Oct. 17, 1944. M. H. ARMS 2,360,462

METALWORKING MACHINE

Original Filed Nov. 9, 1940 7 Sheets-Sheet 1

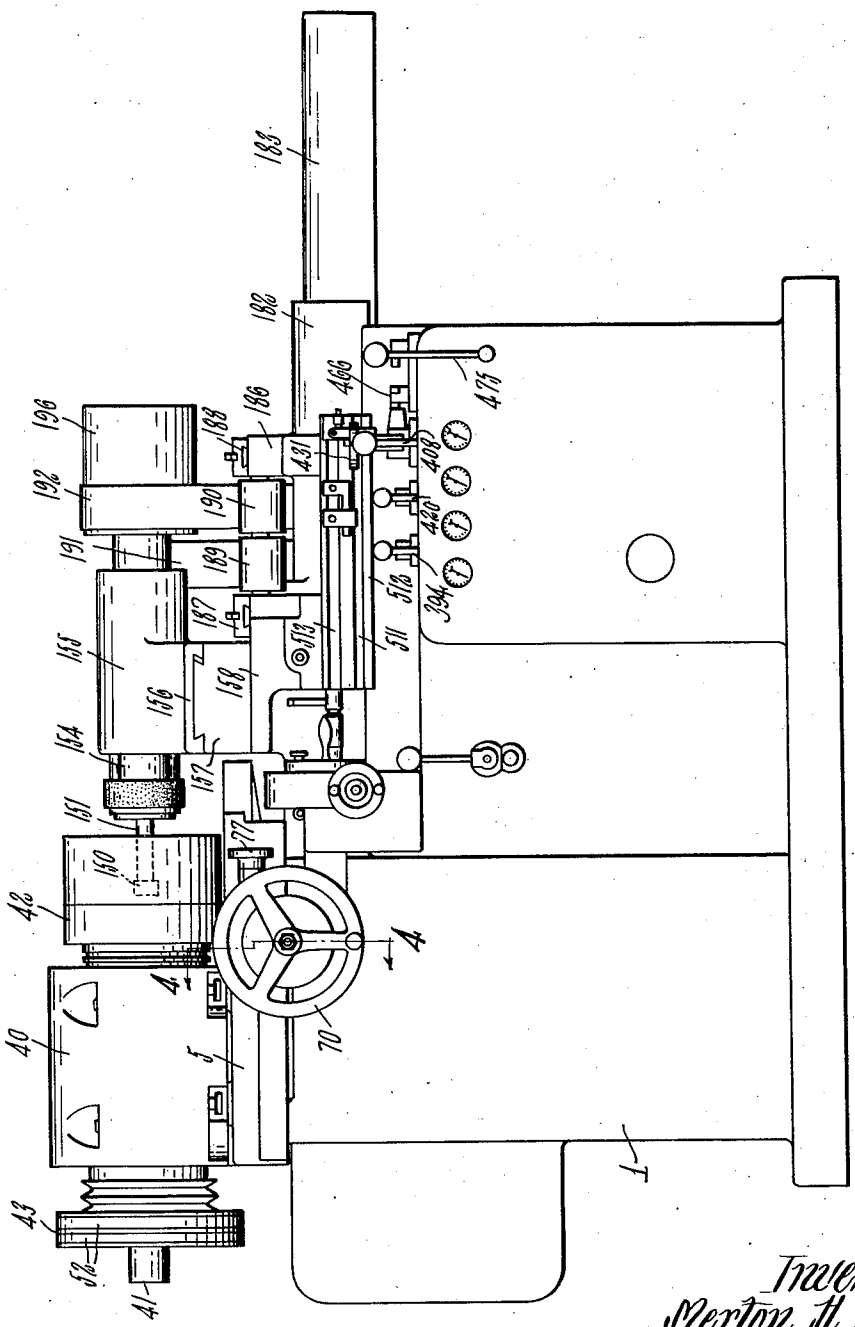


Fig. 1.

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Oct. 17, 1944. M. H. ARMS 2,360,462

METALWORKING MACHINE

Original Filed Nov. 9, 1940 7 Sheets-Sheet 2

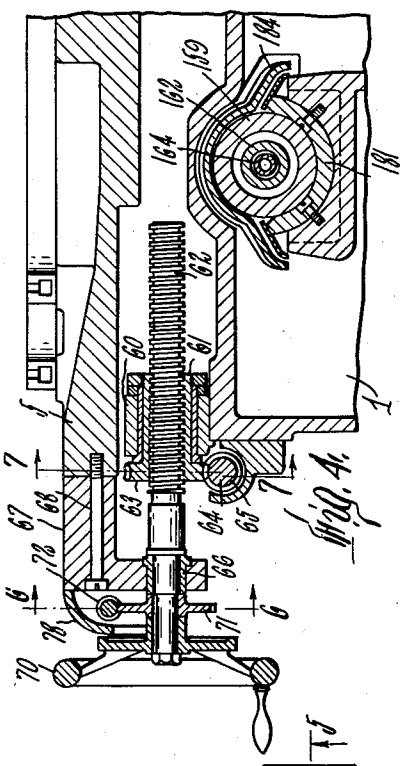


Fig. 4.

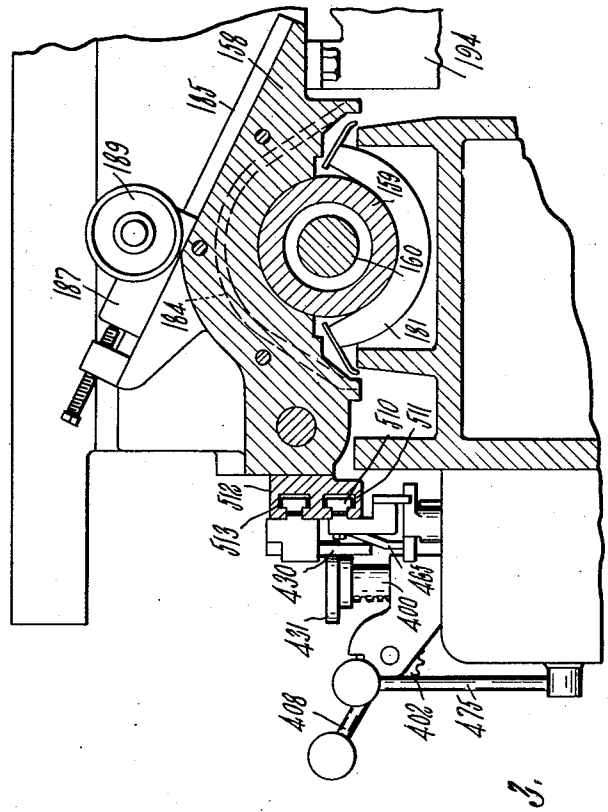


Fig. 3.

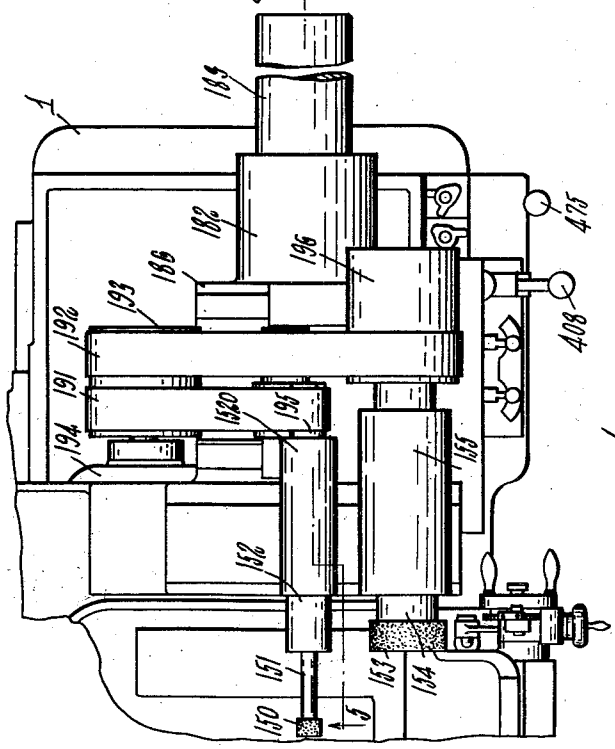


Fig. 2.

