Nov. 18, 1924. 1,516,186

W. J. HAGMAN ET AL

SLOTTING MACHINE

Filed Sept. 16, 1921 4 Sheets-Sheet 1

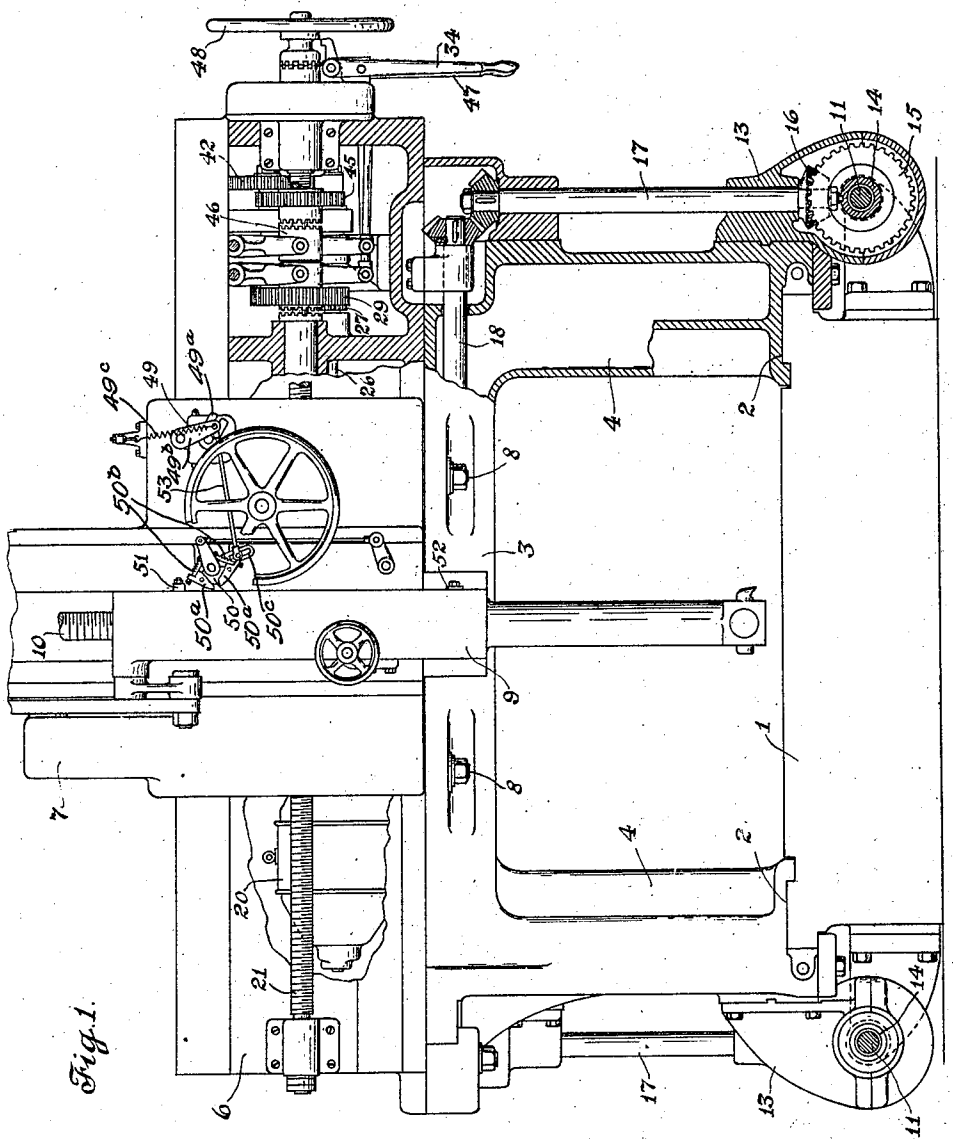


Fig. 1.

Inventors.
W. J. Hagman
and E. H. Wray.
By Fawcus & Wilcox
Attorney.

Nov. 18, 1924.

