ABSTRACT

An end plate assembly for use in tobacco sorting apparatus having a conveyor having a forward end and a sensing system mounted above the forward end of said conveyor. The end plate is spaced below the sensing system in operative position adjacent the forward end of the conveyor and is mounted at the lower end of a pair of arm members. The arms are pivotally mounted to the conveyor frame to permit the plate to swing away from the forward end of the conveyor. Spring means biases at least one of the arm members toward the forward end of the conveyor to maintain the end plate in operative position.

19 Claims, 4 Drawing Figures
TOBACCO SORTING APPARATUS
This is a continuation of Ser. No. 453,079, filed Mar. 20, 1974.

BACKGROUND OF INVENTION
The present invention relates to apparatus for grading tobacco, and in particular, to apparatus for automatically grading tobacco leaf or portions thereof, at high speeds.

In my copending application Ser. No. 235,169, there is disclosed mechanical apparatus for delivering tobacco leaf, or their portions on a moving conveyor belt to a sensing station comprising an array of photo-tubes, spaced above an end plate over which the leaves pass. The end plate is mounted at the end of the belt and acts to provide the leaf with a fixed surface on which it is supported, while the photo-tube senses the leaf's reflection. An air ejection system is mounted below the end plate. In my copending application Ser. No. 235,342, a suitable sensing and control circuit is shown for determining the degree of reflectivity of the leaf and in response thereto the operation of the air ejection system. Reference can be made to both these applications for a more complete disclosure.

In actual practice the conveyor belt is designed to be driven at very high speeds and to carry very large amounts of tobacco leaf, which in general, are arranged in a random disordered fashion. The end plate extends the width of the belt, immediately adjacent its forward end establishing an adjustable surface for the sensing operation. While the plate is mounted so as to be normally as close to the edge of the belt as possible a small space occurs between it and the belt, into which the speedily moving disoriented tobacco on occasion tends to enter. The tobacco becomes jammed between belt and plate causing a pile-up of subsequent tobacco. When this occurs it is necessary to stop the conveyor, and manually clear the jam of tobacco and thereafter manually restart the conveyor.

It was proposed in the aforementioned Ser. No. 235,169, to mount the plate so that it would be slideable within a pair of rails extending forwardly from the conveyor, and to be resiliently biased normally toward the conveyor, so that should a jam or pile-up of tobacco occur, the plate could under the force of tobacco, move away from the conveyor, forming a larger space through which the excess tobacco might pass. Thus, automatically clearing the jam. In general, this reciprocating movement was successful although it has not completely eliminated jams.

It is an object of the present invention to provide a new and improved arrangement, in a tobacco grading apparatus of the type described, for mounting the plate at the end of the conveyor, so that it is more easily movable under pressure of a tobacco jam.

It is a further object to provide in the apparatus described new and improved means for mounting a combined assembly of plate and air ejection system so that it is pivotable, under varying conditions toward and away from the edge of the conveyor rather than reciprocable so that the time required for automatic clearance of the jam is reduced.

It is a further object of the present invention to provide an apparatus of the type described, means for mounting an assembly of plate and air ejection system in which tobacco jams are significantly avoided or reduced.

It is still a further object of the present invention in which the plate may be easily removed, facilitating its replacement.

It was also disclosed in the aforementioned patent, to sweep the obverse surface of the plate with a blast of air, in order to remove dust and other particles which would tend to inhibit the movement of tobacco. The air was provided through a perforated tube lying adjacent the surface of the plate.

It is an object of this invention to provide a new arrangement wherein the air is impinged on the plate from above, so that it acts to both scavange the plate when no tobacco is on it as well as act against the tobacco causing it to become flattened against the plate during optical sensing. This arrangement eliminates excessive shadow, and tends to spread a greater part of the leaf, than heretofore, before the photo-tube.

These and other objects of this invention will become apparent from the following detailed description.

SUMMARY OF THE INVENTION
According to the present invention tobacco sorting apparatus in which leaf is passed over a moving table like conveyor and sensed, as to its reflectivity at one end thereof, there is provided an end plate assembly, adapted to provide a surface for the leaf during sensing.

The end plate assembly comprises a pair of elongated depending arm members spaced apart the width of the conveyor. Arranged at the lower end of the arms is means on which the end plate is supported. The arms are mounted at their upper ends so as to be pivotally movable toward and away from the conveyor. Spring means are provided to normally bias the arms, and thus the end plate into operative position adjacent the conveyor. Should a jam of tobacco, or other material occur between the end plate and the conveyor, the arms will be caused to swing separating the end plate from the conveyor, allowing the jammed tobacco to fall free. Thereafter, the spring means will automatically cause the arms to swing the end plate back into operative position.

