Aug. 9, 1966 J. A. MEANS 3,265,559

PAPER PRESS SECTION

Original Filed May 10, 1960 6 Sheets-Sheet 1

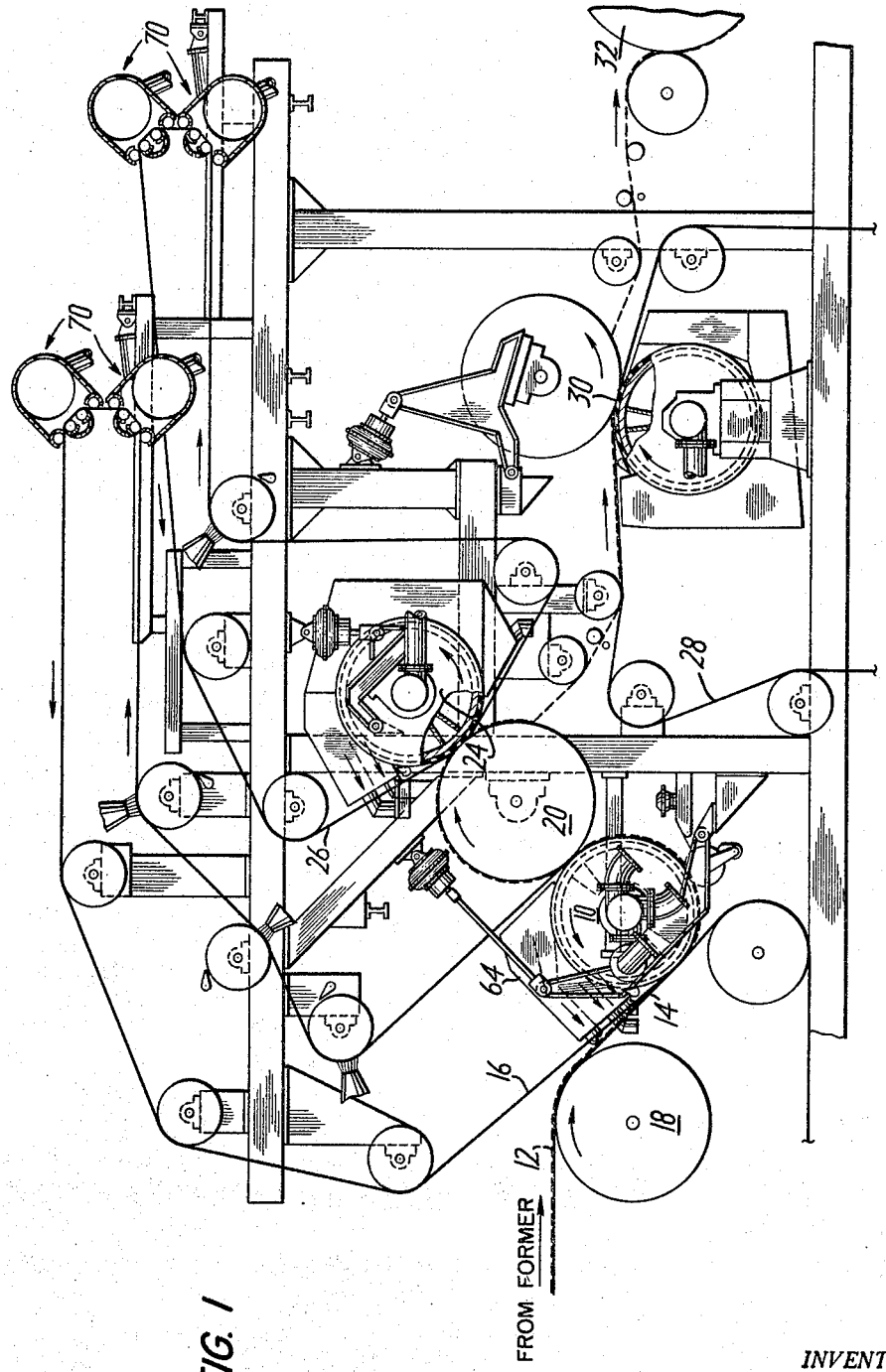


FIG. 1

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Aug. 9, 1966 J. A. MEANS 3,265,559

