

May 12, 1959

M. J. BERLYN
HIGH-SPEED ROLL PRESS FOR EXTRACTING
WATER FROM A WET WEB

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3 Sheets-Sheet 1

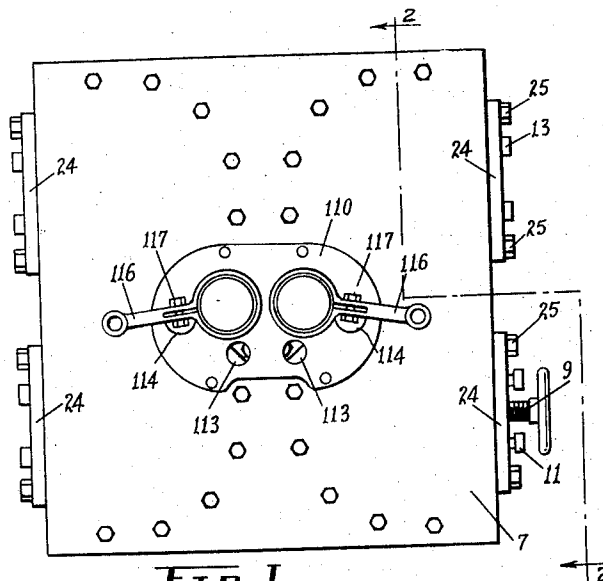


Fig. 1

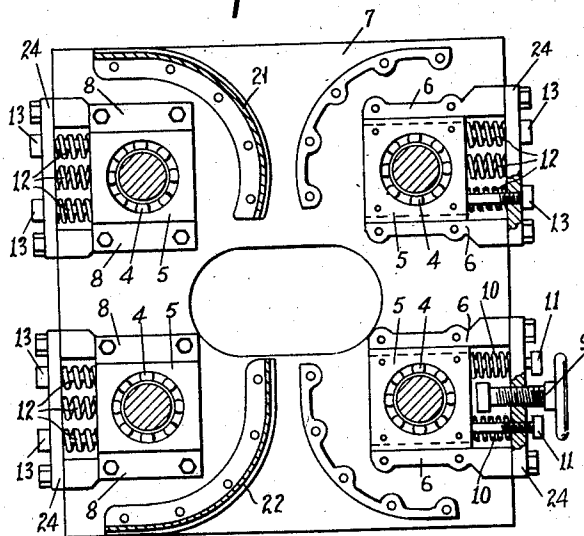


Fig. 5

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3 Sheets-Sheet 2

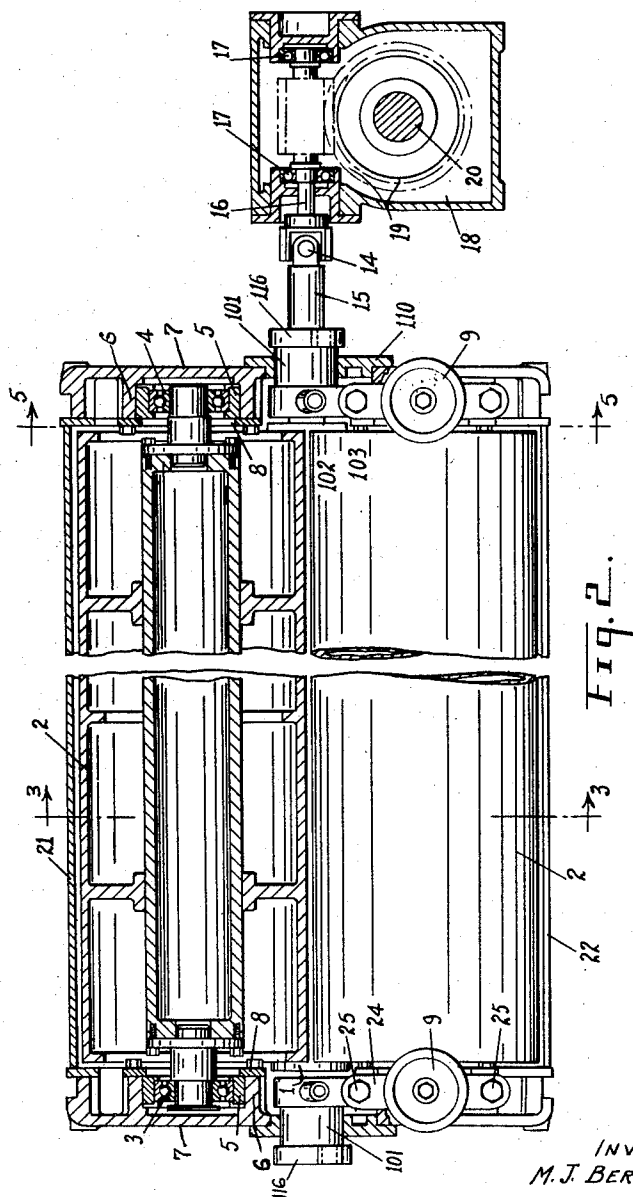


Fig. 2.

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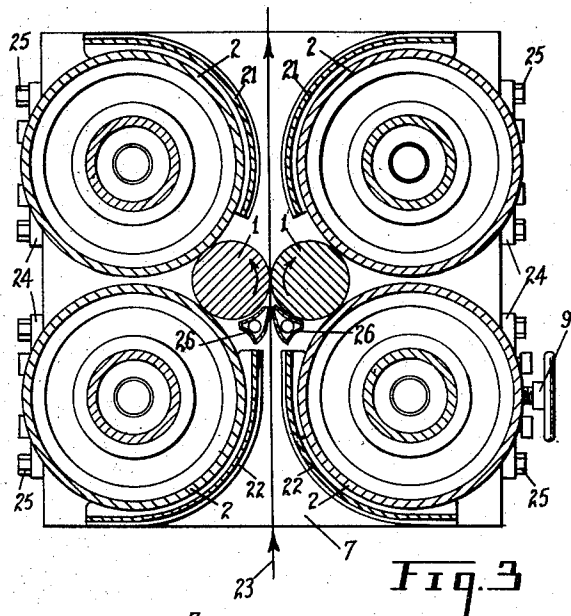


Fig. 3

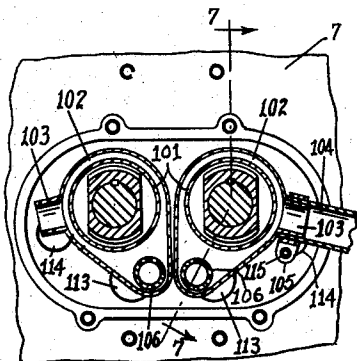


Fig. 6

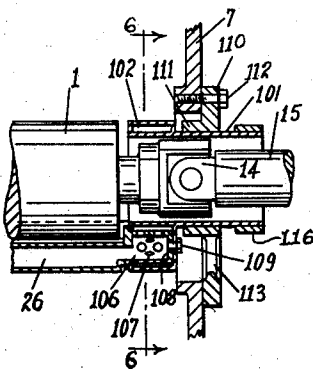


Fig. 7

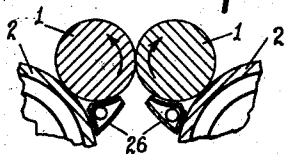


Fig. 4

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HIGH-SPEED ROLL PRESS FOR EXTRACTING WATER FROM A WET WEB

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Application November 27, 1957, Serial No. 699,255

19 Claims. (Cl. 100—160)

This invention relates to a high speed water extracting press, especially adapted for use in connection with high speed newsprint paper machines of the type described and claimed in my copending U.S. applications, Serial No. 574,741 and No. 595,142.