1,516,186

W. J. HAGMAN ET AL

SLOTTING MACHINE

Filed Sept. 16, 1921

4 Sheets-Sheet 2

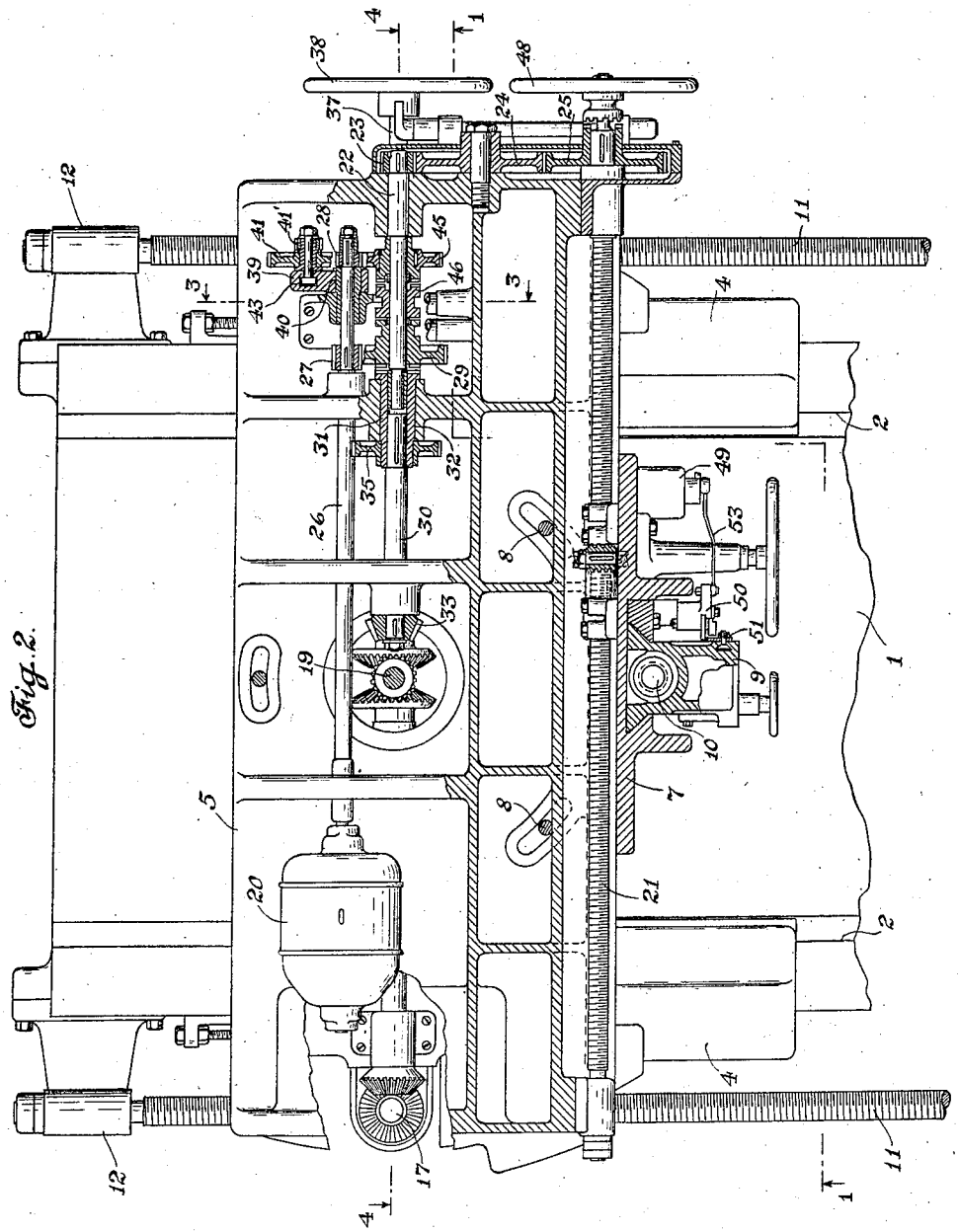


Fig. 2.

Inventors.
W. J. Hagman
and E. H. Wray.
By Laurie J. Witter
Attorney.

Nov. 18, 1924. 1,516,186

W. J. HAGMAN ET AL

SLOTTING MACHINE

Filed Sept. 16, 1921 4 Sheets-Sheet 3

Fig. 3.

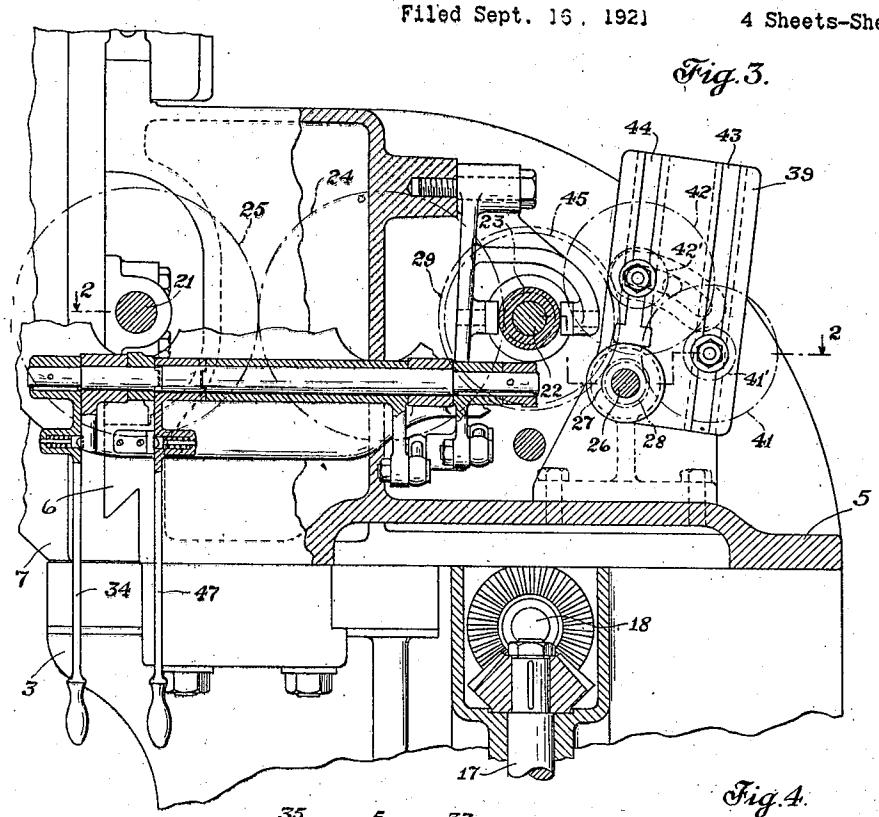
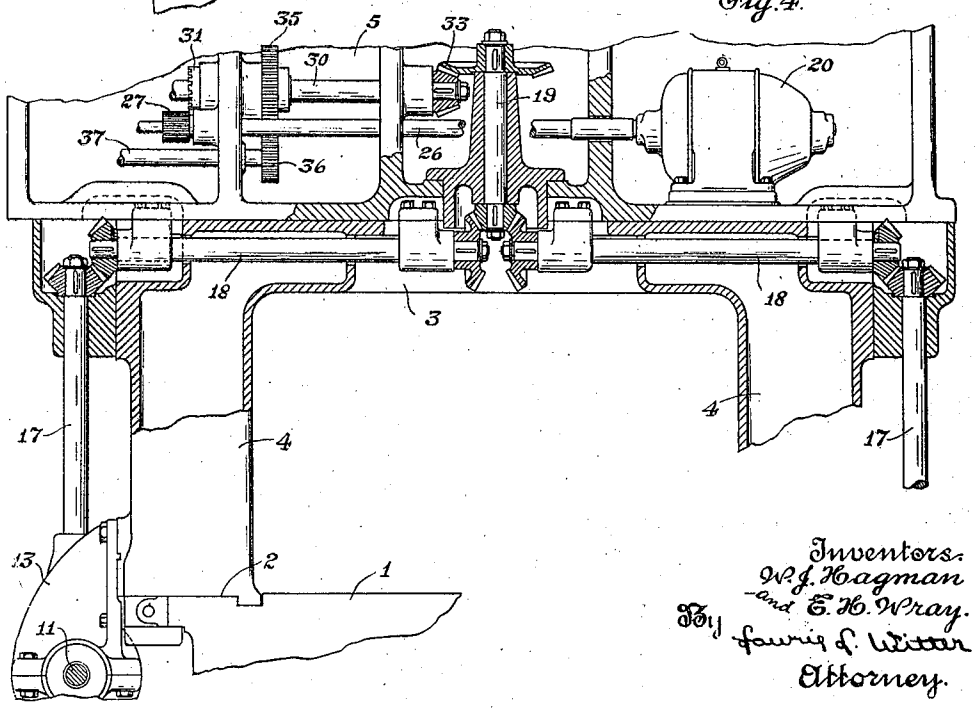


