WINNOWING APPARATUS FOR A CONTINUOUS ROD CIGARETTE-MAKING MACHINE


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This invention concerns improvements in winnowing apparatus for a continuous-rod cigarette-making machine and is a continuation-in-part of application Ser. No. 264,931 filed Mar. 13, 1963, now abandoned.

The cigarette-making machine concerned is of the kind described in U.S. Patent No. 3,030,965, granted Apr. 24, 1962.

In said machine the tobacco is carried upward by a flow of air through a narrow passage whose horizontal cross-section is substantially rectangular, with two long walls extending in the same direction as the length of the continuous rod, said walls being close to one another to define a narrow passage. The top of the passage is partly stopped by a perforated conveyor tape, on which the tobacco builds up to form a tobacco filler.

It is well-known to provide devices, known as winnowers, in cigarette-making machines in order to separate large or heavy fragments, such as large pieces of stem, from the tobacco from which cigarettes are to be made. Such separated fragments are referred to herein as "unsuitable fragments." However, it is sometimes desired to retain certain fragments which are intrinsically heavy but which are small enough in size and of such shape that they can be incorporated into cigarette fillers without detriment. Such particles, referred to herein as "usable fragments" are chiefly fragments occurring when stem is sliced transversely, during the tobacco cutting operation, at angles not far removed from the normal to the stem axis.

In the aforesaid patent means are shown for separating unwanted material, such as unusable fragments, as defined above, and delivering it into a receptacle, such as a box, but the separation may also cause some useful tobacco, such as tobacco shreds which have become entangled with the unusable fragments, to be carried into the tape.

In the U.S. Patent No. 3,093,883, granted July 2, 1963, generally similar winnowing means are shown, but in this case, the material passing to said box is subjected to an upper airflow which tends to strip entangled useless shreds from the unusable fragments to which they are attached and to feed them towards the narrow passage so that they will become incorporated with the tobacco filler on the perforated conveyor tape. The upper airflow emerges from an opening or throat in the box which has an inlet, whereby air may be drawn into the box and through the throat by the flow of air up the narrow passage.

In both of said patents, winnowing is mainly effected by a flow of air (a first airstream) which passes through a perforated plate and moves across tobacco projected by a picker roller, and towards a rotating perforated cylinder, into which air of the first airstream flows. In both of said patents, the perforated plate is a thin membrane, such as a sheet of metal, with numerous perforations in the form of small round holes. As explained in the first-mentioned patent, the combined effect of the picker roller, the rotating perforated cylinder, and the passage of air therethrough, is such as to cause tobacco projected by the picker roller to be blown along a path leading substantially directly into the entry to the narrow passage. The constructions in both the quoted patents are suitable for the manufacture of cigarettes where the filler is mainly composed of thin shreds of cut tobacco.

If it is desired to incorporate a substantial proportion of usable fragments, as previously defined, modifications are necessary to the structure described in the aforesaid patent, and its mode of operation.

Broadly speaking the aims of the invention are to improve the winnowing operation, and the distribution of the tobacco, by substituting a perforated member of a different nature for the said thin perforated plate, and to improve the said throat, so that air coming up from it does not materially interfere with the air which causes projected tobacco to move through the aforesaid curved path. With these modifications, the tobacco first winnowed follows a more accurate curved path than in the patents referred to, and tobacco thrown across the opening of said throat is more effectively winnowed by the air coming up the throat, to carry any usable fragments contained in said thrown tobacco up the narrow passage. These aims will be defined more precisely, after the construction of the machine has been explained, when the various objects will be clearer.

The invention will be further described by way of example with reference to the accompanying drawings.

In the drawings:

FIGURE 1 is a small scale diagrammatic section of a machine embodying apparatus according to the invention.

FIGURE 2 is an enlarged view of part of FIGURE 1.

FIGURE 3 is a view in the direction of the arrow "A," FIGURE 2, showing a fragment of a perforated member.

FIGURE 4 is a view of a fragment of FIGURE 2 showing a modification.

FIGURE 5 is a diagram showing the outline of some parts of FIGURE 2, and the path of movement of tobacco relative to these parts.

FIGURE 6 is another diagram for explaining the movements of air and tobacco in FIGURE 5.

