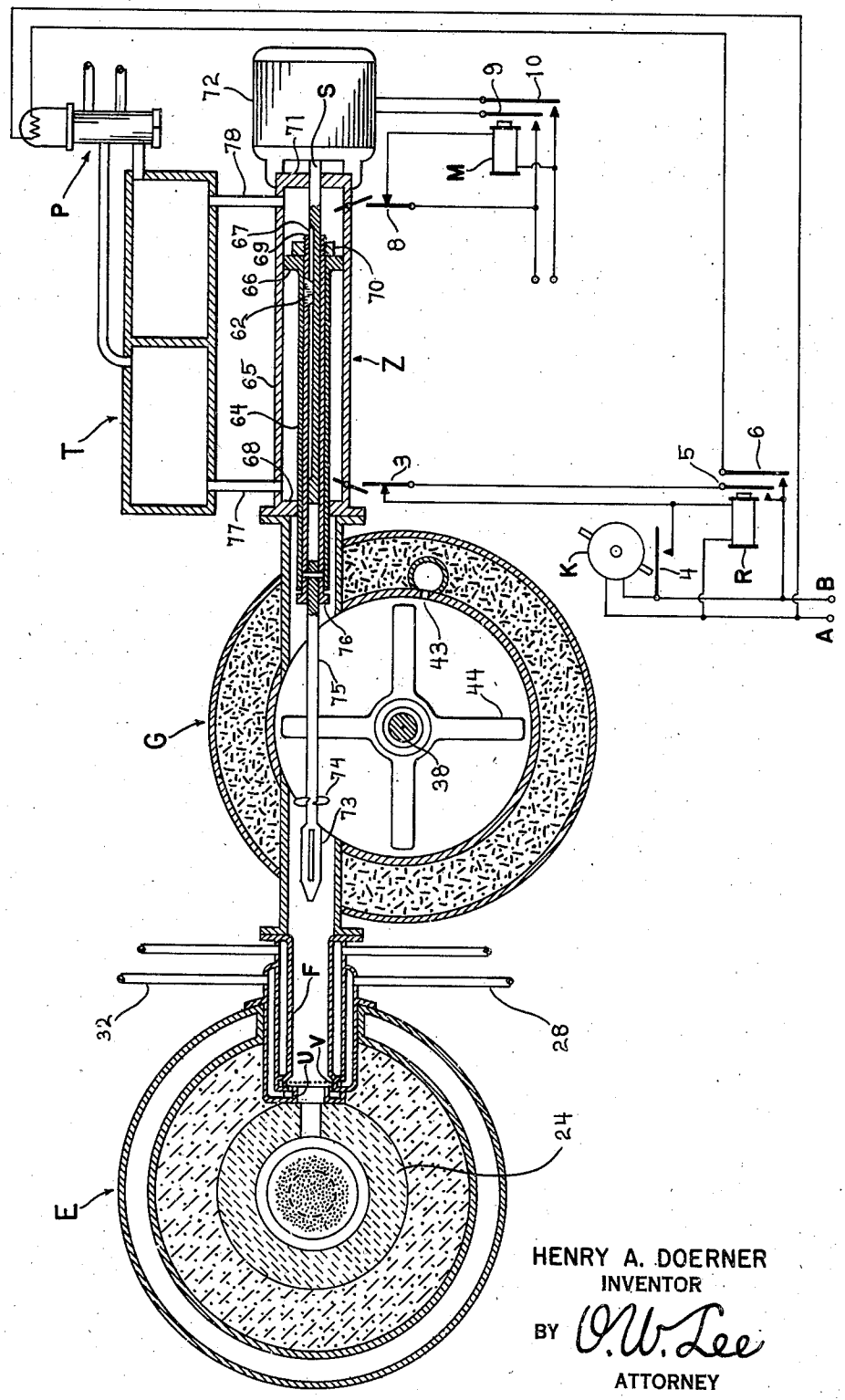
July 10, 1945. H. A. DOERNER 2,380,098

AUTOMATIC REAMER

Filed Jan. 23, 1943



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Patented July 10, 1945 2,380,098

UNITED STATES PATENT OFFICE

2,380,098

AUTOMATIC REAMER

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Application January 23, 1943, Serial No. 473,325

12 Claims. (Cl. 266—42)

The present invention relates to certain new and useful improvements in an automatic reamer for keeping the orifice of a thermal reduction furnace free of deposits which congeal in the orifice at high temperatures well above the melting point of most metals.

