

- [54] **APPARATUS FOR PRODUCING ALL-GLASS MULTIPLE SHEET GLAZING UNITS**
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- [52] U.S. Cl. **65/152, 65/58, 73/37.7, 318/357, 324/34 PS**
- [51] Int. Cl. **C03b 23/20**
- [58] Field of Search **65/58, 152; 73/37.6, 37.7; 324/34 D, 34 PS, 34 M; 318/656, 653, 645, 676, 657; 207/118, 2**

2,847,625	8/1958	Popowsky	318/676
2,954,644	10/1960	Montgomery	65/152
3,498,109	3/1970	Stepoe et al.	73/37.7
3,147,574	9/1964	La Pointe et al.	324/34 PS

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[57] **ABSTRACT**

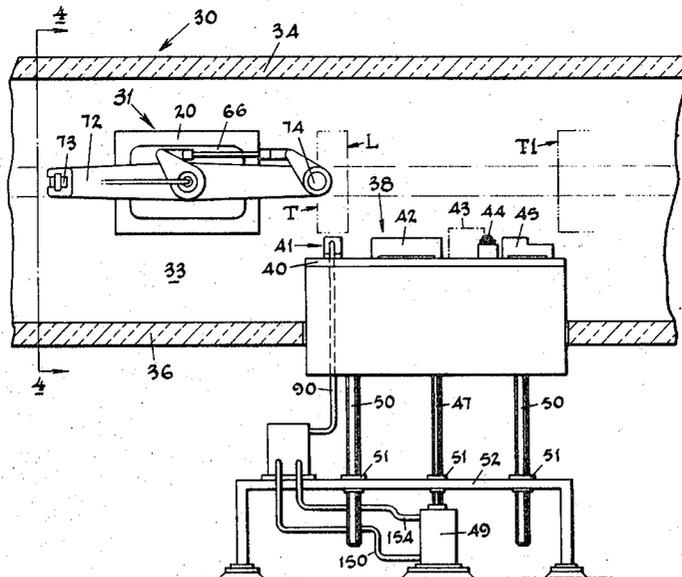
This application discloses, as part of the production of all-glass multiple sheet glazing units, the forming of a continuous edge wall around the margins of two spaced glass sheets by heating the edge portions of the sheets to a semi-plastic condition and then pressing them together by a rolling action to form an integrally sealed wall. The burners and forming rolls for this purpose are mounted on a support element which also carries a sensing or detecting device adapted to actuate control means that will produce movement of the support element and thereby locate the forming rolls at a desired working elevation relative to the edge portions of the sheets.

[56] **References Cited**

UNITED STATES PATENTS

- 2,437,603 3/1948 Hornfeck318/657

7 Claims, 12 Drawing Figures



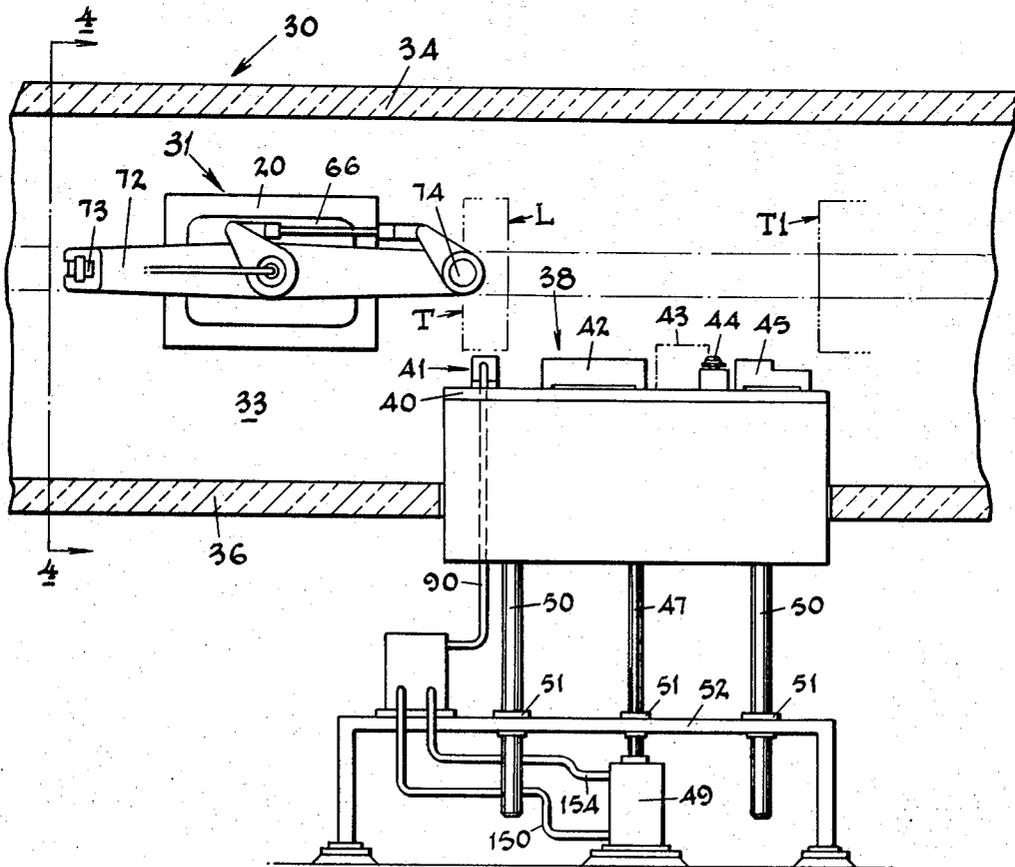
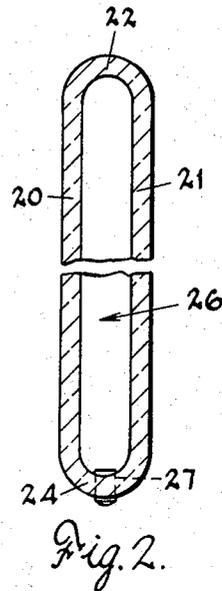
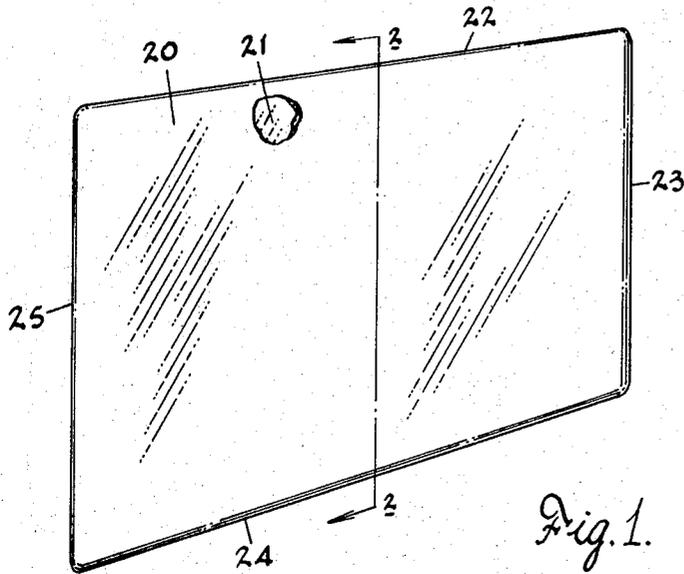