FIGURE 6A is a diagram incorporating part of FIGURE 6, with some additional detail.

FIGURE 7 is a fragment of a perforated wall of a different shape from a wall shown in FIGURE 5, illustrating air movement through a hole.

FIGURE 8 is a fragment of FIGURE 5 showing air movements up a throat, and the direction of air through a perforated wall.

Referring to FIGURES 1 and 2 of the drawings, a carded roller 1, rotating in the direction of the arrow, removes cut tobacco from a supply contained in a reservoir formed between a wall 2, a carded roller 3, and the roller 1. The tobacco is carried out of the reservoir by the roller 1, surplus tobacco above the carding being swept back by the roller 3, which is a brushing or refuser roller. Tobacco is delivered to the reservoir in any suitable way and the invention is not concerned with such delivery.

A fast rotating picker roller 4 picks tobacco from the carding of roller 1 in the usual way, the roller operating over a plate 5 having a portion of its upper face substantially concentric with the picker roller. The picked tobacco is thrown across a perforated member 6, constructed as a thick block or wall, toward a rotating perforated suction cylinder 7 which, in combination with a guide member 8, forms the entry to a long narrow vertical passage 9. Air is passed through perforations 6A, in the wall 6, as explained later.

The passage 9 is partly stopped at its upper end by a perforated conveyor tape 10 on which a filler is formed in the manner described in the aforesaid patents. Above the tape is a suction chamber 11, whereby suction is exerted through the perforations of the tape 10, and thus
there is an upward flow of air through the passage 9. Details of some of the parts referred to in this paragraph and a full explanation of their function are given in the said patents.

Suction in the passage 9, and through the tape 18, is caused by a fan 12, connected to the suction chamber 11. As in the said patents the thrown tobacco, which would normally move along above the upper surface of a perforated member, in the present construction the wall 6, while falling downward due to gravity, is caused by the combined effects of its thrown velocity and the velocity of the air passing through the perforations 6A, in the wall 6, to curve upwards to enter the lower part of the narrow passage.

The air passing upward through the perforations 6A, that is, the first airstream, is mainly due to the aforesaid suction in the perforated cylinder and this airstream will pass across the path of the thrown tobacco and deflect the majority of the shreds of tobacco the airstream is capable of lifting, to cause them to assume a curved path leading towards the entry to the passage 9. The remaining thrown tobacco, chiefly stems, and some usable fragments, continues substantially on its path to strike against a wall 15, having a vertical portion 15A, against which most of the material impacts, whereas after any material, not becoming airborne in the manner explained below, falls downward in the direction of arrow D, FIGURE 2, toward a box 16 which has a long throat 18, defined by walls 15 and 15B. This box has an air inlet, formed by a perforated plate 17, and air will flow through the perforations and constitute an airstream (the second airstream) which flows upward through the throat 18 to the passage 9, and, in so doing, it will pass through the tobacco material falling down through the opening of throat 18 toward the box, and subject it to a further winnowing operation, whereby any remaining light particles, for example, any clinging to it, and carried by, heavy particles, are carried upward to the passage 9. Suction through the passage 9, caused by the fan 12, is augmented by a further fan 19, which is connected by a branch 20A of a pipe 20 to a box 21 opening into the passage 9 through a grille, screen, or like 22, constructed as described in U.S. Patent No. 2,015,793, granted February 6, 1936. The effect of the additional suction in the passage 9, through pipe 20A, is to increase the velocity of the airflow in the passage 9 over that given to the air through suction chamber 11, and the airborne shreds of tobacco, due to their velocity, pass up to the tape 10 and do not, in any material degree, affect any passage through the screen 22.

