

March 3, 1942.

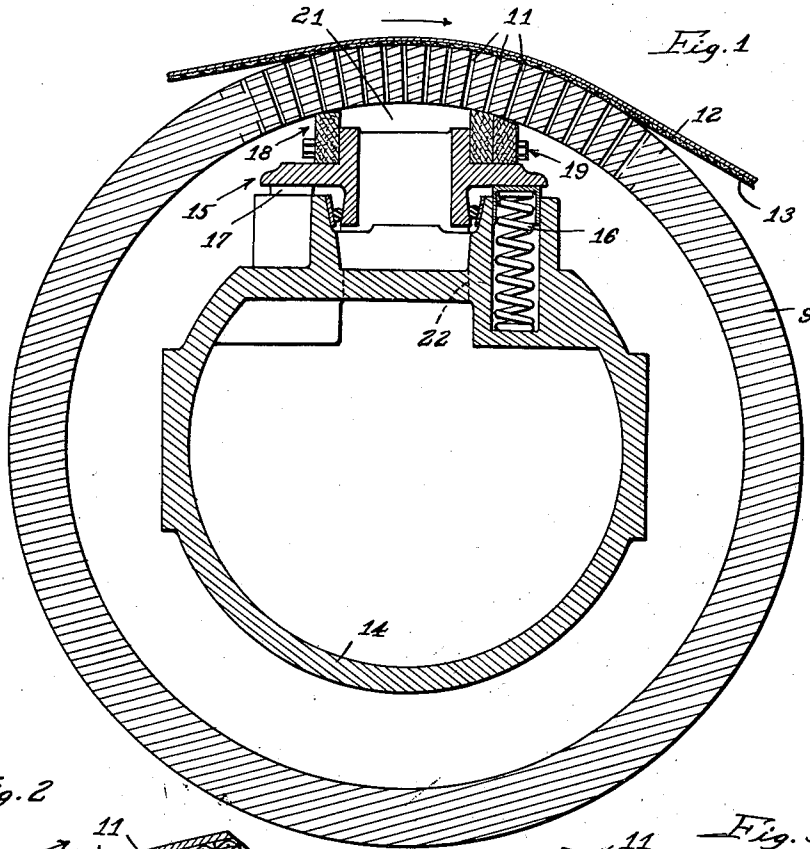
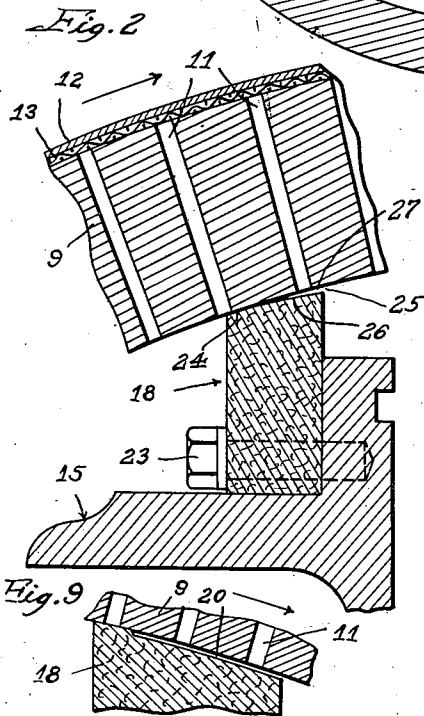
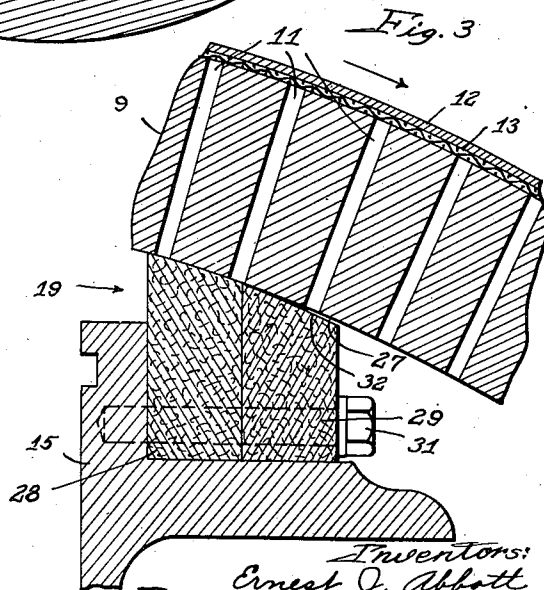
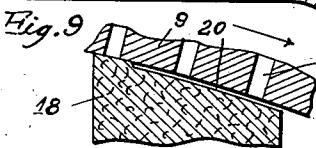
E. J. ABBOTT ET AL