PAPER PRESS SECTION

Original Filed May 10, 1960 6 Sheets-Sheet 2

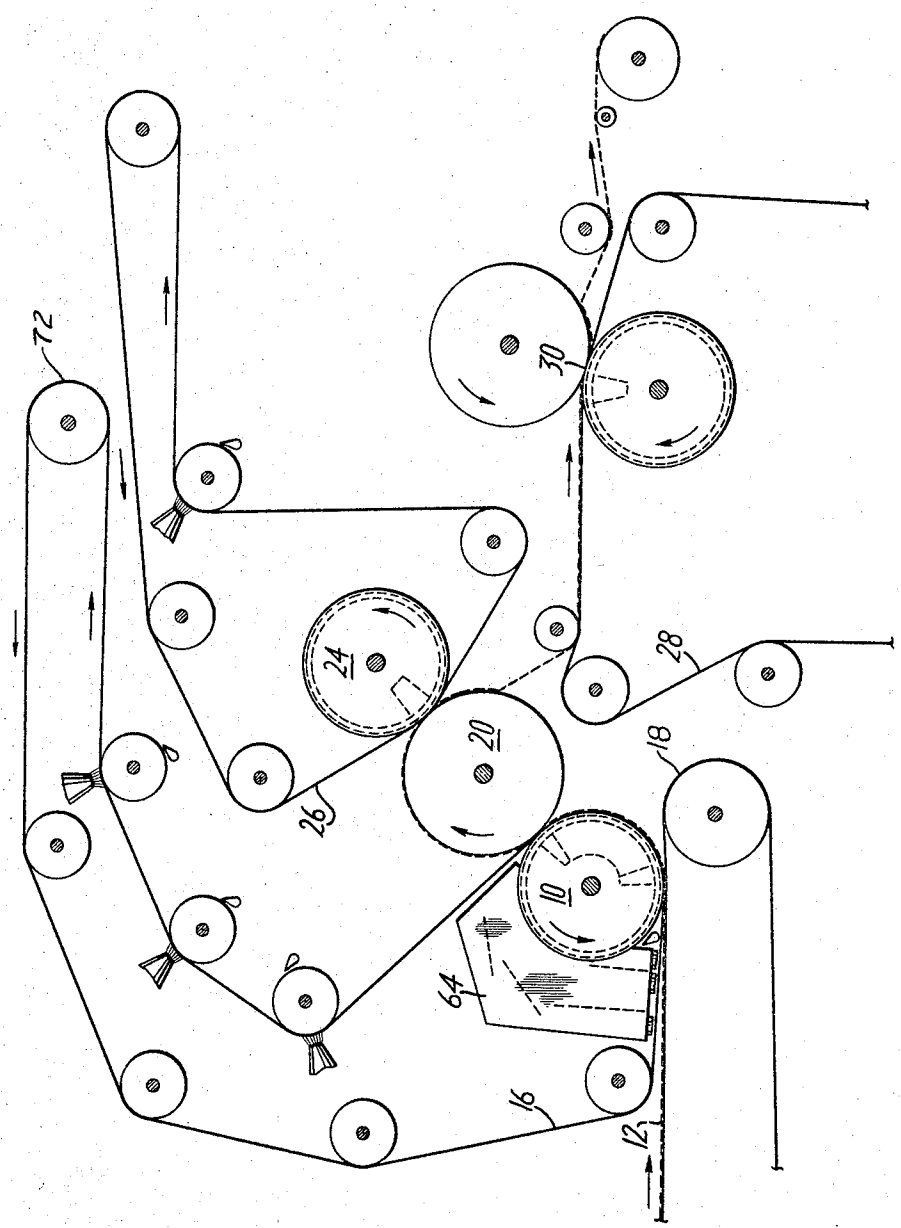


FIG. 2

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Aug. 9, 1966 J. A. MEANS 3,265,559

