Jan. 30, 1940. G. T. PEARCE 2,188,373

FELTED PRODUCT AND METHOD AND MACHINE FOR MAKING THE SAME

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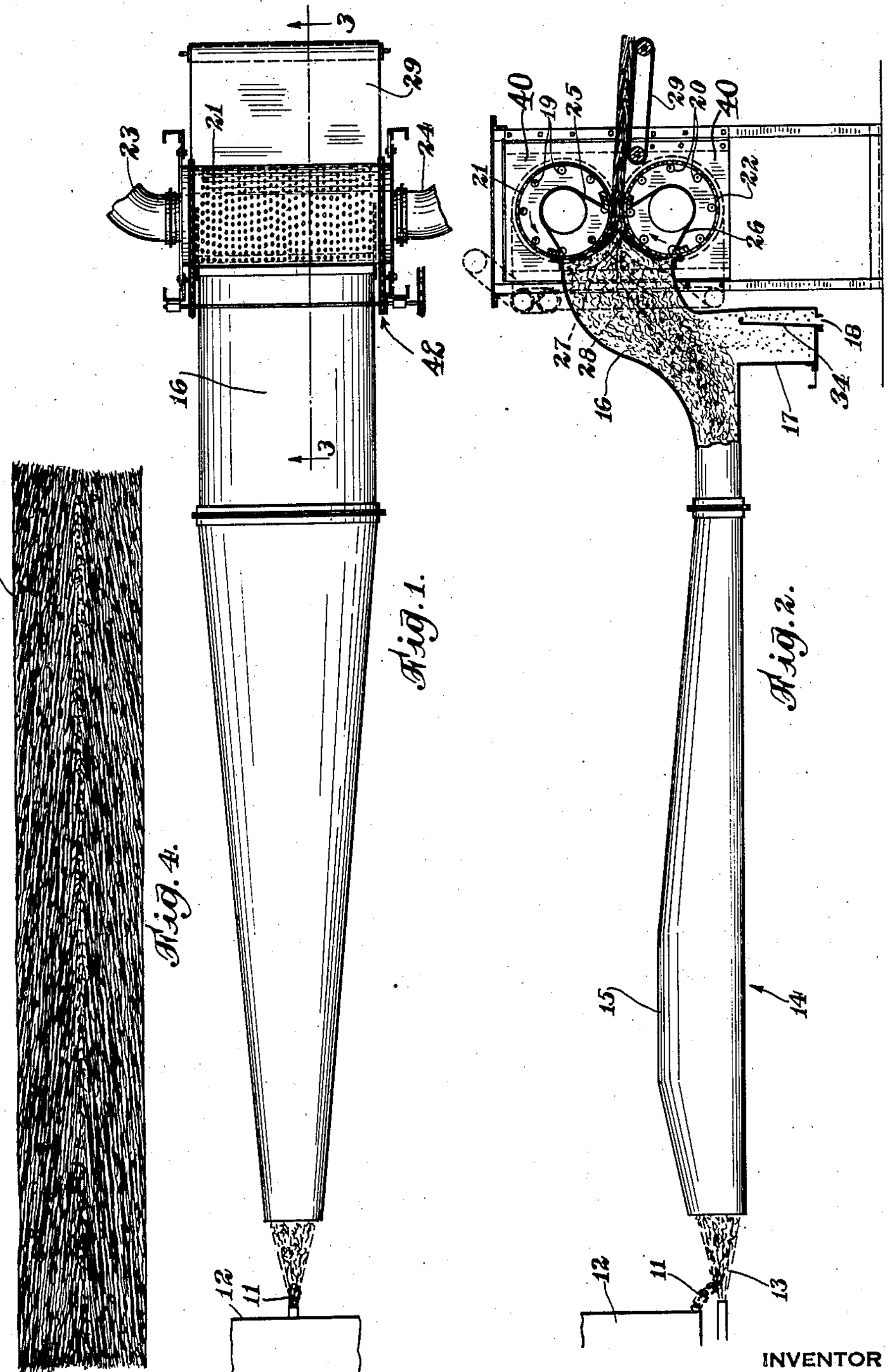

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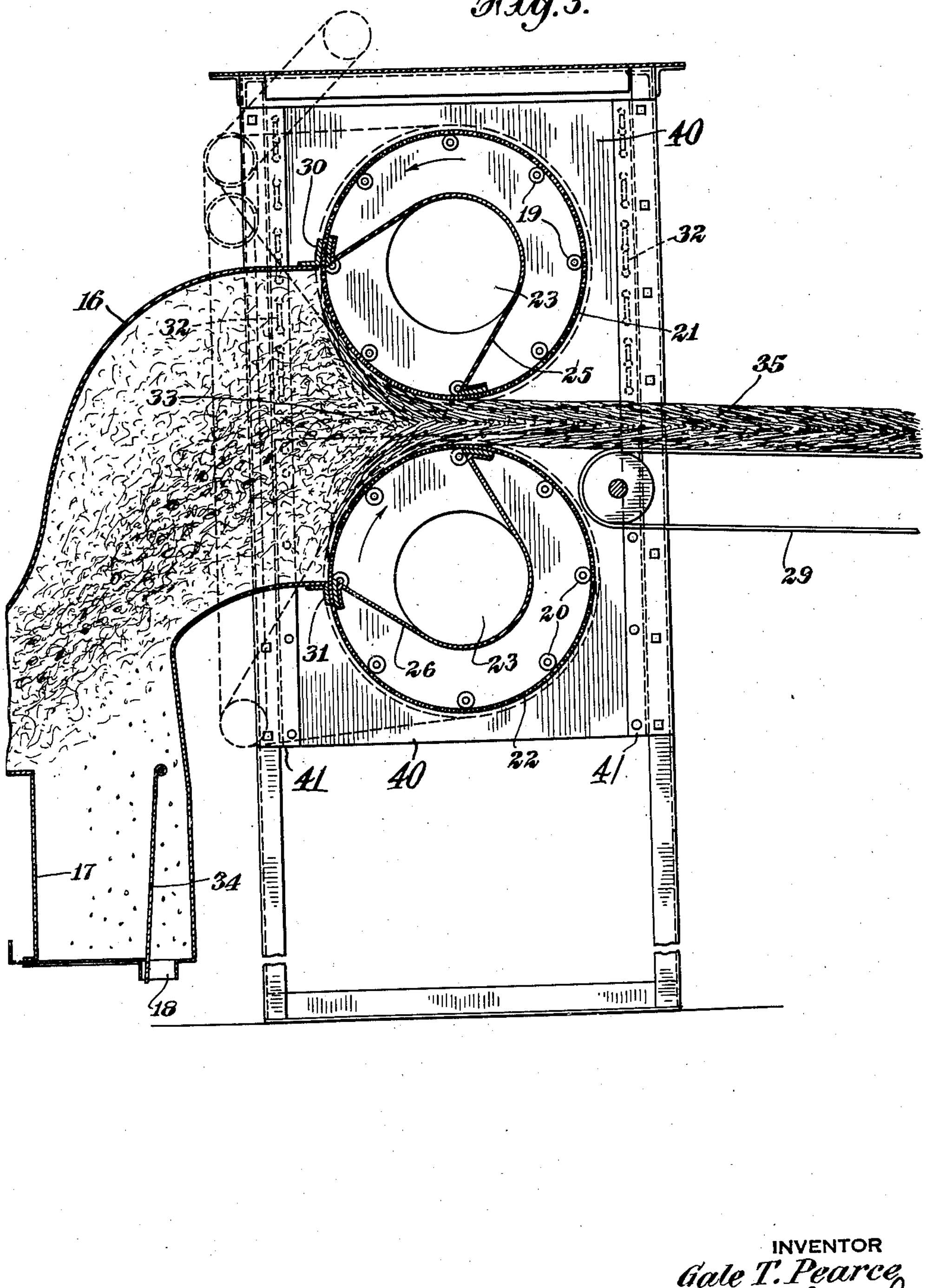
Fig. 3.



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FELTED PRODUCT AND METHOD AND MACHINE FOR MAKING THE SAME

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7 Claims. (Cl. 154—27)

This invention relates to a felting machine and method and the improved felt produced thereby.

The invention is particularly applicable in the industry of mineral wool and will be illustrated especially by reference thereto.

There is need of a mineral wool felt or bat that, although light in weight and constituted of individually very fine fibres, is very coherent and has very evenly and smoothly felted face and back portions.

It is an object of the invention to provide a felt meeting these requirements. Another object of the invention is to provide an apparatus and a method suitable for use in making such a felt, conveniently and economically. Other objects and advantages will appear from the detailed description that follows.

A preferred embodiment of the invention is illustrated in the drawings and the invention will be exemplified by description in connection therewith.

Fig. 1 is a plan view, partly diagrammatic, of my improved felting apparatus.

