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ELECTRIC CIRCUITS FOR PLANERS

Filed Sept. 24, 1925

2 Sheets-Sheet 1

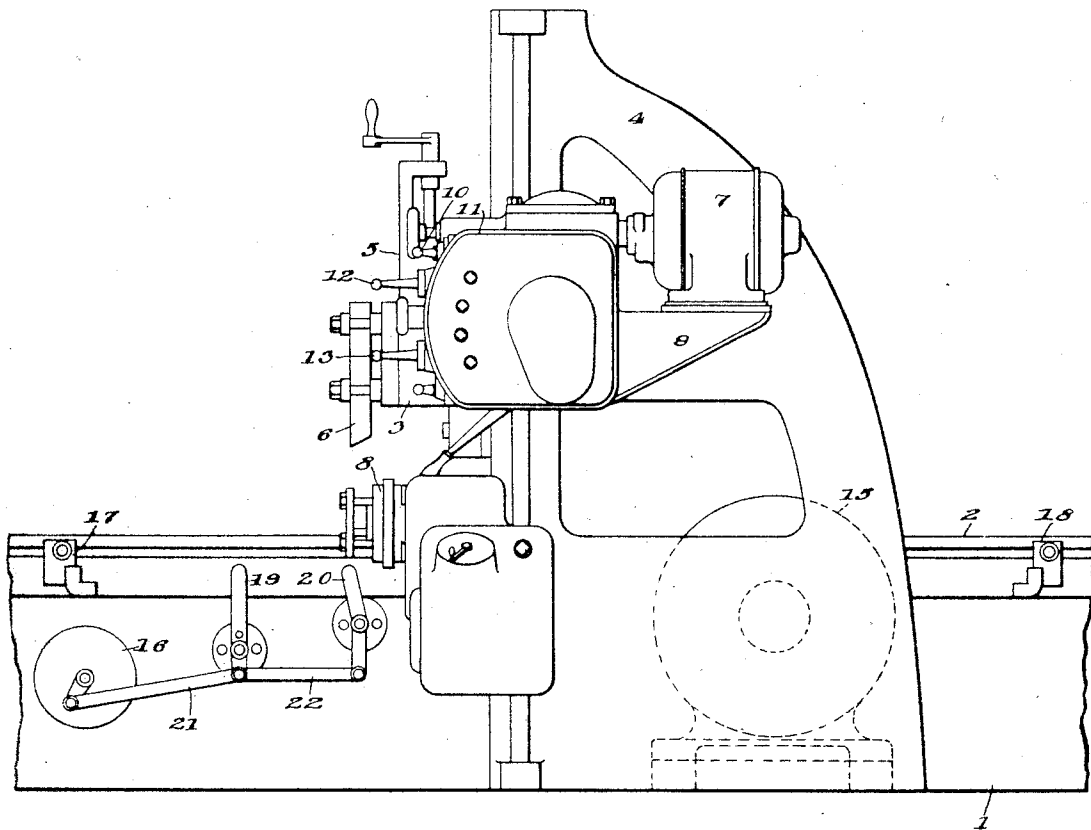


Fig. 1.

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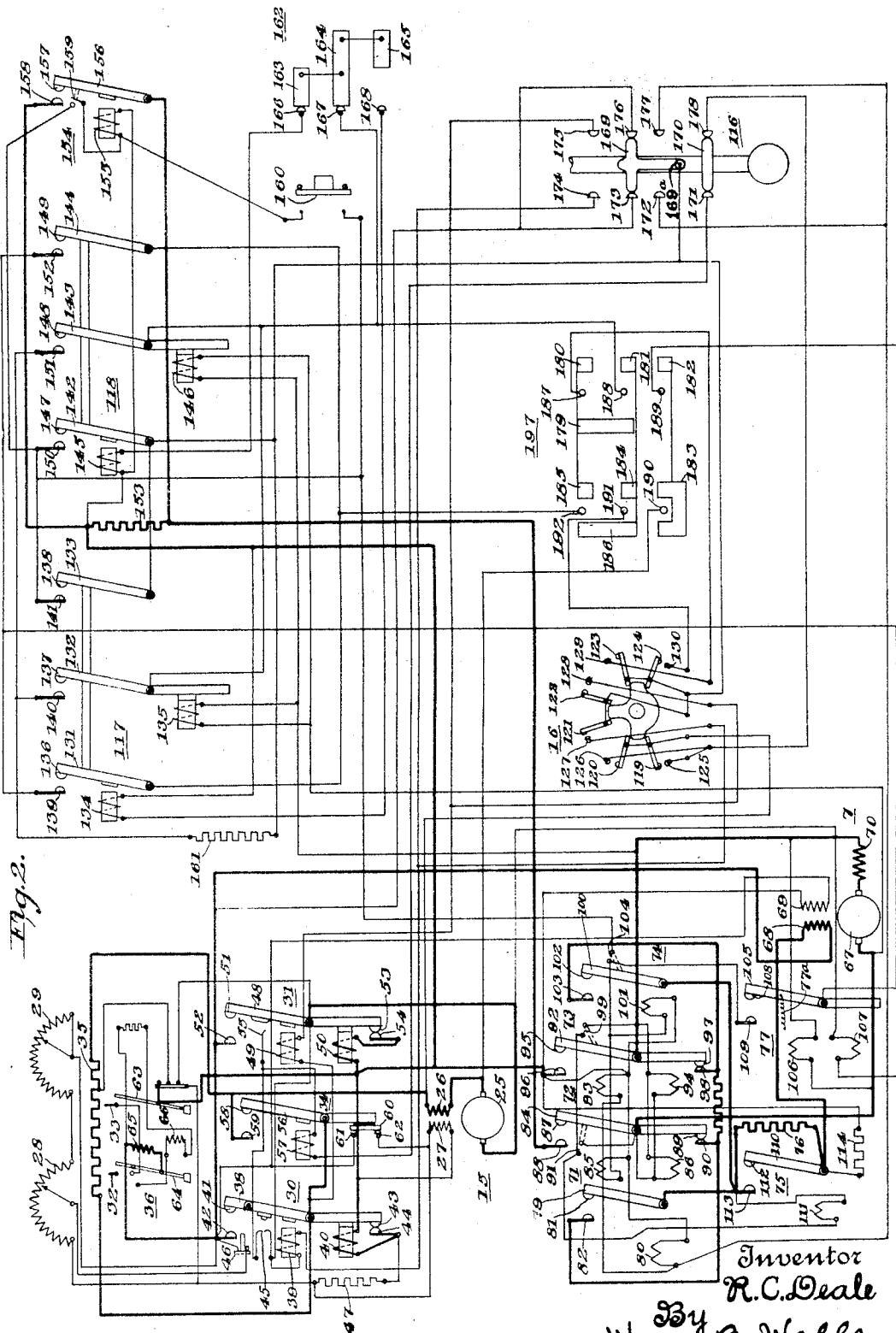
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ELECTRIC CIRCUITS FOR PLANERS

