

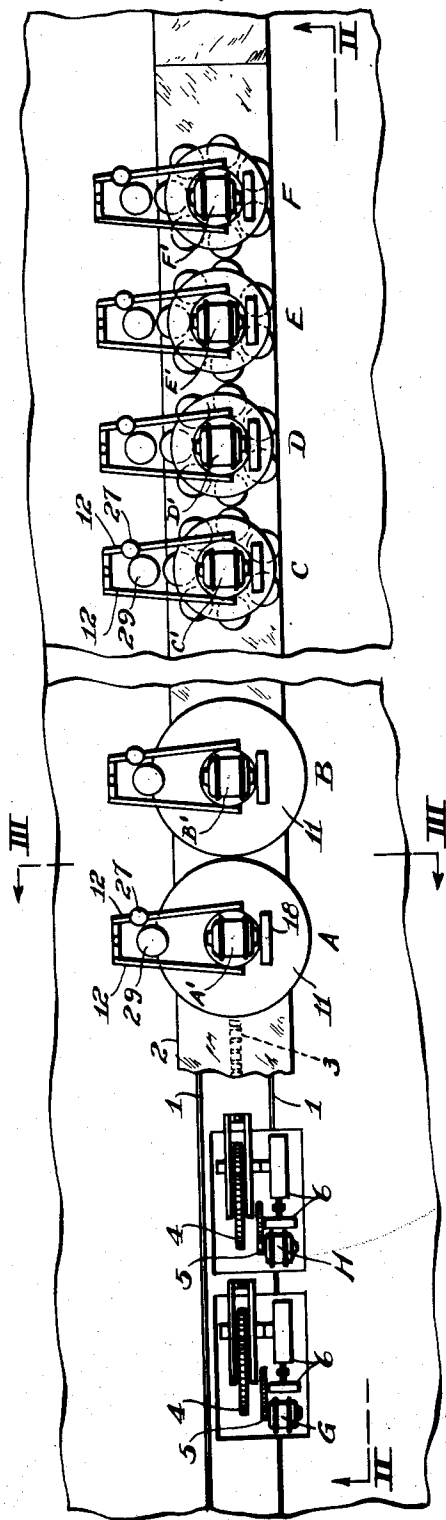
May 29, 1928.

1,671,718

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SHEET SURFACING APPARATUS

Filed May 16, 1927

9 Sheets-Sheet 1



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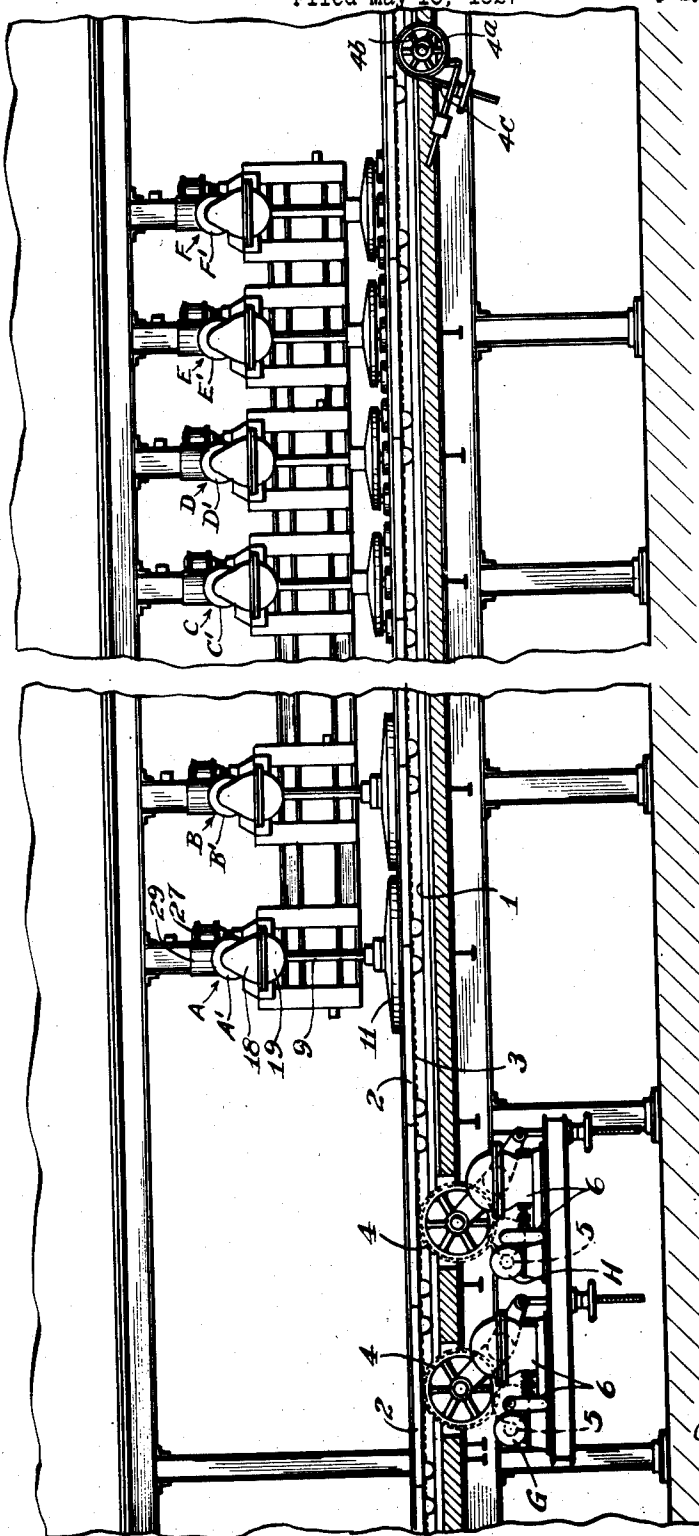
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9 Sheets-Sheet 2

Fig. 2.



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Fig. 3.

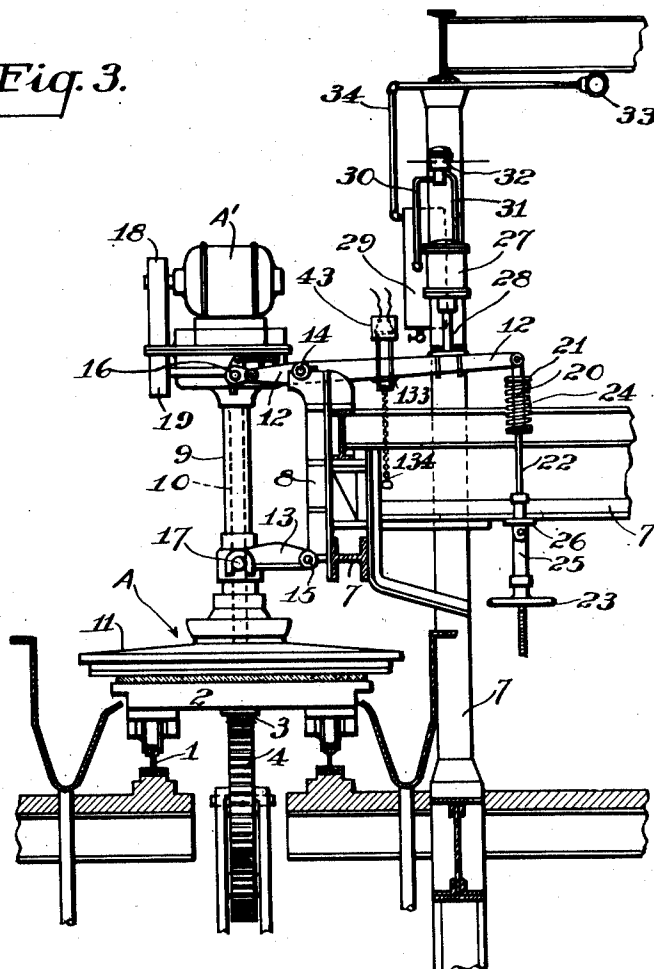
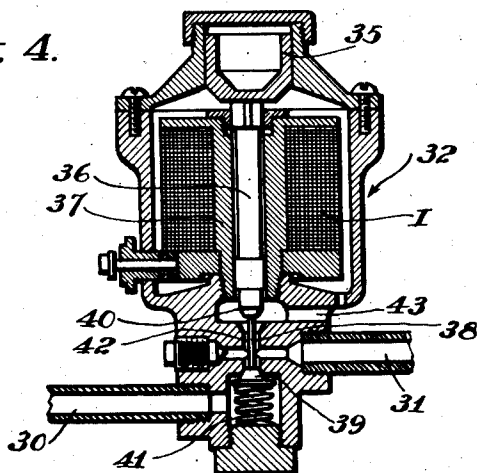


Fig. 4.