The invention was a part of my application Serial No. 372,293 filed December 30, 1940, which matured into Patent No. 2,328,202 issued August 31, 1943, for a Process of producing magnesium metal, and is particularly efficient for that special purpose.

In the thermal reduction of MgO and carbon to form magnesium metal, the reaction temperature is about 2000° centigrade and there occurs some vaporization of the traces of silica which is usually present in the original material. This vaporized silica congeals in the orifice of the thermal reduction furnace and forms a hard deposit which also contains some carbon and some MgO due to slight reversal of reaction and to minor escape of particles of the original charge. Unless constantly removed, this hard deposit gradually accumulates in the orifice and will soon completely block the outlet of the thermal reduction products, and render the equipment inoperable.

The present invention provides a motor driven reamer which is periodically reciprocated by a hydraulic ram so as to frequently ream out the orifice by quickly inserting and withdrawing the rotating reamer. Means are provided to supply a spray of liquid outside the orifice so that the reamer is cooled as it enters and leaves the orifice. During the inactive periods, the reamer is retracted to a convenient distance so as not to interfere with the output of the thermal reduction products. The interval between the periodic reciprocations of the reamer is controlled by a clock mechanism, and means are provided for the ram to automatically reverse itself at the end of the advance stroke of the reamer.

The reamer is arranged so as to operate through a receiving chamber or separator, into which the thermal reduction products are received, and the entire equipment is completely enclosed so as to exclude air from the system, as is essentially necessary in the production of magnesium metal by thermal reduction of MgO and carbon.

The drawing shows a plan view of the invention in sectional detail and includes a wiring diagram for periodically operating the hydraulic ram and motor.

The reamer device is collectively indicated at Z and comprises a hydraulic ram cylinder 65 having a reciprocating piston head 66 to which there is secured a tubular plunger 64, which reciprocates through the head 68 of this ram. A sleeve 69 is rotatably mounted in this plunger and held in longitudinal relation thereto by the nut 70 and head 76. A motor 72 is mounted on the head 71 of this ram and the motor shaft S passes through this head and is slidably mounted in the sleeve 69 by a key 62 traveling in a key-way 67 as shown. It will thus be seen that the motor can be used to drive the sleeve 69 which is reciprocated by the piston head 66 and its attached plunger 64. Secured in the sleeve head 76 is a reamer shaft 75 which carries propellers 74 and a cutting head 73 which serves as the reamer tool. This cutting head may be of any suitable material sufficiently hard for high speed cutting, as for instance, the commercially obtainable Carboloy is particularly satisfactory for the purpose.

The described structure is mounted so as to operate through a separator G which is the same as disclosed in my aforesaid Patent No. 2,328,202 and need not be described here and is further connected by the flue F to the thermal reduction furnace E which is the same as in my aforesaid patent and need not be here described. The flue F is centered with the orifice of the furnace E and spray channels U and V each having a multiplicity of small apertures, are provided for spraying a liquid through either of the pipes 28 or 32 and preferably the liquid is atomized by a gas supplied through one of these pipes while the liquid is supplied through the other. It will be seen that the reamer head 73 will pass through this spray of liquid in entering and leaving the orifice of the furnace.

The reciprocation of the ram is accomplished by pressure alternately supplied through the pipes 77 and 78 which are here shown connecting the ram to opposite sides of the double compartment tank T which is preferably supplied with oil and selectively subjected to air pressure through the magnetic valve P which is of course connected to an air pressure line, and its exhaust pipe may lead to a receptacle for collecting any oil froth that may happen to form. This embodiment is preferable, but of course the pipes 77 and 78 could be connected directly to the valve P so as to operate the ram by air pressure alone.

To provide for periodic energizing of the valve P it is connected to the current supply A and the circuit is completed to the line B through the normally open switch 6 which is closed by ener-

gizing the relay R. The line A is directly connected to the relay R and the circuit is completed through the normally open switch 4 which is periodically closed by the clock mechanism K which is here shown as supplied with current from the terminals A—B but of course might be spring operated instead.

The relay R is rendered self locking by the switch 5 which also completes the circuit through the normally closed switch 3 which is opened by the forward stroke of the ram Z.

