July 30, 1940. E. E. BERRY 2,209,761

PROCESS AND APPARATUS FOR DRYING WEBS

Filed May 31, 1938

Fig. 1

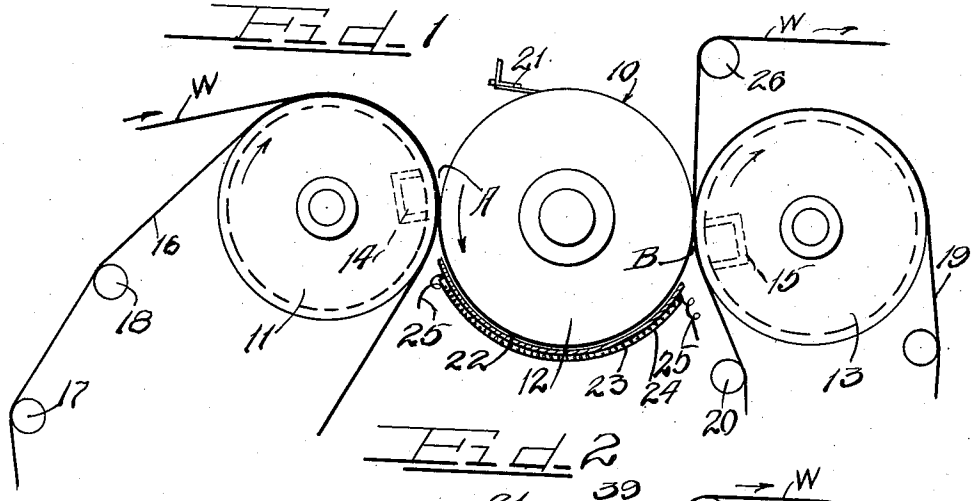


Fig. 2

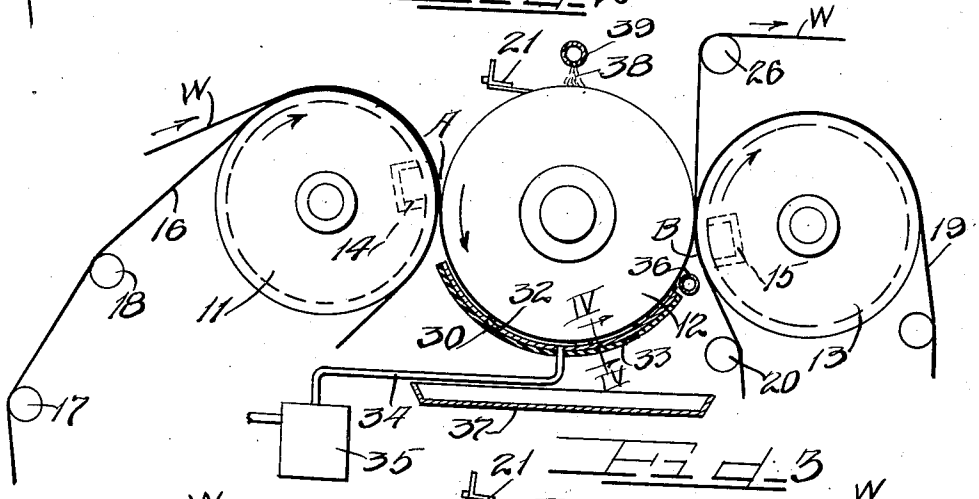


Fig. 3

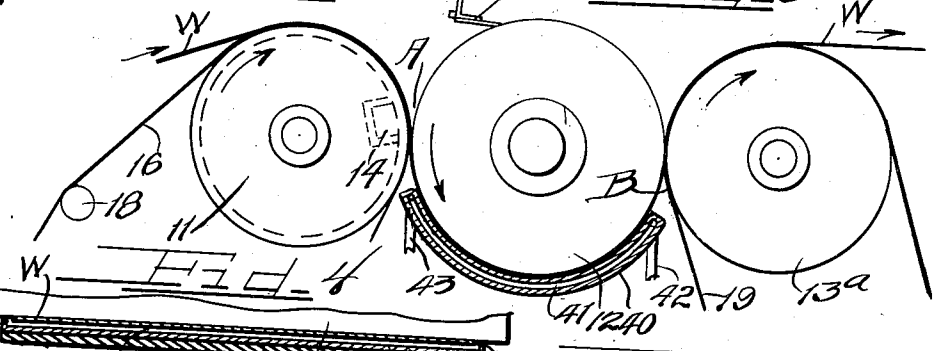


Fig. 4

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PROCESS AND APPARATUS FOR DRYING WEBS

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9 Claims. (Cl. 92—49)

This invention relates to the dewatering of wet fibrous webs by suction, heat and pressure.

