July 1, 1941. H. J. CALDWELL 2,247,479

HONING MACHINE

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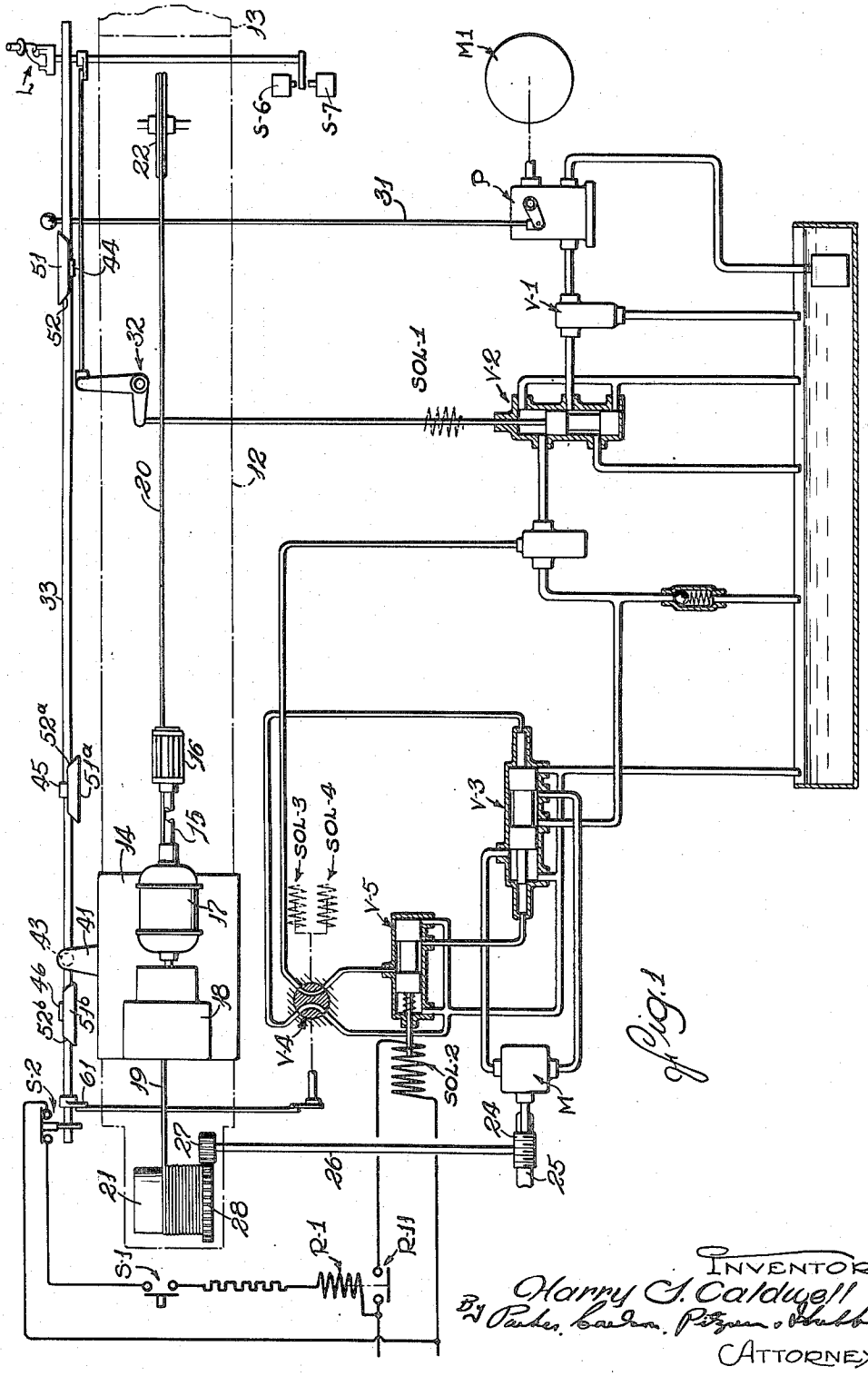

