Sept. 20, 1932. A. M. JOHNSON 1,877,881

HONING MACHINE

Filed June 2, 1928 5 Sheets-Sheet 1

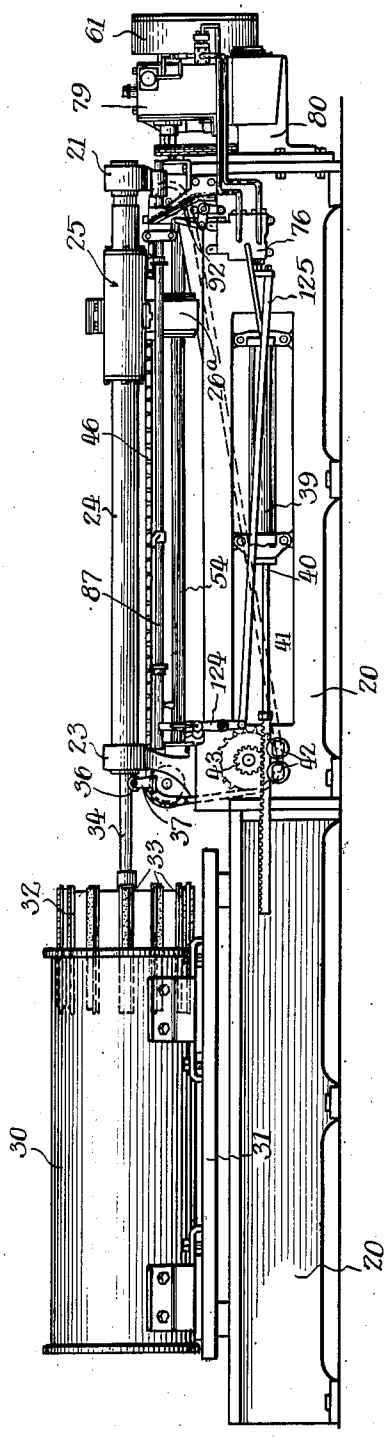

Fig. 1.

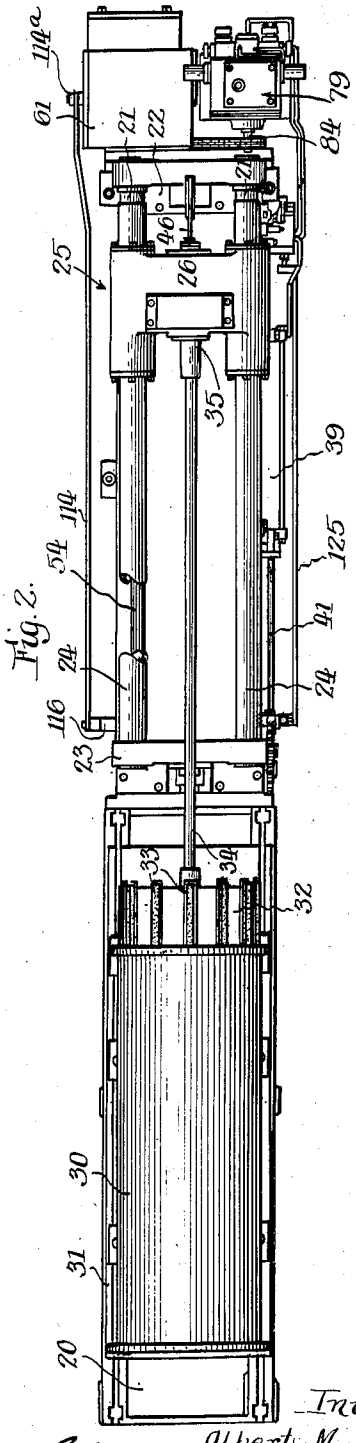

Fig. 2.

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HONING MACHINE

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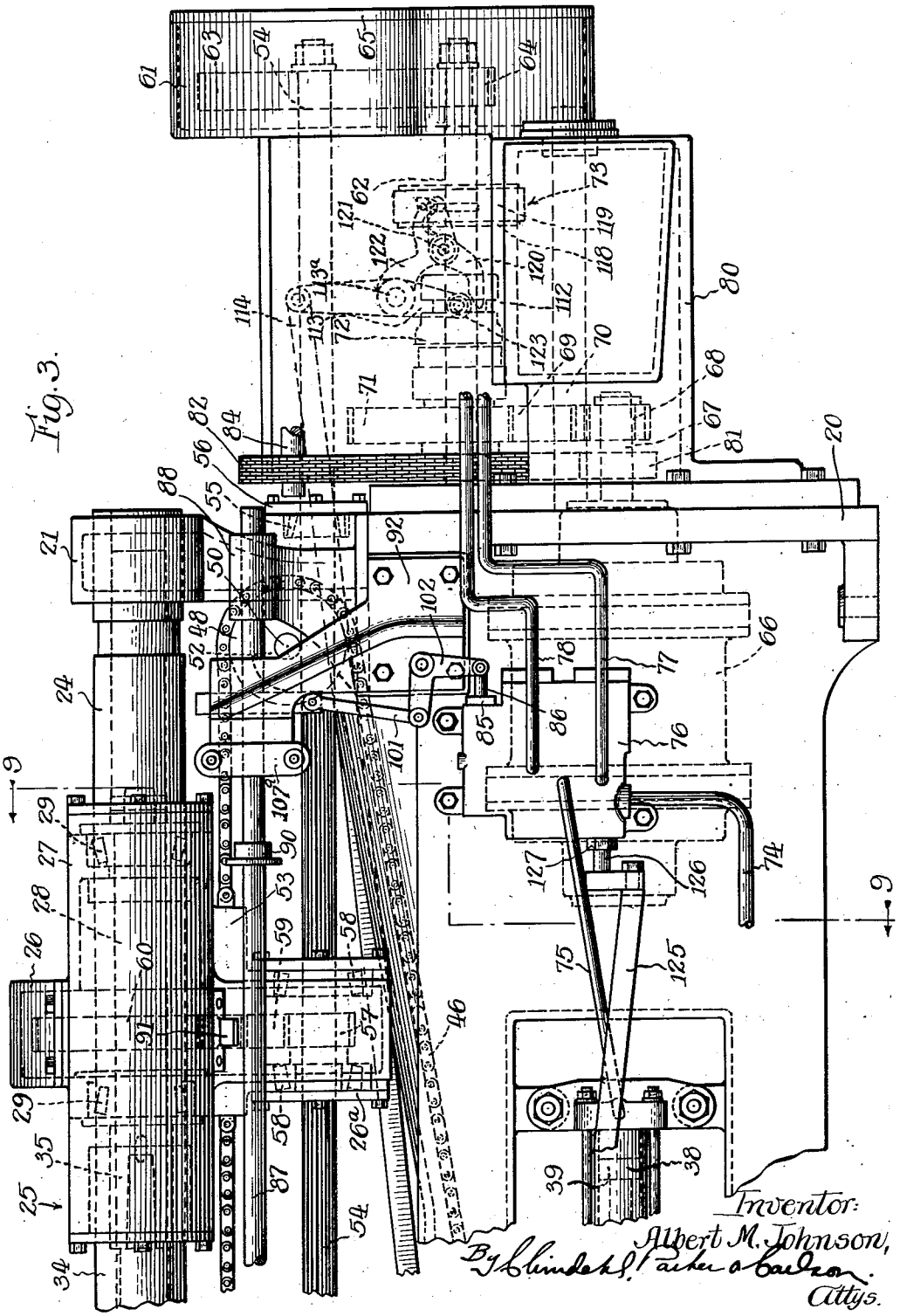
Fig. 3.



