Sept. 27, 1960 H. C. ZIEBER ET AL 2,953,876

AUTOMATIC BLASTING CONTROL

Filed Nov. 5, 1958 2 Sheets-Sheet 1

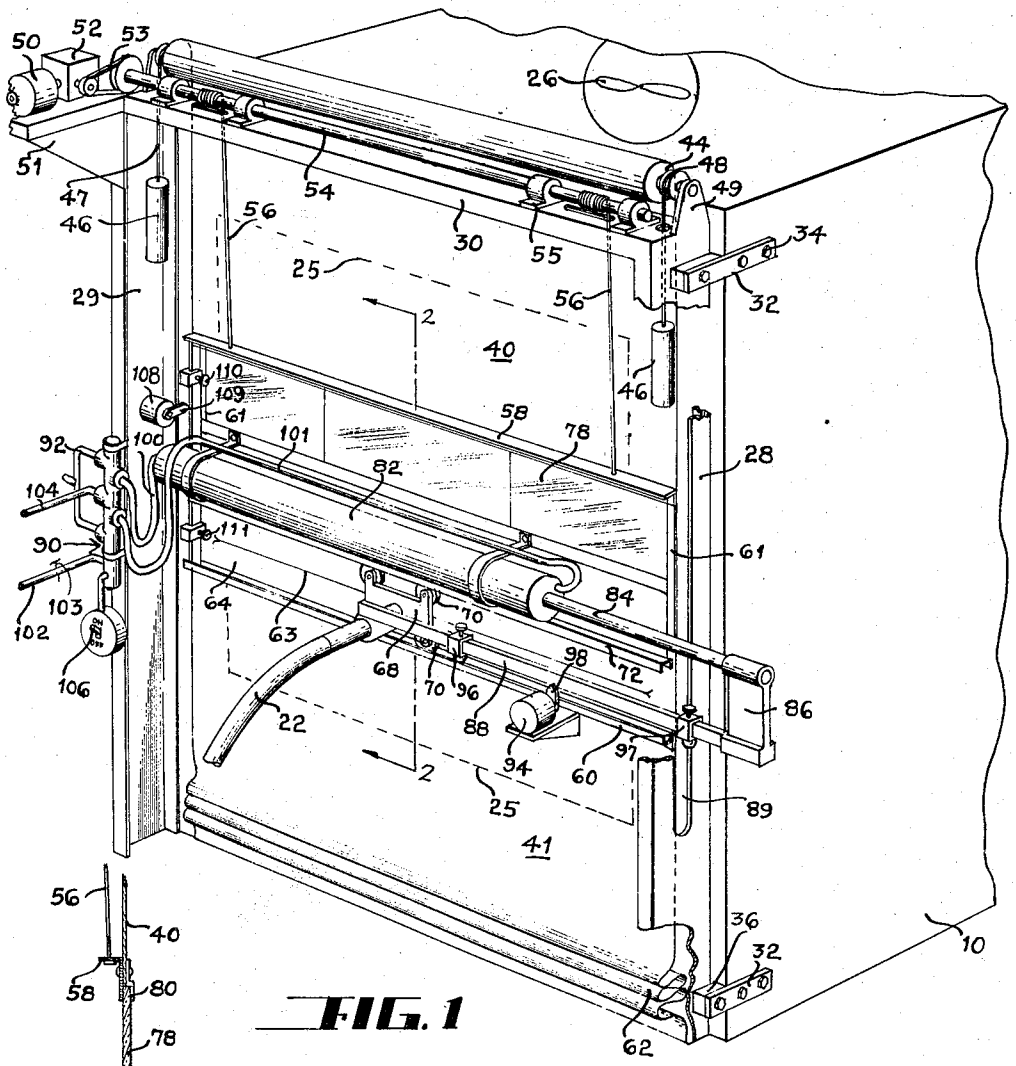

