April 21, 1959 C. FOSCUE ET AL 2,882,969

SILENCING MEANS FOR PAPER MACHINE SUCTION ROLLS

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Fig. 1.

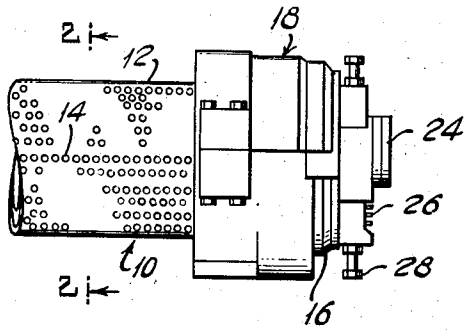
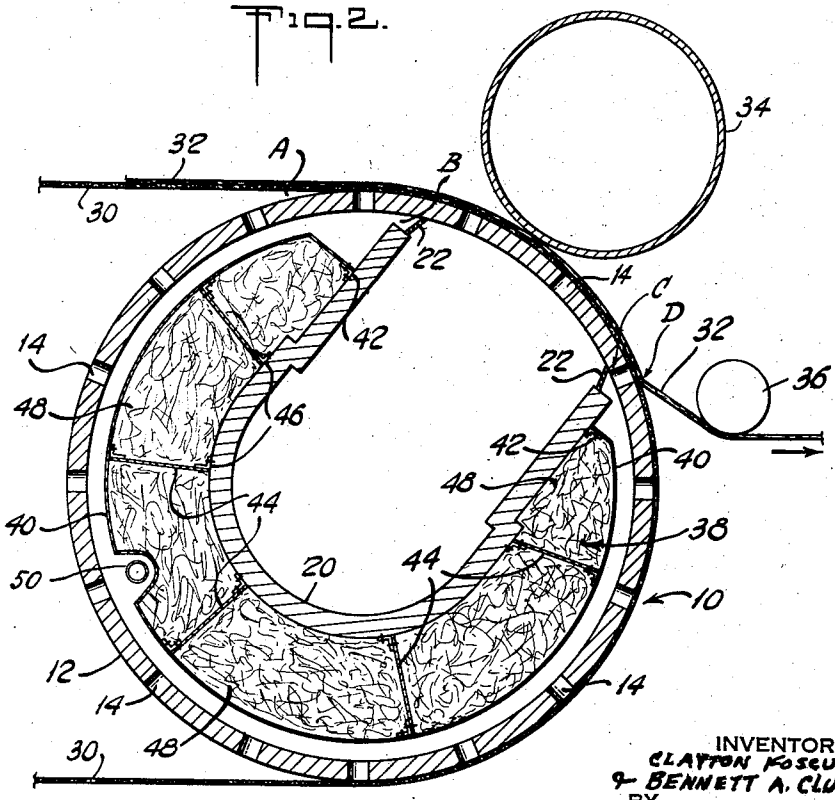


Fig. 2.



INVENTORS
CLAYTON FOSCUE
& BENNETT A. CLUBBS
BY
John J. McGlew
ATTORNEY

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SILENCING MEANS FOR PAPER MACHINE SUCTION ROLLS

Clayton Foscue, Pine Bluff, Ark., and Bennett A. Clubbs, Bastrop, La., assignors to International Paper Company, New York, N.Y., a corporation of New York

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4 Claims. (Cl. 162—369)

This invention relates to new and useful improvements in suction rolls for papermaking machines and particularly seeks to provide a novel internal construction for such rolls that will effect a substantial reduction of the noise generated as the result of their operation.

Many studies have clearly indicated that in the machine rooms of paper mills having modern high-speed equipment it is not uncommon for the over-all noise level to exceed 100 decibels. Suction couch and suction press rolls have been found to be sources of high intensity objectionable noises.

Through the use of suction rolls which are constructed in accordance with this invention a substantial reduction in noise level is obtained by virtually eliminating the noise build-up due to resonance of the air space within the roll shell. This resonance occurs at speeds which are critical to this condition and by minimizing the volume of the air-filled void between the interior of the shell and the exterior of the suction box, the additional noise which normally occurs at the critical speeds is eliminated. This resonant condition at critical speeds could range in magnitude from a few decibels to as much as 20 decibels, depending on the suction roll installation. A suction roll may have as many as six or eight critical speeds within its normal range of operating speeds.

Therefore an object of this invention is to provide a novel construction for paper machine suction couch and suction press rolls that operate at a substantially reduced noise level without any lessening of their abilities to remove water from the wet web or board passing thereover.

Another object of this invention is to provide a suction roll of the character stated in which the noise reduction is obtained as the result of substantially decreasing the volume of the air-filled void between the interior of the shell and the exterior of the suction box.