Application filed September 24, 1925. Serial No. 58,401.

My invention relates to control systems for governing the operation of machine tools and relates particularly to control systems for governing the operation of planers.

5 In many planers it is now customary not only to reciprocate the work table by a main motor but to operate the tool heads and raise and lower the cross rail by an auxiliary or feed motor. The main motor and the feed
10 motor may be automatically controlled in accordance with the movement of the reciprocating work table. Moreover means may be provided for effecting continuous movement of the main motor to traverse the table in
15 either direction and means may be provided for continuously moving the auxiliary or feed motor to effect movement of the cross rail or traverse movement of the tool heads. The feed motor is generally operated at both
20 ends of the table stroke although a feeding movement of the tool head may take place at one end only of the stroke.

One of the principal objects of my invention is to provide a planer control system that
25 shall automatically operate the feed motor only at one end of the table stroke when a feeding movement is desired and always in the same direction.

Another object of my invention is to provide a planer control system that shall be
30 provided with means for selectively determining the end of the planer stroke at which feeding movement of the feed motor is to be effected and that shall effect a delayed
35 operation of the feed motor when a feeding operation is effected at one end of the table stroke and a quick operation of the feed motor when a feeding operation is effected at the opposite end of the table stroke.

40 Another object of my invention is to provide a planer control system that shall automatically operate the feed motor in one direction in accordance with the movement of the work carrying table to effect feeding
45 operation and that shall operate the feed motor in a reverse direction to effect a traverse movement.

Another object of my invention is to provide a planer control system that shall operate the feed motor at very low torque prior

to the placing of the load on the motor to effect a feeding movement and that shall be provided with means for preventing the stopping of the feeding movement of the feed motor by the pilot switch operated by the work table and for insuring the limiting of the feeding movement of the feed motor by a limit switch. 55

A further object of my invention is to provide a planer control system with a manually operated or pendent switch that in an inoperative position shall be interlocked with the circuits completed by the pilot switch for automatically operating the main motor and the feed motor in accordance with the movement of the work table so as to prevent automatic operation of either motor when the pendent switch is in either of its operative positions. In one operative position the pendent switch effects traverse operation of the main motor, either in a forward or in a reverse direction, and in the second operative position the pendent switch effects traverse movement of the feed motor. 60

In a planer control system constructed in accordance with my invention, a pilot switch is automatically operated by the reciprocating work carrying table for operating the main motor in a forward and in a reverse direction and for operating the feed motor in one direction and at one end only of the table stroke. A switch is provided for determining the end of the table stroke at which movement of the feed motor is to take place. When the feeding movement is effected at the end of the cutting stroke the operation of the feed motor is delayed somewhat. When the feeding movement is effected at the end of the return stroke no delay is provided in the operation of the feed motor. 65

The feed motor is directly controlled by two feed switches which in turn are controlled by two auxiliary feed switches. The auxiliary feed switches are alternately operated by the pilot switch in accordance with the movement of the planer table. At one end of the table stroke one of the auxiliary feed switches is operated and at the opposite end of the stroke a circuit is completed through the operated auxiliary feed switch to operate 70
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a main feed switch and effect movement of the feed motor. By means of the auxiliary feed switches it is possible to prevent the pilot switch from limiting the movement of the feed motor. In all cases the holding circuits which are completed through the auxiliary feed switches are released by operation of a limit switch. The limit switch, in the customary manner, is operated by the feed motor.

In planer operation, it is found difficult to accurately obtain very small feeds such for example as a 1/64 of an inch if the feeding load is placed on the motor when it starts from rest. In order to overcome this difficulty and to obtain accurate feeds, even if very small, the feed motor is first operated at very low torque prior to the feeding operation. A resistor of very high resistance is initially included in the feed motor circuit. This resistor is excluded from the feed motor circuit by a switch which is operated after a predetermined movement of the feed motor. The above mentioned resistor is independent of the resistor used in accelerating the feed motor.

The pendent switch provided in the present control system has one inoperative position and two operative positions. In the lower position the circuits are completed through it by the pilot switch for automatically operating the main motor and the feed motor. In either of the operative positions of the pendent switch no automatic operation of the main motor or of the feed motor can be effected by the pilot switch. In one operative position of the pendent switch traverse operation of the feed motor may be effected and in the other operative position of the switch traverse operation of the main motor may be effected. The main motor may be operated in either direction by the pendent switch whereas the feed motor, when feeding, is always operated in the same direction by the pendent switch.