The fan 12 draws air through the tape 10, by the suction chamber 11 and pipe 25, and occasionally discharges the air from its exhaust to a group of cyclone separators 13, so that any tobacco dust in the airflow from the fan may be removed before the air is discharged, for example, to the exterior of a building containing the machine. The fan 19 draws air through the perforated cylinder 7 by means of a duct 49 whose lower ends fit closely against the cylinder. This duct is divided into three sections, as shown by the dividing plates, each section operating over a third of the length of the cylinder as explained in Patent No. 2,015,793. Inside the cylinder 7 are fixed, but adjustable, members 50 and 51, FIGURE 2, so that air can only enter the cylinder in the spaces between the said members. Thus air flows through the cylinder 7, taking in some dust but no useful tobacco. In the pipe 20 is a dust separator 23 whose outlet is connected by a pipe 24 to the pipe 25. A valve 26 in the pipe 24 is used to control the flow from the separator to pipe 25. In this way dust or tiny fragments of tobacco, which may have passed through the screen 22, may be separated by the device 23 or, if separation is not complete, further separation may take place in the cyclone separators 13. The fan 19 discharges through a pipe 28 to an outlet 46, entering a box-like structure 47 which acts as a dust remover. This has an outlet consisting of a convex wall 48 with its convex side upward and made of slit and expanded sheet metal, which is louvered to direct the air in the manner indicated in FIGURE 2, and toward the perforated wall 6. Within the structure 47 is a curved plate 52, with its convex face upward, having a hole at 53, and, beneath the plate, is a chamber 54. In spite of the dust separator 23, some dust or small fragments of tobacco may be carried into the diffuser but as the air flows through, these particles tend to travel over the curved plate 52 and fall off the far end into the chamber 54, while the air diffuses upward through the plate 48. Any air entering the chamber 54, with these particles, can escape through a hole 55 and pass through the hole 53 to join the air diffusing through wall 48.

Beneath the roller 1 is a shield 30 with an adjustable end 31. This is adjusted to leave a small space between it and a plate 32 so that dust and like small particles which fall down from the carded roller 1 may be carried upward and over the perforated wall 6 by the airflow and the far end.

The member 8, previously mentioned, is a long pipe-like structure, as long as the roller 7, and has a number of curved flange-like guides, or vanes, 8A along its length. These guides give the air a component of movement in the direction of movement of the tape 10.

Ignoring the precise structure and position of part 6 and throat 18, the apparatus operates in the following manner:

Air is drawn through the perforations in plate 17 and through the holes 6A in the wall 6 by the fans 12 and 19. The fan 19 draws an airstream into the duct 49 through the perforated wall 6 and enters the second airstream (the first airstream), passing through the stream of tobacco particles impelled by the picker roller 4, across the plate 6 and wall 6, turns the majority of the particles through an angle to flow in a substantially arcuate path into the entry to the narrow passage 9. Because of their momentum, heavier particles, consisting of unusable fragments and some usable fragments, are not turned into the arcuate path but pass across the throat 18 and start to fall toward the box 16. The air drawn up throat 18 moves in the opposite direction to the falling particles and removes them from any lighter particles and carries them up to the entry to the narrow passage 9. These lighter particles may have been carried into the throat by collision or entanglement with heavier fragments.

As previously mentioned, some of the thrown tobacco strikes the wall 15, and, in particular, the vertical portion 15A thereof, and certain parts of the material strike the wall with sufficient energy to cause them to rebound and pass again across the top of the throat 18 so that such parts are subjected twice to the second airstream and some particles may become airborne and pass up to the passage 9 but the explanation of these movements is elaborated later. Some of the unusual material may consist of long thin pieces of stem which are not very heavy, since they are formed by stem being sliced more or less lengthwise during cutting. Such pieces may be termed "silers" and they are referred to again.

The quality of the air flowing through the plate 17, that is, the second airstream is a factor in determining the amount of the winnowings collected in the box 16.

The suction from the fan 12 acts on the particles in the passage 9 and accelerates and impels them up the passage in the form of discrete particles to form the filler on the puffed cigarette. FIGURE 2 can be used to help understand this airflow.

The air through the diffuser 48 forms the major contribution to the air passing through holes 6A in the wall 6 and the remainder of the air through the wall comes from atmosphere at the right-hand side of FIGURE 1.

The above description, excluding the precise nature of the perforated member, namely, wall 6, and the disposition of the throat 18, covers the same apparatus dis-
closed in U.S. Patent No. 3,095,883 previously mentioned. The objects of this invention may now be specified in more detail as follows:

An object of this invention is to distribute the air through the perforated wall 6 in such manner that, whatever the speed and direction of the air through the diffuser 48, the tobacco thrown across the wall 6 and winnowed by the air coming through the holes 6A will be caused to assume the desired curved path to lead it into the narrow vertical passage.

