June 22, 1965 L. A. MOORE 3,190,212

GLOSS CALENDER

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Fig. 1

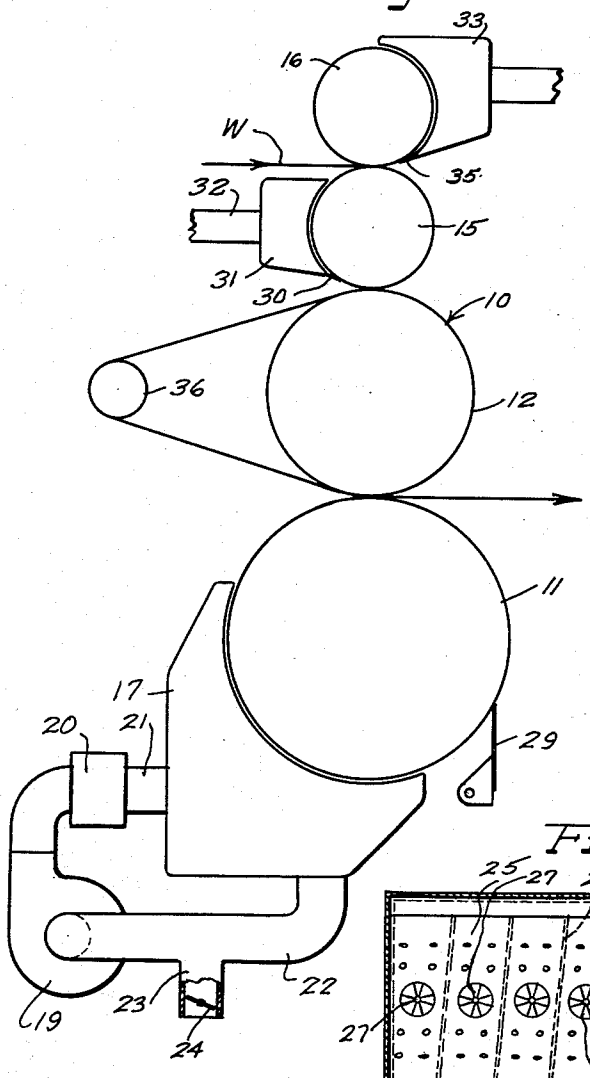
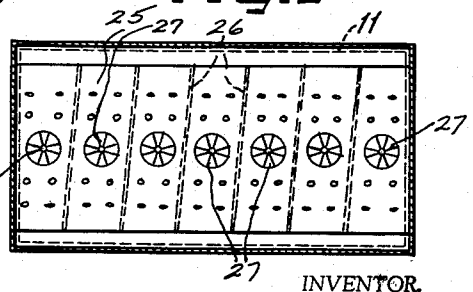


Fig. 2



INVENTOR.

Lawrence Augustus Moore

BY

Hill, Sherman, Meroni, Gross & Simpson

ATTORNEYS

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3,190,212

GLOSS CALENDER

Lawrence Augustus Moore, Beloit, Wis., assignor to Beloit Corporation, Beloit, Wis., a corporation of Wisconsin

Continuation of application Ser. No. 156,258, Dec. 1, 1961. This application May 27, 1963, Ser. No. 283,514
9 Claims. (Cl. 100—38)

This application is a continuation of my copending application Serial No. 156,258, filed December 1, 1961, now abandoned.

A principal object of the invention is to improve upon the calendering of paper webs by providing improved means for heating certain of the rolls of a gloss calender.

Another and important object of the invention is to provide a new and improved method and apparatus for increasing the speed of calendering by heating the finishing roll more rapidly and at higher temperatures than has heretofore been possible.

Another object of the invention is to provide an improved form of means for heating certain of the rolls of a gloss calender by impinging heated air along the surfaces of certain of the rolls and controlling the application of heated air to the rolls to selected zones across the width of the rolls to increase the speed of calendering and to maintain predetermined profiles of the rolls for caliper control.

Still another object of the invention is to improve upon the calendering of paper webs by heating the finishing and pressure rolls of the calender to higher temperatures than formerly and zoning the distribution of heat over the surfaces of the rolls.

Still another object of the invention is to improve upon the calendering of paper webs by providing an improved means for more rapidly heating the surfaces of certain of the rolls of a calender stack, readily adaptable to various conventional calenders with little or no substantial modification in construction of the calenders.