A planer which is adapted to be operated by the control system is disclosed in a companion application of C. F. Randolph, Serial No. 56,397, filed September 14, 1925. The feed motor is always operated a constant amount when automatically controlled by the pilot switch and the amount of feed effected by the tool head or heads is controlled mechanically as set forth in the companion application. The direction of the traverse movements by the head and the direction of movement of the cross rail is also controlled mechanically.

In the accompanying drawings:

Figure 1 is an elevational view of a planer adapted to be operated by the present control system.

Fig. 2 is a diagrammatic view of a control system constructed in accordance with my invention.

Referring to the accompanying drawings and particularly to Fig. 1, a planer is illustrated comprising a bed 1 having a reciprocating work carrying table 2 mounted thereon. A cross rail 3, which is slidably mounted on uprights 4, carries one or more tool heads 5. The tool heads 5 carry suitable cutting tools 6, one only of which is illustrated on the drawings.

The tool heads 5 are fed and traversed along the cross rail 3 by means of a feed motor 7. The feed motor 7 also serves to raise and lower the cross rail 3 on the uprights 4 and to operate suitable side heads 8. The feed motor is directly mounted on a bracket 9 carried by the cross rail 3 and accordingly is raised and lowered with vertical movement of the cross rail. A hand lever 10 mounted on the front of a housing 11, which contains the feed mechanism, serves to control the raising and lowering of the cross rail by the feed motor. Two hand levers 12 and 13, also on this housing 11, serve to control the movements of the tool heads both during feeding and traversing operations. A complete description of the construction and operation of the feeding mechanism is given in the companion application above referred to and a further description thereof in this application is deemed unnecessary. It may be noted, however, that the feed motor is operated in one direction to effect feeding movements and is operated in a reverse direction to effect traversing movements. The direction of the feed and the direction of the traverse is controlled by the levers 12 and 13 in the case of the tool heads.

A main motor 15 is provided for operating this reciprocating table 2. The reciprocating table controls a pilot switch 16 which in turn controls not only the main motor 15 but also the feed motor 7. Two dogs 17 and 18 are adjustably mounted on the side of the table 2. The dogs 17 and 18 at the ends of the table stroke engage levers 19 and 20 for operating the pilot switch 16 through links 21 and 22. At the end of the cutting stroke the dog 17 engages the lever 19 for operating the lever 19 to move the pilot switch in one direction. At the end of the return stroke the dog 18 engages the lever 20 for reversing the position of the pilot switch. The pilot switch serves to effect reversing movements of main motor 15 and to effect continuous feeding movements of the feed motor 7.

Referring to Fig. 2 of the drawings, the main motor 15 is shown comprising an armature 25, a series field-magnet winding 26 and a shunt field-magnet winding 27. Two resistors 28 and 29 are provided for controlling the circuit of the shunt winding 27. Two main switches 30 and 31 are provided for connecting the main motor 15 to supply conductors 32 and 33 and for controlling the direction of rotation of the main motor. An

accelerating switch 34 is provided for short circuiting the resistor 35 to effect acceleration of the main motor in the usual manner. A circuit breaker 36 is provided for protecting the main motor against overload current conditions and low voltage circuit conditions.

The main switch 30 comprises a switch arm 38 which is operated by a main magnet 39 and a holding magnet 40. A contact member 41, which is mounted on one end of the arm 38, is adapted to engage a contact member 42 in the operative position of the switch and a contact member 43, which is mounted on the opposite end of the switch arm 38, is adapted to engage a contact member 44 in the released position of the switch. A switch 45 is closed in the operative position of the switch 30 for completing a circuit through the energizing coil of the accelerating switch 34. A switch 46 is opened upon operation of the switch 30 to insure the including of the resistors 28 and 29 in the circuit of the shunt field-magnet winding 27 during the return stroke of the table. The switch 30 is operated to effect a return movement of the planer table and the resistors 28 and 29 are included in the circuit of the shunt field-magnet winding 27 to effect a relatively rapid movement of the main motor 15. The choke resistor 47 is connected across the shunt field-magnet winding 27 to take care of inductive discharges.

The main switch 31 comprises a switch arm 48, which is operated by main magnet 49, and a holding magnet 50. The switch arm 48 has a contact member 51 mounted on one end thereof for engaging a stationary contact member 52 in the operative position of the switch and has a contact member 53 mounted on the opposite end thereof for engaging a stationary contact member 54 in the released position of the switch. An auxiliary switch 55 is closed in the operative position of the switch 31 for completing a circuit to operate the accelerating switch 34.

The accelerating switch 34 comprises a switch arm 56 which is operated by a magnet 57. The switch arm 56 carries a contact member 58 on one end thereof which is adapted to engage a stationary contact member 59 in the operative position of the switch. In the released position of the accelerating switch a contact segment 60 is adapted to engage contact members 61 and 62.

The circuit breaker 36 comprises two switch arms 63 and 64 which are adapted to engage the line conductors 32 and 33. An overload coil 65 and low voltage coil 66 are provided for controlling the switch arm 64 and 63. Inasmuch as the circuit breaker illustrated is old and well known a detailed description thereof is deemed unnecessary.