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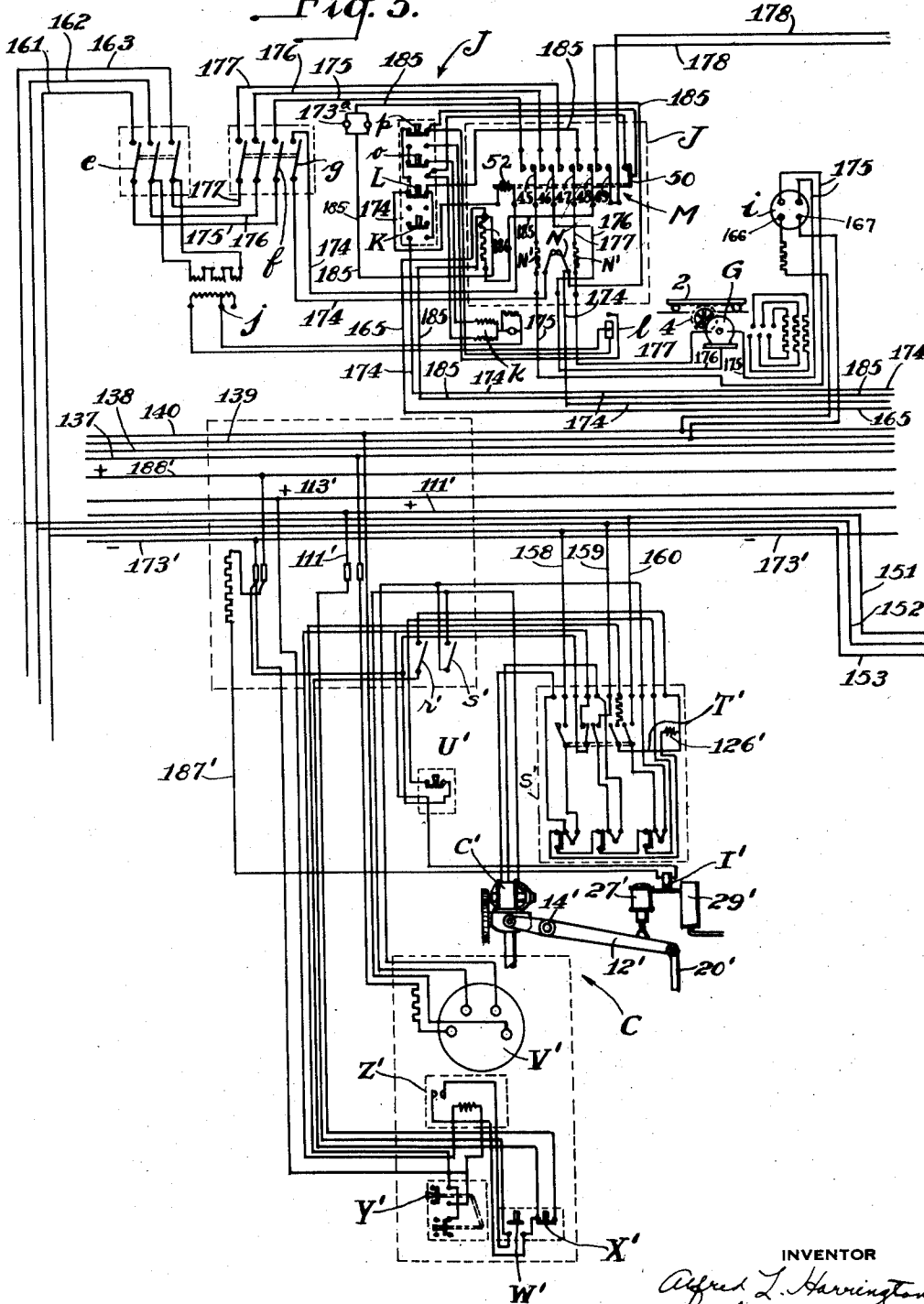
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Fig. 5.



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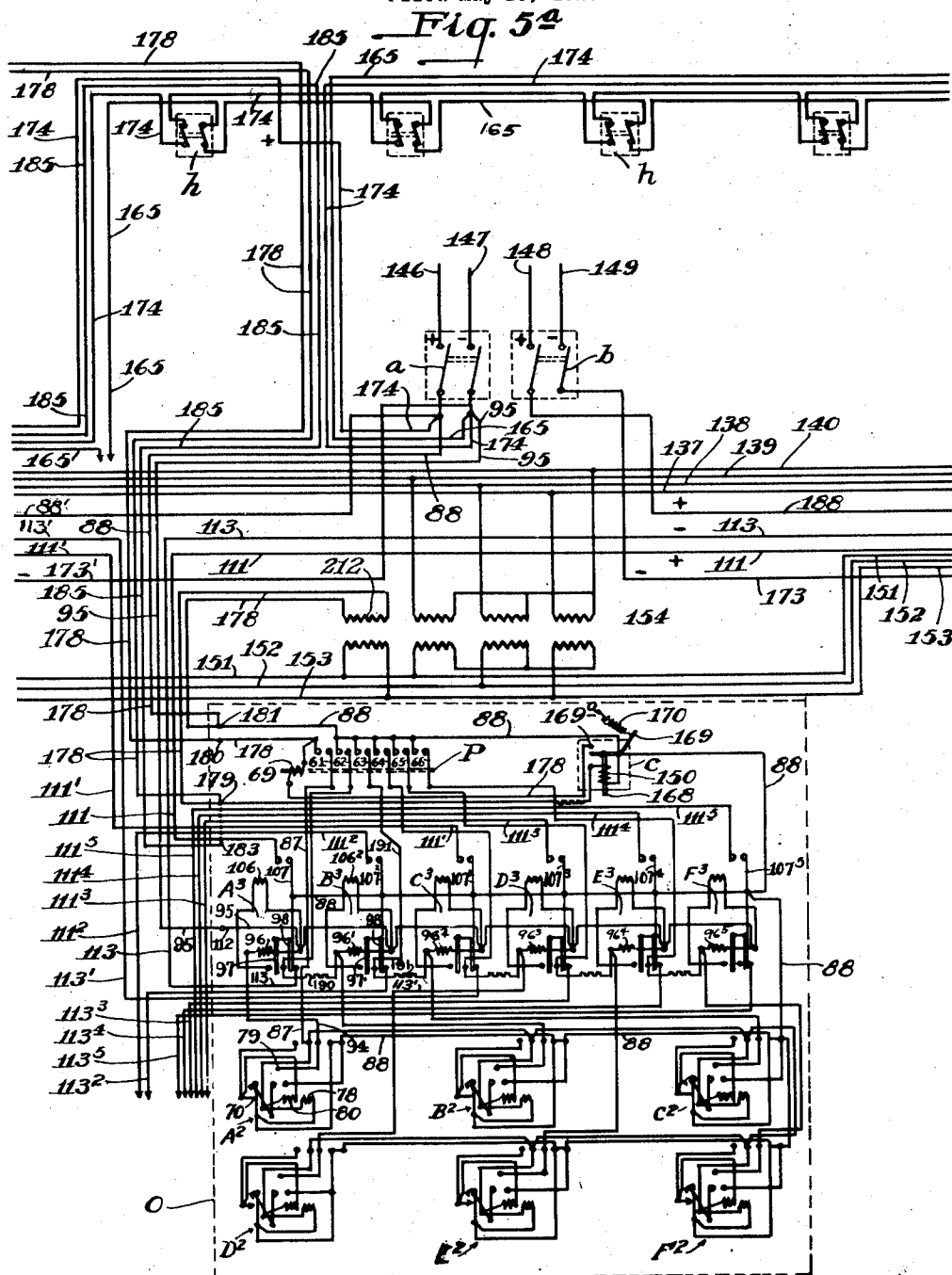
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9 Sheets-Sheet 5



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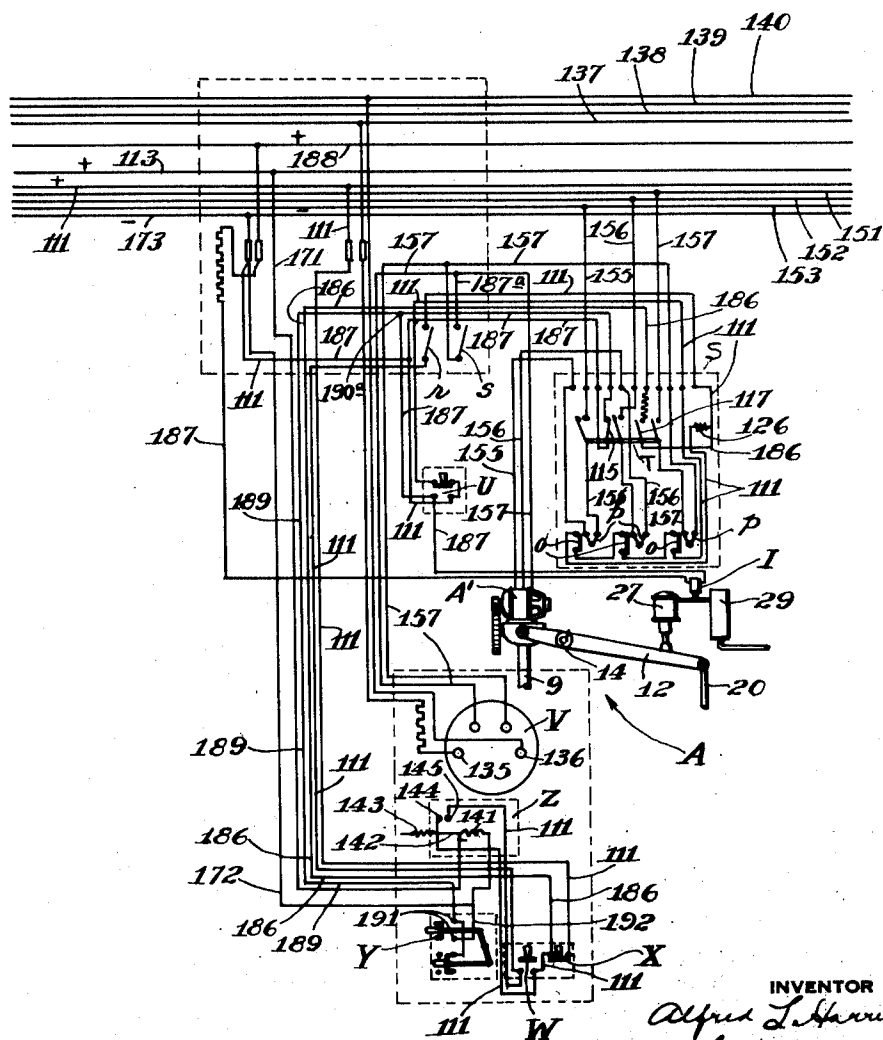
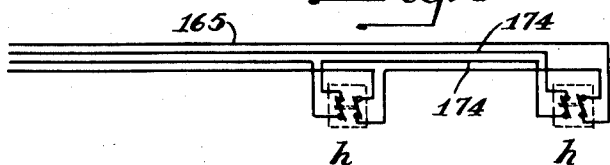
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Fig. 5^b

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Fig. 7.