The calender herein shown is conventionally used to calender uncoated paper as it leaves the drier of a paper making machine, but may also calender sized printing grades of paper or board grades of paper, and by the heating system of the present invention, the calender rolls may be heated more rapidly and at much higher temperatures than formerly, and the application of heat to the rolls may be zoned to maintain the rolls to the required profile for caliper control.

These and other objects of the invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

FIGURE 1 is a diagrammatic view of a gloss calender stack constructed in accordance with the principles of the present invention; and

FIGURE 2 is a diagrammatic view of an air distribution and heating hood, illustrating the manner in which the heated air may be zoned along the surface of a roll of a calender stack.

In the embodiment of the invention illustrated in FIGURE 1 of the drawings, I have shown a calendar stack **10** for finishing a web of paper W, which may be uncoated paper or plasticized coated paper, in which finishing or glossing is attained by the process of pressing the fibers of the web to the web, and in effect ironing the web as it leaves the drier.

As diagrammatically shown in FIGURE 1 of the drawings, the calender includes a lower large diameter finishing roll **11**, commonly called a king roll. Spaced above the roll **11** and in nip defining relation with respect thereto is a roll **12** which may have a resilient face, made from rubber or any other material, providing a hard but resilient surface.

The finishing roll **11** is a driven roll and may be driven from a suitable source of power in a conventional manner (not shown) and may have a plated surface, plated with chrome or nickel, to provide a highly polished surface for glossing treatment. The rubber faced roll **12** is driven by contact with the web W and the finishing roll **11**, although it may be positively driven, if desired.

In diametrical alignment with the rolls **11** and **12** are two pressure rolls **15** and **16** driven by contact with the web and the roll **12**. The rolls **15** and **16** may be also hard surfaced rolls and may be made from cast iron or any other suitable material, and serve to level out the web and thereby control the caliper of the web. The pressure rolls **15** and **16** may be loaded hydraulically or pneumatically in a conventional manner, to hold the exacting nip pressures, which pressures may be controlled automatically in accordance with the condition of the web being run, in a conventional manner.

In conventional calenders, the finishing roll has been heated internally by steam to temperatures high enough to bring the outer surface of the roll substantially to the temperature of the boiling point of water. Where the roll is heated by steam, the temperature to which the outer surface of the roll may be heated is limited principally by limitations in thickness of the finishing roll, the face of which must be thick enough to withstand the heavy pressure of calendering.

It has been found, however, that the finishing roll **11** may advantageously be heated to far higher temperatures than the boiling point of water and that a better calendering effect is attained at these temperatures, by impinging heated air directly on the finishing roll. This increases the speed of calendering and not only improves the finishing of the paper, but the distribution of heat along the surface of the roll may be controlled to maintain the roll to the required profile, with the resultant better caliper control of the paper.

In accordance with the principles of the present invention, I am able to attain these temperatures with a reduced heating time by the use of a drier hood **17** wrapped partially about the periphery of the finishing roll **11**, and impinging air heated to high temperatures directly on the surface of said finishing roll.

As for example, for a wrap of a drier hood of substantially 156° about the finishing roll **11**, and the impingement of air at a temperature of 600° F. on the surface of the finishing roll **11**, the temperature of the surface of the finishing roll may be maintained at 450° F.

The wrap required to maintain the temperature of the surface of the finishing roll **11** at 400° F. with air at a temperature of 600° is substantially 108°, while the wrap required to maintain the temperature of the finishing roll **11** at 350° with an air temperature within the hood of 600° is substantially 76°.

In FIGURE 1, I have diagrammatically shown a fan **19** forcing air through a heater **20** into the hood **17** through an intake duct **21**. The fan **19** may withdraw spent air from the surface of the finishing roll **11** and recirculate the air through an exhaust duct **22**. Fresh air may also be drawn into the fan **19** through an intake duct **23** under the control of a damper **24**.

The hood or "air cap" may be of a type similar to that shown and described in application Serial No. 152,836, filed by Edgar J. Justus and Lawrence A. Moore on November 16, 1961 and entitled "Drier Hood Construction" and assigned to the assignee of the present application. The drier hood is diagrammatically shown in FIGURE 2 as generally having a perforate bottom **25** and having helical baffles **26** dividing said bottom into zones or individual plenum chambers into which air may be forced by the fan **19** and discharged through the per-

forate bottom **25**, under the control of air inlet valves **27**, leading to each individual zone.