The feed motor 7 comprises an armature 67, a series field-magnet winding 68, a shunt field-magnet winding 69 and a compensating

winding 70. The feed motor 7 is controlled by two traverse switches 71 and 73 and two feed switches 72 and 74. An accelerating switch 75 is provided for short circuiting an accelerating resistor 76 to effect acceleration of the feed motor. An auxiliary switch 77 is provided for insuring a quick operation of the feed motor at one end of the planer stroke and a delayed operation of the feed motor at the opposite end of the stroke. In this regard it may be noted that the feed motor 7 is only operated at one end of the table stroke but the end of the stroke at which operation of the feed motor is to take place may be selectively determined.

The traverse switch 71 comprises a switch arm 79 which is operated by means of a magnet 80. A contact member 81, which is mounted on the switch arm, is adapted to engage a stationary contact member 82 in the operative position of the switch.

The feed switch 72 comprises a switch arm 84, which is operated by a main magnet 85, and a holding magnet 86. The switch arm 84 carries a contact member 87, which is adapted to engage a stationary contact member 88 in the operative position of the switch, and a second contact member 89 which is adapted to engage a stationary contact member 90 in the released position of the switch. An auxiliary switch 91 is closed by the switch arm 84 in the operative position of the switch 71 for completing a circuit to operate the accelerating switch 75.

The traverse switch 73 comprises a switch arm 92, which is operated by main magnet 93, and a holding magnet 94. A contact member 95 is mounted on one end of the switch arm 92 for engaging a stationary contact member 96 in the operative position of the switch and a second contact member 97 is mounted on the switch arm for engaging a stationary contact member 98 in the released position of the switch. An auxiliary switch 99 is closed in the operative position of the switch 73 for completing the circuit of the energizing coil of the accelerating switch 75.

The feed switch 74 comprises a switch arm 100 which is operated by a magnet 101. The switch arm 100 carries a contact member 102 which is adapted to engage a stationary contact member 103 in the operative position of the switch. An auxiliary switch 104 is closed in the operative position of the switch 74 for completing a holding circuit through the feed switches 72 and 74.

The auxiliary switch 77 comprises a switch arm 105 which is adapted to be operated by two magnets 106 and 107. The magnet 106 is adapted to be connected across the feed motor armature and the magnet 107 is adapted to be engaged across the main motor armature by a selector switch 197. The switch arm 105 carries a contact member 108 which is adapted to engage a stationary contact mem-

ber 109 in the operative position of the switch 77. A spring 77^a exerts a force tending to close the switch 77. The accelerating switch 75 comprises a contact arm 110 which is operated by means of a magnet 111. The switch 5 arm 110 carries a contact member 112 which engages a stationary contact member 113 in the operative position of the switch. A resistor 114 is provided for taking care of the inductive discharges from the shunt field-magnet winding 69. 10

The traverse switches 71 and 73 operate the feed motor 7 in one direction to effect traverse movements of the tool heads 5 and the feed switches 72 and 74 operate the feed motor in a reverse direction to effect feeding movements thereby. The switches 72 and 74 are automatically controlled by the pilot switch 16 whereas the switches 71 and 73 are controlled by a manually operated pendent switch 116. The pilot switch 16 directly controls two auxiliary feed switches 117 and 118 which in turn directly control the feed switches 72 and 74. The pilot switch 16 20 comprises movable contact members 119 to 124, inclusive, which are respectively operated to engage stationary contact members 125 and 130, inclusive.

The auxiliary feed switch 117 comprises 20 three switch arms 131, 132 and 133, which are operated by a main magnet 134, and a holding magnet 135. The three switch arms 131, 132 and 133 respectively carry contact members 136, 137 and 138 which are adapted 35 to engage stationary contact members 139, 140 and 141. The auxiliary feed switch 118 comprises three switch arms 142, 143 and 144, which are operated by a main magnet 145, and a holding magnet 146. The arms 142, 143 40 and 144 carry contact members 147, 148 and 149 which respectively engage stationary contact members 150, 151 and 152 in the operative position of the switch.

A resistor 153 of very high resistance is 45 initially included in the circuit of the feed motor to insure operation of the feed motor at very low torque prior to the feeding movement. The resistor 153 is excluded from the feed motor circuit by means of a switch 154. 50 The switch 154 comprises a magnet 155 and a switch arm 156. The switch arm 156 carries the contact member 157 which is adapted to engage a stationary contact member 158 in the operative position of the switch. 55 An auxiliary switch 159 is closed in the operative position of the switch 154 for completing a holding circuit through the coil 155. The switch 154 is operated by a switch 160 which in turn is mechanically operated by the feed motor. A resistor 161 is provided in the holding circuits for the auxiliary feed 60 switches 117 and 118.

A limit switch 162, which is operated by the feed motor, comprises three contact segments 65 163, 164 and 165 which are adapted to engage

contact fingers 166, 167 and 168. The pendent switch 116 comprises three contact segments 169, 169^a and 170 which are adapted to engage contact fingers 171 to 178, inclusive.

A selector switch 197 is provided for selecting the end of the planer stroke at which automatic operation of the feed motor 7 takes place. The switch 197 comprises contact segments 179 to 186, inclusive, which are adapted 70 to engage contact fingers 187 to 192, inclusive. When the selector switch 197 is moved towards the left, as shown in Fig. 2 of the drawings, the feed motor is operated at the end of the cutting stroke. When the selector switch is moved toward the right, as shown in Fig. 2 of the drawings, the feed motor is 75 operated at the end of the return stroke.

