Nov. 10, 1964 H. F. BOEHME 3,156,072

GRINDING APPARATUS

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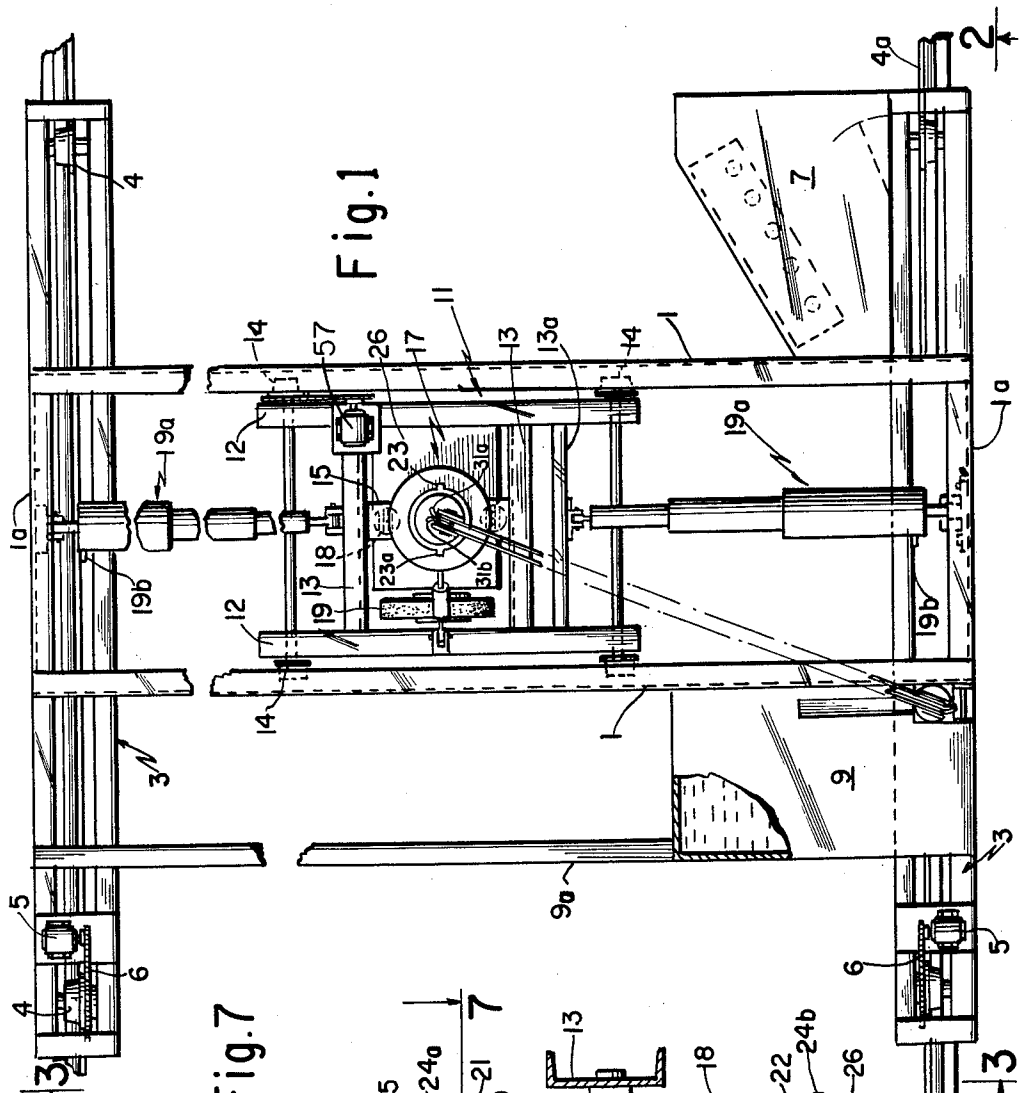


