

Jan. 24, 1967

Filed Nov. 21, 1963

E. M. WOODFORD
HYDRAULIC STARTING DEVICE FOR AN ELECTRIC MOTOR WHICH DRIVES
HEAVY MACHINE ELEMENTS

3,300,697

3 Sheets-Sheet 1

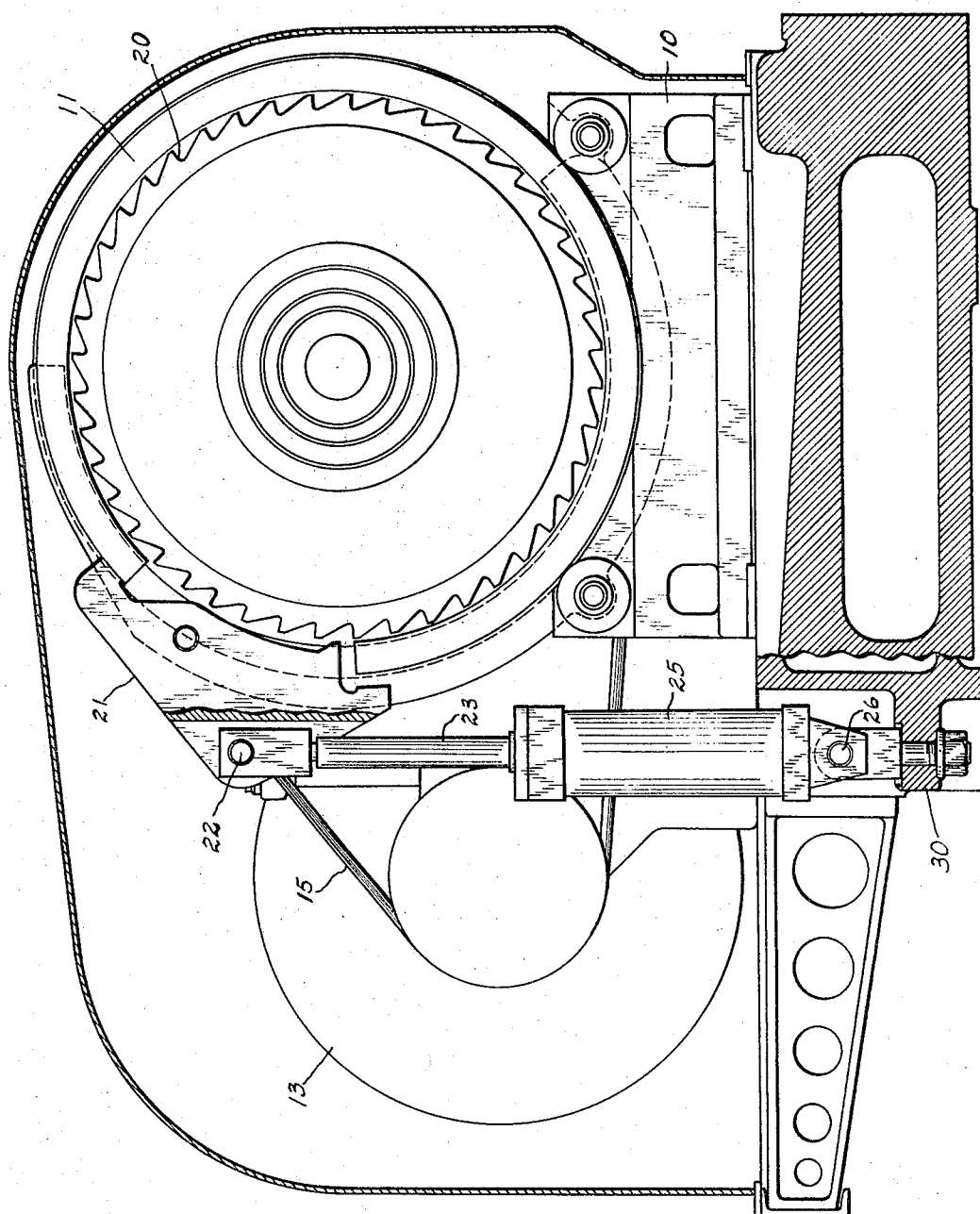


Fig 1

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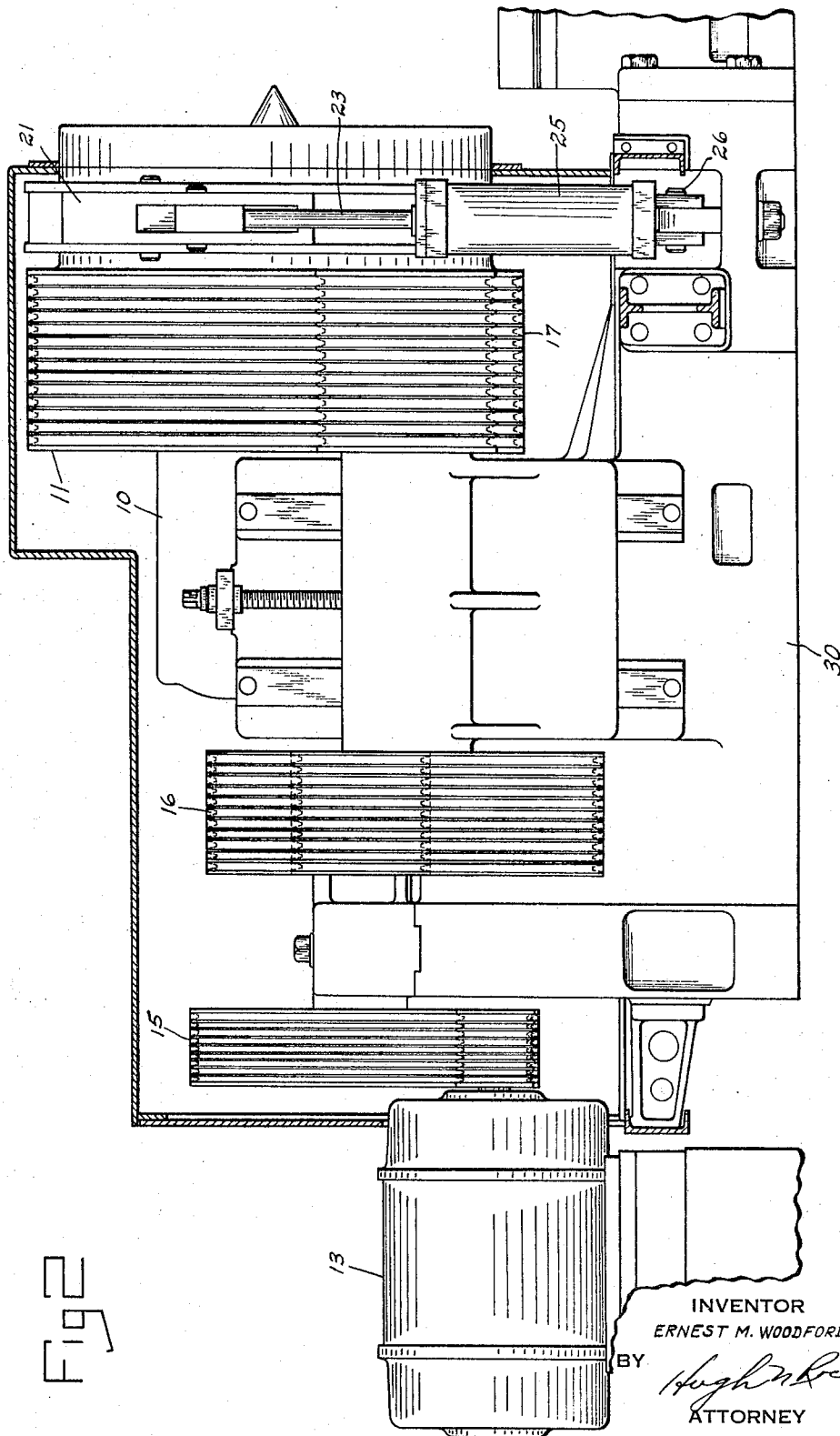