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Oct. 17, 1944. M. H. ARMS 2,360,462

METALWORKING MACHINE

Original Filed Nov. 9, 1940 7 Sheets-Sheet 3

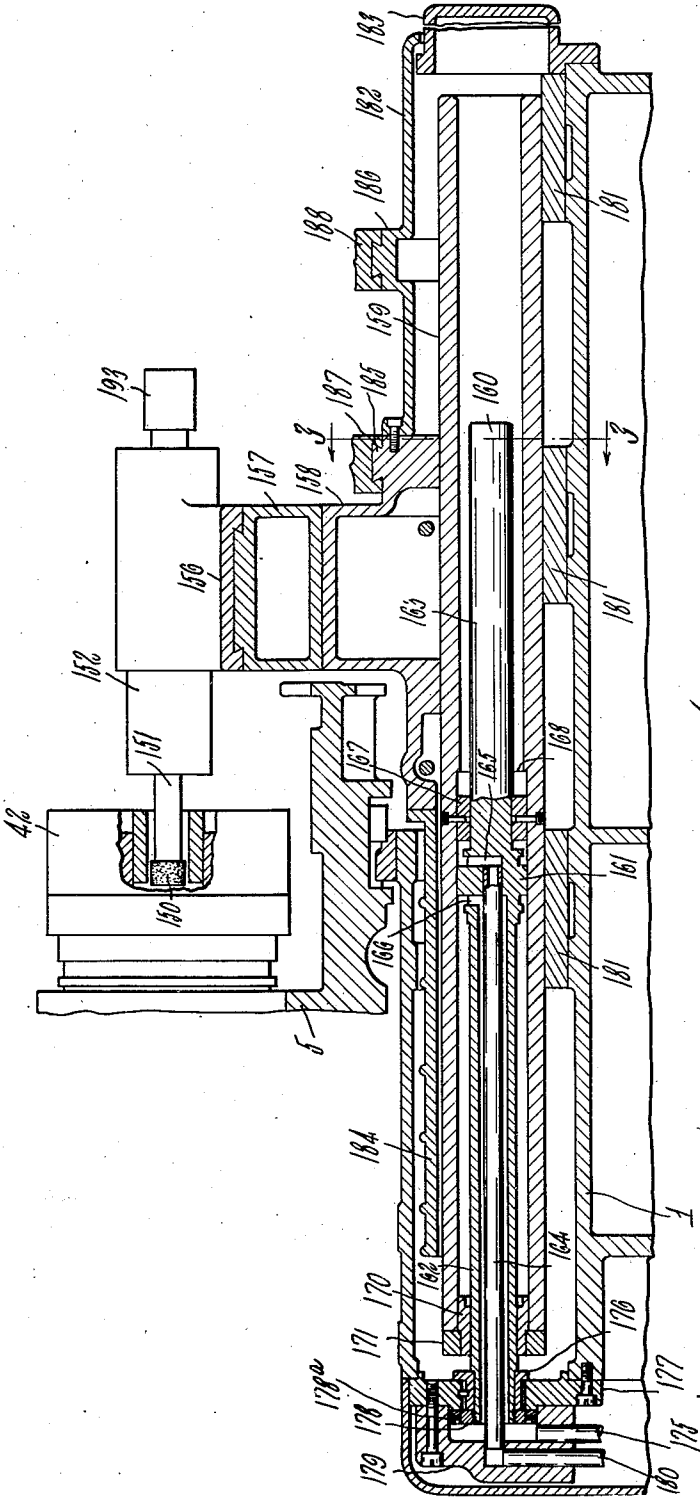


Fig. 1.

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Oct. 17, 1944. M. H. ARMS 2,360,462

METALWORKING MACHINE

Original Filed Nov. 9, 1940 7 Sheets-Sheet 4

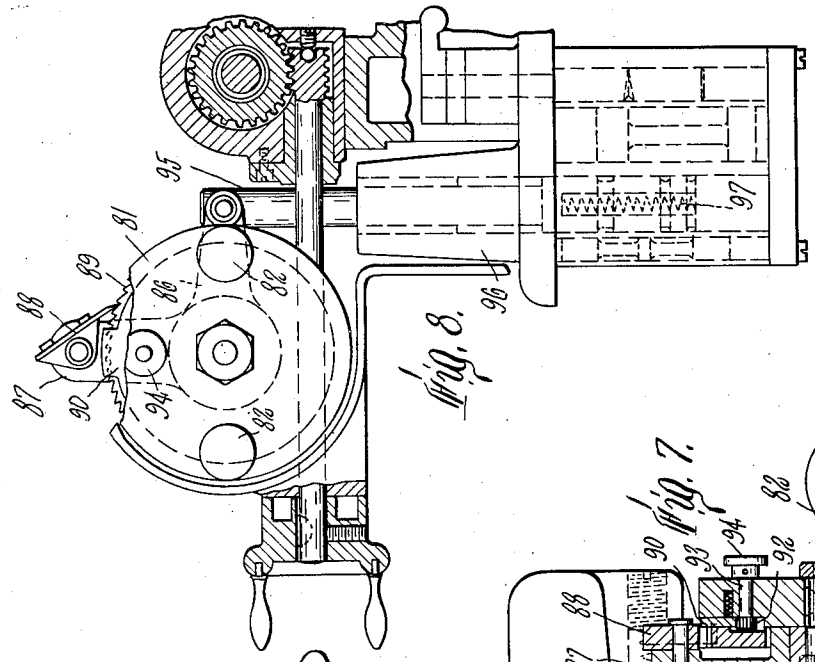


Fig. 8.

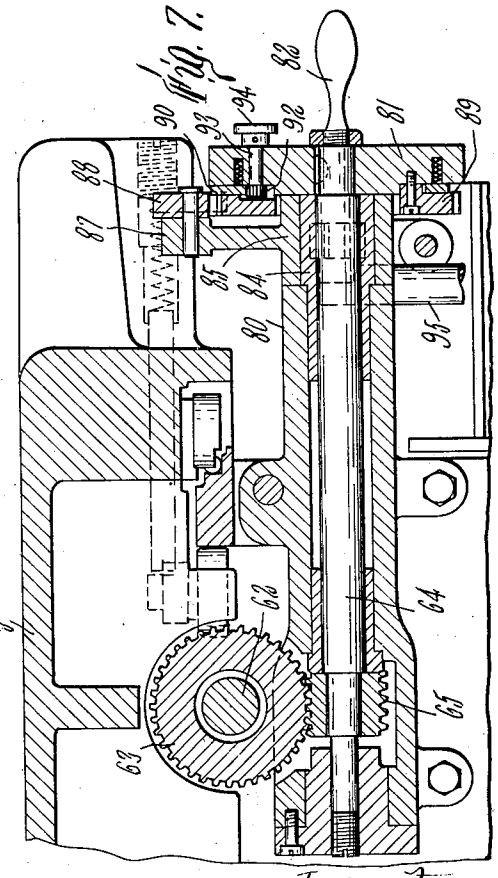


Fig. 7.

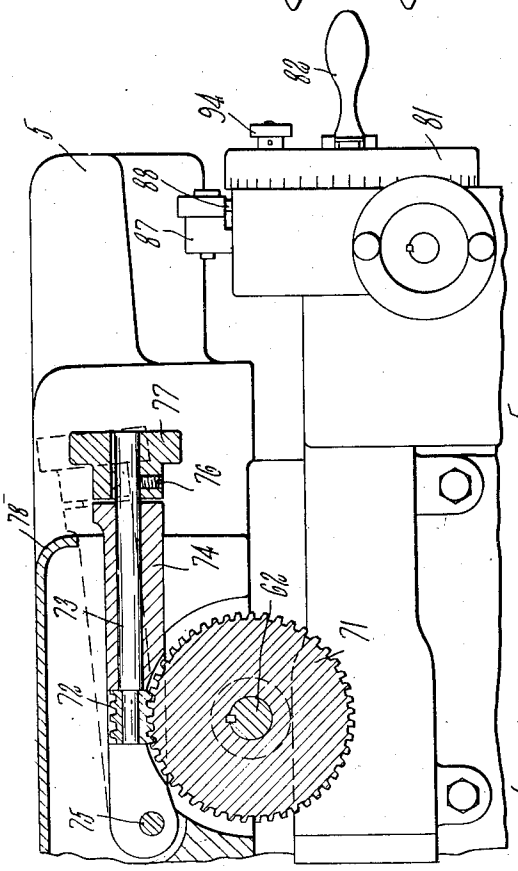


Fig. 6.

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METALWORKING MACHINE

Original Filed Nov. 9, 1940 7 Sheets-Sheet 5

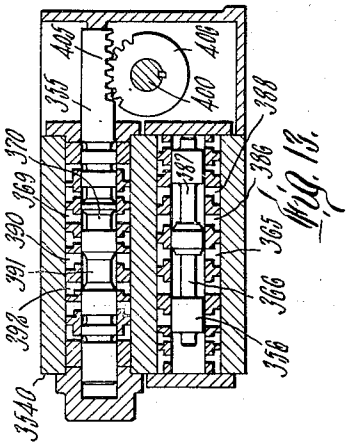


Fig. 13.