Fig. 1

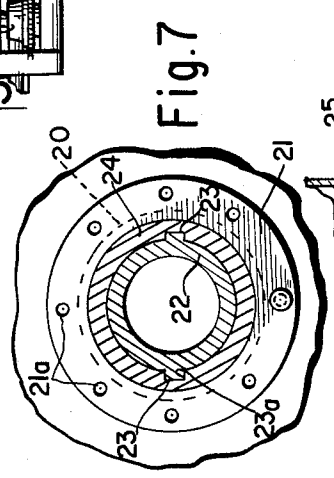


Fig. 7

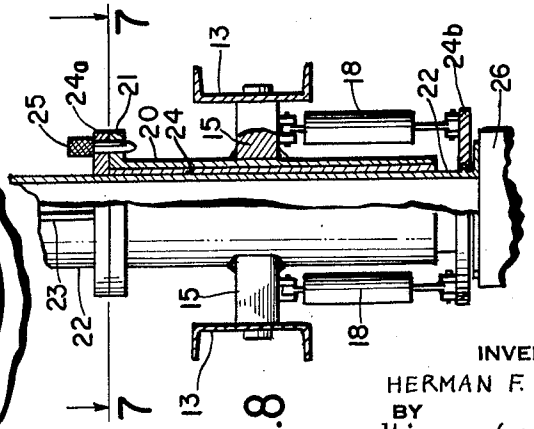


Fig. 8

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Fig. 2