PAPER PRESS SECTION

Original Filed May 10, 1960 6 Sheets-Sheet 3

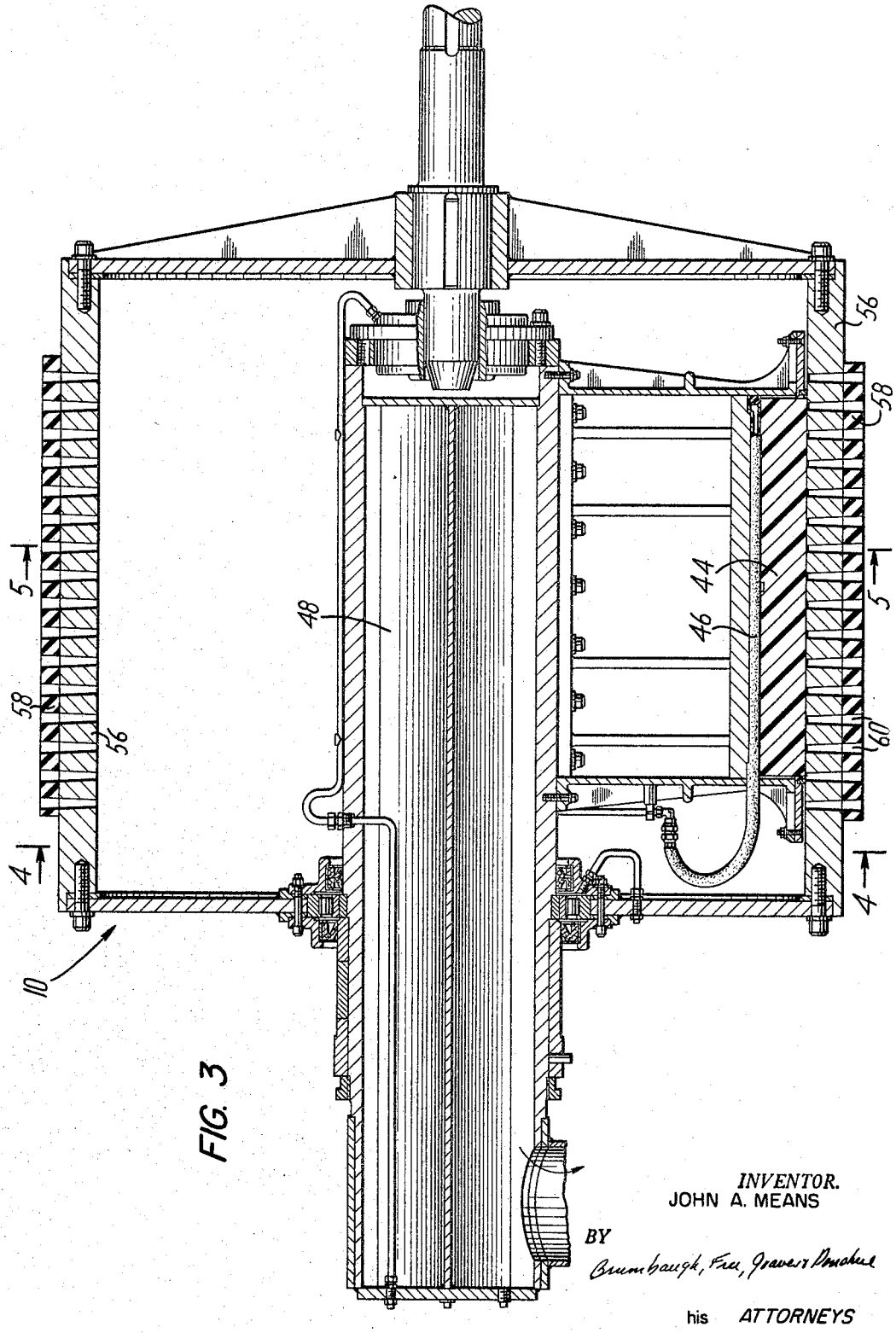


FIG. 3

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PAPER PRESS SECTION

Original Filed May 10, 1960

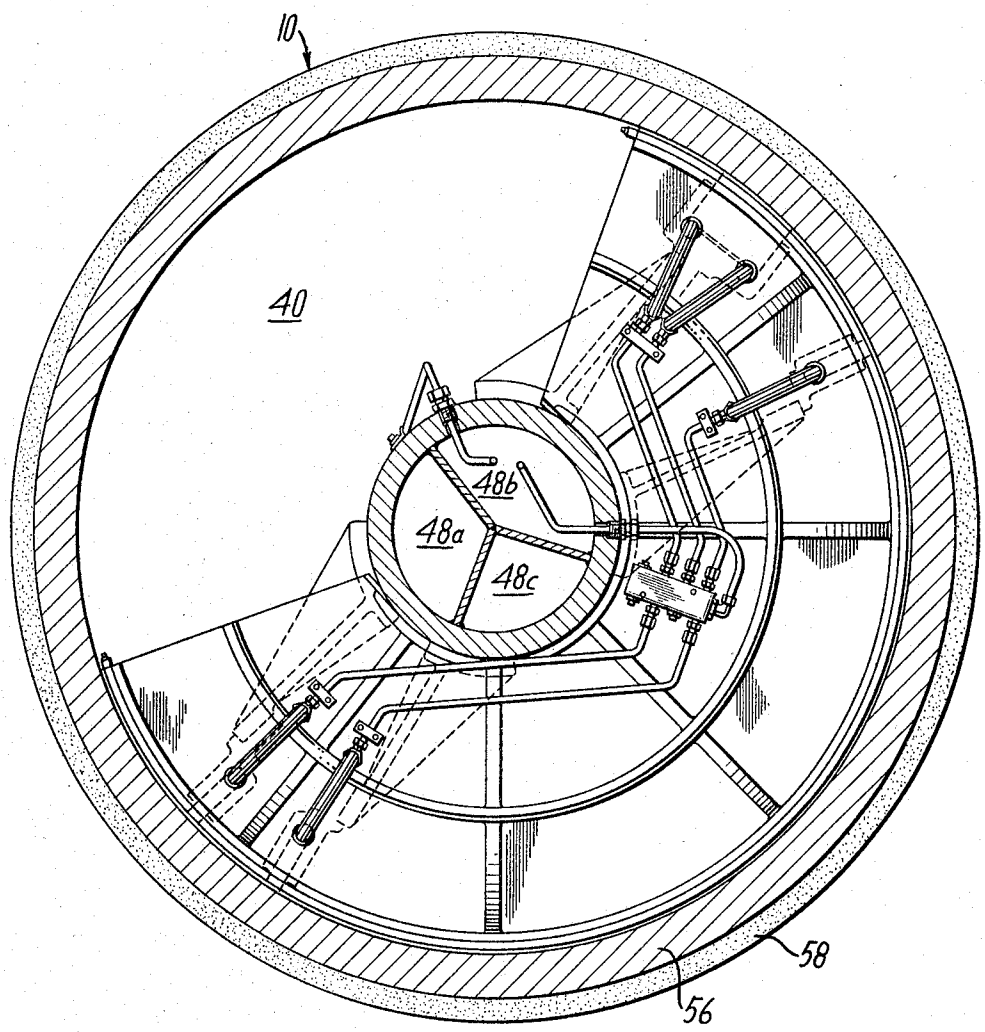


FIG. 4

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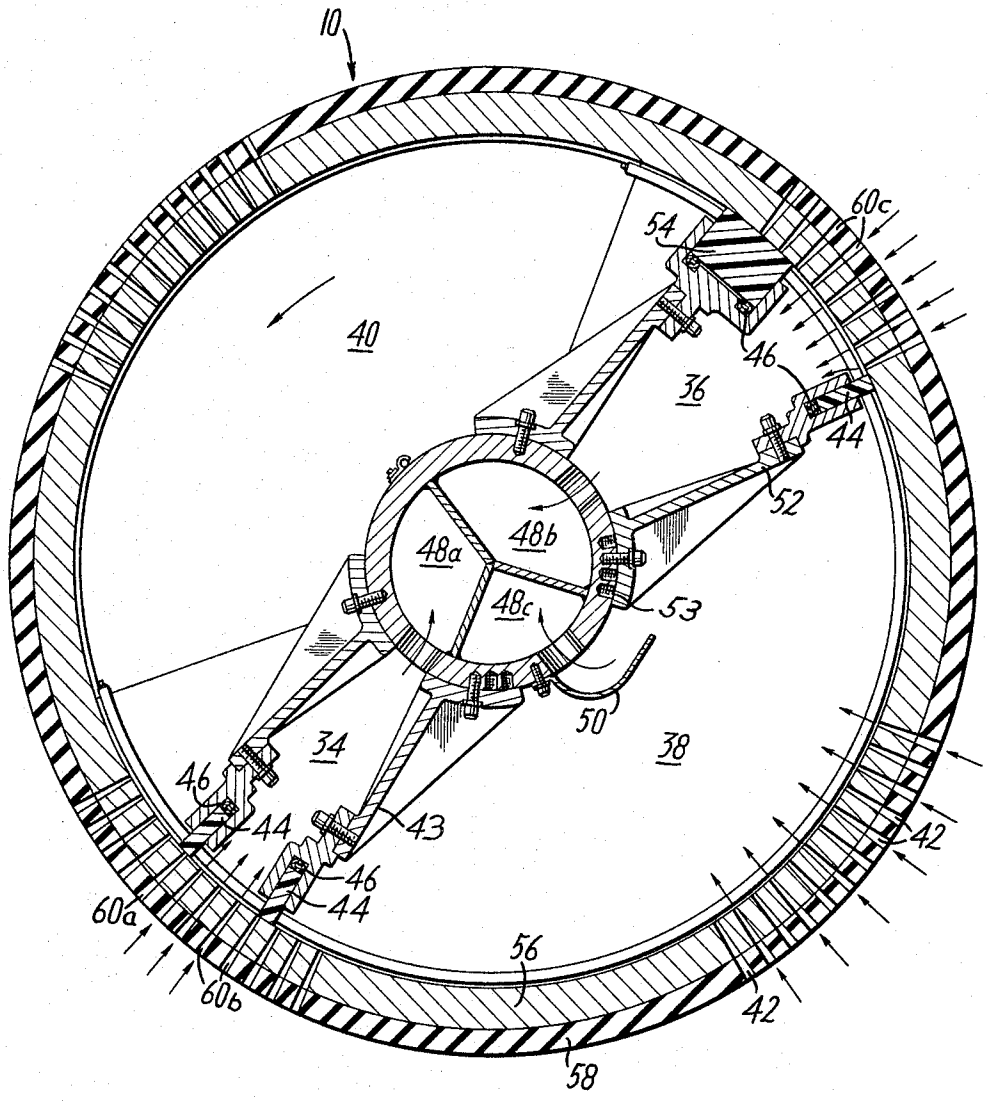