A further object of this invention is to provide a suction roll of the character stated which includes a rotary perforated shell, a suction box stationarily held within the shell and having sealing or packing strips in contact with the inner surface thereof, and an imperforate generally cylindrical blister or jacket affixed to the suction box with the major portion of its outer surface concentric with but slightly spaced from the inner surface of the shell.

With these and other objects in view, the nature of which will be more apparent, the invention will be more fully understood by reference to the drawings, the accompanying detailed description and the appended claims.

In the drawings,

Fig. 1 is a side elevation of one end of a suction couch roll incorporated in a Fourdrinier machine and constructed in accordance with this invention; and

Fig. 2 is a vertical transverse section taken on the line 2—2 of Fig. 1.

Referring to the drawings in detail, the invention as embodied therein comprises a suction couch roll assembly generally designated 10 and includes a cylindrical shell 12 having a plurality of perforations 14 therein. The shell 12 is journalled in bearing mounts, one of which 16 is shown. The bearing mount 16 is associated with power drive connections (not shown) for rotating the shell 12 which are contained in a housing generally indicated at 18. A generally U-shaped suction box or manifold 20 is arranged inside the shell 12, coextensive therewith, and held in a stationary position with the open end directed upward at a slight angle from the vertical into proximity with the shell 12 from which it is separated by pairs of packing strips 22 effective to form a tight seal between the manifold and the rotating shell. One end of the manifold 20 is closed by a plate (not shown) and the other end is connected to a vacuum pump (not shown) through a pipe or flexible coupling 24. The manifold 20 is resiliently supported on compression springs 26, the compressive force of which is adjustable through the medium of an adjusting screw 28.

A wire 30 of the Fourdrinier machine on which the suction couch roll 10 is employed feeds in a direction towards the couch roll 10 at the top thereof and thence around the roll and away from the roll at the bottom. The wire 30 carries on its top side wet stock which forms into a web of paper 32 and is delivered on top of the wire between the couch roll 10 and a lump-breaker roll 34 and thence over a portion of the couch shell 12 above the open end of the manifold 20.

Fluids are drawn from the wet paper web 32 through the perforations 14 on the shell 12 by the vacuum in the manifold 20 generated by the vacuum pump. The web of paper 32 is then lifted from the wire 30 and passed beneath a blow roll 36 to the press section of the Fourdrinier machine.

It has been determined that during the operation of couch rolls there are four principal points, designated A, B, C and D (see Fig. 2), in the vicinity of the shell 12 which cause pressure variations on the air entering and leaving the cavity formed between the manifold 20 and the inside surface of the shell. These pressure variations are in accordance with the number of perforations 14 passing each point per second. Point A is the point where the wire and wet paper web 32 come in contact with the couch roll 10. Since the outside surface of the roll closes rapidly with the bottom surface of the wire, air is forced into the air cavity at this point as each axial row of perforations 14 comes into contact with the wire 30. Thus pressure pulses are set up in the cavity which have a frequency equal to the number of rows of perforations passing that point per second.

Point B is the intersection of the leading lip on the manifold 20 adjacent the packing strips 22 and the inside surface of the shell 12. Here the air which has been close to the inside surface of the shell finds a pocket and undergoes a certain amount of shock each time a row of perforations passes by. This shock is transmitted back to the greater air mass of the cavity and thereby offers a second source of vibrations in the air cavity which have a frequency equal to the number of rows of perforations passing that point per second.

Point C is the intersection of the trailing lip on the manifold 20 and the inside surface of the shell 12. The air inside each perforation as it passes over the lip of the manifold returns to atmospheric pressure by drawing air from inside the cavity formed between the manifold 20 and the shell 12. This causes pulses in this cavity equal to the number of rows of perforations passing the trailing lip of the manifold per second.

Point D is the point where the paper web 32 leaves the couch roll 10. As the paper leaves the outside surface of the roll it causes a flow of air from inside the roll to the outside and pulses equal to the number of rows of perforations passing that point per second.

Thus the air in the cavity between the manifold 20 and the inside surface of the shell 12 is under constant vibration, being energized at the same frequency from four different sources, A, B, C and D, producing pressure vibrations of the same frequency, but not neces-

sarily in phase, on the air inside the cavity as a resultant effect. These pressure vibrations would normally produce a complete or substantially complete standing sound wave inside the cavity formed between the manifold and the inside surface of the shell. In cases where the space from the outer surface of the manifold **20** to the inner surface of the shell **12** is sufficiently great to permit a complete standing sound wave to form, besides this fundamental sound wave additional harmonic waves of the same sound can also be maintained in this space. Upon rotation of the couch roll the perforations **14** become instantaneously aligned with the sound waves thus formed so that the waves are projected through the perforations and into the outside free air. In the frequency ranges encountered in the operation of the couch roll **10** it has been found that the sound waves generated have an antinode equal in length to less than that of the distance between the outside surface of the manifold **20** and the inside surface of the shell **12**. Thus with the previous constructions of couch rolls, since an antinode of the fundamental sound wave can exist inside the cavity, a great number of shorter length harmonic waves can also exist therein.