Assume the pilot switch, when viewed in Fig. 2, to be moved in a counter clockwise direction at the end of the return stroke of the table 2 to effect a cutting stroke and the selector switch 197 to be moved towards the right, as shown in Fig. 2, to effect a feeding movement at the end of the return stroke. 80 The contact member 122 of the pilot switch 16 engages the contact member 128 for operating the main switch 31 to complete a circuit through the main motor. The circuit completed by the contact members 122 and 128 extends from the supply conductor 32 through the switch arm 64, contact member 173, contact segment 169, and contact 169^a of the pendent switch, contact member 122, contact member 128 of the pilot switch, main magnet 49 of the main switch 31, switch arm 38 of the main switch 30, contact members 43 and 44, holding coil 40 and the switch arm 63 to the supply conductor 33. The main switch 31 is 85 operated and a circuit is completed for operating the main motor 15. The circuit through the main motor 15 extends from the supply conductor 32 through the switch arm 64, coil 65, contact members 51 and 52, switch arm 48, armature 25, series field-magnet winding 26, accelerating resistor 35, switch arm 38, contact members 44 and 43, holding coil 40, and the switch arm 63 to the supply conductor 33. The main motor 15 is operated in a direction to effect a cutting stroke by the table 2. 90 95 100 105 110 115

The contact members 120 and 126 complete a circuit for connecting the coil 57 of the accelerating switch 34 across the main motor 15. The circuit completed by the contact members 120 and 126 may be traced from one terminal of the series field-magnet winding 26 through the contact members 120 and 126, contact members 171 and 178 of the pendent switch, which are bridged by contact segment 170, magnet 57 of accelerating switch, switch 55, which is closed by the arm 48 of the main switch, and the armature 25 to the other terminal of the field-magnet winding 26. The accelerating switch 34 is operated, when a predetermined counter electro- 120 125 130

motive force is developed in the main motor, to short circuit the accelerating resistor 35.

Initially the circuit for the shunt field-magnet winding 27 extends from the supply conductor 32 through the switch arm 64, contact members 61 and 62, which are bridged by the contact member 60, shunt winding 27, and the switch arm 63 to the supply conductor 33. Upon operation of the accelerating switch 34 when the switch 31 is operated, the circuit for the shunt winding 27 extends from the supply conductor 32 through the switch arm 64, switch 46, resistor 28, shunt winding 27 and the switch arm 63 to the supply conductor 33. The resistor 47 is connected across the shunt winding to take care of the inductive discharges.

At the end of the cutting stroke the position of the pilot switch 16 is reversed to release the main switch 31 and complete a circuit for operating the main switch 30. Upon releasing of the main switch 31 a dynamic braking circuit is completed for the main motor 15 through the accelerating resistor 35. When the pilot switch 16 is moved in a clockwise direction, as shown in Fig. 2 at the end of the cutting stroke, the contact member 121 is moved into engagement with contact member 127 to complete a circuit for operating the main magnet 30. The operating circuit for the main magnet 30 extends from the supply conductor 32 through the switch arm 64, contact member 173, contact segment 169 of the pendent switch, contact members 121 and 127 of the pilot switch, magnet 39 of the main switch, switch arm 48, contact members 53 and 54, holding coil 50 and the switch arm 63 to the supply conductor 33. The main switch 30 is operated and a circuit is completed through the main motor which extends from the supply conductor 32 through the switch arm 64, contact members 41 and 42, switch arm 38, resistor 35, series winding 26, armature 25, switch arm 48, contact members 53 and 54, holding coil 50 and the switch arm 63 to the supply conductor 33. The main motor 15 is operated in a reverse direction to effect a return stroke by the table 2.

The accelerating switch 34 is operated at this time by means of a circuit which extends from one terminal of the series winding 26 through the contact members 125 and 119 of the pilot switch, contact members 171 and 178 of the pendent switch, which are bridged by contact segment 170, magnet 57, switch 45 and armature 25 to the other terminal of the winding 26. Upon operation of the accelerating switch the circuit for the shunt field magnet winding 27 extends from the supply conductor 32 through the switch arm 64, resistors 29 and 28, winding 27, and switch arm 63 to the supply conductor 33. Inasmuch as the resistors 28 and 29 are now included in circuit of the shunt field-magnet winding the

return stroke will be effected at a relatively rapid rate.

The contact member 123 engages the contact member 129 of the pilot switch at the end of the cutting stroke to complete a circuit for operating the auxiliary feed switch 118. The circuit through the coil 145 of the auxiliary feed switch 118 extends from the supply conductor 32 through the switch arm 64, contact finger 173, contact segment 169, contact 169^a, contact members 129 and 123, contact fingers 187 and 188, which are bridged by the contact segment 179 of the selective switch, contact fingers 166 and 167 of the limit switch, which are bridged by contact segments 164 and 163, magnet 145, and switch arm 63 to the supply conductor 33. The auxiliary feed switch 118 is operated and a holding circuit therefor is completed through the switch arm 143. The holding circuit extends from the supply conductor 32 through the switch arm 64, contact member 173, contact segment 169, contact 169^a, resistor 161, contact fingers 151 and 148, switch arm 143, contact fingers 167 and 166, which are bridged by the contact segment 163 and 164, magnet 145, and switch arm 63 to the supply conductor 33.