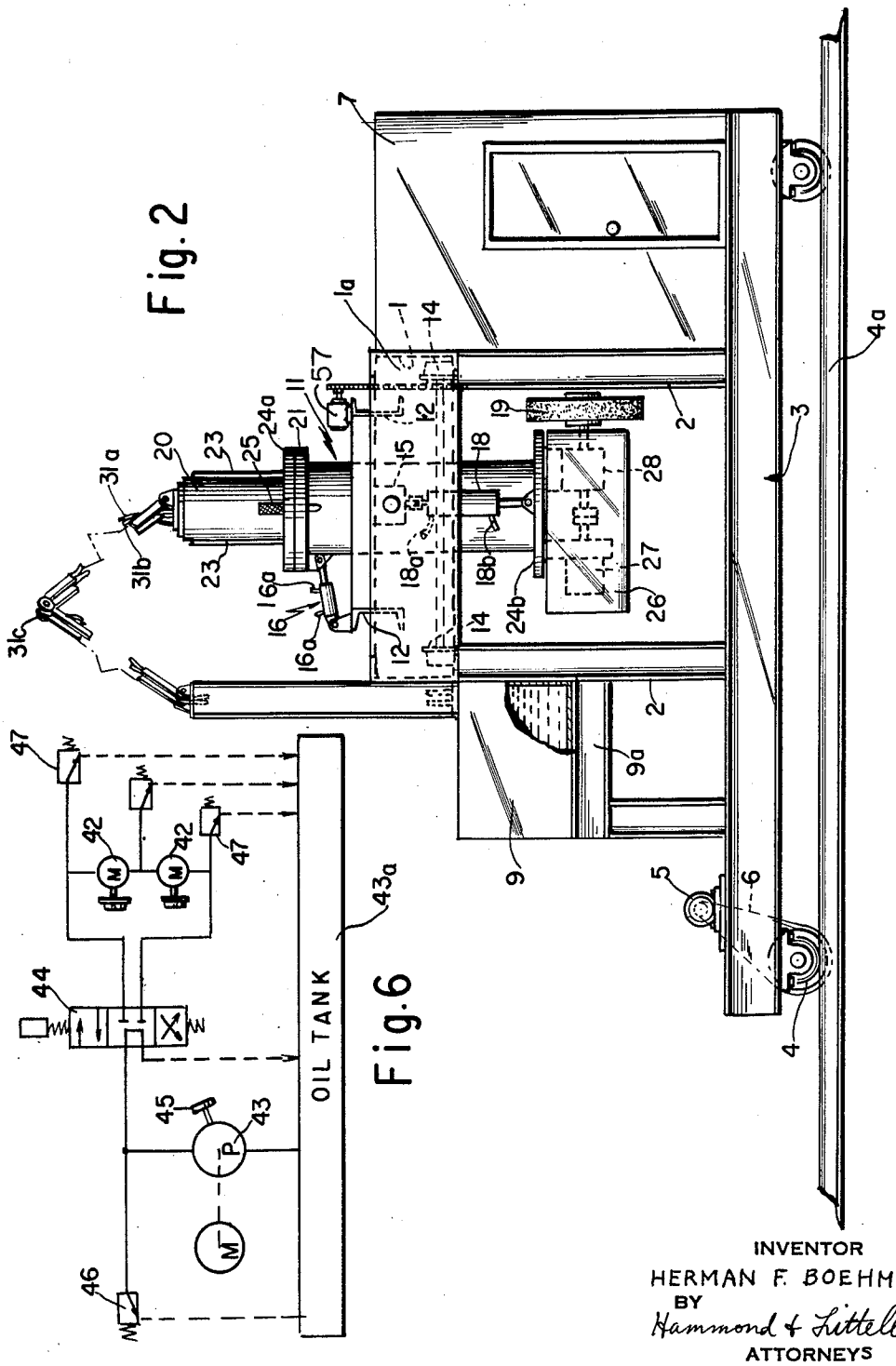


Fig. 6

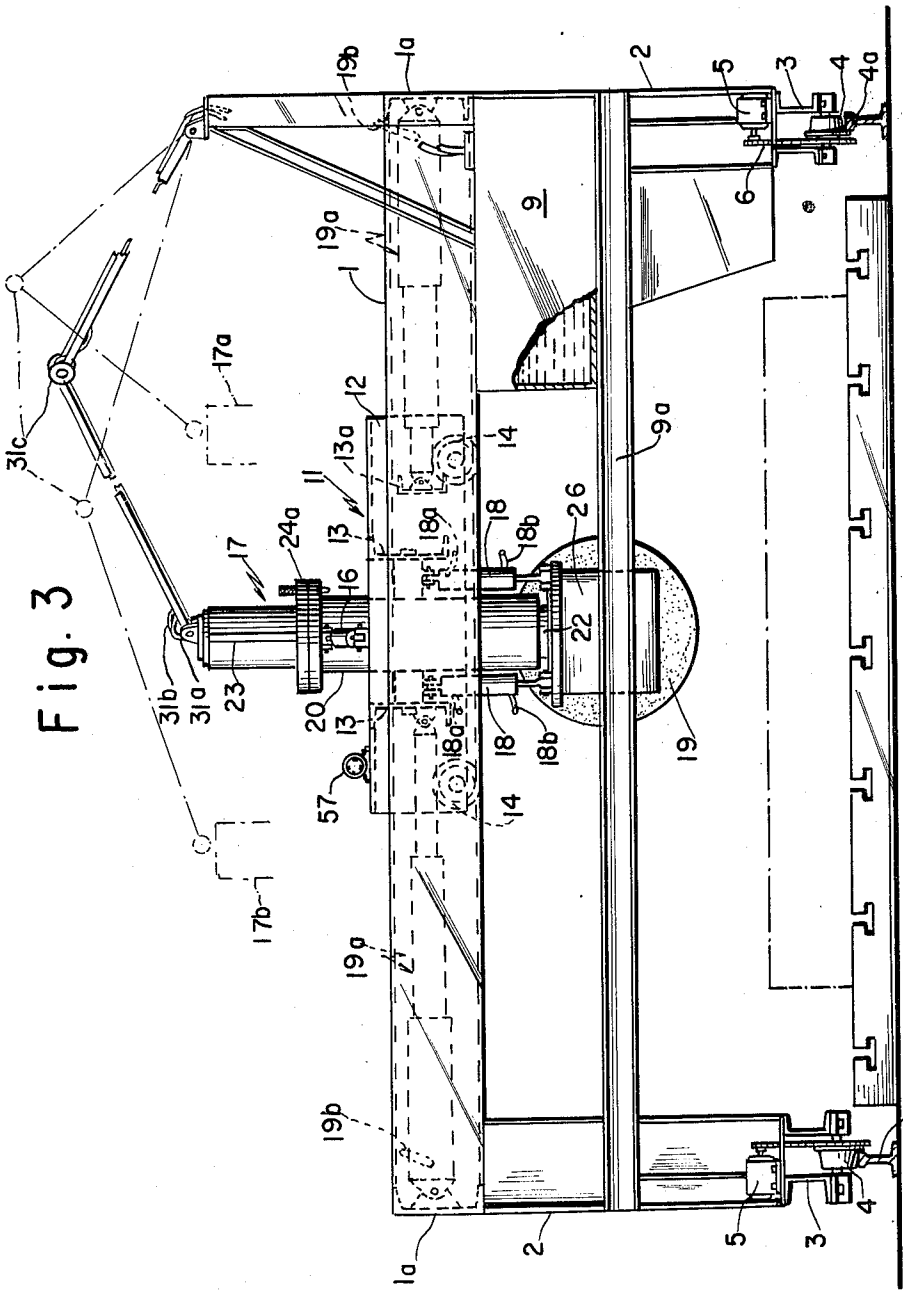
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Fig. 3