Fig. 4.



Inventors.
W. J. Hagman
and E. H. Wray.
By Laurie L. Witter
Attorney.

Nov. 18, 1924.

1,516,186

W. J. HAGMAN ET AL

SLOTTING MACHINE

Filed Sept. 16, 1921

4 Sheets-Sheet 4

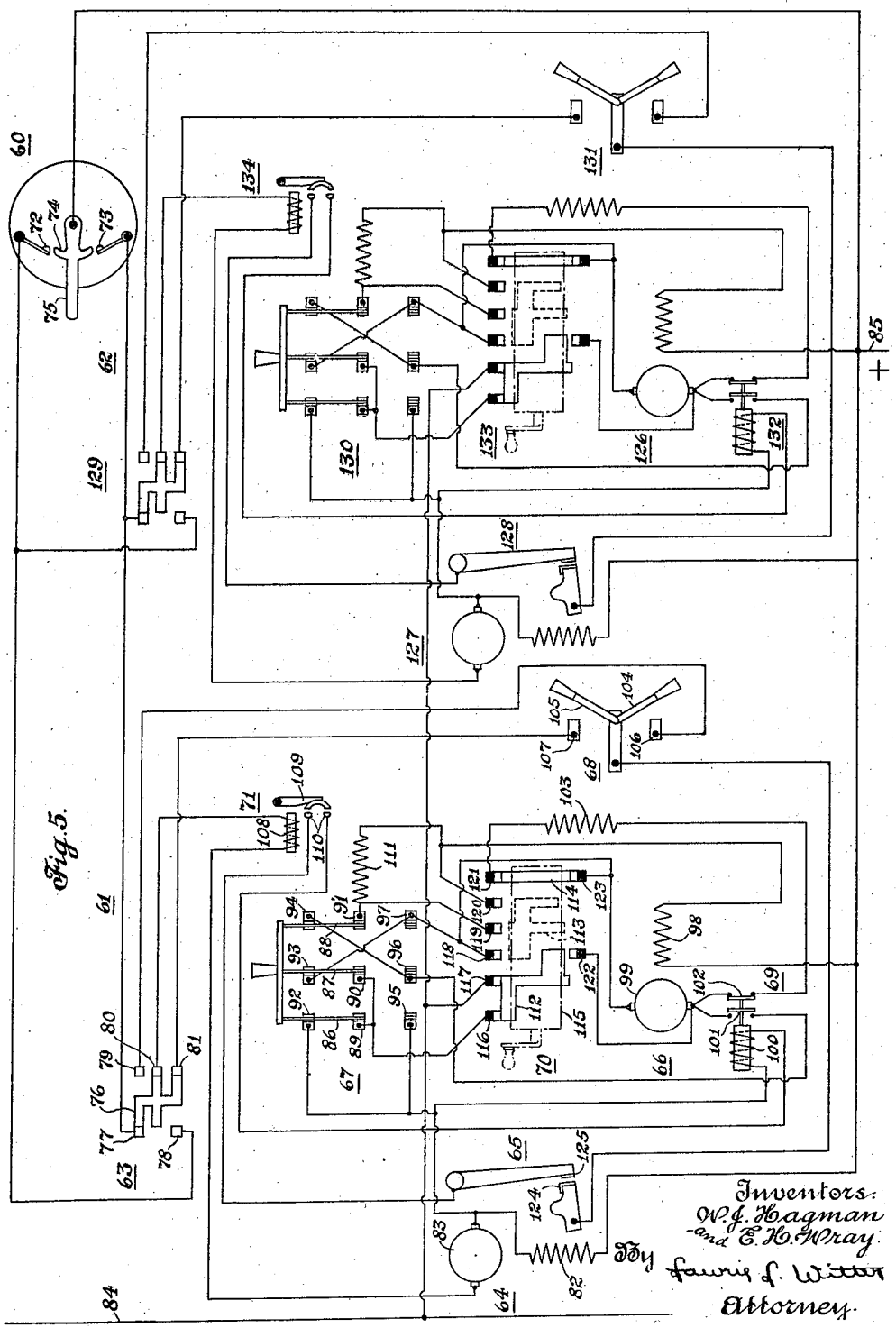


Fig. 5.