At the end of the return stroke and upon reversal of the pilot switch, a circuit is completed by the contact members 124, and 130 through the switch 118 for operating the feed switches 72 and 74. The circuit completed by the pilot switch through the auxiliary feed switch 118 extends from the supply conductor 32 through the switch arm 64, contact member 173, contact segment 169, contact 169^a, contact members 124 and 130, contact members 191 and 192, which are bridged by the contact segment 186, switch arm 144, contact members 152 and 149, switch arm 105 of the switch 77 which is in a closed position, contact members 108 and 109, magnets 101 and 85 in parallel and the switch arm 63 to the supply conductor 33. When operation of the feed motor is effected at the end of the return stroke, as assumed by the position of the selector switch 197, the switch 77 is held in operative position by the coil 106 and the spring 77^a. The feed switches 72 and 74 are operated for completing a circuit through the feed motor 7. The circuit through the feed motor extends from the supply conductor 32 through switch arm 64, series field-magnet winding 68, resistor 76, switch arm 100, contact members 102 and 103, contact members 97 and 98, switch arm 92, winding 70, armature 67, switch arm 84, contact members 87 and 88, low torque resistor 153, and the switch arm 63 to the supply conductor 33. At this time the feed motor is operated at very low torque by the reason of the resistor 153 which is included in its circuit. After a predetermined rotation of the feed motor the switch 160 is mechanically operated for effecting operation of the switch 154. The

operating circuit for the switch 154 extends from the supply conductor 32 through the switch arm 64, contact finger 173, contact segment 169, contact 169^a, switch arm 142, contact fingers 150 and 147, switch 160, coil 155, and the switch arm 63 to the supply conductor 33. The switch 154 short circuits the resistor 153 to permit the acceleration of the motor 7 by means of the accelerating switch 75. Upon operation of the switch 154 a holding circuit is completed which extends from the supply conductor 32 through the switch arm 64, contact finger 173, contact segment 169, contact 169^a, contact arm 142, contact members 150 and 147, auxiliary switch 159, coil 155, and the switch arm 63 to the supply conductor 33. The holding circuit thus traced prevents the releasing of the switch 154 until the auxiliary feed switch is released by the limit switch 162.

The switch 77 serves to effect a delayed operation of the feed motor when a feeding operation is effected at the end of the cutting stroke. The coil 106 of the switch 77 is connected across the feed motor armature 7 and the coil 107 which opposes the coil 106 is connected across the main motor armature 15 through the selector switch 197. In the circuits heretofore traced the switch 197 is assumed in the position towards the right, as shown in Fig. 2, in order to effect a movement of the feed motor 7 only at the end of the return stroke. At the end of the return stroke no delayed operation of the feed motor is desired or required. Accordingly during such operation and when the selector switch is in the assumed position towards the right the switch 77 is held in closed position. The coil 107, which is connected across the main motor 15, only operates to open the switch 77 when the selector switch 197 is in the position towards the left, as shown in Fig. 2 of the drawings.

Assuming the selector switch 197 is in the position towards the left, as shown in Fig. 2 of the drawings, the coil 107 of the switch 77 is connected across the main motor 15 by a circuit which extends from one terminal of the armature 15 through the coil 107, contact member 189 of the selector switch, contact segments 182 and 183, and contact member 190 to the other terminal of the armature 25. In such a position of the selector switch it will be noted the coil 107 is always connected across the armature of the main motor. Accordingly when any current is flowing through the main motor as for example during dynamic braking, the coil 107 will hold the switch 77 open and prevent the operation of the feed switches 72 and 74 until the main motor is stopped. The spring 77^a which tends to hold the switch 77 in closed position, will effect the closing of the switch for operating the feed motor. Upon operation of the feed motor the coil 106 prevents the energiza-

tion of the coil 107 from opening such switch. Thus, it is apparent the switch 77 serves to effect a delayed operation of the feed motor when operation thereof is effected at the end of the cutting stroke. The selector switch 197 serves to select the end of the table stroke at which the operation of the feed motor will take place.

Upon operation of the limit switch 162 by the feed motor the holding circuits for the auxiliary feed switch 118 and the switch 154 are broken to release the feed switches 72 and 74. Upon releasing of the feed switches 72 and 74 a dynamic braking circuit is completed through the feed motor 7 in a well-known manner. In this regard it may be noted a separate dynamic braking resistor is provided which is independent of the accelerating resistor 76. The limit switch 162 separates the contact segment 163 from the contact finger 166 and engages the contact segment 165 with the contact finger 168. The change in position of the limit switch serves to permit operation of the auxiliary feed switch 117 by the pilot switch in place of the auxiliary feed switch 118. The circuits for operating the auxiliary feed switch 117 will be traced with the selector switch in a position towards the right, as shown in Fig. 2 of the drawings. The energizing circuit through the coil 134 of the auxiliary feed switch 117 extends from the supply conductor 32 through the supply arm 64, contact finger 173, contact segment 169, contact 169^a, contact members 123 and 129 of the pilot switch, contact fingers 187 and 188 of the selector switch, which is assumed in a position towards the right as viewed in Fig. 2, contact segment 179, contact fingers 167 and 168, which are bridged by the contact segment 164 and 165, coil 134 and the switch arm 63 to the supply conductor 33. The auxiliary feed switch 117 operates in the same manner as the auxiliary feed switch 118 and a detailed description thereof is deemed unnecessary. The switch arm 131 of the switch 117 completes a circuit for operating the feed switches 72 and 74 in the same manner as the switch arm 144 of the switch 118. The switch arm 132 of the switch 117 completes a holding circuit for the coil 134 of the switch 117 in the same manner as the switch arm 143 of the switch 118 completes a holding circuit for the coil 145. The switch arm 133 of the switch 117 completes a holding circuit for the coil 155 of the switch 154 in the same manner as the switch arm 142 of the switch 118 completes a holding circuit through the coil 155. In this regard it should be noted the auxiliary feed switches 117 and 118 are alternately operated by the pilot switch 16. At one end of the stroke of the table the pilot switch operates one of the auxiliary feed switches 117 and 118 and at the opposite end of the table stroke the pilot switch completes

a circuit through the operated auxiliary switch for operating the two feed switches 72 and 74. The two feed switches 72 and 74 effect operation of the feed motor 7. The auxiliary feed switches 117 and 118 are provided with holding coils 135 and 146 which are connected across the feed motor armature to prevent simultaneous operation of them.

