AIR HAMMER APPARATUS OF A TUYERE CHANGING MACHINE FOR A BLAST FURNACE

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ABSTRACT OF THE DISCLOSURE

An air hammer apparatus wherein a piston having an axially bored piston rod is fitted into an air cylinder, and a guide rod, at both ends of which stoppers may be fixed, is freely slideable in the bore of said piston rod so that air may be sent into one or the other end of the said air cylinder to move the piston and piston rod in either direction and one end surface of said piston rod may collide with one stopper in driving a tuyere or the other end surface of said piston rod may collide with the other stopper in pulling out a tuyere.

Detailed explanation of the invention

Most of the work during the shut down of a blast furnace for iron production is occupied with the changing of the tuyere most of which is burnt down. Especially, in case where the tuyere is burnt down during the operation of the blast furnace, it is required to stop sending the blast and change the burnt tuyere in a short period of time. Currently, even in an emergency like this, it usually requires eight to twelve workers to change one tuyere and takes one to two hours, and in case where the tuyere is severely burnt and deposition takes place, it takes two to four hours to change a tuyere.

Tuyeres weighing about 100 kg to 1,000 kg, and other parts of blast pipes are taken off and reinstalled mostly by human power using such tools as large hooks made of forged steel, chain blocks, etc., which method has not changed for the past several decades. In the domestic iron manufacturing factories, it is difficult to employ a large enough number of workers for said furnace maintenance operation because of the bad working environment on account of the leakage of the poisonous gases from the blast furnace and high temperature thereabout. Further, since the blast furnace has become larger in size recently and therefore parts around the tuyere to be used in operation have also got larger, the operation by human power got more difficult. The present invention was completed, in view of the present state above described, so as to obtain an air hammer apparatus in a tuyere changing machine for a blast furnace by which the tuyere can be mounted and demounted easily, and the present invention relates to an air hammer apparatus of a tuyere changing machine for a blast furnace characterized by the structure that a piston having an axially bored piston rod is fitted into an air cylinder, that a guide rod is slidably mounted in the bore of the piston rod, said guide rod having stoppers fixed at both ends and also having at one end an extension provided alternatively with a hook for pulling out a tuyere or a ram for driving in a tuyere, and that the piston rod is moved by changing the direction of sending or exhausting the compressed air into or out of said air cylinder on either side of the piston and that, consequently, the end surface of the said piston rod collides with one or the other said stoppers.

Here is an explanation of an embodiment of the present invention with reference to the attached figures.

Both of the FIGURES 1 and 2 show the structural framework of an air hammer apparatus according to the present invention, where FIG. 1 is an explanatory figure showing the state when the tuyere is pulled out and FIG. 2 is an explanatory figure showing the state when the tuyere is driven in. A hollow piston rod 2 shown as having a piston 2' formed integrally thereon is housed in air cylinder 1, with a guide rod 3 being freely slideable axially in the bore of said hollow piston rod 2, a stopper 7 and a head 4 being fitted to the left part and right end part of the guide rod 3 which correspond to the stroke ends of the piston rod 2, the end surface of the piston rod 2 being made to collide with the stopper 7 or the head 4 by the movement to the left or right (reciprocating motion) of the piston rod 2, and a ram 5 for pulling out the tuyere 8 or a hook 5' for driving in the tuyere 8 is fitted to the head 4 by means of a cotter 6. The pipe arrangement for the compressed air which is to move the piston rod reciprocatively is provided with pipes of a larger inner diameter and a smaller inner diameter as is shown in the figures. To explain in detail, an air receiver 15 is provided which stores the compressed air the pressure of which is reduced through a reducing valve 14, and, between said air receiver 15 and the cylinder 1, two piping systems, i.e., piping system A with pipes of a larger inner diameter and the piping system B with pipes of a smaller inner diameter, are provided.

The pipe arrangement of system A is composed of pipes A', A'' , and A''', with an air supplier 16 and an electromagnetic directional control valve 9 being provided in midway of said pipes, the directional control valve 9 being switched in the direction of the arrow X, when the solenoid is magnetized, in order to let the compressed air enter the right side of the air cylinder 1 through pipes A' and A'', and, the air stored in the left part of the air cylinder 1 being simultaneously sent out through the pipe A'''. The pipe arrangement of system B comprises pipes B', B'' , and B''' , with an air supplier 17 and a four way electromagnetic directional control valve 11 being provided in midway of said pipes, the direction control valve 11 being switched in the direction of the arrow Y when a solenoid 12 is magnetized, so as to let the compressed air enter the left side of the air cylinder 1 through pipes B' and B'', and the air stored in the right side part of the air cylinder 1 being simultaneously sent out through the pipe B''' while if a solenoid 13 is magnetized the directional control valve 11 is switched in the direction of the arrow X to let the compressed air enter the right side part of the air cylinder 1 through pipes B' and B''', and, at the same time, the air stored in the left side part of the air cylinder 1 is sent out through the pipe B''''. Further, the ends of the pipes B'' and B''' are coupled with the ends of pipes A'' and A''''. In the figures, 18 refers to a manual regulation apparatus for regulating the reducing valve 14, 19 to a nut for holding the stopper 7, on the end of guide rod 5, (a) to a contact surface of the tuyere 8 for engagement with the end of the hook 5 when the tuyere 8 is pulled out, and (b) to a contact surface of the tuyere 8 for abutment against the end of the ram 5' when said tuyere 8 is driven in.