Another object of the invention is to avoid any disturbance of the air which causes the tobacco to assume said curved path by the air coming up the throat 18.

A further object of the invention is to improve the separation of stems and other unusable fragments in the winning area beneath the perforated roller 7.

A still further object of the invention is to improve the separation of the tobacco shreds, or lamina, in the throat 18 from the material to be discarded.

Another object of the invention is to prevent, as far as possible, the aforementioned unusable fragments from being discarded and to ensure that they are carried up and into the narrow vertical passage 9.

The construction and disposition of the perforated wall 6 and the throat 18, necessary to attain these objects, will now be described.

Referring to FIGURE 5, it is necessary, in order to cause the air passing through the wall 6 to act satisfactorily on the tobacco thrown by the picker roller, to have on the average, at the place where it meets the tobacco, a component of speed tangential to the moving tobacco and equal to the speed of the latter, so that the tobacco moves through the curved path at constant speed. This speed is $8\frac{1}{2}$ ft./sec., on the average, in machines of the kind being discussed. The air should also have a radial component, that is, a component directed to the center of curvature of the curved path the tobacco is to take such that if:

\[ V_T = \text{speed of tobacco projected by the picker roller} \]
\[ V_I = \text{component of air speed tangential to the moving tobacco} \]
\[ V_R = \text{radial component of air speed} \]
\[ R = \text{radius of desired curved path of the tobacco} \]
\[ V = \text{terminal speed, in free fall, of particles such as are to be directed to the entry of the narrow passage} \]
\[ a = \text{acceleration due to gravity} \]

\[ V_T = \frac{V_Y V_E}{\sqrt{Rg}} \]  
(Formula No. 1)

In this formula $V_T$, $V_E$ and $Rg$ are known for any given conditions, they depend on the machine construction, the tobacco being used, and the speed of the picker roller.

Referring to FIGURE 6, where a fragment of wall 6 is drawn to show the disposition of the diagram, at point B, where the tobacco starts to turn to the desired curved path, the radial component of the first airstream is $V_T$ and the tangential component is $V_I$.

If a parallelogram of velocities is drawn (as shown for two different points in the path) the diagonal makes an angle "a" to the line of $V_T$ such that:

\[ \tan a = \frac{V_T}{V_I} \]  
(Formula No. 2)

or, from Formula No. 1 above,

\[ \tan a = \frac{V_E}{\sqrt{Rg}} \]

To maintain the tobacco in the desired curved path the direction of the air must remain tangential to a circle concentric with said path and from Formula No. 1 and Formula No. 2 combined it can be deduced that the tangents, that is, the directions of the airstream at any point along the curved path, are tangential to a circle having a radius

\[ r = \frac{R}{\sqrt{V^2 + Rg}} \]

This formula is derived as follows: Referring to FIGURE 6A which shows part of FIGURE 6, together with some additional lines, $V_T$ is substituted for $V_r$, and $V_E$, $V_I$ and $Rg$ for $V_r$ in the full line parallelogram. A radius $r$ is drawn at right-angles to the tangent which touches the desired circle. A right-angled triangle is thus obtained with sides $r$ and $R$ and a third side extending along the said tangent and having a length equal to:

\[ \sqrt{R^2 - r^2} \]

and with an angle equal to angle "a" of FIGURE 6, at the position marked O, in FIGURE 6A, which position is the center of the two circles.

This triangle and the triangle at the left-hand side of the parallelogram are similar triangles and thus:

\[ \frac{R}{r} = \sqrt{\frac{V^2 + Rg}{V^2}} \]

Dividing top and bottom by $\sqrt{Rg}$, we have

\[ \frac{R}{\sqrt{V^2 + Rg}} = \frac{R}{\sqrt{Rg}} \frac{V}{\sqrt{Rg}} \]

The circle of radius "r" shown in the figure has been derived on the assumption that the parts are to scale, and the directions correct, and $V_T$ has been reckoned at 148 cms. per second; a typical value.

In FIGURE 5, $V_T$, at a position near reference A, represents the speed of the tobacco thrown by the picker roller. The line on which $V_T$ is marked also represents the trajectory of this tobacco. When the thrown tobacco comes under the influence of the air through the wall 6, that is, the first airstream, the tobacco path begins to turn upward as a circular arc substantially parallel to the periphery of the perforated roller 7, and curving up into the entrance to the narrow vertical passage as indicated by the arrowhead near point C.