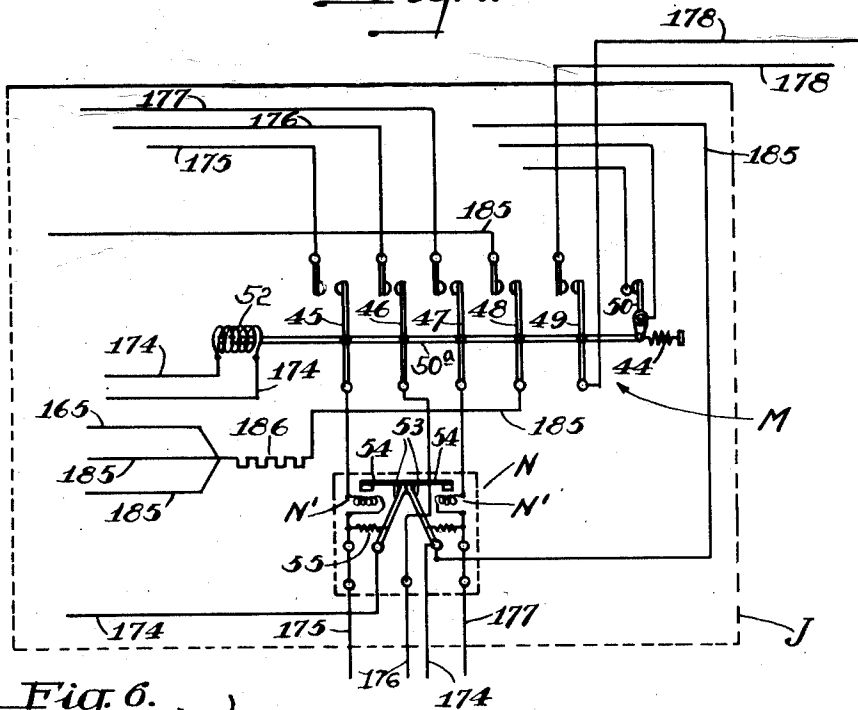


Fig. 6.

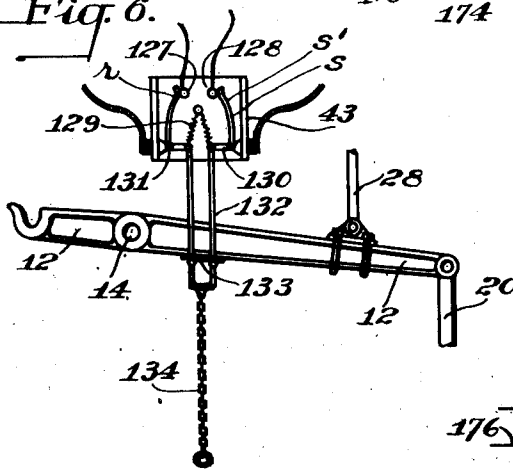
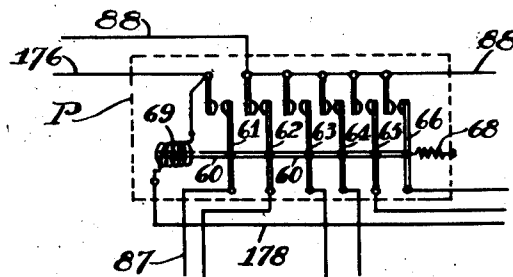


Fig. 8.



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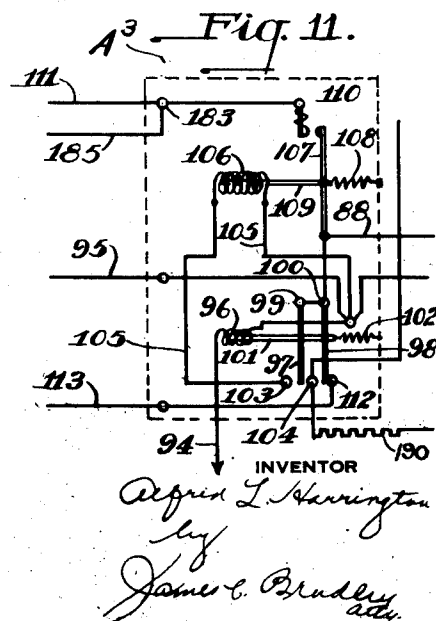
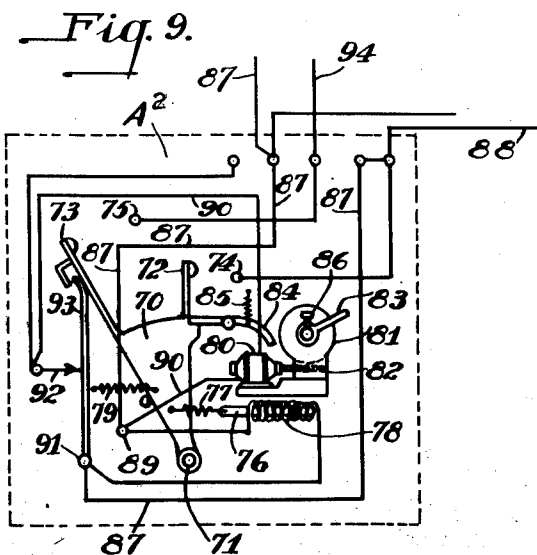
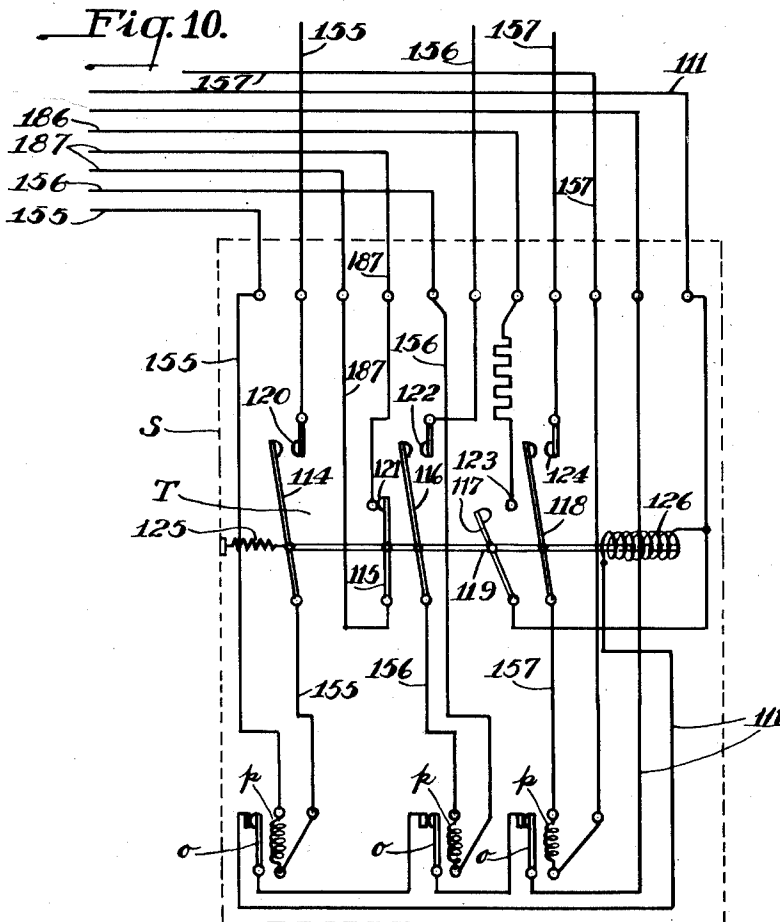
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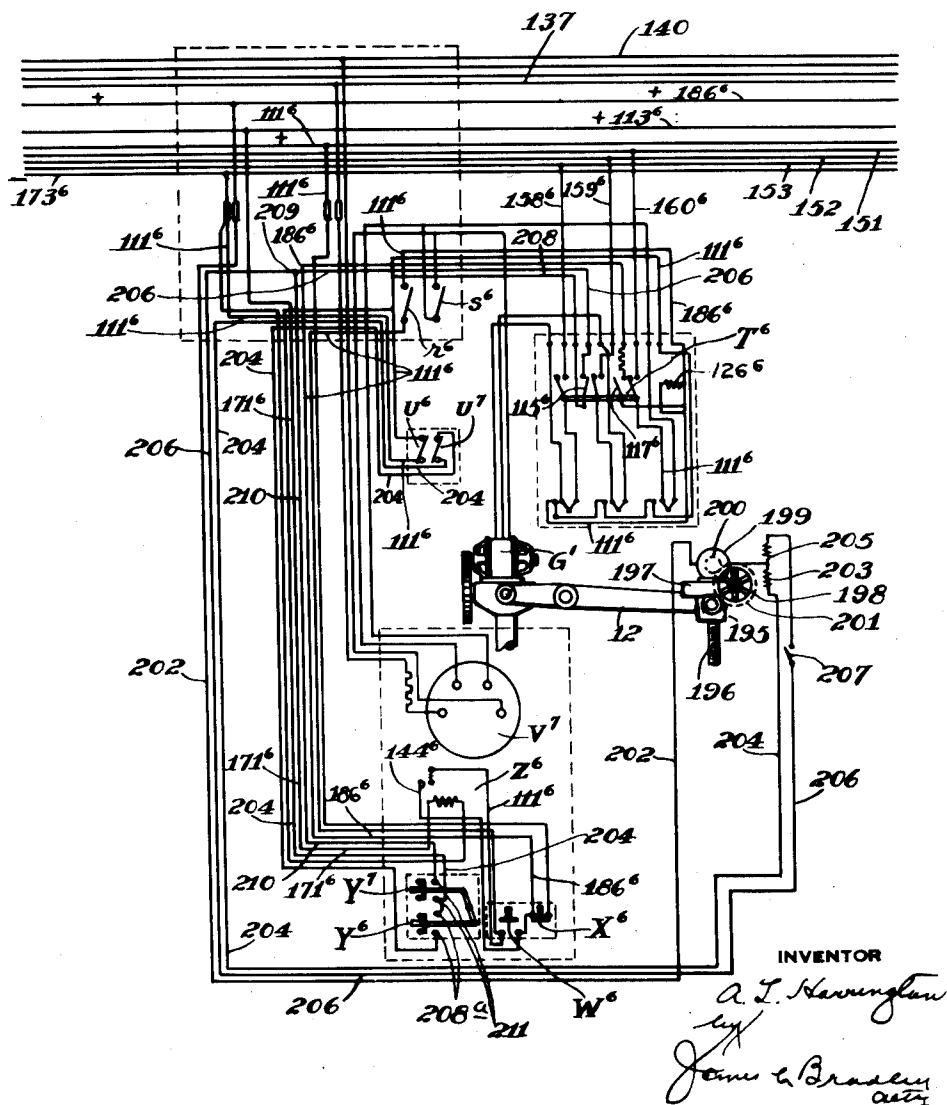
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Fig. 12.