FIG. 1

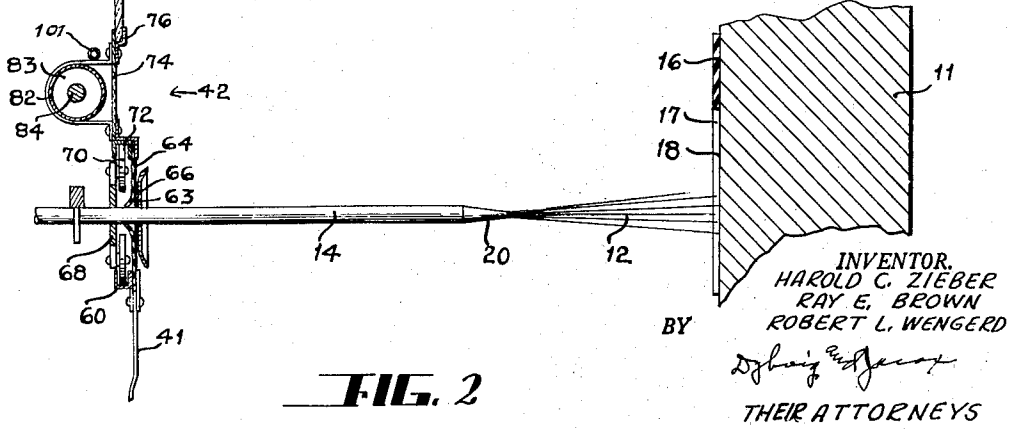

FIG. 2

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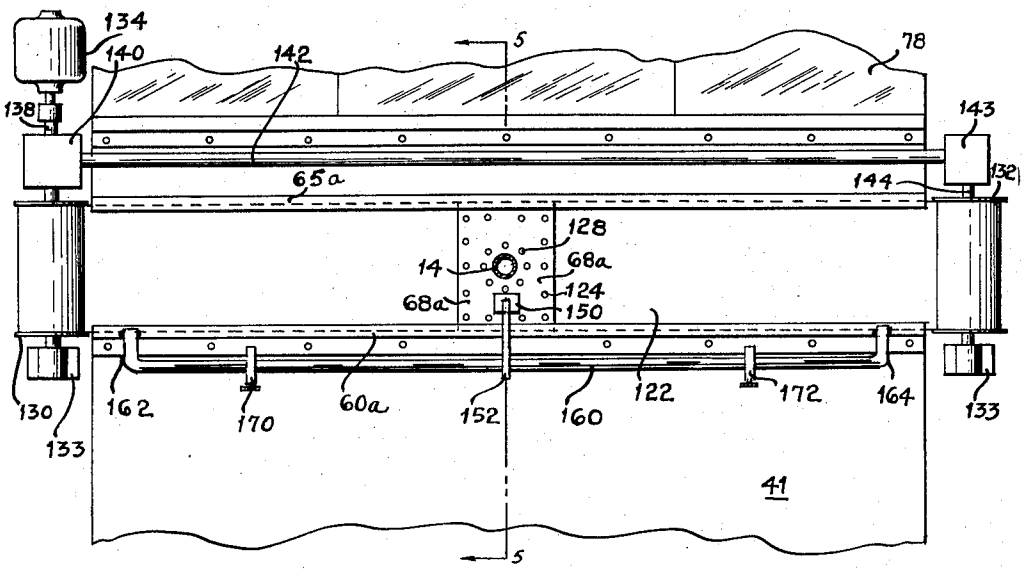