In the preferred embodiment, means limiting the extent of movement of the arms in both directions is provided. Also, sensing means, is provided to sense the arms in their operative positions. Thus movement of the arms from this position can signal the stoppage of the apparatus or at least the feed of the tobacco.

Further, in accordance with the invention, the end plate support means is adjustable to vary its tilt with respect to the plane of the conveyor. Also air means is provided to blow a stream of air onto the end plate. These features enable the leaf passing over the plate to be flattened and momentarily held for the sensor detector.

A flexible flap is provided between the end plate and the conveyor permitting small and insignificant loose tobacco and debris to fall between the two without moving the arm assembly.

A further feature relates to the end plate support which is formed so that the end plate may be easily removed. To this end it is preferred to employ a frame and magnetic holding structure.

Full details of the present invention are set forth in the following description and are shown in the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS
In the drawings:
FIG. 1 is a side elevational view of a leaf sorting apparatus, to which the present invention may be adapted;

FIG. 2 is an isometric view of the front end of the apparatus of FIG. 1 showing the arrangement of the present invention;

FIG. 3 is a side elevational view of the apparatus of FIG. 2; and

FIG. 4 is an end view of the apparatus shown in FIG. 2.

DESCRIPTION OF INVENTION

In FIG. 1, the general configuration of tobacco sorting apparatus as described in the aforementioned application is shown. The apparatus comprises a system wherein tobacco leaves L, which may be whole, cut tips or butts or particles of threshed or unthreshed leaves, are fed from a feeder onto an endless conveyor belt 12 mounted on a stationary frame 14 for movement in the direction of the arrow A. At the forward end of the conveyor belt 12, the tobacco passes through an end plate assembly P. The tobacco passing through the end plate assembly is scanned by one or more detectors 16 suitably located in a housing 18 mounted above the table. The leaf is illuminated by light banks 20 arranged in conjunction with the detectors 16. The detectors are more fully disclosed in our aforementioned copending applications and produce a signal indicative of the reflectivity of the tobacco leaf L passing beneath it. The desired tobacco leaf L is caused to drop into a near hopper 22 while the undesirable tobacco leaf is blown into a far hopper 24 by an air jet 26 associated with the respective detector.

In accordance with the present invention, there is provided at the forward end of the conveyor 12 a pair of standards 30. The standards may be T-shaped, or comprise a solid wall or open beam frame. Each standard 30 is bolted or otherwise fastened to the opposite sides of the frame 14 on which the conveyor itself is mounted so that it extends upwardly, parallel to the other straddling the conveyor. The standards terminate in a supporting upper edge 32 which are secured to spacer bolts and bushings 34 adapted to adjustably carry a horizontal bracket 36. Resting on the upper edge of the horizontal bracket 36 is the housing 18, in which the photo sensor tubes and light banks are located. Suitable bolts or other fastening means can be used to secure the housing 18 to the bracket 36.

The end plate assembly P is located generally below the housing and comprises a pair of arm members 38, each one being located adjacent a respective standard 30, to be spaced from each other at least equal to the width of the conveyor. The arms 38 depend below the housing 18 toward the floor on which the frame rests. The arm members 38 are preferably rectangular wall like plates or sheets, having upper and lower edges, although an open frame work, beam construction or other forms are possible. Each arm member 38 is freely pivoted at its upper forward corner (i.e. remote from the forward end of the conveyor) to the horizontal bracket 36 by a fixed pin 40. The pins 40 are aligned along a single axis. Fixed by a pin 42, to each of the arms 38 between the pivot pin 40 and the rear corner of the arm, is one end of an elongated tension spring 44 which is stretched and anchored at its other end to a pin 46 fixed on the housing 18. The spring 44 normally biases the arm member in a counterclockwise direction as viewed in FIG. 3 in an upward arc shown by arrow B.

This upward biasing or movement is limited by a stop member 48, comprising a circular cam mounted on an eccentric shaft 50, journaled in the horizontal supporting beam 36. The shaft 50 is adapted to be rotated by a wrench, screw driver or the like to cause a selected portion of the cam edge to engage the upper edge of the depending arm, whereby the degree of movement in the direction of arrow B can be adjusted.

As seen in FIG. 3, a brace 52 is secured at the rear, between the arm members 38, at approximately the level of the conveyor 12. The brace 52 is secured to each of the depending arms in a manner to fixedly connect them together, so that they are conjointly movable. The lower end of the arm members 38 are further connected by an open frame work 54 in which a plurality of magnet members 56 are set. A removable end plate 58 rests on the magnets 56. The end plate 58 comprises a rough non-metallic or a metallic sheet of ferrous, non-ferrous, or aluminum material, which may or may not have its obverse surface coated, anodized or otherwise provided with a reflective finish of the degree required for the photo sensing operation. The obverse surface may be sandblasted to obtain its rough finish. If the end plate 58 is made of non-ferrous material, its reverse side is provided with ferrous or magnetic disks or wafer correspondingly situated to coat with magnets 56.