UNITED STATES PATENT OFFICE.

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SHEET-SURFACING APPARATUS.

Application filed May 16, 1927. Serial No. 191,577.

The invention relates to sheet surfacing machines and particularly to those for use in surfacing sheet glass in a straight away or straight line operation, in which the glass sheets upon a train of tables or cars are passed beneath a series of grinding and polishing machines. In such an operation, there may be a series of 24 or more grinding machines followed by 48 or more polishing machines, and it is the object of the present invention to provide improved means for controlling the operation of these machines, the raising and lowering movements of the runners and the operation of the drive of the cars or tables, so that, (1) the danger of breakage of the glass upon the tables is reduced to a minimum; (2) the starting and stopping of the apparatus is facilitated and loss of time avoided; (3) the load upon the electrical circuits is properly distributed; (4) and the safety of the apparatus is increased. Certain embodiments of the invention are illustrated in the accompanying drawings, wherein:

Figure 1 is a plan view of the apparatus, a small number only of the individual grinding and polishing machines being shown. Fig. 2 is a longitudinal section on the line II—II of Fig. 1. Fig. 3 is a section on the line III—III of Fig. 1 on an enlarged scale. Fig. 4 is a section on an enlarged scale through the casing of the air valve and its magnetic control. Figs. 5, 5^a and 5^b together show the wiring diagram of the system. Fig. 6 is a detail of one of the runner supporting levers and the switches operated thereby. Figs. 7, 8, 9, 10 and 11 are enlarged views of different parts of the apparatus shown in Figs. 5, 5^a and 5^b, such views being diagrammatic in character. And Fig. 12 shows a modification, involving a different prime mover for raising the runner, and the wiring diagram therefor.

Referring to Figs. 1, 2 and 3, A, B, C, D, E and F are a plurality of surfacing machines arranged in series above the track 1, the machines A and B being grinding machines, and C, D, E and F polishing machines. As a matter of fact, each machine represents a group of about 12 machines, it being impracticable to illustrate such a large number of units and their wiring diagrams, as will be apparent later when Figs. 5, 5^a and 5^b are considered. It will be under-

stood that all the machines of each group have the same wiring control and operate simultaneously, so that a consideration of a representative machine of each group will make clear the entire arrangement.

Mounted on the track 1 are a series of tables 2, 2, 2, etc. placed end to end in abutting relation and provided on their lower sides with the racks 3, by means of which the tables are fed continuously forward from left to right (Fig. 2), tables being supplied at the left hand end of the system as they are removed from the right hand end thereof. The glass sheets to be surfaced are embedded in plaster upon the tops of the tables so that the series of cars constitute in effect a continuous grinding table. The racks are driven by two spur wheels 4, 4 at the left hand end of the track, such gears being in turn operated from the motors G and H through the spur gears 5, 5 and suitable reduction gearing in the casing 6, 6. Either motor is sufficient to move the tables forward, the use of the two being merely a matter of precaution to take care of an emergency which might arise due to the failure of a single drive motor.

At the end of the track toward which the cars are moving (Fig. 2) is a friction brake comprising a shaft 4^a having a pinion in engagement with the racks 3, a wheel 4^b keyed to the shaft, and a brake band 4^c passing around the wheel. This device provides a yielding resistance retarding the movement of the tables so that any danger of the tables becoming separated is avoided and the rate of their movement beneath the surfacing machines is made more even and uniform.

The construction of one of the surfacing units, preferably employed, will be seen by reference to Fig. 3, which shows the first grinding machine A of the series. The movable parts are supported upon a framework 7, which carries the casting 8. A tubular casing 9 carries the runner shaft 10, which in turn supports the runner 11. The casing, and with it the runner shaft and runner, are guided for vertical movement by the lever 12 and the arm 13 pivoted upon the pins 14 and 15 mounted in the casting 8. The lever and arm engage the trunnions 16 and 17 on the casing 9, the lever 12 serving to support such casing and move it up and down, as later described. A motor

A' is supported on the upper end of the casing 9 and serves to drive the runner shaft 10 through the intermediary of suitable reduction gearing in the casings 18 and 19.

The lever 12 carries at its outer end the yoke 20, in which is guided for vertical movement the block 21, through which extends a rod 22 threaded at its lower end and carrying the adjusting hand wheel 23. The lower end of the yoke 20 supports the base of the coil spring 24, so that when the rod 22 is moved downward, moving the block 21 downward, the spring is compressed, thus tending to counterbalance the weight of the grinding unit on the other end of the lever 12. The wheel 23, which is threaded on the rod 22, is held against upward movement by means of a sleeve 25 pivoted in brackets 26 secured to the lower flanges of one of the frame members. The hand wheel 23, in connection with the rod 22 and spring 24 thus serve as a means of counterweighting the grinding unit to any desired extent depending upon the grinding conditions, and also serves as a means for lifting the runner entirely out of contact with the glass when this becomes necessary.

Mounted above the lever 12 of each of the grinding and polishing machines is an air lift for the grinding unit carried by the lever. This lift consists in each case of a cylinder 27 secured to the framework of the machine, together with a suitable piston in the cylinder provided with a piston rod 28 pivoted at its lower end to a bracket clamped to the lever arm. Alongside each piston is an air storage cylinder 29 having pipe connections 30 and 31 leading to the upper end of the cylinder 27 via the valve casing 32, the flow from which cylinder is electrically controlled, as hereinafter more fully explained. The storage cylinders are supplied with air under pressure from an air line 33 extending longitudinally of the series of grinding machines and provided with outlet branches 34 leading to the various storage cylinders. Provision of a storage cylinder adjacent each of the lifts insures a sufficient quantity of air to operate the cylinders promptly and in unison.

The electrically controlled valve mechanism in the casing 32 will be seen by reference to Fig. 4. A magnet winding I is provided in fixed position in the casing, adapted, when energized, to cause the downward movement of the tubular armature 35 slidably mounted in the upper end of the casing. This armature engages at its lower end a rod 36 slidably guided in a sleeve 37, which acts as the core to the winding I. Mounted in the lower end of this rod 36 is a valve stem 38 carrying the valves 39 and 40, the valve 39 being normally held closed and the valve 40 open by means of the coil spring 41 located beneath the valve 39.

When the valve is in this position, the chamber of the cylinder 27 on the upper side of its piston is vented to the atmosphere via the pipe 31, the passage 42 and the outlet 43. When current is supplied through the magnet winding I, the downward movement of the armature 35 causes the valve 40 to close and the valve 39 to open. This closes the outlet from the cylinder 27 through the passage 43 and admits a supply of air from the storage cylinder 29 via the pipe 30, the passage 42, and the pipe 31. The up and down movement of the arm 12 also opens and closes a pair of other switches *r* and *s* in the casing 43, whose functions are set forth later herein in connection with the description of the wiring diagram.

Figs. 5, 5^a and 5^b of the drawing shows the electrical apparatus for the system. The complete wiring diagram of only two of the machines is shown, but the arrangement of all the others will be readily apparent from a consideration of the two. The two selected are the first and third of the series; viz., A and C. It will be further understood that these two machines are representative of two groups of machines, each consisting of about 12 or more machines. The wiring for all the members of each group is a duplication of that of the individual machine of the group, as illustrated and described.

The starting and stopping of the entire system, including the motors which drive the tables and those for driving all the runners is controlled from the panel J. This panel includes the start button K, the stop button L, the multiple switch M, and the thermo-relay switch N, which opens when the flow of current through either of the heating coils N', N' increases beyond a certain point. A part of this panel is shown on an enlarged scale in Fig. 7. As here shown, the parts of the switch M are yieldingly held in the position shown by the spring 44, thus holding the switch arms 45 to 49, which are attached to the solenoid bar 50^a open, and the arm 50 closed. When current is passed through the coil 52, the bar is pulled to the left closing the switches 45 to 49 and opening the switch 50. As hereinafter more fully described, the pressing down of the push button K causes current to pass through the coil 52, thus moving the bar 50^a to the left, closing the arms 45 to 49 and opening the arm 50. This completes the circuits through the table driving motors so that they start, and also completes a circuit through a coil on the sequence control panel O which closes the contacts, which closing eventuates in the starting of the motors which drive the runners in a definite sequence, and in the downward movement of the runners from raised position. This timed sequence of operation avoids putting too heavy a load on the circuit at any one

time and insures that the runners shall be rotating and the tables moving therebeneath before the runners engage the glass. The arms 53, 53 of the switch N are yieldingly held closed by the bi-metallic strips 54, 54 fixed at their outer ends, such strips being located adjacent the heating coils N', N'. The arms 53, 53 lie in the same circuit as the coil 52 and are provided with springs 55, 55 tending to open them. When the current through the heating coils rises above a predetermined point, the heat from the coils causes the arms 54, 54 to bend or warp, releasing the ends of the arms 53, 53 so that they open, thus interrupting the flow of current through the arms and through the coil 52 so that the switch M opens, interrupting the operation of the entire system. Thermo-relays of this type are well known in the art so that no detailed showing or explanation is necessary.