It will be seen from FIGURE 5, where the centre lines of a few holes 6A are marked by broken lines, that the holes in the wall 6 are all radially directed to a point marked P. The wall 6, as drawn, is a compromise between what is desirable and the economic manufacture of the part. The circle of radius "r" in FIGURE 6 is reproduced here in FIGURE 5 and the tangents drawn in full lines, as near as may be, through each hole. Considering that jets of air are to issue from the holes it will be seen that by making the holes radially directed to the point P, the first airstream moves substantially in the desired direction. Of course the holes 6A could be drilled to make them parallel with the respective tangents but the wall 6 illustrated is satisfactory in practice.

Although, because the holes are made radially from P instead of being tangential to the circle of radius "r," the thrown particles will tend to slow down between the points marked B and M on the drawing, this slowing down is compensated for by the acceleration given to the particles between points A and B. In any case these changes of speed of the particles are very small because the time during which the air can act on the thrown to-
bacco is very short. The angle "a" and thus the position of the point P, at any setting of the wall 6, depends on the terminal speed Ve of those particles which ought to be deviated towards the narrow vertical passage, that is, towards the lamina. For this reason the arrangement of the wall 6 is arranged to be adjustable on a pivot 35, arranged as shown in FIGURE 2, to take into account the nature of the particular tobacco being treated and to assist the forces tending to cause the tobacco to assume the curved path. As far as possible the curvature between points B and C, of FIGURE 5, should be constant and so arranged, that is, concentric with the centre of the cylinder 7 as not to cause the tobacco to lift between the points A and B because this might cause laminae, carrying slivers along with it, to stick on the suction roller 7. Therefore the volume of air through the wall 6 and its distribution must be such that the average action of the air is equal to the force of gravity on the thrown tobacco between A and B and to the centrifugal force between B and the point C. For this reason the pitch or spacing of the holes 6A in the wall 6 is greater at the side near the edge of the plate 5, that is, between the right-hand side of an arc marked "b" and the plate 5.

As it is desirable that the curvature of the tobacco path should be constant between points B and C and as the speed should not vary, the speed of the air should also be constant. Under these conditions the pitch or spacing of the holes the arc marked "c" should be greater than the pitch or spacing of the holes at the arc marked "b." This is because the path of the tobacco in the region defined by the angle subtended by the arc "c" is nearer to point P than in the region defined by the angle subtended by the arc "b." It is pointed out that the direction and distribution of air which is to cause the tobacco to assume the curved path could be obtained by a simple thin perforated curved plate, as in the patent first referred to, instead of the wall 6, said plate having a variable "permeability." Permeability, which depends on the diameter of the holes in a perforated plate and their pitch or spacing, is the total perforated area per unit of plate area. In a plate having variable permeability its holes would be more closely pitched at one part than at another. But with such a plate the air would have to arrive on the lower face of the perforated plate with a negligible speed. To ensure this, the air coming from the diffuser 48 would have to be uniformly distributed and perfectly diffused but this result has now yet been attained in practice. For these reasons the length of the holes in the wall 6 (and thus the thickness of the wall) must be sufficient to render the streams of air so that the latter are correctly directed at the exit from the holes. It is difficult to state exactly a minimum ratio of length of the holes to their diameter, that is L/d, because it depends on the aerodynamic field under the wall. The more this field differs from the desired field the bigger this ratio of L/d should be. It appears however that if the ratio of L/d is less than 3 the wall would be useless, as compared with a thin curved perforated plate and, as previously mentioned, the length of the holes must be sufficient to ensure that the streams of air are correctly directed at the exit from the holes and this means in practice a ratio L/d of the order of at least three.

It will be observed from FIGURES 2 and 5 that the lower face of the wall 6 is a circular arc, struck from the point P, as this provides surfaces at the entry side of the holes which are normal to the axes of the holes. If the wall is not shaped in this manner, the ratio L/d should be increased to take account of the eccentric position of the vena contracta; see FIGURE 7 where the position is marked by a black dot, the wall 6 in that view being flat on both sides.