2,274,641

SUCTION ROLL

Filed Feb. 7, 1938

2 Sheets-Sheet 1



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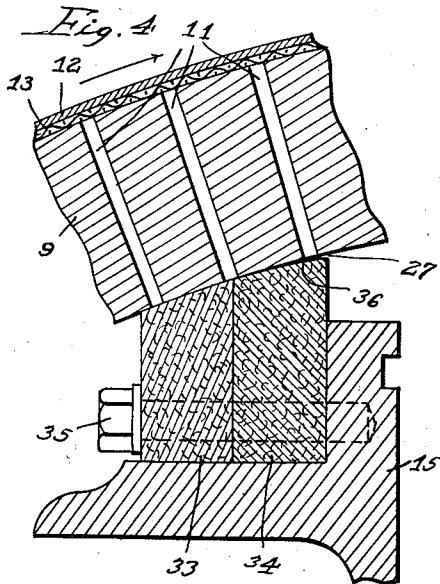
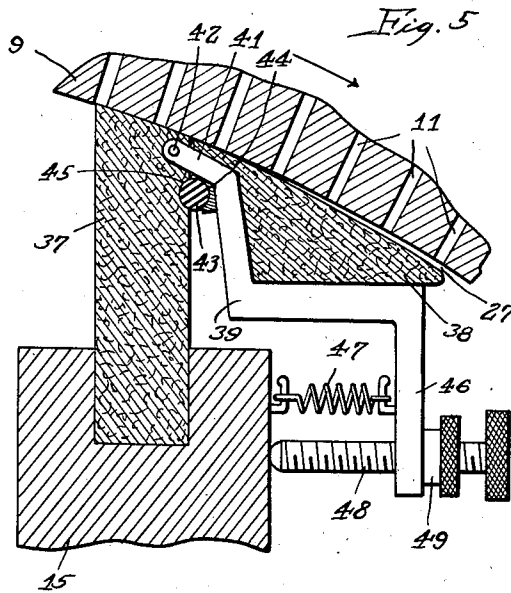
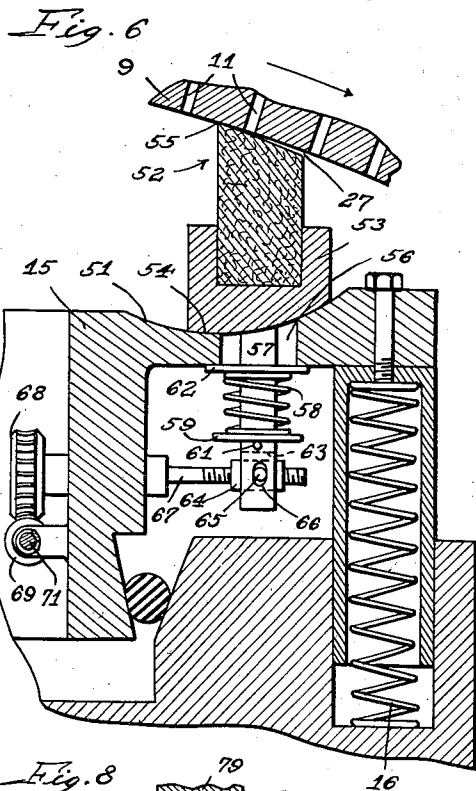
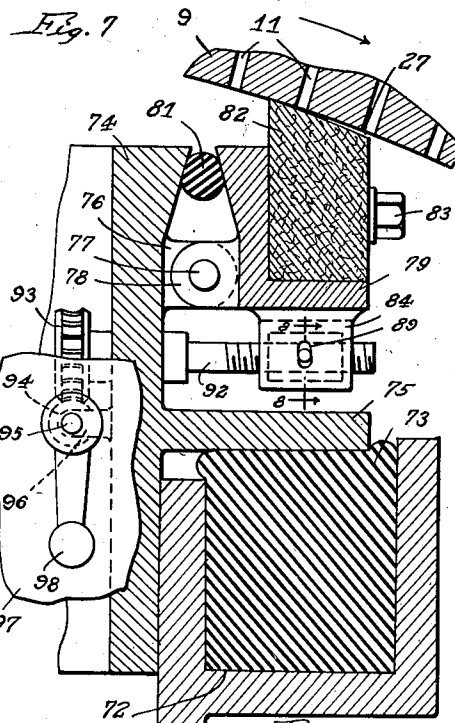
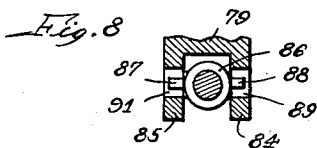
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SUCTION ROLL