FIG. 3

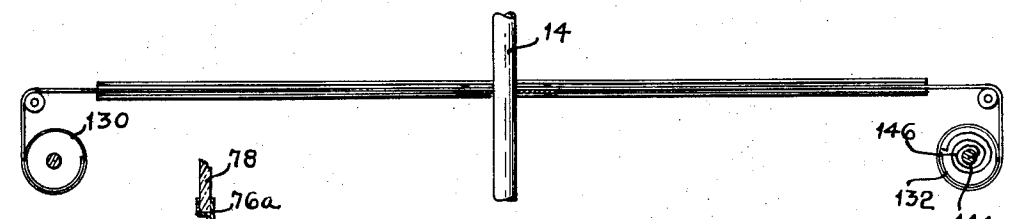

FIG. 4

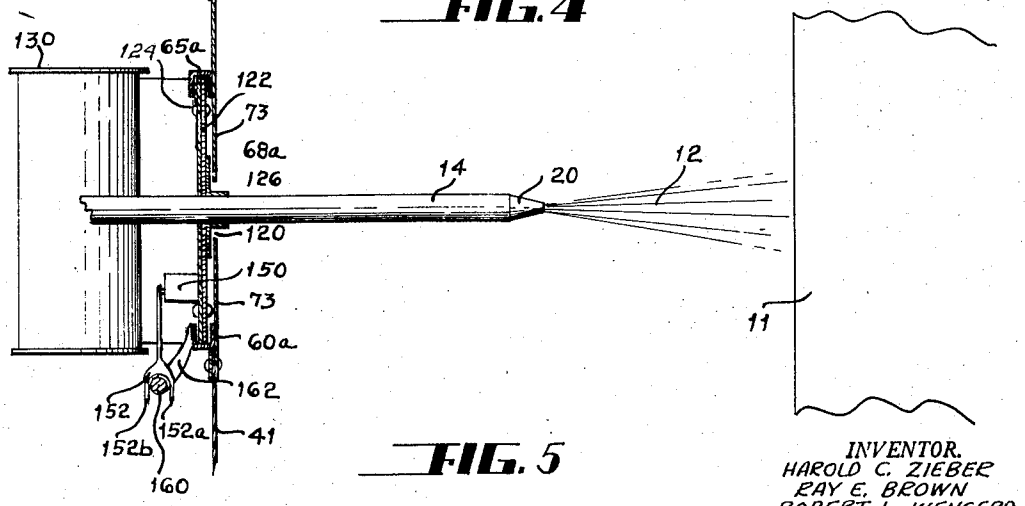

FIG. 5

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United States Patent Office 2,953,876 Patented Sept. 27, 1960

2,953,876

AUTOMATIC BLASTING CONTROL

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Filed Nov. 5, 1958, Ser. No. 772,037

9 Claims. (Cl. 51—8)

This invention relates to an apparatus for automatic sandblasting of tombstones, tiles, tablets of stone, steel, copper, bronze and any other material which has a surface to be acted upon by a comminuted abrasive material blast to provide a satin or frosted surface, a grooved lettering, border line and similar surfaces. Ordinarily, though not necessarily, the surface to be acted upon is covered by a protecting stencil, made of rubber or the like, which is adhesively secured to the tombstone, tablet, tile, et cetera. The stencil has the configuration desired to be acted upon cut out of the stencil. Thereafter, the comminuted abrasive material blast is produced, for example, by a sandblasting gun or jet directed against the exposed portion surrounded by the stencil covered surface. The cut-out portions of the stencil are acted upon by the blast. The protected surfaces underneath the solid part of the stencil are not acted upon by the blast.

This blasting process previously has been performed in a booth or enclosure adapted to receive the work to be acted upon. A curtain with a plurality of slots in it is hung over the access opening. The curtain is provided with a plurality of slots through which the operators insert the sandblast jets and through which the operators stick their arms and hands to operate the jets. Even with the most skillful of operators, the sandblasting effect is not of the uniform quality, depth and thoroughness which is desired. The operators cannot manipulate the jets with uniform motion and they are likely to cut too deeply in some places and not deeply enough in others.

The work previously performed is very harmful to the operators. The silica in the sand, or similarly harmful substance in any other abrasive material, is continually inhaled by the operators. In the course of time, lung diseases, such as silicosis, and the like, are contracted. It has been estimated that the average working life in such a vocation is twenty years, more or less.

According to this invention, on the other hand, the blast jet is passed through a wall of an enclosure, means are provided automatically to move the jet in a predetermined pattern with respect to the work, and means are provided to maintain a sealing relationship between the jet and the enclosure sufficient to prevent any substantial outward escape of air and harmful abrasive material from the enclosure past the jet. More specifically, a curtain structure is placed in front of the access opening of the booth or enclosure through which the blast jet is passed into the enclosure. Means are provided for moving the curtain structure transversely with respect to the opening and for moving the jet laterally with respect to the motion of the curtain structure. A composite movement is given by these combined motions to produce a uniform predetermined lateral pattern with respect to the work within the enclosure. Preferably, the motion of the jet is of a character such that a very uniform etching-like effect is produced upon the work.