In accordance with this invention the distance between the inside surface of the shell **12** and the outside surface of the manifold **10** is substantially reduced with a consequent minimizing of the volume of the air-filled void between the two surfaces.

When this invention is to be used in connection with existing suction rolls a major portion of the space inside the couch roll **10** between the outer surface of the manifold **20** and the inside of the shell **12** has been filled by a jacket or blister construction generally indicated at **38** which is effective to substantially reduce the noises created by operation of the couch roll. The construction **38** includes a curved outer sheet metal plate **40** which is coextensive in length with the manifold **20** and extends substantially completely around the latter in spaced relation thereto with its outer surface concentric with but spaced about 1" or so from the inside of the shell **12**. The plate is secured to the manifold by means of angle irons and screws **42** affixed at each end thereof, and is divided into compartments by radial brace plates **44** which extend between the outer sheet metal plate **40** and the manifold **20** and are secured to each as by angle irons and screws **46**. The compartments thus formed are filled with a fibrous material **48** or other material preferably having sound-deadening properties. A pipe **50** is located within and is coextensive with the length of the shell **12** and is provided with perforations thereon and connected to a water supply to produce a water shower at this location within the shell in the usual manner.

The jacket **38** by reducing the distance from the outside surface of the manifold to the shell **12** to as little as 1" is effective to substantially eliminate any possibility for complete fundamental sound waves to form in the cavity at the objectionable operating frequencies encountered. The half wave lengths of any sound waves encountered in frequencies up to 3300 are more than 2" and cannot form inside the cavity. Thus with the jacket **38** formed in accordance with this invention standing waves of objectionable frequencies cannot exist in the cavity so that noise emanating therefrom to the outside is substantially eliminated and the general operating noise level of the couch roll operation is substantially reduced by at least 7 to 10 decibels from an original overall noise level on the order of 100 decibels.

When this invention is to be used in connection with the fabrication of new suction rolls it may be desirable to modify the construction of the suction box in such a manner as to provide it along its full length with a wall portion having the major portion of its outer surface concentric with but slightly spaced from the inner surface of the rotary shell.

Thus the invention provides a suction box or manifold construction which may be easily installed on commercial types of suction rolls without substantial alteration or great expense and without in any way affecting the normal operation of the suction roll, but resulting in a substantial lessening of the noise of operation thereof.

It is, of course, to be understood that various details or arrangements and proportions of parts may be modified within the scope of the appended claims.

We claim:

1. In a Fourdrinier paper making machine which includes a suction roll having a continuously rotatable cylindrical shell which is perforated from inside to outside with a multiplicity of holes, a suction box arranged inside said shell with closed and open portions, said open portion having edges extending lengthwise of and into close proximity with said shell and means to reduce the pressure in said suction box and through said holes at said open portion, and in combination, a generally cylindrical element surrounding said closed portion and extending substantially lengthwise of said suction box, said element having an external surface substantially concentric with said outer shell and spaced from said shell a distance which is less than one half the wave length of sound waves produced by the movement of said holes relative to said suction box at operating speeds of rotation of the shell and which is sufficiently great to avoid contact with said shell, thereby reducing the noise level of said suction roll at said operating speeds without increasing the rotative load produced on the shell by friction.

2. In the combination as set forth in claim 6, said generally cylindrical element comprising an imperforate jacket supported on said suction box by radially extending walls and having compartments formed by said walls and said shell filled with a sound deadening material.

3. In the combination as set forth in claim 6, sealing strips extending lengthwise of said edges of the open portion and between said edges and the inner surface of said shell.

4. In a Fourdrinier paper making machine which includes a suction couch roll and a Fourdrinier wire running over said couch roll, said suction couch roll having a continuously rotatable cylindrical shell which is perforated from inside to outside with a multiplicity of holes, a suction box arranged inside said shell with closed and open portions, said open portion having edges extending lengthwise of and into close proximity with said shell and means to reduce the pressure in said suction box and through said holes at said open portion, and in combination, a generally cylindrical element surrounding said closed portion and extending substantially lengthwise of said suction box, said element having an external surface substantially concentric with said outer shell and spaced from said shell a distance which is less than one half the wave length of sound waves produced by the movement of said holes relative to said suction box at operating speeds of rotation of the shell and which is sufficiently great to avoid contact with said shell, thereby reducing the noise level of said suction roll at said operating speeds without increasing the rotative load produced on the shell by friction.

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CERTIFICATE OF CORRECTION

Patent No. 2,882,969 April 21, 1959

Clayton Foscue et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, lines 31 and 36, for the claim reference numeral "6", each occurrence, read -- 1 --.

Signed and sealed this 13th day of October 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents