Aug. 15, 1939. J. H. SIMPSON 2,169,435

AIR CONDITIONING APPARATUS

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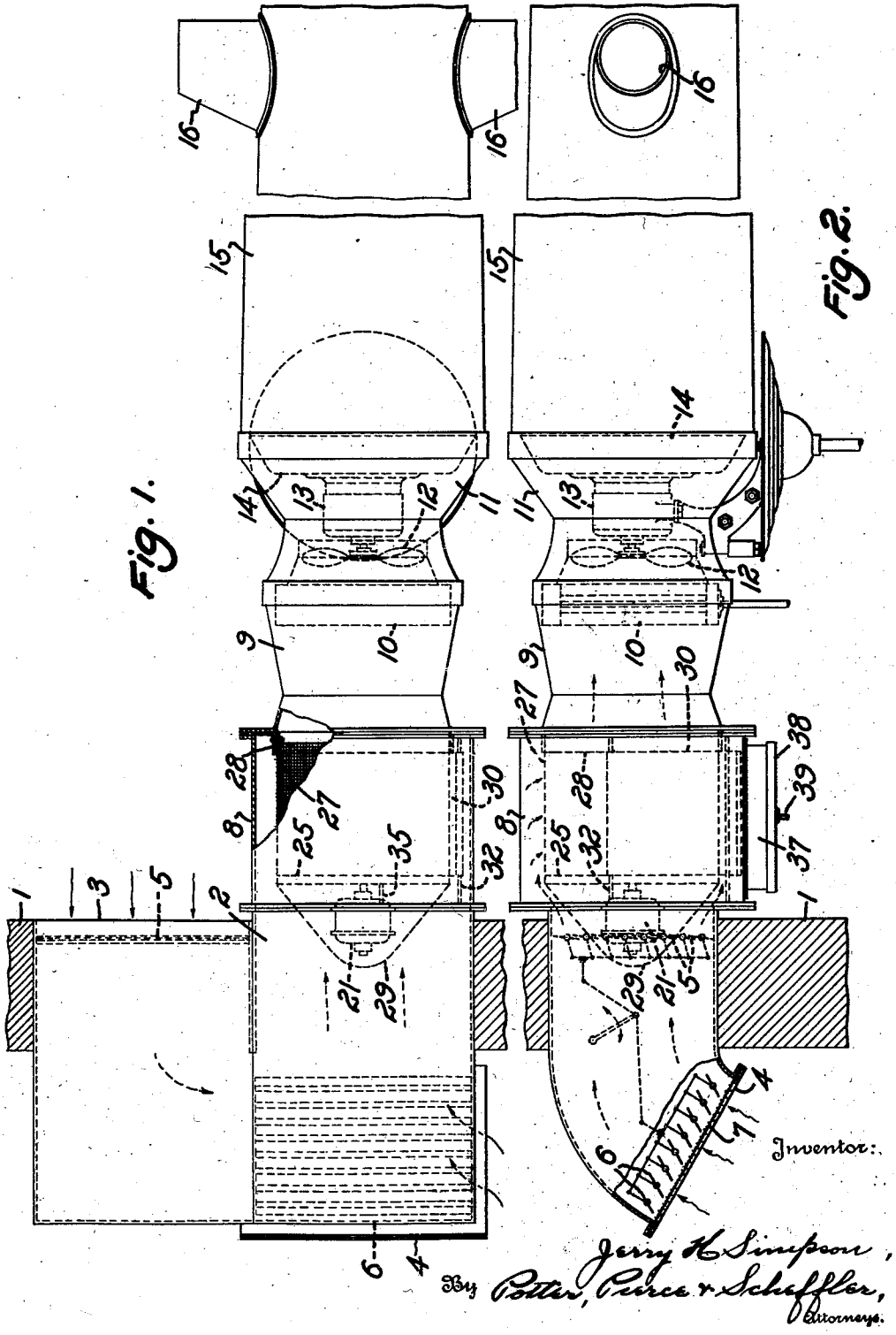


Fig. 1.

Fig. 2.

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AIR CONDITIONING APPARATUS

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Fig. 3.

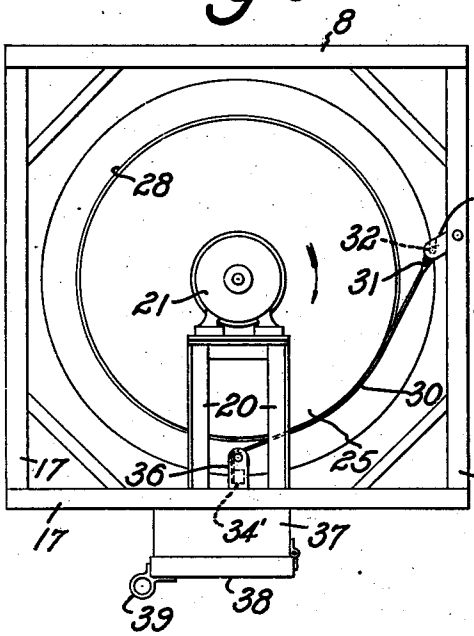


Fig. 4.

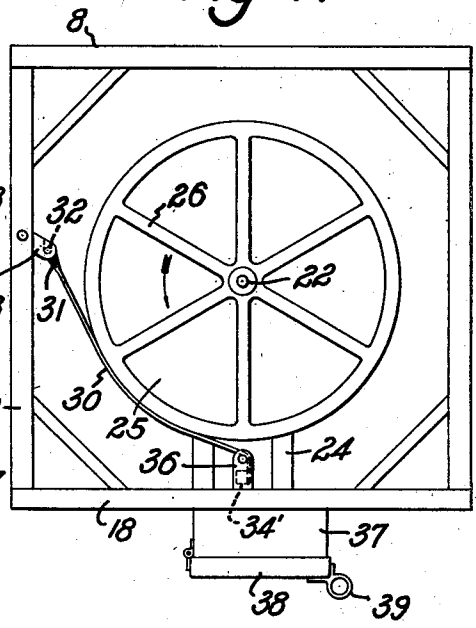
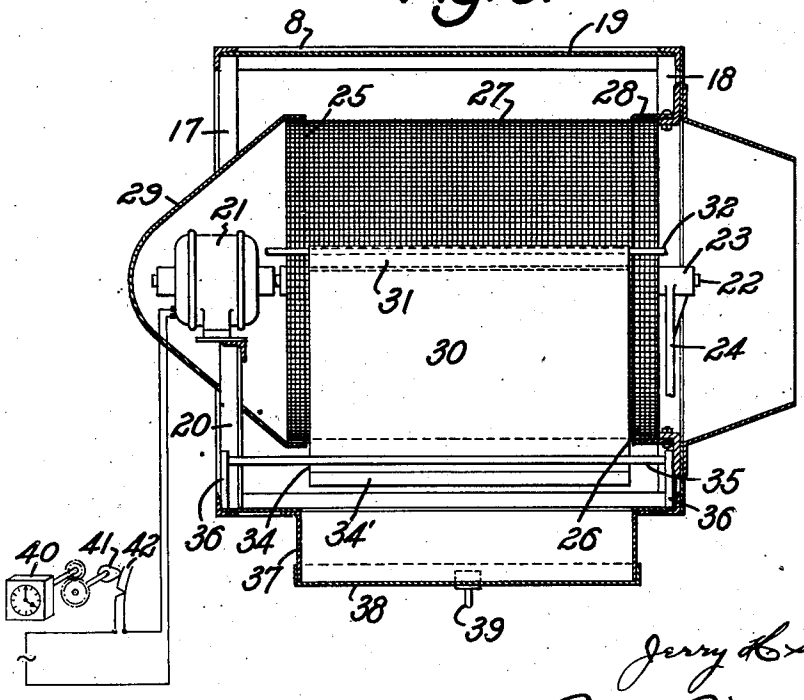


Fig. 5.



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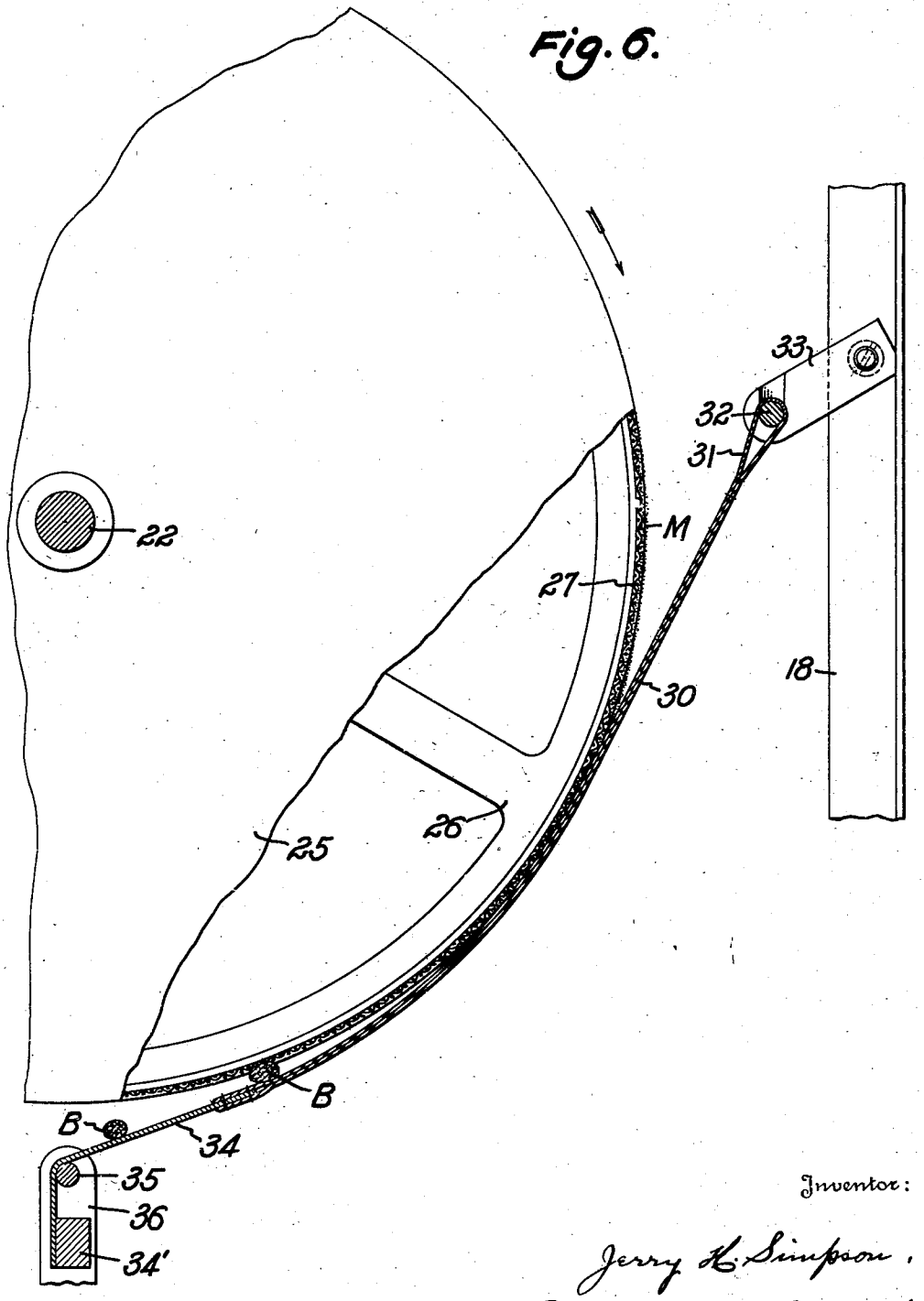
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Fig. 6.



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UNITED STATES PATENT OFFICE

2,169,435

AIR CONDITIONING APPARATUS

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Application October 30, 1937, Serial No. 171,972

8 Claims. (Cl. 183—52)

This invention relates to air conditioning apparatus and parts thereof, and more particularly to an air conditioning system for use in shops or mills in which the air normally carries a substantial quantity of dust, lint and the like.

Lint and dust of the sizing material used on cotton thread are always present in the air in cotton spinning and weaving mills, and this dust content may be so high that it is impossible to see clearly from one end to the other of a long weaving room. A relatively high humidity must be maintained and the mixture of size dust and lint tends to adhere to surfaces which it contacts as the moist air is circulated in the mill. It has been proposed to remove the size dust and lint by flat screen filters in the air circulating system, but the quantity and character of the material are such that the filters must be cleaned every few hours. The material is readily filtered from the air stream but the cleaning of the filters has presented a difficult problem which, up to the present, has necessitated a manual cleaning.

An object of the present invention is to provide air conditioning apparatus including filters of novel design for removing dust, lint and the like from the air. An object is to provide an air conditioning system of the type in which the room air is maintained in continuous circulation during use of the room, and which includes a self-cleaning filter for removing dust and lint from the air. More specifically, objects are to provide air filters and/or air conditioning systems including air filters, in which the filter is of the cylindrical screen type and includes elements for periodically or continuously removing dust and lint accumulations from the filter. A further object is to provide apparatus including a rotatable screen filter, and filter cleaning apparatus for removing the collected felt of dust and lint upon a rotation or partial rotation of the screen. Another object is to provide a filter section for incorporation in the duct of an air conditioning system, the filter section including a casing housing a self-cleaning filter for removing dust and lint from the air before it passes the air conditioning elements within the duct.

These and other objects and advantages of the invention will be apparent from the following specification when taken with the accompanying drawings in which:

Fig. 1 is a fragmentary plan view of an embodiment of the invention which includes one or more ducts for circulating, humidifying and/or heating the air, and a self-cleaning filter for removing dust and lint from the air;

Fig. 2 is a fragmentary side elevation of the same;

Figs. 3 and 4 are end views, from the inlet and outlet end, respectively, of the filter unit;

Fig. 5 is a sectional view through the filter unit, the filter and cleaning apparatus being shown in elevation; and

Fig. 6 is an enlarged fragmentary end elevation of the cleaning apparatus and a portion of the rotatable filter screen.

In the drawings, the reference numeral 1 identifies a part of an outside wall into which a mixing chamber 2 is built; the chamber having a room opening 3 and an exterior opening 4 for admitting room air and outside air, respectively, to the mixing chamber. Interconnected louvers or dampers 5, 6 are arranged in openings 3, 4, respectively, for regulating the mixture of room and outside air, and a screen 7 is placed across the exterior opening 4. The chamber 2 opens into the casing 8 of a filter unit which, in turn, opens into the casing section 9 that houses a tubular heater 10. The next casing section 11 of the air duct houses a humidifier element that is preferably of the type including a circulating fan 12, motor 13 and rotating disk humidifier 14. A heater and humidifier assembly such as described in the patent to Frederic F. Bahnson, No. 1,745,239, is shown in the drawings but the exact construction of these parts is not an essential feature of this invention.

The casing 11 opens into the tapered distributing duct 15 that has a plurality of laterally directed openings 16 along one or both sides. The arrangement of the openings 16 depends upon the particular air circulation that is to be set up in the room. The duct 15 will extend approximately to the center line of the room, just below the ceiling, and will have outlets along one side when the room air is circulated in a single closed circuit, there being one or more similar ducts at the opposite side of the room with the outlets opening in the opposite direction. Openings 16 will be provided at both sides of the duct 15 when the room air is circulated in two closed loops at opposite sides of the duct. The relative quantities of recirculated room air and of fresh air are regulated by the adjustment of the dampers 5, 6, and this regulation is preferably automatic but the particular control is not a part of the present invention. This general arrangement for conditioning air by circulation through one or more ducts within the room is known, but none of the prior systems have included a self-clean-

ing filter unit for removing dust and lint from the air stream.

According to the present invention, the circulating air is filtered before it reaches the heater and/or humidifier of the air conditioning system, and the collected material is removed continuously or periodically from the filter. The casing 8 of the filter includes end frames 17, 18 and a circumferential wall 19. Supports 20 on the frame 17 carry the motor 21 which rotates the shaft 22. A journal 23 for the other end of the shaft is carried by a skeleton support 24 on the frame 18 at the outlet end of the casing 8. A solid disk or plate 25 at the inlet end and a spoked wheel 26 at the outlet end support a rotatable screen filter 27 that may be cylindrical, as shown, or conical. A sealing ring 28 of tape or thin leather is mounted on the outlet end wall of the casing 8 and overlies the outlet end of the rotatable screen 27 to prevent the short circuiting of air around the filter. A domed or streamlined shell 29 is preferably arranged about the motor 21 to shield the same from the dust and lint of the entering air stream and to guide the air stream smoothly into the space between the casing wall 19 and the filter screen 27. The air current established by fan 12 enters the casing 8 around the screen 27, passes radially through the screen, and leaves the casing axially of and from within the filter screen.

The screen mesh is not fine enough to stop all of the size dust but the lint is stopped by the screen and forms a filter mat that will remove even the finest particles of dust. The resistance to air flow increases as the felted mass of lint and size dust builds up on the filter screen, and this felt must be removed either continuously or at intervals during the day. The timing for one rotation of the screen, either continuously or intermittently, will depend upon the amount and nature of the removed material.

Rotary brushes, scrapers and rapping devices cannot be employed for automatically removing the felted mass of lint and dust. A clean rotary brush will remove the felt, but the mass immediately clogs the brush and prevents any further cleaning action. Scrapers and devices for rapping the screen are not effective, whether or not a shield is used to block the air stream from the part which is to be cleaned. Rotary brushes and rapping devices tend to loosen some of the dust caught in the felted mass accumulated on the filter screen, permitting such dust to pass through the screen, while scrapers have been observed to produce a similar result in somewhat less degree. The present cleaning means was developed to remove, with the least possible disturbance, the accumulation of lint and dust on the screen, and even with this construction the screen must revolve slowly—with a surface speed of only a few feet per minute. In certain applications where the dust is fine, the fan must be stopped while the screen is moving, which result is readily accomplished by controlling motor 21 and the motor driving fan 12 by a double throw switch.

We have found that the felted mat M of lint, sizing dust and other particles may be readily removed by first rubbing and rolling the felted mass into strands or bats. The pressure and rolling motion for forming the strands or bats B are obtained by yieldingly holding the flexible pressure band 30 against a longitudinal strip of the screen cylinder 27 above and in advance, as viewed in the direction of rotation, of the bottom portion of the cylinder. The upper edge of the double thickness band 30 of relatively smooth cloth is formed as a loop 31 for supporting the band on a rod 32 that is mounted on arms 33 secured to the end frames 17, 18. A strip 34 of smooth flexible material, such as glazed leather, oilcloth or a sheet of cellulose acetate is secured between the lower edges of the band 30 and extends over a rod 35 that is supported by posts 36 on the end frames. A metal bar 34' on the strip 34 supplies the pressure for holding the band 30 against the surface of the screen cylinder. The band 30, being double surfaced, may be reversed when one side is worn. A dust box 37 depends below the shell 19 of casing 8, and its hinged bottom door 38 has a ring 39 for engagement by a hooked rod when the box is to be opened to drop the collected material into a bag.