Fig. 2 is a side view, also partly diagrammatic, of the same apparatus.

Fig. 3 is an enlarged vertical sectional view on line 3—3 of Fig. 1.

Fig. 4 is an edge view of the felt made with the improved apparatus.

Referring to the drawings, Figs. 1, 2, and 3 illustrate an apparatus for producing mineral wool which comprises any suitable furnace or cupola **12** for melting raw material and discharging the molten material in a stream **11**. The molten stream **11** is blasted by a jet of gas **13** moving at a high velocity. The gas may be steam, compressed air, or other compressed gas. The gas **13** converts the molten stream **11** into fibres which are suspended and carried along by the moving gaseous stream. A certain amount of unfiberized particles, commonly known as "shot," is inevitably formed in addition to the fibres.

The stream of suspended fibres and unfiberized particles is received within a blow chamber which may comprise a horn **14** and a member **16** which connects the horn with members which collect the fibres and felt them into a body, commonly known as a "blanket." The blow chamber constitutes a conduit for the stream of suspended fibres.

For best results, the horn is flaring in width, as, for example, continuously from the end adjacent to the shredding to the opposite end. Thus, the horn may increase gradually in width from 8 inches to 34 inches and be about 18 feet long.

The horn may be made of sheet metal, as, for instance, of 20 gage black iron.

The thickness of the horn (vertical dimension) increases from the narrow end, at which it may be about 8 inches, to the position **15** at which the thickness may be 14 inches or so.

The portion of the horn extending towards the felting members from the point **15**, spaced a substantial distance from the position of shredding of the fibres, say about eight feet therefrom, has an area of cross section that is approximately constant. The thickness (depth) of the horn in this area decreases as the width increases or flares. The speed of movement of the suspension at any cross section of this portion of the horn is, therefore, nearly the same as that at any other section. Minimum turbulence and maximum separation of shot-like granules are thus favored.

All of these dimensions, obviously, are subject to considerable variation. The preferred actual dimension of the horn at its narrow end depends partly on the size of the stream **11**. The horn of dimensions stated has been used with a stream delivering about 300 to 1,200 pounds an hour of molten material for rock wool manufacture. At the widest end, the horn should be about as wide as the felting members to be described or as wide as the entrance to the connection **16** between the horn and said members.

Suitably, the entrance or small end of the horn is spaced about 1.5 to 3 feet from the position of outflow of the stream **11** from the furnace.

At the rear end of the horn there is a connecting member **16** for deflecting the suspension of fibres upwardly and completely out of line with the direction of their travel through the horn to the felting members. This connecting member includes at its lower portion a trap **17** for granules (shot-like particles) which settle out and an air inlet **18**, to admit additional air for air-washing the shot as it separates from the stream of suspended fibres, diluting the said stream, and assisting in deflecting the rock-wool-laden gas stream in an upward direction. The air inlet is adjustable in width, as by shifting the pivotally mounted damper **34**.

The felting apparatus comprises two pairs of end plates **40** suitably bolted to and supported by frame members **41**. Each of the upper end plates **40** rotatably supports a series of small rollers **19** arranged in a circle, and each of the lower end plates 40 likewise rotatably supports a series of small rollers 20 arranged in a circle. The felting roller 21 is rotatably supported by the small rollers 19 and the felting roller 22 is rotatably supported by the small rollers 20. The felting rollers 21 and 22 may be formed of foraminous materials such as woven wire screens or perforated metal sheets.

Suitable means, such as a system of chains and sprockets 42 driven by any suitable prime mover, rotates the rollers 21 and 22 in opposite directions.

The openings in the upper pair of plates 40, through which the bolts pass which connect the plates to the supporting members 41, are elongated as shown at 32 to enable the upper pair of plates 40 to be adjusted vertically and thereby vary the spacing between the rollers 21 and 22. The spacing between the rollers is usually adjusted to a distance somewhat less than the desired thickness of the finished felt so that the felt will be moderately compressed during its passage between the rollers.

Suction is applied by means of pipe lines 23 and 24, each of which communicates at one end with one end of each of the felting rollers and at the other end with a suction fan (not shown). Sheet metal members 25 and 26, disposed within the felting rollers, as illustrated, and closed at their ends, restrict the area of the felting members behind which the suction is applied, to that portion upon which the felt is to be formed. This area may be about a fourth or less of the total area of the face of each of the rollers. Closing members 27, 28, 30 and 31, which may be shape-retaining gaskets, flash the connections between the connecting member 16 and the rollers. The suction acts, therefore, to draw the suspension through the horn 14 and additional air through the inlet 18, as well as to orient the fibres into a desirable felting arrangement.