Fig. 2

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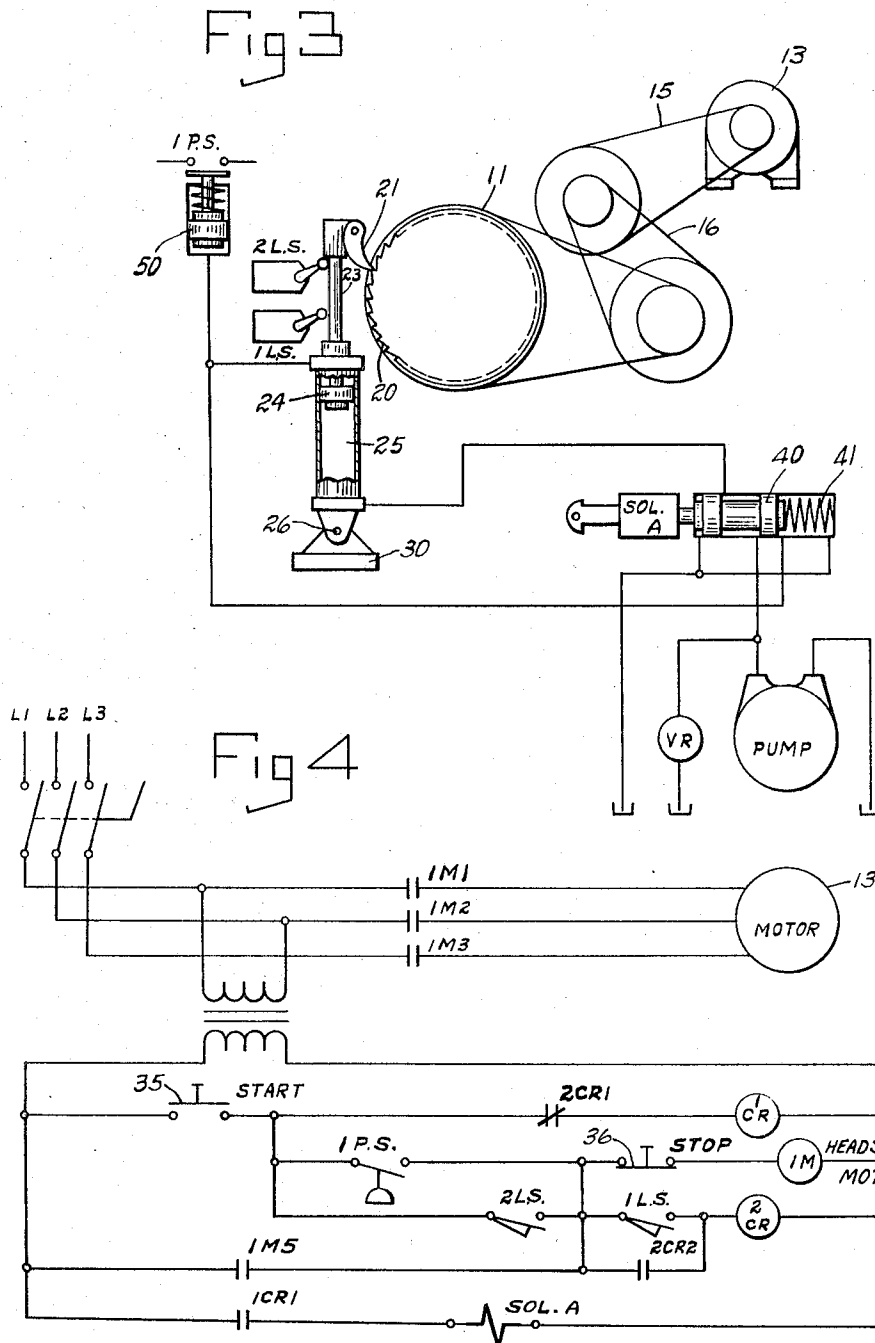
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HYDRAULIC STARTING DEVICE FOR AN ELECTRIC MOTOR WHICH DRIVES HEAVY MACHINE ELEMENTS

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Filed Nov. 21, 1963, Ser. No. 325,267

7 Claims. (Cl. 318-136)

This invention relates to machine tools, particularly cylindrical grinding machines or lathes for machining heavy workpieces such as steel mill rolls.