In high-speed newsprint paper machines, the web formed on the Fourdrinier wire contains, as it leaves the wire, about 80% (by weight) water and 20% fibre.

Finished newsprint, as it is reeled at the "dry end" of the machine, contains some 6% of water and 94% fibre.

For every thousand pounds of finished paper, therefore, about three thousand nine hundred and forty pounds of water must be extracted from the web after it leaves the wire and before it reaches the reel.

In current practice, the press removes up to two thousand pounds of this water and the dryer extracts the remainder.

The press section is smaller and less costly than the dryer section; also the press demands less power for its drive than the dryer and unlike the dryer, uses no steam. This is to say that the cost of extracting a pound of water from the web in a dryer is appreciably higher than the cost of extracting a pound of water from the web in a press. In other words the mechanical extraction of water from a web, when this method is applicable, is much more economical than thermal drying.

This has long been recognized in the industry, and the effectiveness of the press has been progressively improved, to the point where it now removes (at best) a little more than half the water that the web contains when it enters the press.

Thermal drying, which to some extent is a function of time, becomes a major impediment to speeds of operation substantially in excess of current practice.

The burden of the thermal drying means could be reduced by extraction of a greater amount of water mechanically from the web. Improvement in the effectiveness of the press is therefore a promising avenue to increased operating speed of newsprint paper machines.

In current practice the press consists usually of two or three similar elements through which the web passes in succession. Each element includes a heavy roll, commonly made of granite, a perforated rubber-covered suction press roll, an interposed felt, and means for augmenting the contact pressure due to the weight of the granite roll.

Owing to the yielding nature of the felt and of the rubber covering on the suction press roll, there is no "line contact" such as results from juxtaposition of two parallel rigid cylindrical bodies, but a rather considerable area of contact is developed by the "penetration" of the rigid cylindrical surface of the granite roll into the relatively soft and yielding felt-wrapped rubber-covered roll. The development of appreciable contact area is unfavourable to the achievement of adequate unit normal pressure in the nip and, to bring this unit pressure up to a value which is effective in water extraction from the web, the weight of the granite, or equivalent, roll must be augmented by

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the application of a considerable external force. This force, applied (by weights and levers, pneumatically, or hydraulically) to the roll journals through the bearings, introduces problems of roll deflection and even of roll strength. Crowning of rolls and other devices are used to obtain uniformity of pressure across the width of the web.

Due to wear, the peripheries of the rolls sometimes become eccentric with reference to their journals. This condition can cause cyclical variations of pressure in the nip, with resultant lack of uniformity in the dryness of the web.

This invention is related to the press section of a high-speed newsprint paper machine, such as that disclosed in my copending U.S. applications, Serial No. 574,741 and No. 595,142, dedicated to operation at speeds in the order of 100 feet per second, which is between twice and three times the highest speed employed in contemporary practice; it is more particularly dedicated to, though by no means restricted to, machines narrower than those commonly in use today.

In a press made in accordance with this invention there is no felt, nor is a suction roll employed. The web is passed through the nip between two rolls of rigid material such as granite. These rolls are of very much smaller diameter than those commonly employed at present; in fact about one tenth of the diameter of present day press rolls. The effect of their small radius of curvature in combination with the rigidity of the material on both sides of the web, is that high unit pressure on the web is achieved with a low value of normal load; i.e., low loading in terms of "pounds per lineal inch," as it is expressed in the industry. Since these small-diameter press rolls rotate at some 6,000 r.p.m. critical whirling would be encountered if they were journaled at their ends in accordance with current practice; also, due to their small diameter (and notwithstanding their relatively light lineal loading) their poor resistance to bending would result in low nip pressure in the central portion of their span as compared with the nip pressure near the roll ends.

In this invention the small-diameter press rolls are not journaled for support or position control but the axis of each is maintained on its proper centre by a three-line cage system. Each of the small-diameter press rolls is provided with two relatively large-diameter and relatively stiff back-up rolls; the three-line cage for each press roll derives from one line of contact with each of its back-up rolls and a third line of contact with the other press roll; the contact lines constituting the cages are spaced at wide intervals around the periphery of each press roll and are parallel with the press roll axes.

