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(54) RENEWABLE TIP HAMMER FOR A CRUSHER

(71) We, DRESSER INDUSTRIES, INC., a corporation organized under the laws of the State of Delaware, United States of America, of the Dresser Building, Elm & Akard Streets, Dallas, Texas, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The invention relates to a machine suitable for reducing ores, coal and other friable materials in size, and to a renewable-tip hammer for use in such a machine which facilitates quick and easy removal and/or replacement of a worn or damaged hammer tip in situ.

The term "swing-hammer type" or "flex-hammer type" is used herein to denote a machine in which hammers are pivotably mounted on a rotor such that they are propelled under centrifugal force to impact the material to be crushed, but yet can yield position if they encounter foreign bodies, for example pieces of metal. Thus, unlike machines with fixed or rigid hammers, the swing-hammer type machine is not as readily damaged or jammed by tramp metal or other foreign objects.

Because they are continuously subject to high impact forces and abrasion even the swing-type hammers are subject to wear and breakage. While a number of means for connecting the wear tip to the shank of the hammer are envisionable, the connection should be as simple as possible and such that the tip can be removed without removing the hammer arm or the rotor. One of the simplest connections used is a pin passing through aligned holes in the two parts. Of course, some means to maintain the pin in the joint is necessary.

In the rotor disclosed in U.S. patent specification 3,844,494 the tip is connected to the body of each hammer by a retaining pin extending through collinear holes in the overlap of the two parts. During normal rotor rotation cenrifugal force holds the hammers in such a position that the retaining pin is between adjacent rotor arms. However, the hammer can be rotated such that the pin is no longer retained between the rotor arms and can thereby be removed. The problem with this design is that a foreign object, such as a piece of tramp metal, can force the hammer into this latter described position while the machine is operating. If during that situation the retaining pin should drift axially and become completely or partially disengaged from the joint, the hammer would either come apart or fail to return to its proper operating position. Either condition could result in damage or disruption of the operation.

According to the present invention there is provided a swing-hammer type crusher comprising: a rotor including a shaft and a plurality of radially extending discs spaced along the shaft; a plurality of hammers pivotably mounted at selected locations about the rotor, each hammer including a shank which is pivotably mounted at one end between a pair of the rotors discs and which has a free end movable between said rotor discs, and a replaceable tip section connected to the free end of the shank by a straight connecting pin extending freely through co-aligned holes in the tip section and shank; and a removable pivot stop which is positioned adjacent each hammer between the associated pair of rotor discs to limit the outward pivotal freedom of the hammer shank so that the connecting pin is confined between said associated pair of rotor discs at all times during operation of the crusher but which can be removed to allow the shank to pivot outward until the connecting pin is outside the rotor discs where it can be extracted to replace the tip section when desired.

The invention will be better understood from the following description of a preferred embodiment thereof, given by way of example only, reference being had to the accompanying drawings, wherein:

FIGURE 1 is a cross sectional view in elevation through an embodiment of swing-hammer crusher according to the present invention;

FIGURE 2 is a side elevation view of the rotor of the crusher of Figure 1;

FIGURE 3 is a side elevation view partly in cross section of a hammer taken along the line 3—3 in Figure 2; and

FIGURE 4 is a frontal view partly in cross section of a hammer taken along the line 4—4 in Figure 2.

The invention is hereinafter described with particular reference to a swing-hammer crusher for reducing friable materials such as coal. However, it will be apparent that the invention has application in other comminuting machines where movable hammers are used.

Referring to Figure 1, the crusher comprises a housing 2 with a material receiving inlet 3 and discharging outlet 4. Inside the housing is the crushing chamber 5, the upper walls of which are lined with replaceable wear resistant panels. A rotor 8 having a plurality of hammers 10 is mounted in the crushing chamber on a horizontal axis of rotation and connected to a drive motor which is not shown. The bottom of the crushing chamber is defined by a screen bar 9 which is generally concentric with the rotor 8 and has openings sized according to the product desired.

In operation, unprocessed material U, such as chunk coal, is fed into the crusher through the inlet 3. The rotor rotates in the direction of the arrow at sufficient speed that the hammers 10 impact the large chunks and either break them on impact or crush them against the breaker bar 11 or the screen bar 9. The crushed or processed material P passes through the openings in the screen bar 9 and is discharged through the outlet 4.

The unprocessed material will frequently be contaminated with foreign objects or materials having radically different properties, such as tramp metal. Therefore, the hammers 10 are pivotably connected to the discs of the rotor 8, as described in greater detail later. During rotation of the rotor centrifugal force keeps the hammers in their extended and most efficient crushing position. However, when a hammer encounters a piece of tramp metal it can flex or pivot, as shown by the broken line at the left of the rotor in Figure 1, to avoid damage to the hammer or rotor or jamming of the machine. The pieces of tramp metal TM are carried along the screen bar 9, propelled off the deflector plate 6 and finally fall into the receptacle 7 for later removal.