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HONING MACHINE

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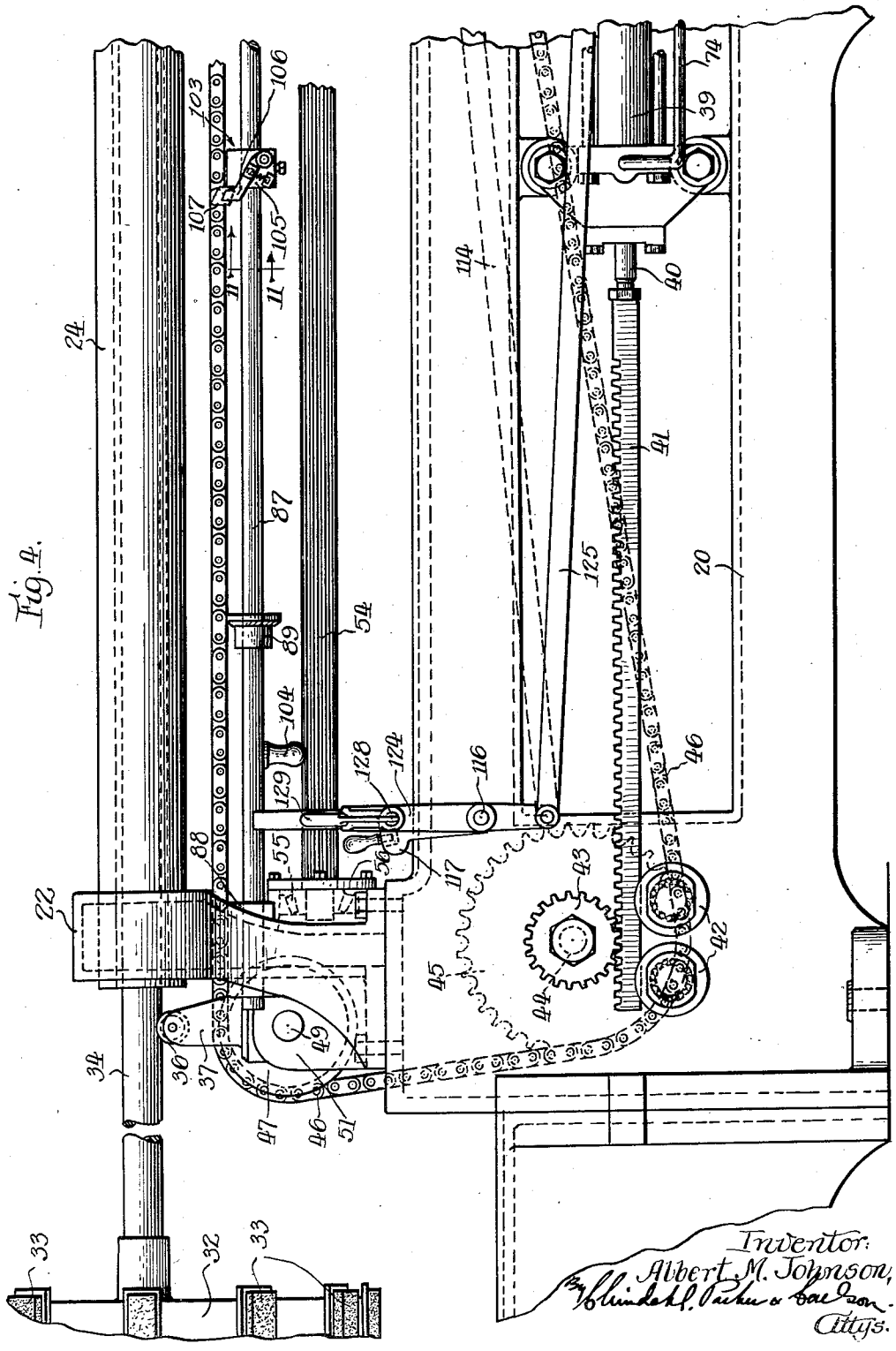

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HONING MACHINE

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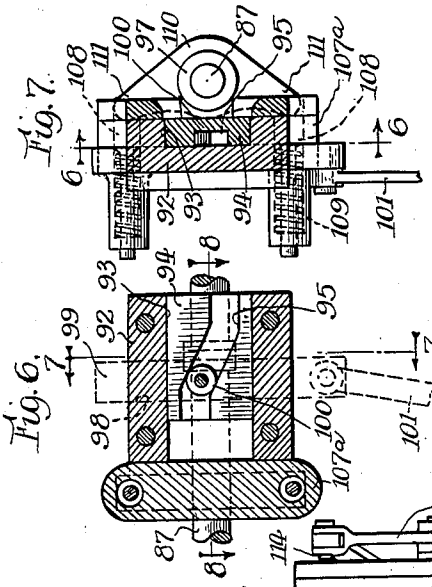

Fig. 7.