Control of the pressing of the web is achieved entirely by adjustment of the nip spacing of the two press rolls and not, as in contemporary practice, by adjustment of the force urging one press roll toward the other. The adjustment of the nip spacing of the two press rolls is effected as hereinafter described. At least one of the four back-up rolls is journaled in bearings whose housings are adapted to be moved in relation to the press frame structure by screw-jacks, or equivalent unyielding and irreversible devices; the remaining back-up rolls are journaled in bearings whose housings are in virtually fixed relationship to the press frame structure. The bearing housings of at least one of these last-mentioned back-up rolls are provided with means to prevent damage to the press from overload due to entry of foreign bodies, such as chips or wads, into the nip of the press rolls.

The printability of paper is adversely affected by wire-marks on the web. The side of the web bearing heavy wire marks is commonly against the felt when going through the press and the inherently smoother side of the

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web is usually against the granite roll when going through the nip.

In some newsprint machines a "reversed press" is now employed, in which the "wire side" of the web is brought into contact with the granite roll. This practice sometimes leads to another defect in the product, namely felt-marks on the side of the web which used to be smooth before the "reversed press" was introduced. Elimination of felt-marks is sometimes achieved by use of a special quality of felt which, however, is less durable than that used in the normal press arrangement; this means more frequent shut-downs for felt changing.

In presses employing felts the web is carried on the felt but when starting the "tail" through the press, owing to the tendency of the web to adhere to the granite with more tenacity than to the felt, the "tail" tends to wrap around the granite roll instead of following the felt. To prevent such winding of the web on to the granite roll, the "tail" is blown off the "leaving" side of the granite roll and on to the felt by means of an air jet, and when steady-state operation has been established, and the full-width web is running through the press on the felt, any tendency for the web to wrap around the granite roll is overcome by the lineal pull of the web, which "peels" it off the granite roll; this lineal pull is imparted to the web by its frictional contact over the large area of felt on which it is carried away from the nip.

In the press according to this invention the web alone passes through the nip between two granite rolls; there being no felt. Even if the tendency of the tail to wrap around the granite rolls were to be overcome by the use of air jets the web would be subjected to intolerable tension to "peel" it off the rolls at the leaving side of the nip, since it lacks benefit of a felt, or other, vehicle. This is the reason for the small diameter of the granite rolls. At a surface speed of 100 feet per second, a roll of 4 inches diameter turns at around 5,750 r.p.m. and the centrifugal force acting on an object at the periphery of such a roll is about 1850 times gravity. This provides more than adequate force to throw the web off the surface of a granite roll without recourse to any lineal pull in the web, and the web is thus ejected cleanly from the roll nip without disruptive stress.

An object of this invention is to provide a paper machine press which will operate satisfactorily at a speed in the neighborhood of 100 feet per second.

Another object is to provide a press which will extract more water from the web than can be extracted by present-day presses.

Another object is to provide a paper machine press which will operate at high speed for long periods of time without requiring shutdown for such maintenance and servicing as is required in contemporary presses, for example, for changing felts.

Another object is to provide a paper machine press which will eliminate wire marking from the web.

Another object is to provide a paper machine press which will not impart felt marks to the web.

Another object is to provide a paper machine press which will be quiet in operation.

Another object is to provide a paper machine press having a low power input requirement.

Another object is to provide a paper machine press of simple construction and low first cost.

Fig. 1 shows an outside view looking on the side of the press remote from the drive in a direction parallel with the roll axes.

Fig. 2 shows a partial section on section line 2—2 of Fig. 1.

Fig. 3 shows a section on section line 3—3 of Fig. 2.

Fig. 4 shows a partial section on section line 3—3 of Fig. 2.

Fig. 5 shows a partial section on section line 5—5 of Fig. 2.

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Fig. 6 is a sectional view along section line 6—6 of Fig. 7.

Fig. 7 is a partial sectional view along section line 7—7 of Fig. 6.

As shown in these drawings, my improved press includes a pair of relatively small diameter press rolls 1 supported by back-up rolls 2 of larger diameter. Each back-up roll 2 is carried in a front bearing 3 and a rear bearing 4. Bearings 3 and 4 are carried in bearing housings 5 which are slidably mounted in ways 6 which are formed integral with frames 7. Bearing housings 5 are maintained in ways 6 by means of gibs 8. One of the back-up rolls 2 is provided with means 9 for adjusting the nip of the press rolls 1 and is also provided with relatively light springs 10 for maintaining contact between press rolls and back-up rolls before the web is fed into the press roll nip. Stops 11 are provided to limit the spring-urged travel of bearing housings 5 when press rolls 1 are removed and back-up rolls 2 are left in place. One or more of the other three back-up rolls 2 is provided with relatively heavy springs 12 urging their bearing housings 5 towards press rolls 1; stops 13 limit the travel of bearing housings 5 in the direction in which they are urged by heavy springs 12.

The loading due to heavy springs 12 which urges bearing housings 5 against stops 13 is greater than the opposing load due to normal force in the nip between press rolls 1 under steady state operation of the press; the centres of the back-up roll, or rolls, 2 whose bearing housings 5 are provided with heavy springs 12 are therefore fixed as to position except when chips or wads pass through the nip of press rolls 1; when this occurs the development of abnormal load which overcomes the force of heavy springs 12 displaces bearing housings 5 and permits the press rolls 1 to move apart so as to pass the foreign matter through the nip without destructive stress in the back-up rolls 2, bearings 3, or 4, or frames 7.

The bearing housings 5 of the back-up roll 2 which is fitted with nip adjusting means 9 can not be displaced in the nip-opening direction by a non-destructive overload but, provided that any of the other three other back-up rolls 2 is capable of "unloading" as described above, the unyielding characteristic of nip-adjusting means 9 does not endanger the structure of the press in the event of oversized solids passing through the nip.

Press rolls 1 are not journaled in bearings. Each press roll 1 is located radially by entrapment in a three-bar cage of which one bar is due to its line contact with the web in the nip, or with the other press roll 1, and the other two bars consist of line contacts with its two back-up rolls 2.

Location of press rolls 1 in the axial direction is effected through universal joints 14, floating shaft 15, wormshaft 16 and wormshaft bearings 17 of the speed-increasing worm drive unit 18 which contains a pair of worm-and-wormwheel trains 19 of opposite hand to each other. Wormwheel shaft 20 drives both wormwheels in the same direction and the two worms turn in opposing directions driving the press rolls 1 in the direction as indicated by arrows in Figs. 3 and 4.

It is to be noted that back-up rolls 2 are driven solely by the tangential force due to their frictional contact with press rolls 1.

The frames 7 are structurally connected to each other by two upper cross-ties 21 and two lower cross-ties 22. These cross-ties 21 and 22 are of substantially arcuate cross-section transversely of their length and are so shaped in order to fulfill the following requirements. It is desirable to provide between frames 7 a structure having the maximum torsional stiffness which can be developed in the space available while at the same time meeting the requirement that any or all of the back-up rolls 2 may be removed from the assembly without interference with the main static structure of the press, as constituted by the frames 7 and the cross-ties 21 and 22, and without in-

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interference with each other. It is also desirable to provide shields to isolate the web 23 from the windage of the back-up rolls 2 since this is opposing the motion of the web 23.

To remove a back-up roll 2 it is only necessary to remove keeps 24 by undoing nuts 25 and slide the sub-assembly of back-up roll 2 with its bearing housings 5 complete with springs 10 and stops 11, or springs 12 and stops 13 as the case may be, outwardly along ways 6 until clear of the structure.