In order to pull out the tuyere 8, the hook 5 for pulling out the tuyere 8 will be fitted to the head 4 and will be made to catch the contact surface (a) of the tuyere 8, and, if the solenoid 10 of the electromagnetic directional control valve 9 and the solenoid 13 of the four way electromagnetic directional control valve 11 are magnetized simultaneously and the compressed air is sent into both of the piping systems A and B, the compressed air will be sent into the right side part of the air cylinder 1 to make the piston rod 2 move to the left at an accelerated high speed and the piston rod 2 will collide...
with the stopper 7 to give the impulsive force to the nose of the hook 5 through the guide rod 3.

For returning the piston rod to the right side, the solenoid 10 of the electromagnetic directional control valve 9 will be demagnetized and the directional valve 9 will be moved in the direction of the arrow Y to stop the flow of system A, and at the same time the solenoid 12 of the four way electromagnetic directional control valve 11 will be magnetized and the compressed air will be sent into the left side part of the air cylinder 1. This will make the piston rod 2 move to the right at a slow speed for the inner diameters of the pipes of the system B are smaller. The above operation will be repeated to pull out the tuyere 8. Further, the power for pulling out the tuyere 8 can be increased or decreased by means of the regulation of the reducing valve 14.

In the next place, in order to drive in the tuyere 8, the ram 5" for driving in a tuyere will be fitted to the head 4 and the nose of said ram 5" will hit the contact surface b of the tuyere 8, the solenoid 12 of the four way electromagnetic directional control valve being magnetized to send the compressed air to the left side part of the air cylinder 1, the piston rod 2 being accelerated with slow speed to collide with the head 4 at the nose of the rod 3, and the ram 5" being given the impulsive force to drive in the tuyere 8. For returning the piston rod 2, the solenoid 13 of the four way electromagnetic directional control valve 11 will be switched to send the compressed air into the right side part of the air cylinder 1 and to return the piston rod 2 to the left side with slow speed.

The above operation will be repeated to drive in the tuyere 8. Thus, only the system B will be used to drive in the tuyere not being used.

For the air hammer apparatus of the tuyere changing machine, pulling out a tuyere requires an impulsive force as the deposited tuyere cannot be pulled out by the static force, and mounting the new tuyere also requires an impulsive force, though it need not be so strong as in the case of pulling out.

Though complicated organization is required to realize said both two functions in the mechanical system, the present invention displays such advantageous effects that the two operations, i.e., pulling out or driving in the tuyere, can be carried out with rapidity and exactness through a simple structure, in which the impulsive force can be easily controlled by regulating the pressure, and so forth, for the present invention has the structure including the axially bored piston rod through which passes the guide rod which has the stopper and the head at its back end and front end, these parts being housed in the cylinder, with the hook for pulling out or driving in the tuyere being fitted to the nose of the guide rod, and the piston rod being rapidly moved back or slowly moved back and forth by suitably changing the flow direction of air run through the piping system for sending the compressed air to the air cylinder.

What I claim is:

1. An air hammer apparatus of a tuyere changing machine comprising, an air cylinder, a piston slideable therein, an axially bored piston rod fixed to the piston and extending therefrom through both ends of the cylinder, a guide rod freely slideable in the bore of the piston rod, stops on said guide rod on each side of the piston rod, said stops being spaced apart a distance greater than the length of the piston rod, a tuyere moving tool fixed to one end of said guide rod, means for supplying compressed air to and exhausting air from both ends of the cylinder and air supply control means adapted to cause movement of the piston and piston rod in either direction toward and against either of said stops.

2. An air hammer apparatus according to claim 1 in which the air supply means includes two systems of different capacities, and the control means includes a directional valve in each system, operable to move the piston and piston rod at different speeds and with different force.

3. An air hammer apparatus according to claim 1 in which the tuyere moving tool is a hook engageable with an inner surface of the tuyere, and in which the air supply means and control means are adapted to drive the piston rod forcefully against the stop on the guide rod remote from said tool and to return the piston more slowly in the opposite direction.

4. An air hammer apparatus according to claim 1 in which the tuyere moving tool is a ram engageable with an outwardly facing surface of the tuyere, and in which the air supply means and control means are adapted to drive the piston rod against the stop on the guide rod adjacent said tool, and to return the piston more slowly in the opposite direction.

5. An air hammer apparatus according to claim 1 in which the air supply means includes two systems, each system having an air supply tank, an electromagnetic directional control valve and pipes connecting the tank to both ends of the cylinder, the pipes in one system having greater capacity than the pipes in the other system, the control valve in said one system being operable to drive the piston and piston rod forcefully in a direction to remove a tuyere and the control valve in said other system being operable to drive the piston and piston rod in a direction to drive in a tuyere, each said valve being operable to return the piston and piston rod more slowly in the opposite direction.

References Cited

UNITED STATES PATENTS

1,566,631 12/1925 Sturtivant 173—91
1,665,135 4/1928 Jones et al. 173—91 X
2,251,577 7/1951 Knudsen 29—254 X
2,641,831 6/1953 Hellon 29—255

FOREIGN PATENTS

5,924 4/1915 Great Britain.

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29—254