The rotor 8 is shown from another view in Figure 2. It consists of a shaft 20 which is supported at its ends by bearings located at opposite ends of the crusher housing. One end of the shaft is keyed for connection to the motor or other drive means.

A plurality of circular discs 22 are keyed to and rotate with the shaft 20. The discs 22 are spaced equally along the shaft by cylindrical spacers 21. The assemblage of discs and spacers is clamped against a shoulder on the shaft 20 by a nut or other well known retaining means 24. A plurality of hammers 10 are positioned at selected locations about the rotor with each hammer being pivotably mounted between an adjacent pair of rotor discs 22 on a rod 26.

Referring now to Figures 3 and 4, the hammer 10 consists of two parts, a shank 30 and a replaceable tip section 40. Since the shank has minimal contact with the process material and therefore is less subject to direct impact and abrasion, it can be made out of a suitably strong but less expensive material such as standard steel plate. On the other hand, the head or tip 40 is preferably made of a hard and good wearing material such as cast iron, manganese steel, or other alloys and materials well known for these properties. While such materials may be more expensive, the volume of the tip section 40 is small relative to the volume of the complete hammer 10. Since only the tip 40 need be replaced when worn or damaged, a savings in replacement costs of hammers is realized.

The hammer shank 30 has an aperture 33 through which the rotor rod 26 extends to hold the hammer in place. The shank has a body section 31 from which a lug 32 projects laterally in the outward radial direction of the rotor. The body 31 and lug 32 are provided with tabs 35 and 36 respectively which co-operate with a pivot stop 28 on the rotor to confine the pivotal movement of the hammer 10 within predetermined limits as shown in Figure 3. The shank is also provided with the force bearing surface 34.

The replaceable tip 40 has a front impact surface 41 and a rear surface 42 which matches the configuration of the surface 34 on the lug 32. The rear of the tip also includes a bifurcation forming two legs 43 and 44 disposed on either side of the shank lug 32. Holes 45 and 46 in the legs 43 and 44 respectively, align with a hole 37 through the lug 32. A simple cylindrical retaining pin 50 extends through the collinear holes 45, 37, and 46 to join the tip 40 and shank 30 together.

Because of the location of the pivot stop 28 and the tab 35 on the shank 30, the joint between the tip and shank is always maintained within the perimeter of the space between the adjacent rotor discs 22. Therefore, during normal operation, the retaining pin 50 cannot drift out of place. However, if it becomes necessary to replace the tip 40 it can be done simply and quickly. It only requires removing, or moving aside, the stop 28, whereupon the hammer shank can be pivoted radially outward until the retaining pin 50 is clear of the rotor discs 22. The pin 50 is quickly removed and replaced when a new tip is put in place. Then the hammer is rotated back in position, the pivot stop 28 replaced, and the rotor is ready for operation again.

As shown here, the pivot stop 28 is a cylindrical rod or pin which extends through the series of discs 22 from end to end of the rotor

8. The rod 28, like the mounting rod 26, is removable from one end of the rotor through an access cover at that end of the crusher housing.

However, where as shown in Figure 2, the hammers 10 are positioned only in alternate spaces, it is apparent that the pivot stop for retaining a particular hammer could be a short pin or threaded bolt which could be retracted into the next rotor spacing to free the hammer for tip replacement. With this design, the retaining pin could be removed within the crushing chamber without having to remove the access cover on the housing.

The hammer and rotor design just described offers the feature that while the connection between the non-replaceable shank 30 and the replaceable tip 40 is a simple free-fitting pin 50, the connection is retained within the confines of adjacent rotor discs 22 during normal operation so there is no chance of a pin coming loose to disrupt the operation or cause damage.

WHAT WE CLAIM IS:—

1. A swing-hammer type crusher comprising: a rotor including a shaft and a plurality of radially extending discs spaced along the shaft; a plurality of hammers pivotably mounted at selected locations about the rotor, each hammer including a shank which is pivotably mounted at one end between a pair of the rotors discs and which has a free end movable between said rotor discs, and a replaceable tip section connected to the free end of the shank by a straight connecting pin extending freely through co-aligned holes in the tip section and shank; and a removable pivot stop which is positioned adjacent each hammer between the associated pair of rotor discs to limit the outward pivotal freedom of the hammer shank so that the connecting pin is confined between said associated pair of rotor discs at all times during operation of the crusher but which can be removed to allow the shank to pivot outward until the connecting pin is outside the rotor discs where it can be extracted to replace the tip section when desired.