The air in the interior of the enclosure preferably is maintained at a slightly reduced pressure, compared to atmospheric pressure, so that any slight leakage which might take place along the sealed surfaces is inward toward the booth and there is no outward movement of the sand or other abrasive material into the atmosphere of the room. Improved working conditions and improved products are therefore possible with the practice of this invention.

Hence, an object of this invention is to provide a new and useful apparatus having an enclosure adapted to receive work to be acted upon by a blast of comminuted material. A blast jet carries comminuted material into the enclosure. The apparatus is provided with automatic means to move the jet in a predetermined pattern with respect to the work, without any substantial outward escape of air and abrasive material from the enclosure past the jet.

Another object of this invention is to provide an apparatus according to the foregoing object in which the speed of movement of the jet may be varied to vary the cutting effect on the work.

Another object of this invention is to provide an apparatus or frame having means for attachment to an existing booth or enclosure, the apparatus or frame having means for carrying the blast jet, the means automatically moving the jet in a predetermined pattern with respect to the work, and means to maintain a sealing relationship between the jet and the enclosure sufficient to prevent any substantial outward escape of air and abrasive material past the sealing relationship so produced.

Other objects and advantages reside in the construction of parts, the combination thereof, the method of manufacture and the mode of operation, as will become more apparent from the description that follows.

Referring to the drawings, Figure 1 is a view in perspective of the front of an apparatus embodying features of this invention.

Figure 2 is a cross section taken along the line 2—2 of Figure 1.

Figure 3 is a front view of another embodiment of this invention.

Figure 4 is a horizontal cross section of a portion of Figure 3.

Figure 5 is a vertical cross section taken along the line 5—5 of Figure 3.

According to this invention, a booth or enclosure **10** is provided which is adapted to receive the work **11** which is to be acted upon by a blast of comminuted abrasive material **12** which is carried by air or other fluid under pressure, and which is discharged by the jet **14** against the exposed surface of the work **11**. If the work **11** is heavy, such as a tombstone, the work is preferably located on a truck or dolly moved into the enclosure. Generally, the work **11** is covered by a stencil **16**, made of rubber or the like, which is adhesively secured to the work **11** in a manner so it may later be removed, as is well known in the art. The desired configurations are cut in the stencil, as indicated at **17**, to expose the surface **18** of the work being acted upon, and which is to be acted upon by the comminuted abrasive material blast jet **14**. For example, the abrasive material may be sand of the desired degree of comminution, which is propelled by a blast of fluid, such as air under pressure, which is discharged through the nozzle **20** of the jet. The jet is connected to a flexible conduit **22**, which, in turn, is connected to an automatic air and sand mixer of well known construction, so the air and sand are delivered through the conduit **22** at a pressure of 200 pounds, more or less, per square inch. Merely as an

illustration, the jet 14 may extend sixteen inches into the enclosure and the end of the nozzle 20 may be approximately nine inches from the work being acted upon. (The words "sand," "sandblast," "air-jet" and similar names are used in a broad sense and are merely illustrative of any comminuted abrasive material, any suitable fluid carrying medium and any suitable discharging device.)

The enclosure 10 has an access opening indicated by the dotted line 25 and is maintained at a slightly subatmospheric pressure by means of a suction fan or blower diagrammatically indicated at 26, which blower discharges into a suitable sand separator, not shown, which is generally located outside the building.

A frame, having channel-shaped sides 28 and 29 and top channel-shaped member 30, is provided with means for attachment to the access opening 25 of the booth or enclosure. Such means may take the form of brackets 32 which are attached to the side members 28 and 29 of the frame and to the sides of the enclosure 10 by means of the screw bolts 34. If necessary, suitable spacers 36 may be included to compensate for dimensional variations between the frame and the enclosure 10.