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,274,641

SUCTION ROLL

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Application February 7, 1938, Serial No. 189,043

14 Claims. (Cl. 92—53)

This invention relates to suction rolls and has special reference to the combination therein of means for silencing the operation thereof and for eliminating the particularly offensive sound caused thereby.

The invention is directed to the problem of eliminating the noise or sound incidental to the operation of high speed modern suction rolls of the type in which the holes in the shell are frequently small in diameter and relatively long, the shell travels at high speed and relatively high vacuums are employed. In the development of the art, as the shells of the rolls have been made thicker, the speeds higher and the vacuum greater, the sound created by the rolls has become progressively more objectionable until at the present time the situation has become so aggravated as to interfere with the physical well being and the efficiency of the workmen. The pitch and character of the sound is such as to be particularly aggravating and the characteristic whine or siren type sound has now become familiar in the environment of paper mills and can be heard for a considerable distance around the mill.

We are aware that attempts have been made to accomplish a solution of the problem, notably by Berry, Hornbostel and Goodwillie, as shown in their Patent No. 2,107,812, over which this invention is an improvement. However, such attempts have not been entirely successful. While the devices therein shown are effective to eliminate the sound in substantial part, possibly to the extent of 90%, which may be a sufficient reduction in many cases, yet in aggravated cases there may still remain a material residue of sound sufficient to be highly aggravating.

The primary object of this invention is the provision of a suction roll construction wherein the sound caused by the movement of air with respect to the holes of the shell is substantially entirely eliminated, in most cases being reduced to less than 1% of the sound energy which would otherwise be produced, and to provide a simple, efficient and adjustable construction for accomplishing this result.

We have also aimed to provide a suction roll construction wherein the suction box packing is caused to control the flow of air between the holes of the shell and the atmosphere into which the holes open so as to prevent the production of sound.

Other objects and advantages will be apparent from the following description and the accompanying drawings, in which—

Figure 1 is a transverse section through a suction roll embodying our invention;

Fig. 2 is a fragmentary section similar to Figure 1 showing the packing and shell at the oncoming side of the suction chamber in substantially full size;

Fig. 3 is a fragmentary view similar to Figure 1 showing the parts at the offgoing side of the suction box in substantially full size;

Fig. 4 is a view similar to Fig. 2 showing a second strip adjacent the packing strip adapted to control the flow of air;

Fig. 5 is a view similar to Fig. 3 showing a modified form of silencing device;

Fig. 6 is a fragmentary section through a suction roll showing a construction in which the position of the packing strip may be adjusted to control the flow of air;

Fig. 7 is a fragmentary section through a suction roll showing a modified form of means for adjusting the packing;

Fig. 8 is a section on the line 8—8 of Fig. 7, and

Fig. 9 is a fragmentary section showing a wide packing strip.

Referring first to Figure 1, we have shown a portion of a suction roll embodying our invention. This consists of an outer shell 9 of conventional nature having the usual perforations or holes 11 for transmitting the vacuum through the shell to the paper stock 12 carried on the usual felt or wire 13 in contact with the outer surface of the roll in the usual manner. The shell moves in the direction indicated by the arrow in this as well as in the other views. The roll has a suction box 14 positioned within the shell which carries a packing holder 15. Spring members 16 and 17 on opposite sides of the packing holder urge the packing against the inner surface of the shell. The packing holder 15 carries two packings 18 and 19 adjacent opposite sides thereof defining a vacuum chamber 21 extending longitudinally of the roll. The chamber 21 communicates with the interior of the suction box 14 through a plurality of ports 22 spaced longitudinally of the suction box. The parts described represent a substantially conventional suction roll construction commonly used in combination with suitable high capacity vacuum pumps arranged to maintain a relatively high vacuum within the suction box 14 and the chamber 21.

