilitate this lifting movement, the lever arm 4 is provided with a surface 15 adapted for engagement with catch member 13. As shown in the position at the right side of FIG. 1, the surface 15 extends in the same vertical plane as the inner surface of the catch member 13. As soon as the lever arm 4 of the plate being shifted is released it contacts a stop pin 16 carried by the lever arm 4 of the preceding filter plate. The lever arm 4 of the filter plate being shifted is thus turned counterclockwise so that cam 6 moves the actuating members 3 and 3' into operative locking position. Accordingly, the pawls 9 engage racks 10 and 10' so that the filter plates are relocked after having been pulled apart. As shown, the components are so dimensioned that the hook-like member 11 will release the lever arm 4 before the arm 4 contacts pin 16 of the preceding lever arm 4 and is rotated counterclockwise thereby. The arm 4 is thus released before the filter plate being shifted moves against the previously shifted stack of plates. During the last part of its movement the filter plate being shifted is not moved by the hook-like member 11 but by its own inertia. Accordingly, the hook-like members 11 and the means for moving the same are not subjected to jerky or erratic movements and undue wear.

The hook-like members 11 are driven and guided by appropriate means such as the endless chain 23. With the filter plates being shifted along the tracks 18 and 18', the catch members 13 of the hook-like members 11 preferably extend horizontally in the same plane as the shafts 19 and 19' of the rollers 17 and 17'. Accordingly, the thrust of the hook-like members 11 does not exert undue forces on the filter plates. While the racks 10 and 10' require no movement at all they are preferably not stationary but are shiftable laterally so that they may be engaged by the pawls 9 or disengaged therefrom. It will be apparent that where the racks 10 and

10' are not shifted laterally out of the path of movement of the pawls 9, the pawls merely slide over the teeth of the racks 10 and 10'. That is, the racks 10 and 10' are shifted laterally by hydraulic cylinders 24 to avoid noises caused by the pawls 9 riding over the teeth of racks 10 and 10'. However, at the beginning of the opening of the plates the racks 10 and 10' are returned to operating position. The driving and guiding means required for this purpose may be varied. For example, we show a separate drive means, such as a hydraulic cylinder 24, which moves the racks 10 and 10' to selected lateral positions relative to the pawls 9. Also, conventional drive means which is operatively connected to the press may be employed so that lateral movements of the toothed racks 10 and 10' is synchronized with the opening and closing movements of the filter press. After each filtration run the pressure head or follower is moved back and simultaneously the racks 10 and 10' are brought into working position in which they lock the filter plates. The filter plates are then shifted one by one to the right, as viewed in FIG. 1, by means of the hook-like members 11. When all filter plates have been pulled apart and emptied of cake, the pressure head or follower is returned to operating position in the usual manner and simultaneously the racks 10 and 10' are moved laterally and disengaged so that no noise is caused by the rack and pawl elements when the plates are pushed up against each other. In view of the fact that the follower and the means for actuating the same are of a conventional type, no further description thereof is deemed necessary.

In the event the lever arm 4 of one filter plate 1 is inadvertently disengaged by the hook-like member 11 during shifting of the filter plates, this particular filter plate is not locked by the racks 10 and 10'. Accordingly, the actuating members 3 and 3' are not exposed to undue stress. To accomplish this, the center of gravity of the lever arm 4 and the actuating members 3 and 3' are so disposed relative to a vertical plane 20 crossing the pivot shaft 2 that the lever arm 4 and the actuating members 3 and 3' are in an unbalanced position with the mass at the left side of the pivot shaft 2 being greater than the mass at the right side thereof while in the FIG. 4 position. That is, the greater mass is on the left and the smaller mass is on the right side of a vertical plane 20 passing through the center of the shaft 2. Accordingly, the forces applied, indicated by arrow 21, will exert a counterclockwise torque on the assembly. However, when the lever arm 4 is shifted its center of gravity changes to the right side of the vertical plane 20, as shown in FIG. 5. In this position the greater mass is shifted to the right side of the vertical plane 20 so that the torque exerted will be clockwise. On being shifted from the operative, FIG. 4 position to the inoperative, FIG. 5 position the center of gravity of the lever arm 4 and actuating members 3 and 3' passes through the vertical plane 20 above the pivot point for the lever arm 4 and actuating members 3 and 3'. Even when the hook-like member 11 is disengaged, the lever arm 4 will stay in the position indicated in FIG. 5. The actuating members 3 and 3' are reengaged only when the lever arm 4 is raised. Accordingly, the plates may be hand-shifted if required.