The sequence control panel O includes the multiple switch P, the series of time relays A², B², C², D², E², and F², one for each group of runner motors, and a series of relays A³, B³, C³, D³, E³, and F³. The time relay A² and the relay A³ together control the operation of the motor A' of grinding machine A, (Fig. 5^b) or if A is a group of 12 or more grinding machines, then the relays A² and A³ control all the members of the group. Similarly, the relays C² and C³ control the operation of the motor or group of motors C', as shown in Fig. 5.

The multiple switch P (Fig. 8) is similar to the switch M above described. It comprises a solenoid bar 60, operating the switch arms 61 to 66 and yieldingly pulled to the right by the spring 68. The bar is moved to the left to close the arms by the coil 69. The coil 69 is operated by alternating current from the transformer coil 212. This circuit, including the coil 69, passes through the arm 49 of the switch M, so that the energizing of the coil 69 and the closing of the switch arms 61 to 66 is dependent upon the closing of the switch M, which, as above explained, occurs only after the start button K is pushed down. It follows that the actuation of the time relays A² to F² and the starting of the runner motors A' to F' must be preceded by the closing of the multiple switch P, all of which appears in detail after the following brief discussion of the remainder of the control apparatus.

The six time relays which are closed after, and due to the closing of the multiple switch P, are all similar to the relay A², shown in Fig. 9. This relay comprises the arm 70 pivoted at 71 and having the contact ends 72 and 73 adapted to engage the contacts 74 and 75 when the arm swings to the right, the solenoid bar 76 connected to the arm 70 by the spring 77, the coil 78 for pulling

the bar 76 to the right, the spring 79 for pulling the arm to the left, the motor 80 driving the disc 81 through the worm 82, the contact arm 83 adjustable circumferentially on the axle of the disc 81, and the latch 84 held in the position shown by the spring 85. The time interval which elapses after current is supplied to the motor and to the coil 78 before the arm 70 closes, is regulated by the position of the arm 83, which can be held in any position of circumferential adjustment by the thumb screw 86 or any other suitable means. When current is supplied through the wire 87, it passes through the coil 78 to the return wire 88. It may be here interpolated to avoid confusion that the wires 87 and 88 are in the alternating current circuit, including the winding 69 and that the wire 88 also carries direct current. The current through 87 divides at the point 89 and passes through the circuit 90 to the motor 80 and back to 87 at the point 91, via the contact 92, which engages the arm 93 pivoted at such point 91. The coil 78 and motor are thus energized when current flows through 87, and the disc 81 with the arm 83 begins to rotate. When the time elapses for which the relay is set, the arm 83 engages and trips the latch 84, and the spring 77 placed under tension by the solenoid bar 76, pulls the arm 70 to the right so that the contact ends 72 and 73 engage the contacts 74 and 75, thus establishing a circuit between the wires 88 and 94, the wire 88, as above stated, being the lead-in wire carrying direct current. The wire 94 leads to the relay A³ (Fig. 11) and serves to close this relay, as later described, so as to cause the actuation of the starter of the motor A'. The movement of the arm 70 to the right breaks the circuit between 92 and 93, so that the operation of the motor 80 is stopped after the arm 70 is moved to closed position. When the circuit between 87 and 88 is broken, the spring 79 will move the parts back to the position shown, the arm being engaged and locked in open position by the latch 84. When the circuit through the coil 78 is interrupted, automatic means, not shown, move the worm 82 out of engagement with the worm wheel 81, and a spring returns this wheel and the arm 83 to starting position, as shown. This time relay is standard equipment, known in the art, and, therefore, not illustrated in all its details.

The closing of the relay A², as just described, controls the operation of the relay A³, such relay closing so that direct current is permitted to flow through the relay and to the starter of the motor A'. This relay A³ will be understood by reference to Fig. 11, wherein 94 is the inlet wire from the relay A² (Fig. 9) above referred to and 95 is the return wire through which the current flows back to the negative side of the DC gener-

ator after passing through the coil 96. This causes the contact arms 97 and 98 pivoted at 99 and 100 and connected to the solenoid bar 101 to swing to the left against the tension of the spring 102, engaging the contacts 103 and 104. This completes a circuit from the line 88 through the arm 97, contact 103, line 105 and coil 106 back to the line 95, so that the contact arm 107 is swung to the left against the tension of the spring 108 by the solenoid bar 109, causing the arm to engage the contact 110. This completes a circuit from the positive line 88 to the line 111, which supplies current to the starter of the motor A' and causes the operation of such starter, as later described. The movement of the arm 98 to the left also breaks the contact between such arm and the contact 112 at the terminal of the line 113, so that current to such line which had up till this time been supplied from the line 88 is cut off. The line 113 also leads to the control apparatus of the motor and functions in connection therewith, as later described.

The starting panel S for the motor A' is controlled from the line 111 (Fig. 10) completed by the closing of the arm 107, and includes a multiple relay switch T similar to the multiple relay switch of Fig. 7. It includes a series of switch arms 114 to 118 operated by the solenoid bar 119 and adapted to engage, when closed, the contacts 120 to 124. The bar is held yieldingly to the left by the spring 125 and is moved to the right to close the switch arms 114, 116, 117 and 118 and to open the arm 115, when the coil 126 is energized. The closing of the arms 114, 116 and 118 completes the circuits to the motor A', while the opening of the arm 115 breaks the circuit through the magnet coil I, which holds the air valve open, so that the energizing of the coil 126 and the moving of the bar 119 to the right results in the starting of the motor A' and the release of the air from the cylinder 27, permitting the runner to move down by gravity and engage the glass. The members *o, o, o* are thermal relay switches lying in the circuit, which energizes the coil 126, such switches being opened by the heating coils *p, p, p* in the three lines of the circuits of the motor A', the principle of operation of these switches and their functions corresponding to those of the switch N, heretofore described.

Other apparatus used in connection with the grinding unit A, and the control panel S, as just described, are (see Fig. 5^b) the switches *r* and *s*, the safety switch U, the watt meter V, the start button W, the stop button X, the up and down switch Y and the slow drop out relay Z. The switches *r* and *s* are arranged so as to be closed when the runner reaches its upper limit of movement and to open when the runner starts down from its upper position. The switch *r* lies in the cir-

cuit including the coil 126 of the multiple switch T, so that the motor A' cannot be started unless the runner is in its upper position. The switch *s* lies in a circuit, which short circuits the watt meter V, so that the watt meter is protected against the heavy current flowing through the motor circuit when the motor is starting. When the motor moves down, the switches *r* and *s* open. Fig. 6 shows the switches *r* and *s* in detail. The switch arms are held in engagement with the contacts 127 and 128 by the springs 129, which are attached to the crank arms 130 on which the switch arms are mounted, the crank arms being pivoted at 131. A pair of depending rods 132 engage a plate 133 lying beneath the lever arm 12, which supports the runner. When the runner moves down, thus allowing the plate 133 and rods 132 to move up, the springs 129 cause the arms *r* and *s* to move away from the contacts 127 and 128. When the runner moves up again, the rods 132 are moved down, closing the switch arms. In order to permit the closing of the switch arms by hand when the runner is down, the dependent chain 134 is provided. This would permit the starting of the motor with the runner in lowered position and would short circuit the watt meter at such starting time.

The safety switch U when in the position shown completes the circuit through the coil 126, which closes the multiple switch T. If this switch is moved down and breaks this circuit, it is impossible, therefore, to start the motor A'. This switch is designed to be operated by a key and is locked in open position when repairs or other work is being done of such a character that the accidental starting of the motor would endanger the workmen.

The stop and start buttons X and W are of the type which are yieldingly held in the positions shown and return to such positions after the operating pressure is released. As later described, these buttons with their connections permit the stopping and starting of the motor A' independent of the rest of the runner motors B' to F'. Similarly, the switch Y may be moved from the open position shown to closed position to cause the runner of the grinding unit A to move up independent of all the other runners and may then be moved back to the position shown to cause the unit A to move down again to grinding position, this being accomplished without stopping the rotation of the runner.

The watt meter V has one of its terminals 135 at the end of the potential coil connected to the line 137 supplied from the transformer 154 (Fig. 5^a) of the three-phase current supply, while its other terminal is connected to a neutral 140, so that the potential supplied is single-phase current. This permits the use of much cheaper watt meters than if the

potential coil were supplied with three phase current. This is a matter of considerable economy because each of the seventy odd surfacing units in the system must be provided with its own watt meter to indicate the amount of work which each runner is doing.

The slow drop out meter Z has its coil 141 energized by current supplied from the line 113 leading from the relay A³, and this coil acts to pull the solenoid bar 142 to the right against the tension of the spring 143, so that the arm 144 engages the contact 145 until the circuit from 113 is broken by the movement of the arm 98 of the relay A³ to the left. The relay is of the slow drop out type, so that after the circuit through the coil 141 is broken, the arm 144 remains closed long enough to permit the arm 107 of the relay A³ to be closed, and for the current thus supplied from the line 111 through the coil 126 of the multiple switch T and through the arm 145 to close such multiple switch T, the purpose of this arrangement appearing later in connection with the description of the operation.

Direct current is supplied to the system from the lines 146 and 147, and 148 and 149 past the switches *a* and *b*. This current is utilized in operating the coil 52 of the multiple switch M, the coil 126 of the multiple switch T; and the coils 96 and 106 of the relays A³ to F³. Alternating current is supplied from the transformer winding 212 for operating the coil 69 of the multiple switch P, the coil 150 of the contact making voltmeter *c* (later described), the coils 78 of the time relays A² to F², and the motors 80 of such last relays.