Fig. 6.

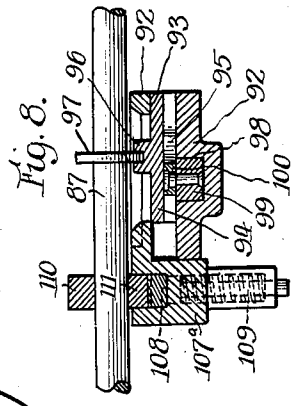

Fig. 8.

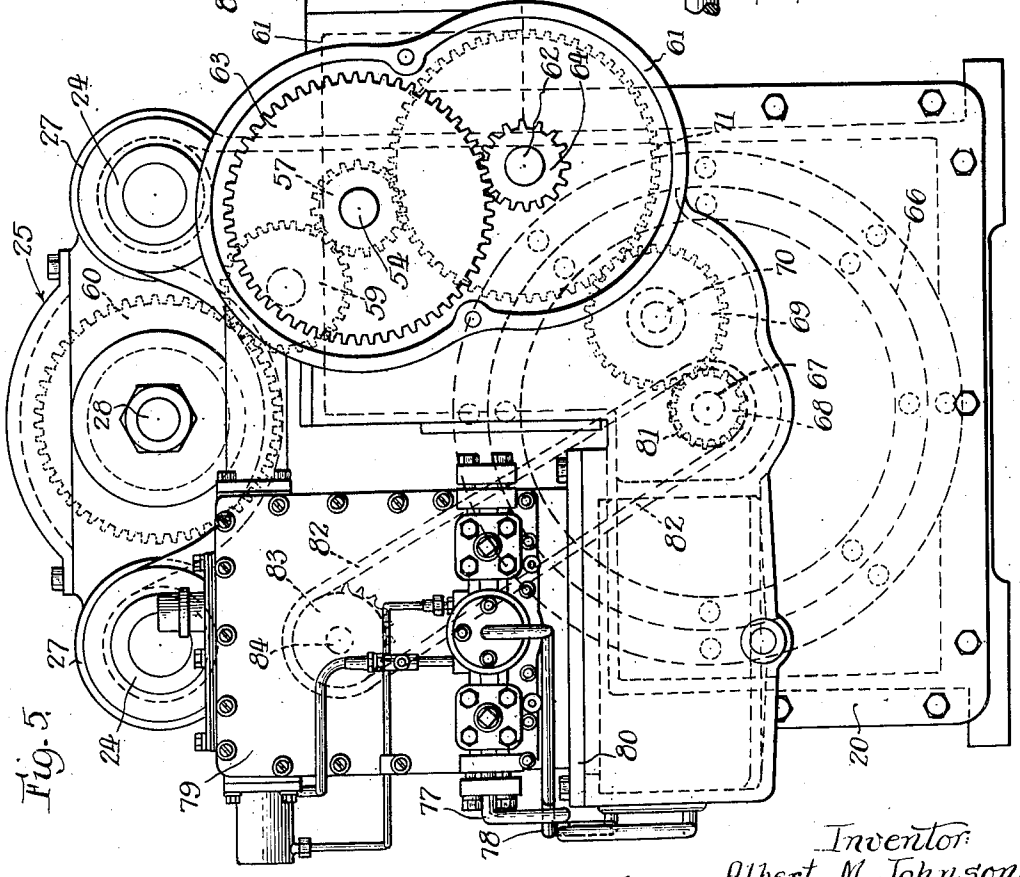

Fig. 5.

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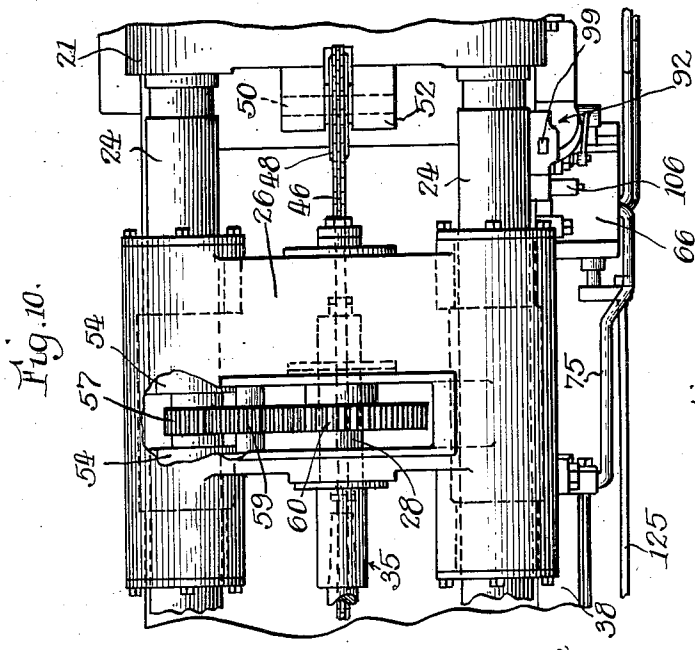

Fig. 10.

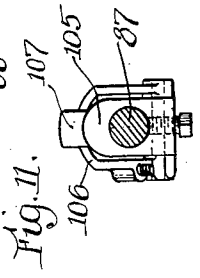

Fig. 11.