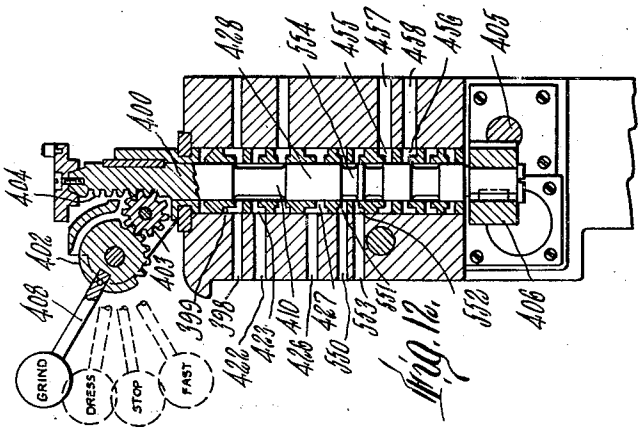


Fig. 12.

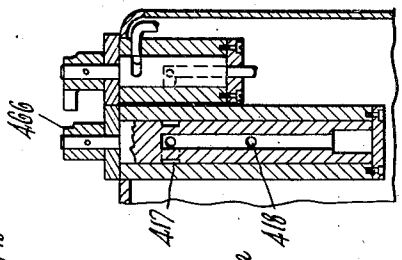


Fig. 11.

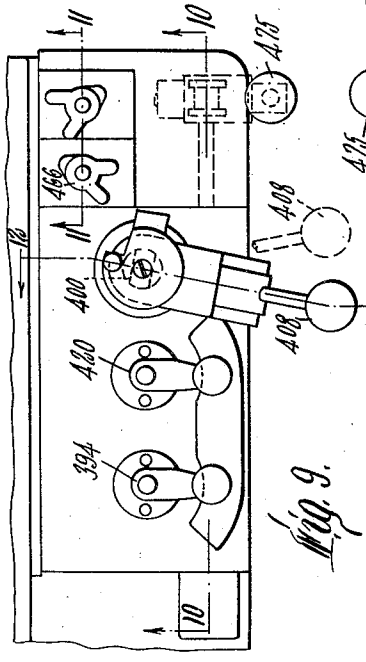


Fig. 9.

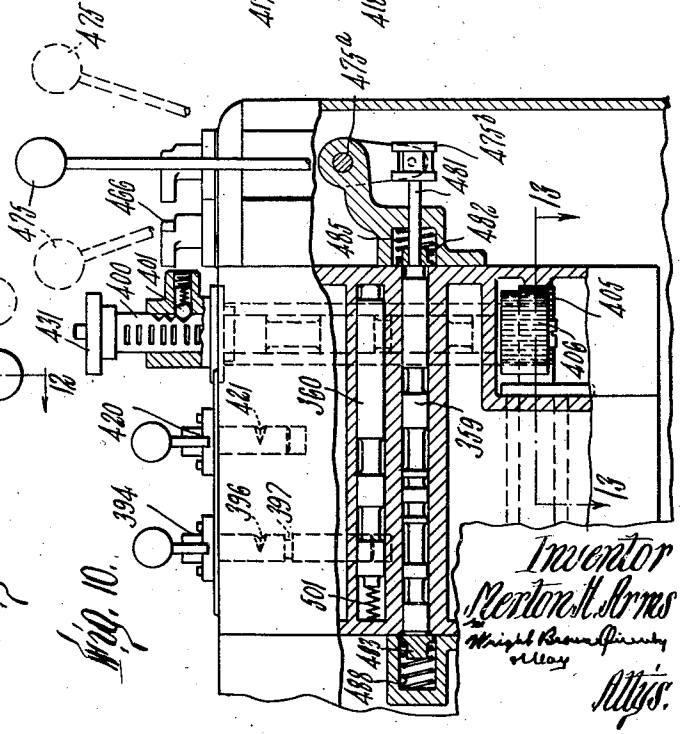


Fig. 10.

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METALWORKING MACHINE

Original Filed Nov. 9, 1940 7 Sheets-Sheet 6

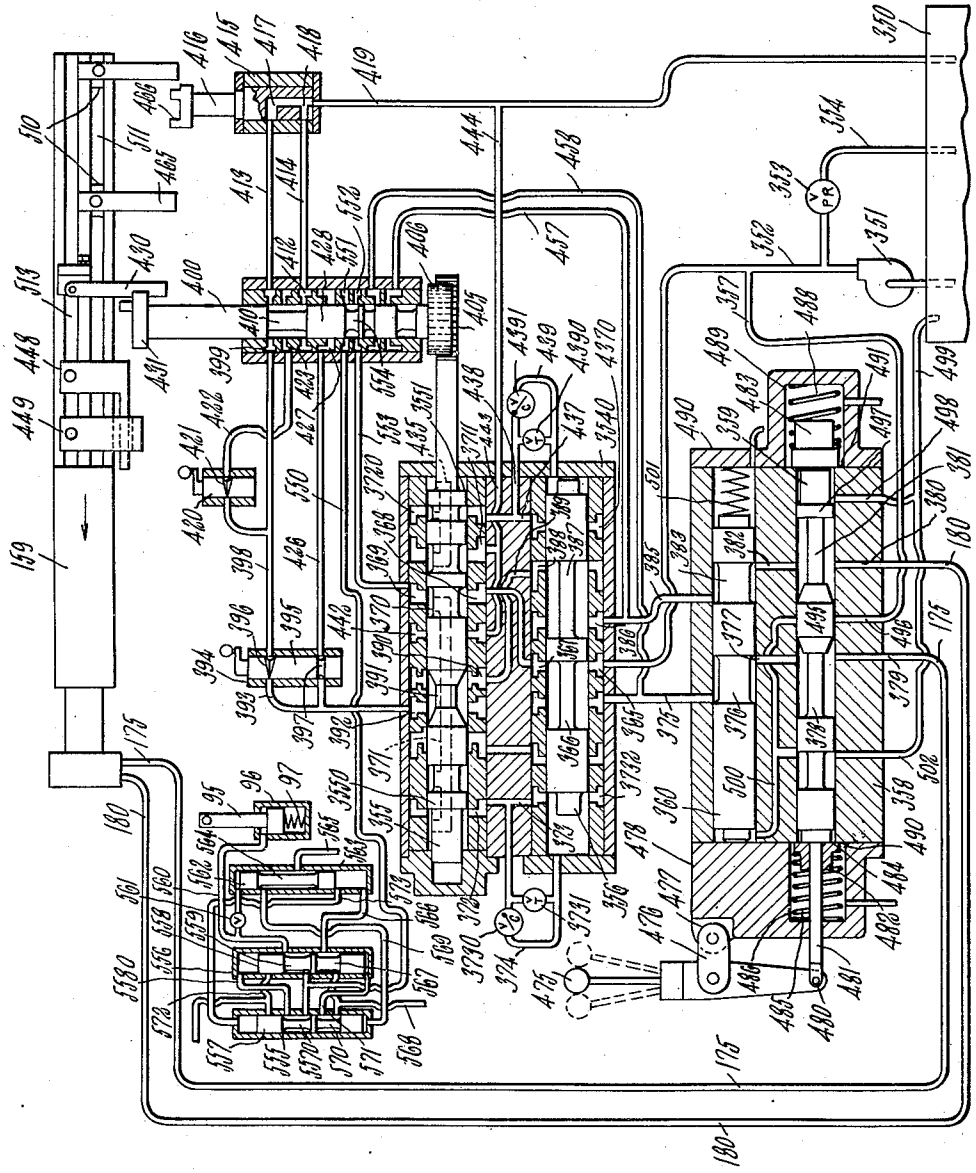


Fig. 14.

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Oct. 17, 1944. M. H. ARMS 2,360,462

METALWORKING MACHINE

Original Filed Nov. 9, 1940 7 Sheets-Sheet 7

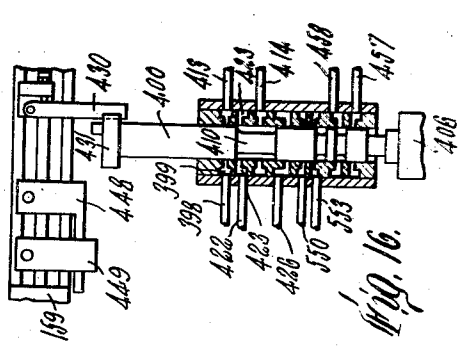


Fig. 16.

