APPARATUS FOR SCORING SHEET MATERIAL

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ABSTRACT

A cutter assembly for scoring a score line in a surface of sheet material, is connected to the piston of a double-acting pneumatic cylinder and piston operable to urge the cutter assembly towards the surface to be scored.

10 Claims, 4 Drawing Figures
APPARATUS FOR SCORING SHEET MATERIAL

BACKGROUND OF THE INVENTION

The invention relates to apparatus for scoring sheet material, e.g., glass sheets or continuous glass ribbons, prior to breaking the sheet along the score line or lines.

SUMMARY

According to the invention apparatus for scoring a score line in a surface of sheet material, comprises a cutter assembly, and a double-acting pneumatic cylinder and piston, the cutter assembly being connected to the piston whereby the piston is operable to urge the cutter assembly towards the surface to be scored.

Preferably the cutter assembly is mounted on a foot connected to the piston, said foot having wheels disposed on either side of the cutting tool of the cutter assembly for engagement with the edges of said surface immediately preceding and subsequent to the scoring operation.

Preferably the relative dimensions of the piston and the cylinder are arranged so that there will be a flow of air between said cylinder and piston during movement of said piston, said air flow being sufficient to create an air bearing between said cylinder and piston.

It is also preferred that said cutter assembly is connected to one end of a shaft comprising an extension of the piston, and the cylinder comprises a housing having a passageway through which said shaft projects, the relative dimensions of the shaft and the passageway being arranged so that there will be a flow of air between said shaft and passageway during movement of the piston, said air flow being sufficient to create an air bearing between said shaft and passageway. Flow-assisting shoulders may be provided at the end of the passageway adjacent the cylinder.

In a case in which the apparatus is adapted to score at least two score lines in a surface of sheet material, the apparatus includes a corresponding number of cutter assemblies and respective independently operable double-acting pneumatic cylinders and pistons mounted on a support bar whereby the spacing between the cutter assemblies is variable.

In one form of the invention the apparatus is adapted to be mounted above a conveyor, the cutter assembly or assemblies being adapted to longitudinally score the upper face of sheet material passed along said conveyor. The conveyor may be a roller conveyor, the cutter assembly or assemblies being mounted above a transverse roller of the conveyor.

In another form of the invention there are provided means for moving the cutter assembly or assemblies at an angle across moving sheet material, in a forwardly direction, the angle and speed of the cutter assembly or assemblies being related to the speed of the sheet material whereby the upper face of the sheet material is scored transversely.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation, partly in section and part cut-away, of apparatus by way of example for longitudinally scoring sheet material.

FIG. 2 is a front elevation of another apparatus for longitudinally scoring sheet material.

FIG. 3 is a front elevation of apparatus for transversely scoring sheet material, and

FIG. 4 is a side elevation of the apparatus of FIG. 3.
permitting a very quick and responsive action of the cutting wheel 14 to any variations in the upper surface of the glass sheet S. To facilitate this small flow of air, flow guiding shoulders 29, are provided at the upper end of the passageway 28, i.e. at the end of the passageway adjacent the cylinder.

In operation, the apparatus is positioned above a transverse roller 27 of a horizontal roller conveyor. A sheet S, e.g. of glass, travels on the conveyor towards the foot 1 in the direction shown by arrow A in FIG. 1. The foot is in the downward position with air pressure applied to the cylinder 4 via the line 6. When the leading edge of the sheet S reaches the foot 1 it strikes a cam-like leading surface 30 thereof, and lifts the foot 1. The sheet S then contacts the wheel 19 which lifts the foot 1 clear of the sheet S ready for the cutting wheel 14 to make a longitudinal score thereon. The wheel 14 is held in contact with the sheet S by a suitable air pressure in the cylinder 4 acting upon the piston 5 whilst the sheet S is carried over the roller 27. When the whole sheet S has passed under the cutting wheel 14 the foot 1 is held clear of the trailing edge of the sheet S by the wheel 20 so that the edge is not damaged by contact with the foot 1. When the sheet S is no longer in contact with the wheel 20 the foot 1 is returned to its downward position ready for the delivery of the next sheet S.

As previously explained, the foot 1, shaft 2 and piston 5 are constructed so as to have a very low inertia and the piston 5 and shaft 2 move very freely due to their air lubrication. This enables the foot 1 to react very rapidly to any irregularities in the surface being cut or any undulations in the sheet S. In this way a continuous score line is obtained on the surface of the sheet S, instead of the discontinuous line often produced with conventional equipment which does not have the necessary rapid response to be able to follow exactly the surface being scored.

It will be appreciated that where a plurality of longitudinal score lines are required on the sheet S a corresponding plurality of cutter assemblies 13 as described above may be employed. Conveniently, the cutter assemblies are operable independently and adjustably mounted on a support beam so that the spacing between adjacent cutters can be adjusted to provide the required spacing between adjacent score lines. FIG. 2 shows, by way of example, an apparatus having two cutter assemblies 31, 32 individually operable by means as described above with reference to FIG. 1. These cutter assemblies 31, 32 and their respective operating means 35, 36 are adjustably mounted side-by-side on a support beam 33 having a graduated scale 34 to facilitate the scoring of two parallel longitudinal score lines of the sheet S, a predetermined distance apart.

As will be appreciated, the apparatus of FIG. 1 and that of FIG. 2 are each designed for scoring one or more score lines on a sheet in the direction in which the sheet is travelling. The sheet is then broken along the score line or lines.