Fig. 1

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Fig. 2

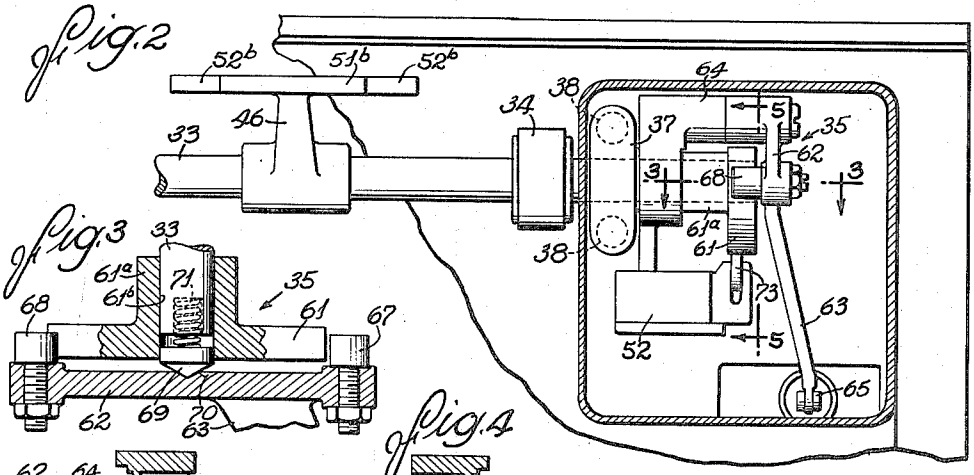


Fig. 3

Fig. 4

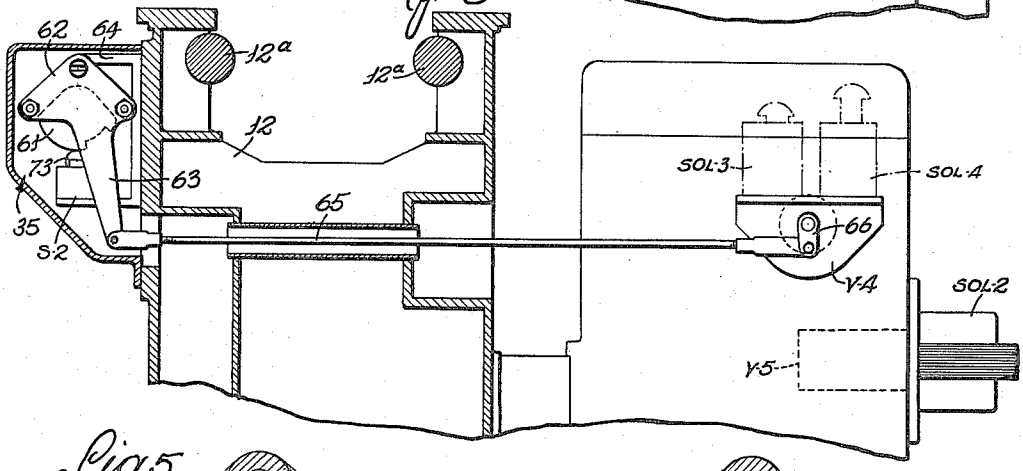


Fig. 5

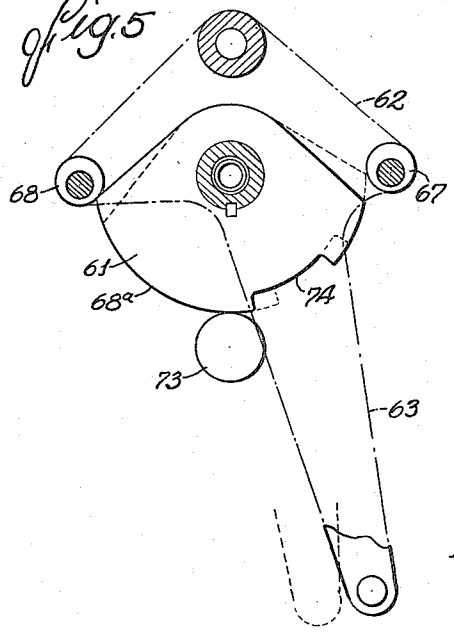
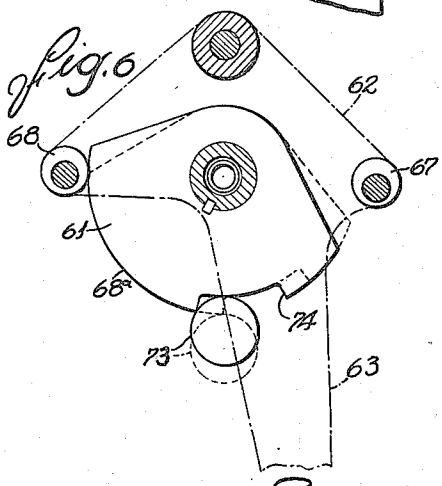