FIG. 5

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PAPER PRESS SECTION

Original Filed May 10, 1960 6 Sheets-Sheet 6

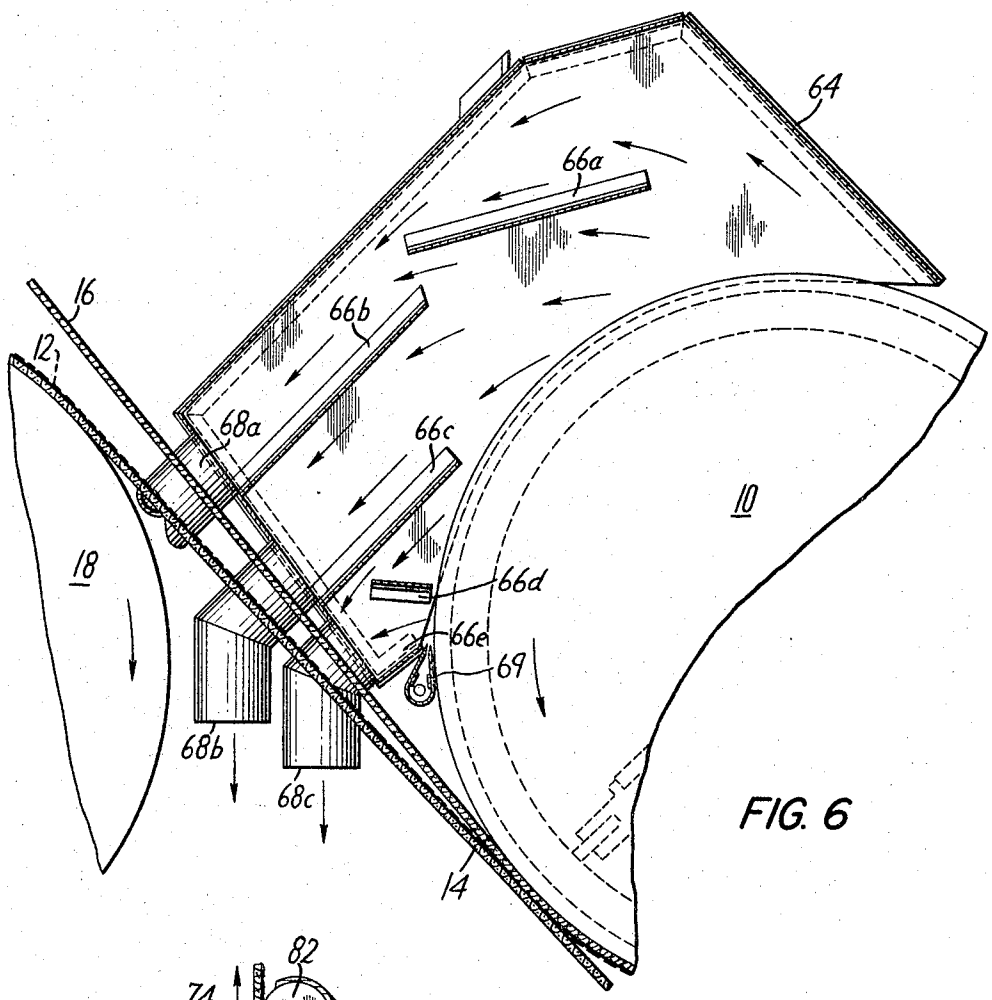


FIG. 6

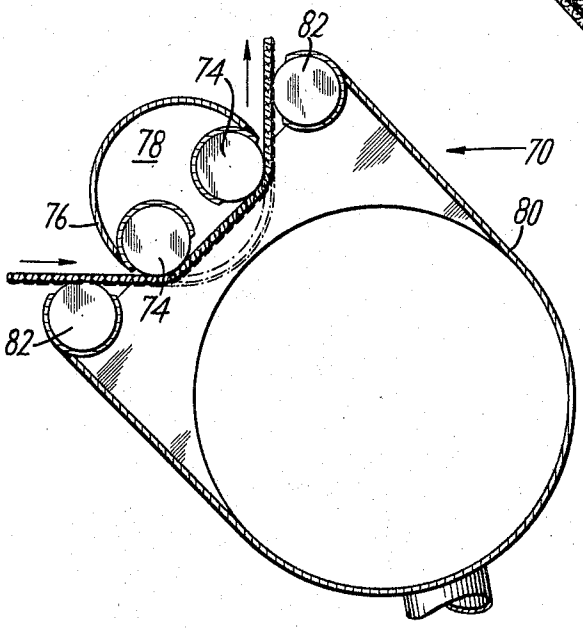


FIG. 7

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United States Patent Office 3,265,559 Patented August 9, 1966

3,265,559

PAPER PRESS SECTION

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Continuation of abandoned application Ser. No. 28,114, May 10, 1960. This application May 3, 1965, Ser. No. 456,883

3 Claims. (Cl. 162—276)

This is a continuation of application Serial No. 28,114, filed May 10, 1960, for "Paper Press Section," now abandoned.