The rear edge of the frame 54 is pivotally connected to the side arms 38 about an axis parallel to the edge of the belt. Suitable hinges formed by pivot pins 60 are used to this end. Alternatively, a hinge means can connect the frame to the transverse brace 52. The frame 54 is thus enabled to tilt, raising or lowering its front edge in the direction of arrow C, so as to seat at an angle to the plane of the belt. The depending arms 38 are provided with a plurality of holes 60 into which a suitable locking pin, such as a cotter, can be inserted to hold the frame 54 in its adjusted position. The frame 54 is similarly provided with holes to receive the locking pin.

The ability to tilt the plate enables the effective level of the contact surface for the leaf to be adjusted so that the leaf is supported during the period it is sensed by the photo-tube. For example, the angle of tilt may be varied in dependence upon the speed of the leaf travel so that if the leaf is accelerated at a high speed off the end of the belt giving if the tendency to fly from the belt, the plate may be elevated to a high upward angle to thereby insure that leaf contact. At slower leaf speeds the plate may be lowered since the leaf itself does not tend to fly over the plate.

Contact of the leaf with the plate serves first to insure the absence of shadow between leaf and plate, and secondly, to insure that the leaf is as best as possible in extended or in stretch condition beneath the photo-tube.

Another advantage of creating contact with the plate, is the ability of the equipment to insure proper reading no matter the variance in size or lack of homogeneity of the leaf. It is well known that leaf under conditions of grading vary in size, vary in openness or degree of wrinkles, moisture content, stem content etc. All of these conditions influence the accuracy of the sensing process. By insuring that even the smallest leaves contact the plate, it is assured that a more accurate, uniform and constant reading is obtained.

In general, the frame work 54, magnets 56, plate 58 and the transverse brace 52 should be formed so that
the trailing edge of the obverse surface of the plate and the transverse brace 52 lie substantially flat and coplanar with, or slightly below the conveyor. Other means for removably seating the end plate 58 on the frame 54, such as spring clips, may be used rather than employing magnets.

Mounted on the frame work 54 below the end plate 58, is an air ejection system of the type disclosed in the aforementioned patent applications. The system comprises an elongated tube 62a rotatably journaled at each end in a supporting block 64, so as to extend transversely to the conveyor and parallel to the forward edge of the end plate 58. The tube is provided with a plurality of air holes or nozzles 66, which are divided by a plurality of inner walls, so that the tube is formed with discrete lengths each having a number of holes. Each length of the tube 62 is connected via a conduit to a solenoid controlled air valve 68, which is adapted to be activated on receipt of an impulse signal as described in the aforementioned application. The tube is rotatable to direct the nozzle within a funnel like range, indicated for illustration only by the angle $\alpha$ in FIG. 3.

Secured to the upper edge of the transverse brace 52, is a flexible flap 70 which extends across the width of the brace between the depending arm members 38. The flap 70 is preferably formed of a plastic, or composition fabric material to have a predisposed arcuate bend, so that it extends freely and resiliently downward and backward into engagement with the forward end of the conveyor 12. The free end of the flap 70 extends substantially below the horizontal central plane of the drum over which the conveyor 12 is rotated so that it effectively seals the space between the brace 52 and the conveyor 12, (i.e. bridging the normally open space between the conveyor 12 and the end plate 58) while simultaneously being free to follow the direction of rotation of the conveyor. Being bent in this arcuate configuration, small numbers of heavy tobacco leaf pads or chumps as well as dirt, carried by the belt will be easily able to squeeze past the flap 70 on to the floor, while the larger numbers of leaf will move over the flap on to the end plate. Preferably, the flap 70 is secured to the brace 52 by set screws, a retaining cover strip or the like so that it may be easily removed, but will not interfere with the flow of tobacco.

In operation, should leaves jam between the conveyor 12 and the flap 70 (or the arm members 38), as they are being fed, such leaves will push on the flap 70 in the direction of their travel A. When such pushing force is greater than that of the biasing spring 44, the leaves will cause the lower end of the end plate assembly to swing away from the forward end of the conveyor 12, as indicated by the arrow D. This will cause both arms simultaneously to swing away about their pivot pin 40, in an arc opposite to that of the arc indicated by arrow B carrying with it the brace 52, the end plate 58 and the air ejection system into the dotted line portion seen in FIG. 3. As a result the flap 70 is caused to move away from the conveyor 12 leaving a relatively large space therebetween through which the jammed tobacco abutting against the flap will fall by its own weight, the movement of the conveyor and subsequent tobacco automatically clearing the jam. When the jam is cleared, the biasing spring will again act to swing the entire plate assembly in the direction of arrow B closing the space between flap 70 and conveyor 12.