The sound generated by a roll of this type is produced by pressure waves generated when a volume of air is suddenly placed in communication with another volume of air at different pressure. Such discontinuities of pressure occur, we

have found, at two points—first, when holes containing air at atmospheric pressure come into communication with the suction chamber 21 as the holes pass over the inner edge of the packing 18, and second, when the holes containing air at the suction box pressure come into communication with atmospheric pressure as they pass over the outer edge of the packing 19. Usually, the latter discontinuity is more important in producing sound externally to the machine, but we have found that when this is properly quieted, the source at the oncoming side of the suction box becomes important and that both must be treated in order to obtain the substantially complete elimination of the sound. According to our invention, quieting of the roll is achieved by providing a gradual change of pressure during the interval that the holes are coming into and out of registration with the suction chamber so that by the time they have reached the edge of the packing, the pressure in the holes has reached that of the volume of air with which the holes then communicate. We have found that this method effectively reduces the sound at its source, and measurements have shown that by this means the sound energy emitted by the roll can be reduced by more than 99%, or in other words, to less than 1% of its original value.

The gradual changes of pressure for quieting operation of the roll may be provided either by modifying the shape of the packing itself or providing auxiliary means adjacent the packing for accomplishing this purpose, and in either case the means for accomplishing the purpose may be fixed or adjustable to suit conditions or the desires of the operator. In Figs. 1 to 3, inclusive, we have shown a non-adjustable form. As will be seen from Fig. 2, the packing 18 at the oncoming side of the suction chamber 21 is fixedly secured in the holder 15 by means of cap screws 23. The outer surface of the packing 18, which may be any of a number of materials well known in the prior art, such, for example, as wood or "micarta," is not shaped to conform with the inner surface of the shell 9 as in conventional practice, but instead is formed so that the outer or oncoming corner 24 thereof abuts against the inner surface of the shell and the inner corner is spaced from the surface of the shell as shown at 25, the outer surface of the strip sloping toward the shell as shown at 26 to provide a tapering space between the inner surface of the shell and the outer surface of the packing strip, converging toward the outer corner of the strip. This provides a wedge-shaped air space forming a vent or graduated restriction 27 which communicates at its larger end with the volume into which the holes 11 are about to come into communication, in this instance the suction chamber 21. The angle of convergence between the sides of this space and the width of the space theoretically depends upon a number of factors such as the difference in pressure between the holes and the volume into which they break, the size of the holes and the speed of the machine, but in practice it is possible to make the width of the space sufficiently great and the angle sufficiently small to care for most variations in these factors. It is furthermore not essential that the space be tapered or graduated, but it may be a slot of uniform cross-section as shown at 20 in Fig. 9 if the distance between the inner surface of the shell and the opposed surface of the slot together with the width of the slot be

properly balanced with respect to the size of the shell holes, the speed of the shell and other factors. This slot may be in the form of a long slot extending longitudinally of the packing, or in the form of grooves extending inward from the offgoing side of the packing spaced longitudinally of the packing so as to be in registration with each row of holes in the shell.

Referring now to Fig. 3, it will be seen that this same principle has been applied to the offgoing side of the suction box. In this instance the packing 19 consists of two strips 28 and 29 of suitable packing material (though they can as well be made of a single strip properly formed) secured to the packing holder by cap screws 31. The strip 28 conforms to the inner surface of the shell throughout the entire width of its upper edge while the strip 29 is relieved or gradually recedes therefrom as shown at 32 to provide the restriction 27 heretofore described. Through this construction the seal formed in the conventional way by the packing strip 28 is undisturbed and functions throughout the width of the strip.

This in effect constitutes merely a wider or thicker packing strip but may be of slightly greater convenience because of being formed from two independent strips 28 and 29.