Fig. 3.

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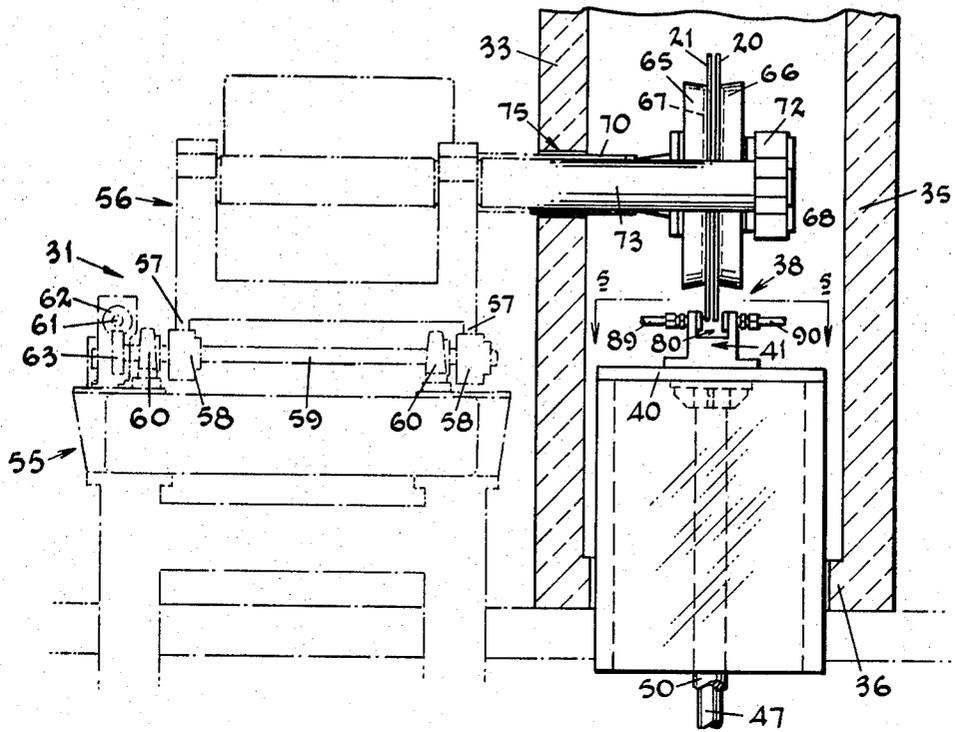


Fig. 4.

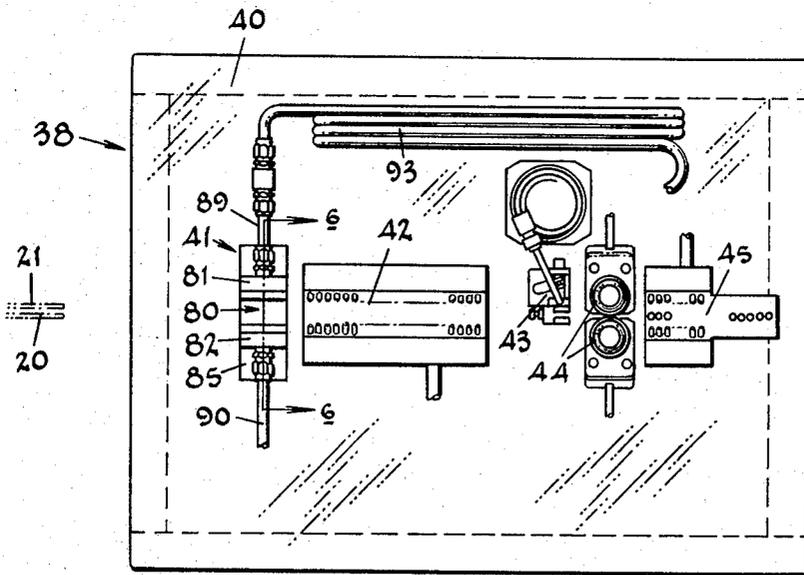


Fig. 5.