The suction corresponds, advantageously, to about 6 to 40 inches of water and draws about 2,000 to 5,000 cubic feet of air a minute, through the screens 21 and 22.

I have used to advantage felting rollers of a circumference each of about 6 feet, rotated at a rate of ¼ to 5 R. P. M.

With the mechanism described, the aeriform suspension of the fibres is delivered to a portion of each of the rollers that is being turned towards (is approaching) the corresponding portion of the other roller, so that felts are first formed directly on portions of the two felting members 21 and 22. Then additional felts or additional fibres are deposited upon and between the said first formed felts. The composite is then passed promptly between the rollers at their nearest point.

The suction applied to the felting rollers is adequate to cause deposition on the felting members of two felts and of intermediate connecting fibres which, together, have a thickness appreciably in excess of the spacing apart of the rollers at their nearest point. As the composite passes this point, it is appreciably compressed and thereby further consolidated. Thus, the composite may be compressed momentarily to about a fourth or less of its original thickness. After the felt passes the said point, the felt is allowed to expand freely and means are provided for removing it from the rollers.

After passing this point of maximum convergence of the roller surfaces, no suction is in effect on the formed felt. As a result of the felted condition of the fibre structure and absence of suction on the roller surfaces, the felt emerges from between the rollers in a continuous layer, in the thickness determined by the combined effect of the quantity of fibre introduced, the resilient reexpansibility of the felt, and the spacing between the rollers.

The felt then passes over the conveyer 29 delivering the felt to any point desired.

The spacing between the felting rollers, at the nearest point, may be of the order of 1¼ inches, for making a felt hat, after passage between the rollers and reexpansion is to be 1.5 to 2 inches thick.

It will be observed that certain portions of the fibres follow more readily the path of gas flow and are deflected to a greater extent than others. The heavier masses, such as suspended flocks of fibres, are deflected the least, whereas the individualized lighter fibres are deflected most. The individualized or well dispersed lighter fibres tend, to a greater extent than the flocks, to be deposited on the felting members at the point of entry of the said members into the space between the upper and lower sides of the connecting member 16.

For this reason, individualized fibres predominate at positions of felting that are farthest removed from the stream of fibres at the midpoint 33 of the felting apparatus. Furthermore, these fibres, individually suspended just before being laid on the screen felting member or upon each other, are predominantly oriented in directions generally tangential to the felting member at that point or parallel to the face portions of the finished felt. The felting of such individualized fibres is very firm. Also, the heavier mass or flocks of fibres that accumulate near the midpoint 33 are oriented to a substantial extent and arranged in the successive layers in which the felt is formed. Also, some fibres near the middle of the felt bridge across and extend into the felts first formed on each of the felting members, securing the felts together and causing consolidation of the inner portions of the felt, as formed on the rollers.

The finished felt or pad 35 includes a plurality of thin connected, interfelted laminae, formed by successive depositions of the fibres under the influence of the suction which, though the fibres individually extend generally parallel to the face of the pad, appear as laminae inclined with respect to the faces of the pad and constitute generally V-shaped structures, nesting with each other and with the points of the V-structures at approximately the midportion of the pad.

Each of the V-structures is very narrow in proportion to its length, from the point of the V to the edge thereof exposed on the face or back of the pad. For a pad of 0.5 to 2 inch thickness the length of the V's may be about 10 to 18 inches. The fibres are oriented in the V's at a small angle with respect to the planes of the face and back.

The inner portions of the finished felt are less densely felted and are more yieldable than the better oriented and more firmly felted face portions.

The consolidation referred to assists in the interlocking of the laminae and minimizes shifting of the several laminae with respect to each other in the felt.

The fibrous suspension to be felted includes preferably, a small amount, say 2 to 5 parts by weight, to 100 parts of fibres, of readily yieldable but hardenable binder, as for example, a bituminous composition. The binder is applied in conventional manner to the fibres at a position adjacent to the shredding point. The fibres are felted as described and the felt is straightened and moderately compressed, very promptly, by passage through the space between the felting rollers, while the binder is still in readily yieldable condition and before it has had an opportunity to harden appreciably.

In a typical operation, the suspension is passed through the horn at a linear speed of 1,000 feet a minute or more, so that only a momentary period, say, a second or less, elapses, after the shredding, until the fibres are deposited and bonded in a felt. A preferred speed is 3,000 feet a minute.