When this relay R is energized by closure of the switch 4 it will close the switch 6 and supply current to operate the valve P to provide pressure through the pipe 78 to move the piston 66 forward until its full stroke opens the switch 3 and breaks the circuit to the relay R and open the switch 6 so as to reverse the valve P and supply pressure through the pipe 77 to the opposite side of the piston and return it to its initial position, where it remains until the clock K again closes the switch 4.

The motor 72 may be constantly driven or any suitable means may be provided to stop the motor during each inactive period of the ram. In the present instance there is shown two normally open switches 9 and 10 through which power is supplied when closed by the relay M which is connected to one terminal of a power source and the circuit is completed through the normally closed switch 8 which is held open by the piston head 66 when in its initial stationary position. The power source may be the terminals A—B, but in the present instance separate terminals are shown, as it is sometimes desirable to use a D—C motor and an A—C valve, or vice versa.

In operation it is necessary that the reamer head 73 enter and leave the orifice very quickly, because otherwise most cutting tools would not withstand the high temperature. This necessitates that the reaming be done frequently, be cause otherwise the accumulation in the orifice would be too much to be cut away quickly. For this reason the clock K should operate to close the switch 4 at intervals of say about every five minutes, or less if desired. The ram should operate at sufficient rate to complete its strokes in both directions in a few seconds.

As disclosed in my aforesaid Patent No. 2,328,202, the magnesium metal issues from the thermal reduction furnace as a vapor and is shock cooled by a spray of liquid hydrocarbons so that the metal condenses in fine particles which are enveloped in globules of the unvaporized hydrocarbons so as to produce a thick sludge in the separator G. In the operation of the present invention, as the reamer passes through the flue F the propellers 74 wind their way through the flue, and as the reamer is withdrawn, the propellers 74 will effectively clear the flue of any accumulation of sludge so as to preclude accumulation on the flue walls.

From the described operation it will be seen that the invention can be used to ream the orifice of the furnace, and also to clear the flue F of any accumulation, and that the invention is operated at frequent intervals during the constant operation of the thermal reduction furnace, and that air is excluded from the system as is essentially necessary. The operation is entirely automatic, as is essentially necessary for utilizations of this kind where the equipment must be operated twenty-four hours a day, for commercial practicability.

In the present application, I claim as my invention:

1. An automatic reamer comprising a piston within a cylinder, a tubular plunger carried by said piston, a sleeve rotatably mounted within said plunger and held against longitudinal movement relative thereto, a reamer shaft secured to the outer end of said sleeve, a cutting head and propeller blades secured to said shaft, an elongated shaft mounted within said sleeve and slidably engaged therewith by a key traveling in a keyway so as to rotate said sleeve during reciprocation thereof, a motor for driving the latter said shaft, an electromagnetic valve selectively supplying pressure to opposite sides of said piston, a self-locking relay for energizing said valve, a clock operated circuit for periodically energizing said relay, a normally closed switch opened by the stroke of said piston to break the circuit to said relay and reverse said valve, and a circuit for said motor including a normally closed switch held open by said piston in its initial stationary position.

2. An automatic reamer comprising a stationary cylinder having a pressure operated piston therein, a cutting head reciprocated by said piston, a motor rotating said cutting head, clock actuated means to periodically supply pressure to advance said piston means operated by said piston to reverse the pressure and return the piston to its initial position and hold the same stationary until the next period of operation, and means operated by said piston at its stationary position to render said motor inoperative while said piston is stationary.

3. An automatic reamer comprising a motor driven cutting head including clock actuated means to periodically reciprocate the same into and out of an orifice to be reamed, a receiving chamber through which said reamer reciprocates, a flue for connecting said chamber to an orifice to be reamed, and propellers carried by said reamer for removing material from said flue and out into said receiving chamber.

4. An automatic reamer comprising a piston within a cylinder, a tubular plunger carried by said piston, a sleeve rotatably mounted within said plunger and held against longitudinal movement relative thereto, a reamer shaft secured to the outer end of said sleeve, a cutting head secured to said shaft, an elongated shaft mounted within said sleeve and slidably engaged therewith by a key traveling in a keyway so as to rotate said sleeve during reciprocation thereof, a motor for driving the latter said shaft, an electromagnetic valve selectively supplying pressure to opposite sides of said piston, a self-locking relay for energizing said valve, a clock operated circuit for periodically energizing said relay, and a normally closed switch opened by the stroke of said piston to break the circuit to said relay and reverse said valve.