Broadly speaking, the direction of the axes of the holes in the wall 6 and their distribution are imposed by the arrangement of the plate 5, the roller 7 and the wall 6 itself.

The permeability of the block should be sufficiently low to cause above the block a suction effect capable of drawing in the necessary air; some coming from the throat 16 and some from the space between the plates 31 and 32, FIGURE 2, where, as previously mentioned, dust and like fragments falling from the carded roller 1 are carried by the air through the space between 31 and 32 to join the tobacco proceeding towards the narrow vertical passage.

Under these conditions the permeability of the wall 6 depends essentially on that of the plate 17. In the particular machine being described the plate 17 has a permeability of 35% and the suction above the block 6 is around 0.5" water gauge and the permeability of the wall 6, as considered in relation to its flat upper surface, is 25%.

It remains now to settle the diameter of the holes in the wall 6 and also the mean pitch between the holes, since these factors are imposed by the permeability decided on. These points are discussed in the following text.

It is vital that the aerodynamic field created by the wall 6 is not disturbed by the air coming up the throat 18. This requirement is met by the following arrangements:

Referring to FIGURE 7, the line X-Y represents the average plane along which tobacco from the picker is thrown and arrows show how material, not carried up the passage 9 in the first instance, strikes the part 15A of wall 15. The momentum of the air from the wall 6 in the zone marked Z on FIGURE 7 is increased, as compared with the arrangements in the two patents first referred to. At the exit from the holes the streams of air dilate and lose part of their kinetic energy. To reduce this loss the diameter of the holes must be increased. For example, the speed of the air at 1" from the exits of the holes increases by 65% when the diameter of the holes is increased from 1/8" to 1/4".

To avoid disturbing the said aerodynamic field the horizontal momentum of the air coming from the throat 18 is reduced as follows:

The direction of the axis of the channel 18 and its shape are altered from that shown in the two patents first referred to. As will be seen from FIGURE 5, the wall 15B is attached to the wall 6, and moves with it if the latter is adjusted on its pivot 35. The wall 15B (and the axis of the throat 18) is at an angle "e" of the order of 40° to the flat face of the wall 6 giving the throat an inclination of about 56° (angle "g") to the horizontal in an average setting of the parts. The wall 15 of the throat 18 can be adjusted somewhat when the wall 15B moves with the wall 6.

It will be appreciated that the angle given as 56° will change when the wall 6 is adjusted for position and any substantial rearrangement of parts, such, for example, as the picker roller and plate 5, will affect the various values given in the specifications but FIGURE 5 and the relevant text will form a basis for any structure of a similar kind.

The speed of the particles entering the throat 18 has been considerably reduced by the construction of the wall 15 of this throat. The particles strike the vertical part of the wall, marked 15A, and lose all their speed. Because of this the force of the air emerging from the throat and moving in a direction which is, to some extent, opposite to the direction of movement of said particles has been reduced and that of the air causing the tobacco to take the curved path is increased as compared with the conditions in the constructions described in said two patents.

To improve the separation of stems from the remainder of the tobacco under the roller 7 the following procedure is adopted. The permeability being selected as indicated above, if it is decided to use holes of larger diameter the space which separates two neighbouring jets of air has to increase to keep the permeability constant. The result is
that particles or groups of particles very close to one another, are subjected to a shaking action which favours the separation of stems by diffusing or separating the stream of particles.

To improve the separation of lamina in the throat 18 the following procedure is adopted. It has been observed in trials that the particles of tobacco thrown by the picker are not all projected at the same speed. In particular, certain fairly short particles of lamina as well as short pieces of stem, all these being usable fragments, have speeds higher than those of long thin curved stems (slivers) which have to be eliminated. These speed differences might cause excessive elimination of usable fragments because the airstream coming up the throat 18 may be too weak to effect any considerable braking action on the particles, taking into account the differing final speeds of these different particles.

The vertical wall 15A is provided, as previously noted, to make all these different particles lose their differing respective speeds so that separation takes place only on the basis of their respective terminal speeds.