The felt is then subjected to treatment to harden (set) the binder. This treatment includes cooling the felt, if the binder is asphalt, pitch, gilsonite, stearin pitch, rosin, or the like.

The resulting felt, consisting largely of mineral wool but comprising also a small proportion of binder, is well adapted for use in automobile bodies or freight cars, under conditions in which the conventional and less coherent felts would undergo serious settling, collapse, or deterioration, due to vibration. Although as light as 2 to 5 pounds to the cubic foot, the felt is so coherent that a piece as large as ten feet square or more may be supported by a single corner for an appreciable period. The individual fibres may be fine, say, of the order of 5 mm. long and 2 microns in diameter.

It will be understood that the molten mineral composition, referred to in certain claims, may be a glass mix, slag, an argillaceous limestone, or like suitable material commonly used in the manufacture of mineral wool.

It will be understood, also, that the details given are for the purpose of illustration, not restriction, and that variations within the spirit of the invention are intended to be included in the scope of the appended claims.

What I claim is:

1. A mineral wool forming apparatus of the kind described, including means for converting a molten mineral composition into fibres, a felting member, and a horn for conducting the fibres in aeriform suspension to the felting member, the said horn, over a large part of its total length, flaring in width continuously and varying substantially in inverse ratio in thickness and becoming relatively thin at the part thereof nearest the felting member, the area of cross section in the said part remaining substantially constant.

2. An apparatus for producing a body of felted mineral wool fibres, comprising means for forming discrete fibres and unfiberized particles from heat liquified raw material and suspending the fibres and said particles in a moving gaseous stream, means for confining and directing the stream of gas-suspended fibres and particles in a definite path, means for changing the direction of movement of the said stream to separate the particles from the fibres, means for receiving the particles, means for passing additional gas counter current to the separating particles to remove entangled fibres and return them to the stream of suspended fibres, and spaced felting members disposed in the path of the fibre stream.

3. A coherent felt comprising mineral wool fibres lying predominantly in a direction generally parallel to the faces of the felt and providing therein lamina-like formations extending generally at opposite angles from opposed faces of the felt, the portions of the felt adjacent the faces thereof being more densely felted and composed predominantly of lighter and more individualized fibres than the inner portion of the felt.

4. A coherent felt comprising mineral wool fibres lying predominantly in a direction generally parallel to the faces of the felt, the portions of the felt adjacent the opposed faces thereof being more densely felted and composed predominantly of lighter and more individualized fibres than the inner portions of the felt and a minor proportion of a binder dispersed throughout said felt and bonding together the fibres thereof.

5. A method of making a coherent felt comprising forming discrete mineral wool fibres from heat-liquified mineral wool forming raw material, suspending the fibres in a moving gaseous stream confined in a definite path, with the suspension comprising predominantly individualized fibres and a smaller proportion of heavier fibre masses, directing the movement of the stream to pass said suspension into a felting zone, separating lighter individualized fibres from said suspension and first felting said individualized lighter fibres in separate layers, felting said heavier fibre masses between said layers and in contact therewith, and pressing said felts against said fibre masses in a manner to secure a fibre bond therebetween.

6. A method of making a coherent felt comprising forming discrete mineral wool fibres from heat-liquified mineral wool forming raw material, applying a readily yieldable hardenable binder to the fibres and suspending the same in a moving gaseous stream confined in a definite path, with the suspension comprising predominantly individualized fibres and a smaller proportion of heavier fibre masses, directing the movement of the stream to pass said suspension into a felting zone, separating lighter individualized fibres from said suspension and first felting said individualized lighter fibres in separate layers, felting said heavier fibre masses between said layers and in contact therewith, pressing said felts against said fibre masses in a manner to secure a fibre bond therebetween, and hardening the binder.

7. A method of making a coherent felt comprising forming discrete mineral wool fibres and unfiberized particles from heat-liquified mineral wool forming raw material, applying a readily yieldable hardenable binder to the fibres, suspending the fibres and particles in a moving gaseous stream confined in a definite path, with the suspension comprising predominantly individualized fibres and a smaller proportion of heavier fibre masses and said particles, changing the direction of movement of said stream to separate particles from the fibres and to pass said fibres and fibrous masses into a felting zone, separating lighter individualized fibres from said suspension and first felting said individualized lighter fibres in separate layers, felting said heavier fibre masses between said layers and in contact therewith, pressing said felts against said fibre masses in a manner to secure a fibre bond therebetween, and hardening the binder.

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