For example, in one physical embodiment of the invention the packing strips were made in accordance with Figs. 3 and 4 with the exception that the strips 28 and 29 were formed as a single piece, and the strips 33 and 34 were a single piece. Each of the strips were 2" thick which gave an arc approximately $2\frac{1}{4}$ " long. $\frac{3}{4}$ " of this distance conformed with the shell contour, while the remainder was tapered to give an opening of $\frac{1}{2}$ " at the offgoing edge. The roll was a 30" diameter roll of $2\frac{1}{2}$ " shell thickness, and the holes were $\frac{1}{8}$ " in diameter. The vacuum was about 18" of mercury, and the speed of the felt was about 1500 feet per minute.

As shown in Fig. 4, the packing strip at the oncoming side of the suction box may be formed in the same manner as that shown in Fig. 3 at the offgoing side by providing a packing formed of two strips 33 and 34 secured to the holder by means of cap screws 35, the upper edge of the packing 33 conforming through its width with the inner surface of the shell 9, and the strip 34 diverging therefrom as shown at 36 to provide the vent passage 27.

Referring now to Fig. 5, we have therein shown a modified form of the invention wherein an auxiliary element or lip is provided adjacent the packing, and means are provided for adjusting the angle of divergence between the inner surface of the shell and the surface of the lip to bring about optimum silencing conditions and to compensate for wear on the packing strip. In this form of the invention the packing strip 37 is in contact with the inner surface of the shell throughout the entire width of its upper edge and carries an adjustable lip 38. The lip 38 is carried on a plurality of brackets 39 having fingers 41 seated in the side of the strip and pivotally carried on a pin 42 extending longitudinally of the strip 37. The brackets 39 are spaced longitudinally of the strip 38 so as to provide suitable support. In the case of very short rolls, the brackets may be at the ends of the strip. Interposed between the lip 38 and the strip 37 is a rod 43 of resilient rubber seated in arcuate depressions 44 and 45 of the lip and strip for the purpose of sealing the junction between the lip and the strip. The lower ends of the brackets 39

have arms 46, and springs 47 are interposed between the packing holder 15 and the arms, tensioned to draw the arms inward. Bolts 48 having knurled heads are threaded into the arms 46 and serve to limit the inward movement of the arms so as to define the relative positions of the lip 38 and the inner surface of the shell, the bolts having lock nuts 49. This arrangement allows the thickness of the vent passage 27 to be adjusted for optimum silencing operation.

In Figs. 6 and 7 we have shown constructions wherein the angle of the packing strip may be adjusted with respect to the inner surface of the shell so as to bring about and maintain the proper vent passage. In Fig. 6 we have shown a construction in which the packing holder is altered somewhat from that shown in Figure 1 in that arcuate upper surfaces 51 are provided for the purpose of supporting the packing strips. In this case a packing strip 52 is carried in a base member 53 having an arcuate surface 54 complementary to the surface 51, the curvature of the arcuate surfaces being such that when the base member 53 is rotated in a plane parallel with Fig. 6, the inner corner 55 of the packing strip in contact with the inner surface of the shell will remain stationary and the thickness at the open end of the vent passage 27 will be varied. The packing holder has slots 56 for the passage of rods 57, the base 53 being held against its seat by springs 58 acting between the washers 59 seated against pins 61 in the rods 57 and washers 62 seated against the lower surface of the packing holder. The lower ends of the pins 57 are slotted as shown at 63 for the reception of nuts 64 pivotally supported therein by pins 65 seated in slots 66. Screws 67 are seated in the packing holder and received in the nuts 64 so that upon rotation the nuts will travel along the screws, thus moving the base member 53 along the arcuate seat 51 to tilt the packing strip. The screws 67 also carry worm gears 68 adapted to cooperate with worms 69 carried on and driven by a flexible shaft 71 whereby rotation of the shaft brings about tilting of the packing strip in the fashion described. The shaft 71 can be rotated from a point beyond the end of the suction box 14 in the manner which will be described in connection with Fig. 7. It will be seen that with this construction the character of the vent passage 27 may be varied to produce optimum silencing conditions by tilting of the packing strip without in any way disturbing the roll and from a point outside the roll, and while the roll is in operation.