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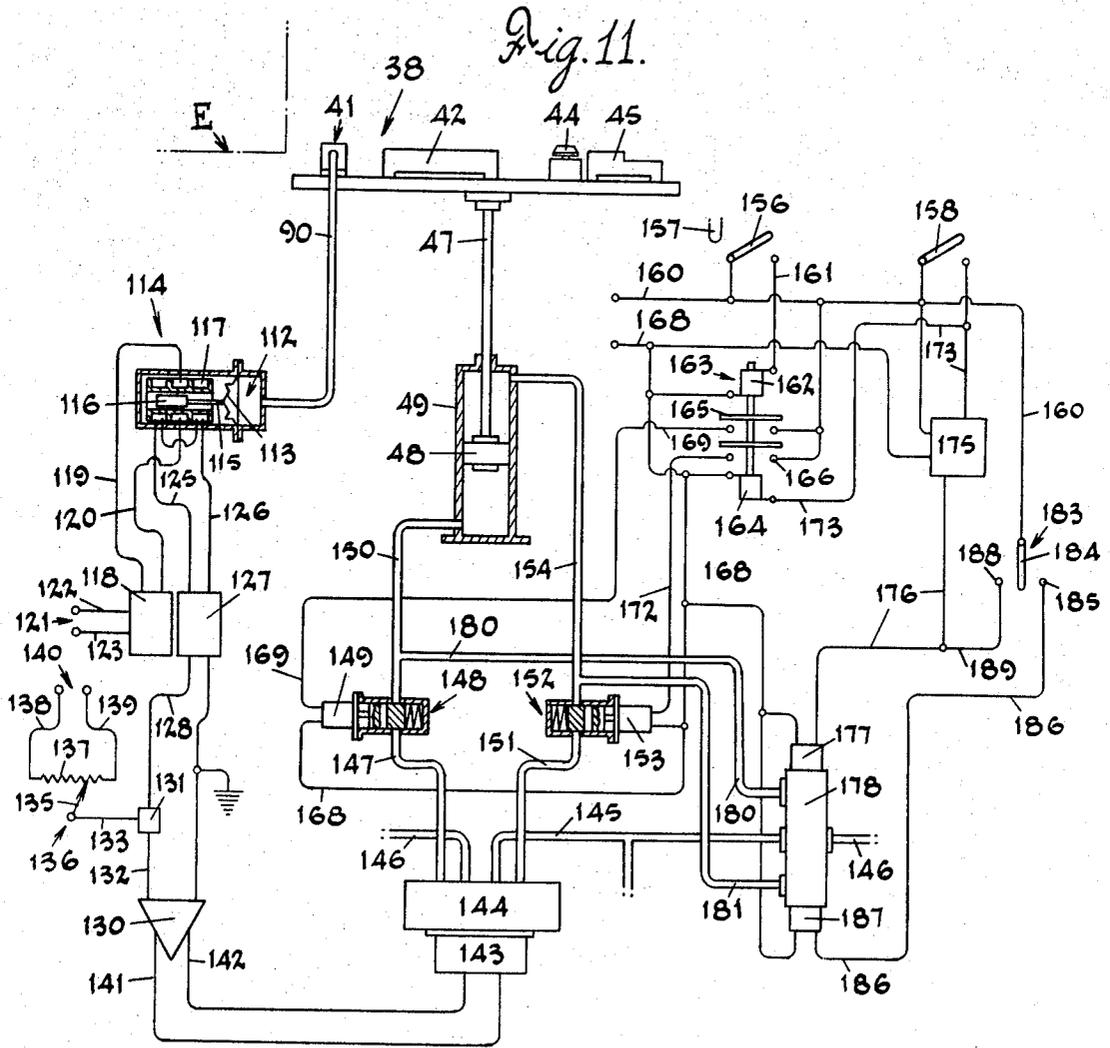
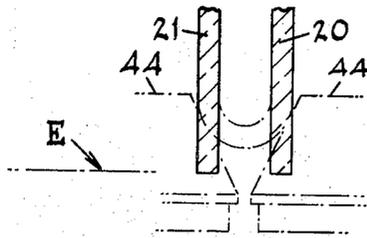


Fig. 12.

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APPARATUS FOR PRODUCING ALL-GLASS MULTIPLE SHEET GLAZING UNITS

BACKGROUND OF THE INVENTION

The invention is concerned with all-glass multiple sheet glazing units of the same general character and produced in a similar manner to that disclosed in U.S. patents to H. N. Dean et al., U.S. Pat. No. 3,097,943, issued July 16, 1963 and E. C. Montgomery et al., U.S. Pat. No. 3,257,187, issued June 21, 1966. Thus, in each of these prior art patents, there is provided a support element which carries a glass heating burner unit together with a pair of forming rolls that are adapted to press the heated, lower, marginal edge portions of a pair of glass sheets into integrally sealed relation with one another. By progressively heating and pressing the marginal edge portions around the peripheries of the sheets into sealed relation a continuous edge wall is formed and an enclosed air space thus created between the sheets.

Also, in U.S. patent to E. C. Montgomery, U.S. Pat. No. 2,954,644, issued Oct. 4, 1960, there is disclosed a sensing device for controlling vertically directed movement of the support element or platform for the burner and forming rolls and for locking the platform from movement during an ensuing sealing operation.

However, the primary object of this invention is to provide, in a method and apparatus of that type improved sensing and control means for more accurately and expeditiously locating and positioning the elements used in sealing the edges of the spaced sheets of glass.

Other objects and advantages of the invention will become more apparent during the course of the following description when read in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same.

FIG. 1 is a perspective view of an all-glass multiple sheet glazing unit of the type with which this invention is concerned;

FIG. 2 is a sectional view of the glazing unit taken substantially along the line 2—2 in FIG. 1;

FIG. 3 is a fragmentary, longitudinal, vertical, sectional view of apparatus for producing all-glass multiple sheet glazing units according to this invention;

FIG. 4 is a transverse vertical sectional view taken substantially along line 4—4 in FIG. 3;

FIG. 5 is a horizontal, plan view taken substantially along line 5—5 in FIG. 4;

FIG. 6 is a longitudinal, vertical, sectional view of a detecting unit constructed in accordance with this invention taken substantially along line 6—6 of FIG. 5;

FIG. 7 is a horizontal, sectional view taken substantially along the line 7—7 of FIG. 6;

FIG. 8 is a transverse, vertical, sectional view taken on the line 8—8 of FIG. 6;

FIG. 9 is a transverse, vertical, sectional view taken on the line 9—9 of FIG. 6;

FIG. 10 is a perspective view of an air-receiving plate;

FIG. 11 is a schematic view of the manner of forming an edge wall; and

FIG. 12 is a diagrammatic view of the control system in which the detecting or sensing unit is incorporated.

As already indicated the present invention is designed to produce hermetically sealed glazing units

made entirely of glass and there is illustrated in FIGS. 1 and 2 of the drawings an all-glass multiple sheet glazing unit of the character contemplated by the invention. As there shown, such a unit comprises two sheets of glass 20 and 21, fixedly held in spaced, parallel, face-to-face relation by continuous, integral edge wall portions 22, 23, 24 and 25 which also act to create a hermetically sealed air space 26 from which any moisture-containing air may be removed through a tubular insert 27 (shown in dotted lines) which can then be sealed shut.