This invention relates to an improved suction press assembly for paper making machines, and, in particular, to a stacked press arrangement which incorporates a novel pickup and first suction press roll and means in combination therewith adapted to increase press drying speeds and efficiencies.

Relatively recent developments in press sections for paper-making machines have included the innovation of the compact stacked press arrangement, and the use of a vacuum pickup roll which was adapted to directly contact a paper web traveling on a wet end or Fourdrinier wire. The roll was adapted to draw the web directly from the wire onto a pickup felt, and thereby eliminated the conventional open draw through which the web previously was caused to travel. A modification, generally termed the semistacked press arrangement, provided the principle of utilizing a plain surface roll at the first and second press nips, arranged to press against the wire side or reverse side of the web at both nips, and to cause the water to be withdrawn from the felt side only.

One principal disadvantage with the conventional semistacked press arrangement is that there is an inefficient withdrawal of water from the formed sheet resulting in the removal of less water from the sheet than should be obtainable.

Another difficulty experienced is in the collection of water discharged from holes contained in the surface of the press roll, and the avoidance of rewetting of the felt before the latter reached the pickup area. At high speeds and high vacuums in the press suction areas, rewetting is generally experienced.

A further serious difficulty involves the problem of increasing or even maintaining useful felt life. Vacuum pickup of the paper web from the Fourdrinier wire causes the felt to become readily clogged with fine fibers, pitch, and size off of the top of the web. This latter problem is particularly pronounced in the use of the semistacked press arrangements, developed for newsprint and kraft papers, writings and printings, wherein the pulp is generally composed of a large number of fines.

The improvements of the present invention provide a novel first press and pickup roll and means associated with it capable of obviating the above disadvantages, and specifically, capable of increasing, conspicuously, the dryness of the pulp as it leaves the press section and/or the speeds at which the press section may be operated. In particular, the present invention provides an improvement which is useful for the semistacked press arrangement.

Essentially, there is provided a novel single vacuum press and pickup roll which utilizes a first vacuum pickup box, and a second vacuum box at the first press nip, and an additional third suction box interposed in the turning area between the pickup and first press areas. As a modification of the above, the first press roll may rather comprise a single large, continuous, vacuum box extending between the pickup and first press nip areas, including or encompassing those areas, and the intermediate turning area as well.

A primary advantage obtained from this arrangement

is that a greater amount of water may be caused to be removed at the first press nip, in a manner that will become apparent, thereby permitting higher press speeds and improved press efficiency. Also, as will be seen, the arrangement permits the use of a lower vacuum in the pickup area, which effects an improved felt life by causing a lesser loss or withdrawal of fines from the paper web in that area. A secondary advantage which inures from the arrangement is that it permits the use of a dry felt. In conventional machines, a minimum felt wetness is required to cause adherence of the web to the felt. This is particularly true in the more recent semistacked press arrangements which utilize a pickup box and first press box positioned in separate spaced apart rolls, and an intermediate turning roll or guide roll about which the felt is trained. Although this latter arrangement provides certain advantages, it does have the definite disadvantage that the felt and web are caused to traverse an open draw area, and adherence of the web to the felt is thus a principal problem, and minimum wetness is required. In the present invention, it is an object on the contrary to have the felt approaching the pickup area as dry as possible, thereby providing, quite obviously, a means for improving the efficiency of water removal from the web.

As indicated, it will become apparent that the invention causes a greater amount of water to be removed from the pulp web at the first press nip. Accordingly, there is provided an improved drainage pan or save-all adapted to more effectively remove the water and at the same time prevent rewetting of the felt.

A further provision of the invention is in a novel means for conditioning the felt and extracting a maximum amount of water from the felt without materially lessening its absorptive features. In this way, a highly absorptive and dry felt is advanced to the pickup area.

Other objects and advantages will become apparent upon further consideration of the specification and accompanying drawings in which:

FIGURE 1 is an elevation view of a press assembly according to the present invention;

FIGURE 2 is a schematic elevation view of a modification thereof;

FIGURE 3 is a section view taken along the axis of a first pickup and vacuum press roll according to the present invention;

FIGURE 4 is a section view taken along line 4—4 of FIGURE 3;

FIGURE 5 is a section view taken along line 5—5 of FIGURE 3;

FIGURE 6 is a section view of a save-all according to the present invention; and

FIGURE 7 is a section view of a means for conditioning the felt according to the present invention.

Referring to FIGURE 1, the numeral **10** designates a first vacuum press roll or bottom roll adapted to transfer a paper web **12**, from an extended portion **14** of a Fourdrinier wire of a conventional forming machine, to a first press felt **16**. The forming machine roll designated by the numeral **18** may be a conventional couch roll. The paper web is taken on the first press felt through a first press nip located between the vacuum press roll **10** and an intermediate plain surface or bare roll **20**. The web **12** is then separated from the first press felt **16** and carried about the intermediate roll **20** to a second press nip located between a top vacuum press roll **24** and the intermediate plain surface roll **20**, whereat it is brought into contact with a second press felt **26**. The web **12** is then transferred from the plain surface roll **20** across an open draw to a third press felt **28** by which it is conveyed to a third press nip, generally designated by the numeral **30**, and subsequent press sections if necessary. Subsequently, the web is taken to a dryer, designated by

the numeral 32. Much of the above arrangement, as described so far, is conventional.

A primary feature of the invention resides in the construction of the pickup and first vacuum press roll 10, which roll is, in brief, comprised as shown in FIGURE 5 of a pickup vacuum chamber or suction box 34 located in the area of contact of the first press felt with the Fourdrinier wire, a vacuum press chamber or suction box 36 located in the area immediately prior to the first press nip, and a third vacuum chamber 38 located in the turning or circumferential portion of the roll intermediate of the above-mentioned pickup and press suction boxes. The area designated by the numeral 40 is subject to atmospheric pressure, and is the throw-out portion of the roll where water is permitted to be ejected from drilled holes 42 in the surface or shell of the roll.

Portions of the circumference of the roll encompassed by the suction boxes, in this embodiment of the invention, are, in reference to the arc of the roll encompassed, about 30° for the pickup suction box, about 30° for the press suction box, and about 120° for the turning suction box. Respective vacuums imposed on the suction boxes may be from 7 to 12 inches of mercury for the vacuum pickup box, from about 3 to 7 inches of mercury for the turning suction box, and from about 7 to 15 inches of mercury for the press suction box.

As shown in FIGURE 5, each vacuum area is defined by a pair of structural members, such as member 43, each member supporting and holding a Teflon (polytetrafluoroethylene) strip 44 pressed against the inner surface of the shell or roll and sealing off the suction area. The strip is held firmly against the roll by an expandable duct 46, contained in the structural member, the ducts being provided with means, not shown, adapted to vary the pressure therein. A central manifold coincident with the axis of the roll is divided into multiple chambers 48*a*, *b*, and *c*, each chamber being placed in communication with a respective vacuum box. Water flowing by gravity from the intermediate turning box upper structural member 52 is deflected by deflector 50 into its respective manifold chamber 48*b*, thus preventing the collection of a pool of water at the bottom of the roll. For the purpose of adjustment, certain of the structural members may be variably positioned radially about the axis of the roll by using a multiple number of tapped holes 53 in the circumference of the roll manifold, in an obvious manner, as shown.

Conventional seal strips have been made of molded graphite blocks, which have generally required a lubricating water spray. It has now been discovered that polytetrafluoroethylene does not require a lubricating spray, thereby improving on the efficiency of water withdrawal by the roll. In addition, polytetrafluoroethylene provides better wear quality and less frictional drag on the rolls.

A seal strip 54 of substantial width is positioned adjacent to the nip of the roll and functions not only as a seal for the vacuum box, but also as a silencer, incorporating known principles. In the present invention, by modifying its dimensions, it is given an additional function of controlling water throwout from the roll in this area. The width of the strip may be increased, for example, from a conventional 2¾ inches, to about 4 inches, preventing rapid loss of vacuum in the holes, using the retained vacuum to hold water droplets in the shell until a complete collection of them by the save-all can be insured, thereby eliminating a troublesome problem in the field.

The shell of the roll is relatively conventional comprised of an inner 2" brass cylinder 56 covered with a 1" rubber layer 58, having spaced radial 5/32" holes 42 drilled therein.

Details of the roll are also shown in FIGURES 3 and 4, which show the shell 56, outer rubber covering 58, a vacuum chamber seal strip 44 (FIGURE 3), pressed against the inner surface of the roll by an expandable

duct 46, the partitioned manifold 48, and the like. FIGURES 3 and 4 also illustrate the manner in which a pressure may be transmitted to the expandable ducts 46.

In operation, the roll surface portion 60*a* (FIGURE 5) adjacent the leading edge of the vacuum pickup box 34 is brought into contact with the felt, which felt is, at about the same time, or shortly thereafter, brought into contact with the paper web then being conveyed on the Fourdrinier wire, thereby causing a pickup of the web onto the felt. As can be seen, a vacuum is continuously maintained on the felt and web, past area 60*b* up to the point of disengagement of the felt from the roll, and of the web from the felt, in area 60*c*.

Although the actual mechanism is not known for certain, it is believed that the increased water extraction may be due to the provision of a means for greatly increasing the vacuum area immediately preceding the press nip to thereby effect an increased time increment during which the individual holes in the shell are subjected to a vacuum. With a conventional suction press roll, the relatively narrow (4"–6") box permits the vacuum to be applied to the holes for a short period of time only, and as a result, most of the vacuum goes to reducing the air in the hole, with little or no time being available for the vacuum to work on the felt and paper web.

In conventional machines, the withdrawal of water from the web was accomplished primarily or solely by the pressing action of the rolls at the nip forcing the water out of the sheet, and press suction boxes adjacent the press nip functioned only to collect the water so forced out. Any vacuum used in the pickup and turning areas of conventional stacked and semistacked presses offered little or no assistance to water withdrawal at the nip, since on the release of the vacuum in these pickup and turning areas, the web acted as a blotter and any water drawn into the felt was withdrawn back into the web. This was further generally aggravated by the presence of a high centrifugal force, particularly at the speeds contemplated, forcing the water radially out of the felt and shell holes. In fact, the web at the first press nip was often as wet as or wetter than in the pickup area.

In the present invention, an initially dry felt is advanced to the pickup area and is maintained continuously dry, as compared to the dryness of the web, up to and through the press nip area for substantially the full length of time during which the felt and paper web are in contact with each other. The relatively dry felt thus provides a continuous efficient blotting action on the web during the period of contact, and in particular, a much more efficient blotting action at the press nip and in the area immediately preceding the press nip.