Fig. 6



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HONING MACHINE

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Fig. 7

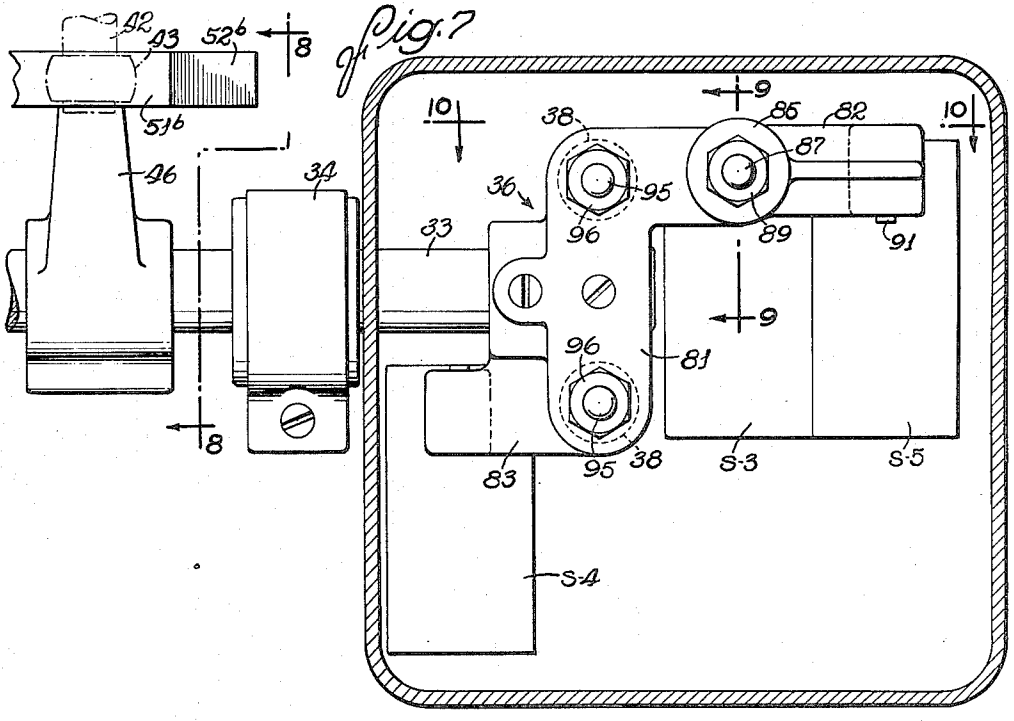

Fig. 9

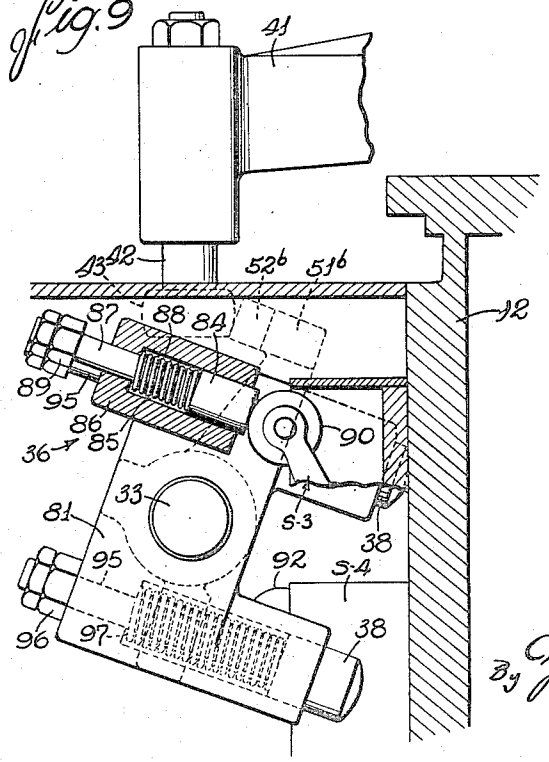

Fig. 8

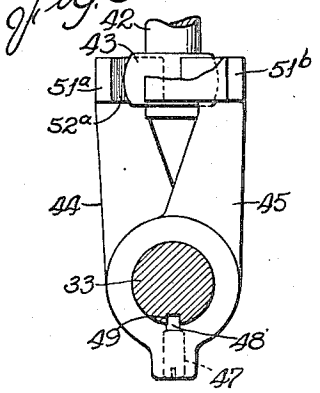

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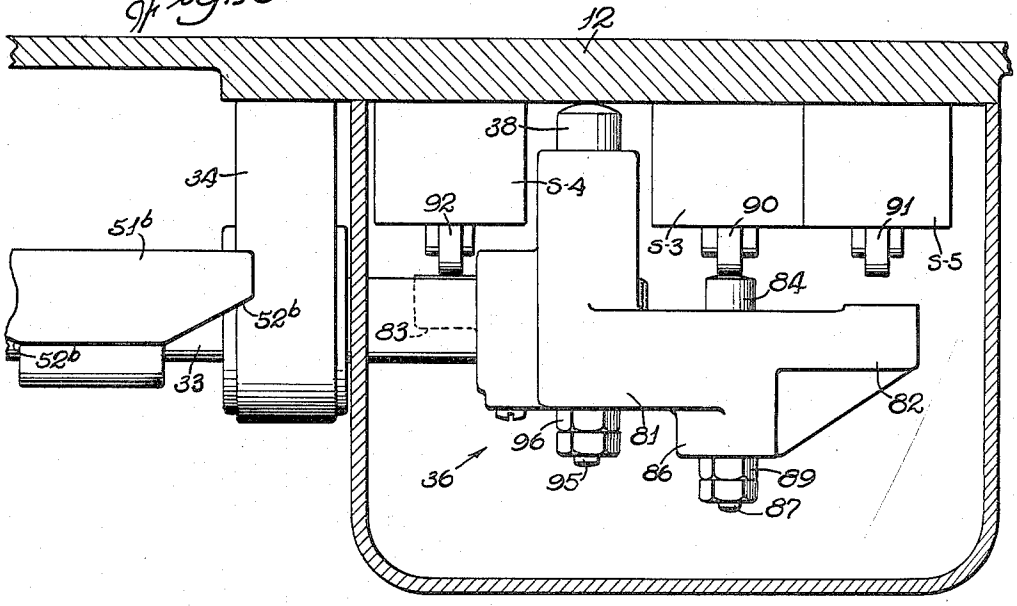
Fig. 10



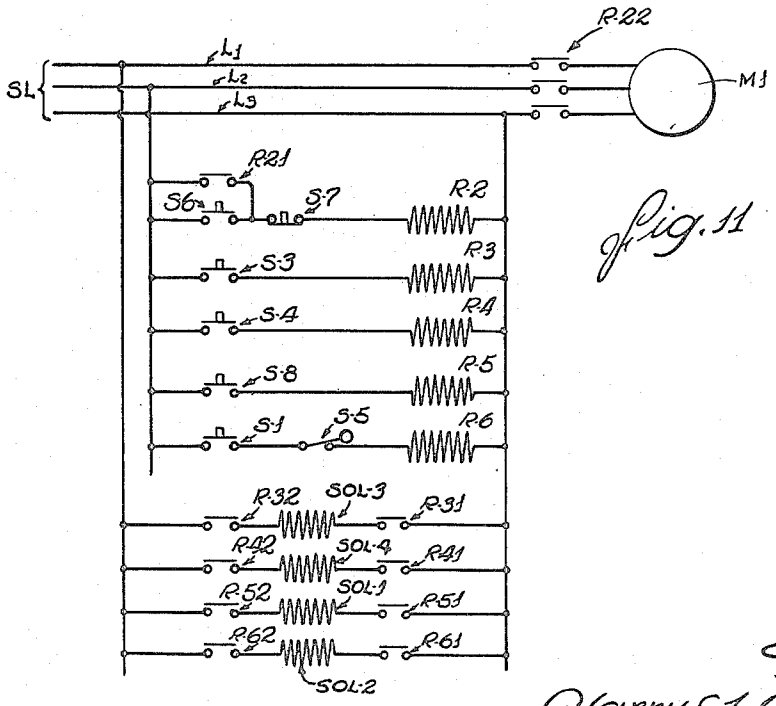


Fig. 11

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2,247,479

HONING MACHINE

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Application April 13, 1939, Serial No. 267,572

18 Claims. (Cl. 51—34)

The invention relates to machines for honing cylindrical surfaces, and more particularly to honing machines of the horizontal type.

Horizontal honing machines are used extensively in dressing the surfaces of work pieces which, because of their relatively great length, are most conveniently operated on while held in a horizontal position. In this operation, relative rotation is imparted to the tool or hone and the work, while the supports which carry the tool and work are simultaneously relatively reciprocated to traverse the tool repeatedly from one end of the work piece to the other. In practice, only one of the supports is reciprocated, usually the tool support, and to this end the reciprocable support is mounted on a horizontal guideway for movement toward and from the other support.

Movement of the reciprocatory support is effected by power actuated means of any suitable character. The power actuated means frequently comprises a motor which may be of the reversible type or which may be arranged to drive the support through a reversible drive mechanism. In either case it is essential that the reversal take place at exactly the right point in the reciprocatory cycle of the support in order to insure uniform action of the tool over the entire surface of the work piece and yet avoid overrunning the ends of the same.

One object of the present invention is to provide improved control mechanism for controlling the reciprocation of the movable support of a machine of the above general character.

Another object is to provide mechanical control mechanism for horizontal honing machines which, by reason of the novel and improved construction of the moving parts to provide low inertia or momentum and thereby minimize the shock or jar incident to the movement of the same, is quiet in action, reliable and accurate in operation, readily adjustable to adapt the machine for operating on work pieces of different length, and capable of standing up under the hard usage to which such mechanism is necessarily subjected.

Still another object is to provide improved mechanical reciprocation control mechanism which is universally adaptable for actuating either electrical or hydraulic control devices.

A further object is to provide an improved reciprocation control mechanism for horizontal honing machines particularly adapted to facilitate the disassociation of the tool and work upon completion of the honing operation.

Other objects and advantages of the invention will become apparent from the following detailed description of the preferred embodiments illustrated in the accompanying drawings, in which:

Figure 1 is a plan view of a hydraulically operated horizontal honing machine embodying the features of the invention, the hydraulic equipment being shown diagrammatically.

Fig. 2 is a fragmentary view of a preferred form of the control mechanism showing one end of the control rod equipped with cam means for operating a hydraulic valve.

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2 showing details of the control rod cam and the valve operator detent means.

Fig. 4 is a transverse sectional view through the machine illustrated in Fig. 1 showing the relationship of the control rod, the cam means and the control valve operated thereby.

Figs. 5 and 6 are sectional views taken along the line 5—5 of Fig. 2 showing the cam in different operating positions.

Fig. 7 is a view similar to Fig. 2 but showing the control rod equipped for operating electrical switches.