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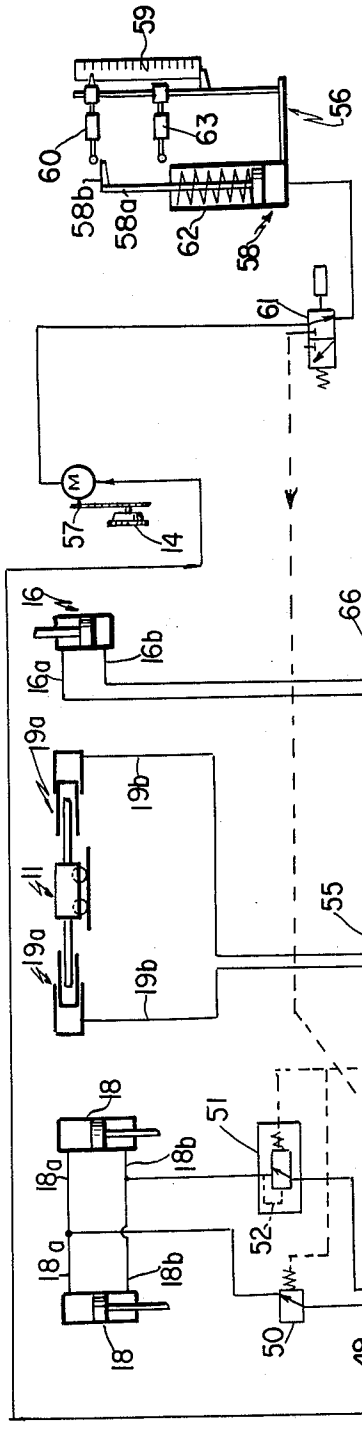


Fig. 5

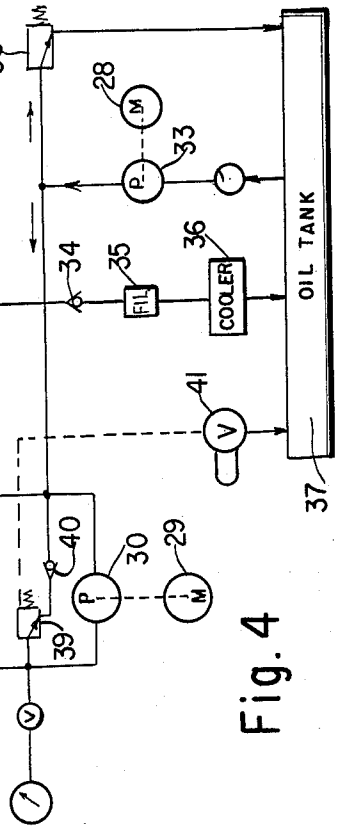


Fig. 4

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3,156,072

GRINDING APPARATUS

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Filed Nov. 9, 1962, Ser. No. 236,611
6 Claims. (Cl. 51—32)

This invention relates to grinding machines. More particularly, this invention relates to an improved surface grinder for grinding operations on large articles, such as metal billets or slabs, for scalping, descabing, leveling, etc.

In the prior art, such grinding machines have generally required an elaborate electrical control system for regulating the speed of the grinding wheel, the positioning of the wheel relative to the object being ground, and the movement of the grinding wheel over or along the object to be ground. Various difficulties have been encountered in the maintenance of the electrical equipment of grinders employed and their accuracy of control left much to be desired.