The main supply of three-phase alternating current is supplied from the buss lines 151, 152 and 153. In order to operate the watt meters on a relatively low voltage, so that cheaper instruments may be employed, the transformer 154 is used, which gives the desired reduced voltage on the lines 137, 138, 139 and 140, heretofore referred to, in connection with the watt meters V. All of the runner driving motors, including A' and C' are supplied from the lines 151, 152 and 153 by the lines 155, 156 and 157 and 158, 159 and 160, respectively, while the table driving motors G and H are supplied by the lines 161, 162 and 163, in which lines are located the switches *e* and *f*, the latter switch having connected to work with it the switch arm *g* lying in the direct current line, which energizes the coil 52 of the multiple switch M. A number of other hand operated switches *h*, *h*, *h* are also located in the same direct current line, and located at intervals along the length of the line of surfacing units. By opening any one of these, the circuit through the operating coil 52 of the switch M is interrupted and this results in the stopping of the table drive motor G and

of all the runner drive motors A' to F' and the raising of the runners driven thereby. These are emergency switches, as they provide for the quick stopping of all of the driving motors from any point along the system in case of accident. They are shown as double, the right hand side of each switch controlling a second direct current circuit 165, which in turn governs equipment on another panel duplicating that of the panel J and including a multiple switch similar to the switch M. This other switch, when closed, completes the circuits from the source of alternating current to the duplicate drive motor H. This is an obvious matter of duplication in the wiring arrangement and is, therefore, omitted, no claim being made to the feature of using a duplicate table drive motor, as this is a common expedient in other relations for adding to the certainty of operation.

The motor G is provided with a watt meter *i*, which like the watt meter V has one terminal 166 of its potential coil connected to the neutral line 140 and the other terminal 167 connected to one of the other alternating current supply lines 139. The contact making volt meter *c* (Fig. 5^a) whose coil 150 lies in the alternating current line from the transformer winding 212, serves to cause a lifting of the runners and the interruption of the current supply to the runner motors. The coil operates the solenoid bar 168 pivoted to the contact arm 169, which is normally held closed by the coil acting upon the solenoid bar. When the potential in the AC lines 151, 152 and 153 drops below a certain point, a corresponding decrease is registered in the transformer winding 212, and the tension spring 170 opens the contact arm 169, and interrupts the AC current through the coil 69 of the multiple switch S, so that such switch opens and results in the cutting off of current to the runner driving motors in timed sequence (through the intermediary of the time relays) and in the raising of the runners. When the voltage rises again, the arm 169 closes again, and the time relays are actuated in sequence to again secure a flow of current to the runner motor, to which the current flow has been discontinued, all of which is more fully set forth in the description of the complete operation which follows.

The wiring diagram of the connections for the motor G (Fig. 5) discloses a pilot motor transformer *j*, a split field pilot motor *k* and a pilot motor limit switch *l*, which in connection with the slow and fast buttons *o* and *p* and the switch arm 50 of the switch M, control the speed of the motor G, but no description of these parts or their functioning is regarded as necessary, as they involve standard equipment well known in the art and have nothing to do with the present invention, the showing in the drawings of

these parts being included merely to make the wiring diagram complete.

In starting the operation of the system, the hand operated switches are all closed, and it will be assumed that all of the runners are in upper position, the switches *r* and *s* are closed, the push buttons are all spring held in the positions shown in Figs. 5, 5^a and 5^b, none of the motors of the system are operating, and all of the coil operated relay switches are open, except that of the slow drop out relay Z. The coil 141 of such relay Z is energized at this time by direct current from the line 146 through the line 88 to the relay A² (Fig. 11) through the arm 98, the line 113 and the lines 171 and 172 to the negative return line 173.

The operation is started by pressing down the start button K of the panel J, and holding it down until light shows in the lamps 173^a, after which the button may be released, permitting it to return to open position. Direct current flows to the button contacts from the line 146 through the line 174, past the contacts of the buttons K and L, through a further section of the line 174 to the coil 52, through a further section of the line 174 to switch *g*, through a further section of the line 174 to the switch N, through this switch and the further sections of the line 174 leading past all the emergency switches *h* and back to the negative side of the switch *a*. The coil 52, thus energized causes the switch M to close, thus completing the three circuits 175, 176 and 177 leading from the AC lines 161, 162 and 163 to the table drive motor G, such current flowing through the contact arms 45, 46 and 47 (Fig. 7), the circuit 175 passing through the current coil of the watt meter *i*. The other table drive motor is similarly started at the same time by current through the line 165, heretofore referred to, which is in parallel with the line 174 and passes to a panel, which includes equipment similar to that of the panel J.

The closing of the switch M also completes another circuit due to the closing of the arm 49, such circuit including the AC transformer winding 212 and the closing coil 69 of the multiple switch P. This circuit is designated as 178. Starting with the right hand end of the transformer coil 70, it includes the section 178 leading to the point 179, the further section 178 leading from 179 to the arm 49, the further section 178 leading to the point 180, coil 69, section 178, arm 169 and wire 88 to point 181, and section 178 to the left hand end of the transformer coil 212. At this time, the arm 169 of the relay *c* is closed, as its coil 150 is energized by alternating current from the winding 212. The coil 69 now closes the switch P, including the arm 61, so that alternating current from the point 180 passes through such arm to the line 87, and thence

through the time relay A² and back to the point 181 and winding 212 via the line 88. The actuation of this relay has been described in connection with Fig. 9, the current from the line 87 passing through the coil 78 and the windings of the motor 80, so that the spring 77 is placed in tension and the arm 83 driven from the motor trips the catch 84, after a predetermined interval of time, the arm 70 then being swung to the right by the spring 77, so that the contact ends 72 and 73 engage the contacts 74 and 75, thus completing the circuit between the lines 94 and 88. Direct current now flows from the line 88 to the line 94 via the arm 70 and thence through the coil 96 of the relay A² from which it returns to the negative line 147 via the line 95. This causes the arm 97 to swing to the left so that direct current from the line 88 flows through such arm, the line 105 (Fig. 11), and the coil 106, to the negative return wire 95. The flow of current through the coil 106 closes the arm 107, so that direct current from the positive line 88 flows through the arm 107 to the point 183.

From the point 183, the current from the line 88 makes two circuits, one of which flowing through the line 111 energizes the operating coil 126 of the multiple switch T (as later described), while the other passes through the line 185, the resistance 186, section of line 185, arm 48, section of line 185, contacts of stop button L, section of line 174, coil 52, section of line 174, switch *g*, section of line 174, switch N, and line 174 leading past the switches *h* back to the negative line 147 at switch *a*, as heretofore described. This provides a second or holding circuit through the coil 52, so that, when the button K is released, breaking the circuit at this point, the switch M will still be held closed. This circuit also provides for lighting the lamps 173^a, as these lights are in shunt with a part of the circuit. Starting at the switch N, this shunt circuit includes the section of line 185 to the right of the switch N, the lamps 173^a and the section of the line 185 leading to the end of the resistance 186. The lighting of the lamps 173^a, therefore, indicates the time when the holding circuit 185 is completed by the closing of the contact arm 107 of the relay A², so that the operator is informed of this fact, permitting him to release the button K.

As above explained, the closing of the contact arm 107 of the relay A² also supplies current to the line 111. This completes a circuit through the coil 126 of the multiple switch T via the section of line 111, contacts of push button X, section of line 111, contact arm 144 of slow drop relay Z, section of the line 111, switch *r*, section of line 111, coil 126, section of line 111, thermo-relay switches *o*, *o*, *o*, section of line 111.

contacts of safety switch button U, and section of line 111 to negative return line 173. The contact arm of the relay Z was held closed long enough to permit the energizing of the coil 126, due to its slow opening characteristic, the coil 141 having its current from its supply circuit 171 cut off, as soon as the arm 98 of the relay A², moved to the left under the influence of the coil 96, breaking the circuit from the line 88 to the line 113. The current, as thus briefly supplied to the coil 126, moves the switch T to closed position. The closing of the arm 117 of the switch T establishes a new circuit through the coil 126, which acts as a holding circuit, after the other circuit through the coil 126 is broken at the slow drop out relay Z. This circuit comprises the section of line 111 leading to the push button X, line 186, arm 117 of switch T, section of line 186, coil 126, section of line 111, thermal relay switches o, o, o, section of line 111, button U, and section of line 111 back to negative line 173. The switch T is thus closed and held closed, after the relay Z opens, and this circuit is maintained after the switches r and s are opened by the downward movement of the runner, as the holding circuit, as above described, does not pass through these switches.

The closing of the switch T completes the three circuits 155, 156 and 157 through the contact arms 114, 116 and 118 and through the windings of the motor A', so that the rotation of the motor and the surfacing runner starts upon the closing of the switch. In case the load on these circuits becomes too heavy, the coils of the thermal relay switches o, o, o heat up and open the switches, and break the circuit through the line 111 and coil 126, so that the switch T opens.

At the time the motor A' is thus started and while in upper position, the switch s short circuits the line 157, which passes through the current coil of the watt meter V, so that at this moment of high load, when the motor is starting, the watt meter is relieved of this current, which flows from one section of the line 157 to another section thereof via the line 187* and switch s.

The closing of the multiple switch T also results in the lowering of the motor A' and its runner carried by the arm 12. This is caused by the opening of the arm 115 of the switch T (Fig. 10) as the solenoid bar is moved to the right by the coil 126. This interrupts the circuit 187, 187 from the line 188 back to the line 173 through the winding I, so that the valves 39 and 40 (Fig. 4) are moved to the positions of Fig. 4 by the spring 41, thus cutting off the supply of air to the cylinder 27 and permitting the air therefrom to exhaust through the passage 31 and opening 43. As a result, the arm 12 and the runner 11 carried thereby begin to move

downward by gravity, thus opening the switches r and s. The opening of the switch r interrupts the closing circuit of the switch T through the coil 126, so that only the holding circuit through such coil remains effective, while the opening of the switch s directs the current of the motor circuit line 157 through the watt meter V, so that from this time on the watt meter registers the current used by the motor A.