Fig. 8 is a vertical sectional view through the control rod taken along the line 8—8 of Fig. 7 showing the arrangement of the control rod actuating mechanism.

Fig. 9 is a sectional view taken along the line 9—9 of Fig. 7 showing details of the switch operating mechanism and the control rod and restoring means.

Fig. 10 is a horizontal sectional view taken along the line 10—10 of Fig. 7 showing details of the switch operating mechanism.

Fig. 11 is a schematic diagram of the electrical control circuit of a machine embodying the control mechanism illustrated in Figs. 7 and 10.

For purposes of illustration, the invention has been shown and described herein as applied to a honing machine in which the tool support is reciprocated relative to a stationarily supported work piece by hydraulically operated driving means, but it is to be understood that the invention is readily applicable to other types of honing machines. It is also to be understood that various modifications and adaptations in the form, construction and arrangement of parts comprising the improved reciprocation control mechanism may be made by those skilled in the art without departing from the spirit and scope

of the invention as expressed in the appended claims.

Referring to Fig. 1 of the drawings, the machine selected to illustrate the invention comprises an elongated base 12 having an extension 13 at one end constituting a work support. The base 12 is equipped with spaced parallel guide bars 12ª (Fig. 4) which provide a guideway for a reciprocatory head or tool support 14 (Fig. 1) on which is journalled a forwardly projecting spindle 15 adapted to carry a conventional honing tool 16. A driving motor 17 mounted on the tool support is arranged to rotate the spindle through suitable gearing enclosed in a gear housing 18.

In performing a honing operation, the work piece is secured to the work support 13 and the honing tool 16 is traversed over the surface to be honed by movement of the tool support toward and from the work piece. Such movements are imparted to the tool support by power operated means herein shown as comprising a pair of flexible tension members or cables 19 and 20 anchored respectively to opposite ends of the support and wound in different directions around a grooved cable drum 21 rotatably supported at one end of the base 12. One of the cables, in this case the cable 19, is led directly to the cable drum while the other cable 20 is carried over a sheave 22 journaled at the opposite end of the base 12 so that the cables act alternately to advance and retract the tool support, that is, to draw it forwardly and back on the guideway when the drum 21 is rotated first in one direction and then in the other direction.

In the exemplary machine, rotation of the cable drum 21 is effected by a reversible hydraulic motor M. The motor as herein shown is of the rotary type, and is arranged to actuate the drum through the medium of a driving mechanism including a worm 24 and cooperating worm wheel 25, the latter being fast on a cross shaft 26 to which is keyed a pinion 27 meshing with a gear 28 rigid with the drum. Pressure fluid is supplied to the motor M by a variable delivery pump P through a suitable hydraulic circuit in which is interposed a pressure controlling valve V—1, a stop valve V—2, and a reversing valve V—3, all of well known construction. An electric motor M—1 is arranged to drive the pump P at substantially constant speed, the output of pressure fluid to the hydraulic circuit being varied as required to regulate the speed of the motor M and thus the rate of movement of the head 14 by manipulation of a manually operable member 31. Starting and stopping of the motor M is controlled by the stop valve V—2 which may be operated manually as by a hand lever L, mechanically coupled with the valve through a suitable linkage 32, or by a solenoid SOL—1 arranged to shift the valve plunger.

The direction of rotation of the motor M and consequently the direction of movement of the tool support 14 is controlled by the reversing valve V—3. The reversing valve, as herein shown, is operated under control of a pilot valve V—4 arranged to control the flow of pressure fluid to operating cylinders formed in opposite ends of the reversing valve casing for the purpose of shifting the valve plunger to either of its two positions. An auxiliary valve V—5 interposed between the pilot valve and the reversing valve is effective when operated to prevent operation of the latter when the pilot valve is reversed at one end of the stroke of the reciprocatory support, thus causing the support to move beyond its normal working range to fully retracted position. In this way, the tool is disassociated from the work at the end of the honing operation.

As herein shown, the auxiliary valve V—5 is spring-biased to a normal open position and is adapted to be operated by a solenoid SOL—2. The energizing circuit for the solenoid is controlled by a relay R—1 through the medium of a switch R—11 closed when the relay is energized. Relay R—1, in turn, is connected in a circuit adapted to be completed by closure of a switch S—1 which may be actuated manually or in any other suitable manner. A normally closed switch S—2 in the relay circuit is arranged to be operated automatically, as will be described hereinafter, to deenergize the relay R—1 and solenoid S—2, and thus prepare the machine for the next operating cycle when the tool support has been fully retracted.

In the normal operation of the machine, the reversal of the direction of movement of the tool support at alternate ends of its working stroke is effected by shifting the pilot valve V—4 between its alternate active positions. The operation of this valve at the proper point in the reciprocatory cycle of the support is the function of the control mechanism of the present invention. The operation may be effected through a direct mechanical connection between the control mechanism and the valve, or indirectly through the medium of solenoids SOL—3 and SOL—4 arranged to be energized selectively under control of the mechanism.

For either direct or indirect control of the pilot valve, the control mechanism includes essentially an elongated control rod 33 extending substantially parallel to the reciprocatory path of the tool support 14. In the preferred forms illustrated in Figs. 2 and 7 of the drawings, the control rod is rotatably supported for rocking motion in bearings formed in brackets 34 projecting laterally from the sides of the base 12 adjacent the top of the base. One end of the control rod is equipped with appropriate mechanism operative in rocking movements imparted thereto to actuate the pilot valve V—4 directly through suitable mechanical linkage or indirectly through the medium of switches arranged to control the solenoids SOL—3 and SOL—4. A preferred form of the mechanism for operating the pilot valve directly, indicated generally by the reference character 35, is shown in Figs. 2–6. Suitable mechanism 36 for indirect operation of the pilot valve is shown in Figs. 7–10.

Suitable means is also provided for yieldably holding the control rod in a neutral position and for restoring it to such position after each operation. As herein shown, this means comprises an elongated cross-member 37 (Fig. 2) extending transversely of the control rod and rigidly secured thereto in any suitable manner. Sockets formed at opposite ends of the member seat spring-pressed plungers 38 which bear against the side of the machine frame and thus yieldably urge the rod to neutral position.

The control rod 33 is arranged to perform its controlling functions upon being rocked through a relatively small angle against the action of the spring-pressed plungers 38, thus requiring the expenditure of relatively little power for this purpose and effectually eliminating the shock and jar inherently accompanying axial shifting of a relatively long and heavy rod. Rocking of the control rod is effected in the present instance by the

tool support as an incident to its movement along the guideway. For this purpose there is secured to the reciprocatory head 14 a horizontal bracket 41 projecting laterally over the control rod 33 (Figs. 1 and 9). A vertical stud 42 set in the end of the bracket carries on its lower end a cam roller 43 adapted to coact with cam surfaces formed on radially projecting actuating members or arms 44, 45 and 46 rigidly secured to the control rod.