Referring to FIGS. 3 and 4, an apparatus is illustrated for scoring a sheet transversely, i.e. perpendicularly to the direction in which the sheet is travelling. As before, a cutting assembly 13 is mounted on a foot 1 depending from a vertically movable shaft 2. Air to the cylinder (not shown) internally of the housing 3 is again fed through one of the pipes 6, 7, the selection being controlled by a solenoid valve 40 interconnecting the pipes 6, 7 and a common pipe 41. The feed pipe 6 includes an air pressure gauge 42 since it is this pipe 6 through which air is fed during the scoring operation. In this embodiment the alignment shaft 11 is reversed and, at its upper end, is provided with a pair of nuts 43 to act as an adjustable limit stop for the lowermost position of the foot 1.

The housing 3 is mounted on a back plate 44 provided with four pulleys 46 on its reverse side for running along horizontal guide rails (not shown) secured to a fixed structure, the upper pulleys running on top of the upper guide rail and the lower pulleys running beneath the lower guide rail. The plate 44 is driven back and forth along the guide rails by an endless metal belt (not shown) of which the upper run is split and the ends of the belt are fixed to the plate 44 at the parts 45, the belt being driven by reversible drive means. At each side of the plate 44, there are provided a pair of buffers 47 which abut against appropriate stops at each end of the run of the plate.

In the operation of this embodiment the apparatus is driven in the direction of arrow B in FIG. 3, across and at an angle to the advancing sheet, the apparatus having a forward speed component and a lateral speed component whereby the apparatus moves forward and laterally with respect to the sheet at a selected angle and speed relative to the forward movement of the sheet so that a score line perpendicular to the direction of travel of the sheet is made on the top surface of the sheet.

If desired, the apparatus of this embodiment may be provided with a mist lubricator 22 in the same manner as the first embodiment illustrated in FIG. 1.

One advantage of all the embodiments described above is that the apparatus may be employed to score different thicknesses of sheet material without the need for complex adjustment of the apparatus.

The invention is not limited to the specific details of the embodiments described above. For example, each scoring apparatus may be employed for scoring one or more score lines on other sheet material besides glass sheets, for example glass ribbons or sheets of other materials, e.g. acrylic sheets.

Further, the apparatus described above as being used for scoring individual sheets may be used for scoring a continuous ribbon of sheet material either longitudinally or transversely, i.e. perpendicularly to the direction of travel of the ribbon. Yet further, the apparatus can be used in producing discontinuous or interrupted score lines, i.e. score lines which commence and/or terminate at a position on the surface of the sheet material and do not extend from one edge thereof to another. In this case the cutting head can be lowered onto the surface of the sheet material to commence a score line at a required position by introduction of pressure air through the line 6 into the cylinder 4, and can be raised from the sheet material to terminate a score line at a required position by introduction of pressure air through the line 7 into the cylinder 4. It has been found that with the described arrangement a rapid lowering and raising of the cutting head can be achieved.

Also, the sheet material being scored may be travelling horizontally as described above, but alternatively may be travelling vertically or at an angle inclined to the horizontal.
Furthermore, the sheet material being scored may be supported on other types of conveyor besides a roller conveyor, e.g. a belt conveyor.

We claim:

1. Apparatus for scoring a score line in a surface of glass sheet material, comprising a cutter assembly and a double acting pneumatic cylinder and piston, the cutter assembly being connected to the piston whereby the piston is operable to urge the cutter assembly towards the surface to be scored, said cylinder and piston comprising a housing defining the cylinder in which the piston is slidable, said housing having an apertured end wall, and a shaft connected with the piston and extending axially of the cylinder through said passageway in the wall of the housing so as to project therefrom, the cutter assembly being connected to the projecting end of the shaft, and the piston being under-size relative to the cylinder and the shaft under-size relative to the passageway thereby permitting flow of air between the piston and the cylinder wall and between the shaft and the passageway wall, whereby two spaced air bearings are provided facilitating controlled movement of the cutter assembly.

2. Apparatus according to claim 1, wherein the cutter assembly is mounted on a foot connected to the piston, said foot having wheels disposed on either side of the cutting tool of the cutter assembly for engagement with the edges of said surface immediately preceding and subsequent to the scoring operation.

3. Apparatus according to claim 2, wherein the foot has a lead-in surface disposed on the other side of one of the wheels from the cutting tool, the leading edge of a surface to be scored engaging said lead-in surface before engaging said one wheel.

4. Apparatus according to claim 1, wherein flow-assisting shoulders are provided at the end of the passageway adjacent the cylinder.

5. Apparatus according to claim 1, including means to maintain the alignment of the cutter assembly.

6. Apparatus according to claim 1, including a mist lubricator whereby oil-laden air may be supplied to the cutter assembly.

7. Apparatus according to claim 1, for scoring at least two score lines in a surface of sheet material, including a corresponding number of cutter assemblies and respective independently operable double-acting pneumatic cylinders and pistons mounted on a support bar whereby the spacing between the cutter assemblies is variable.

8. Apparatus according to claim 1, adapted to be mounted above a conveyor, the cutter assembly being adapted to longitudinally score the upper face of a sheet material passed along said conveyor.

9. Apparatus according to claim 8, wherein the conveyor is a roller conveyor, the cutter assembly being mounted above a transverse roller of the conveyor.

10. Apparatus according to claim 1, including means for moving the cutter assembly at an angle across moving sheet material, in a forwardly direction, the angle and speed of the cutter assembly being related to the speed of the sheet material whereby the upper face of the sheet material is scored transversely.

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