In Fig. 7 we have shown a still further apparatus for supporting the packing strip to tilt the same in order to adjust the characteristics of the vent passage 27. While this view shows the construction in use at the offgoing side of the suction box, it will be apparent that this construction as well as that shown in Fig. 6 may likewise be employed at the oncoming side of the suction box. In this form the suction box has a channel 72 within which is carried a flexible rubber supporting member 73, the packing holder 74 having a laterally extending flange 75 seated on the top of the rubber support 73 so as to urge the holder upward and maintain the packing strips in contact with the inner surface of the shell. The packing holder also has a plurality of laterally extending ears 76 supporting pins 77 which in turn carry ears 78 of a packing strip base member 79. A seal 81 is provided between the packing strip base member 79 and the holder 74. In this instance a packing strip 82 is supported on the

base member by means of cap screws 83, the upper edge thereof normally diverging from the inner surface of the shell so as to provide the vent passage 27. The lower surface of the base member 79 has spaced ears 84 and 85 spaced longitudinally thereof between which is received a nut 86 having laterally extending pins 87 and 88 seated in slots 89 and 91 of the ears as shown in Fig. 8. The nuts 86 receive threaded rods 92 carried in the holder 74 in such manner that upon rotation of the rods the packing is tilted so as to vary the characteristics of the vent passage 27. The rods 92 carry worm gears 93 adapted to mesh with worms 94 carried on a flexible shaft 95 supported on the holder 74 by means of ears 96 and passing through the end 97 of the suction box, the flexible connection such as flexible shafting permitting relative movement between the end of the suction box and the shaft 95 whereby to permit of movement of the packing holder. A crank 98 is connected to the shaft externally of the suction box so that upon rotation of the crank the nuts 86 are moved longitudinally of the rods 92 and the packing tilted with respect to the inner surface of the shell, thereby varying the vent passage 27 to obtain optimum silencing conditions.

Attention is directed to the numerous and manifest advantages of the invention, most important of which is the fact that substantially complete quieting of the disturbing sound of the suction roll is obtained, the sound energy being reduced to 1% or less of that which would normally be produced by the roll. This may be accomplished if desired without adding additional parts of any kind to the suction roll, that is, by merely relieving the customary packing at the offgoing side of the packing either at the oncoming side of the suction box, the offgoing side of the suction box, or both. We have also shown means whereby the result may be accomplished without in any way changing the sealing properties of the conventional packing strip by increasing the thickness of the packing strip through the addition of a second strip parallel to and in contact with the conventional packing strip. We have also shown constructions whereby the silencing means may be adjusted from the exterior of the roll and while the roll is in operation in order to produce the optimum operation conditions. We have accomplished the substantial silencing of the roll by eliminating the sound at its source; in other words, by actually preventing the production of sound through preventing sudden discontinuities of pressure. The gradual changes of pressure necessary to quiet the operation of the roll may be provided by modifying the shape of the packing, by providing on the entering side of each packing strip a section whose shape conforms to that of the inner surface of the shell to form a bearing area between the packing and the shell and provide a suitable seal for the vacuum on the inside of the suction box. The remainder of the width of the packing is relieved or modified in such manner as to provide a vent passage, preferably a graduated restriction communicating at its larger end with the volume (either within the suction box or on the exterior thereof) on the leaving side of the packing. As the holes pass the packing strip, they are first sealed off from the pressure at the entering side, and then connected to the leaving side by means of a thin passage which greatly restricts the flow of air and thus prevents discontinuities of pressure with their attendant radiation. As the holes progress

across the packing strip, the resistance to the flow of air tending to equalize the pressure becomes less and less, due to both a shortening of the length of the path and to an increase in the width of the connecting passage so that when the holes break free of the packing strips, the pressure within the holes has reached substantial uniformity with that of the volume into which they come into communication.

This arrangement precludes any possibility of discontinuities in pressure, and measurements show that it is effective over a wide range of operating conditions. In many respects it is self-compensating for different factors. For example, an increase in pressure difference, increases the rate of flow, and thus tends to equalize the pressure in about the same time as with smaller pressures. Similarly, an increase in the volume of the holes, or of leakage into the holes through the felt or wire, increases the pressure within the hole at a given point of its passage past the packing, and this additional pressure affects the flow so as to offset the effect of the increased volume or leakage. If the speed of the roll is decreased, equilibrium of pressure is achieved before the holes have completed their passage across the packing, but as the time of transit is longer, the change of pressure still takes place at about the same rate. Measurements show that silencing lips of this type are effective over wide ranges of speed, vacuum, and shell dimensions.