As will be seen by reference to Fig. 1, the actuating arms 44 and 45 are spaced apart a substantial distance longitudinally of the rod. These arms define the limits of the working stroke of the tool, that is, the range of travel of the tool when operating upon a work piece. In order to provide for variation of the working stroke to accommodate work pieces of different length, both actuating arms are preferably adjustably secured to the control rod as by set screws 47 (Fig. 8) each of which is preferably formed with a reduced end portion 48 engaging in a groove 49 extending longitudinally of the control rod. One such groove is provided for each actuating arm and these are so spaced that the arms are invariably held in the correct position relative to the cam roller 43 carried by the head.

The third actuating arm 46 is located rearwardly of the arm 45 and in the present instance serves to define the extreme limit of movement of the tool support toward retracted position. This arm is similar in construction to the arms 44 and 45 hereinbefore described and if desired may be similarly adjustably secured to the control rod.

Referring more particularly to Figs. 1 and 2, the control rod actuating arms terminate at their upper ends in elongated generally horizontal cross members 51, 51a and 51b. The opposite ends of the cross-members are beveled as at 52, 52a and 52b to form inclined cam surfaces for engagement by the cam roller 43. The cam surfaces of the actuating arms 44 and 45 are faced in opposed directions as will be seen by reference to Fig. 1, so that the control rod will be rocked in opposite directions upon engagement of the respective cam surfaces by the roller 43. In other words, upon the engagement of the cam surface 52a the control rod is rocked in a clockwise direction as viewed in Figs. 5, 6, 8 and 9, while engagement of the roller with the cam surface 52 rocks the control rod in a counterclockwise direction. The amplitude of this rocking movement depends upon the form of the cam surface and the relative position of the actuating arms and is preferably relatively small.

The cross-member of the actuating arm 46 is formed with cam surfaces 52b similar to the cams 52 and 52a and faced in the same direction as the latter cam surfaces. It will be observed however (Fig. 1) that the cross-member 51b of the arm 46 is displaced angularly with respect to the cross-member of the arm 45 so that roller 43, upon engaging the cam 52b, rocks the control rod to a limit position beyond the intermediate position to which it was rocked by engagement with the cam 52a.

It will be seen from the foregoing that the control rod 33 is adapted to be rocked from its neutral position to either of two limit positions or to an intermediate position. The movement to one limit position is effected by the approach of the tool head to the forward end of its working stroke while movement to the other limit position occurs as the tool head approaches its fully retracted position. The tool head on approaching the rearward end of its working stroke rocks the control rod to its intermediate position. The mechanisms by which these rocking movements of the control rod are utilized to control the reciprocation of the tool support will now be described.

When the control rod is to be utilized to operate the pilot valve V—4 mechanically, the operating mechanism 35 provided for this purpose comprises a generally segmental cam plate 61 (Figs. 2–6) having an integrally formed collar 61a through which extends a bore 61b for the reception of the control rod. The cam is keyed or otherwise nonrotatably secured to the control rod. A valve actuating member 62 having a generally triangular body portion and an integrally formed elongated arm 63 is pivoted on a stationary bracket 64 secured to the side of the machine frame. A rigid link 65 connects the free end of the arm 63 with a crank 66 fast on the movable member of the pilot valve V—4 whereby movement of the actuating member on its pivot is effective to operate the valve.

The pivotal axis of the actuating member is substantially parallel to the axis of the control rod and spaced above the same so that the triangular body portion of the member extends over the face of the cam 61. Mounted on the body portion on opposite sides of the cam are a pair of cam followers 67 and 68, preferably in the the form of rollers, adapted to be engaged alternately by the active areas of the side edges of the cam as the control rod is rocked about its axis. In this way, the actuating member is rocked to alternate valve operating positions.

The shape of the cam 61 and the spacing of the followers 67 and 68 provides a degree of lost motion sufficient to enable the member 62 to remain in either operated position after the control rod and cam return to neutral position. This condition is illustrated in Fig. 5 in which the cam is shown in neutral position while the member 62 is in the position to which it was previously operated by movement of the cam to the position shown in dotted line. When the control rod is subsequently rocked in a clockwise direction, as viewed in this figure, the active edge of the cam engages the follower 68 and positively rocks the member through an angle such as to shift the arm 63 to the dotted line position shown. This position is attained just as the control rod reaches its intermediate position, and upon further movement of the control rod toward its limit position, the roller 68 rides over the arcuate edge 68a of the cam, thus serving to hold the member in operating position but imparting no further movement thereto. Upon movement of the control rod toward its other limit position, the actuating member remains stationary until the opposite active area of the cam engages the follower 67 and rocks the member back to the position shown in Fig. 5.

Since the pilot valve must be maintained in operated position throughout the entire working stroke of the tool head, latch means is provided for holding the member 62 in operated position until it is positively shifted by the cam 61, as above explained. To this end, a spring-pressed detent 69 (Fig. 3) is arranged to cooperate with suitable depressions 70 formed in the inner face of the member 62. As herein shown, the detent 69 comprises a relatively short, generally cylindrical plunger slidably supported coaxially with the control rod 33 in a recess formed by one

end of the bore 61b in the cam 61. A coiled compression spring 71 interposed between the end of the control rod and the inner end of the detent plunger urges the latter into engagement with the member 62.

As explained hereinbefore, the control rod is rocked beyond its intermediate position when the tool head is fully retracted and is adapted under such conditions to actuate the auxiliary valve releasing switch S—2 and thus prepare the machine for the next operating cycle. In the particular organization shown, switch S—2 is of the well known spring actuated type which tends to move to an open position. Accordingly, the arcuate edge 68a of the cam 61 is arranged to bear against a switch operating member 73 so as to hold the switch S—2 closed while the control rod is at any point between its forward limit position and its intermediate position and thereby place the relay R—1 under control of the switch S—1 during this stage of an operating cycle. A notch 74 cut in the edge of the cam is located so as to register with the switch member 73 when the control rod is moved beyond the intermediate position, as shown in Fig. 6. When this occurs, the switch member enters the notch, thereby opening the switch to deenergize the auxiliary valve operating solenoid SOL—2.