Inventors:
W. J. Hagman
and C. H. Wray.
By Lewis L. Witter
Attorney.

Patented Nov. 18, 1924. 1,516,186

UNITED STATES PATENT OFFICE.

WILLIAM J. HAGMAN AND EDWARD H. WRAY, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS TO NILES-BEMENT-POND COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

SLOTTING MACHINE.

Application filed September 16, 1921. Serial No. 501,131.

To all whom it may concern:

Be it known that we, WILLIAM J. HAGMAN and EDWARD H. WRAY, citizens of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Slotting Machines, of which the following is a specification.

This invention relates to slotting machines and particularly to an improved slotting machine of the type commonly called locomotive frame slotters. Such a machine is illustrated in our Patent No. 964,421 dated July 12, 1910. A machine of this type broadly comprises a bed along which is slidable one or a plurality of heads spanning the bed, each head comprising a cross rail on which is mounted for transverse sliding movement a tool supporting saddle. Means is provided for traversing and synchronously feeding the head and saddle on their respective guides. It is the primary object of the invention to provide improved means for performing these functions.

Heretofore the feeding mechanism for the head and saddle have been operated from the main power means of the machine. In the improved machine herein disclosed the feeding operation is preferably accomplished from an independent source of power, as the electric feed motor means illustrated in the drawings, motor control means being provided for intermittently operating the motor means to perform the feeding operation.

It is an object of the invention to provide an improved slotter of this type wherein the head and saddle may be fed in a definite relative ratio from the feed motor means and wherein supplemental means is provided for relatively varying the feeding movements of such elements.

A further and more specific object of the invention is to provide a head and saddle mechanism of the type stated, a motor for feeding such elements in a constant relative ratio and supplemental mechanism comprising change speed gearing for varying the relative feeding movements of the elements.

With these and other objects in view, our invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings. In such drawings annexed hereto and forming a part of this specification, we have illustrated certain embodiments of our invention in a locomotive frame slotter but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

Referring to the figures of the drawings:

Figure 1 is an end elevation partially in section of a frame slotter comprising the present invention, such view being taken approximately on line 1—1 of Fig. 2.

Fig. 2 is a sectional plan view thereof, taken approximately on line 2—2 of Fig. 3.

Fig. 3 is a detail sectional view taken approximately on line 3—3 of Fig. 2, certain change speed gearing thereof being shown in dot and dash lines.

Fig. 4 is a vertical sectional view taken approximately on line 4—4 of Fig. 2, certain parts being shown in elevation.

Fig 5 is a diagrammatic view illustrating an electric control system for the tool feeding and traversing mechanism, such mechanism comprising a modified form of our invention.

Referring to Figs. 1 to 4 of the drawings, 1 indicates the main frame or bed of the machine which is ordinarily relatively long. Horizontal guideways 2 are provided at opposite sides of the bed for receiving the tool heads or carriages 3. In the drawings, we have illustrated but one such head although it will be understood that one or a plurality of such heads, as disclosed in our aforesaid patent, may be provided. This head comprises two uprights 4 resting on the guideways and integrally connected at their upper ends to provide a support for an angularly adjustable member 5. The member 5 provides a cross rail 6 on which is slidably mounted a tool supporting saddle 7. The member 5 with the cross rail 6 thereon is slightly adjustable about a vertical axis, bolt and slot connections 8 being provided between the head 3 and member 5 for permitting such adjustment and for securing the member 5 in its adjusted positions. A cutter bar 9 is mounted for vertical reciprocation

in the saddle, a screw 10 being adapted to reciprocate the bar.

For the purpose of feeding and traversing the head and saddle along their respective guides, we have preferred to illustrate a mechanism similar in some respects to that disclosed in our before-mentioned patent, although it will be understood that the same may be variously modified within the scope of the appended claims. Extending along each side of the bed is a stationary screw 11 secured in brackets 12 at the ends. A bracket 13 on each upright 4 is provided with a rotatable nut 14 threadedly engaging its screw. These nuts are secured to bevel gears 15 meshing with bevel gears 16 on the lower ends of vertical shafts 17. Horizontal shafts 18 with bevel gears thereon operatively connect the vertical shafts to a central shaft 19 about which the member 5 is adjustable. This shaft 19 is adapted to be operated from a feed motor 20 through mechanism hereinafter described.

The saddle 7 is adapted to be fed and traversed along the cross rail 6 by means of a rotary screw 21 threadedly engaging a nut in the saddle. The screw is adapted to be rotated from a shaft 22 through gears 23, 24 and 25, the shaft 22 being adapted to be driven from the feed motor 20 through mechanism to be hereinafter described.

The motor 20 is mounted on the member 5 and the motor shaft 26 is provided with two pinions 27 and 28 thereon. The pinion 27 is operatively connected to the vertical central shaft 19, for feeding the head 3, through the following mechanism. The pinion 27 meshes with a gear 29 loose on shaft 22. A shaft 30 is keyed to a sleeve 31 rotatable in a bearing 32 coaxial with shaft 22. The gear 29 and sleeve 31 have clutch teeth on their adjacent ends and the gear may be shifted longitudinally to engage such clutch teeth for driving the sleeve and shaft 30. The shaft 30 is operatively connected to the central shaft 19 through bevel gears 33. A hand lever 34 is provided as illustrated in Figs. 1 and 3 for shifting the gear 29. A gear 35 is secured to the sleeve 31 and meshes with a gear 36 on a shaft 37. A hand wheel 38 is mounted on the shaft 37 whereby the head may be moved by hand when desired.