As shown in FIGS. 3 and 4, the means for producing such all-glass multiple sheet glazing units normally includes a furnace 30 and associated means 31 adapted to support and carry a pair of glass sheets upright and in spaced face to face relationship through the furnace. Within the insulated four walls 33, 34, 35 and 36 of the furnace, there is arranged one or more sealing assemblies designated by the numeral 38, which include (FIG. 5) a support element or platform 40 on which may be mounted a sensing or detecting device 41, a fusion burner unit 42, an insert feeding unit 43, a pair of forming rolls 44 and a burner unit 45 for fire-polishing the outer surface of the newly formed edge wall. The platform 40 is connected to the outer end of a rod 47 (FIGS. 3 and 4) having a related piston 48 (FIG. 12) contained within a cylinder actuator 49; and the rod 47, together with guide rods 50 for the platform, are supported for vertically reciprocal movement in sleeve bearings or bushings 51 on a framework 52.

Since, for purposes of the present invention, the supporting and conveying means designated 31 may be of any known construction capable of supporting and conveying the glass sheets in proper relationship through the furnace and of turning them at specified intervals to bring successive edges into operative position, a substantially identical structure to that used for this purpose in U.S. Pat. No. 3,257,187, above referred to, has been illustrated more or less diagrammatically here and will be described only briefly.

Thus, as best shown in FIG. 4, the exterior or conveyor portion of the means 31, which has been shown in broken lines in FIG. 4, includes a roll supporting framework 55 and a carrier 56 equipped with runner bars 57. The rolls 58 for supporting the runner bars are mounted in pairs on shafts 59 journaled in bearings 60 on the framework 55. The roll shafts are driven by a common shaft 61 and meshing worm and wheel gears 62 and 63.

To support and carry a pair of glass sheets in vertically parallel, spaced, face-to-face relation through the furnace, the carrier further includes means for structurally supporting a pair of vacuum platens 65 and 66, the opposed surfaces of which are provided with grooves 67 and 68 connected to a source of evacuation (not shown) to hold glass sheets against the said opposed surfaces.

The platen 65 is mounted at the end of a shaft 70 which is supported on the carrier in a manner to permit the platen 65 to be moved toward and away from the platen 66 as well as to turn the platen.

Vacuum platen 66 on the other hand is carried on a beam 72 supported from the carrier by spaced annular bars 73 and 74 (FIGS. 3 and 4), and platen 66 is adapted to be turned with reference to the platen 65 so that the pair of glass sheets can be rotated to sequen-

tially present their edge portions for the sealing operation. The shaft 70 and bars 73-74 from the carrier extend into the furnace by way of an elongated slot, indicated at 75, in the wall 33, to move the glass sheets into and through each of the one or more sealing stations.

For a complete disclosure of this type of glass conveying and supporting means, reference is made to FIGS. 13, 22, 26, 32, 41 and 58, and to the accompanying descriptions thereof in U. S. Pat. No. 3,257,187.

In practicing the present invention in this environment, a pair of glass sheets 20 are preferably preheated to temperatures above their point of strain, then located between the platens 65 and 66 and supported thereby in spaced face to face relation for movement through the sealing furnace 30.

As the sheets 20 approach a sealing station (FIG. 3), the lower corners of the leading ends are carried through a pass 80 (FIGS. 5 and 6) defined between vertically disposed legs 81 and 82 and upper surface 83 of a bifurcated block 84 of the detecting device 41; the base 85 of the block being mounted on the platform 40. As shown in FIGS. 6 and 7, each leg 81 and 82 is provided with a bore 87 and 88, respectively, connected to pipes 89 and 90 by suitable pipe fittings 91 and 92 to provide conduits opposing each other across the pass 80.

The pipe 89 is used as the supply pipe from a source of air under pressure which is directed through a coiled section 93 (FIG. 5) before reaching the section of pipe designated by the numeral 89. The incoming air is thereby heated to sustain the relatively high temperature at the marginal edge portions of the sheets presently heated above the point of strain. This also acts to reduce turbulence and rapid expansion of the air at the detecting device 41. The pipe 90 serves as the receiver pipe and connects to an element of the control system, as will shortly be described.

On the inner surface of leg 81, a plate 95, having aperture 96 axially aligned with the bore 87, is mounted by screws 97; said plate carrying a centrally disposed disc 98 secured therein by screws 99. Similarly, on the inner surface of leg 82, screws 101 support a plate 102 having an aperture 103, axially aligned with the bore 88, and a centrally disposed disc 104 secured by screws 105. As viewed in FIGS. 7 and 8, disc 98 is provided with a vertical slot defining a supply orifice 107, while the disc 104, as in FIGS. 7 and 9, has a vertical slot defining a receiver orifice 108; supply slot 107 being of narrower width or horizontal dimension than the opposed slot 108. As viewed in FIGS. 7 and 10, the disc 104 is provided on one surface with a pair of ears 109 having opposed, outwardly divergent surfaces 110. The ears 109 are located in the bore 88 of the leg 82 and by their surfaces 110 reduce turbulence in the air stream passing through the receiver slot 108.

A stream of air A flowing across the pass 80 will thus also cross and be located in the path traversed by the lower edge portions of the glass sheets 20 so that these edge portions, as they move therepast will intercept at least a portion of the air in said stream and so affect the amount of pressure received at the orifice 108. This pressure differential then becomes instrumental in causing the sealing assembly to be moved vertically — i.e., upwardly or downwardly — until particularly the

fusion burner unit 42 and the pair of forming rolls 44 are located at a predetermined elevation with reference to the margins of the lowermost edges of the glass sheets.

When a pair of glass sheets are not passing through the sealing area, the streams of air from the supply pipe 89, passing through the orifice 107 of disc 98, will be received at full volume as it is directed toward and passes through the orifice 108 of the disc 104 to the receiver pipe 90 but, as will be shown later, the related control system will remain on an inactive basis until a pair of glass sheets are carried into the sealing area.

Referring now to FIG. 12, in which the complete control system is schematically illustrated, it will become apparent that, while functioning of the control system is initiated by the volume of air pressure from the detecting device 41, the system also embodies electric circuitry which directs the pressure of a hydraulic fluid to the cylinder actuator 49. Thus, the receiver pipe 90 connects to a chamber 112 closed at one side by a diaphragm 113 so that the static pressure of air in the chamber 112 will effect deflection of said diaphragm. The diaphragm 113 thus provides the actuator component of a pressure, or differential pressure transducer-transmitter 114 which includes a rod 115 fixed to the medial area of the diaphragm 113 and forming an integral portion of an armature 116 in the center of a coil 117. The coil 117 of the transducer-transmitter 114 has a primary side connected to an oscillator 118 through lines 119 and 120; said oscillator being powered from a source 121 of A.C. (alternating current) electrical energy by lines 122 and 123.

