June 26, 1951 W. D. MAURER ET AL 2,558,097

STEAM HEATING APPARATUS

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Fig. 1.

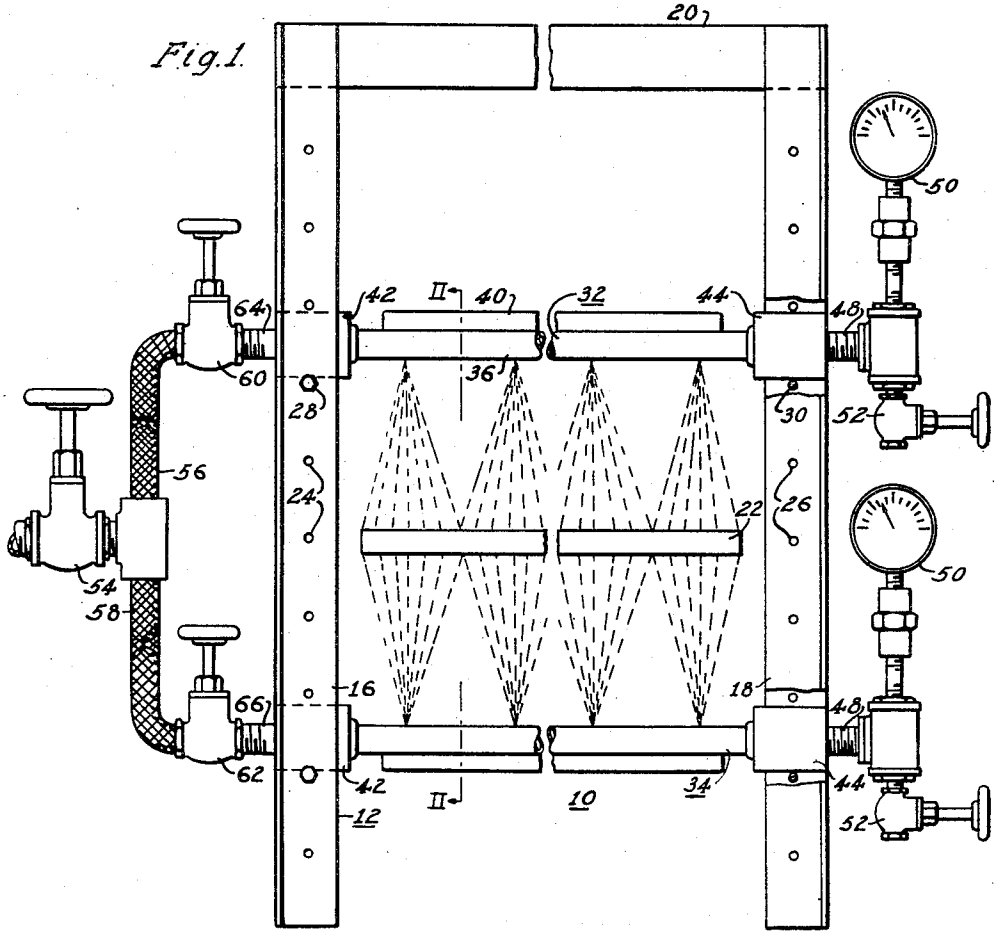


Fig. 2.

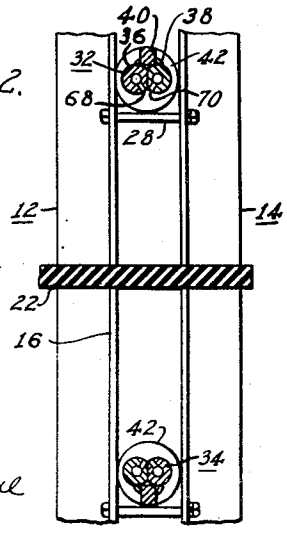
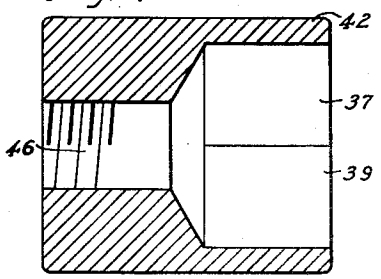


Fig. 3.