Where in this application we refer to the packing strip as being of relatively inelastic material, we mean a material which is sufficiently hard and inelastic that it will not be distorted into the holes of the shell under the seating pressure applied to the packing strip or under the vacuum of the holes.

It will be understood that the specific embodiments herein shown are by way of illustration and not by way of limitation, and that we do not wish to be limited except as required by the prior art and the scope of the appended claims, in which—

We claim:

1. The combination in a suction roll of a perforate shell having a plurality of holes, a suction box for applying reduced pressure to said holes, a seal between the suction box and the inner surface of the shell defining areas of pressure change in said holes, means located at the areas of pressure change in the holes, positioned and shaped to provide a restricted passage of relatively great width with respect to thickness tapering continuously outwardly in the direction of travel of the shell for progressively effectuating equalization of pressure between the holes and the atmosphere into which the holes are approaching and dissipate the energy of the air entering said holes, and means for adjusting the taper of said passage.

2. The combination in a suction roll of a perforate shell, a suction box, spaced normally stationary packing strips of relatively inelastic material acting between the suction box and the inner surface of the shell defining a suction chamber, each of said packing strips having a portion at the oncoming side thereof in contact with the inner surface of the shell to form a seal, the packing diverging from said surface toward the offgoing side thereof to provide a slender tapering vent passage of relatively great width with respect to thickness for controlling

the flow of air with respect to the perforations and thereby prevent the production of sound.

3. The combination in a suction roll of a perforate shell, a suction box, a normally stationary packing of relatively inelastic material acting therebetween, said packing having a portion at the oncoming side thereof in contact with the inner surface of the shell to form a seal, the packing diverging from said surface toward the offgoing side thereof to provide a vent passage of relatively great width with respect to thickness for controlling the flow of air with respect to the perforations and thereby prevent the production of sound, and means for tilting the packing to vary the angle of said divergence.

4. The combination in a suction roll of a perforate shell, a suction box, a packing acting therebetween, said packing having a portion at the oncoming side thereof in contact with the inner surface of the shell to form a seal, the packing diverging from said surface toward the offgoing side thereof to provide a vent passage for controlling the flow of air with respect to the perforations and thereby prevent the production of sound, means for tilting the packing to vary the angle of said divergence, and means for actuating said tilting means from outside the roll while the shell is rotating.

5. The combination in a suction roll of a perforate shell, a suction box, a normally stationary packing acting between the suction box and the inner surface of the shell to form a seal, a silencing member attached adjacent to said packing and having sealed contact thereagainst, said member having a face opposed to the inner surface of said shell diverging from the shell to provide a graduated restriction of relatively great width with respect to thickness for the flow of air into the perforations to prevent the production of sound, and means for pivotally supporting said member for rotation toward and away from the shell to adjust the angle of divergence.

6. The combination in a suction roll of a perforate shell, a suction box, a normally stationary packing acting between the suction box and the inner surface of the shell to form a seal, a silencing member attached adjacent to said packing and having sealed contact thereagainst, said member having a face opposed to the inner surface of said shell diverging from the shell to provide a graduated restriction of relatively great width with respect to thickness for the flow of air, to prevent the production of sound, means for tilting the silencing member to vary the angle of said divergence, stop means for predetermining the position of said member, and spring means for maintaining said member against said stop means.

7. The combination in a suction roll of a perforate shell, a suction box, a packing acting between the suction box and the inner surface of the shell to form a seal, a silencing member pivotally attached adjacent to said packing and having sealed contact thereagainst, said member having a face opposed to the inner surface of said shell diverging from the shell at a small angle to provide a graduated restriction of relatively great width with respect to thickness for the flow of air to prevent the production of sound, and manually operable means for predetermining the pivotal position of said member to select an optimum sound eliminating angle of divergence therefor.