The reason why a felt without the customary minimum wetness may be used is evident. The suction applied continuously to the felt is transmitted to the web, holding it onto the felt and against both the pull of the Fourdrinier wire on the web, and the high centrifugal force experienced by the web. Further, by incorporating all three boxes into a single roll, there is an elimination of any open draw area which the felt and web must traverse. As indicated above, conventional machines which use a separate guide or turning roll experience the danger of separation of the web and felt in the open areas between the rolls, and felt wetness in these presses was the only way in which adherence of the felt and web could be insured.

The present invention provides a further advantage, namely, that the vacuum in the suction boxes of the first press roll may be advantageously varied. In a conventional machine, a vacuum of 16 inches of mercury is generally maintained in the vacuum pickup box so as to firmly adhere the sheets to the bottom side of the felt, thereby further insuring against separation of the felt and paper web. This high vacuum has a tendency, first, to draw water out of the Fourdrinier wire into the felt, decreasing the efficiency of the press, and further to draw

pulp fines into the felt, thereby lessening the effective felt life and decreasing the quality of the paper. For instance, in the formation of writings and printings, the presence of these fines and difficulty in cleaning the felt may cause the latter to last for as little as from a week to twelve days running time. In the present invention, where adherence of the web to the felt is not a problem, a vacuum as low as 7 inches of mercury may be used in the pickup suction box, sufficiently low to significantly obviate the above disadvantages.

The following table indicates the improved results obtainable using the concepts of the present invention. The conventional machine used in comparison is the semi-stacked press described in the introductory portions of this specification, namely, one using a supplementary guide roll or turning roll. The turning roll is provided with a suction gland similar to the turning suction box used in the present invention, and actually has an effective area greater than that of the present invention. Such a machine is described in the Hornbostel et al. Patent No. 2,869,437, granted January 20, 1959.

The pulp used in both instances was compounded to form a 27 pound sheet composed of approximately 70% ground wood and 30% chemical pulp.

Table 1

	New Press Design			Conventional Press Design		
	Pressure, lbs./in. width at Press Nip	Dryness	Vacuum, in. of Hg	Pressure, lbs./in. width at Press Nip	Dryness	Vacuum, in. of Hg
Pickup area		18%	7		18%	12
Turning area			7			5
1st Press nip	150	34-35% (cold web)	7	150	27-28% (hot web)	15
2nd Press nip	250	38-39.2% (cold web)	8	250	32-33% (hot web)	10
3rd Press nip	325	41-42.7% (cold web) / 43.5-45% (hot web)	11	350	35-37% (hot web)	15

The principal variables involved, other than press structures and methods, are stock freeness, pressures at the press nips, speed of the press, and vacuum applied at the nips. As indicated, the nip pressures used in the present system differed only slightly from those used in the conventional machines and actually less pressure was used in the present machine at the 3rd press nip. The vacuum used in the present system was, except for the turning area, consistently less. Running speed for the machines in both instances ranged from 1600 to 1800 feet per minute. Actually, the present machine has been run at speeds up to 2500 feet per minute, with a drop in dryness of less than 1%. It should also be noted that the results were obtained using a cold web on the present machine, as compared to a heated web on the conventional machine, and it is well known that improved dryness is obtained by heating the web. The results clearly indicate that an improved press efficiency is obtained using the concepts of the present invention.

As a modification of the invention, the structural members designated in FIGURE 5 by the numerals **43** and **52** which form the intermediate or turning suction box may be eliminated forming a single continuous vacuum chamber between and inclusive of the pickup and first press areas and area intermediate thereof. A roll so constructed has been run using a vacuum of 7 inches of mercury, and the results obtained were substantially the same as those outlined in Table 1. The results also seem to indicate that as long as the vacuum applied at the pickup area is maintained up to and through the first press nip, the particular vacuum applied, as long as it is equal to at least 7 inches of mercury, is immaterial, and a higher vacuum affords no improvement, and possibly, a greater loss of fines from the web.

FIGURE 6 illustrates a compartmented drainage pan or save-all **64** designed to catch the increased amount of water discharged from the shell of the press roll. Basically, it comprises a number of baffles **66***a*, *b*, *c*, *d*, and *e* so positioned that portions of the water discharged from different points about the circumference of the roll are directed to a multiple number of drainage ducts **68***a*, *b*, and *c*. In this way, the bulk of the water is prevented from flowing into a single drainage area and backing up against the surface roll, thereby rewetting it.

The first baffle **66***a* is positioned primarly to prevent spray discharged from the top of the roll and impinging on the rear of the pan from being reflected back to the surface of the roll. The baffle **66***b* directs the initial high discharge to a portion of the pan most removed from the roll, and into a duct **68***a*, as shown. Baffle **66***c* and *e* function in a manner similar to that of baffle **66***b*, directing the water discharge to a particular area of the save-all, while baffle **66***d* functions in a manner similar to that of first baffle **66***a*, to deflect sprays away from the surface of the roll. The baffles **66***a* and **66***d* thus constitute a first plurality of baffles adapted to deflect water thrown from the roll **10** into the save-all **64**, and the baffles **66***b*, **66***c*, and **66***e* constitute a second plurality of baffles adapted to collect water deflected by the first plurality of baffles and channel the water to the water-draining means **68***a*, **68***b*, and **68***c*. An air jet or air knife **69** is added and directed at the surface of the roll at an angle of about 20° thereto, blowing the remaining water on the surface of the shell into the third drainage area and duct **68***c*. In addition, the air jet acts as a siphon and actually, draws out of the shell holes any excess water left therein. In this embodiment, the pressure maintained in the air knife is about 3 to 5 pounds per square inch, and the air is forced through about a .010 inch opening at a speed of about 4000 f.p.m.