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STEAM HEATING APPARATUS

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This invention relates to apparatus for applying steam to strip material.

In the manufacture of impregnated fibrous material, such as paper, cloth, or the like, impregnated with a resinoid, it has been recently found that better impregnation is obtained by applying steam to the strip material immediately after the resin is applied to the strip. The steam apparently aids in the removal of solvent from the resin and opens the pores of the strip material to facilitate entry or impregnation thereof with the result that the time of producing impregnated strip material is greatly reduced.

In applying the steam to the strip material, preferably to both sides of the strip simultaneously, it has been found to be difficult to control the quality of the impregnated strip. This is primarily caused by inadequate apparatus for applying the steam to the strip with the result that an improper dispersion of the steam is obtained at the surface of the strip with accompanying condensation of moisture on the strip. Such deposited condensation causes spotting of the surface of the impregnated strip.

An object of this invention is to provide apparatus to facilitate the application of steam to strip material.

Another object of this invention is to provide apparatus for delivering an even dispersement of steam to strip material.

A further object of this invention is to provide apparatus for delivering an even dispersement of steam simultaneously to both sides of moving strip material.

A more specific object of this invention is to provide, in apparatus for delivering steam to strip material, means for adjusting the apparatus and controlling the delivery of the steam to effect an even dispersement thereof across the strip material.

Other objects of this invention will become apparent from the following description when taken in conjunction with the accompanying drawing, in which:

Figure 1 is a view in elevation, with certain parts removed therefrom, of apparatus embodying the teachings of this invention;

Fig. 2 is a view taken along the line II—II of Fig. 1, and

Fig. 3 is a view in section and greatly enlarged of a detail of the structure of Fig. 1.

Referring to the drawing and in particular to Fig. 1 thereof, this invention is illustrated by reference to a steam-applying apparatus 10. The apparatus 10 comprises a pair of frames 12 and

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14 (shown in Fig. 2), each of which is formed of two vertical extending angle members 16 and 18 held in spaced relation by an upper cross-bar 20 which is secured to the upper ends of the angle members in any suitable manner. The vertical angle members 16 and 18 of each of the frames 12 and 14 are spaced apart a predetermined distance by the cross-bar 20, whereby a strip 22 of fibrous material carrying a resinoid may pass therebetween at substantially right angles thereto. The vertical members 16 and 18 of each of the frames 12 and 14 are provided with a plurality of spaced openings 24 and 26, respectively, therein for receiving spacing and supporting bolts 28 and 30, respectively, as will be referred to hereinafter.

As illustrated in Figs. 1 and 2, a pair of tubular members 32 and 34 are disposed to be supported by the bolts 28 and 30 in a horizontal position between the frames 12 and 14 and spaced a predetermined distance apart, depending upon the position of the bolts 28 and 30 in the frames 12 and 14.

Each of the tubular members 32 and 34 comprises two tubes 36 and 38 disposed in a horizontal plane in side-by-side relation and secured in line contact as by soldering, brazing or welding. In the embodiment illustrated, the tubes 36 and 38 forming each of the tubular members 32 and 34 are pressed together so as to effect a flattening of the contacting surfaces thereof and are maintained in such position by brazing them substantially throughout their entire length, a backing or supporting bar 40 being secured thereto for strengthening the assembled tubes. The assembled tubes 36 and 38 have their ends secured in headers 42 and 44, the headers being illustrated in Fig. 3. As shown, suitable recesses 37 and 39 are provided in the headers for receiving the ends of the tubes 36 and 38, the ends being secured therein as by brazing them. The recesses 37 and 39 for receiving the tubes 36 and 38 merge into a single threaded passage 46 at the other end of the header.

With the tubular members formed in this manner, the headers 42 and 44 of each of the tubular members are secured in position between the frames 12 and 14, the headers 44 being connected through connecting pipes 48 to pressure gauges 50 to be used for determining the pressure developed in each of the tubular members. Suitable valve drains 52 are also connected to the pipe 48 for exhausting the tubular members when not in use.