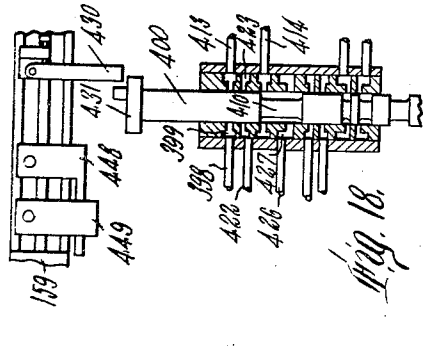


Fig. 18.

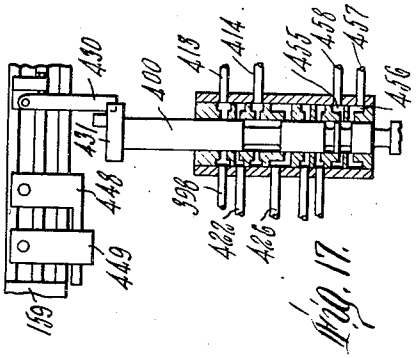


Fig. 17.

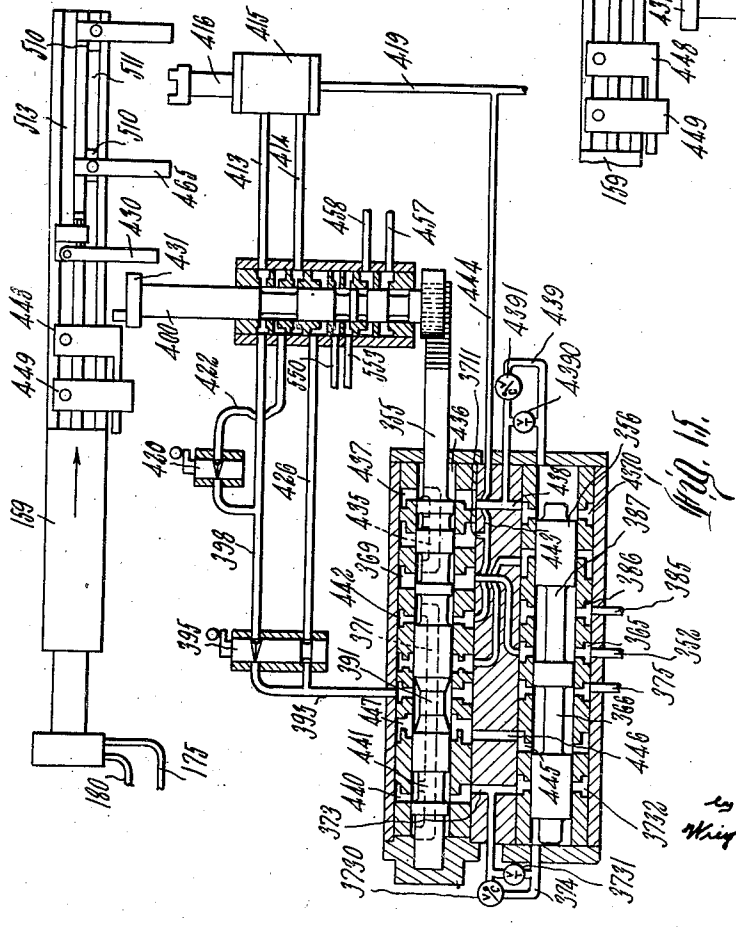


Fig. 15.

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Patented Oct. 17, 1944

2,360,462

UNITED STATES PATENT OFFICE

2,360,462

METALWORKING MACHINE

Merton H. Arms, Springfield, Vt., assignor to Bryant Chucking Grinder Company, Springfield, Vt., a corporation of Vermont

Original application November 9, 1940, Serial No. 365,071, now Patent No. 2,310,338, dated February 9, 1943. Divided and this application July 14, 1942, Serial No. 450,866

23 Claims. (Cl. 51—50)

This invention relates to metal working machines and more particularly to machines for effecting relative traverse and feed between work and a tool. While in its broadest aspect it is not limited to any particular machine, the invention has been developed more particularly to suit the requirements of internal grinding machines.

One object of the present invention is to provide improved hydraulic actuation of the various operations of the machine.

A further object is to provide for control of speed and length of stroke of the reciprocating member which supports either the tool or work, by the position of a control member which automatically determines such speed and length of traverse.

A further object is to provide for automatic control of supplemental mechanism in proper time to the reciprocation of the reciprocating member, through the position of a control member which determines the particular cycle of operations at any particular time.

Further objects and advantageous constructions will appear from a description of the machine exemplifying the invention shown in the accompanying drawings, in which

Figure 1 is a front elevation of an internal grinding machine embodying the invention.

Figure 2 is a fragmentary top plan view of the same.

Figure 3 is a detail sectional view on line 3—3 of Figure 5.

Figure 4 is a detail sectional view on line 4—4 of Figure 1.

Figure 5 is a fragmentary longitudinal sectional view on line 5—5 of Figure 2.

Figure 6 is a detail sectional view on line 6—6 of Figure 4.

Figure 7 is a detail sectional view on line 7—7 of Figure 4.

Figure 8 is a fragmentary view, partly in elevation, and partly broken away and in section, of the grinding wheel feed mechanism.

Figure 9 is a view similar to a portion of Figure 2, but to a larger scale.

Figures 10, 11 and 12 are detail sectional views on the correspondingly numbered section lines of Figure 9.

Figure 13 is a detail sectional view on line 13—13 of Figure 10.

Figure 14 is a diagram of the wheel slide hydraulic drive, the automatic reversing valve being in "grind" position.

Figure 15 is a view similar to a portion of Figure 14 but with the parts in position for reverse direction traverse.

Figures 16, 17 and 18 are views similar to a portion of Figure 14, but showing the automatic reversing valve in "dress," "stop," and "fast" positions, respectively.

As shown best in Figures 1 and 2, the machine may comprise a base 1 supporting at one end portion a work supporting carriage 5. On the carriage 5 is a support 40 within which is journaled a work-carrying spindle 41 which carries a suitable work supporting chuck 42 at its inner end and belt pulleys 43 at its outer end. The pulleys 43 may be driven by belts 52 passing around them and also around pulleys of a suitable motor (not shown).

The work carriage may be moved transversely of the machine as for positioning and feed. For this purpose the top portion of the machine bed, as shown best in Figure 4, may have secured thereto a bearing 60 within which a nut member 61 is rotatably mounted, but held against axial motion. The nut member 61 has threaded engagement with a lead screw 62. This nut member 61 is shown as provided with a worm wheel portion 63 with which meshes a worm 64 on a shaft 65. When the shaft 65 is stationary, the nut member 61 is held against rotation, but rotation of the screw 62 may then be employed to move the work-holding carriage. To this end the lead screw 62 extends through a bearing sleeve 66 secured in a bracket member 67 attached by means such as screws 68 to the forward face of the work carriage 5, and to the forward end of this lead screw 62 is keyed a hand feed wheel 70 by which it may be rotated.

Means may be provided for locking the lead screw 62 against rotation and also for producing, when desired, a slow feed rotation thereto. To this end, the lead screw 62 has secured thereto between the bearing bushing 66 and the wheel 70 a worm wheel 71, and as shown best in Figures 4 and 6 this worm wheel may be engaged by a worm 72. This worm 72 is carried by a shaft 73 which is journaled longitudinally of a lever 74. This lever is fulcrumed at 75 and by upward rocking of this lever, the worm 72 may be lifted out of contact with the worm wheel 71 as shown in the dotted line position of Figure 6. When so lifted the hand wheel 70 is free to be turned, thus rotating the lead screw 62 for relatively fast motion.

When the lever 74 is in the full line position shown in Figure 6 with the worm 72 in engagement with the worm wheel 71, the lead screw 62

is locked against rotation by means of the wheel 70, but it may be given a slow rotation by rotation of the shaft 73 carrying the worm 72. For this purpose the outer end of the shaft 72 has secured thereto as by a set screw 76 a small hand wheel 77. The lever 74 is mounted in a portion of the bracket 67 and is normally substantially covered by a cover plate 78.

As before noted, motion of the work carriage 5 may be produced by rotation of the nut member 61 by rotation of the shaft 64. As shown best in Figure 7, this shaft 64 is journaled within a sleeve 80 and has keyed to its outer end a hand wheel 81 provided with actuating handles 82. Inwardly of the hand wheel 81 there is rockably mounted on a bushing 84 within which the shaft 64 is journaled the hub 85 of a bell crank lever having an arm 86 and an arm 87 (see Figures 7 and 8). The arm 87 has pivoted thereto a feed dog 88 adapted to engage the teeth of a ratchet wheel or ring 89 secured to the inner face of the hand wheel 81, so that by rocking of the bell crank lever a relatively slow intermittent turning of the hand wheel 81 may be produced thus to effect a slow power feed of the work carriage through the slow intermittent rotation of the shaft 64. This feed through rotation of the shaft 64, is, of course, unaffected by the locking of the screw 62 against rotation.