FIGURE 7 illustrates an improved means **70** for cleaning and dewatering the felts. Conventional felt cleaning and dewatering apparatus generally comprises a plain flat suction box over which the felt is passed, although the suction box may be positioned in a suction roll to reduce wear on the felt. Even here, however, the felt traveling at a high speed over the surface of the vacuum boxes or rolls causes a considerable amount of wear on the felt shortening its life, particularly if an effective vacuum is used. The present invention contemplates using two novel turning and felt cleaning or dewatering devices **70**, of the type illustrated in FIGURE 7, each adapted to turn the felt at an angle of 90°, the two to be used in place of a turning roll such as the roll **72** illustrated in FIGURE 2. Basically, the device comprises two turning bars **74** whose length equals the width of the felt. Each bar is supported by a side **76** of a pressurized air chamber enclosure **78** in the manner shown, the pressure in the chamber being maintained at about 5 to 10 pounds per square inch. The paper side or outer side of the felt is directed towards a catch pan **80**, the latter having retaining bars **82** positioned at each side thereof in the manner shown. The air pressure within the air chamber **78** facilitates the formation of a fluid-cushioned bend in the felt; i.e., it causes the felt to be forced in a direction towards the catch pan **80** and away from the turning bars **74**, as shown in phantom

lines, thereby reducing friction and wear on the turning bars **74** and the felt itself. The centrifugal force and air pressure result in an effective removal or ejection of water from each part of the felt on each pass of the felt through the felt cleaner.

FIGURE 2 illustrates a modified form of the invention adapted particularly for use with a wet end machine or former of a type illustrated in application Serial No. 311,278, filed September 16, 1963, by David E. Robinson. In this application, a former is presented which eliminates the conventional couch roll and results in an 18–20% dryness in the horizontal portion of the wire. With such a former, it is possible to position the pickup and first suction press roll **10** on top of the Fourdrinier wire in the area of horizontal travel of the wire, and before the end roll **18**. This permits the felt **16** to be guided so as to approach the pickup area at an increased angle relative to the nip of the roll, thereby enabling a larger save-all pan **64** to be positioned in the throw-out area thereof. In fact, the pan in this embodiment encompasses from 200 to 240° circumference of the roll, as compared to about 180° for the embodiment shown in FIGURE 6. It is thus apparent that an even more efficient collection and removal of water from the shell of the roll can be accomplished by this embodiment. It might be noted that there is an insignificant or minimum lessening of efficiency in removal of water from the paper web. The removal of water from the paper does not in general seem to be significantly dependent upon the area through which the vacuum is applied, as long as a minimum area is used.

In summary, the present invention provides a novel pickup and first press roll which itself affords an improved efficiency in the removal of water from the paper web. In addition, the novel first press roll permits the use of a much dryer first press felt thereby further contributing to the efficiency of water removal. To obtain the now desired dry felt a novel and improved device for conditioning the felt is provided. Also, to remove the greater amount of water withdrawn from the paper web, a novel and improved catch or save-all pan is provided.

A principal, but incidental advantage that is obtained from the novel press roll is an improved felt life, effected primarily by the ability to use a lesser pickup vacuum. However, the unique felt conditioning device also has the additional function of contributing to felt life.

I claim:

1. A Fourdrinier machine machine press section comprising a suction press roll having a foraminous circumferential surface, a press felt which has a water-removal side and a web-carrying side and which is trained about said roll with said water-removal side in contact with said surface, a Fourdrinier wire mounted adjacent to said press felt for carrying a web of paper, a pickup suction chamber mounted within said roll for transferring said web from said Fourdrinier wire to said felt, a second suction chamber mounted within said roll spaced circumferentially around said roll apart from said pickup chamber, a third suction chamber mounted within said roll contiguously to and intermediate said pickup and second chambers, said chambers being positioned to apply a suction to said felt along a portion of said surface coextensive with said felt along an arc of at least 120°, means for maintaining in said pickup chamber a vacuum within the range of seven to twelve inches of mercury, a save-all mounted adjacent to said roll and extending circumferentially around the surface of said roll through an arc substantially equal to 360° less said arc of at least 120°, said arcs covering mutually exclusive portions of said surface and said save-all including a first plurality of baffles, a second plurality of baffles, and water-draining means, said first plurality of baffles being positioned to deflect water thrown from said roll and into said save-all towards said second plurality of baffles and said second plurality of baffles being positioned to collect water deflected by said first plurality of baffles and channel the water to said water-draining means, said roll being rotatable in a given direction, and an air knife mounted within said save-all adjacent to said roll and having an elongated opening of a width substantially equal to the width of the roll, said air knife being positioned to direct a jet of air at said surface at an angle of about 20° with respect thereto and in a direction generally opposed to said direction of rotation.

2. In a Fourdrinier machine press section comprising a suction press roll having a foraminous circumferential surface, a press felt which has a water-removal side and a web-carrying side and which is trained about said roll with said water-removal side in contact with said surface, a Fourdrinier wire mounted adjacent to said press felt for carrying a web of paper, a pickup suction chamber mounted within said roll for transferring said web from said Fourdrinier wire to said felt, a second suction chamber mounted within said roll spaced circumferentially around said roll apart from said pickup chamber, a third suction chamber mounted within said roll contiguously to and intermediate said pickup and second chambers, said chambers being positioned to apply a suction to said felt along a portion of said surface coextensive with said felt along an arc of more than 120°, means for maintaining in said pickup chamber a vacuum within the range of seven to twelve inches of mercury, and a save-all mounted adjacent to said roll and extending circumferentially around the surface of said roll through an arc substantially equal to 360° less said arc of more than 120°, said arcs covering mutually exclusive portions of said surface, the improvement wherein said save-all comprises a first plurality of baffles, a second plurality of baffles, and water-draining means, said first plurality of baffles being positioned to deflect water thrown from said roll and into said save-all towards said second plurality of baffles and said second plurality of baffles being positioned to collect water deflected by the first plurality of baffles and channel the water to said water-draining means.

3. In a Fourdrinier machine press section as defined in claim **2**, the further improvement in which the baffles of said second plurality of baffles are interspersed among the baffles of said first plurality of baffles.

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