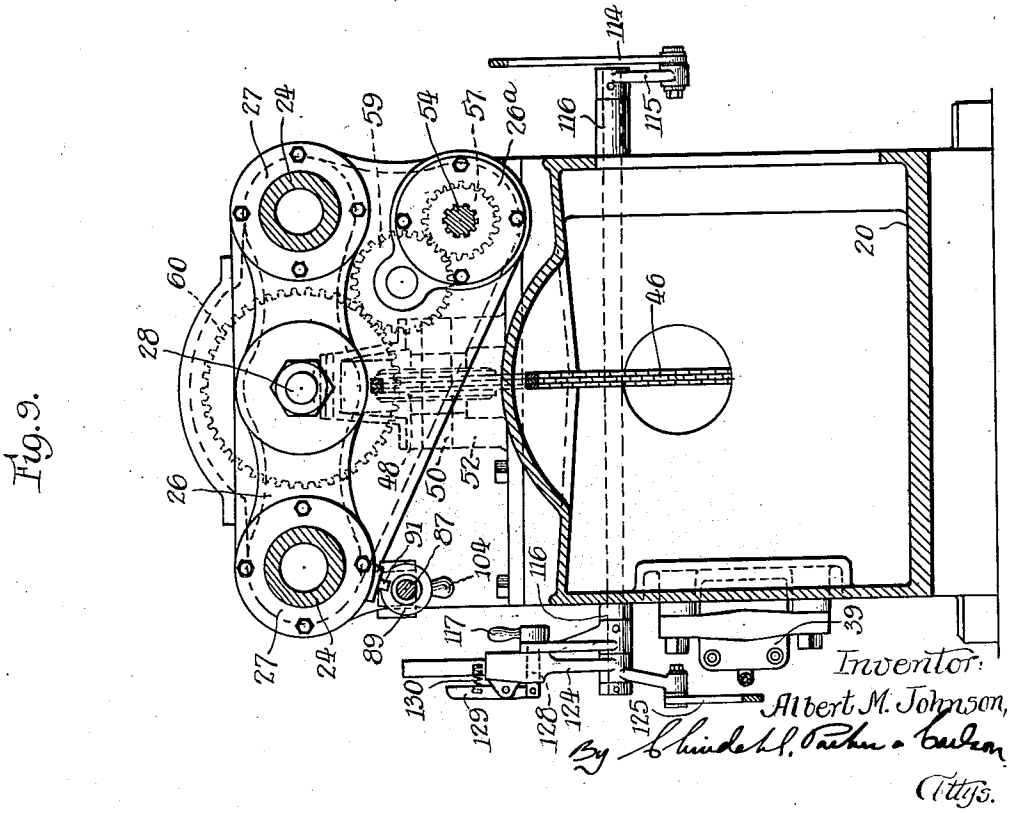

Fig. 9.

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Patented Sept. 20, 1932 1,877,881

UNITED STATES PATENT OFFICE

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HONING MACHINE

Application filed June 2, 1928. Serial No. 282,440.

The invention relates to a machine for dressing cylindrical surfaces to a true contour and smooth finish and more particularly relates to a machine for producing a smooth true finish on internal cylindrical bearing surfaces of cylinders of substantial length, such as engine cylinders, air compressor cylinders and the like.

Heretofore, the finishing of such cylinders has been accomplished generally by internal grinding. Customarily this method employs an abrasive wheel supported on a driving spindle revolving on a fixed axis eccentric of the work, with the wheel engaging a small area only of the surface being smoothed. This method results in appreciable roughness and irregularity in the finished bearing surface and this is particularly true in the case of substantially elongated cylinders of relatively large diameter. After the cylinder has been put in use the inequalities and irregularities in a bearing surface which has been finished by the internal grinding method requires a long use in order to reduce the uneven finish to a smooth surface.

The object of the invention is to provide a machine particularly adapted for honing substantially elongated cylinders and characterized by the provision of means for effectually reciprocating the honing tool at a predetermined speed while rotating coaxially of the cylinder and engaging with the work on all sides simultaneously.

Further objects and advantages will be apparent in the following detailed description of a preferred embodiment of the invention which has been selected for illustration in the accompanying drawings. It will be understood, however, that many changes in form, construction and arrangement may be made by those skilled in the art without departing from the scope and spirit of the invention as expressed in the appended claims.

Referring to the drawings:—

Figures 1 and 2 are side elevation and plan views respectively of the complete machine.

Figs. 3 and 4 taken together are side elevations of the driving mechanism of the machine on an enlarged scale.

Fig. 5 is an enlarged elevational view of the right hand end of the machine as shown in Fig. 1 with the driving gears shown in broken outline.

Fig. 6 is an enlarged sectional view of a detail of the control mechanism taken on the line 6—6 of Fig. 7.

Figs. 7 and 8 are sectional views of the same device taken on the lines 7—7 and 8—8 of Fig. 6 respectively.

Fig. 9 is a transverse section on an enlarged scale taken substantially on the line 9—9 of Fig. 3.

Fig. 10 is a fragmentary plan view on an enlarged scale of the spindle head of the machine and the parts associated therewith.

Fig. 11 is a fragmentary detail view taken on the line 11—11 of Fig. 4 showing the auxiliary stop.

Generally stated, the machine as illustrated herein comprises an elongated supporting frame or bed upon one end of which is mounted a table for carrying the work to be finished. The other end of the bed supports a pair of longitudinally extending guide members, and a carriage mounted for reciprocation along the guide members, operatively supports a honing tool spindle.

The reciprocatory carriage is preferably actuated by hydraulic means and this is accomplished in the present instance through the speed-multiplying agency of a rack and pinion driving a sprocket and chain, the latter being operatively connected to the carriage. The hydraulic means includes a cylinder and piston therein, and a suitable pressure pump is provided with means for automatically diverting liquid to alternate ends of the piston. Manually controllable means may also be employed to vary or disengage said automatic means.

The rotary motion of the honing tool is in this embodiment derived from a driven splined shaft supported upon the bed underlying and parallel to the guide members, which splined shaft is operatively connected with a honing tool spindle in the reciprocating carriage by means of a train of gears supported by said carriage and engaging said shaft throughout the reciprocatory travel thereof.