A press roll 1 can be removed axially by disconnecting its universal joint 14, backing-off nip adjusting means 9, urging the back-up roll 2 which is associated with nip adjusting means 9 against the small loading due to light springs 10, and then extracting press roll 1 axially in a direction away from worm drive unit 18.

Two suction slices 26 are provided for carrying away the water which is extracted from the web in the nip of press rolls 1.

In Fig. 3 the suction slices 26 are shown in the position in which they are maintained when the press is in steady-state operation.

Means are provided for moving suction slices 26 apart, as shown in Fig. 4, so as to give the "tail" more room for its unguided approach to the nip of press rolls 1 when starting the web through the press.

A suitable position adjusting device for each suction slice 26 is shown in Figs. 1, 6 and 7 inclusive and may be described as follows:

A hollow trunnion 101 which is coaxial with each press roll 1 is provided with a hollow lobed extension 102 completely surrounding the end of trunnion 101 which is nearer to the centre line of the press. Hollow lobe 102 is provided with a cylindrical extension 103 onto which a flexible suction hose 104 is held by means of hose clip 105.

Suction slices 26 are provided at their outer ends with cylindrical extensions 106. Each cylindrical extension 106 is provided with a plurality of radial holes 107 and has a closed end 108 provided with a tapped hole to receive the threaded end of bolt 109 by means of which each suction slice 26 is held in attachment to the hollow lobe 102 of one of the hollow trunnions 101.

Each hollow trunnion 101 is carried in a trunnion bearing plate 110 which is provided with a hollow bored boss 111 in which hollow trunnion 101 is freely journaled.

Trunnion bearing plate 110 is attached to frame 7 by means of bolts 112.

Trunnion bearing plate 110 is provided with openings 113 for access to bolts 109 and is also provided with openings 114 for access to bolts 115 of hose clips 105.

An actuating lever 116 is firmly clamped onto the end of each hollow trunnion 101 which is remote from the centre line of the press by means of clamping bolt 117.

The inside bore of each hollow trunnion 101 is made sufficiently large for clearance over the outside of universal joints 14.

The operation of each suction slice position adjusting device is as follows:

Suction is communicated from a suitable suction pump means through flexible hose 104 to hollow lobe 102 through radial holes 107 in the cylindrical extension 106 of suction slice 26. Change in the position of the suction slice with relation to the press roll nip is effected by movement of the actuating lever 116. It will be seen that, since hollow trunnion 101 is coaxial with press roll 1, movement of the suction slice 26 with relation to the press roll nip does not change the clearance of the suction slice lips with relation to the surface of the press roll with which that suction slice is associated.

The arrangement shown, though specifically contrived to accommodate the press roll driving means may be employed also at the ends of the press rolls remote from the driving means. If desired, a slightly simpler arrangement might be employed at the ends of the press rolls

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remote from the drive though, in the interest of standardization of parts, it would probably be preferable to retain the execution as shown at all four points on the press.

While I have herein disclosed what I now consider to be the preferred embodiment of this invention, it will be understood that various modifications in the design and arrangement of the component parts may be resorted to within the scope and spirit of the invention as defined by the appended claims.

What I claim is:

1. A high-speed roll press for extracting water from a wet web of fibrous material such as paper, comprising a pair of relatively small-diameter press rolls supported by backing-up rolls of larger diameter, said backing-up rolls being journaled in and supported by suitable bearing housings and said press rolls being located radially solely by line contact with each other and with the backing-up rolls when the press is not in use or by line contact with the backing-up rolls and with a wet web passing between said press rolls when the press is in use.

2. A high-speed roll press as set forth in claim 1, in which each press roll is located axially by driving means connected therewith and operable to drive the press roll at high speeds of the order of 5,000 r.p.m. and higher.