A particularly advantageous object of the present construction lies in the fact that the bridging flap 70, end plate 58 and air ejection system 62 swing conjointly about a single pivot point 40 which remains fixed with respect to the forward end of the conveyor 12, so that even after successive movements the assembly will be returned to the exact position relative to the conveyor in which it had been initially fixed. The relative positions of the conveyor and end plate assembly is thus never changed during operation by the automatic response to jams.

When initiating operation of the sorting apparatus, or even during operation, the position of the end plate assembly can be determined with respect to the conveyor in several ways. First the height of the end plate, with respect to the level of the conveyor, can be selected by the use of bolts and/or bushings 34 by which the supporting beam 36 is mounted on the standard, of determined length so the entire assembly may be raised or lowered as desired. Adjustable length bolts and spacers are particularly suitable. Secondly, the distance along the horizontal, between the conveyor 12 and the end plate assembly P may be selected by providing the supporting beams 36 with a plurality of holes spaced at defined positions, for receiving the fixed pivot pins 40. Thirdly, the roller cam 48 enables the positioning of the end plate assembly to be further adjusted, by allowing it to be tilted, within given limits, to the horizontal. All or selected combinations of these adjustment means may be employed.

A further advantage arises from the present construction, in that the end plate assembly P and the sensor/light housing 18 are both mounted on the same supporting beam 36. The two assemblies may thus be mounted on the beam prior to installation on the standard, so that the phototubes, lights and end plates may be properly positioned with respect to each other according to factory standards. Thereafter, their relative positions need not be changed, since adjustment can be made of the supporting beam on the standard via the length and axial location of bolts and bushing 34. Further adjustment of the end plate assembly can be made by variation of the roller cam 48.

To sense and determine when a jam has occurred, a micro switch 72 is mounted on the supporting beam 36 above the rear corner of the upper edge of one of the arm members. The leaf contact 73 of the micro switch normally engages the edge of the arm 38 and is closed, but when the end plate assembly P, due to a jam, is pivoted downward, away from it, the switch loosens contact and becomes open. The signal thus derived may be used to light a signal lamp, stop the tobacco feed motor or initiate some other function. When the jam is removed, the upper edge of the arm members again closes the micro switch, indicating that the system is ready for operation. It may automatically restart such operation.

Still further according to the present invention, a stream of air is directed onto the end plate 58 from a hollow tube 74, extending transversely across the end plate assembly. The tube 74 is rotatably journaled in manifold blocks 76 secured to the inside walls of the bracket members 36, to which a conduit 78, from a source of air under low pressure, is connected. The tube 74 is provided with a series of holes 80, which can be aimed at selected portions of the end plate, by simply rotating the tube. This arrangement has particular advantage, in that the air impinging on the plate forces
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7. The apparatus according to claim 6 including an elongated spring secured at one end to said wall between said remote pivot and the conveyor and secured at its other end to said standard.

8. The apparatus according to claim 6, including stop means for limiting the movement of said wall comprising an eccentric cam member, rotatable into a plurality of fixed positions, engaging an edge of said wall.

9. The apparatus according to claim 6, wherein said means for sensing the movement of said end plate includes a switch engaging an edge of said wall.

10. The apparatus according to claim 6 wherein said sensing system is contained in a housing mounted on said standards above said walls.

11. The apparatus according to claim 1 including a flexible flap member secured to the lower end of said arm members adjacent said forward end of said conveyor and extending the width of said conveyor to bridge the space between said end plate and said conveyor.

12. The apparatus according to claim 11 wherein the flexible flap engages the surface of said conveyor and is normally curved in an arc following the direction thereof.

13. The apparatus according to claim 1, including means for remotely supporting said end plate on said arm members.

14. The apparatus according to claim 13 wherein said end plate is metallic and said supporting means comprises magnets secured to said arms.

15. The apparatus according to claim 13 wherein said end plates are ferrous metals and said supporting means comprise connective magnet means secured to said arms and said end plates.

16. The apparatus according to claim 1 including an air ejection system comprising a plurality of nozzles mounted between said arm members below said plate and means for selectively supplying air to said nozzles.

17. The apparatus according to claim 16 wherein said nozzles comprise an elongated rod provided with holes in selected portions thereof, said rod being connected at each end to a respective one of said arms.

18. The apparatus according to claim 1 including means for pivotally mounting said end plate supporting means on said arm members, enabling the tilting of the surface of said end plate with respect to the plane of said conveyor.

19. Tobacco sorting apparatus comprising means for movably carrying tobacco leaves, surface means for receiving the leaves from said carrying means, a scanner juxtaposed with respect to said surface means for sensing said leaves, said surface means being mounted on a movable supporting frame and means for mounting said frame to be pivotal from a position adjacent said carrying means to a position removed therefrom.

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