More specifically described, the machine herein shown comprises a horizontally disposed supporting frame in the form of an elongated bed 20 near one end of which is mounted a pair of transversely spaced upstanding standards 21 having a cross arm 22 which may be formed integrally with the standards and which extends therebetween to provide rigidity. A similarly constructed pair of standards 23 are also supported on the bed of the machine at a point substantially adjacent the means (to be presently described) which supports the piece of work. A pair of guide members 24, which, in this instance are tubular in form, are rigidly supported between the two pairs of standards 21 and 23 to extend parallel to each other longitudinally of and in a horizontal plane above the bed. These guide members are adapted to support and direct the movements of a reciprocating head generally designated as 25, which is mounted thereon.

Preferably, the head comprises a hollow casing 26 (Figs. 3, 9 and 10) supported between a pair of elongated tubular bearing members 27 arranged to fit about the guides 24. Suitable bearing surfaces are provided at the ends of each of the tubular members which assist in holding the head against vibration or twisting movement in the reciprocatory movement thereof. A tool spindle 28 is journaled in suitable bearings 29 provided in the front and rear walls of the casing 26 centrally of the head between the parallel guides. The head also houses a train of gears for driving the spindle as will be hereinafter described at greater length.

Means is provided on the opposite end of the bed 20 for supporting a piece of work 30 (which is generally illustrated in the drawings as being an oil engine cylinder) concentrically of the axis of the spindle. Inasmuch as this means comprises a generally well-known construction of a table 31 for supporting the work in such manner that various adjustments of the work relative to the table may be readily made it is not deemed necessary to consider this construction in detail.

The honing tool 32 may be of any desired construction and generally comprises a series of elongated circumferentially spaced honing stones 33 arranged in suitable retaining heads which permit expansion and contraction of the stones within a limited range of diameter. The honing tool as used in the present construction is provided with a rearwardly extending shank 34, the free end of which is adapted to be received in an ordinary type of chuck 35 or similar fitting carried by the spindle 28 in the head 25, by which the honing tool and the spindle may be detachably secured together. In order to support the honing tool when the machine is inoperative and to assist in guiding the honing tool during the insertion and removal of the tool from the work blank, an anti-friction roller 36, Fig. 4, supported in a suitable bracket 37 may be mounted upon the bed in position to slidably support the shank of the honing tool.

It is preferable that hydraulic pressure means be utilized to reciprocate the head since great and even flow of power may be obtained thereby and since the machine is particularly adapted for use with cylinders of substantial length, a chain and sprocket transmission is provided between a suitable hydraulic actuator and the head 25 to reciprocate the same at proper speed.

The reciprocatory movement of the head 25 is accomplished in this instance by means of a hydraulically actuated pistol 38 (Figs. 3 and 4) operable in a cylinder 39, which is suitably mounted within the bed of the machine. A piston rod 40, connected to the piston, extends through one end of the cylinder and is connected at its outer end to a rack bar 41, the free end of which is supported in any suitable manner as by means of a pair of annular bearings 42 journaled in the bed of the machine. The rack engages a pinion gear 43 rigid on a shaft 44 journaled transversely of the bed 20, and a sprocket wheel 45 is also rigidly fixed on the shaft 44 at a point substantially midway between the two guides 24, in driving engagement with a chain 46. The movement of the chain is guided by a pair of idler sprocket wheels 47 and 48 which are mounted on shafts 49 and 50 journaled in suitable brackets 51 and 52 upstanding from the bed of the machine adjacent and substantially centrally of the pairs of upright supports 21 and 23. The chain 46 is led from the driving sprocket wheel 45 upwardly therefrom about each of the idler sprockets 47, 48 from which the chain extends longitudinally of the bed of the machine centrally of and underlying the guide members 24.

The chain is secured to the head 25 in any suitable manner as by attaching the ends of the chain to a bar 53 which, in turn, is rigidly secured to the lower side of the head. As may be seen in Fig. 4 a desired multiplication of the length of the stroke of the piston may be effected by properly determining the ratio between the pinion gear 43 and sprocket wheel 45. Thus the head is reciprocated by the hydraulically operated piston through an intermediate gear train comprising the rack and pinion 41 and 43, the sprocket 45 and the chain 46 in such manner that a reciprocatory stroke of substantial length may be attained at desired speed.

In the operation of the honing tool it is essential that the tool be continuously rotated during the reciprocatory honing strokes. To this end a driving shaft 54 extends longitudinally of the machine beneath and parallel to one of the guide members 24, which shaft is journaled in bearings 55 carried by suitable brackets 56 mounted on the bed. The shaft

54 which is splined throughout the portion underlying the guide members, is arranged to pass through a depending portion 26ª of the casing 26 on the head 25. A gear 57 (Figs. 3, 5 and 9) is mounted upon the splined portion of the shaft within the depending portion of the casing for slidable and nonrotatable movement relative to the shaft 54. Preferably, the gear is journaled in suitable thrust bearings 58 in either side of the casing and engages an idler gear 59 also journaled in the casing and meshing with a driving gear 60 rigidly mounted upon the tool spindle 28. Thus, the tool spindle may be driven from the shaft during the reciprocatory movement of the head through the engagement of the splined shaft and gear and the gear train 57, 59 and 60.

As may be seen in Fig. 3, the driving shaft extends outwardly beyond the end of the machine, into a gear housing generally designated as 61 (Figs. 2, 3 and 5) which is mounted upon the end of the bed of the machine. A jack shaft 62 (Figs. 3 and 5) underlying and extending parallel to the driving shaft 54, is suitably journaled in the gear housing. The outer ends of the splined shaft 54 and the jack shaft 62 carry a pair of pick-off gears 63 and 64, access to which may be had through the end 65 of the gear housing 61.