With the tubular members 32 and 34 secured in position between the frames 12 and 14, the headers 42 are disposed to be connected to a source of supply of steam (not shown), a main valve 54 being employed for such purpose. One end of the valve 54 is connected to the source of supply (not shown), the other end being connected through flexible hose connections 56 and 58 to control valves 60 and 62, respectively, which in turn are connected by the connecting pipes 64 and 66, respectively, to the headers 42 of the tubular members 32 and 34, respectively, the ends of the pipes 64 and 66 being disposed in the threaded passages 46 of the headers 42. The valves 60 and 62 are disposed for independent operation for controlling the steam supplied to the individual tubular members 32 and 34.

Each of the tubes 36 and 38, utilized in the tubular members 32 and 34, is provided with a plurality of openings 68 and 70, respectively, disposed in spaced relation to each other throughout the length of the tubes for permitting delivery of the steam from the tubular members 32 and 34 to the strip material 22. As illustrated, the openings 68 and 70 are so angularly displaced in the tubes 36 and 38 that lines of extension of each cooperating pair of such openings meet adjacent the tubes 36 and 38, whereby the jets of steam flowing through the cooperating pair of openings 68 and 70 impinge on each other and are angularly deflected as a single stream in substantially a vertical direction toward the strip 22. As the pairs of openings 68 and 70 are closely spaced along the length of the tubular members 32 and 34 and as the force of the steam jets impinging one upon the other forces the steam to flow in a vertical direction, expansion thereof is sideways so that the steam delivered from one pair or set of cooperating openings overlaps the steam delivered by the adjacent pair of cooperating openings to form a blanket or curtain of steam at the point where it meets the strip material 22. In effect, a curtain of steam is delivered across the strip material 22, such curtain having a minimum thickness occasioned by the jets escaping from the cooperating pair of openings impinging upon each other adjacent the tubes 36 and 38. Of course, as will be evident from Figs. 1 and 2, the openings in the lower tubular member 34 are in the upper side thereof and the openings in the upper tubular member 32 are in the lower side thereof so that the steam is delivered simultaneously to the opposite sides of the strip 22.

In operation, the delivery of steam, either saturating or super-heated, to the strip 22 can be closely controlled to prevent condensation of moisture on the strip 22. As will be apparent, the steam is delivered in a very thin curtain in line contact across the strip 22 and the pressure of the steam can be closely controlled either by adjusting the escape or drain valves 52 or by adjusting the control valves 60 and 62 which will control the input pressure of the steam to the individual tubular members 32 and 34, respectively. The spacing or position of the tubular members 32 and 34 can be readily adjusted with respect to the strip material 22 so as to effect the thin curtain of steam impinging upon the strip 22. By adjusting the position of the tubular members 32 and 34 and controlling the valves 60 and 62, an efficient operation of the apparatus can be obtained so that the strip material passing between the tubular members 32 and 34 will be free of any condensation, while permitting the steam to function to effect better impregnation of the strip material.

The apparatus of this invention can be readily duplicated as the parts thereof are standard and can be readily assembled. By reinforcing the tubular members in the manner described, the tubular members can be made of any required length and will have sufficient strength so that any width of strip material 22 can be treated in the apparatus. In a specific example, where the tubular members 32 and 34 are formed with tubes 36 and 38 having a length of 112 inches each, the openings 68 and 70 are formed having a diameter of 0.031 inch with the lines of extension displaced at 45° from the vertical diameter thereof, the openings being drilled in line every inch over a length of 108 inches of the tubes. In this case, a ⅜ inch by ⅝ inch steel bar is brazed to the tubes 36 and 38 on the side thereof opposite the side containing the openings 68 and 70 throughout the 108 inch length of the line of the openings in the tubes.

We claim as our invention:

1. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of cooperating openings therein for the discharge of steam in streams, the tubular members being arranged in pairs secured side by side to each other with the cooperating openings disposed to direct the streams of steam from one tubular member of a pair towards the streams of steam from the other tubular member of the pair to impinge one upon another to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for supplying steam to the plurality of tubular members.

2. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs secured side by side to each other with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from one tubular member of a pair towards the streams of steam from the other tubular member of the pair to impinge one upon another to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for supplying steam to the plurality of tubular members.

3. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs secured side by side to each other with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperat-

ing openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for supplying steam to the plurality of tubular members.

4. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs secured side by side to each other with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperating openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, means for reinforcing the secured members of each pair of the tubular members to increase the strength thereof, and means for supplying steam to the plurality of tubular members.

5. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members beng arranged in pairs with the pairs positionally disposed in spaced relation to each other for receiving the strip material therebetween, the tubular members of each pair being secured side by side to each other with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperating openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for supplying steam to the plurality of tubular members.

6. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs with the pairs positionally disposed in spaced relation to each other for receiving the strip material therebetween, the tubular members of each pair being secured side by side to each other with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperating openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, means for supplying steam to a plurality of tubular members, and means for selectively controlling the supply of steam to each of the pairs of tubular members.

7. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs with the pairs positionally disposed in spaced relation to each other for receiving the strip material therebetween, the tubular members of each pair being secured side by side to each other throughout substantially their entire length with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperating openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for selectively supplying steam to each of the pairs of tubular members.

8. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs with the pairs positionally disposed in spaced relation to each other for receiving the strip material therebetween, the tubular members of each pair being secured side by side to each other throughout substantially their entire length with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperating openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, means disposed along each pair of the tubular members and secured thereto for reinforcing them, and means for selectively supplying steam to each of the pairs of tubular members.

9. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs with the pairs positionally disposed in spaced relation to each other for receiving the strip material therebetween, means for supporting the pairs of tubular members in said spaced relation, the tubular members of each pair being secured side by side to each other with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperating openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction to-

wards the strip material to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for supplying steam to the plurality of tubular members.

10. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a plurality of tubular members having a plurality of openings therein for the discharge of steam in streams, the tubular members being arranged in pairs with the pairs positionally disposed in spaced relation to each other for receiving the strip material therebetween, means disposed for movement to a number of different positions for supporting the pairs of tubular members in said spaced relation, the tubular members of each pair being secured side by side to each other with the openings therein being in spaced relation lengthwise of the tubular members but angularly displaced to provide pairs of cooperating openings disposed to direct the streams of steam from the cooperating openings to impinge on each other to form a laterally expanding common thin curtain of steam flowing from each pair of cooperating openings in a substantially vertical direction towards the strip material to make substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for selectively controlling the supply of steam to each of the pairs of tubular members.

11. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a pair of tubular members disposed in spaced relation to each other for receiving the strip material therebetween, means for supporting the tubular members in said spaced relation, each of the tubular members comprising two tubes secured in line contact side by side to each other and disposed in the same horizontal plane, each tube of each pair having a plurality of openings disposed in spaced relation along the length of the tube adjacent the line contact for discharging steam in streams therefrom, the openings in the cooperating tubes of each tubular member being in the same spaced relation and so angularly displaced towards each other that lines of extension of the openings meet at points closely adjacent the tubes whereby streams of steam from the openings of one tube impinge against corresponding streams of steam from the openings of the other tube of the tubular member to form a laterally expanded thin curtain of steam flowing from each of the tubular members in a substantially vertical direction towards the strip material on opposite sides thereof so as to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for supplying steam to the pair of tubular members.

12. In apparatus for impinging steam against strip material as it moves in a predetermined direction, the combination comprising, a pair of tubular members disposed in spaced relation to each other for receiving the strip material therebetween, means for supporting the tubular members in said spaced relation, each of the tubular members comprising two tubes secured in line contact side by side to each other and disposed in the same horizontal plane, means disposed along the two tubes of each of the tubular members and secured thereto for reinforcing them, each tube of each pair having a plurality of openings disposed in spaced relation along the length of the tube adjacent the line contact for discharging steam in streams therefrom, the openings in the cooperating tubes of each tubular member being in the same spaced relation and so angularly displaced towards each other that lines of extension of the openings meet at points closely adjacent the tubes whereby streams of steam from the openings of the one tube impinge against corresponding streams of steam from the openings of the other tube of the tubular member to form a laterally expanded common thin curtain of steam flowing from each of the tubular members in a substantially vertical direction towards the strip material on opposite sides thereof to make a substantially line contact therewith transversely of the strip as it is moved in the predetermined direction, and means for selectively controlling the supply of steam to each of the tubular members.

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