8. The combination in a suction roll of a perforate shell, a suction box, a packing holder on

the suction box, a normally stationary packing strip adapted to abut against the inner surface of the shell, said strip having a portion at the oncoming side thereof in contact with the inner surface of the shell to form a seal, the strip diverging from said surface toward the offgoing side thereof to provide a vent passage of gradually increasing thickness and of relatively great width with respect to thickness for restricting the initial flow of air to the perforations and thereby prevent the production of sound, means for supporting the packing strip on the packing holder, and means for adjusting the angular position of said last mentioned means with respect to said shell to vary the divergence of said strip from said surface to an optimum sound silencing position.

9. The combination in a suction roll of a perforate shell, a suction box, a packing holder having an arcuate seat, a normally stationary packing support having an arcuate surface complementary to said seat, a normally stationary packing in said support having an oncoming edge bearing against the inner surface of said shell to provide a seal, the packing diverging at a small angle from the inner surface of the shell toward the offgoing edge of the packing to provide a vent passage of relatively great width with respect to thickness for controlling the flow of air with respect to the perforations, and means for moving said support on said arcuate seat to adjust the position of the packing to vary the angle of divergence to an optimum silencing angle.

10. The combination in a suction roll of a perforate shell, a suction box, a packing holder having an arcuate seat, a packing support having an arcuate surface complementary to said seat, a packing in said support having an oncoming edge bearing against the inner surface of said shell to provide a seal, said arcuate seat and said surface being generated on an arc about the point of contact between the oncoming edge of said packing and the surface of said shell, the packing diverging from the inner surface of the shell toward the offgoing edge of the packing to provide a vent passage for controlling the flow of air with respect to the perforations, and means for moving said support on said arcuate seat to adjust the angularity of the packing and thereby vary the angle of divergence to an optimum silencing angle.

11. The combination in a suction roll of a perforate shell, a suction box, a packing holder having an arcuate seat, a packing support having an arcuate surface complementary to said seat, a normally stationary packing in said support having an oncoming edge bearing against the inner surface of said shell to provide a seal, the packing diverging at a small angle from the inner surface of the shell toward the offgoing edge of the packing to provide a restricted vent passage of relatively great width with respect to thickness for controlling the flow of air with respect

to the perforations, means for moving said support on said arcuate seat to tilt the packing and thereby vary the angle of divergence to an optimum silencing angle, and spring means for maintaining said packing support against said seat.

12. The combination in a suction roll of a perforate shell, a suction box, a packing holder having an arcuate seat, a packing support having an arcuate surface complementary to said seat, a packing in said support having an oncoming edge bearing against the inner surface of said shell to provide a seal, the packing diverging from the inner surface of the shell toward the offgoing edge of the packing to provide a vent passage for controlling the flow of air with respect to the perforations, means for moving said support on said arcuate seat to adjust the angularity of the packing and thereby vary the angle of divergence to an optimum silencing angle, a plurality of screws acting between said packing holder and said packing support for adjusting the angle of divergence between the packing and the shell, and means for actuating said screws from a point outside the suction roll.

13. The combination in a suction roll of a perforate shell, a suction box, a packing holder, a packing support, means for pivotally carrying said packing support on said packing holder, a packing in said support having an oncoming edge bearing against the inner surface of said shell to provide a seal, the packing diverging from the inner surface of the shell toward the offgoing edge of the packing to provide a vent passage of gradually increasing thickness in the direction of travel of said shell for controlling the flow of air with respect to the perforations, and means for rotating said support about said pivotal point to adjust the position of the packing and thereby vary the angle of divergence to an optimum silencing angle.

14. The combination in a suction roll of a perforate shell, a suction box, a packing holder, a packing support, means for pivotally carrying said packing support on said packing holder, a packing in said support having an oncoming edge bearing against the inner surface of said shell to provide a seal, the packing diverging from the inner surface of the shell toward the offgoing edge of the packing to provide a vent passage for controlling the flow of air with respect to the perforations, means for rotating said support about said pivotal point to adjust the angularity of the packing and thereby vary the angle of divergence to an optimum silencing angle, a plurality of screws acting between the packing holder and said packing support for adjusting the angle of divergence, and flexible shaft means extending to a stationary point outside the suction roll for turning said screws to adjust the angular position of the packing support.

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