Referring now to Fig. 1, it will be observed that the opening of the switch S—2 in the manner above described interrupts the circuit of the relay R—1, assuming that switch S—1 has been held closed as will generally be the case. Relay R—1 opens switch R—11 to deenergize the solenoid SOL—2. The auxiliary valve V—5 thereupon returns to normal position and opens the hydraulic circuit between the pilot valve V—4 and reversing valve V—3 so that the latter is immediately shifted to reverse position. The machine may now be stopped with the tool withdrawn from the work by operating the stop valve V—2 in the usual way. Since valve V—3 has been shifted into a position corresponding with the position of the pilot valve, the machine is in condition for the next operating cycle as the tool support will be moved forwardly when the pressure fluid is again supplied to the motor M.

When the rotatable control rod 33 is to be utilized for operating the pilot valve indirectly through the medium of solenoids SOL—3 and SOL—4, the operating mechanism 35 is replaced by the mechanism 36 shown in Figs. 7, 9 and 10 of the drawings. This mechanism comprises an operating member in the form of an elongated, generally rectangular block 81 keyed or otherwise rigidly secured to the control rod. Projecting from opposite ends of the block substantially parallel to the axis of the control rod are a pair of switch operating fingers 82 and 83 adapted to cooperate respectively with reversing switches S—3 and S—4 which control the reversal of the tool head at opposite ends of its working stroke as will appear presently.

To provide control of the auxiliary valve V—5, the operating finger 82 is extended to cooperate with a second switch S—5. This is a normally closed switch which performs the same function as the switch S—2 previously described. The relative position of the switch S—5 and the operating finger is such that the switch is actuated upon rotation of the control rod beyond its intermediate position incident to the movement of the head to fully retracted position. Switch S—3, on the other hand, must be operated to closed position as the tool head reaches the rearward end of its working stroke at which time the control rod is rocked to intermediate position. Accordingly, the finger 82 is provided with a yieldable switch operator in the form of a plunger 84 (Fig. 9) slidably supported in a cylindrical recess 85 formed in a shoulder or boss 86 on the finger and extending generally transversely of the axis of the control rod. Projecting from the inner end of the plunger 84 is an extension 87 of reduced diameter which slides in an aperture at the rear of the recess 85 and serves to guide the plunger in its movements of the recess. A coiled compression spring 88 encircling the extension 87 and bearing respectively against the end wall of the recess and the inner end of the plunger urges the latter to a forward position determined by the setting of a stop nut 89 threaded on the projecting end of the extension 87. The normal position of the plunger 84 and thus the point at which it engages the operating member 90 of the switch S—3 may therefore be adjusted as required by turning the nut 89.

Upon movement of the control rod and cam 61 to intermediate position, the plunger 84 engages the switch member 90 and closes the switch S—3. Upon further movement of the control rod toward its limit position, the switch is held closed but the plunger is forced into its recess against the action of the spring 88 so that no damage is done to the switch structure. As the control rod approaches the rear limit position, the finger 82 engages operating member 91 of the switch S—5 and opens that switch. When the control rod is rocked to its alternate limit position upon movement of the tool support to the forward end of its working stroke, the finger 83 engages the switch member 92 and closes the switch S—4.

The switches S—3, S—4 and S—5 are incorporated in a control circuit in a manner such that the momentary opening and closing of a switch is effective to initiate the control function of that switch. After such momentary actuation, the switch is permitted to return to its normal position by restoration of the control rod to neutral position. Such restoration of the control rod is effected by means of spring-pressed plungers 38 as explained hereinbefore. In the modified operating mechanism, the plungers 38 are disposed in sockets formed in the block 81 on opposite sides of the control rod. As shown in Fig. 9, each plunger 38 is formed with a reduced inner end portion 95 slidably in an aperture in the block to guide the plunger in its movements in the recess. Stop nuts 96 threaded on the projecting end portions limit the forward movement of the plungers under the influence of compression springs 97 which yieldably urge the plungers outwardly into engagement with the side of the machine frame 12. The point to which the plungers return the control rod may be readily adjusted by turning the adjusting nuts 96.

The manner in which the control switches, above described, are incorporated in the control circuit of a honing machine is shown diagrammatically in Fig. 11 of the drawings. In the operation of a machine so equipped, the pressure fluid pump motor M—1 is started by closure of a manually operable start switch S—6 which completes a circuit for energizing a relay R—2. The relay R—2 completes a holding circuit for itself by closing its associated switch R—21 and also closes a switch R—22 to connect the motor M—1 across the line conductors L—1, L—2 and

L—3 of the power supply line SL. The motor may be stopped at any time by opening a normally closed stop switch S—7 interposed in the relay holding circuit in series with the switch R—21.

It may be assumed that the stop valve V—2 is still closed after having been operated to closed position to terminate the previous machine cycle. With the valve closed, the pressure fluid delivered by the pump P which is driven by the motor M—1 will be returned to the sump and no movement of the tool head will take place at this time. The operation of the valve V—2 to terminate the machine cycle is effected by energization of the solenoid SOL—1. This solenoid is energized in response to the closure of a manually operable switch S—8 which completes an energizing circuit for a relay R—5. The relay R—5 closes the switches R—51 and R—52 to complete an energizing circuit for the solenoid.

When the tool head is to be reciprocated, the switch S—8 is opened, thereby deenergizing relay R—5 and solenoid SOL—1. The valve V—2 accordingly returns to its normal position and directs pressure fluid through reversing valve V—3 to the motor M which drives the tool head forwardly on its guideway. As the tool head moves from its retracted position it permits the control rod to move to neutral position, thus closing the switch S—5 and opening the switch S—3. The closure of the switch S—5 is ineffective at this time because switch S—1 will be in its normally open position. The opening of switch S—3 will result in the deenergization of relay R—3 which opens the circuit of the solenoid SOL—3. The pilot valve V—4, however, remains in its operated position and forward movement of the head continues.

When the tool head reaches the forward end of its working stroke, the cam roller 43 engages the cam 52 and rocks the control rod to its forward limit position in the manner hereinbefore explained. In this position, the finger 83 of the switch operating mechanism operates to close the switch S—4. Switch S—4 completes a circuit for a relay R—4 which energizes and through the medium of switches R—41 and R—42 completes an energizing circuit for the solenoid SOL—4. Solenoid SOL—4 operates the pilot valve V—4 to its reverse position, thereby operating the valve V—3 and reversing the direction of movement of the tool head. Return movement of the head continues until the control rod is rocked to its intermediate position by engagement of the cam roller 42 with the cam 52a as before explained. In the intermediate position of the control rod the switch operating plunger 84 closes switch S—3 which energizes relay R—3 and solenoid SOL—3 to reoperate the pilot valve.