The secondary side of the transducer-transmitter 114 through lines 125 and 126 is connected to a demodulator 127 with the output signal being proportional to displacement of the armature 116 during deflection of the diaphragm 113. The demodulator 127 by line 128 feeds a signal of DC (direct current) voltage to an amplifier 130 through an input junction or electrical network 131 and line 132. Junction 131 is connected by line 133 to the manually adjusted set-point 135 of a potentiometer 136. The resistance 137 of the potentiometer is connected by lines 138 and 139 to a source of DC (direct current) electrical energy 140.

In practical operation, set-point 135 is adjusted to a position with reference to the resistance 137 such that the voltage carried by line 133 will be of opposite polarity to that of line 128. The amplifier 130 is connected by lines 141 and 142 to a torque motor 143 associated with the servo-valve 144. This valve is connected by pipe 145 to a source of hydraulic pressure and pipe 146 to a return or sump. By pipe 147, one side of the valve 144 is connected to a spring-biased "blocking" valve 148, having solenoid 149, and thence by pipe 150 to the head end of the cylinder 49. Similarly, the other side of valve 144 is connected by pipe 151 through the spring-biased "blocking" valve 152, having solenoid 153, to a pipe 154 and the rod end of cylinder 49.

The desired elevation of the sealing assembly with reference to the lowermost edges of the sheets (see the line designated by the letter E in FIGS. 11 and 12), is obtained by use of the manually adjustable potentiometer 136. According to the position of the set-point 135, a potential of adjustably controlled voltage will be im-

posed on the voltage of line 128 at the input junction or electrical network 131. The voltage of line 133 has an opposite polarity to that of the DC signal carried by line 128. Thus, the elevation of the sealing assembly can be determined by the voltage fed to the amplifier 130 when the sum of the voltages in line 128 and 133 equal zero.

Between sealing operations, the sealing assembly 38 is preferably located at a lowered or rest elevation that may, by way of example, be in the order of about one-fourth inch below the required elevation for sealing of the edge portions of sheets. At this time, a full volume of pressure will exist in the height of air stream between the orifices 107 and 108 of the discs 98 and 104 respectively, resulting in a full volume of air pressure in the pipe 90 that will deflect the diaphragm 113 in the chamber 112 to displace the armature 116 by rod 115. The influence of a full volume of air pressure in the pipe 90 would, normally, produce upward movement of the sealing assembly 38, except for the fact that application of pressure to the cylinder actuator 49 is blocked at valves 148 and 152. However when the lower edges of the leading ends of a pair of sheets enter the pass 80 between the legs 81 and 82 of the detecting device 41, the valves 148 and 152 are adapted to be opened, in a manner to shortly be more fully explained, and the effective pressure of the air stream entering the receiver slot 108 will be dependent upon the upward movement or elevation of the sealing assembly with reference to the lower edges of the sheets. In other words, it is intended that the pressure of air will be varied by upward movement of the sealing assembly and the desired volume of pressure will be obtained when the volume of air pressure at the chamber 112 is reduced, by way of example, to substantially one-half, which is determined by the setting to which the potentiometer 136 has been adjusted. Reduction of the pressure within the chamber 112 will cause less deflection of the diaphragm 113 to produce a change in the demodulator 127 whereby voltage of the DC current in line 128 will be decreased until it balances the predetermined voltage of opposite polarity from the set-point 135. By way of example and for purposes of illustration only, with the predetermined voltage of opposite polarity from the set-point 135 when substantially full pressure of air is present at the diaphragm 113, the demodulator will feed DC current of + (plus) 1 volt through line 128 to the junction 131. The adjusted setting of potentiometer 136 will permit feeding of DC current of - (minus) one-half volt by line 133 to said junction with the resultant sum of voltage being supplied by line 132 to the amplifier. In this situation, the control system is conditioned to cause upward movement of the sealing assembly 38 if valves 148 and 152 are unblocked.

To complete connection of pipe 147 to pipe 150 and the head end of cylinder 49, the solenoid 149 of blocking valve 148 and solenoid 153 of valve 152 are energized when the leading ends of the sheet have advanced a distance as of about 1 inch through the detecting device 41 as at the "single" dot line indicated by the letter L in FIG. 3. Then, when the trailing ends of the sheets are within a distance of about 3 inches from the detecting device, as at the "double" dot line indicated by the letter T in FIG. 3, the said solenoids

will be de-energized to definitely "block" pipes 147-150 and 151-154 at the respective valves 148 and 152. This will "lock" the sealing assembly from movement until the sealing operation is completed as when the trailing ends of the sheet reach a position substantially as at the "triple" dot line indicated by the letter T1. For these purposes, switch devices are located in spaced relation to one another and are actuated in sequence during movement of the carrier 56 on the conveyor system 31.

Briefly stated, a switch device LS 156 will be tripped by an actuator bar 157 on the carrier when the edges of leading ends of the sheets, supported by platens 65 and 66, reach the position of line L in FIG. 3. Switch device LS 158 will then be similarly tripped by the bar 157 when the trailing ends of the sheets arrive at the position of line T. The actuator bar 157 is caused to move downward into a position such that it will trip LS 156 and LS 158 after vacuum is applied to support the sheets on the platens 65 and 66. In the event that either of the platens is not supporting a glass sheet, there will be insufficient vacuum and the actuator bar 157, in one way or another, will remain in an inoperable position. Consequently, as the platens are moved through the sealing area, neither LS 156 nor LS 158 will be tripped.

More particularly, a source line 160 is connected to one side of LS 156 which at its other side is in circuit by line 161 through the solenoid 162 of a relay switch RS 163, having opposed solenoid 164 and normally disengaged pairs of contacts 165 and 166, to the opposite source line 168. Contact pair 165 is adapted to complete a circuit from source line 160 via line 169 through the solenoid 149 of valve 148 to opposite source line 168. Contact pair 166 also complete a circuit from the source 160 by line 172 through the solenoid 153 of valve 152 to source line 168. The valves 148 and 152 now being open, pipes 147-150 will direct hydraulic pressure to the head end of cylinder actuator 49 and beneath the piston 48, causing rod 47 to move the sealing assembly upwardly to seek or detect the lower edges of the sheets. At the same time, pressure at the rod end of the cylinder will be drained through pipes 151 and 154 to the return or sump.