It will be noted that the mechanism thus far described provides an operative connection from the motor 20 to the head or carriage 3 for moving the head along its guideways 2. The motor is adapted to be controlled for either traversing the head continuously or for feeding the same intermittently as the cutter bar reciprocates. The control for the motor also comprises means for varying the amount of feeding movement imparted to the head therefrom at each feeding movement. Such a motor controlling mechanism is illustrated and described in detail in Patent No. 1,342,915 to S. P. Johnson. Also the motor controlling means hereinafter described is adapted to perform this function.

In the mechanism illustrated in Figs. 1 to 4, both the head feed and the saddle feed are operated from the single feeding motor 20. As heretofore stated, the extent of feeding movement imparted by the motor may be varied through the motor control means. It is however also desirable, in performing certain operations, to relatively vary the feeding movements of the head and saddle. One means, comprising change speed gearing, for performing this function will now be described.

As illustrated in Figs. 2 and 3, a change gear supporting bracket 39 is mounted on a hub 40 about the motor shaft 26. Two pairs of gears 41, 41′ and 42, 42′ are illustrated as mounted on studs in slots 43 and 44 in the bracket. A gear 45 is loosely mounted on the before mentioned shaft 22 and may be made to drive the shaft through a cooperating clutch 46 splined to the shaft, a hand lever 47 being adapted to shift the clutch along the shaft. The drive from the pinion 28 on the motor shaft to the gear 45 is as follows: pinion 28, gear 41, gear 41′, gear 42, gear 42′, gear 45 and clutch 46. The gears 41, 41′, 42 and 42′ may be changed as desired to impart the proper feed to the saddle through the screw 21 and to thereby vary the relative feeding movements imparted to the head and saddle respectively. The screw 21 may be rotated by a hand wheel 48 to move the saddle by hand for adjusting purposes.

While in the drawings we have illustrated but one head or carriage 3, it will be understood that one or a plurality of such heads may be mounted on the ways 2, as illustrated in our aforesaid patent. It will also be understood that a tool feeding and traversing mechanism, such for example as that heretofore described, is to be provided on each head for controlling the movements of the head and saddle respectively.

In Fig. 1, we have illustrated one means for controlling the motor 20 to perform the desired feeding operation. In such mechanism, 49 indicates a pilot switch for controlling the motor. This switch is adapted to be operated from the reciprocating tool bar 9 through pivoted means 50 adapted to be alternately engaged and oscillated by dogs 51 and 52 on the tool bar. A link 53 connects the means 50 with the pilot switch. As the tool bar reciprocates vertically, the dogs 51 and 52 alternately engage the means 50 to alternately oscillate the same in opposite directions to impart an oscillatory movement to the pilot switch.

The further operation of the pilot switch on the motor whereby the latter operates the tool feeding mechanism is hereinafter described. Such operation is also fully disclosed in the aforesaid Patent No. 1,342,915.

As illustrated in Fig 1, the said means 50 includes two pivoted elements 50[a] each normally held in operative position by means of a spring 50[b]. The rod 53 connects an arm 50[c] of the oscillating element 50 to a crank arm 49[a] of the pilot switch 49. A loosely pivoted arm 49[b] and a spring 49[c] are provided in connection with the arm 49[a] for fully completing the swinging movement of the switch arm in both directions. As illustrated in Fig. 1, the tool bar 9 is moving upwardly. The dog 52 will engage the upper element 50[a] and rock the means 50 clockwise. Such movement is transmitted to the pilot switch and the movement of the same to its opposite position is completed by means of the spring 49[c]. The movement of the tool bar is thereby reversed. Upon downward movement of the bar, the dog 51 engages the lower element 50[a] and rocks the means 50 anti-clockwise. The pilot switch is thereby moved back to the first said position and the movement of the tool bar again reverses. It should be understood that the details of this mechanism do not, within themselves, comprise a part of our invention and therefore such details may be varied as desired.

Referring to Fig. 5 of the drawings, we have illustrated a modification of our invention wherein the feeding movements of the head and the feeding movements of the tool-supporting saddle are electrically controlled by a system such as disclosed in the application to Sven P. Johnson and Harry Harding, Serial No. 441,827, filed February 2nd, 1921. Separate feed motors are provided for feeding the head and the tool-carrying saddle.

A pilot switch 60, which is controlled in any suitable manner by the movement of the cutter bar as, for example, by the means shown in Fig. 1 and heretofore described, is provided for governing the feeding movements of the head along the bed and the feeding movements of the tool carrying saddle along the cross rail. The system shown in Fig. 5, which is controlled by the pilot switch 60, comprises two sub-systems 61 and 62, each of which is similar in construction and operation to the system disclosed in the above mentioned application of Sven P. Johnson and Harry Harding. Inasmuch as the two sub-systems are similar in construction and operation, a detail description of only one system, namely the sub-system 61 for controlling the feeding movement of the head along the bed will be given.

The pilot switch 60, which is electrically connected to a limit switch 63, controls the operation of a control motor 64. The control motor 64 directly operates a control switch 65 which in turn governs the operation of a feed motor 66. A feed reverse switch 67 is provided for controlling the direction of the feeding operation and a switch 68 is provided for determining at which end of the cutter bar stroke the feeding operation is to be effected. In this regard it may be noted that a feeding operation may be effected at either or both ends of the cutter bar stroke.

A contactor 69, which is governed by the control switch 65, is provided not only for completing an operating circuit through the feed motor 66 but also for completing a dynamic-braking circuit through such motor upon release of the control switch 65. A traverse controller 70 is provided for effecting a traverse operation of the cutting tool at any time and independent of the position of any of the parts for effecting a feeding operation may occupy. A relay 71, which is controlled by the pilot switch 63, is provided for completing the energizing circuit of the contactor 69 through the control switch 65.

The pilot switch 60, which is diagrammatically illustrated in Fig 5 of the drawings, essentially consists of two stationary contact members 72 and 73 and a movable contact member 74. The movable contacting member 74 is provided with an extended portion 75 which is operated in any suitable manner by the reciprocating movement of the cutter bar. It is assumed the extension 75 is operated near the end of the upward movement of the cutter bar to effect engagement between the contact members 73 and 74. Likewise, near the end of the downward movement of the cutting tool, the contact member 74 is moved into engagement with the contact member 72. The feeding operation at either end of the cutter bar movement is controlled as hereinafter set forth.

The limit switch 63 comprises a movable contact segment 76 and five stationary contact members 77 to 81, inclusive. The contact segment 76 is mounted upon a drum (not shown) which is directly operated by the control motor 64, in the manner set forth in the copending application Serial No. 441,827, above referred to. The control motor 64 comprises a field-magnet winding 82 and an armature 83. The field-magnet winding 82 is connected across a supply circuit comprising conductors 84 and 85. The armature 83 is connected across the conductors 84 and 85 through the feed reverse switch 67 and the limit switch 63 by means of the pilot switch 60.

The feed reverse switch 67 comprises three movable contact blades 86, 87 and 88 which are respectively connected to stationary con-

tact members 89, 90 and 91. The contact blades 86, 87 and 88 are adapted to engage stationary contact members 92, 93 and 94 when the switch is in position for effecting a feeding operation in a forward direction and are adapted to engage stationary contact members 95, 96 and 97 when the switch is in position for effecting a feeding operation in a reverse direction.

The feed motor 66, which effects operation of the head along the bed, comprises a field-magnet winding 98 and an armature 99. The contactor 69 comprises an energizing coil 100 and two switch members 101 and 102. The switch member 101 serves to complete an energizing circuit for the feed motor 66 upon operation of the contactor and the switch member 102 serves to complete a dynamic-braking circuit upon release of the contactor. A resistor 103 is provided in the dynamic-braking circuit for the feed motor.

The switch 68 comprises two independently movable switch blades 104 and 105 and two stationary contact members 106 and 107. The switch 68 serves to effect feeding operation at either or both ends of the movement of the cutter bar. When the switch blade 105 engages the contact member 107, a feeding operation is effected at the end of the forward movement of the cutter bar, and when the switch blade 104 is in engagement with the stationary contact member 106, a feeding operation is effected at the end of the downward movement of the cutter bar. The relay 71 comprises an energizing coil 108, which is connected across the supply conductors 84 and 85 by means of the pilot switch 60. A switch arm 109 is operated by the energizing coil 108 to bridge stationary contact members 110. The relay 71 serves to complete a circuit through the control switch 65 and the energizing coil 100 of the contactor 69. A resistor 111 is provided for limiting the speed of the feed motor under certain conditions as will hereinafter be set forth.

The traverse controller 70 comprises three contact segments 112, 113 and 114, which are mounted on any suitable drum 115. The drum is operated by any suitable handle. Stationary contact members 116 to 123, inclusive, are provided for engagement with the contact segments 112, 113 and 114 according to the operative position of the controller. The controller is shown in the off position, and, in such position the contact segment 114 engages the contact members 121 and 123 for completing a dynamic-braking circuit through the feed motor 66. The contact segment 112 bridges the stationary contact members 116 and 117 for connecting various parts of the system to the supply conductor 84 to effect feeding operations.

The control switch 65 comprises a stationary contact member 124 and a movable contact member 125. The construction of the switch and the parts for operating it are described in detail in the copending application Serial No. 441,827, and a further description of such parts in this application is deemed unnecessary. However, it may be stated that two cam members are operated by the control motor for respectively closing and opening the control switch. The relative angular position of such cam members determines the time during which the control switch is maintained in closed position. Moreover, as will be set forth hereinafter, the time during which the control switch remains closed determines the length of operation of the feed motor and accordingly the length of the feeding operation. The control switch is operated by the control motor simultaneously with the operation of the limit switch by the motor.

Assuming the various parts of the subsystems 61 to be in the position shown in Fig. 5 of the drawings and the switch blade 105 of the switch 68 to be in engagement with the stationary contact member 107, the operation of the control system will be described. Upon completion of the upward movement of the cutter bar, the contact member 74 of the pilot switch 60 is moved into engagement with the stationary contact member 73 for completing a circuit from the supply conductors 84 and 85 to effect a feeding operation of the head along the bed of the machine. One circuit, which is completed through the pilot switch 60, extends from the supply conductor 85 through the contact members 74 and 73 of the pilot switch, contact members 77 and 80, which are bridged by the contact segment 76 of the limit switch 63, the energizing coil 108 of the relay 71, armature 83 of the control motor, contact members 92 and 89, which are bridged by the switch blade 86, and the contact members 116 and 117, which are bridged by the contact segment 112, to the supply conductor 84. The completion of the above circuit effects operation not only of the relay 71 but also of the control motor 64. Upon operation of the control motor 64, the control switch 65 is operated to effect engagement between the contact members 124 and 125. Upon engagement between the contact members 124 and 125, a circuit is completed which extends from the supply conductor 85 through the contact members 74 and 73 of the pilot switch 60, contact members 77 and 81, which are bridged by the contact segment 76 of the limit switch 63, contact member 107, the switch blade 105 of the switch 68, control switch 65, contact members 110, which are bridged by the switch arm 109, energizing coil 100 of the contactor 69, contact members 92 and 89, which are bridged by the switch blade 86

and the contact members 116 and 117, which are bridged by the contact segment 112, to the supply conductor 84.

Thereupon the contactor 69 is operated for completing a circuit through the feed motor 66. The circuit through the feed motor 66 extends from the supply conductor 85 through the field-magnet winding 98, resistor 111, contact members 91 and 94, which are bridged by the switch blade 88, contact member 96, switch member 101, armature 99, contact member 97, contact members 93 and 90, which are bridged by the switch blade 87, and the contact members 116 and 117, which are bridged by the contact segment 112, to the supply conductor 84. Thereupon the motor 66 is operated to effect a feeding operation of the head along the bed of the machine.

At a predetermined time the control switch 65 is opened by the control motor 64 to limit the feeding operation. Upon opening of the control switch 65, the circuit of the energizing coil 100 of the contactor 69 is opened to release such contactor. The circuit through the feed motor 66 is broken and a dynamic-braking circuit is completed which extends from one terminal of the armature 99 through the switch member 102, resistor 103, and contact members 121 and 123, which are bridged by the contact segment 114, to the other terminal of the armature 99. The dynamic-braking circuit effects an efficient and quick stopping of the feed motor 66 to limit the feeding operation.

The contact segment 76 of the limit switch 63 is operated by the control motor 64 to disengage the contact members 77 and 81 and to engage the contact members 79 and 78. The limit switch prepares the system for effecting a feeding operation at the end of the downward movement of the cutter bar. Accordingly, if the blade 104 of the switch 68 is moved into engagement with the contact member 106, a feeding operation of the motor 66 will take place at the end of the downward movement of the cutter bar. The feed motor is operated when the pilot switch effects engagement between the contact members 74 and 72. Inasmuch as the various parts of the system operate at the end of the downward movement of the cutter bar to effect a feeding operation in a manner exactly similar to the operation heretofore set forth for effecting the feeding operation at the end of the upward movement of the cutter bar, a further description thereof is deemed unnecessary. Moreover, a complete description of the system for effecting the feeding operation at either end of the stroke of a reciprocating member is completely disclosed in the copending application Serial No. 441,827.

In case it is desired to effect a traverse operation at any time independent of the position of the apparatus for effecting a feeding operation, the traverse controller 70 is given a rotation either in a clockwise or in a counterclockwise direction according to the operation desired. If the controller is given a movement of rotation in a clockwise direction, a traverse operation in a reverse direction is effected and if the controller is given a movement of rotation in a counterclockwise direction, a traverse operation in a forward direction is effected.

If the controller is given a movement of rotation in a clockwise direction to effect a traverse operation in a reverse direction, the contact terminal 116 is disconnected from the contact segment 112 to open the circuits which are adapted to effect a feeding operation. The dynamic-braking circuit, which extends through the contact members 123 and 121, is opened by reason of the disengagement between the contact member 121 and the contact segment 114. The contact segment 112 engages the contact terminal 122 and the contact segment 113 engages the contact terminals 118 and 119. The portion of the contact segment 112, which is disposed adjacent to the contact terminal 117, extends entirely around the controller drum in order to constantly connect such segment to the supply conductor 84. In such position of the traverse controller 70, a circuit is completed through the feed motor 66, which extends from the supply conductor 85 through the field-magnet winding 98, resistor 111, contact terminals 119 and 118, which are bridged by the contact segment 113, armature 99 of the feed motor 66, and the contact terminals 122 and 117, which are bridged by the contact segment 112, to the supply conductor 84. In the next position of the controller, the contact segment 113 engages the contact terminal 120 for excluding the resistor 111 from circuit to increase the speed of operation of the feed motor. Thus, the traverse operation is effected to rapidly move the head on the bed in a reverse direction.

When it is desired to effect a traverse operation in a forward direction, the controller 70 is given a movement of rotation in a counterclockwise direction to effect engagement between the contact segment 112 and the contact terminal 118 and also to effect engagement between the contact segment 113 and the contact terminals 122 and 119. The contact terminal 116 is disengaged from the contact segment 112 and the contact terminal 123 is disengaged from the contact segment 114 for the purpose heretofore set forth. A complete description of the circuits completed through the controller while in the above described position is deemed unnecessary.

The rotation of the feed motor 66 and

accordingly the direction in which the head of the machine is fed is controlled by the feed reverse switch 67. When the switch is in the position shown, the head is fed in the forward direction and when thrown to the reverse direction, the head is fed in a reverse direction. The switch 67 merely controls the direction of current flow through the feed motor 66.

The sub-system 62, which controls the feeding operation of the tool-supporting saddle, is operated by the pilot motor 60 in exactly the same manner as the sub-system 61 which controls the feeding movement of the head on the bed. The sub-system 62 comprises a feed motor 126, a control motor 127 and a control switch 128 and a limit switch 129 which are operated by the control motor 127. A switch 130 is provided for governing the direction of rotation of the feed motor 126, and a switch 131 is provided for selectively effecting a feeding operation at either or both ends of the reciprocating movements of the cutter bar. A contactor 132 is provided for completing an energizing and a dynamic-braking circuit through the feed motor 126. A controller 133 is provided for effecting a traverse operation of the feed motor at any time independent of the position of the apparatus for effecting a feeding operation. A relay 134 is provided similar to the relay 71.