It is, therefore, an object of this invention to provide a grinding apparatus which is completely fluid powered, thereby eliminating elaborate electrical control systems and reducing the total cost.

A further object is to provide a grinding apparatus having a fluid power driven grinding wheel with a speed control to be selected stepless for the correct surface speed required for the grinding wheel diameter.

Another object is to provide a fluid powered grinding apparatus with a speed control for the grinding wheel providing an automatically adjustable speed for increasing the grinding wheel speed with the decreasing of the diameter of the grinding wheel due to wear.

Still another object is to provide a grinding apparatus having constant grinding pressure to be selected stepless for the required material to be ground.

A further object is to provide a grinding device to hold the grinding wheel in its horizontal grinding plane or position if the grinding wheel over-rides the grinding surface of the object being ground.

Another object is to provide in a grinding machine a device for indexing a grinding motion remotely selected by an operator.

Another object is to provide a grinding machine having a device to synchronize the movement of each side of a grinding bridge drive.

These and other objects of my invention will become apparent as the description thereof proceeds.

The present invention will be better understood by those skilled in the art, from the following description and the embodiment apparatus shown in the accompanying drawings, in which:

FIG. 1 shows a plan view of the complete apparatus.

FIG. 2 shows a side of the grinding apparatus substantially from the line 2—2 of FIG. 1.

FIG. 3 shows an end view of the grinding apparatus substantially from the line 3—3 of FIG. 1.

FIG. 4 shows the fluid driving and control system for the grinding wheel drive in diagrammatical outline.

FIG. 5 shows the fluid driving and control system for the trolley drive and the grinding device.

FIG. 6 shows the fluid driving and control system for the bridge drive in diagrammatical outline.

FIG. 7 shows a partial cross-sectional view taken along the lines 7—7 of FIG. 8, illustrating details of the vertical cylinders for controlling the raising and lowering and the indexing of the grinding wheel.

FIG. 8 shows a partial view in elevation with parts broken away of the telescoping means for elevating or lowering the grinding wheel.

The apparatus shown in the accompanying drawings, briefly described, comprises a bridge supported on two legs and movable longitudinally along tracks on each side of the object to be ground, a trolley movable transversely on said bridge, a grinding head suspended vertically from said trolley by a telescoping device supported on pivots and movable vertically, including a fluid motor coupled directly to a grinding wheel, and a fluid driving system for effecting longitudinal, transverse and vertical movement of the grinding wheel supports.

The bridge is a double-legged type (see FIGS. 1, 2 and 3) and comprises four upright legs and crossmembers 1*a* (which may be steel channel beams or the like) forming a substantially rectangular top structure having the supporting legs 2 at each corner and auxiliary crossmembers 9*a*. Legs 2 are supported by trucks 3 having wheels 4 running on rails 4*a*.

Two fluid motors 5 drive the wheels 4 on one end of each truck 3 over a chain reduction 6 to effect longitudinal movement of the bridge along rails 4*a*. An operator's cab 7 is mounted on the trucks 3. Fluid power unit 9 is mounted on trucks 3 by means of the structural members 9*a*.

A trolley 11 is mounted on U-shaped cross beams 1 extending between bridge beams 1*a* (see FIGS. 1, 2 and 3). The trolley comprises frame members 12 and crossmembers 13. Two pairs of wheels are attached to members 12 and roll on cross beams 1. Two pivot supports 15 are attached to trolley cross-members 13 for supporting the grinding head 17 described in greater detail below. A pair of double acting fluid cylinders 18 are attached to the lower side of pivot supports 15 for lowering and raising grinding head 17 and also applying grinding pressure to support flange 24*b* for grinding wheel 19. A fluid cylinder 16 is pivoted to one of the trolley frame elements 12 and to the adjacent side of grinding head cylinder 17 for oscillating cylinder 17 about pivots 15 and consequently providing an oscillating adjustment for grinding wheel 19.

A fluid cylinder 19*a* is mounted between each bridge cross-member 1*a* and trolley cross-members 13*a* (see FIGS. 1 and 2) for effecting transverse motion of the entire trolley 12. Fluid cylinders 19*a* may also be used for indexing a grinding operation and this operation will be explained more fully in subsequent paragraphs.