Reciprocation of the tool head through its working stroke continues with reversal automatically effected at each end of its stroke by alternate closure of the switches S—3 and S—4 in the above manner. When the honing operation is finished and the tool is to be withdrawn from the work, switch S—1 is closed manually, thereby energizing the relay R—1. Relay R—1 in turn energizes solenoid SOL—2 which operates the auxiliary valve V—5 and thus prevents reversal of the valve V—3 when the control rod is rocked to intermediate position in response to the tool head reaching the rearward end of its working stroke. Accordingly, rearward movement of the head continues until the extreme limit of the withdrawal stroke is reached whereupon the switch S—5 is opened in the manner previously explained. Valve V—5 is accordingly returned to its normal position and valve V—3 is reversed to initiate movement of the tool head in the opposite direction. Before such movement takes place, however, the tool head may be stopped by closure of the valve V—2 either by manipulation of the control lever L or by actuation of the switch S—8. The tool head is brought to rest with the tool withdrawn from the work so that the work piece may be removed and a new one substituted in its place.

It will be apparent from the foregoing that the invention provides a novel and advantageous reciprocation controlling mechanism for honing machines. The mechanism is quiet in action, reliable in operation, readily adjustable to adapt the machine for operating on work pieces of different lengths and, by reason of its simple, rugged construction, is capable of functioning accurately for long periods under the hard usage to which such mechanisms are necessarily subjected. The major portion of the mechanism may be utilized for either direct or indirect control of the reversing valve mechanism of the machine. Moreover, the improved control mechanism embodies novel means for facilitating the disassociation of the tool and work upon completion of a honing operation together with means for insuring proper operation of the reciprocating means in the next operating cycle of the machine.

I claim as my invention:

1. The combination in a honing machine having work and tool supports and power actuated means for reciprocating one of said supports relative to the other support to traverse the tool from one end of the work to the other, of control mechanism for said power actuated means including a rotatable control rod extending substantially parallel to the reciprocatory path of said one support, means on said one support engageable with means on said rod for rocking the rod alternately into either of two angularly spaced positions as the support approaches respective opposite ends of its working stroke, reversing means actuated by said rod upon its operation to either of said positions to reverse the direction of movement of said one support, and auxiliary control means operable to render said reversing means when actuated ineffective to reverse the direction of movement of said one support as the support approaches one end of its working stroke whereby to effect movement of the support through an abnormally long stroke for disassociating the tool and work.

2. The combination in a honing machine having work and tool supports and pressure fluid actuated means for reciprocating one of said supports relative to the other support to traverse the tool from one end of the work to the other, of control mechanism for said pressure fluid actuated means including a rotatable control rod extending substantially parallel to the reciprocatory path of said one support, means on said one support engageable with means on said rod for rocking the rod alternately into either of two operated positions as the support approaches respective opposite ends of its working stroke, a control valve operated by said rod upon its actuation to either of said positions for reversing said pressure fluid actuated means to reverse the direction of movement of said one support, an auxiliary valve operable to render said control valve ineffective to reverse the direction of movement

of said one support at one end of the working stroke whereby to initiate an abnormally long stroke of the support to disassociate the tool and work, and means operated by said one support through the medium of the control rod at a predetermined point in said abnormal stroke for restoring said auxiliary valve to normal position.

3. The combination in a honing machine having work and tool supports and pressure fluid actuated means for reciprocating one of said supports relative to the other support to traverse the tool from one end of the work to the other, control mechanism for said pressure fluid actuated means including a rotatable control rod extending substantially parallel to the reciprocatory path of said one support, means on said one support engageable with means on said rod for rocking the rod alternately to either of two operated positions as the support approaches respective opposite ends of its working stroke, a control valve operated by said rod upon its actuation to either operated position for reversing said pressure fluid operated means to reverse the direction of movement of said one support, an auxiliary valve operable to render said control valve inoperative to effect said reversal whereby to initiate an abnormally long stroke of said one support for disassociating the tool from the work, a solenoid adapted to be energized to operate said auxiliary valve, a circuit for said solenoid including a normally open switch and a normally closed switch, said first switch acting when closed to complete the circuit for energizing said solenoid, and means operated by said control rod upon movement of said one support to a predetermined position beyond the range of its working stroke to open said normally closed switch and thereby deenergize said solenoid.

4. In a honing machine, the combination of a reciprocatory support, pressure fluid operated means for reciprocating said support, control mechanism for said pressure fluid operated means including a control valve operable to one position to effect movement of the support in one direction and to another position to effect movement of the support in the opposite direction, means for operating said valve to said two positions alternately comprising an elongated control rod extending substantially parallel to the path of movement of the support, spaced members projecting radially from said rod for engagement by said support to rock said rod alternately to two angularly spaced positions, a cam fast on said rod, an arm pivoted adjacent said rod and having a pair of followers engaging said cam, said cam being shaped to move said arm through a predetermined angle incident to the movement of said rod between said spaced positions, and a rigid link extending from said arm to said valve to operate the valve.

5. In a honing machine, the combination of a reciprocatory support, pressure fluid operated means for reciprocating said support, control mechanism for said pressure fluid operated means including a control valve operable to one position to effect movement of the support in one direction and to another position to effect movement of the support in the opposite direction, means for operating said valve between said positions comprising an elongated control rod extending substantially parallel to the path of movement of the support, spaced members projecting radially from said rod for engagement by said support to rock said rod into alternate active positions, a third member projecting radially from said rod for engagement by the support to rock the rod beyond one of said active positions, a cam fast on the rod, an arm pivoted adjacent the rod and having followers engaging said cam, said cam being shaped to move said arm only through a predetermined angle when the rod is rocked between said active positions or beyond such positions, and a rigid link extending from said arm to said valve to operate the valve.

6. In a honing machine, the combination of a reciprocatory support, pressure fluid operated means for reciprocating said support, control mechanism for said pressure fluid operated means including a control valve operable to one position to effect movement of the support in one direction and to another position to effect movement of the support in the opposite direction, means for operating said valve between said positions comprising an elongated control rod extending substantially parallel to the path of movement of the support, a cam on said rod, spaced members projecting radially from said rod for engagement by said support to rock said rod into alternate active positions, a third member projecting radially from said rod for engagement by the support to rock the rod beyond one of said active positions, a valve operating member having means coacting with said cam and movable by the cam only to a predetermined position to operate said valve when the shaft is rocked between said active positions or beyond the same, and an auxiliary control device operated by said cam when the shaft is rocked beyond said one active position.