5. An automatic reamer comprising a piston within a cylinder, a tubular plunger carried by said piston, a sleeve rotatably mounted within said plunger and held in longitudinal relation therewith, a reamer shaft fixed to said sleeve, a cutting head secured to the end of said shaft, a motor having a shaft slidably keyed inside said sleeve, clock actuated means for periodically supplying pressure to advance said piston, means operated by the stroke of said piston to reverse the same and return it to stationary position, and a self closing switch held open by said piston at its stationary position so as to operate said

motor only during the movements of said piston.

6. An automatic reamer comprising a piston within a cylinder, a tubular plunger carried by said piston, a sleeve rotatably mounted within said plunger and held in longitudinal relation therewith, a reamer shaft fixed to said sleeve, a cutting head secured to the end of said shaft, a motor having a shaft slidably keyed inside said sleeve, clock actuated means for periodically supplying pressure to advance said piston, and means operated by the stroke of said piston to reverse the same and return it to the initial position and hold the same stationary until the next period of operation.

7. An automatic reamer comprising a hydraulic ram including a piston having a hollow plunger secured thereto, a sleeve rotatably mounted in said plunger and held in longitudinal relation therewith, a reamer shaft fixed to said sleeve, a cutting head secured to the end of said shaft, radially disposed propeller blades secured to said shaft, a motor having a shaft slidably keyed inside said sleeve, a casing through which said reamer reciprocates, a spray flue for connecting said casing to an orifice to be reamed, clock actuated means for periodically supplying pressure to advance the piston of said ram, and means operated by the stroke of said piston to reverse the same and return it to the initial position and hold the same stationary until the next period of operation.

8. An automatic reamer comprising a hydraulic ram including a piston having a hollow plunger secured thereto, a sleeve rotatably mounted in said plunger and held in longitudinal relation therewith, a reamer shaft fixed to said sleeve, a cutting head secured to the end of said shaft, a motor having a shaft slidably keyed inside said sleeve, a casing through which said reamer reciprocates, a spray flue for connecting said casing to an orifice to be reamed, clock actuated means for periodically supplying pressure to advance the piston of said ram, and means operated by the stroke of said piston to reverse the same and return it to the initial position and hold the same stationary until the next period of operation.

9. An automatic reamer comprising a hydraulic ram including a piston having a hollow plunger secured thereto, a sleeve rotatably mounted in said plunger and held in longitudinal relation therewith, a reamer shaft fixed to said sleeve, a cutting head secured to the end of said shaft, a motor having a shaft slidably keyed inside said sleeve, a casing through which said reamer reciprocates, a spray flue for connecting said casing to an orifice to be reamed, clock actuated means for periodically supplying pressure to advance the piston of said ram, means operated by the stroke of said piston to reverse the same and return it to stationary position, and a self closing switch held open by said piston at its stationary position so as to operate said motor only during the movements of said piston.

10. An automatic reamer comprising a piston within a cylinder, a tubular plunger carried by said piston, a sleeve rotatably mounted within said plunger and held against longitudinal movement relative thereto, a reamer shaft secured to the outer end of said sleeve, a cutting head secured to said shaft, an elongated shaft mounted within said sleeve and slidably engaged therewith by a key traveling in a keyway so as to rotate said sleeve during reciprocation thereof, a motor for driving the latter said shaft, and means to reciprocate said piston.

11. An automatic reamer comprising a stationary cylinder having a pressure operated piston therein, a cutting tool reciprocated by said piston, a motor for rotating said cutting tool, an electromagnetic valve selectively supplying pressure to opposite sides of said piston, a self-locking relay for energizing said valve, a clock operated circuit for periodically energizing said relay, and a normally closed switch opened by the stroke of said piston to break the circuit to said relay and reverse said valve.

12. An automatic reamer comprising a stationary cylinder having a pressure operated piston therein, a cutting tool reciprocated by said piston, a motor for rotating said cutting tool, an electromagnetic valve selectively supplying pressure to opposite sides of said piston, a self-locking relay for energizing said valve, a clock operated circuit for periodically energizing said relay, a normally closed switch opened by the stroke of said piston to break the circuit to said relay and reverse said valve, and a circuit for said motor including a normally closed switch held open by said piston in its initial stationary position, so that said motor operates only during the reciprocation of said piston.

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