3. A high-speed roll press as set forth in claim 2, in which the drive means connected to the press rolls is of the worm and worm wheel type.

4. A high-speed roll press as set forth in claim 2 in which the drive means for each press roll is of the worm and worm wheel type and is connected to the press roll by motion-transmitting connecting means designed to permit the press roll to move laterally without change in the orientation of the axis of rotation.

5. A high-speed roll press as set forth in claim 2 in which the drive means for each press roll includes a fixed-axis drive shaft and a floating shaft connected to the drive shaft and to the press roll in such manner as to permit the press roll to move laterally without change in the orientation of the axis of rotation of the press roll.

6. A high-speed roll press as set forth in claim 5 in which the floating shaft is connected to the drive shaft and to the press roll by universal joints.

7. A high-speed roll press as set forth in claim 1, including frame structures slidably supporting the bearing housings of the backing-up rolls and resilient means abutting said bearing housings and yieldable to permit lateral displacement of at least one of the backing-up rolls in response to inadvertent overload.

8. A high-speed roll press as set forth in claim 1, including frame structures slidably supporting the bearing housings of the backing-up rolls, resilient means abutting said bearing housings and yieldable to permit lateral displacement of the backing-up rolls in response to inadvertent overload, and retractable rigid-pressure applying means operable into engagement with the bearing housings of one of the backing-up rolls to adjust the nip of the press rolls.

9. A high-speed roll press as set forth in claim 8, in which the loading of the last mentioned bearing housings by the resilient means abutting said bearing housings is less than the loading of the other bearing housings by the resilient means abutting same.

10. A high-speed roll press as set forth in claim 8, including stops arranged to limit travel of the bearing housings of three of the backing-up rolls in the direction in which said bearing housings are urged by said resilient means.

11. A high-speed roll press as set forth in claim 7, in which said frame structures are interconnected by cross members which are of substantially arcuate cross-section transversely of their length, said cross members being arranged to partially shroud the backing-up rolls in such a manner as to prevent contact between the backing-up rolls and a web passing between the press rolls.

12. A high-speed roll press as set forth in claim 7,

in which at least one of the frame structures is provided with an opening through which the press rolls may be removed axially.

13. A high-speed roll press as set forth in claim 7, characterized in that the component parts of each backing roll assembly, including the backing-up roll itself, the associated bearing housings and the said resilient means, are removable as a unit from the frame structures.

14. A high-speed roll press as set forth in claim 1, including suction slices arranged in close proximity to the press roll nip to receive and carry away water extracted from the wet web during its passage through the nip of the press rolls.

15. A high-speed roll press as set forth in claim 14, in which the suction slices are mounted for movement, toward or away from the press roll nip, in arcuate paths concentric with the cylindrical surfaces of the press rolls.

16. A high-speed roll press as set forth in claim 7, including suction slices arranged in close proximity to the press roll nip to receive and carry away water extracted from the wet web during its passage through the nip of the press rolls.

17. A high-speed roll press as set forth in claim 7, including suction slices arranged in close proximity to the press roll nip to receive and carry away water extracted from the wet web during its passage through the nip of the press rolls, said press rolls and suction slices being

axially removable through an opening in one of said frame structures.

18. A high-speed roll press as set forth in claim 7, including suction slices arranged in close proximity to the press roll nip to receive and carry away water extracted from the wet web during its passage through the nip of the press rolls; said suction slices being mounted for movement, toward or away from the press roll nip, along arcuate paths concentric with the cylindrical surfaces of the press rolls.

19. A high-speed roll press as set forth in claim 7, including suction slices arranged in close proximity to the press roll nip to receive and carry away water extracted from the wet web during its passage through the nip of the press rolls, said suction slices being mounted for movement, toward or away from the press roll nip, along arcuate paths concentric with the cylindrical surfaces of the press rolls, said press being further characterized in that the press rolls and the suction slices are removable axially through an opening in one of said frame structures.

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