The grinding head 17 comprises an assembly of three telescoping cylinders 20, 22 and 24 (see FIGS. 7 and 8). Cylinder 20 is an outer, fixed cylinder supported on pivots 15 and is connected with the pivoting cylinder 16. Cylinder 20 also has a bearing flange 21.

An intermediate cylinder 24 fits within cylinder 20 and is stationary in the vertical direction. A flange 24*a* of cylinder 24 rests on flange bearing 21 of cylinder 20. Flanges 21 and 24*a* are pinned or bolted together during operation of the grinder by means of pins or lock screws 25 in threaded holes 21*a* of the flanges. The third cylinder 22 moves vertically within cylinder 24 and is guided and prevented from rotational movement by keys 23 on cylinder 22 which ride in keyways 23*a* in cylinder 24. Vertical movement of cylinder 22 is effected by means of fluid cylinders 18 attached at their upper ends to stationary pivot supports 15 and at their lower ends to flange 24*b* fitted to the lower end of cylinder 22 by a tongue and groove fit. The grinding head may be rotated in either direction in the horizontal plane. This is accomplished by removing lock screws 25 and rotating cylinder 24 until the openings 21*a* in flanges 21 and 24*a* coincide and relocking the flanges together. The keyed cylinder 22 is also thus rotated and the grinding wheel operates in the newly set position.

The grinding wheel head comprises a dustproof hous-

ing 26 connected to cylinder 22, a fluid motor 27, high speed bearings 28 and grinding wheel 19.

From the above description it will be apparent that movement of grinding wheel 19 is possible in five different directions. Longitudinal movement is effected by movement of the bridge longitudinally along the rails 4*a*, transverse movement by movement of the trolley 12 along U beams 1, vertical movement by fluid cylinders 18, oscillating movement in a vertical plane by fluid cylinder 16 and rotational movement in a horizontal plane by means of intermediate cylinder 24 in the grinding head assembly.

The movement of the various components of the grinding apparatus, and thus of the grinding wheel itself, is accomplished by an integrated fluid power system.

Those skilled in the art will understand from FIGS. 4, 5, and 6 and the following description the functioning of the fluid power system.

Fluid for the entire system is stored in separate compartments in fluid supply unit 9. The fluid power system is composed of three separate systems each operating from a separate compartment of fluid supply unit 9, but all controlled from a central control panel in the operator's cab 7.

Referring to FIG. 4, the fluid power system for grinding wheel 19 is operated from fluid tank 37 in fluid supply unit 9.

In this system, fluid is provided through inlets 31*a* and 31*b*. An electric motor 29 drives a fluid piston pump 30 having constant volume. The fluid is circulated through the pump 30 to a variable displacement fluid motor 31, driving the grinding wheel 19, and back to the pump 30. The fluid motor displacement is changed by a small electric motor 32. This electric motor 32 is operated from the cab 7 and thus it is possible to change the drive speed of the motor 31 by maintaining a constant horsepower on the grinding wheel. The speed selection is possible either in stopped or running conditions of the motor 31. A small fluid pump 33 supplies cooled fluid from tank 37 to the motor pump drive. The additional fluid supplied to the motor pump drive is released over a spring loaded check valve 34 through a filter 35 and a cooler 36 to the tank 37.

The pump 33 is protected from excess pressure by the relief valve 38. A check valve 40 prevents the fluid supply from pump 33 from entering a second relief valve 39. The relief valve 39 is remote-controlled by a valve 41 thus, if the valve 41 is open, the relief valve operates to relieve pressure out of the pump motor drive, which is necessary if the wheel drive is stopped and acts as a brake. Therefore, the solenoid valve 41 will be closed if the electric motor 28 and the grinding wheel are running. The solenoid valve 41 will be de-energized for closed position with the electric motor switch at running position.