The pendent switch 116 is provided with two contact segments 169 and 170 which are respectively included in the operating circuits for the feed switches 72 and 74 and the operating circuits for the main magnets 30 and 31. Thus, only when the pendent switch is in the position shown in Fig. 2 is it possible to automatically control the main motor and the feed motor by means of the pilot switch 16. When the pendent switch is raised and rotated to bridge the contact fingers 173 and 172 or to bridge the contact fingers 176 and 177, a circuit is completed for operating the traverse switches 71 and 73 to effect traverse operation of the feed motor 7. The circuit through the coils of the switches 71 and 73 extends from the supply conductor 32 through the switch arm 64, contact fingers 172 and 173, which are bridged by the contact segment 169, coils 80 and 83 in parallel and the switch arm 63 to the supply conductor 33. Upon operation of the switches 71 and 73 a circuit is completed through the feed motor 7 which extends from the supply conductor 32 through the switch arm 64, series winding 68, resistor 76, switch arm 79, contact members 81 and 82, contact members 89 and 90, armature 67, winding 70, switch arm 92, contact members 95 and 96, and the switch arm 63 to the supply conductor 33.

It should be noted the switches 71 and 73, which are controlled by the pendent switch 116, operate the feed motor 7 in a direction opposite to the operation of the feed motor by the switches 72 and 74. Thus, the feed motor 7 is operated in one direction to effect feeding movements and is operated in a reverse direction to effect transverse movements.

Upon moving the pendent switch to the second operative position, the main motor 15 may be traversed in one direction by bridging the contact members 173 and 174 and may be traversed in a reverse direction by bridging the contact members 175 and 176. The bridging of the contact members 174 and 173 serves to operate the switch 30 by a circuit which extends from a supply conductor 32 through the switch arm 64, contact members 173 and 174, which are bridged by contact segment 169, coil 39, switch arm 48, contact members 53 and 54, holding coil 50, and the switch arm 63 to the supply conductor 33. The bridging of the contact members 175 and 176 completes a circuit through the coil 49 of the switch 31 which extends from the sup-

ply conductor 32 through the switch arm 64, contact members 175 and 176, which are bridged by the contact segment 169, coil 49, switch arm 38, contact members 43 and 44, coil 40, and switch arm 63 to the supply conductor 33.

The holding coils 86 and 94 for the switches 72 and 73 are connected across the feed motor and serve to prevent the simultaneous operation of the two switches. The coil 111 of the accelerating switch 75 is connected across the armature by different circuits according to whether a traverse or a feeding operation of the motor 7 is being effected. During a traverse operation when the switches 71 and 73 are operated, the circuit for the coil 111 of the accelerating switch 75 extends from one terminal of the armature 67 through the switch arm 84, contact members 89 and 90, contact members 82 and 81, switch arms 79, coil 111, switch 99 and the winding 70 to the other terminal of the armature 67. During a feeding movement when the switches 72 and 74 are operated the circuit for the coil 111 of the accelerating switch 75 extends from one terminal of the armature 67 through the switch arm 84, switch 91, coil 111, switch arm 100, contact members 102 and 103, contact members 98 and 97, switch arm 92 and the coil 70 to the other terminal of the armature 67.

The auxiliary switch 104, which is operated by the feed switch 74, completes a holding circuit through the coils 101 and 85 of the feed switches 74 and 72. The holding circuit completed by the switch 104 extends from the supply conductor 32 through switch arm 64, contact member 173, contact segment 169, contact 169^a, switch arm 142 or 133 according to the auxiliary feed switch operated, switch 104, coils 101 and 85 in parallel and the switch arm 63 to the supply conductor 33. The holding circuit above traced serves, when the planer is operating automatically, to insure that the feed cycle will be completed each time it is started. This circuit prevents the interruption of the feed cycle by the pilot switch. Without this holding circuit, when the planer is operating on short strokes, the pilot switch may be thrown before the feed is completed with the result that the feed cycle is not completed until some subsequent stroke.

In many of the planer control systems now in service trouble is encountered at times because of continuous operation of the feed motor. The feed motor is operated a portion of the feed cycle until the limit switch is operated. The feed motor always drifts somewhat and if the drift of the feed motor extends to half a revolution of the limit switch, the circuit of feed switch is again completed and the feed motor in place of making one feeding movement and stopping continues to operate. This will cause spoiled work or broken tools and means are therefore

provided for preventing trouble from this source.

In the present system the circuits for the feed switches 72 and 74 do not pass through the limit switch 162. The circuit broken by the limit switch is a holding circuit for the switch 117 or the switch 118. The resistor 161 in the holding circuit prevents the operating of the switch 117 or 118 in the above indicated manner by the limit switch.

Modifications in the system, and in the arrangement and location of parts may be made within the spirit and scope of my invention and such modifications are intended to be covered by the appended claims.

What I claim is:

1. In a planer control system, the combination comprising a reciprocating table, a main motor for operating said table, a feed motor, a pilot switch for automatically operating the main and the feed motor in accordance with the movement of the table, means comprising a large resistance in the feed motor circuit for starting the feed motor at very low torque prior to a feeding operation, and means for excluding said resistance from the feed motor circuit after a predetermined movement of the feed motor to effect a feeding operation.

2. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch for automatically operating the feed motor in accordance with the movement of said table, means comprising a large resistance in the feed motor circuit for starting the feed motor at very low torque prior to a feeding operation, means for excluding said resistance from the feed motor circuit after a predetermined movement of the feed motor and prior to a feeding operation, and means for accelerating the feed motor.

3. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch for automatically operating the feed motor in accordance with the movement of the table, an accelerating resistor initially in the circuit of the feed motor, an auxiliary resistor of large resistance initially in the circuit of the feed motor for insuring movement of the feed motor at low torque prior to a feeding movement, means for excluding the auxiliary resistor from the feed motor circuit after a predetermined movement of the feed motor, and automatic means for excluding the accelerating resistor from the feed motor circuit to accelerate the feed motor.

4. In a planer control system, the combination comprising a reciprocating table, a feed motor operable in one direction to effect feeding movements, a pilot switch for automatically operating the feed motor in accordance with the movement of the table, an accelerating resistor initially in the circuit of the feed

motor, an auxiliary resistor of large resistance initially in the circuit of the feed motor for insuring movement of the feed motor at low torque prior to a feeding movement, means comprising a switch mechanically controlled by the feed motor for excluding the auxiliary resistor from the feed motor circuit after a predetermined movement of the feed motor, and automatic means for excluding the accelerating resistor from the feed motor circuit to accelerate the feed motor.

5. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch for automatically operating the feed motor in accordance with the movement of the table, an auxiliary resistor of large resistance initially in the circuit of the feed motor for insuring movement of the feed motor at low torque prior to a feeding movement, and means comprising a switch mechanically controlled by the feed motor for excluding the auxiliary resistor from the feed motor circuit after a predetermined movement of the feed motor.

6. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch for automatically operating the feed motor in accordance with the movement of the table, an accelerating resistor initially in the circuit of the feed motor, an auxiliary resistor of large resistance initially in the circuit of the feed motor for insuring movement of the feed motor at low torque prior to a feeding movement, means mechanically operated by the motor after a predetermined movement thereof for excluding the auxiliary resistor from the feed motor circuit, and means automatically operated in accordance with electrical operation of the feed motor for excluding the accelerating resistor from the feed motor circuit.

7. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch for automatically operating the feed motor in accordance with the movement of the table, a low torque resistor initially in the circuit of the feed motor, and means mechanically operated by the feed motor after a predetermined movement thereof for excluding the low torque resistor from the feed motor circuit.

8. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch for automatically operating the feed motor in accordance with the movement of the feed motor, a limit switch for limiting the movement of the feed motor, a low torque resistor initially in the circuit of the feed motor, means mechanically operated by the feed motor after a predetermined movement thereof for excluding the low torque resistor from the feed motor circuit, and means for insuring the exclusion

of the low torque resistor from the feed motor circuit during a feeding movement thereby.

9. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated in accordance with the movement of the planer table, two auxiliary feed switches operated alternately by said pilot switch for effecting feeding movement by the feed motor, said pilot switch operating one auxiliary feed switch at one end of the table stroke and completing a circuit through the operated auxiliary feed switch for operating the feed motor at the opposite end of the table stroke, and a limit switch operated by the feed motor for releasing said auxiliary feed switch.

10. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated in accordance with the movement of the planer table, means operated by the pilot switch for effecting feeding movements by the feed motor, and a limit switch for limiting the operation of the feed motor irrespective of the position of the pilot switch.

11. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated at each end of the table stroke, means operated by the pilot switch at one end of the table stroke for preparing a circuit to operate the feed motor and operated at the opposite end of the table stroke for completing a circuit to operate the feed motor, and means comprising a limit switch for limiting the operation of the feed motor irrespective of the position of the pilot switch.

12. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated in accordance with the movement of the planer table, means operated by the pilot switch for operating the feed motor, a limit switch, and means for insuring the stopping of the feed motor only in accordance with the operation of the limit switch.

13. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated in accordance with the movement of the planer table for starting the operation of the feed motor, a limit switch operated by the feed motor, and means for stopping the feed motor only in accordance with the operation of the limit switch and irrespective of the operation of the pilot switch.

14. In a planer control system, the combination comprising a reciprocating table, a main motor for operating the reciprocating table, a feed motor, a pilot switch operated in accordance with the movement of the table for starting and stopping the main motor and for starting the feed motor, a limit switch operated by the feed motor for limiting the

operation of the feed motor, and means for preventing the stopping of the feed motor by the pilot switch.

15. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated in accordance with the movement of the planer table for starting the operation of the feed motor, a limit switch operated by the feed motor for limiting the operation of the feed motor, and means for preventing the stopping of the feed motor by the pilot switch.

16. In a planer control system, the combination comprising a reciprocating table, a main motor for operating the reciprocating table, a feed motor, a pilot switch operated in accordance with the movement of the table for operating the main motor in a forward and in a reverse direction and for starting the feed motor, a limit switch operated by the feed motor for limiting the operation of the feed motor, and means for preventing the stopping of the feed motor by the pilot switch.

17. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated by the table, means controlled by the pilot switch for operating the feed motor, a limit switch operated by the feed motor only at one end of the table stroke, and means for insuring the stopping of the feed motor upon operation of the limit switch irrespective of the position of the pilot switch.

18. In a planer control system, the combination comprising a reciprocating table, a feed motor, a pilot switch operated by said table, two auxiliary feed switches controlled by said pilot switch in accordance with the movement of said table, two feed switches controlled by said auxiliary feed switches for operating said feed motor, a resistor for completing a holding circuit through a selected one of said auxiliary switches upon operation of the pilot switch, and a limit switch operated by the feed motor for breaking said holding circuit.

In testimony whereof, I hereto affix my signature.

ROBERT C. DEALE.

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