More specifically this invention relates to the heating of a fibrous web passing through a press roll assembly to reduce the viscosity of the water in the web for facilitating its removal from the web.

It has heretofore been proposed to pass a fibrous web around a heated press roll for assisting the dewatering of the web. Such practice, however, is not satisfactory because the wet web sticks to the heated roll surface and is damaged upon being pulled from the heated surface.

In accordance with this invention, the rolls of a press roll assembly are unheated but the web passing through the assembly is heated by means of an element not forming part of the roll structure.

According to this invention, one or more members, such as plates, pans or shoes extend partially around one or more of the rolls of a press roll assembly in spaced relation from the rolls. The member is heated by steam, electricity, gas or any other heating means so as to radiate heat into the web passing through the assembly. In one embodiment of the invention, the member defines, with the press roll, a passageway for steam, hot air or other heating fluid to heat a wet web passing around the roll. The roll surface itself is unheated and may even be kept cool by a water spray applied thereto after the web has been removed therefrom.

This invention is especially well adapted for cooperation with the middle roll of press roll assemblies including three horizontally aligned rolls, and will be hereinafter specifically described in connection with such press roll assemblies. It should be understood, however, that the heating means of this invention are adapted for use in other types of roll assemblies.

It is, then, an object of this invention to reduce the viscosity of liquids in wet, fibrous webs without damaging the webs.

A further object of this invention is to heat a paper web passing through a press roll assembly without heating the rolls of the assembly so as to cause the web to stick to the rolls.

A further object of this invention is to radiate heat into paper webs passing through a press roll assembly from an exposed surface of the web.

Another object of the invention is to direct a heating fluid against a wet paper web passing through a press roll assembly for reducing the viscosity of water in the web.

Other and further objects of the invention will become apparent to those skilled in the art from the following detailed description of the annexed sheet of drawings which discloses several embodiments of the invention.

On the drawing:

Figure 1 is a diagrammatic side elevational view of a horizontal press roll assembly equipped with an electrically heated shoe, according to this invention, for heating a web of paper passing through the assembly.

Figure 2 is a diagrammatic side elevational view of a horizontal press roll assembly equipped with a shoe mounted under the middle roll of the assembly according to this invention, to define a passageway for a heating fluid adjacent a web passing around the middle roll.

Figure 3 is a diagrammatic side elevational view of a horizontal press roll assembly including a hollow pan, according to this invention, mounted under the middle roll of the assembly to heat a web passing around the middle roll.

Figure 4 is a broken vertical cross-sectional view taken along the line IV—IV of Figure 1.

As shown on the drawing:

In Figure 1 the reference numeral 10 designates generally a horizontal press roll assembly comprising a first suction roll 11, a plain middle roll 12 and an end suction roll 13. The rolls 11 and 13 are urged against the middle roll 12 to define a downward passage pressure nip A and an upward passage pressure nip B for a web of paper W. The suction roll 11 has a suction head 14 defining a localized suction area at the nip A and extending above the nip as shown. Likewise the suction roll 13 has a suction head 15 defining a localized suction area at the nip B and extending beneath the nip.

A felt 16 is trained around the suction roll 11 and around guide rolls 17 and 18 so as to meet the incoming web W for conveying the same over the top of the roll 11 and through the nip A. After the web passes through the nip A it travels around the under side of the middle roll 12 and up through the nip B where it meets a felt 19 trained around the roll 13. The felt 19 is directed against the localized suction area provided by the suction head 15 before it contacts the web W by a guide roll 20. In this manner water can be removed from the felt before it contacts the web.

A scraper 21 can be mounted at the top of the middle roll 12 for cleaning the surface of the roll and for removing films of water carried thereon to prevent the water from entering the nip A.

In accordance with this invention a metal shoe

22 is mounted around the bottom portion of the middle roller 12 so as to be as close as practical to the web W traveling thereon without contacting the web. The shoe 22 is of segmental cylindrical shape so as to conform with the contour of the roll 12. The shoe 22 is heated by means of electric heating coils such as 23 extending therebeneath and insulated from the atmosphere by means of a layer of insulation 24. The coils 23 can be heated from current supplied through wires 25.