The vertical wall 15A helps to prevent usable fragments from being discarded, for without it it is comparatively easy for short pieces of stem, that is usable stem, to be discarded because their initial speeds at the picker roller and also their final speeds are greater than those of the said slivers. The impact on the wall 15A causes the short pieces of stem to rebound in a direction more or less towards the roller 7 because of their high speed and their high coefficient of restitution as compared with those of slivers and lamina. As these pieces of usable stem return rapidly across the airstream up the throat 18 they have a second chance of being carried by this air upward to the narrow vertical passage. The wall 15B has an air inlet marked 15C. This helps to prevent any usable stem, or even lamina, which may deposit on the wall, from sliding down into the box 16 instead of becoming airborne.

As mentioned in the earlier description, two stationary members 50 and 51 are provided in the interior of the roller 7. As these serve to control the movement of air inside the cylinder they should be moved round the axis of the roller when the disposition of the wall 6 is altered by adjusting the wall about the pilot 35.

In addition to the adjustment provided for the wall 6, the width of the opening 18 can be adjusted by a bracket 27 and the guide member 8 can be adjusted by rotation, though this adjustment is not shown. The effect of these adjustments will be to alter the velocity of the air in the throat 18. The adjustment of wall 6 will also alter the air stream up the throat 18 as the wall 15B thereof is moveable with wall 6.

Referring again to FIGURE 3, it will be seen that the holes 6A are arranged in parallel rows and their centres line in planes normal to the length of the wall 6, consequently normal to the length of the roller 7, or the horizontal length of the narrow passage. In FIGURE 3, the holes are all shown as circles, for ease of illustration, but it will be appreciated that it is only at the middle of the width of the wall that they would appear as circles, and that holes away from the mid-width would appear as ellipses because of the angular disposition of the holes with respect to the flat face of the wall shown in the figure. The holes in the wall 6 illustrated are \( \frac{1}{4} \text{"} \) diameter and the pitch is such as to give the permeability decided on.

A wall constructed exactly as illustrated, and well proved in practice, is very satisfactory. In the earlier constructions, where a thin perforated plate is used, instead of this wall, pieces of stem, or other obstructions, sometimes lodged in the small perforations and impaired the performance of the machine.

It is necessary at times to empty the box 16, and as its removal during operation of the machine would upset the airflow, as the perforated plate 17 is part of the box, a further perforated plate 17A is provided, hinged at 17B, so that it can be swung round to the broken line position before the box is removed, and opened again when the box is replaced. Movement of 17A is effected by a crank and handle 17D, and an overcentre spring 17E keeps the plate 17A in either position. In addition, the normal position of the plate 17A can be adjusted by sliding a shunter 17C across the plate 17, thus altering the total effective aperture of plate 17.

FIGURE 4 shows a desirable improvement to the box, whereby mere withdrawal of the box operates flap 17A to close it. The rapid closure of some importance, as although the box is only removed at long intervals, it is necessary to close the passage 18 quickly, as a sudden additional flow of air up towards the entry would impair the winnowing action. The crank 17D is therefore pivoted to a link 40, whose lower end is pivoted to an arm 41 of a bell-crank lever pivoted at 42. The other arm 43 of the bell-crank lever is held against a stop 44 by a spring 45. The stop is fixed to the box so when the box is withdrawn, the spring pulls the arm 41 upwards to move the crank 17D so that the flap 17A closes the opening 18. On the return of the box to the position shown, the stop 44 presses the arm 43, and the flap 17A is returned to its normal position.

By altering the orientation of the wall 6, by adjusting it on its pivot 35, the general direction of jets of air streaming through the holes 6A (the first airstream) can be changed. By adjusting the plate 17C, the volume and speed of the air up the throat 18 (the second airstream) may be varied. The momentum of air from wall 6 influences the movement of air coming from the throat 18 and the reaction tends to crowd the air from the throat 18 toward the vanes 8A, and enhances the guiding function of these vanes. In addition to the manual adjustments possible, all of which can influence the speed and volume of airflow it is, of course, possible to alter the actual flow of air up passage 9 and through roller 7 by regulation of the fans.