The frame (28, 29 and 30) carries a curtain structure which is adapted to be placed in front of the access opening 25 which has a sealing surface cooperating with the access opening 25 in sufficient sealing relationship with the enclosure to prevent any substantial outward escape of air and abrasive material past such sealing surface. In the embodiments shown in Figures 1 and 2, such curtain structure may include an upper flexible curtain 40, a lower flexible curtain 41 and an intermediate panel construction indicated by the arrow 42. Such curtain structure (40, 41 and 42) is movable transversely of the opening 25, and preferably in an up and down direction. For example, the upper curtain 40 may wind and unwind with respect to the roller 44. The roller 44 maintains the curtain 40 under upward tension by means of the weights 46 which are attached to the cables 47, which wind and unwind the pulleys 48 which are fixedly secured to the roller 44. The roller 44 is supported on bearing plates 49 extending upwardly from the sides 28 and 29 of the frame.

The panel 42 is raised and lowered by the reversible motor 50, which is mounted on the bracket 51 at the upper end of the frame side member 29. The reversible motor 50 drives a gear reducer 52 which, in turn, drives the pulley and belt transmission 53, reversibly to rotate the shaft 54 which is supported on bearing members 55 on top of the upper frame member 30. Cables 56 are attached to the upper metal angle member 58 of panel 42, so that the panel 42 is raised and lowered by the reversing rotation of the motor 50.

The panel 42 is one rigid structure between the upper metal angle 58 and the lower horizontal metal member 60, these members being united by the vertical side metal members 61. The lower member 60 of the panel is secured to the upper edge of the flexible curtain 41. The curtain 41 is made of a heavy flexible material, so that it can hang, slide and pleat at 62 near the lower part of the booth 10. The construction of the curtain structure (40, 41 and 42) is such that its position is governed by the position of the panel 42 which, in turn, is determined by the reversible rotation, or non-rotation, of the motor 50. The weight of the panel 42 is such that it dominates the position of the entire curtain structure as it hangs on the cables 56 which wind and unwind on the shaft 54. The upper curtain 40 is maintained under tension at the position determined by the position of the panel 42 by the action of the weights 46 which cause an upward pulling of the curtain 40 by the turning movement of the roller 44. The lower curtain 41 hangs from the panel 42 and is maintained under tension by its own weight as it pleats upon itself at 62. A sealing surface at the edge of the curtain structure cooperates with the edge of the access opening 25 to produce a sufficient sealing relationship between the curtain structure (40, 41 and 42) and the access opening 25 of the enclosure to prevent any substantial outward escape of air and abrasive material past such sealing surface. The slight subatmospheric pressure within the enclosure 10 tends to maintain the sealing edges or surfaces of 40, 41 and 42 sufficiently tight against the front wall of the enclosure 10 to prevent any such outward escape of air and abrasive material. In fact, a slight inward leakage of air into the booth 10 takes place and this has a beneficial effect on the operators, since such inward air movement prevents any accidental outward escape of sand or other abrasive material.

The panel 42 carries the blast jet 14, so the jet may be moved horizontally, or in a direction transverse to the movement of the curtain structure. To this end a horizontal slot 63 is provided in a rubber sheet 64 of the curtain structure. The jet 14 passes through this slot and can be moved horizontally along such slot, since the slot temporarily spreads to permit such motion of the jet 14, as shown in Figure 2. The jet 14 carries a circular or rectangular plate 66 which bears tightly on the sheet 64 to prevent any accidental outward leakage or escape at the jet 14 extending through the slots 63 in the rubber sheet 64.

The jet 14 is supported for lateral movement on the panel 42. To this end a plate or carriage 68 holds the jet 14 securely, and is provided with wheels or pulleys 70 which ride in the lower channel 60 and in the upper channel 72, which is securely held in the panel 42. The carriage 68 and the jet 14 are moved back and forth along the slot 63 by a mechanism to be described. The panel 42 also includes a metal sheet or plate 74 which has a clamping construction 76 to receive the lower edge of the window panes 78, which panes are held at their edges by the clamping construction 80, which is formed in part by the angle member 58.