When the detecting device 41 with the sealing assembly has thereby been raised, the pressure of air received at the orifice or receiver slot 108 will be reduced, resulting in deflection of the diaphragm 113 to displace the rod 115 and armature 116 with reference to the coil 117 until the voltage by line 128 from the demodulator 127 balances the voltage from the set-point 135 by line 133. Thus, the sum of a present voltage of + (plus) one-half in line 128 and - (minus) one-half voltage in line 133 will result in a condition of zero voltage to amplifier. In consequence, the torque motor 143 will become idle. Also, the application of pressure by pipes 150 and 154 equally through presently open valves 148 and 152 and servo-valve 144 will act to maintain the sealing assembly at the fusing level. Although not shown in detail, LS 156 can also be instrumental in opening the supply pipes from a source of combustible gas to the fusion burner unit 42 and fire-polishing unit 45 whereby the flames in one unit will raise the lower edge portions of the sheets to a semi-plastic condition and the flames of the second unit will produce a smooth, fire-polished surface on the edge wall after it has been formed by the rolls 44.

Since the elevation of the sealing assembly 38 must be substantially fixedly maintained after the trailing ends of the sheets have been carried from the detecting device 41 and until these ends of the sheets have been carried beyond the burner unit 45, LS 158 is tripped by the actuator bar 157, on the carrier 56, substantially at the instant the trailing ends of the sheets reach the position T. LS 158 is adapted to de-energize solenoids 149 and 153 and simultaneously activate a timing relay that is adapted to later cause return of the sealing assembly to the lowered elevation and also terminate connection of the burner units to the source of combustible gas.

Thus, LS 158 is connected to source line 160 and completes a circuit by line 173 through the opposed solenoid 164 of RS 163 to source line 168 to disengage pairs of contacts 165 and 166. This will deenergize solenoids 149 and 153 of related valves 148 and 152 to again block communication between pipes 147-150 and 151-154 respectively. Now, although the pressure of the air stream between orifices 107 and 108 will again be restored to full volume, the fact that the valves 148 and 152 are spring-biased to the closed position will maintain the pressures above and below the piston 48 in a static condition.

Line 173 is also completed to timing relay TR 175, in series with source lines 160 and 168; said timing device being of the adjustable interval variety and presently set for the duration of time required for the trailing ends of the glass sheets to be carried from the detecting unit 41, see line T in FIG. 3, to a point beyond the fire-polishing burner unit 45, line T1 of FIG. 3. This setting can be determined by the horizontal dimensions of the sheets. These of course (both the horizontal and vertical) will vary due to the variations of dimensional size of the sheets and completed glazing units formed therefrom.

After lapse of the interval of time for which TR 175 is set, a circuit will be extended by line 176 through the end 177 of a reversible four-way valve 178 to source line 168. This valve, suitably connected to supply pipe 145 and return pipe 146, has one side joined to pipe 150 by pipe 180 and its opposite side to pipe 154 by pipe 181. While the end 177 is energized, hydraulic pressure will be directed from pipe 145 through pipes 181 and 154 to the rod end of the cylinder 49 thereby driving piston 48 downward and lowering the sealing assembly. At the same time, pressure is exhausted from beneath the piston 48 by pipes 150-180 to pipe 146. With the flames of burner units 42 and 45 being extinguished, the sealing assembly will be conditioned for subsequent operation.

Experience in production of all-glass multiple sheet glazing units of the type herein disclosed has resulted in findings that an improved formation of the integrally fused edge walls will be obtained when the elevation of the sealing assembly is adjusted, upwardly or downwardly, from that elevation at which the lowermost edges of the sheet will reduce the pressure of the air stream to substantially one-half volume. By adjustment of the set-point 135 of potentiometer 136, the voltage of line 133 can be raised or lowered to alter the sum total of the voltage supplied to the amplifier 130. Thus, in one exemplary instance, such as when the elevation of the forming rolls 44 should be moved slightly upward relative to the lower edges of the sheets, the setting of the potentiometer is adjusted to

create a DC current of - (minus) 0.4 volts in line 133. Accordingly, the distance of the lower sheet edges, line E in FIGS. 11 and 12, from the surface 83 of the detecting device will be reduced and the voltage sum, from an original sum of + (plus) 1 volt in line 128, will be reduced to a present voltage of + (plus) 0.4 and - (minus) 0.4 volt in line 133, will result in a condition of zero voltage in line 132 to the amplifier.

Also, when the elevation of the forming rolls 44 is to be moved slightly downward relative to the lower sheet edges, the set-point of the potentiometer should be adjusted to create a DC current of - (minus) 0.6 volt in line 133. In this event, the distance of the lowermost edges of the sheets from the surface 83 will be increased the determined amount and the voltage sum to line 132 will be reduced to zero when the original + (plus) 1 volt in line 128 is reduced to + (plus) 0.6 volt.

It is realized when it is desired to change the size of the sheets for a glazing unit of different dimensions, that such changes in dimension, as from the axial centers of the sheets on the vacuum platens to the lower edges and the desired elevation of the sealing assembly with reference to said lower edges for satisfactory fusion, will necessitate an initial raising or lowering of the assembly without, of course, altering the distance of vertical movement that the detecting device 41 and associated control system will be moved at start of each fusion operation.

To this end, a two-way manual switch device MS 183 is equipped with a movable contact 184 connected to source line 160; fixed contact 185 connected by line 186 to the end 187 of the valve 178 and contact 188 connected by line 189 to the opposite end 177. Thus, completion of a circuit from contacts 184 and 185 by line 186 through the valve end 187 to source line 168 will cause the direction of pressure from supply pipe 145 through pipes 180-150 to the head end of the cylinder 49 to raise the sealing assembly a desired distance; a return of fluid being obviously through pipes 150-181 and 146. On the other hand, engagement of contact 184 with contact 188 will complete line 189 via line 176, to the end 177 and energize valve 178 to direct pressure from pipe 145 through joined pipes 181 and 154 to the rod end of the cylinder 49; pipes 150-180 and 146 carrying the return fluid. Downward motion of the piston 48 will operate to lower the sealing assembly to a new elevation from which it can be moved upwardly in response to action of the detecting device 41 and ultimately downward under control of the timing relay TR 175.