In the embodiment of the machine shown in the drawings, the prime mover or driving means is mounted in the machine, but it will be apparent that power may be derived from an external source. The driving means herein shown comprises preferably an electric motor 66 suitably mounted within the bed of the machine with the motor shaft 67 extending longitudinally toward the rear or right hand end of the bed of the machine into the gear housing. The motor shaft 67 carries a gear 68 which operably engages an idler gear 69 mounted on a short shaft 70 journaled in the gear housing, which idler gear in turn engages a gear 71 rigidly mounted on the jack shaft 62. Thus, the driving connection between the prime mover 66 and the driving shaft 54 comprises the gear train 68, 69 and 71, the jack shaft 62 and the pick-off gears 63 and 64. The jack shaft 62 also carries, within the gear housing a commercially well known type of clutch, generally designated as 72, which controls the operation of the drive shaft 54. In addition a brake mechanism 73 is mounted on the jack shaft operable to stop the movement of the driving shaft when the clutch collar is disengaged. The construction and operation of these elements will be more fully described hereinafter.

Each end of the cylinder 39 (Figs. 3 and 4) is provided with conduits which communicate respectively through suitable piping 74 and 75 with a pressure fluid circulating or hydraulic system for actuating continuous reciprocatory mechanism. This type of a system is well-known and forms per se no part of the present invention. It is therefore only partially disclosed herein, and for clarity is described as to its principal elements which are designed to operate with oil. The pipe connections 74 and 75 lead to a controlling valve 76 (Fig. 3). Other pipe connections 77 and 78 also leading to the valve 76 are respectively connected with the pressure side and the suction side of a suitable oil pump, the latter being generally indicated at 79 in Figs. 1, 2 and 5, which pump is enclosed in a suitable casing and is mounted upon the bracket 80 supported adjacent the gear housing 61 on the end of the bed.

Preferably, power for operating the pump is derived from the driving motor 66 through the intermediate agency of a pinion 81 secured to the motor shaft 67 which pinion drives a chain 82, preferably of the noiseless type, which in turn meshes with a sprocket 83 rigid with the pump shaft 84. The control valve 76 operates to direct the pressure fluid alternately into the opposite ends of the cylinder to cause continuous reciprocation of the piston therein, such operation being controlled in the usual manner by a pilot valve 85 mounted in a valve casing. The pilot valve 85 includes a moving piston for controlling the operation of the control valve, which piston in turn is controlled by means of a piston rod 86 extending longitudinally of the bed of the machine.

Means is provided for automatically controlling the position and correct operation of the pilot valve during the reciprocation of the head in the following manner. Near one of the guide members 24 is a stop bar 87 which is supported for rotational and limited longitudinal movement in a pair of bearings 88 secured upon the standards 21 and 22. The stop bar is provided with a pair of stop disks 89 and 90 rigidly secured to the bar and positioned to be engaged by a lug 91 secured to and projecting from an appropriate point on the head 25 into the path of the stop disks.

At the limits of movement of the head 25 as actuated by the hydraulic piston 38, the depending lug 91 will engage one or the other of the stop disks, depending upon the direction of travel of the head, to move the stop bar 87 longitudinally of the machine. This movement of the stop bar operates a pilot valve actuating mechanism to change the direction of flow of pressure fluid from one end of the cylinder to the other.

More particularly described, the pilot valve actuating mechanism comprises a bracket 92 secured on the bed of the machine which has a portion thereof extending to a position adjacent one end of the stop bar 87 (see Figs. 3, 6, 7 and 8). The bracket 92 is provided with a transverse slot 93 which forms a guide-

way therein paralleling the axis of the stop bar 87. A cam block 94, having a suitably formed cam slot 95 therein, is mounted in the guideway in the bracket and is adapted to be moved horizontally in one direction or the other by the longitudinal travel of the stop bar.

Any suitable means for connecting the stop bar with the cam block may be employed but since for another purpose it is desirable to permit relative rotation between the stop bar 87 and the cam block 94 it is preferred to provide a lug 96 (Fig. 8) on the cam block, which lug is grooved to receive an annular collar 97 rigid with the stop bar 87. The bracket 92 is also provided with a vertical slot 98, registering with the guideway 93, and arranged to receive a vertically sliding cam bar 99. The cam bar carries at an appropriate point a cam roller or follower 100 which engages the cam slot 95 in the cam block. The cam slot 95 is so formed that in movement of the cam block in one direction the sliding cam bar 99 will be moved upwardly and in the other direction the cam bar will be moved downwardly.

At the lower end of the sliding cam bar 99 a link 101 is pivotally connected, and the lower end of the link is pivoted to one arm of a bell crank lever 102 (Fig. 3) suitably mounted upon the bracket 92. The other end of the bell crank lever is pivotally secured to the outer end of the pilot valve piston rod 86. Thus, movement of the stop bar 87 in one direction or the other causes a corresponding movement of the pilot valve 85 to change the direction of stroke of the head.

The stop bar 87 is also provided with one or more auxiliary stops 103 (Fig. 4) which are adjustably mounted on the bar intermediately of the stop disks 89 and 90. Only one such stop is shown in the present embodiment which preferably is arranged for normal engagement with the depending lug 91 on the head. If, however, the stop bar is mounted for limited rotational movement the stop may be moved out of the path of the lug. A hand lever 104 may be mounted at a suitable position near one end of the stop bar for rotating the bar.

The selectively engaged auxiliary stop 103 is secured in either operative or inoperative position by means of a collar 105 slidably mounted upon the stop bar and adapted to be secured rigidly thereto in any desirable position of adjustment. The collar has pivotally mounted thereon an upstanding member 106 which may be in the form of a yoke and which presents an engaging face 107 to the depending lug 91 on the head. Thus, the auxiliary stop may be positioned at any point upon the stop bar intermediate the stop disks and to be engaged by the lug on the head, thereby limiting the reciprocatory stroke of the head.

When it is desired, for any reason, to permit the head to make one or more strokes of greater length the stop bar may be rotated by means of the handle 104 to move the engaging face of the auxiliary stop out of the path of the lug. In this event the head will move between the extreme limits of travel as indicated by the stop disks. This is particularly advantageous where it is desired to withdraw the hone from the work for removing a finished piece and replacing it with a new one. Preferably the engaging yoke 106 is resiliently held in a normal engaging position in order to permit the stop bar to be returned to its normal position as soon as the lug on the head has passed the auxiliary stop member whereupon the lug on its return stroke may depress and ride over the engaging yoke.