A ring member 90 having a suitable pawl knock-off may be rotatably supported between the ratchet 89 and the back face of the hand wheel 81 and it may be provided with internal teeth meshing with a pinion 92 of a shaft 93 projecting through the hand wheel 81 and carrying a knob 94 on its outer end by which it may be turned, thereby to adjust the angular position of the knock off ring 90 and thus to determine the extent of feed by rocking of the bell crank lever arm 86. For the purpose of rocking this bell crank, its arm 86 is operatively connected to the upper end of a feed actuating hydraulic plunger 95 working in a cylinder 96 and normally held elevated as by a spring 97. The operation of this feed mechanism will be more fully described in connection with the hydraulic system.

Tool carriage mounting and control

The tool herein shown as a grinding wheel 150 is carried by a rotatable shaft 151 journaled in a long quill 152 carried by a wheel head bracket 1520 and there may be, if desired, a second tool or grinding wheel 153 carried by a shaft (not shown) journaled in a quill 154 in a second wheel head bracket 155. These brackets are shown as carried by a base 156 which has dovetail connection with a supporting hollow block 157 and support the grinding wheel shafts outwardly of the base 156 allowing a long grinding stroke with rigid support of the grinding wheels. This block 157 is carried by a carriage 158. This carriage is rockably supported by a tube or hollow bar 159 which is slidably and rockably mounted on semi-cylindrical bearing members 181. Extending into the tube 159 is a shaft 160 provided with an enlarged diameter portion 161 which slidably fits within the tube 159 and forms a piston therefor.

The shaft 160 has reduced diameter end portions 162 and 163. The portion 162 is hollow and through the center thereof passes a pipe 164 which extends into the piston portion 161 and communicates through a port 165 to the interior of the tube 159 to the right of the piston as shown in Figure 5. The space outwardly of the pipe 164 and between it and the inside of the shaft portion 162 communicates through the port 166 with the left hand side of the piston 161. The shaft portion 163 is solid in cross section and is slidably guided through a sleeve 167 which engages a larger internal diameter portion of the tube 159 and forms a closed end to the pressure cylinder which travels relative to the piston 161. The right hand end of the tube 159 is open but the left hand end is closed by a bushing 170 having a portion filling the space between the outside of the shaft portion 162 and the inside of the tube 159. A second collar 171 secured against the left hand end of the tube 159 and a reduced diameter portion of the collar 170 completes the closure of this end of the tube 159 to the hollow piston rod portion 162. The inner end of the bushing 170 and the adjacent face of the piston 161 have mating concentric stepped portions which act as a dash pot to cushion the slide motion at the outer limit of its motion.

This tube 159 thus forms a fluid pressure cylinder, fluid under pressure being introduced into the pipe 164 and discharging through the port 166 and pipe 175 serving to force the tube 159 and the tool carriage carried thereby to the right from the position in Figure 5, while fluid introduced into the space between the pipe 164 and the inside of the shaft section 162 through the pipe 175 while the escape of fluid is permitted through the pipe 164 acts to move the tool slide to the left or toward the work spindle. The left hand end of the shaft portion 162 extends through a bushing 176 loosely mounted in an end wall member 177 secured as by screws to the machine base 1, and on the left hand end of this portion 162 there is positioned a nut 178 which holds the shaft 162 in position. The loose mounting of the bushing 176 prevents cramping of the shaft portion 162, and a yieldable sealing ring 178*a* prevents the escape of oil around this bushing. The pipe 175 then enters into an opening in an end cap 179 into which also extends the pipe 164 with which communicates a second pipe 180. The right hand end of the tube 159 may be covered by a hood 182 which is telescopically related to a second hood member 183 into which the right hand end of the tube 159 may pass when the tool carrier is retracted to its greatest extent. A guard or shield 184 secured to the left hand end of the carriage 158 and having downwardly and outwardly sloping top faces overlying the tube 159 extends beneath the bed 1 and has transversely extending top ribs for directing foreign matter laterally.

The carriage 158 and the member 182 are provided with a pair of spaced inclined ways 185 and 186, respectively, on which may be adjustably supported a pair of slides 187 and 188 which support between them belt tightener pulleys 189 and 190. These pulleys engage belts 191 and 192, respectively, which pass over a driving pulley 193 of a driving motor 194 and over pulleys 195 and 196 on the grinding wheel shafts 151 and one (not shown) journaled within the quill 154, respectively. The motor 194 is carried by the tool carriage as shown in Figure 3, being bolted to the lower face thereof, so that it partakes of the motion of this carriage and remains in the same relation to the grinding wheel pulleys 195 and 196 at all times.

The tool carriage extends rearwardly of the tube 159 which rockably supports it and as shown in the parent application Serial No. 365,071, filed November 9, 1940, now Patent No. 2,310,338, granted February 9, 1943, for Metal working ma-

chine, of which the present application is a division, means may be provided for controlling the angular position of the tool carriage about the axis of the tube 159. As this mechanism forms no part of the present invention, however, it is not illustrated herein.

Tool carriage traverse mechanism

The hydraulic mechanism for effecting traverse and control of the tool carriage is shown in detail in Figures 5 to 14, inclusive. Referring first to Figure 14, at 350 is shown a tank having a liquid such as oil which is employed to drive the tool carriage, being supplied and discharged through the pipes 175 and 180 shown in detail in Figure 4 as previously described. The movable cylinder 159 is indicated diagrammatically in Figure 14, this cylinder supporting the tool carriage. Liquid is pumped from the tank 350 by the pump 351 into the pipe 352. A limiting pressure valve 353 communicating with the pipe 352 and discharging to the tank 350 through the pipe 354 acts to maintain pressure in the pipe 352 at the desired amount. This pipe 352 leads to a valve casing 3540 within which is positioned a pilot valve 355 and a reversing valve 356. It also leads through the pipe 357 to a valve casing 358 containing an operator actuable controlling valve 359 and a shut off valve 360, which may be actuated at suitable times to cut out the automatic valve within the casing 3540 when hand control of the traverse is desired. In the position shown in Figure 14 for automatic grinding traverse, liquid under pressure passes from the pipe 352 through the passages 365 and 368, the valve port 369, to the pilot valve, through the longitudinal passage 371 in this valve, through the port 372, the passage 373 and the passage 374, through the check valve 3730 and throttle valve 3731 and finally also through port 3732 to the left end of the reversing valve 366, thus forcing the reversing valve 356 into the position shown, the fluid under pressure escaping from the right hand end of this valve first through the pipes 438 and 439 and later through the pipe 439 only when the valve closes the port 4370, the throttle valve 4390, passage 438, port 437, through the valve passage 435, port 3711, passage 443 and pipe 444 to the discharge pipe 419. A check valve 4391 in the pipe 439 prevents free discharge through the pipe 439 so that the rate of flow and thus the rate of motion of the reversing valve near the end of its stroke is determined by the setting of the throttle valve 4390. This adjustment of the speed of motion of the reversing valve allows for a sharp control of the cut off for the tool slide so that the slide is stopped at a definite point. In this position of the reversing valve, fluid under pressure around the neck 366 of the reversing valve may pass through the passage 375 around the neck 376 of the valve 360, port 377, around the neck 378 of the hand operated valve 359 and out through the port 379 to the pipe 175, thus forcing the cylinder 159 to the left. The discharge from the opposite end of the cylinder takes place through the pipe 180, the port 389, around the neck 381 of the manual control valve 359, through the port 382, around the neck 383 of the valve 360, through the pipe 385, through the port 386, around the neck 387 of the reversing valve, through the port 388 and passage 389, the port 390 of the pilot valve, around the neck 391 of this valve, the port 392, and the pipe 393 to a valve casing 394. Within this valve casing 394 is a rocker valve 395 having two ports 396 and 397 therearound. The port 396 is a restricted port, the extent of opening of which may be adjusted by turning the valve 395, thus to determine the rate of discharge of fluid from the cylinder 159 and thus to determine the traverse rate. The port 397 is always wide open until after port 396 is wholly closed, but in grinding position no liquid passes therethrough as will later appear. The parts in this figure are in the grinding condition during which the port 396 allows the discharge through the pipe 398 into the port 399 of the manual control valve 400 which is vertically movable to any selected of four positions in any of which it may be yieldably retained as by a ball detent 401 shown in Figure 10, and determines in order whether the control is set for grinding, dressing, stop or fast speed.