In machines of this type, power required to start work rotation is far in excess of that required to keep the work turning once it has been started. Driving belts capable of keeping the work turning may not be capable of transmitting sufficient power for starting. Auxiliary starting motors have been used which function only until the work drive motor is in operation. Most of these require the use of a mechanical speed reducer.

It is, therefore, an object of the present invention to provide a simple and inexpensive auxiliary starting device for machines such as roll grinders and roll cutting lathes.

Another object is to provide an auxiliary starting device which would not require a mechanical speed reducer.

Another object is to provide an auxiliary starting device which consists mainly of a direct acting reciprocable member.

Another object is to provide an auxiliary starting device which returns to starting position after a predetermined movement.

FIG. 1 is an end elevation of an auxiliary starting means for a headstock drive.

FIG. 2 is a front elevation of a headstock drive mechanism.

FIG. 3 is a hydraulic diagram.

FIG. 4 is an electric diagram.

Headstocks of this type usually have a non-rotating spindle and center. The face plate and work driving connection is, therefore, attached to the pulley which rotates on the headstock spindle.

Numerals 10 indicates the headstock casting. Pulley 11 which is rotatably mounted on the headstock spindle (not shown) is driven by headstock motor 13 through a series of belt drives 15, 16 and 17. Ratchet 20 is mounted for rotation with pulley 11.

Means for actuating ratchet 20 consists of a pawl 21 which is pivotally attached at 22 to piston rod 23 having a piston 24 slidably mounted in cylinder 25. Cylinder 25 is pivotally mounted at 26 and bed 30. The dimensions of piston 24 and cylinder 25 are such that pawl 21 is capable of exerting a torque substantially equal to that of motor 13.

OPERATION

Headstock motor 13 is started by closing start switch 35 to complete a circuit through normally closed relay contact 2CR1 to energize relay 1CR.

Relay contact 1CR1 completes a circuit to energize valve solenoid A which shifts valve 40 to the right against spring 41 and directs fluid from the pump to the upper end of cylinder 25.

Piston 24 moves downwardly, causing pawl 21 to engage one of the teeth of ratchet 20 to start rotation of pulley 11.

The pressure required to shift piston 24 acts on piston 50 of pressure switch PS to close said switch and complete a circuit through stop switch 36 to energize motor relay 1M.

Limit switch 2LS, closed by downward movement of pawl 21, parallels pressure switch 1PS to start motor 13, in case pressure in pawl cylinder 25 is not enough to close pressure switch 1PS.

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Motor relay contact 1M5 is a holding contact, maintaining the circuit not only to relay 1M, but also through pressure switch PS and normally closed relay contact 2CR1 to hold relay 1CR.

Start switch 35 may now be released and opened.

The combined turning force of motor 13 and piston 24 acting on pulley 11 is sufficient to overcome starting friction and inertia.

As soon as piston 24 reaches the end of its stroke and motor 13 takes over rotation of pulley 11, limit switch 1LS is actuated by movement of pawl 21 to complete a circuit to energize relay 2CR.

Relay contact 2CR2 with relay contact 1M5 provides a holding circuit around limit switch 1LS.

Normally closed relay contact 2CR1 opens to deenergize relay 1CR.

Relay contact 1CR1 opens to deenergize valve solenoid A.

Valve 40 moves to the left, directing fluid from the pump to the lower end of cylinder 25.

Piston 24 moves upwardly to reset pawl 21 out of contact with ratchet 20.

Pressure switch 1PS opens when the rod end of cylinder 25 is connected to exhaust.

Limit switch 1LS opens when released by resetting pawl 21.

At the end of a grinding operation, the entire circuit is reset by opening stop switch 36 to deenergize motor relay 1M and stop motor 13.

Motor relay contact 1M5 opens to deenergize relay 2CR.