If it now becomes necessary to stop the motor A' and lift the runner independent of the rest of the system, this can be done by pushing the stop button X, which interrupts the holding circuit flowing through the lines 111 and 186 and the coil 126 of the switch T, so that such switch opens, breaking the motor circuits 155, 156 and 157 and closing the arm 115 so that the winding of the coil I is energized and the runner is lifted. After the button X is released and moves back to closed position, the switch T still remains open, since the holding circuit through the coil 126 has been opened by the finger 117, and since the closing circuit through the relay Z is now broken at such relay. The motor can be started and lowered, however, by closing the start button W, which completes the closing circuit through the coil 126, so that the switch T is again closed and the circuit through the coil I is broken. The motor, therefore, starts again and the runner is lowered, and this condition is continued after the button W is released and opens, since the holding circuit past the button X and through the lines 111 and 186 is again made effective.

In case it is desired to raise the runner and lower it again without stopping the rotation of the runner, this is accomplished by the use of the up and down switch Y. When this switch is moved from the position shown, it completes the circuit through the winding I from the positive bus 188, through a series resistance, through the line 187, the winding I, through a section of the line 187 passing a tap connection on the safety switch U, through a section of the line 187 to a tap 190* on the line 189, through a section of the line 189, through the contacts 191 of the switch Y (now assumed closed), through the lines 192 and 172 to the negative bus 173, and the winding I thus being energized, the runner moves up. When the switch Y is moved back to the position shown, this breaks the circuit through the winding I, so that the runner again moves down.

The surfacing unit A is thus under independent control, so that the runner may be moved up or down or stopped or started as desired. This unit, as well as all the other units may now be stopped from the master control panel J. This is accomplished by

pressing down the stop button L. This interrupts the holding circuit through the coil 52, as heretofore described, so that the multiple switch M opens, breaking the three circuits 175, 176 and 177 through the table drive motor G at the contact arms 45, 46 and 47, so that this motor stops. The opening of the switch M also breaks the alternating current circuit through the arm 49, so that the circuit 178 leading through the coil 69 of the switch P (Fig. 8) is interrupted and such switch opens. The opening of the arm 61 interrupts the circuit 87 through the coil 78 (Fig. 9) of the time relay A² so that the spring 77 opens the switch arm 70^a. The opening of this arm interrupts the circuit 88, 94 to the coil 96 and return line 95, so that the switch arms 97 and 98 open to the position of Fig. 11, thus interrupting the circuit from the line 88 to the return line 95 via the arm 97, wire 105, coil 106 and wire 105. This permits the arm 107 to open, interrupting the circuit through the line 111.

As heretofore explained, the circuit 111 is the one through which current flows to the coil 126, which holds the multiple switch T closed, so that when this circuit is interrupted, the switch opens, interrupting the three circuits 155, 156 and 157 of the runner driving the motor A' and closes the circuit through the magnet winding. The rotation of the motor is, therefore, stopped and the runner is raised by the air cylinder 27. The movement of the arm 98 of the relay A² to its original position, as illustrated, again completes the circuit through the coil 141 of the slow drop out relay via the lines 113 and 172, so that the arm of this relay is closed, placing the parts in their original position, as described in the beginning, and so that the starting of the motor A' may be accomplished by pressing the start button K, as heretofore described. The upward movement of the runner supporting arm 12 also closes the switches *r* and *s*, so that the motor can be started in its upper position and so that the watt meter V is short circuited during such starting movement. The fast and slow buttons *p* and *o* (Fig. 5) operating in conjunction with the pilot motor *k* control the speed of rotation of the motor G, and the arm 50 of the switch M, which is normally closed, insures that in starting the system, the motors will operate at slow speed until the fast button P is pressed down.

The foregoing sets forth the operation involved in starting only one of the motors of the group to which the runner motor A' belongs. It will be understood that the wiring and control apparatus for each of the other motors of the group is the same, direct current being supplied to such other members of the group by the lines 111, 113, 173 and 188, so that the group is controlled

from the relays A² and A³. The control of the other groups B to F is similarly affected through the relays B² to F² and B³ to F³, the relays B² to F² being adjusted so that they close in sequence one after the other after A² closes. For instance, the arm of the relay B² may be set to close one-third of a second after the arm 70 of the relay A' closes and the other relays C² to F² will similarly close in sequence at intervals of two-fifths of a second. The groups of runner driving motors will, therefore, be started in sequence at intervals of one-third of a second, thus distributing the load upon the supply line 151, 152 and 153.

The manner in which another group of motors C' are connected to the system and operated from the relays C² and C³ is illustrated in Figs. 5 and 5^a. Here the closing of the arm 107' is accomplished in the same manner as the closing of the arm 107, heretofore described, and the closing of this arm secures the supply of direct current from the line 88 to the line 111', such line corresponding to the line 111. Similarly, direct current passing through the relay C² is supplied to the line 113', such line corresponding to the line 113, heretofore described. The line control of the runner motor C' and the functioning of the apparatus associated therewith merely duplicates that for the motor A², and the operation is obvious without further description or explanation, the reference numerals and letters employed being the same as for the motor A', except in the application of the prime mark to each of such numerals and letters. The other relays B², D², E² and F² and B³, D³, E³ and F³ control the contact arms 107², 107³, 107⁴ and 107⁵ from which the lines 111², 111³, 111⁴ and 111⁵ are supplied with direct current and lead to the other groups of runner motors B', D', E' and F' in the same manner as illustrated for the lines 111 and 111'. Similarly, the lines 113², 113³, 113⁴ and 113⁵ correspond in function to the lines 113 and 113', in their control of the several slow drop out relays corresponding to the relays Z and Z'.

The contact making voltmeter *c* functions in connection with the switch P to cause the runner driving motors to be disconnected from the power lines in groups in regular sequence with a definite time interval between groups in case of a failure of the alternating current supply. Further, the arrangement is such that should the failure of the alternating current power supply be just a dip of voltage and of very short duration, so that the voltage is back on the line before the sequence is completed the groups remaining on the line stay on, and the groups that have been cut off are again started in their regular order with a definite time interval between groups.

The coil 150 is energized from the winding 212 of the transformer which is operated from the alternating current power lines 151, 152 and 153, so that the voltage through the coil 150 fluctuates with that in the power lines. In case of a failure of the power supply, the voltage in the coil 150 drops and the spring 170 opens the contact arm 169, thus interrupting the current through the coil 69, so that the switch P opens. As heretofore described in connection with the stopping of the system by the pressing of the button K, the opening of the switch P causes the successive opening of the arms 107, 107', etc., so that, if the drop in voltage is continued, all of the groups of runner motors with their runners are raised and come to a stop in due course. If the drop in voltage does not involve a prolonged failure of the power supply, but merely a dip, the result is different. In such case, although all of the contact arms 70 open immediately, when the switch P opens, the opening of the arms 107, 107', etc. is delayed and occurs in time sequence. The first contact arm of the series 107, 107', etc. which opens upon the opening of the contact arms 70 is the arm 107. This is not instantaneous upon the breaking of the circuit through the coil 96, as the residual magnetism in the coil prevents the arms 97 and 98 from instantly moving to the right. During this interval of delay, current continues to flow through the coil 96' of the next relay B³ from the line 88 via the arm 98 and line 190, so that until the arm 98 opens, the current continues to flow through the coil 96' and the residual magnetism in this coil 96' then keeps the arms 97' and 98' closed a definite interval after the arms 97 and 98 open. As a result, the arm 107² opens at a definite period after the arm 107. Similarly, the arms of the other relays C³ to F³ open at successive spaced intervals. In case the voltage is restored in the power circuit when only a part of the arms 107 to 107⁵ have opened, the contact arm 169 of the voltmeter *c* closes followed by the closing of the switch P. If only the first two of the relays A³ and B³ have opened their arms 107 and 107² when this occurs, the rest of them will not open up, since a flow of current is restored through their coils 96² to 96⁵ due to the closure of the arms 63 to 66 of the relay P. For instance, the closing of the arm 63 permits a flow of current through the coil 96² from the line 88, via such arm 63, and the line 191. The closing of the arms 64, 65 and 66 performs a similar function with relation to the coils 96³ to 96⁵ of the relays D³, E³ and F³. The supply of current is now restored to the runner motors of the groups A and B, due to the closing of the arm 61 of the switch P, the operation being the same as heretofore described in connection with the press-

ing of the start button K, namely, the arms 70 of the relays A² and B² close in timed sequence, followed by the closing of the arms 107 and 107².

Fig. 12 illustrates a modification involving the use of a different form of prime mover for swinging the lever arm 12, which supports the motor and runner. In this modification, the prime mover is an electric motor which operates through a worm and threaded shaft to raise and lower the arm 12. Direct current is employed to operate the motor and the control system is very similar to that described in connection with the apparatus using the air cylinder as the prime mover for controlling the up and down movement of the arm 12, and the parts carried thereby.

Referring to the drawing, the arm 12 carrying the meter G' and the runner, has pivotally mounted in its outer end, the block 195, through which is threaded the operating shaft 196, carrying at its upper end a worm wheel in the casing 197. This worm wheel is driven by a worm carried by the shaft 198, and this shaft is driven from the motor 199 through the intermediary of the gears 200 and 201 carried respectively by the motor shaft and the shaft 198. The motor 199 is of the split field type arranged so that current from the line 202 passing through the coil 203 and line 204 rotates the motor in a direction to lower the runner, while current from the line 202 passing through the coil 205 and line 206 rotates the motor in a direction to raise the runner.