The air inlet valves **27** may thus control the distribution of air across the surface of the finishing roll and by regulating the distribution of the air across the surface of the finishing roll, the contour of the roll may be maintained to a required contour.

The finishing roll **11** is also shown as having the usual doctor blade **29** mounted on the outrunning side of the nip between the rolls **11** and **12** to keep the finishing roll clean. The top pressure roll **15** has a doctor blade **30** mounted at its outrunning side to keep the roll clean and to prevent the web W from running up said roll. The doctor blade **30** is shown as extending from a drier hood **31**, wrapped partially about the roll **15**, for heating the surface of said roll by the impingement of heated air thereonto, in a manner similar to which the surface of the roll **11** is heated. The drier hood **31** may be constructed on principles similar to the drier hood **17** and may be zoned across the width thereof, to enable the distribution of heated air across the width of the roll **15** to be controlled, to give the required profile to the roll **15** for caliper control. The drier hood **31** has an intake duct **32** which may be supplied with heated air under pressure in the same manner the intake duct **21** of the drier hood **17** is supplied with heated air under pressure.

The top pressure roll **16** is also shown as having a drier hood **33** partially wrapped thereabout, which may be zoned like the drier hoods **17** and **31**, not only to heat the pressure roll **16**, but also to give said pressure roll the proper profile for caliper control. A doctor blade **35** extends from the drier hood **33** to the surface of the roll **16**, at the outgoing side of the nip between the rolls **15** and **16**, to keep the roll **16** clean and to prevent the paper web from running up roll **16**.

The web W thus passes through the nip between the pressure rolls **15** and **16**, which serve to level off the paper web to the proper thickness.

The web W is then wrapped partially about the roll **15** and passes in the nip between the rolls **12** and **15** around a direction changing idler **36** spaced laterally of the roll **12**. The web then changes its direction about said idler and passes in the nip between the rolls **11** and **12**, which serves to finish the web to the required gloss by ironing the web as it passes through the nip between said rolls.

It may be seen from the foregoing that a new method of calendering paper webs has been provided by more rapidly heating the rolls of a calender stack to higher temperatures than formerly by impinging air over a substantial area thereof, which not only makes it possible to heat the surfaces of the rolls to much higher temperatures than formerly and thus facilitate the calendering operation, but which also makes it possible to distribute the heat to the rolls in zones along the widths of the rolls, to maintain the rolls to the proper profile and to thus attain a better caliper control of the web, with a resultant more uniformly finished product, with less waste than formerly.

It may further be seen that the heating means may be adapted for various types of calenders and makes it possible to reduce the cost and speed of calendering and at the same time to provide a more accurate caliper control of the web and a better final product.

While I have herein shown and described one form in which my invention may be embodied, it may readily be understood that various variations and modifications in the invention may be attained without departing from the spirit and scope of the novel concepts thereof.

I claim as my invention:

1. A method of calendering an uncoated paper web as it leaves the drier of a paper making machine, comprising the passing of the web through the nips of a series of pressure rolls and through the nip between a backing roll and a finishing roll of a calender stack, and heating the surface of the finishing roll to a temperature greater than the boiling point of water and at the incoming side of the nip between the finishing roll and the backing roll by impinging heated air on the surface of the finishing roll over a substantial area thereof.

2. A method of calendering an uncoated paper web as it leaves the drier of a paper making machine, comprising the passing of the web through the nips of a series of pressure rolls and through the nip between a backing roll and a finishing roll of a calender stack and impinging air heated to a temperature of at least 600° on the surface of a finishing roll for substantially the width thereof and along a circumferential area thereof of at least 75° and thereby heating the surface of the finishing roll to a temperature in the order of 350° F.

3. A method of calendering an uncoated paper web as it leaves the drier of a paper making machine, comprising the passing of the web through the nips of a series of pressure rolls and through the nip between a backing roll and a finishing roll of a calender stack, wrapping a drier hood about the finishing roll at the incoming side of the nip between the finishing roll and the backing roll along a circumferential surface of the finishing roll of at least 75° and for substantially the full width of the finishing roll, and impinging air through the drier hood along the finishing roll for the entire extent of wrap of the hood thereabout at a temperature in the order of 600° and thereby heating the surface of the finishing roll to a temperature in the order of 350°.