Means is provided to hold the stop bar in normal position and to return the stop bar to such a position after the bar has been rotated. This means preferably comprises (Figs. 6, 7 and 8) a plate 107^a carried by the bracket 92 in substantially tangential relation to the stop bar 87. The plate is recessed at opposite ends to receive plungers 108 which are yieldingly pressed in the general direction of the stop bar by suitable means such as the coiled springs 109 seated in the recesses. The stop bar carries rigidly fixed thereon a member 110 which has extending therefrom a pair of substantially opposed fingers 111 arranged to engage the spring pressed plungers 108. Thus, rotational movement of the stop bar in either direction is opposed by one or the other of the plungers 108 which exert a force to rock the bar to its normal position after the bar handle 104 has been released by the operator.

The means for manually controlling the operation of the machine comprises the clutch and brake mechanisms 72 and 73 (Fig. 3) which govern the rotational movement of the honing tool, and also a means associated with the control valve for controlling the passage of pressure fluid to the cylinder 39. The clutch mechanism 72 is preferably the commercially well known type of multiple disk friction clutch interposed in the jack shaft 62. The clutch includes the usual annular groove 112 adapted to be engaged by fingers upon a yoke 113 mounted for swinging movement on a shaft 113^a in the gear housing. Exteriorly of the housing is an arm 114^a rigid with the shaft 113^a and a link 114 connects the free end of the arm 114^a with an arm 115 (Fig. 9) rigidly carried by a rock shaft 116 journaled in and extending transversely through the bed of the machine. The opposite end of the rock shaft carries an operating handle 117 rigidly secured thereto for rocking the shaft to engage or disengage the clutch.

The brake mechanism 73 (Fig. 3) is mount-

ed upon the jack shaft 62 and is associated with the clutch mechanism 72 in such manner that movement of the clutch out of engagement operates the brake mechanism to stop the rotation of the honing tool. The brake mechanism comprises a conventional type of brake drum 118 fixed upon the jack shaft 62 adapted to be frictionally engaged by a contracting brake band 119 supported upon the periphery of the drum. In order to engage the brake band with the drum only when the clutch is moved out of engagement, a bell crank lever 120 operatively connected by one arm to one end of the brake band 119 is pivotally supported as at 121 upon a suitable bracket 122 extending between the yoke shaft 113[a] and the other end of the brake band. The free end of the bell crank lever provides a cam surface adapted to be engaged by a roller 123 mounted upon the lower end of the clutch operating yoke 113 in such manner that as the yoke is swung to move the clutch out of engagement the cam surface on the bell crank lever 120 will be engaged by the roller to swing the lever and thus draw the brake band into frictional engagement with the drum. Conversely when the clutch is moved into engagement the roller 123 releases the bell crank lever 120 and disengages the brake mechanism thereby permitting the spindle to operate.

The means by which operation of the control valve is governed comprises a valve controlling lever 124 (Fig. 9) pivotally mounted intermediate its ends upon the rock shaft 116 in a position immediately adjacent the clutch operating handle 117. A link 125 connects the lower end of the lever 124 with the stem 126 (Fig. 3) of a suitable cut-off valve 127 mounted in the control valve 76 which controls the passage of fluid from the pump through the valve. Thus, the reciprocation of the head may be directly controlled by means of the operating lever 124.

A convenient combined hand manipulating control for simultaneously operating the clutch and brake mechanisms and the fluid pressure system, which is also adapted to permit the selective operation of either of these mechanisms, may be provided. In this embodiment such a means is shown (Fig. 9.) as comprising a locking pin 128 slidably mounted in the valve control lever 124 and extending therefrom into engagement with the clutch operating handle 117. A lever 129 pivoted on the valve controlling lever 124 and operatively engaging the pin 128 permits the pin to be readily drawn out of engagement with the clutch control handle. Preferably, a spring 130 is provided normally to seat the pin in engagement with the handle.

In this manner movement of the valve lever 124, while the pin is in engagement with the handle 117, operates both the cut-off valve in the pressure system and the clutch and brake mechanisms on the jack shaft. By simply releasing the engagement of the pin with the clutch handle either the valve or the clutch and brake mechanisms may be operated separately. By this means, it will be obvious, the main control valve and thereby the reciprocating movement of the head may be controlled independently of or coincidently with the starting and stopping of the mechanism which rotates the tool spindle. This is of great convenience and importance in the movement of the spindle into and out of position in the replacing of work to be operated upon.

I claim as my invention:

1. A honing machine comprising, in combination, an elongated frame, a head mounted on said frame for relative movement longitudinally thereof, a spindle journaled in said head and movable therewith, means at one end of said frame for supporting the work concentrically of the axis of said spindle, a honing tool adapted to enter the work on said supporting means and having a shank secured to said spindle, a hydraulically operated means for reciprocating the head including a driving sprocket and a chain connected with the head and driven by said sprocket, and means for rotating the spindle during its reciprocation with the head.

2. A honing machine comprising, in combination, an elongated frame, a head mounted on said frame for relative movement longitudinally thereof, a spindle journaled in said head and movable therewith, means at one end of said frame for supporting the work concentrically of the axis of said spindle, a honing tool adapted to enter the work on said supporting means and having a shank secured to said spindle, a reciprocatory rack bar mounted in the frame, a speed multiplying gear train including a sprocket and chain driven by said rack bar connecting said bar to said head, means for reciprocating the rack bar and means for rotating the spindle during its reciprocation with the head.