The carriage 68 and the jet 14 may be moved back and forth along the slot 63 by any suitable means. For example, a pneumatic motor system may be used. This may comprise a cylinder 82 carried by the plate 74. The cylinder 82 contains a piston 83 which is attached to the rod 84, which, in turn, is connected to a bracket 86 which, in turn, is connected to another rod 88 secured to the carriage 68. The rods 84 and 88 reciprocate in the slot 89 in the frame member 28. The piston 83 (Figure 2) may be selectively subjected to air pressure on its two opposite ends under the control of the four-way solenoid valve 90, of well known construction. The valve 90 includes two solenoids selectively energized by the electric cable 92. The cable 92 contains wires which are selectively energized by the two-way switch 94 fixedly attached to the rail 60, as clearly shown in Figure 1, which switch snaps to its two positions under impact of the triggers 96 and 97 which are adjustably secured to the rod 88. The switch 94 has a lever or trigger 98 which is actuated by the triggers 96 and 97 to its two opposite positions in turn to energize the opposite solenoids, or similar solenoid constructions, within the valve 90, as is readily understood.

When the carriage 68 reaches its desired rightward terminus, the trigger 96 actuates the lever 98 to oppositely energize the valve 90 to reverse the direction of travel of the carriage 68. Thereafter, the carriage 68 travels leftward until it reaches the desired leftward terminus, whereupon the trigger 97 engages the lever 98 and reverses the switch 94 to reverse the valve 90 and thus to reverse the pneumatic power in the cylinder 82 to initiate a rightward movement of the carriage 68. In this manner, the jet 14 moves back and forth in a horizontal direction.

The four-way valve 90 is connected by the pneumatic cables 100 and 101 to opposite ends of the cylinder 82. The air pressure line 102 is provided with a hand valve

103, and the flow of air through this line 102 is governed selectively by the four-way valve 90 to enter either the cable 100 or the cable 101, as is readily understood. The air which is driven out of the cylinder 82 by the motion of the piston 83 flows back to the valve 90 and thence out through the discharge pipe 104 to the atmosphere. Manual adjustment of the valve 103 determines the speed of horizontal back and forth travel of the jet 14 and the carriage 68, as the valve 103 determines the volumetric flow of air into the cylinder 82. The electrical energization of the valve 90 may be controlled by the on and off switch 106. The switch 106 may be a master switch which also controls the motor 50, or the motor 50 may have its own on and off switch. Preferably, the valve 90 and the motor 50 each has its own on and off switch and both switches are controlled by a master switch.

The direction of movement or rotation of the motor 50 is controlled by the reversing switch 108 fixedly mounted on the side frame member 29, as clearly shown in Figure 1, which switch has a lever 109 which is moved to its opposite two positions by the triggers 110 and 111, these being adjustably secured upon the side member 61 of the panel 42. When the curtain construction has reached its upper desired limit of travel the trigger 111 contacts the switch lever 109 and causes the motor 50 to rotate in a direction to move the panel 42 and the entire curtain construction donwardly. When the curtain construction has reached the lower desired limit, the trigger 110 contacts the lever 109 to move the switch lever 109 to its lower position, thereby to reverse the motor 50 and reverse the travel of the curtain construction so that it starts to rise.

The horizontal back and forth motion or periodicity of the jet 14 and carriage 68 is much more rapid than the vertical motion or periodicity of the curtain construction (40, 41 and 42). The horizontal back and forth movement of the jet 14 is relatively very frequent. It is thus to be seen that the actual travel of the jet 14 and nozzle 20 is a zig-zag upward or downward course in which the vertical distances between the reversing points of the horizontal travel are very short and are less than the vertical dimension of the area of contact of the blast of abrasive material 12 where it impinges upon the surface 18 of the work 11. Hence, there is an overlap in adjacent paths of the blast of abrasive material 12 as the jet 14 moves horizontally back and forth. Also, because of a repeated up and down movement of the curtain structure 40, 41 and 42, any slight inequalities in the effect of the blast of abrasive material 12 are equalized by the repeated slow upward and downward movements of the jet 14 in combination with the rapid horizontal back and forth movements of the jet 14. Thus, the jet 14 is automatically moved in a predetermined lateral pattern with respect to the work 11, such pattern being determined by the adjustment of triggers 96, 97, 110 and 111.

Under certain conditions, the curtain structure 40, 41 and 42 may be moved slowly upwardly only once while the jet 14 moves horizontally back and forth with relatively great speed, so the vertical spacing of the horizontal reversing points is very small. Under these conditions, a single upward traverse of the curtain structure is sufficient to produce a satisfactory cutting action on any particular piece of work 11. Under these conditions, an additional door, not shown, in the enclosure 10 is opened and the work is changed. The curtain structure is then lowered for the repetition of the operation on a new piece after the additional door is closed.