The coils 23 heat the metal plate 22 so as to radiate heat into the wet web W passing around the roll 10. This heating of the web will occur inwardly from the exposed surface thereof and thus will not cause the web to stick to the roll 12. The heated web then passes upwardly through the nip B and because the water in the web is heated, it is more readily extracted from the web by the suction and pressure treatment at the nip B due to its reduced viscosity condition.

The higher fluidity of the water makes possible a greater removal of water from the web so that the web W emerging from the nip B is in a drier condition than has heretofore been possible by press roll treatment. The web W passes upwardly from the nip B over a guide roll 26 as shown in Figure 1.

The plate 22 need not be heated so as to cause evaporation of water in the web W. It is only necessary that the water in the web be heated to increase its fluidity.

In Figure 2 and in Figure 4 parts identical with parts described in Figure 1 have been marked with the same reference numerals.

In Figure 2 a segmental cylindrical shoe 30 is mounted around the lower portion of the middle roll 12. As best shown in Figure 4, the shoe 30 is somewhat wider than the width of the web W passing around the roll 12 and is turned up at its sides as at 31 so as to define a passageway 32 around the web W on the under side of the roll 12.

The bottom face of the shoe 30 can have a layer of insulation material 33 thereon to decrease heat radiation from the passageway 32.

A drain pipe 34 communicates with the passageway 32 preferably at the lowermost level thereof and is connected with a steam trap 35.

A perforated steam pipe 36 is mounted adjacent the roll 12 at the web discharge end of the passageway 32 to supply live steam into the passageway. This live steam directly contacts the web W on the roll 12 to heat the water in the web. Condensate can be removed from the passageway 32 through the drain pipe 34.

A drip pan 37 is mounted beneath the shoe 32 to collect condensate bleeding from the passageway.

It has been found that any small amounts of moisture imparted to the web by the live steam contact is greatly offset by the ease in removing the heated water from the web at the nip B. The steam feed from the pipe 36 can be adjusted to flow steam through the entire passageway 32 and to have a small overflow of steam out of the web inlet end of the passageway.

The middle roll 12 can be cooled by a spray of water 38 from a shower pipe 39 mounted above the top of the roll. The scraper 21 prevents this water from entering the nip A.

In operation the web W may be fed directly from its forming surface onto the felt 16. The felt 16 conveys the web W around the roll 11 and through the nip A. The felt is then removed from the web and the web follows around the middle roll 12 through the passageway 32 where it is heated by steam flowing through the passageway in a countercurrent direction to the direction of travel of the web. The heated web then passes upwardly through the nip B where the heated water is removed by the action of suction and pressure.

Instead of feeding live steam to the passageway 32, hot air or other heating fluid may be used.

In Figure 3 parts identical with parts described in Figures 1 and 2 have been marked with the same reference numerals. In Figure 3, however, the end roll of the assembly is a plain press roll 13a.

In Figure 3, a segmental cylindrical hollow pan 40 is mounted under the roll 12 in as close relation to the roll as possible without contacting the web W thereon. The pan 40 has a chamber 41 therein for receiving a heating fluid from a feed pipe 42. The exhausted heating fluid is removed from the chamber 41 through an outlet pipe 43.

Steam, hot water, hot oil or other heating fluid can be fed through the chamber 41.

In the operation of the apparatus shown in Figure 3 the web W is conveyed through the nip A on the felt 16 for the removal of water from the web by suction and pressure. Upon leaving the nip A the web is conveyed on the middle roll 12 over the heated surface of the pan 40 where it is heated by radiation from the pan. The heated web then passes upwardly through the nip B into contact with the felt 19 where the heated water is removed from the web by pressure.

From the above descriptions it should be understood that this invention provides for the heating of webs passing through press roll assemblies to reduce the viscosity of water in the webs. The heating is effected by radiation or by direct contact with a heating fluid. Heated passageways are provided through which the web passes while held tightly on a revolving roll. Since the web is heated inwardly from its exposed surface, the roll conveying the web does not become heated to temperatures higher than the web temperature and will not cause the web to stick thereon.

The reducing of the viscosity of water in wet webs before the same pass through the final nip of a press roll assembly makes possible the extraction of more water from webs than was heretofore obtainable by pressure and/or suction treatment.