In Figure 12 these four positions, grinding, dressing, stop and fast speed are shown indicated by the corresponding angular positions in a vertical plane of a control handle 408 which carries a mutilated gear 402 meshing with a pinion 403, which, in turn, meshes with a rack portion 404 and the valve 400. This valve is also permitted a rocking motion, this for the purpose of controlling the axial position of the pilot valve 355, one end of which is formed as a rack bar 405 with which meshes a gear 406 on the lower end of the valve 400. The rocking motion of this valve 400 does not, however, affect in any way its control of its valve ports and the handle 408 rocks with it in a horizontal plane.

In the grinding position shown for this valve 400 in Figure 14, the discharge from the pipe 398 and the port 399 passes around the valve 400 to the pipe 413, around the valve neck 410 and through the port 412 and pipe 414, both pipes 413 and 414 leading to a valve casing 415 within which is a rockable valve 416. The pipe 413 is always open to the pipe 398 through an annular passage around the outside of the valve 400 regardless of the position of the valve 400. The valve 416 has a pair of ports 417 and 418, both of which, in the position shown in Figure 14, communicate with the discharge pipe 419 leading back to the tank 350. Beside passing through the pipe 398 to the valve 400 there is also a by-pass discharge from the pipe 398 through an adjustable restricted rocker valve 420 having the V port 421, through the pipe 422, the port 423 of the valve 400, which also leads around the neck 410 of this valve from which the discharge takes place, as previously described. The port 397 of the adjustable valve 395 leads through a pipe 426 to a port 427 of the valve 400, but in this position of the parts, this port 427 is closed by the part 428 of the valve 400 so that in grind position the traverse speed is controlled by the extent of opening of the port 396 of the valve 395. The pilot valve is also forced fully to its right hand position by a "load and fire" hydraulic means, since as soon as this valve has been moved far enough to open the valve passage 371 to pressure, this pressure acts on the left hand face of the valve shoulder 3550 while the shoulder 3551 at the right hand end of the pilot valve is open to discharge through the valve passage 435.

When the tool carriage approaches the left hand end of its travel, a dog 430 thereon engages the head 431 of the valve 400 and continued motion of the carriage rocks the valve 400 and moves the pilot valve 355 axially toward the position shown in Figure 15 to which it is forced by

the hydraulic "load and fire," fluid under pressure passing to the right hand face of the shoulder 3551 through the valve passage 435 and being discharged from the left hand face of the shoulder 3550 through the valve passage 371, as will appear. In this position of the valve 355, the valve passage 371 has been moved out of registry with the port 369 and a valve passage 435 placed in registry therewith, thus permitting the fluid under pressure to pass through this passage 435 through the valve passage 436 and the port 437, the passage 438, and the passage 439 to the right hand end of the reversing valve 356, thus driving the reversing valve to the left to the position shown in Figure 15, while the left hand end of the reversing valve discharges through the pipe 374, the passage 373, the valve port 440 around the neck 441 of the pilot valve through the valve passage 371, the port 442, passage 443, and pipe 444 to the discharge line 419. With the reversing valve in this position, fluid under pressure passes from the pipe 352 and port 365 around the neck 387 of the reversing valve, port 386 to the pipe 385 leading to the manual traversing valve casing, around the neck 383 of the valve 360, passage 382, around the neck 381 of the hand control valve, and through the pipe 180 to the power cylinder 159 to drive the carriage in the reverse direction or to the right, the discharge taking place through the pipe 175, past the neck 378 of the hand control valve, neck 376 of the valve 360, the passage 375, around the neck 366 of the reversing valve, through the port 445, passage 446, port 447, around the neck 391, through pipe 393, past the valve 395 and from thence back around the valve 400 and through the valve 416 to discharge. This takes place until the dog 448 impinges on the valve 400 and rocks it back toward its initial position to which it is forced by the hydraulic load and fire mechanism previously described, whereupon the cycle is repeated. It will be noted that neck 391 of the pilot valve is provided with conical ends which effect initial and final throttling through the ports controlled thereby, thus slowing the traverse before reversing and returning.

In the dress position the valve 400 is lowered to the position shown in Figure 16 in which it is too low to be affected by the dog 448 so that the tool carriage is permitted an extended outward traverse at which time the dog 449 becomes effective to reverse the traverse at one end while the dog 430 is still in effective relation at the other end. From an inspection of Figure 16 it will be seen that in this position of the valve 400 it shuts off port 399 from around the neck 410 and the discharge through the pipe 414, but does not prevent flow from this port around the valve to the pipe 413. This permits the tool slide to retract and remove the wheel from the work at normal traverse speed until the wheel approaches "dress" position, whereupon the dog 465 engages the rabbit ears 466 and shuts off the valve port 417 while leaving open the port 418. All the discharge is then forced to take place through the throttle valve 421, pipe 422, around the valve neck 410 and through pipe 414, so that the outward travel of the wheel carriage is slowed for dressing. The wheel, therefore, comes out of the hole in the work and returns at grinding speed, but its traverse is slowed during the truing portion of its extended traverse. Automatic reversal of this extended stroke is produced by the dog 449, turning the valve 400.

On depressing the handle 408 to the stop position indicated in Figure 12, the valve 400 is brought into the position shown in Figure 17. In this position of the valve, it will be noted that there is open communication through ports 455 and 456 between the pipes 457 and 458. These pipes communicate with the pipes 385 and 375, respectively, which in the inoperative position of the hand traverse valve 359, communicate with the pipes 175 and 180 which lead to opposite ends of the power cylinder 159. The pressures in opposite ends of the cylinder 159 are thus balanced and the wheel slide stops. The tool carriage may now be moved freely by hand or by actuation of the hand traverse mechanism, which, as will later be shown, shuts off the pipes 375 and 385 from the cylinder 159. In all of the positions of the valve 400, except the stop position, the pipes 457 and 458 are cut off from each other by suitable parts of the valve 400.

Further depression of the handle 401 bringing the valve 400 into fast position is shown in Figure 18. In this position of the valve 400 the discharge port 423 is closed, but the unrestricted discharge pipe 426 is open through the port 427 and around the neck 410 of the valve 400 through the discharge pipe 414, thus permitting unrestricted discharge of fluid from one or the other side of the power cylinder 159, depending upon the setting of the reversing valve. In this position of the parts, also, the top of the valve 400 is lowered to a point where it is unaffected by the stop 449 so that the traverse may be further extended in an outward direction. The stop 430 is long enough to reverse the traverse at the inner end of its stroke automatically.

The stop dog 465 which controls the angular position of the valve 416 is fixed to a block such as 510 adjustable within a T slot 511 in a bracket 512 secured to the tool carriage, as best shown in Figure 3, while the dogs 430, 448, and 449 are similarly secured in an under cut groove 513 of the same bracket 512. As shown best in Figures 9 and 12, the handle 408 may be rocked angularly by hand in a horizontal plane to turn the valve 400, thus to effect reversal of the direction of traverse at will.

Hand traverse control

As before mentioned, the traverse may be controlled by the operator by a manual control of the valve 359, actuation of this valve for such control serving automatically to cut out the automatic traverse control. In the inoperative position of the hand control, the parts being in the position of Figures 10 and 14, a hand lever 475 is in vertical position, this lever as shown in Figure 14 being pivoted to a link 476, which, in turn, is pivoted to an ear 477 on the cap 478 closing the end of the valve casing 358. The lower end of the hand lever 475 is pivoted at 480 to a rod 481 extending from one end of the valve 359. In Figure 10 a slightly different mounting of the hand lever 475 is shown in which it is fulcrumed on a fixed pivot 475*a* and its lower end engages between flanges of a spool 475*b* carried by the valve rod 481. At each end of this valve 359 is positioned a spring centering device, this comprising a pair of spring seat members 482 and 483. The seat member 482 is perforated for the passage of the rod 481 and is normally pressed against an end shoulder 484 of the valve by a spring 485 seated in a socket 486 in the cap 478. The spring seat 483 normally engages the opposite end of the valve 359 and is spring pressed by a spring 488 seated in a socket 489 in the end