In operation of the filter press, the ratchet elements 10 and 10' are moved into operating position only at the beginning of the filter plate shifting phase. When the filter plates are no longer under pressure and the

cake has been allowed to expand and the last plate has been shifted open, the ratchet elements 10 and 10' are moved to disengage the pawls and return to neutral position. The control means for the power means which moves the ratchet elements 10 and 10' into engagement and disengagement with the pawls is operatively connected to the pressure head or follower of the filter press so that the control means is actuated at the end and beginning of each cycle, respectively. Accordingly, there will be no ratchet and pawl noises when the filter plates are pushed together at the beginning of each new filtration run. Also, our improved locking means may be disengaged at any time for such purposes as mounting, inspection or washing down of plates.

The ratchet elements of racks 10 and 10' are preferably toothed racks engaged by the pawls 9 of the plates 1, the toothed racks may be provided with one tooth for each pawl 9 spaced to suit the distance between plates, after expansion of the stack. However, the spacing of teeth may be wider or smaller so that the rack may be used for a wide range of cake and/or plate thickness. Even if the racks 10 and 10' are provided with only a small number of serrations or teeth so as to engage only every second or third filter plate, the plates will be prevented from sticking together on being shifted by the hook-like member 11 that opens the filter press, because any plate sticking to the plate which is opened by the hook-like member 11 will be arrested automatically by the next free tooth of the racks so that each plate is shifted separately.

These and other advantages and details of the novel locking means and its control elements and devices are apparent from the foregoing description taken in connection with the accompanying drawings. It is, of course, possible to provide each filter plate 1 with a plurality of pawls for cooperation with associated racks which are preferably arranged on either side of a vertical plane passing through the center of the filter press.

While we have shown our invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof.

What we claim is:

1. In apparatus for locking filter plates in a filter press embodying a plurality of filter plates movable longitudinally along guides:

- a. at least one rack-like member extending longitudinally of the filter press in the direction of movement of said filter plates with said filter plates being adapted for movement relative to said rack-like member,
- b. at least one movable actuating member carried by each filter plate and movable selectively to an operative position in engagement with said rack-like member and to an inoperative position out of engagement with said rack-like member,
- c. an elongated drive member movable longitudinally of the filter press,
- d. hook-like members carried by said drive member with each hook-like member being movable selectively to an upper inoperative position and a lower operative position,
- e. a lever arm carried by each filter plate and movable with said actuating member and extending into the path of movement of and engageable with said hook-like member to move said actuating

member from its operative position in engagement with said rack-like member to its inoperative position out of engagement with said rack-like member and then shift said filter plate, and

- f. means for moving said hook-like member out of engagement with said lever arm at the end of the shifting movement of each filter plate.

2. Apparatus as defined in claim 1 in which each hook-like member has a leading, sloped cam portion which precedes a catch element on said hook-like member so that upon contacting a preceding lever arm said cam portion moves said catch element out of engagement with the succeeding lever arm on a succeeding filter plate.

3. Apparatus as defined in claim 1 in which said rack-like member is movable selectively to an inoperative position outwardly of the path of movement of said actuating member and to an operative position in the path of movement of said actuating member whereby it is engageable with said actuating member.

4. Apparatus as defined in claim 1 in which said rack-like member is a toothed rack and said actuating member carries a pawl which cooperates with said toothed rack.

5. Apparatus as defined in claim 1 in which each filter plate is provided with a stop member in position to engage and actuate the actuating member of the succeeding filter plate as viewed in the direction in which the filter press is opened to force said actuating member into operative position.

6. Apparatus as defined in claim 5 in which said lever arm is mounted for independent pivotal movement relative to said actuating member, and cams are carried by said lever arm in position to engage said actuating member after a limited amount of pivotal movement of said lever arm relative to said actuating member in either direction so that said actuating member rotates with said lever arm after said limited amount of pivotal movement.

7. Apparatus as defined in claim 1 in which each filter plate carries stop members in position to limit movement of said actuating member in opposite directions so that said actuating member is stopped in said operative position upon movement in one direction and is stopped in said inoperative position upon movement in the other direction.

8. Apparatus as defined in claim 1 in which said actuating member is movable about a pivot point and the center of gravity of said actuating member while in said operative position is shifted to one side of a neutral position located in a vertical plane passing through said pivot point and while in said inoperative position is shifted to the other side of said vertical plane passing through said pivot point.

9. Apparatus as defined in claim 1 in which a pair of laterally disposed actuating members are carried by each filter plate in position to cooperate with a pair of laterally disposed rack-like members mounted at opposite sides of a vertical plane passing through the center of the filter press.

10. Apparatus as defined in claim 1 in which shifting means is provided for shifting said rack-like member into operative position only when the pressure head of the filter press has been moved away from a stack of filter plates and pressure on the filter plates is released and means is provided for shifting said rack-like member to said inoperative position before the pressure

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head of the filter press is returned to operating position.
11. Apparatus as defined in claim 10 in which said shifting means is actuated by control means which is operatively connected to said pressure head so that said

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ratchet member is moved to said operative position and said inoperative position at the end and at the beginning of each cycle, respectively.

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