Normally closed relay contact 2CR1 closes in the circuit to relay 1CR in preparation for the next starting of motor 13.

I claim:

1. In a headstock for a machine tool for machining heavy workpieces in which the power required to start rotation of said workpiece is substantially greater than that required to maintain rotation, a work drive member, a motor for driving said work drive member, means for assisting said motor to initiate rotation of said work drive member comprising ratchet teeth on said work drive member, and a hydraulically operated pawl for engaging said ratchet teeth to start rotation of said work drive member, a supply of power for operating said motor, a supply of fluid under pressure, and a pressure switch operable by said fluid under pressure when applied to said hydraulically operated pawl to connect said motor with said power supply.

2. In a headstock for a machine tool for machining heavy workpieces in which the power required to start rotation of said workpieces is substantially greater than that required to maintain rotation, a work drive member, a motor for driving said member, means for assisting said motor to initiate rotation of said member comprising ratchet teeth on said member, and a hydraulically operated pawl for engaging said ratchet teeth to start rotation of said member, a supply of fluid under pressure, a solenoid valve normally in position to direct said fluid under pressure to hold said pawl in starting position, means to energize said solenoid to shift said valve to a position to actuate said pawl, a supply of power for operating said motor, and control means operable in cooperation with said pawl to connect said motor with said power supply.

3. In a headstock for a machine tool for machining heavy workpieces in which the power required to start rotation of said workpiece is substantially greater than that required to maintain rotation, a work drive member, a motor for driving said member, means for assisting said motor to initiate rotation of said member comprising ratchet teeth on said member, a hydraulically operated pawl for engaging said ratchet teeth to start rotation of

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said member, a hydraulic circuit for controlling the operation of said pawl, a supply of power for operating said motor, and a pressure switch in said hydraulic circuit to connect said motor with said power supply.

4. In a headstock for a machine tool for machining heavy workpieces in which the power required to start rotation of said workpieces is substantially greater than that required to maintain rotation, a work drive member, a motor for driving said member, means for assisting said motor to initiate rotation of said member comprising a hydraulically operated device, co-acting means on said work drive member and said hydraulically operated device for starting rotation of said work drive member, a supply of fluid under pressure, means to direct said fluid under pressure to said hydraulically operated device, and a pressure switch operable by said fluid under pressure to start said motor.

5. In a headstock for a machine tool for machining heavy workpieces in which the power required to start rotation of said workpieces is substantially greater than that required to maintain rotation, a work drive member, a motor for driving said member, means for assisting said motor to initiate rotation of said member comprising ratchet teeth on said member, a hydraulically operated pawl for engaging said ratchet teeth to start rotation of said member, a supply of power for operating said motor, a hydraulic circuit for said pawl including a supply of fluid under pressure, a pressure switch in said circuit, a limit switch actuated by said pawl, said pressure switch and said limit switch being connected in parallel between said power supply and said motor.

6. In a headstock for a machine tool for machining heavy workpieces in which the power required to start rotation of said workpieces is substantially greater than that required to maintain rotation, a work drive member, a motor for driving said member, means for assisting said motor to start said member comprising a hydraulically operated reciprocating member, means for engaging and dis-engaging said reciprocating member with said work

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drive member, a supply of fluid under pressure, means to direct said fluid under pressure to said reciprocating member to start rotation of said work drive member, a pressure switch operable by said fluid under pressure to start said motor, a limit switch in parallel with said pressure switch, a circuit through said limit switch to said motor operable by movement of said reciprocating member for starting said motor in case the hydraulic pressure is not sufficient to actuate said pressure switch.

7. In a headstock for a machine tool for machining heavy workpieces in which the power required to start rotation of said workpieces is substantially greater than that required to maintain rotation, a work drive member, a motor for driving said member, means for assisting said motor to start said member comprising a reciprocating member, means for engaging and dis-engaging said reciprocating member with said work drive member, means responsive to movement of said reciprocating member for energizing said motor, and means operable by said reciprocating member at one end of its stroke for reversing and resetting said reciprocating member for the next starting operation.

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