Referring to FIG. 6, the fluid power system for longitudinal movement of the bridge may be seen. In this system two fluid motors 42, driving the wheels 4 with a constant displacement, are supplied with fluid pressure by a variable volume fluid pump 43 pumping from tank 43*a* over a valve 44. The volume of the pump 43 is variable by a handwheel 45, therefore, the two fluid motors have a variable speed which drives the bridge at variable speed. The two fluid motors 42 are connected in "series" which means each motor receives the same amount of oil and, therefore, is synchronized for rotation. The relief valve 46 protects pump 43. The relief valves 47 are used to act as a hydraulic brake for the bridge drive. If the motors are stopped or reversed, this taps oil in motors 42 to act as a brake until the valve setting of valves 47 is overcome then pressure is released.

Referring to FIG. 5, the fluid power system for transverse, vertical and oscillating movement and for indexing trolley movement is shown. In this system the double-acting cylinders 18 receive their fluid from a power unit

43 over a four-way valve 49, the pressure regulating valve 50 adjusts the pressure on the piston side of the cylinders 18 by feeding fluid through inlets 18*a* of the cylinder. Therefore, the grinding pressure on the grinding wheel is adjustable.

A counter-balancing valve 51 holds a pressure proportioantely and equivalent to the grinding head weight on the rod side of the cylinders 18 by feeding fluid into inlets 18*b* of each cylinder. Therefore, the grinding wheel does not drop if the valve 49 is positioned for the down motion of the grinding wheel. During the grinding operation the grinding pressure is variable by changing the pressure setting of the valve 50. If the grinding wheel over-rides the grinding material and the piston rods of the cylinders 18 do not receive any action from the grinding wheel, a pilot pressure acting on decreasing line 52 of the valve 51 closes the valve 51. Therefore, the grinding wheel does not drop if the wheel over-rides the grinding material. Both valves 50 and 51 are remote-controlled by a pilot valve 53 and adjustable at the same time for any selected grinding pressure. Therefore, the counter-balancing feature will be effective at any pressure setting.

The two telescoping cylinders 19*a* driving the trolley 11 also receive fluid from the power unit 48 over a four-way valve 55 through inlets 19*b*. The valve 55 directs the fluid either to one or the other cylinder depending on which way it is desired to traverse the grinding wheel. The valve 55 may be operated with a push button by the operator or, if desired, automatically as selected by an indexing device 56. The indexing device comprises a transmitter 57, a receiver 58 and a selector 59. The transmitter, a constant displacement fluid pump 57, is driven by one of the wheels 14 on trolley 11. Pump 57 delivers fluid to a receiver which is a fluid cylinder 58, proportionately to the movement of the trolley. Therefore, piston rod 58*a* of cylinder 58 travels proportionately to the trolley movement. The piston rod has a cam 58*b* at its end which trips limit switch 60 which is movably adjustable on the selector 59. The switch 60 closes the valve 55 and stops the movement of the trolley, thus indexing the trolley movement as selected by the operator. The switch 60 also opens valve 61 and spring 62 presses out the fluid of the cylinder 58 by returning piston rod 58*a* to the retracted position and cam 58*b* trips the switch 63 which will close the valve 61 and a new indexing may take place. Thus repeated traversing for a preset distance may be effected automatically by use of the indexing device.

As shown in FIG. 3, the fluid lines 31*a* and 31*b* are provided with a hanger means 31*c* which raises or lowers as trolley 11 traverses from position 17*a* to 17*b*. This keeps the fluid lines from hanging slack and possibly becoming entangled with moving elements of the apparatus.

A flow control valve 64 is used to adjust the trolley speed if operated manually. The oscillating motion of the grinding wheel is selected by the operator by use of valve 66 which will supply the fluid to cylinder 16 through inlets 16*a* and 16*b*.

While I have set forth specific embodiments and preferred modes of practice of my invention, it will be understood that this is solely to enable persons skilled in the art to better understand and practice the invention. It will be understood that the structural elements of my invention may comprise materials well known in the art and do not form a part of the invention subject matter. It will be understood that various changes and modifications may be made in my invention without departing from the spirit of the disclosure or the scope of the appended claims.