It should be noted that, when the lowermost edges of the sheets are not at an exact elevation, as at line E, the desired elevation of the sealing assembly beneath the said edges will still be obtained when the volume of the stream received by the orifice 108 is reduced to substantially one-half its pressure. Consequently, when LS 156 is tripped and the blocking valves 148 and 152 are actuated to open communication between pipes 147-150 and 151-154, respectively, the condition to which the diaphragm 113 is deflected will cause displacement of the armature 116 within coil 117 to resultantly cause torque motor 143 and servo-valve 144 to deliver pressure to the cylinder 49. This will produce movement of the sealing assembly, in either direction, until the stream of air reaching the orifice

108 and through pipe 90 will deflect the diaphragm 113 at the desired degree of pressure to produce the resultant balancing of the sum of voltage received by the amplifier 130.

An additional novel feature of this invention is the provision of means for maintaining the open size of the receiver orifice 108 at its maximum area and the related edges unobstructed from dust or even particles of glass. For this purpose, a vertical passageway 195 is made in the block 84 to open into the bore 87 of the integral leg 81 and a passageway 196 is similarly provided to open into the bore 88 of the leg 82. Both of the passageways are closed adjacent the base 85 of the block by plugs 197. The block is horizontally drilled to provide a cross-passageway 198 that is tapped at its opposite ends and closed by suitable pipe plugs 199. From its medial area to a point outwardly of the vertical passageway 195, the passageway 198 is internally threaded to receive a threaded plug 100 having a restricting bore 201 of relatively small dimension, as in FIG. 8. The air pressure within the bore 87 of leg 81 and directed toward the orifice 107 in the disc 98 will thusly be also directed downwardly by passageway 195 through the restricting bore 201 of the plug 200 and by passageway 198 through passageway 196 upwardly into the bore 88 in leg 82. This will result in reversely directed air pressure at the receiving orifice 108 to loosen, disperse or otherwise discharge any objectionable particles adhering to the edges of the slot or orifice 108.

OPERATION

Assuming that the sealing assembly 38 is located in the desired lowered position to which it has been predeterminedly adjusted, the forward movement of a pair of preheated glass sheets, supported by vacuum platens 65 and 66 on a carrier 56, will carry the leading ends thereof into the pass 80 defined by the legs 81, 82 and surface 83 of the body of the detecting device 41. During the idle phases of operation, the stream of preheated air A will be supplied by pipe 89 and, through orifice 107, have at least a vertical dimension substantially equaling the vertical dimension of the orifice. This air stream is received at the orifice 108, the edges of which are kept clean by the air current emanating from the passageway 196. The orifice 108, and bore 88 in the leg portion 82 of the body portion or block 84, are connected by pipe 90 to the chamber 112 in the casing of the pressure transducer 114. The diaphragm 113, closing the chamber and being deflected outwardly by the contained air pressure, moves the armature 116 by rod 115 to displace the same with reference to coil 117. From a normally idle position, displacement of the armature 116 causes a maximum output signal from the secondary side of the coil 117 to produce a response in the amplifier 130 such that it will activate the torque motor 143, and through the servo-valve 144, act to direct hydraulic pressure from supply pipe 145 to pipe 147 and return pipe 146 to pipe 151. Connection of these pipes to associated pipes 150 and 154 and the respective ends of the cylinder 49 is however at this time interrupted by the blocking valves 148 and 152.

As the leading ends of the glass sheets are carried to a position, designated by the letter L of FIG. 3, the bar

157 on the carrier 56 (FIG. 11) is in a lowered operable position and will trip LS 156 to cause energization of the valve solenoids 149 and 153 and complete connections of pipes 147-150 to pipes 150-154, respectively. Consequently, pressure at the head end of cylinder 49 will raise the sealing assembly 38 which includes the detecting device 41, fusion burner unit 42, insert feeding device 43, pair of forming rolls 44 and fire-polishing burner unit 45; all being mounted on the platform 40 attached to the upper end of the piston rod 47. When especially the detecting device 41 has been moved upwardly with reference to the lowermost edges of the sheets, they will obstruct the stream of air in the pass 80 between the orifices 107 and 108. As the pressure of the air is gradually reduced to substantially one-half by upward movement of the sealing assembly, the amount of pressure received within the chamber 112 will be proportionately reduced and cause displacement of the armature 116 relative to the coil 117 from the idle or rest position. As hereinabove pointed out, the potentiometer 136 can be adjusted to vary the voltage in line 133 and in actual operation, places a voltage of desired potential at the input junction, or electrical network, 131 to the amplifier 130; said voltage having an opposite polarity to the polarity of the signal from the demodulator 127. Therefore, until the air stream A to the receiving orifice 108 is half-blocked by the presence of the lower edges of the glass sheets the unbalance of these signals at the amplifier input junction will result with the amplifier imposing a signal on the torque motor 143 of the servo-valve 144 in such a manner as to make the above-described connections to the cylinder 49 via particularly pipes 145, 147 and 150. As the pressure is reduced in chamber 112, the transducer output signal will be diminished until the summation of voltages to the input junction 131 of amplifier 130 approaches and arrives at zero. This is reflected in temporary idling of the torque motor and servo-valve and a resultant static condition in the ends of the cylinder 49.

In the event that the orifices 107 and 108 of the detecting device are raised to an elevation with reference to the lowermost edges of the sheets that the stream of air A is reduced substantially more than half of the full pressure, the signal from the transducer 114 will cause the demodulator 127 to supply DC current through the line 128 at a potential of, as for example, +0.4 volt. Since the setting of the potentiometer 136 will presently produce a DC current with a potential of - (minus) 0.5 volt, the voltage in line 132 to the amplifier will be unbalanced or lowered such that said amplifier will activate the torque motor 143 and servo-valve 144 to lower the sealing assembly until the stream of air equals substantially half the full pressure and the sum of the voltages in lines 128 and 133 will equal zero. This is obtained by connecting supply pipe 145 to pipes 151-154 and the rod end of the cylinder 49.