3. A honing machine comprising, in combination, an elongated frame, a head mounted on said frame for relative movement longitudinally thereof, a spindle journaled in said head and movable therewith, means at one end of said frame for supporting the work concentrically of the axis of said spindle, a honing tool adapted to enter the work on said supporting means and having a shank secured to said spindle, a reciprocatory actuating rack bar mounted in the frame, a speed multiplying gear train connecting said bar to said head, said gear train including a pinion gear engaging said rack bar, a sprocket wheel rotatable with said pinion and a chain driven by said sprocket wheel and having a portion thereof extend-

ing longitudinally of said frame adjacent the path of said head and means connecting said chain to said head, means for reciprocating the bar, and means for rotating the spindle during its reciprocation with the head.

4. A honing machine comprising, in combination, an elongated frame, a head mounted upon said frame for longitudinal movement thereof, a honing tool carried by said head, a rack mounted in said frame extending substantially in parallel relation with the reciprocatory path of said head, a hydraulically actuated piston arranged to reciprocate said rack, a pinion meshing with said rack, a sprocket adapted to be driven with said pinion, a chain engaging said sprocket, guiding means for said chain arranged to support a portion of said chain underlying and substantially parallel to the path of said head, and means connecting said chain with said head.

5. In a honing machine, the combination of an elongated frame, a head mounted on said frame for relative movement longitudinally thereof, a spindle journaled in said head and movable therewith, means for reciprocating said head, and means for rotating the spindle during the reciprocation thereof with said head, said means comprising a prime mover, a splined shaft journaled in said frame substantially parallel to the reciprocatory path of said head, gears interposed between said prime mover and said shaft and a train of gears carried by said head, one of the gears of said train being mounted on said shaft in slidable non-rotative movement relative thereto.

6. A honing machine comprising, in combination, a horizontal elongated bed, a pair of spaced parallel guide members mounted on said bed and extending longitudinally thereof, a head slidably mounted on said guides for reciprocatory travel, a spindle journaled in said head and movable therewith, means for reciprocating said head, a shaft journaled on said bed underlying and parallel to one of said guide members, a train of gears carried by said head for movement therewith, one of said gears being rigid with said spindle and another of said gears having a slidable non-rotatable relation with said shaft, and means for driving said shaft.

7. A honing machine comprising, in combination, a horizontal elongated bed, a pair of spaced parallel guide members mounted on said bed and extending longitudinally thereof, a head slidably mounted on said guides for reciprocatory travel, a spindle journaled on said head and movable therewith, means for reciprocating said head, means for rotating the spindle during the reciprocatory travel of said head, said means including a driven splined shaft underlying and extending substantially parallel to said guide members, a gear mounted concentrically of said splined shaft and journaled in said head for slidable non-rotative movement relative to said shaft, and means carried by said head and connected to said gear for driving said spindle.

8. A honing machine comprising, in combination, a horizontal elongated bed, a pair of spaced parallel guides mounted on said bed and extending longitudinally thereof, a head slidably mounted on said guides for reciprocatory travel, a spindle journaled in said head and movable therewith, said spindle being disposed centrally of the head between the guide members, means for reciprocating said head, and means for rotating the spindle during the reciprocation thereof with said head comprising a shaft underlying and extending parallel to said guide members, a train of gears carried by said head and connecting said spindle and said shaft, and means for driving said shaft including a clutch device controlling the movement of said spindle, and a brake device operable to stop said spindle when said clutch device is disengaged.

9. In a honing machine, the combination of a reciprocatory head, hydraulically actuated means for reciprocating said head, a valve controlling the passage of pressure fluid to said means, and means controlling the position of said valve including a movable cam block, a stop bar connected to said block to effect said movement, spaced stops on said bar engageable by said head at the limits of travel thereof, linkage including a cam follower operatively connecting said cam and said valve, and an auxiliary stop adjustably mounted on said stop bar and normally engageable by said head, said connection between said stop bar and said cam block being fashioned for relative rotation of said bar to said block to permit said auxiliary stop to be moved to an out of the way position.

10. In a honing machine, the combination of a reciprocatory head, means for reciprocating said head including a control member movable to effect the reciprocation of said head in one direction or the other, means for moving said control member comprising an elongated bar positioned adjacent and extending substantially parallel to the direction of travel of said head, spaced stop members mounted on said bar for engagement by said head to effect a longitudinal movement of said bar, an auxiliary stop adjustably mounted on said bar and normally positioned for engagement by said head, said bar being rotatable to permit said auxiliary stop to be moved out of the path of said head, a cam block having a cam slot mounted therein connected to said bar for longitudinal travel with said bar, a stationary support for said cam block, means including a cam follower connecting said cam block and said control member to produce a movement of said member corresponding to

the movement of said bar, and resilient means interposed between said cam block support and said bar exerting a force on said bar tending to maintain said bar in the normal position thereof.

11. In a honing machine, the combination of a reciprocatory head, means for reciprocating said head including a control member movable to effect a reciprocation of said head in one direction or the other, means for moving said control member comprising an elongated bar, spaced stop members mounted on said bar for engagement during the movement of said head to effect a movement of said bar at the limits of travel of said head, an auxiliary stop mounted upon said bar between said stop members, said bar being rotatable from a normal operative position to permit said auxiliary stop to be moved to an out of the way position, and said auxiliary stop being adapted to yield in the return movement of the head with said bar in its normal position and means connecting said bar with said control member for effecting a movement of said control member in accordance with the movements of said control bar.

12. In a honing machine, the combination of a reciprocatory head, means for reciprocating said head including a control member movable to effect a reciprocation of said head in one direction or the other, and means for moving said control member as said head reaches a predetermined position, said means comprising an elongated bar, spaced stop members mounted on said bar for engagement by a moving part of said head when said head reaches a predetermined position, an auxiliary stop mounted on said bar and normally engageable by said moving part, said bar being mounted for rotatable movement to permit said auxiliary stop to be moved from its normal position to a position out of the path of said moving part, resilient means yieldably resisting the movement of said auxiliary stop from the normal position thereof, and connections interposed between said bar and said control member for translating the longitudinal movements of said bar to said control member.

In testimony whereof, I have hereunto affixed my signature.

ALBERT M. JOHNSON.