7. In a honing machine, the combination of a reciprocatory support, pressure fluid operated means for reciprocating said support, control mechanism for said pressure fluid operated means including a control valve operable to one position to effect movement of the support in one direction and to another position to effect movement of the support in the opposite direction, means for operating said valve between said positions comprising an elongated control rod extending substantially parallel to the path of movement of the support, spaced members projecting radially from said rod for engagement by said support to rock said rod into alternate active positions, a cam fast on one end of said rod, a valve operating member pivoted adjacent said rod and extending over the face of said cam, followers on said member engageable by said cam to rock the member to one or the other of its valve operating positions, and detent means carried by said cam for holding said member in operated position independent of the engagement of the followers by the cam.

8. A control mechanism for honing machines comprising, in combination, a rotatable control rod, a cam fast on one end of said rod, a control member pivoted adjacent said control rod and extending over said cam, means on said member engageable by said cam upon rotation of the control rod to operate the member to one or the other of two active positions, means for restoring the control rod and cam to a neutral position, and means for holding said member in operated position upon the return of said cam to neutral position including a detent slidably mounted in the face of said cam coaxial with said control rod, and spring means tending to force said detent into engagement with said member.

9. The combination in a honing machine hav-

ing a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support comprising, a rotatable control rod extending substantially parallel to the reciprocatory path of the support, means on said control rod engageable by the support in its reciprocation through a predetermined range of travel for rocking the control rod alternately to two active positions, a control device operated under control of said rod in said active positions for reversing the direction of movement of the support, means for temporarily rendering said device ineffective to reverse the direction of movement of the support and thereby initiate movement of the support beyond said predetermined range of travel, means on the control rod engageable by the support incident to said last mentioned movement for rocking the control rod to a third active position, and a control device actuated by the control rod in said third active position for again rendering said first mentioned control device effective to reverse the direction of movement of the support.

10. The combination in a honing machine having a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support including a control rod extending generally parallel to the reciprocatory path of the support, means supporting said control rod for rotation about its longitudinal axis, means on the control rod engageable by the support in its reciprocation for rocking the control rod into alternate active positions, electrically operated means for reversing the direction of movement of the support, and switches arranged to be actuated by said control rod in its respective active positions and effective to control said electrically operated means.

11. The combination in a honing machine having a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support including a control rod extending generally parallel to the reciprocatory path of the support, means supporting said control rod for rotation about its longitudinal axis, means on the control rod engageable by the support in its reciprocation for rocking the control rod into alternate active positions, a valve operable to either of two positions to reverse the direction of movement of the support, a pair of solenoids each adapted when energized to operate said valve to one of its positions, a first switch arranged to be actuated by the control rod in one active position for energizing one of said solenoids, and a second switch arranged to be actuated by the control rod in the other active position for energizing the other of said solenoids.

12. The combination in a honing machine having a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support comprising, a rotatable control rod extending substantially parallel to the reciprocatory path of the support, means on said control rod engageable by the support in its reciprocation through a predetermined range of travel for rocking the control rod alternately to two active positions, means on said control rod engageable by said support incident to its movement beyond said predetermined range of travel for rocking the control rod to a third active position, and separate control devices actuated by the rod in each of said active positions.

13. The combination in a honing machine having a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support comprising, a rotatable control rod extending substantially parallel to the reciprocatory path of the support, means on said control rod engageable by the support in its reciprocation through a predetermined range of travel for rocking the control rod alternately to two active positions, switches adapted to be actuated by the control rod in the first and second active positions respectively to reverse the direction of movement of the reciprocatory support, means for rendering one of said switches temporarily ineffective to reverse the direction of movement of the support and thereby cause the support to move beyond said predetermined range of travel, means on said control rod engageable by the support incident to said last mentioned movement for rocking the control rod to a third active position, and a switch actuated by the rod in said third active position for reversing the direction of movement of the support.

14. The combination in a honing machine having a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support comprising, a rotatably supported control rod extending substantially parallel to the reciprocatory path of the support, means on the support cooperating with means on the control rod for rocking the rod to either of two limit positions or to an intermediate position, a plurality of electrical switches for controlling the movements of the support, actuating mechanism carried by said control rod including a rigid member operable upon movement of the rod to one limit position for operating one of said switches, a second rigid member operable upon movement of the rod to the other of said limit positions for operating another of said switches, and a yieldable member operable upon movement of the control rod to said intermediate position for operating a third one of said switches, said last mentioned member yielding to prevent damage to the switch upon movement of the control rod beyond the intermediate position to one of said limit positions.

15. The combination in a honing machine having a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support including a control rod extending generally parallel to the reciprocatory path of the support, means supporting said rod for rocking motion about its longitudinal axis, means yieldably urging the control rod to a neutral position, cam means on the control rod engageable by a member on the support in approaching one end of its stroke for momentarily rocking the control rod into one active position, other cam means on the control rod engageable by said member as the support approaches the other end of its stroke for momentarily rocking the control rod into an alternate active position, means actuated by the control rod incident to its movement into either active position for reversing the direction of movement of the support, and means for maintaining the effectiveness of said reversing means after the control rod is returned to neutral position.

16. The combination in a honing machine having a power driven reciprocatory support, of control mechanism for controlling the reciprocation of the support including a control rod extending generally parallel to the reciprocatory path of the support, means supporting said control rod for rocking motion about its longitudinal axis, means on the control rod engageable by a member on the support in the reciprocation of the support

for rocking the control rod into alternate active positions, a control device operable in response to movement of the control rod into either active position to reverse the direction of movement of the support, means for temporarily rendering said device inactive to reverse the direction of movement of the support when the control rod is rocked into one of its active positions, said support moving beyond its normal range of travel, and means actuated by the control rod upon movement of the support to a predetermined position for disabling said last means to again render said device effective to reverse the direction of movement of the support.

17. A control mechanism for honing machines having a reciprocatory support and power actuated means for reciprocating the support, said control mechanism comprising, in combination, an elongated control rod supported to rock about its longitudinal axis, means yieldably holding said rod in a neutral position, means for momentarily rocking said rod in either direction from said neutral position, a cam on said rod, a control member movable by said cam incident to the rocking of the control rod in either direction, detent means for holding said member in either operated position upon the return of the control rod to neutral position, and means operated by said member for controlling the power actuated support reciprocating means.

18. A control mechanism for a honing machine having a reciprocatory support and hydraulically actuated means for reciprocating the support, said control mechanism comprising, in combination, a valve for controlling the hydraulically actuated support reciprocating means, a control rod supported for rocking movement, means yieldably holding said rod in a neutral position, means for momentarily rocking said rod in either direction from said neutral position, a cam on said rod, a control member movable by said cam into either of two positions incident to the rocking of said control rod, detent means for holding said member in either active position upon the return of the control rod to neutral position, and means providing a mechanical connection between said member and said valve.

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