In the embodiment shown in Figures 3, 4 and 5, the lower curtain 41, the upper cutrain 40, not shown, and much of the panel 42 are the same as in Figures 1 and 2. All of the construction previously described with respect to Figures 1 and 2 is incorporated in the embodiment of Figures 3, 4 and 5, whether shown or not, with the exception of the mechanism for moving the jet 14 horizontally back and forth, now to be described.

The sheet 64, plate 74 and the pneumatic mechanism of Figures 1 and 2 may be changed to a belt construction shown in Figures 3, 4 and 5. In Figures 3, 4 and 5, a plate 73, of rigid construction, may have a slot 120 extending substantially across the curtain structure in a horizontal direction. Its upper clamping construction 76*a* is attached to the window panels 78 in a manner similar to Figures 1 and 2. The lower edge of the plate 73 is connected to the lower curtain 41. An intermediate channel 60*a* is supported on the plate 73. A flexible belt 122 has its upper and lower edges riding in the channels 60*a* and 65*a*. A steel plate or carriage 68*a* is riveted to the belt 122 at 124. The jet 14 is provided with a flanged disc 126 which is adjustably secured to the nozzle 14. The disc 126 is secured to the belt 122 and the plate 68*a* by means of the rivets 128.

The jet 14 and the plate 68*a* are moved horizontally back and forth by a longitudinal movement of the belt 122 in the slot formed by channels 60*a* and 65*a*, as the belt winds and unwinds on the rollers 130 and 132 which are carried on bearings 133, and similar bearings, all supported on the panel 42. The winding and unwinding action of the belt 122 is produced by the reversible motor 134 which is also carried on the panel 42 and which is actuated and reversed by a switch construction similar to switch 94 to produce a reversing action.

The motor 134 has a shaft 138 which drives the roller 130 through the gear box 140. Another shaft 142 is driven from the gear box 140 and drives the bevel gear 143 and a shaft 144 of the roller 132. The shaft 144 is connected to the perimeter of the roller 132 by a spiral spring 146 which is biased to maintain the belt 122 in tension at all times. The spring 146 compensates for the varying diameters which are produced by the winding and unwinding of the belt 122 on the rollers 130 and 132. The belt 122 is maintained under tension regardless of the slight differential in the rotation of winding action of the two rollers 130 and 132, as is apparent.

The contacting edge surfaces of the belt 122 produce a seal sufficient to prevent outward travel of air and abrasive material from the enclosure.

In the preferred embodiment, the switch 94 is stationary and is actuated by triggers or adjustable stops 96 and 97. The switch could be mounted for movement with respect to the jet and stationary stops could be used. This structure has been shown in connection with the modification shown in Figures 3, 4 and 5. A switch 150 is mounted upon the plate 68*a* and has a downwardly projecting, pivotally mounted switch actuating arm 152. The lower end of the arm 152 is provided with a pair of bifurcations 152*a* and 152*b*. The furcations 152*a* and 152*b* straddle a rod 160 having the ends 162 and 164 turned at right angles and welded to one flange of the channel member 60*a*. This rod 160 is provided with a pair of adjustable stops 170 and 172. When the switch actuating arm 152 engages the stop 170 or the stop 172, it reverses the switch and thereby reverses the motor 134 used in actuating the plate 68*a* and the jet 14 transversely across the slot 120.

The sandblasting apparatus has been described in connection with an enclosure that may have subatmospheric pressure. This arrangement may be used in many plants which finish stones and frost other articles, such as glass, plastic, steel, brass and the like. In quarries, for example, a boot may be provided for the apparatus.

In that event, the stone or material to be sand-blasted is mounted outside of the booth or room. It may be out in the open, adjacent an opening in the wall of the booth or room. In order to eliminate dust blowing into the enclosure of the booth or the room, this booth or room may be pressurized, so as to have an air pressure higher than the ambient air pressure on the outside. In some installations, the stone or the work to be sand-

blasted may be mounted on the outside of the building. A hole or slot may be provided in the wall of the building and the sandblasting equipment overlying this opening, so that the jet directs the sandblast on the outside of the building. A differential in air pressure is preferable, although not absolutely essential. This depends on the location, the type of work operated upon and many other factors.