What we claim as our invention and desire to secure by Letters Patent is:

1. In a continuous-rod cigarette-making machine of the kind in which cut tobacco is carried upward to form a filler on an air-pervious conveyor by a flow of air through a narrow, substantially vertical passage, at the top of which the conveyor is located, said passage having a rectangular cross section with two long walls extending in the same direction as the direction of movement of the conveyor and the continuous rod, and tobacco is impelled towards the lower end of the passage by a picker roller which throws the tobacco along a path between a rotating perforated cylinder and a performer through which air is drawn by suction applied through said cylinder whereby the airstream between the perforated member and the cylinder effects a winnowing operation and applies a force to such tobacco shreds as the airstream is capable of lifting and imparts a curving direction to them leading them towards the entry of said passage, while the remainder of the thrown tobacco passes between two walls constituting a throat up which a second airstream is flowing to effect a further winnowing operation on said remainder and carry any particles airborne by the second airstream towards the entry to said passage, the improvement consisting of said perforated member having holes therethrough such that the air issuing from them is in the form of jets, said holes being oriented at angles such that the jets are tangential to a circle concentric with the perforated roller, said circle having a radius \( r' \) derived from the formula:

\[
r' = \frac{R}{\sqrt{1 + \frac{Ve^2}{g}}}
\]

wherein R is the radius of the desired curved path of the tobacco shreds led towards the entry of said passage, \( Ve \) is the terminal speed in free fall of said tobacco shreds, and g is the acceleration due to gravity.
2. In a continuous-rod cigarette-making machine as set forth in claim 1, wherein said holes in said perforated member are oriented to a common focal point, so positioned that the majority of the jets issuing from said holes are substantially tangential to said circle.

3. In a continuous-rod cigarette-making machine as set forth in claim 1, in which the side wall of said throat which is remote from said picker roller has a vertical portion against which the thrown tobacco impacts, causing said thrown tobacco to rebound from said vertical portion and pass across said throat again and be subjected again to the second airstream, whereby short pieces of stem, suitable for incorporating in a cigarette, are carried upward towards the entry of said vertical passage.

4. In a continuous-rod cigarette-making machine of the kind in which cut tobacco is carried upward to form a filler on an air-pervious conveyor by a flow of air through a narrow, substantially vertical passage, at the top of which the conveyor is located, said passage having a rectangular cross section with two long walls extending in the same direction as the direction of movement of the conveyor and the continuous rod, and tobacco is impelled towards the lower end of the passage by a picker roller which throws the tobacco along a path between a rotating perforated cylinder and a perforated member through which air is drawn by suction applied through said cylinder whereby the airstream between the perforated member and the cylinder effects a winnowing operation and applies a force to such tobacco shreds as the airstream is capable of lifting and imparts a curving direction to them leading them towards the entry of said passage, while the remainder of the thrown tobacco passes between two walls constituting a thrrost up which a second airstream is flowing to effect a further winnowing operation on said remainder and carry any particles air-borne by the second airstream towards the entry to said passage, the improvement consisting of said perforated member being thick and having a flat face on the side nearer the perforated cylinder, said face being substantially parallel to the trajectory of the tobacco thrown by the picker roller, said perforated member having long holes therethrough such that the air issuing from them is in the form of jets, said holes being oriented at angles such that the jets are tangential to a circle concentric with the perforated roller, said circle having a radius \( r \) derived from the formula:

\[
r = \frac{R}{\sqrt{1 + \frac{V^2}{g}}}
\]

wherein \( R \) is the radius of the desired curved path of the tobacco shreds led towards the entry of said passage, \( V \) is the terminal speed in free fall of said tobacco shreds, and \( g \) is the acceleration due to gravity.

5. In a continuous-rod cigarette-making machine as set forth in claim 4, wherein said perforated member has a second face opposite said flat face through which the air enters said holes, said second face being shaped to provide surfaces surrounding said holes substantially normal to the axes of the respective holes.

6. In a continuous-rod cigarette-making machine as set forth in claim 4, in which said perforated member is of a thickness at least three times the diameter of the holes.

7. In a continuous-rod cigarette-making machine as set forth in claim 4, in which the axis of the throat up which the second airstream flows is inclined at an angle of substantially 40 degrees to the plane of the flat face of said perforated member.

References Cited by the Examiner

UNITED STATES PATENTS

1,999,120 4/35 Werner.
3,030,965 4/62 Labbe 131—110 X
3,092,117 6/63 Labbe 131—110
3,095,883 7/63 Morris 131—84

FOREIGN PATENTS

311,618 5/29 Great Britain.
445,044 4/36 Great Britain.

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