I am aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim as my invention:

1. A press roll assembly for dewatering wet paper webs which comprises three horizontally aligned rolls in peripheral pressure relation, the middle roll of said rolls adapted to have a wet web of paper lapped around the under side thereof, a segmental cylindrical shoe mounted under said roll in closely spaced relation therefrom to define a passageway beneath a web carried by the rolls, means for introducing live steam to said passageway against the web, means for removing condensate from the passageway, and said middle roll including means associated with the outside thereof keeping the roll in substan-

tially cool running condition to eliminate sticking of the web thereon.

2. The method of dewatering a wet paper web which comprises lapping a wet paper web around a roll, condensing live steam into the lapped web to heat the water therein, squeezing the web to express condensate and additional water therefrom before removal of the web from the roll, and maintaining the roll in a substantially unheated condition to eliminate sticking of the web thereon.

3. A press roll assembly for dewatering wet paper webs which comprises a plurality of unheated rolls in peripheral pressure relation defining a water extracting pressure nip therebetween, means for lapping a wet web of paper around one of said rolls before the web enters said nip, heating means outside of said roll having the web lapped thereon adjacent said web for successively heating localized portions of the web to supply a heated web to the nip, means for removing the web from said roll on which it was lapped after passage through said nip, and means for cooling said roll before it recontacts another portion of said web.

4. A press roll assembly for dewatering wet paper webs which comprises a plurality of press rolls in peripheral pressure relation defining a water extracting pressure nip therebetween, means for lapping a wet web of paper around one of said rolls to travel thereon into said nip, means outside of said press rolls positioned ahead of said nip for injecting live steam into the lapped web on said roll for reducing viscosity of liquids in the wet web to supply a heated web to the nip, and said roll having the web lapped thereon including means associated therewith to maintain the roll surface in cool running condition to eliminate sticking of the web thereon.

5. A press roll assembly comprising three horizontally aligned rolls in peripheral pressure relation defining a pair of water extracting pressure nips, the middle roll of said rolls having a smooth continuous peripheral surface carrying a wet web of paper lapped around the under side of the roll as it passes between the pair of pressure nips, a pan mounted under said middle roll having side walls extending upward into close proximity to the roll for defining an open ended passageway around the bottom portion of the roll receiving the wet web lapped on the roll therethrough, means for injecting live steam against said web traveling through said passageway between the pair of nips to supply a heated web to the second nip, a drain line communicating with the bottom portion of said pan for removing steam condensate therefrom, and means for maintaining the peripheral surface of the middle roll in a cool condition to eliminate sticking of the wet web to the roll.

6. A press roll assembly comprising three horizontally aligned rolls in peripheral pressure relation defining a pair of vertical water extracting pressure nips, the middle roll of said rolls having a smooth continuous peripheral surface, means for feeding a wet web of paper downwardly through the first nip for travel on the underside of the middle roll upwardly through the second nip to extract liquid from the web and to lap the web tightly on the smooth continuous surface of the middle roll, means mounted under the pressure nips adjacent the middle roll to condense live steam into the web lapped on the middle roll, and means for maintaining the smooth continuous surface of the middle roll in an unheated condition to eliminate sticking of the web to the roll.

7. The method of dewatering a wet paper web which comprises cooling the peripheral surface of a press roll, lapping a wet paper web around said cooled peripheral surface, condensing live steam into the lapped web to heat the water therein, squeezing the web against the roll to express condensate and additional water therefrom, removing the web from the roll, recooling the peripheral surface of the roll after the web has been removed therefrom, and recontacting the cooled peripheral surface of the roll with another portion of the web.

8. The method of dewatering a wet web of paper which comprises passing a newly formed wet paper web at normal forming temperatures into a press roll assembly, lapping the web around a continuous surfaced press roll in said assembly, condensing live steam into the lapped web to heat the water in the web, conveying the steam treated web on said roll through a pressure nip to extract the heated water therefrom, and maintaining the continuous surfaced press roll in a substantially unheated condition.

9. The method of dewatering wet paper webs which comprises lapping a wet web of paper around a press roll, injecting live steam into a local portion of the exposed surface of the lapped web on the roll while maintaining the roll surface in a substantially unheated condition for heating the water in the web only, and immediately thereafter pressing the web on the roll to extract the heated water therefrom.

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