wall member 490 of the valve casing 358. Both of these spring seats 482 and 483 are limited in their inward motion by annular shoulders 490 and 491, respectively, at the ends of the valve casing 358. By pulling the handle 475 outwardly toward the dotted line position shown in Figure 14, the valve 359 is moved to the right against the pressure of the spring 488, this causing the left hand edge of central valve portion 495 to uncover the port 496 to which the pressure pipe 357 leads from the pressure pipe 352. This allows fluid under pressure to pass directly from the port 496 to the port 379 and to the power cylinder 159 through the pipe 175, while its shoulder 497 uncovers the port 498 leading to the discharge pipe 499, thus opening up the opposite pipe 180 from the power cylinder 159 to discharge, thus causing the cylinder 159 to be moved to the left. At the same time fluid under pressure from the port 496 passing around the valve neck 378 escapes through the passage 500 to the left end of the valve 360, driving it to the right against the pressure of the spring 501 reacting against its right hand end, and shuts off passages leading to the pipes 375 and 385, thus cutting off the automatic traverse mechanism. On moving the lever 475 inwardly toward the right hand dotted line position of Figure 14, the valve 359 is moved in the reverse direction, opening up the port 496 at the right hand end of the valve port 495 and connecting through the port 380 directly to the pipe 180 leading to the opposite end of the power cylinder 159 so that this power cylinder is driven to the right, the discharge taking place through the pipe 175, passage 379, passage 502 to the discharge pipe 499. Likewise the fluid under pressure may then pass around the neck 381 of this valve through the passage 500 to the left hand end of the valve 360, thus driving this valve 360 in the same direction as before and cutting off the pipes 375 and 385. The traverse is thus in the reverse direction, but as before the automatic traverse mechanism is cut off by the same position of the valve 360. It will be noted that the valve portion 495 has tapered ends so that the port 496 is opened or closed gradually on motion of this valve. Thus the speed of traverse as controlled by this valve depends on the extent of its displacement so that the further the handle 475 is moved from its central position, the faster is the speed of traverse of the wheel slide.

Power cross feed

The power cross feed which actuates the plunger 95 is operative only when the valve 400 is in grinding position, in which position only, the pipe 550 leading from a port 551 of the casing of the valve 400 is open to fluid under pressure through port 552 and pipe 553 from the port 369 of the pilot valve, around the neck 554 of the valve 400. This establishes hydraulic pressure in the pipe 550 regardless of the direction of traverse of the wheel and leads to the two cylinders 555 and 556 (see Figure 14) containing the piston valves 557 and 558, respectively. In the positions shown in Figure 14 with the plunger 95 in its upper position and with both of the pistons 557 and 558 in the lowered positions shown, fluid pressure from the pipe 550 may pass around the neck 559 of the valve 558 out through the pipe 560 above the piston of the plunger 95 so as to force this plunger downwardly and effect a feeding oscillation to the bell crank feed lever. At the same time fluid under pressure in the pipe 560 passing the throttle valve 561 builds up pressure above the piston valve 562 slidable in a cylinder 563, forcing this valve downwardly, fluid under pressure escaping from beneath the valve 562 through the pipe 566, around the neck 567 of the valve 558, and through the discharge pipe 568. When the valve 562 is driven downwardly to a sufficient distance, it opens connection to the fluid pressure above it through the pipe 569 beneath the piston valve 557 while fluid escapes from above this valve 557 through the pipe 573, around the valve neck 564 to the return line 565, thus raising this valve 557, permitting fluid to pass from the pipe 550 around the neck 570 of the valve 557 and the pipe 571 beneath the valve 558 while discharging from above the valve 558 through the pipe 5580, around the neck 5570 of the valve 557 to the discharge pipe 572. This lifts the valve 558, shutting off the connection from the pipe 550 to the pipe 569 and opening the pipe 560 to the pipe 572 which leads to the discharge. This allows the spring 97 to lift the plunger 95 and permits the slow escape of fluid under pressure through the throttle valve 561 from above the valve 562 past the neck 559 and pipe 572 to discharge. This position of the valve 558 opens connection from the pressure pipe 550 past the neck 567 of the valve 558. through the pipe 566 and beneath the valve 562, lifting this valve. As soon as the valve 562 is raised sufficiently, fluid under pressure beneath this valve passes through the pipe 573 to the upper end of the cylinder 555 and so forces the piston 557 downwardly, fluid under pressure escaping from beneath the valve 557, through the pipe 569, around the neck 564 of the valve 562, and out through the discharge pipe 565. These various discharge pipes from this mechanism may, of course, lead to a common discharge pipe passing to the fluid pressure tank. It will thus be seen that whenever the valve 400 is in grind position and in that position only, there is an intermittent feed produced, depending for its speed of action on the setting of the throttle valve 561 which controls the rate of motion of the valve 562.

From the foregoing description of an embodiment of this invention it should be evident to those skilled in the art that changes and modifications may be made without departing from the spirit or scope of this invention.

I claim:

1. In combination, a traversing carriage, power means for traversing said carriage including an axially movable and rockable control member, means responsive to the angular position of said member for determining the direction of traverse of said carriage, elements carried by said carriage in position to impinge on said member and rock said member as said carriage traverses to reverse the direction of traverse at traverse limits dependent at least in part on the axial position of said member, and means controlled by said member in accordance with its axial position for determining the speed of traverse.

2. In combination, a traversing carriage, fluid pressure means for traversing said carriage including an axially movable and rockable control valve, means responsive to the angular position of said valve for determining the direction of traverse of said carriage, elements carried by

said carriage in position to impinge on said valve and rock said valve as said carriage traverses to reverse the direction of traverse at traverse limits dependent at least in part on the axial position of said valve, and means controlled by said valve in accordance with its axial position for determining the speed of traverse.

3. In combination, a traversing carriage, power means for traversing said carriage including an axially movable and rockable control member, means responsive to the angular position of said member for determining the direction of traverse of said carriage, elements carried by said carriage in position to impinge on said member and rock said member as said carriage traverses to reverse the direction of traverse at traverse limits dependent at least in part on the axial position of said member, a second carriage, means for producing relative motion between said carriages transverse to the line of traverse of said traversing carriage, and means controlled by said member in accordance with its axial position determining whether or not said producing means will be operative.

4. In combination, a traversing carriage, fluid pressure means for traversing said carriage including an axially movable and rockable control valve, means responsive to the angular position of said valve for determining the direction of traverse of said carriage, elements carried by said carriage in position to impinge on said valve and rock said valve as said carriage traverses to reverse the direction of traverse at traverse limits dependent at least in part on the axial position of said valve, and means controlled by the axial position of said valve for determining the control of speed of traverse, a second carriage, means for producing relative motion between said carriages transverse to the line of traverse of said traversing carriage, means controlled by said member in accordance with its axial position determining whether or not said producing means will be operative.

5. In combination, a traversing carriage, power means for traversing said carriage including an axially and rockably movable member having an end portion extending toward a portion of said carriage, means controlled by said member in accordance with its angular position determining the direction of traverse, elements carried by said carraige and projecting by different amounts therefrom in position to strike and rock said member end portion depending upon the axial position of said member and thus defining limits of carriage traverse dependent on the positions of the elements projecting sufficiently to strike and rock said member at any selected axial position of said member, and means for adjusting the axial position of said member.

6. In combination, a traversing carriage, fluid pressure means for traversing said carriage including an axially and rockably movable valve having an end portion extending toward a portion of said carriage, means controlled by said valve in accordance wtih its angular position determining the direction of traverse, elements carried by said carriage and projecting by different amounts therefrom in position to strike and rock said valve end portion depending upon the axial position of said valve and thus defining limits of carriage traverse dependent on the positions of the elements projecting sufficiently to strike and rock said valve at any selected axial position of said valve, and means for adjusting the axial position of said valve.

7. In combination in a machine having a grinding wheel carrying traversing carriage, power means for effecting traverse of said carriage, a member for controlling said power means, elements carried by said carriage in position to move said member adjacent to desired traverse limits to cause said member to control said traversing means to reverse the direction of traverse, said member having a grinding position and a dressing position, in which dressing position one end limit element operative in grinding position is inoperative thereby permitting an extended stroke of said carriage, a low speed limiting device for said power means, and means carried by said carriage effective when said carriage enters said extended stroke to actuate said device to slow the speed of traverse in said extended stroke to a speed suitable for wheel truing.

8. In combination in a machine having a grinding wheel carrying traversing carriage, hydraulic means for effecting traverse of said carriage, a valve for controlling said hydraulic means, elements carried by said carriage in position to move said valve adjacent to desired traverse limits to cause said valve to control said hydraulic means to reverse the direction of traverse, said valve having a grinding position and a dressing position, in which dressing position one end limit element operative in grinding position is inoperative thereby permitting an extended stroke of said carriage, a low speed limiting device for said hydraulic means, and means carried by said carriage effective when said carriage enters said extended stroke to actuate said device to slow the speed of traverse in said extended stroke to a speed suitable for wheel truing.