The motor G' is driven from current supplied by the lines 158⁶, 159⁶ and 160⁶ and these circuits are controlled by the switch T⁶ having the closing coil 126⁶ and similar throughout in construction to the switch T. The coil 126⁶ is energized by direct current supplied from the line 111⁶, this circuit corresponding to the circuits 111 and 111' of Fig. 5 the contact arm 144⁶ of the slow drop out relay Z⁶ being held shut at this time by current supplied from the line 113⁶ through the line 171⁶. After the switch T⁶ is closed, a holding circuit is established through the arm 117⁶ via the lines 111⁶, 186⁶, 111⁶, switch U⁶ and section of line 111⁶, so that after the circuit through the line 111⁶ is broken by the opening of the switch T⁶, the switch T⁶ will still remain closed, subject to interruption when desired by pressing the stop button. A limit switch 207 is provided in the line 206, such switch being opened by suitable means (not shown) when the runner approaches its upper position and being closed again automatically when the runner starts down.

If the runner is in its lower position and the current supply to the coil 126⁶ is cut off, permitting the switch T⁶ to open, such opening closes the arm 115⁶ so that current flows

to the motor 200 from the line 202 and back to the negative line 173^a, via the following circuit:—line 206, arm 115^a, line 208, arm U^a and section of line 111^a. This causes the motor to rotate so as to raise the runner, such movement continuing until the limit switch 207 is opened automatically as the runner reaches its upward limit of movement, thus causing the motor to stop. In order to cause the motor 200 to rotate in the reverse direction to move the runner down, it is necessary to press in the button Y^a. This completes the circuit from the positive line 202 through the motor and back to the negative line 173^a via the following connections:—line 204, switch arm U^a, line 204, contacts 208^a of switch Y^a, line 204, switch arm U^a and line 111^a. The buttons Y^a and Y^b are connected together and spring controlled, so that when either button is released from manual pressure, the buttons return to the neutral position shown. The buttons Y^a is, therefore, released when the motor 202 has rotated sufficiently to lower the runner to surfacing position. The motor may now be caused to operate to raise the runner by pressing in the button Y^b. The arm 115^a of the switch T^a is now open, but the up circuit through the line 206 back to the negative line 173^a is completed from the point 209 via the line 210, the contacts 211 of the button Y^b, and the line 204.

The motor G' may be stopped and the runner lifted by pressing the stop button X^a and may be started by pressing the start button W^a, the pressing of the button X^a serving to interrupt the holding circuit 186^a to the coil 126^a, while the pressing of the button W^a completes the closing circuit 111^a through such coil.

What I claim is:

1. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable driven runner, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current to said motor, and means, including a relay governed from said power circuit, for securing the actuation of said prime movers to lift the runners upon a failure of the power supply to said circuit.

2. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced

continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, and means, including a relay governed from the power circuit, for cutting off the supply of current to the runner rotating motors, and for securing the actuation of said prime movers to lift the runners upon failure of the power supply to said circuit.

3. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable driven runner, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current to said motor, and means, including an automatic switch governed by said power circuit and relay means, for securing the actuation of said prime movers to lift the runners in case the current flow through said motor increases beyond a predetermined point.

4. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, and means, including an automatic switch governed by said power circuit and relay means, for securing the actuation of said prime movers to lift the runners and to cut off the flow of current to the runner rotating motors in case the current flow through said motor for moving the supporting means for the glass increases above a predetermined point.

5. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said

supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a master relay for controlling all of said relays, and also the flow of current to the motor which drives said supporting means, a manual control for said master relay, and still other relay means also controlled from the master relay and from said power circuit and arranged to open and cause the opening of the first relays and the actuation of the prime movers to raise the runners upon a failure of the power supply to said power circuit.

6. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a master relay for controlling all of said relays, and also the flow of current to the motor which drives said supporting means, a manual control for said master relay, and an automatic switch controlled by the flow of current to the motor which moves said supporting means and adapted, when such flow rises above a predetermined point, to open and cause the opening of said master relay, which in turn causes the opening of the other relays, cutting off the supply of current to the runner rotating motors and causing the actuation of the prime movers to raise the runners.

7. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a series of time relays adapted to close in sequence after actuating current is supplied thereto and controlling said first relays, a master relay controlling the flow of actuating current to the time relays, and also the flow of current to the motor, which drives said glass supporting means, a manual control for said master relay, and means governed from the power circuit for causing the opening of the time relays upon a failure of the power supply to said power circuit.

8. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a series of time relays adapted to close in sequence after actuating current is supplied thereto and controlling said first relays, a master relay controlling the flow of actuating current to the time relays, and also the flow of current to the motor, which drives said glass supporting means, a manual control for said master relay, and means governed from the power circuit for causing the opening of the time relays upon a failure of the power supply to said power circuit.

9. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a series of time relays adapted to close in sequence after actuating current is supplied thereto and controlling said first relays, a master relay controlling the flow of actuating current to the time relays, and also the flow of current to the motor, which drives said glass supporting means, a manual control for said master relay, and means governed from the power circuit for causing the opening of the time relays upon a failure of the power supply to said power circuit.

rent to the time relays, and also the flow of current to the motor, which drives said glass supporting means, a manual control for said master relay, and means governed from the power circuit for causing the opening of the time relays in timed sequence upon a failure of the power supply to said power circuit.

10. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a series of time relays adapted to close in sequence after actuating current is supplied thereto and controlling said first relays, a master relay controlling the flow of actuating current to the time relays and also the flow of current to the motor, which drives said glass supporting means, a manual control for said master relay, and means governed from the power circuit for causing the opening of the time relays in timed sequence upon a failure of the power supply to said power circuit, said time relays being arranged to close again automatically in timed sequence in case the failure of the power supply is a mere dip.

11. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a series of time relays adapted to close in sequence after actuating current is supplied thereto and controlling said first relays, a master relay controlling the flow of actuating current to the time relays, and also the flow of current to the motor, which drives said glass supporting means, a manual control for said master relay, and a manual control

for each of said relays for each machine, so that each runner may be raised and the current supply to its drive motor cut off independently, and so that such runner may be lowered and the supply of current to its motor continued.

12. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a series of time relays adapted to close in sequence after actuating current is supplied thereto and controlling said first relays, a master relay controlling the flow of actuating current to the time relays, and also the flow of current to the motor, which drives said glass supporting means, a manual control for said master relay, and a manual control for the circuits which control the supply of current for actuating each of said prime movers, arranged so that each runner may be raised and lowered independent of the master relay without interrupting the flow of current to the runner drive motor.

13. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a master relay for controlling all of said relays, and also the flow of current to the motor which drives said supporting means, a manual control for said master relay, and timing means intermediate the master relay and said relays for each machine arranged so that a definite time interval lapses after the master relay closes and the glass supporting drive motor starts, before any of said relays for each machine are closed to cause the runner drive motors to start and before the runners

are moved down to engage the glass on said supporting means.

14. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a master relay for controlling all of said relays, and also the flow of current to the motor which drives said supporting means, a manual control for said master relay, and timing means intermediate the master relay and said relays for each machine arranged so that a definite time interval elapses after the master relay closes and the glass supporting drive motor starts, before any of said relays for each machine are closed to cause the runner drive motors to start and before the runners are moved down to engage the glass on said supporting means, said timing means also being arranged so that the motor drive relays are closed in sequence.

15. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a master relay for controlling all of said relays, and also the flow of current to the motor which drives said supporting means, a manual control for said master relay, timing means intermediate the master relay and said relays for each machine arranged so that a definite time interval elapses after the master relay closes and the glass supporting drive motor starts, before any of said relays for each machine are closed to cause the runner drive motors to start and before the runners are moved down to engage the glass on said supporting means, and means controlled from said power circuit for causing

the opening of said relays for each machine in case of a failure of the power supply to said circuit, thus cutting off the supply of current to the runner drive motors and causing the prime movers to raise the runners out of contact with the glass.

16. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to said prime mover for controlling its operation, a master relay for controlling all of said relays, and also the flow of current to the motor which drives said supporting means, a watt meter for each machine, and means controlled by the up and down movement of each machine for short circuiting the current coil of such watt meter when the runner is in raised position and for securing a flow of current through the current coil of the watt meter when the runner is lowered, the parts being arranged so that the closing of the master relay causes the closing of the other relays, thus supplying current to the runner drive motors and securing the actuation of the prime movers to lower the runners, and so that the opening of the master relay causes the opening of said other relays, thus cutting off the current to the runner drive motors and securing the actuation of the prime movers to raise the runners.

17. In apparatus for continuously surfacing sheets of material, a series of surfacing machines, each having a vertically movable runner, an electric motor for rotating each runner, and means for supplying current thereto, supporting means for carrying a series of sheets of material to be surfaced continuously beneath the series of runners, a prime mover at each machine adapted to raise the runner thereof out of contact with the sheets carried upon the supporting means, an electric motor for driving said supporting means, a power circuit for supplying current thereto, a relay for each machine for controlling the flow of current to the runner rotating motor and to the prime mover for controlling its operation, said last relays each including an operating coil, a closing circuit and a holding circuit for each coil, a switch in the closing circuit closed by the upward movement of the runner and opened by its downward movement, a man-

ually operated switch in the holding circuit, a master relay for controlling the flow of actuating current through all of said closing circuits and also the flow of current to the motor which drives said supporting means, and a manual control for said master relay, the parts being arranged so that the closing of the master relay causes the closing of the other relays, thus supplying current to the runner drive motors and securing the actuation of the prime movers to lower the runners, and so that the opening of the master relay causes the opening of said other relays, thus cutting off the current to the runner drive motors and securing the actuation of the prime movers to raise the runners.

In testimony whereof, I have hereunto subscribed my name this 28th day of April, 1927.

ALFRED L. HARRINGTON.