The control motor 127 is governed by the pilot switch 60 to operate the control switch 128 and the limit switch 129. The control switch 128 operates the contactor 132 and accordingly the feed motor 126 to effect a feeding operation of the tool-supporting saddle. The switches 130 and 131, the relay 134 and the controller 133 operate in the same manner as like parts in the sub-system 61.

From the above description it is apparent the pilot switch 60 serves to control two feed motors 66 and 126 to effect not only a feeding operation of the head along the bed but also to effect a feeding operation of the tool-carrying saddle on the cross rail. The amount of feed effected by either of the motors 66 and 126 may be varied at will by varying the cam connection between the control motors and the control switches which govern the feeding motors. The cam connections between the control motors and the control switches is completely described and claimed in the copending application Serial No. 441,827. Moreover, it is apparent the feeding operation may take place at either or both ends of the stroke of the cutter bar.

What we claim is:

1. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation in the saddle, power means for reciprocating the bar, electric motor means for feeding the head along its guideways and the saddle along the cross rail in a definite relative ratio respectively, control means for intermittently operating the motor means to perform the feeding operation, and supplemental means for relatively varying the feeding movements of the head and saddle.

2. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation in the saddle, power means for reciprocating the bar, electric motor means for feeding the head along its guideways and the saddle along the cross rail in a constant relative ratio respectively, control means for intermittently operating the motor means to perform the feeding operation, and means for varying the said relative ratio.

3. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways extending along opposite sides thereof, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head substantially at right angles to the guideways, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation in the saddle, power means for reciprocating the bar, electric motor means for feeding the head along its guideways and the saddle along the cross rail in a constant relative ratio respectively, control means for intermittently operating the motor means to perform the feeding operation, supplemental means for relatively varying the feeding movements of the head and saddle, and means supplemental to the feeding means for continuously traversing the head and saddle in either direction.

4. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, power means for reciprocating the bar, electric motor means for intermittently feeding the head along its guideways and the saddle along the cross rail in a constant relative ratio respectively and in timed relation to the bar reciprocation, control means operated from the tool bar reciprocation for intermittently operating the

motor means to perform the feeding operation, and means for varying the said relative ratio.

5. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, power means for reciprocating the bar, electric motor means for intermittently feeding the head along its guideways and the saddle along the cross rail in a constant relative ratio respectively and in timed relation to the bar reciprocation, control means for intermittently operating the motor means to perform the feeding operation, means for varying the said relative ratio, and means supplemental to the feeding means for continuously traversing the head and saddle in either direction.

6. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways extending along opposite sides thereof, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head substantially at right angles to the guideways, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, power means for reciprocating the bar, a fixed screw extending along each guideway, a rotatable nut on each side of the head threadedly engaging each screw, electric motor means operatively connected with said nuts and with the saddle for feeding the head along its guideways and the saddle along the cross rail in a constant relative ratio respectively, control means for operating the motor means to perform the feeding operation and means supplemental to the feeding means for relatively varying the feeding movements of the head and saddle.

7. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, power means for reciprocating the bar, a feed motor for feeding the head along its guideways and the saddle along the cross rail in a definite relative ratio respectively, control means for intermittently operating the motor to perform the feeding operation, and mechanical means supplemental to the feeding means for relatively varying the feeding movements of the head and saddle.

8. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, an electric motor for reciprocating the bar, a feed motor for feeding the head along its guideways and the saddle along the cross rail in a constant relative ratio respectively, control means for intermittently operating the motor to perform the feeding operation, and gearing supplemental to the said means for relatively varying the feeding movements of the head and saddle.

9. In a frame slotter, the combination of a bed a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, means for reciprocating the bar, mechanism for feeding the head along its guide ways, mechanism for feeding the saddle along the cross rail, means for intermittently operating both said mechanisms in a constant relative ratio and in timed relation to the bar reciprocation, and change speed gearing supplemental to one of the said mechanisms for varying the feed imparted by the said mechanism.

10. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, means for reciprocating the bar, mechanism for feeding the head along its guideways, mechanism for feeding the saddle along the cross rail, means for intermittently operating both said mechanisms in a constant relative ratio and in timed relation to the bar reciprocation, change speed gearing supplemental to one of the said mechanisms for varying the feed imparted by the said mechanisms, and means supplemental to the feeding means for continuously traversing the head and saddle in either direction.

11. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, mechanism for feeding the head along its guideways, mechanism for feeding the saddle along the cross rail, a motor on the head for operating both said mechanisms, control means for intermittently operating the motor to

perform the feeding operation, and change speed gearing supplemental to one of the said mechanisms for varying the feed imparted by the said mechanism.

12. In a frame slotter, the combination of a bed, a pair of spaced horizontal guideways thereon, a tool supporting head spanning the bed and slidably mounted on the guideways, a horizontal cross rail on the head over the bed, a tool saddle slidably mounted on the cross rail, a cutter bar mounted for reciprocation on the saddle, means for reciprocating the bar, mechanism for feeding the head along its guideways, mechanism for feeding the saddle along the cross rail, a motor on the head for operating both said mechanisms, control means operative on the motor for intermittently feeding the head and saddle in a constant relative ratio respectively and in timed relation to the bar reciprocation, and change speed gearing supplemental to one of the said mechanisms for varying the feed imparted by the said mechanism.

In testimony whereof, we hereto affix our signatures.

WILLIAM J. HAGMAN.
EDWARD H. WRAY.