9. In combination in a machine having a traversing carriage, hydraulic means including a hydraulic power cylinder connected to said carriage for effecting traverse of said carriage, an axially movable and rockable valve controlling said hydraulic means, the angular position of said valve determining the direction of traverse, elements carried by said carriage positioned to turn said valve from one to another angular position at the desired limits of traverse for reversing supply and discharge connections to said cylinder to reverse the direction of traverse, said valve having a plurality of axial positions in one of which positions said hydraulic means is conditioned to produce traverse of said carriage and in another of which positions both ends of said cylinder are in communication with each other so that the traverse stops and said carriage is free to be moved in either direction.

10. In combination in a machine having a traversing carriage, hydraulic means including a hydraulic power cylinder connected to said carriage for effecting traverse of said carriage, an axially movable and rockable valve controlling said hydraulic means, the angular position of said valve determining the direction of traverse, elements carried by said carriage positioned to turn said valve from one to another angular position at the desired limits of traverse for reversing supply and discharge connections to said cylinder to reverse the direction of traverse, said valve having a plurality of axial positions in one of which positions said hydraulic means is conditioned to produce traverse of said carriage with restricted hydraulic flow to produce a working speed of traverse, and in another of which axial positions said hydraulic means is conditioned to

traverse said carriage without such flow restriction to produce a high speed idle carriage traverse.

11. In combination in a machine having a traversing carriage, hydraulic means including a hydraulic power cylinder connected to said carriage for effecting traverse of said carriage, an axially movable and rockable valve controlling said hydraulic means, the angular position of said valve determining the direction of traverse, elements carried by said carriage positioned to turn said valve from one to another angular position at the desired limits of traverse for reversing supply and discharge connections to said cylinder to reverse the direction of traverse, said valve having a plurality of axial positions in one of which positions said hydraulic means is conditioned to produce traverse of said carriage with restricted hydraulic flow to produce a working speed of traverse, and in another of which axial positions said hydraulic means is conditioned to traverse said carriage without such flow restriction to produce a high speed idle carriage traverse, one of said elements being out of operative relation to said valve when said valve is in said other axial position, whereby the traverse of said carriage in one direction is extended out of control of said elements.

12. Carriage moving means comprising a reciprocable member, hydraulic means for moving said member in one direction, said hydraulic means including mechanism automatically releasing the fluid pressure on motion of said member to a predetermined point and for re-establishing fluid pressure on return of said member to starting position, means effective to return said member to starting position when said pressure is released, and means operative on motion of said member in one direction and connecting said reciprocable member and carriage to cause motion of said member to feed said carriage.

13. Carriage moving means comprising a reciprocable member, hydraulic means for moving said member in one direction, said hydraulic means including mechanism automatically releasing the fluid pressure on motion of said member to a predetermined point and for re-establishing fluid pressure on return of said member to starting position, means effective to return said member to starting position when said pressure is released, said hydraulic means including a device for adjusting the rate of flow of fluid to act on said member, and means operative on motion of said member in one direction and connecting said reciprocable member and carriage to cause motion of said member to feed said carriage.

14. In combination in a machine having a traversing carriage, power means for effecting traverse of said carriage, a member for controlling such power means, elements carried by said carriage in position to move said member adjacent to desired traverse limits and cause said member to control said traversing means to reverse the direction of traverse, an operator movable member, and connections from said operator movable member to said power means causing one motion of said operator movable member to operatively disconnect said controlling member from said power means and another motion of said operator movable member to control said power means to cause said carriage to be traversed in either selected direction.

15. In combination in a machine having a traversing carriage, fluid pressure means for effecting traverse of said carriage, a valve for controlling such power means, elements carried by said carriage in position to move said member adjacent to desired traverse limits and cause said valve to control said traversing means to reverse the direction of traverse, an operator movable valve, and connections from said operator movable valve to said fluid pressure means causing one motion of said operator movable valve to operatively disconnect said controlling valve from said power means and another motion of said operator movable valve to control said fluid pressure means to cause said carriage to be traversed in either selected direction.

16. In combination in a machine having a traversing carriage, power means for traversing said carriage, automatically acting means controlling said power means by the position of said carriage to reverse the direction of traverse at desired traverse limits, an operator actuable member for controlling said power means to reverse the direction of traverse of said carriage, said operator actuable member having operative connections to said automatically acting means to render said automatically acting means inoperative before said operator actuable member may be made effective to control said power means.

17. In combination, a traversing carriage, power means for traversing said carriage, automatically acting means controlling said power means to reverse the direction of traverse of said carriage at desired traverse limits, other control means for said power means, operator actuated means for actuating said other control means to actuate said power means to move said carriage, and means controlled by said other control means for rendering inoperative said automatically acting control means on actuation of said operator actuated means to control said other control means, and to render operative said automatically acting means on actuation of said operator actuated means to stop the action of said other control means.

18. In combination, a traversing carriage, fluid pressure means for traversing said carriage including fluid pressure actuated controlling valves, means controlled by said carriage for controlling fluid pressure to actuate said controlling valves for automatically reversing the direction of traverse at desired traversing limits of said carriage, an operator actuable valve for controlling the supply and discharge of fluid pressure to and from said traversing means, and means actuated by said operator actuable valve to cut out said pressure actuated valve before said operator actuable valve can control the supply and discharge of fluid under pressure to and from said fluid pressure carriage traversing means.

19. In combination, a traversing carriage, fluid pressure means for traversing said carriage including fluid pressure actuated controlling valves, means controlled by said carriage for controlling fluid pressure to actuate said controlling valves for automatically reversing the direction of traverse at desired traversing limits of said carriage, an operator actuable valve for controlling the supply and discharge of fluid pressure to and from said traversing means, and means actuated by said operator actuable valve to cut out said pressure actuated valve before said operator actuable valve can control the supply and discharge of fluid under pressure to and from said fluid pressure carriage traversing means, said operator actuable valve having throttling ports to control

by the position of said operator actuable valve the speed of carriage traverse.

20. In combination, a traversing carriage, power means for traversing said carriage comprising a pair of valves each movable axially to cover and uncover ports spaced axially of its respective valve, one of said valves being rockable about its axis, connections from said rockable valve to the other of said valves causing the rocking of said rockable valve to move said other valve axially, means controlled by said other valve in accordance with its axial position by selection of covered and uncovered ports to determine the direction of traverse of said carriage, means controlled by said rockable valve in accordance with its axial position to determine the speed of traverse of said carriage, and elements carried by said carriage in position to impinge upon and rock said rockable valve at desired limits of traverse determined by the axial position of said rockable valve.

21. In combination, a traversing carriage, power means for traversing said carriage comprising a pair of valves each movable axially to cover and uncover ports spaced axially of its respective valve, one of said valves being rockable about its axis, connections from said rockable valve to the other of said valves causing the rocking of said rockable valve to move said other valve axially, means controlled by said rockable valve in accordance with its axial position by selection of covered and uncovered ports to determine the direction of traverse of said carriage, a feed carriage, means for feeding said feed carriage transverse to the direction of traverse of said traversing carriage, means controlled by said rockable valve in accordance with its axial position to determine whether or not said feeding means is operative, and elements carried by said carriage in position to impinge upon and rock said rockable valve at desired limits of traverse determined by the axial position of said rockable valve.

22. In combination, a traversing carriage, power means for traversing said carriage comprising a pair of valves each movable axially to cover and uncover ports spaced axially of its respective valve, one of said valves being rockable about its axis, connections from said rockable valve to the other of said valves causing the rocking of said rockable valve to move said other valve axially, means controlled by said other valve in accordance with its axial position by selection of covered and uncovered ports to determine the direction of traverse of said carriage, a feed carriage, means for intermittently feeding said feed carriage at predetermined intervals transverse to the direction of traverse of said traversing carriage, means controlled by said rockable valve in accordance with its axial position to determine whether or not said feeding means is operative, and elements carried by said carriage in position to impinge upon and rock said rockable valve at desired limits of traverse determined by the axial position of said rockable valve.

23. In combination, a traversing carriage, power means for traversing said carriage comprising a pair of valves each movable axially to cover and uncover ports spaced axially of its respective valve, one of said valves being rockable about its axis, connections from said rockable valve to the other of said valves causing the rocking of said rockable valve to move said other valve axially, means controlled by said other valve in accordance with its axial position by selection of covered and uncovered ports to determine the direction of traverse of said carriage, elements carried by said carriage in position to impinge upon and rock said rockable valve at desired limits of traverse determined by the axial position of said rockable valve, and means controlled by said rockable valve at one axial position to render said traversing means inoperative and said carriage free to be traversed out of control of said power traversing means.

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