4. A method of calendering an uncoated paper web as it passes the drier of a paper making machine comprising the passing of the web through the nips of a series of pressure rolls and through the nip between a backing roll and a finishing roll of a calender stack, heating the surfaces of the pressure rolls at the incoming sides of the nips therebetween to temperatures substantially greater than the boiling point of water by impinging heated air thereon over a substantial area thereof, and heating the surface of the finishing roll at the incoming side of the nip between the finishing roll and the backing roll to a temperature substantially greater than the boiling point of water by impinging heated air on the surface of the finishing roll over a substantial area thereof.

5. A method of calendering an uncoated paper web as it leaves the drier of a paper making machine in accordance with claim **4** in which drier hoods are partially wrapped about the pressure rolls at the incoming side of the nips therebetween and a drier hood is partially wrapped about the finishing roll at the incoming side of the nip between the finishing roll and the backing roll, wherein the hoods are wrapped about the finishing and pressure rolls for at least 75° and wherein the hoods impinge air heated to a temperature substantially 600° on the finishing roll and pressure rolls for substantially the areas covered by said hoods and thereby heat the surfaces of the finishing roll and pressure rolls to temperatures in the order of 350°.

6. A calender comprising a bottom finishing roll having a hard finishing surface, a vertically spaced backing roll having a resilient surface in nip defining relation with respect to said finishing roll, pressure rolls above said backing roll in nip defining relation with respect to said backing roll, and in nip defining relation with respect to each other, means guiding a paper web to pass between the nips defined by said pressure rolls and said backing roll and finishing roll, and means for heating the surface of said finishing roll to a temperature above the boiling point of water to thereby increase the speed of calendering, comprising a hood extending for the width of said finishing roll and having an air impingement surface partially wrapped about said finishing roll on the incoming side of the nip between said finishing roll and said backing roll for at least 60° and extending for substantially the width of said finishing roll, a blower forcing heated air through said hood and thereby impinging

heated air through said air impingement surface directly on the surface of said finishing roll over a substantial area of the roll.

7. A calender comprising a bottom finishing roll having a hard finishing surface, a vertically spaced backing roll in nip defining relation with respect to said finishing roll, pressure rolls above said backing roll in nip defining relation with respect to said backing roll and in nip defining relation with respect to each other, and means for increasing the speed of the calender operation comprising means for heating the surface of said finishing roll over a substantial area thereof to a temperature above the boiling point of water, comprising a drier hood having an air impingement surface wrapped about said finishing roll on the incoming side of the nip between said finishing roll and said backing roll for at least 60° and extending the width of said finishing roll, a blower and a connection from said blower to said hood, forcing heated air through said hood and out through said air impingement surface directly on the surface of said finishing roll, said drier hood being zoned to enable the distribution of heated air across the width of said finishing roll to be controlled over a substantial area of the roll and to thereby control the profile of said finishing roll.

8. A calender comprising a bottom finishing roll having a hard finishing surface, a vertically spaced backing roll having a resilient surface in nip defining relation with respect to said hard finishing surface of said finishing roll, pressure rolls above said backing roll in nip defining relation with respect to said backing roll and in nip defining relation with respect to each other, means guiding a paper web to pass between the nips defined by said pressure rolls and said backing roll and finishing roll, and means for increasing the speed of calendering and thereby facilitating the calendering operation comprising a drier hood having an air impingement surface extending for the width of said finishing roll and about said finishing roll on the incoming side of the nip between said finishing roll and said backing roll for at least

75°, means supplying heated air at a temperature on the order of 600° F., and a blower having communication with said hood and forcing heated air from said air supplying means through said air impingement surface onto the surface of said finishing roll for the full area of said air impingement surface.

9. In a calender stack, a lower finishing roll having a hard finishing surface, a backing roll in nip defining relation with respect to said finishing roll, a pair of top pressure rolls in nip defining relation with respect to each other, the lowermost of said pressure rolls being in nip defining relation with respect to said backing roll, and means for increasing the speed of calendering and thereby facilitating the calendering operation comprising a dryer hood extending substantially the width of one of said pressure rolls and having an air impingement surface wrapped about said roll and extending about said roll for a substantial area, means for forcing the heated air through said air impingement surface onto said pressure roll, and a second dryer hood having an air impingement surface wrapped partially about said finishing roll on the incoming side of the nip between said finishing roll and backing roll and means for supplying the air heated to a temperature of at least 600° and forcing air through said air impingement surface onto the surface of said finishing roll and thereby heating the surface of said finishing roll to a temperature greater than the boiling point of water.

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WALTER A. SCHEEL, *Primary Examiner.*