Until the trailing ends of the sheets reach the position, generally designated by the line T in FIG. 3, the control system maintains the sealing assembly substantially stationary during formation of the edge wall. At this point and when about 3 inches of the margins of the trailing ends remain to be carried through the pass 80, the bar 157 is caused to trip LS 158 which causes de-energization of the solenoids 149-153 to permit

reclosing of the spring-biased valves 148 and 152. Blocking of the connections between pipes 147-150 and 151-154 removes influence of the control system to move the sealing assembly in either direction, and so locks the sealing means in position, despite the fact that the volume of air stream A has been restored to full pressure in the pass 80 of the detecting device. LS 158 also activates TR 175 having a timed interval which is substantially equal to the interval of time required for the trailing ends of the sheets to be carried from line T to line T1 which depends upon the actual horizontal dimensions of the sheets.

When this interval of time has elapsed, TR 175 completes a circuit through the valve 178 to connect supply pipe 145 through pipe 181 and 154 to the rod end of cylinder 49. This will operate to lower the sealing assembly to the elevation of its rest position.

While the foregoing description has been directed to use of a detecting device to control the elevation of a sealing assembly and thus initiate upward movement of the assembly relative to the lower edges of a pair of glass sheets, it is also contemplated that the detecting device as herein disclosed will be equally adapted for use to move a sealing assembly downwardly from an initial rest elevation. Thus, in operations where the lower and upper edge portions of a pair of glass sheets are simultaneously sealed or fused together, a detecting device would be employed with an upper sealing assembly as well as a lower sealing assembly.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention.

We claim:

1. In apparatus for sealing together the edge portions of spaced glass sheets including means for supporting said sheets in spaced face-to-face relation, means for moving said sheet supporting means and the sheets supported thereby along a definite path, sealing means arranged along said path, means for carrying said sealing means and supported for movement toward and away from said path, means for moving said carrying means, means for passing a fluid medium across said path, means for receiving said fluid medium, and means for converting variations in the pressure of said received fluid medium into impulses which activate said moving means to move said carrying means and said sealing means toward and into and away from and out of sealing position with respect to the path of the marginal edge portions of said sheets; the improvement in which said converting means includes an electrical circuit for controlling said impulses; and a differential pressure transducer-transmitter; said means for passing a fluid medium across said path comprises a conduit, means for supplying fluid under pressure to said conduit, and means restricting said conduit to a slot-like discharge passageway; said means for receiving said fluid medium comprises a conduit having a slot-like orifice leading thereto that is in substantial alignment with said slot-like passageway from said first mentioned conduit; a pair of ears extend into said last mentioned conduit from opposite sides of said slot-like opening; said differential pressure transducer-transmitter comprises a chamber

communicating with said fluid medium receiving means, a flexible diaphragm closing said chamber, an armature connected to said diaphragm for movement therewith, and a coil surrounding said armature and having a primary side connected to a source of power and a secondary side having a signal output which is proportionate to the displacement of said armature; and said electrical system includes a demodulator connected to receive said signal from said coil.

2. Apparatus as defined in claim 1 in which said electrical circuit also includes an amplifier, and said amplifier is connected to receive the output from said demodulator.

3. In apparatus for sealing together the edge portions of spaced glass sheets including means for supporting said sheets in spaced face-to-face relation, means for moving said sheet supporting means and the sheets supported thereby along a definite path, sealing means arranged along said path, means for carrying said sealing means and supported for movement toward and away from said path, means for moving said carrying means, means for passing a fluid medium across said path, means for receiving said fluid medium, and means for converting variations in the pressure of said received fluid medium into impulses which activate said moving means to move said carrying means and said sealing means toward and into and away from and out of sealing position with respect to the path of the marginal edge portions of said sheets; the improvement in which said converting means includes an electrical circuit for controlling said impulses; and a differential pressure transducer-transmitter comprising a chamber communicating with said fluid medium receiving means, a flexible diaphragm closing said chamber, an armature connected to said diaphragm for movement therewith, and a coil surrounding said armature and having a primary side connected to a source of power and a secondary side having a signal output which is proportionate to the displacement of said armature; said means for receiving said fluid medium includes a conduit having an orifice leading thereto, and means is provided for reversely directing a fluid medium through said receiving means to clear the same; and said electrical circuit includes a demodulator connected to receive said signal from said coil.

4. In apparatus for sealing together the edge portions of spaced glass sheets including means for supporting said sheets in spaced face-to-face relation, means for moving said sheet supporting means and the sheets supported thereby along a definite path, sealing means arranged along said path, means for carrying said sealing means and supported for movement toward and away from said path, means for moving said carrying means, means for passing a fluid medium across said path, means for receiving said fluid medium, and means for converting variations in the pressure of said received fluid medium into impulses which activate said moving means to move said carrying means and said sealing means toward and into and away from and out of sealing position with respect to the path of the marginal edge portions of said sheets; the improvement in which said converting means includes an electrical circuit for controlling said impulses; and a differential pressure transducer-transmitter comprising a chamber communicating with said fluid medium receiving means, a flex-

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ible diaphragm closing said chamber, an armature connected to said diaphragm for movement therewith, and a coil surrounding said armature and having a primary side connected to a source of power and a secondary side having a signal output which is proportionate to the displacement of said armature; said means for passing a fluid medium across said path comprises a conduit, means for supplying fluid under pressure to said conduit, means for restricting said conduit at its discharge end to a slotted passageway; said means for receiving said fluid medium comprises a conduit having a slotted orifice leading thereto that is in substantial alignment with said slotted passageway; and a pair of ears extending into said last mentioned conduit at opposite sides of said slotted orifice and having opposed outwardly divergent surfaces designed to reduce turbulence in said fluid medium flowing therepast; and said electrical circuit includes a demodulator connected to receive said signal from said coil.

5. Apparatus as defined in claim 1 in which said slot-

like opening is slightly wider than said slot-like passageway, and said ears have opposed outwardly divergent surfaces.

6. Apparatus as defined in claim 4 in which said slotted orifice is slightly wider than said slotted passageway, and means is provided for diverting part of said fluid supplied under pressure to said first mentioned conduit from said first mentioned conduit to said second mentioned conduit and reversely directing the same outwardly through said slotted orifice to clean the same.

7. Apparatus as defined in claim 2, in which said electrical circuit further includes a manually adjustable potentiometer connected to a source of power and a motor for supplying power to said moving means, said connection from said demodulator to said amplifier is through an electrical network connected to said potentiometer, and said amplifier is connected to said motor.

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