An improved blasting apparatus is thus provided which produces an improved, uniform cutting action on the work. The apparatus is automatic and requires a minimum of attention. It eliminates the dusty atmosphere which is present in previous apparatus and, hence, improves the working conditions and the health of the operator or operators.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described our invention, we claim:

1. An automatic sandblasting machine for use with an enclosure adapted to receive work to be acted upon by a blast of comminuted abrasive material, said enclosure having an access opening, a movable curtain structure having a sealing surface cooperating with said access opening to produce a sufficient sealing relationship with said enclosure to prevent any substantial outward escape of air past said sealing surface, said curtain having a transverse slot, a belt movable back and forth longitudinally overlying said slot, said belt being supported by the curtain and movable with the curtain in the direction of movement of the curtain, and movable transversely of said curtain, a comminuted abrasive material blast jet projecting through the slot and movable with the curtain and movable back and forth with the belt, driving means for driving the curtain to and fro across the access opening and driving means for driving the jet and the belt to and fro along the slot, the improvement comprising adjustably mounted reversing mechanism for reversing the movement of the curtain, and adjustably mounted reversing mechanism for reversing the movement of the belt, each of the reversing mechanisms including a reversing electrical switch and stop means for actuating said reversing switch.

2. A control mechanism for use in an automatic sandblasting machine which is used with an enclosure having an access opening, a movable curtain structure having a transverse slot and having a sealing surface cooperating with said access opening to produce a sufficient sealing relationship with said enclosure to prevent any substantial escape of air past said sealing surface, the work to be acted upon being located on one side of the curtain and the control mechanism on the opposite side of the curtain, a carriage movable back and forth in the slot, means for supporting the carriage upon the curtain and movable with the curtain in the direction of movement of the curtain, a comminuted abrasive material blast jet projecting through the slot and supported upon the carriage, said control mechanism including driving means for driving the curtain to and fro across the access opening and driving means for driving the carriage and the jet to and fro along the slot, the improvement comprising adjustably mounted reversing mechanism for reversing the movement of the curtain, and adjustably mounted reversing mechanism for reversing the movement of the jet and carriage, each of the reversing mechanisms including a reversing electrical switch, and stop means for actuating the reversing switch.

3. A control mechanism according to claim 2, wherein one of said driving mechanisms include a cylinder and a piston, means for supplying fluid to the ends of the cylinder, and a valve responsive to the reversal of the electrical switch for supplying fluid alternately to opposite ends of the cylinder.

4. In a control mechanism according to claim 2, wherein one of said driving mechanisms includes cable means driven by a reversible electric motor, said motor reversing in response to the reversal of the reversing switch to drive the cable means alternately in opposite directions.

5. In a control mechanism according to claim 2, wherein means are provided for varying the relative speeds of the two driving mechanisms.

6. In a control mechanism according to claim 2, wherein the adjustably mounted reversing mechanism for reversing the curtain includes the electrical reversing switch which is fixedly mounted on the enclosure and the stop means which includes a pair of adjustably mounted stops moving with the curtain.

7. In a control mechanism according to claim 2, wherein the adjustably mounted reversing mechanism for reversing the movement of the jet and carriage includes a bar mounted on the carriage, which bar adjustably supports a pair of stops for actuating the reversing switch for reversing the movement of the carriage.

8. In control mechanism according to claim 2, wherein the adjustably mounted reversing mechanism for reversing the curtain includes the electrical reversing switch means and the stop means which includes a pair of adjustably mounted stops, said switch means and stop means being movable relative to each other, one of said means being fixedly mounted on the enclosure and the other of said means moving with the curtain.

9. A control mechanism according to claim 2, wherein the adjustably mounted reversing mechanism for reversing the movement of the jet and the carriage includes the electrical reversing switch means and the stop means which includes a pair of adjustably mounted stops, said switch means and stop means being movable relative to each other, one of said means being mounted upon the carriage for movement therewith and the other being mounted upon the curtain for movement therewith.

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