The band 30 is relatively smooth, to prevent the lint from adhering to it, but it offers a substantial resistance to the movement of the felted material M between the screen 27 and the band when the screen is rotated, and the material is thus rolled and twisted into bats B that do not adhere to the screen 27. The bats B thus slide freely over the smooth lower portion 34 of the band and drop into the dust box when the strand is relieved from the pressure of the band 30.

The working of the felted mass into strands or bats will release some of the finer sizing dust from the mass, and the band 30 is therefore of fine mesh to have a high resistance to air flow through the band. This is particularly desirable when the screen is rotated continuously at slow speed. The fine dust which passes the filter screen during cleaning will not be objectionable when the several sections of the casings are designed, as shown, to decrease the effective cross-section of the air stream as it passes from the filter to the duct outlets. The air stream is thus continuously accelerated and the small content of dust will be held in suspension.

It is preferable, however, to clean the screen at intervals and by fractions of a revolution, for example a quarter turn. If conditions are such that the entire screen surface should be cleaned every two hours, the motor 21 can be energized for two or three minutes, at half-hour intervals, to effect a quarter revolution of the filter screen. As shown diagrammatically in Fig. 5, a timing device 40 may drive a cam 41 to close the switch 42 in the motor circuit.

The references to cotton mill conditions and to typical time cycles for operating the cleaning mechanism are indicative of one useful application of the invention but it is to be understood that the invention is not limited to the conditioning, or filter for use in the conditioning of air in cotton mills, and that the cleaning operation may be performed continuously or in widely different time cycles in accordance with the particular conditions encountered.

I claim:

1. In an air conditioning system a filter comprising a rotatable screen, means for rotating the screen, and a flexible cleaning member yieldingly contacting a portion of the screen at the air inlet side to roll a felted accumulation of removed material into bats.

2. In an air conditioning system, the invention as claimed in claim 1, where said rotatable screen comprises a shaft, axially spaced screen supports of solid and skeleton form on said shaft,

and a filter screen coaxial with said shaft and carried by said screen supports.

3. In an air conditioning system, a filter section for incorporation in an air duct, said section comprising a casing, a shaft approximately coaxial with said casing, a solid disk on the end of the shaft adjacent the casing inlet end, a skeleton supporting ring on the other end of the shaft, a screen extending between the peripheries of the disk and ring, means restricting the flow of air through the outlet end of the casing to that which passes through said screen, a flexible pressure band, means yieldingly holding said band against a longitudinal strip of the screen above and in advance, as viewed in the direction of rotation of the screen, of the bottom of the screen, and means for rotating said shaft and the screen mounted thereon.

4. A filter section as claimed in claim 3, in combination with a dust box extending along and below the casing of the filter section, and a hinged bottom door for said dust box.

5. A filter for use in an air conditioning system, said filter comprising a rotatable shaft carrying a screen coaxial with said shaft, means cooperating with said screen to restrict air flow to a path radially through and into the interior of said screen, a flexible pressure band contacting said screen to roll felted material accumulated thereon into bats, and motor means for rotating said shaft and the screen carried thereby.

6. A filter as claimed in claim 5, in combination with means for periodically energizing said motor means to effect a partial revolution of the shaft and screen.

7. In apparatus for removing lint, dust and the like from air, a shaft having axially spaced screen supports, a screen coaxial with said shaft and connected between the peripheries of said screen supports, one of said supports being apertured to permit air flow therethrough, means preventing air from entering axially of the screen at the other support, means for rotating the shaft and the screen supported thereon, a pressure band extending along and contacting the screen, and means yieldingly holding said band against said screen, whereby accumulations of felted material on the screen will be rolled into strands when said screen is rotated.

8. Apparatus as claimed in claim 7, wherein said band comprises a doubled flexible sheet having a loop along one edge, a strip of smooth flexible material secured at one edge to the second edge of said doubled sheet, and means weighting the other edge of said strip; and said holding means comprises a rod extending through the loop of the flexible sheet, and a second rod extending along and below said screen; said strip extending over the second rod.

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