I claim:

1. A grinding apparatus comprising a longitudinally movable bridge, fluid power means on said bridge to move said bridge longitudinally in either direction, a trolley mounted on said bridge and movable transversely,

fluid power means to move said trolley transversely in either direction relative to said bridge, a vertically movable cylindrical carrier mounted on said trolley with its axis substantially perpendicular to the horizontal plane of said trolley, fluid power means to move said carrier in a vertical direction along its cylindrical axis, a variable speed grinding wheel mounted on said carrier powered by a variable displacement fluid motor, and means to oscillate said grinding wheel about an axis parallel to the horizontal diameter of said grinding wheel.

2. A grinding apparatus comprising a longitudinally movable bridge, fluid power means on said bridge to move said bridge longitudinally in either direction, a trolley mounted on said bridge and movable transversely, fluid power means to move said trolley transversely in either direction relative to said bridge, a vertically movable carrier pivotally mounted on said trolley, said carrier comprising concentric telescoping cylinders with the axis of said cylinders being perpendicular to the horizontal plane of said trolley, fluid power means to move said carrier in a vertical direction along its cylindrical axis and to oscillate said carrier about said pivot mounts, a variable speed grinding wheel mounted on said carrier powered by a variable displacement fluid motor.

3. A grinding apparatus comprising a longitudinally movable bridge, fluid power means on said bridge to move said bridge longitudinally in either direction, a trolley mounted on said bridge and movable transversely, fluid power means to move said trolley transversely in either direction relative to said bridge, including means to index said transverse movement, a vertically movable cylindrical carrier mounted on said trolley with its axis substantially perpendicular to the horizontal plane of said trolley, fluid power means to move said carrier in a vertical direction along its cylindrical axis, a variable speed grinding wheel mounted on said carrier powered by a variable displacement fluid motor, and means to oscillate said grinding wheel about an axis parallel to the horizontal diameter of said grinding wheel.

4. A grinding apparatus comprising a longitudinally movable bridge, fluid power means on said bridge to move said bridge longitudinally in either direction, a trolley mounted on said bridge and movable transversely, fluid power cylinders operatively connected between said bridge and trolley to move said trolley transversely in either direction relative to said bridge, indexing means for said transversely movement operatively connected to said trolley and controlled thereby, a vertically movable cylindrical carrier mounted on said trolley with its axis substantially perpendicular to the horizontal plane of said trolley, fluid power means to move said carrier in a vertical direction along its cylindrical axis, a variable speed grinding wheel mounted on said carrier powered by a variable displacement fluid motor, and means to oscillate said grinding wheel about an axis parallel to the horizontal diameter of said grinding wheel.

5. A grinding apparatus comprising a longitudinally movable bridge, fluid power means on said bridge to move said bridge longitudinally in either direction, a trolley mounted on said bridge and movable transversely, fluid power means to move said trolley transversely in either direction relative to said bridge, a carrier mounted substantially vertically on said trolley, said carrier comprising inner and outer concentric cylinders with the outer cylinder pivotally mounted on said trolley, double-acting fluid power cylinders to move said inner cylinder up and down in a vertical direction, a fluid cylinder operatively connected between said trolley and said carrier to oscillate said carrier about said pivot mounts, a variable speed grinding wheel mounted on the lower end of said inner cylinder of said carrier powered by a variable displacement fluid motor, means to keep a constant downward pressure and a constant upward pressure in said double acting fluid power cylinders during grinding, and means to maintain said upward pressure when said grinding wheel over-rides.

6. A grinding apparatus comprising a longitudinally movable double legged bridge having an overhead frame, fluid power operated means on said bridge to move said bridge longitudinally in either direction, a trolley mounted on said overhead frame of said bridge and movable transversely, fluid power means to move said trolley transversely in either direction relative to the carriage, a vertically movable carrier comprising concentric cylinders, the outer cylinder being mounted on said trolley, the inner cylinder being slidable within said outer cylinder, fluid power means operatively connected between said inner and outer cylinders to move said inner cylinder in a vertical direction, means to rotate said inner cylinder within said outer cylinder in a horizontal plane and lock said rotational movement, a variable speed grinding wheel mounted on the lower end of said carrier powered by a variable displacement fluid motor, means to vary the speed of said grinding wheel to compensate for decreasing diameter due to wear and obtain a constant surface speed of said wheel, and fluid power means to oscillate said grinding wheel about a horizontal axis parallel to the horizontal diameter of said grinding wheel.

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