2. A swing-hammer type crusher according to claim 1 wherein each hammer shank includes a tab at its free end which co-operates with the pivot stop on said rotor to prevent said hammer from pivoting outward to a position in which the connecting pin is exposed beyond the outer periphery of said rotor discs unless said pivot stop is first removed from between said pair of discs.

3. A swing-hammer type crusher according to claim 1 or claim 2 wherein the tip section includes a bifurcation and the free end of the shank has a lug adapted to fit into said bifurcation, and the connecting pin passes through aligned holes in the legs of the bifurcation and the lug.

4. A swing-hammer type crusher, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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Sheet 1

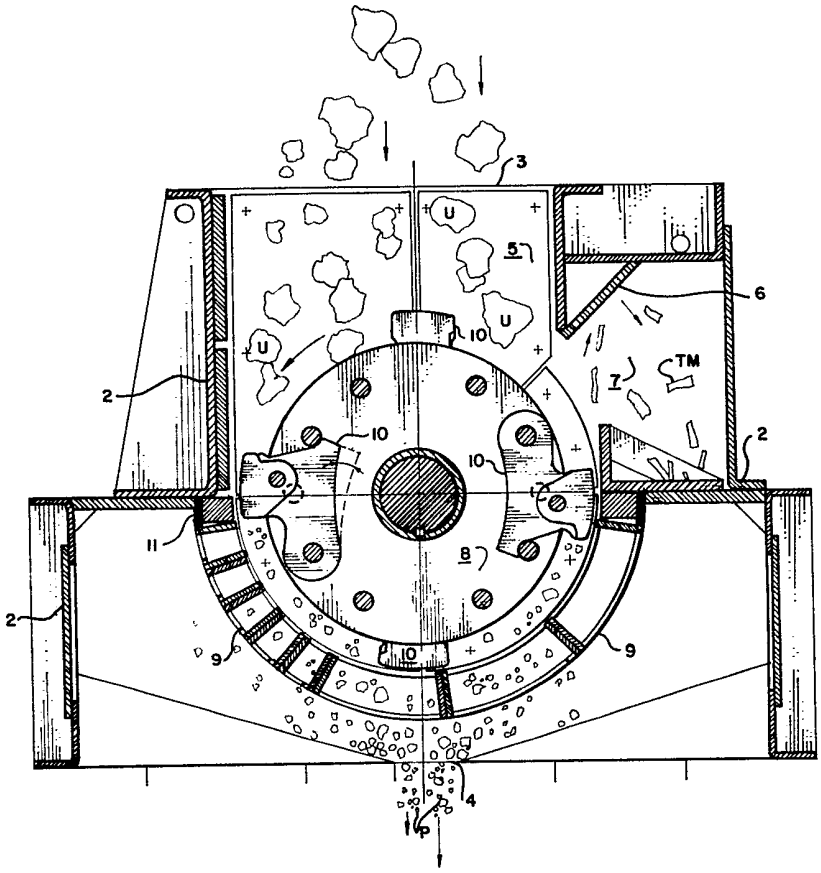

FIG. 1

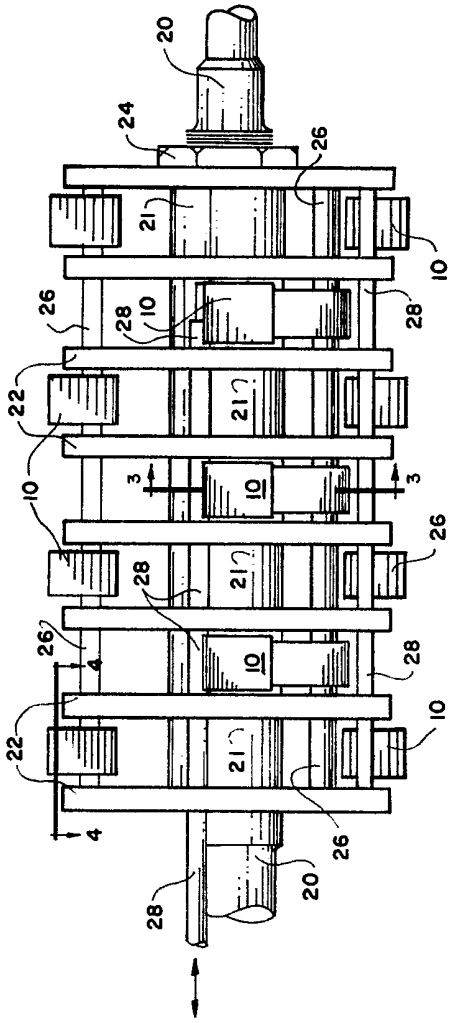

FIG. 2

1599936 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 3

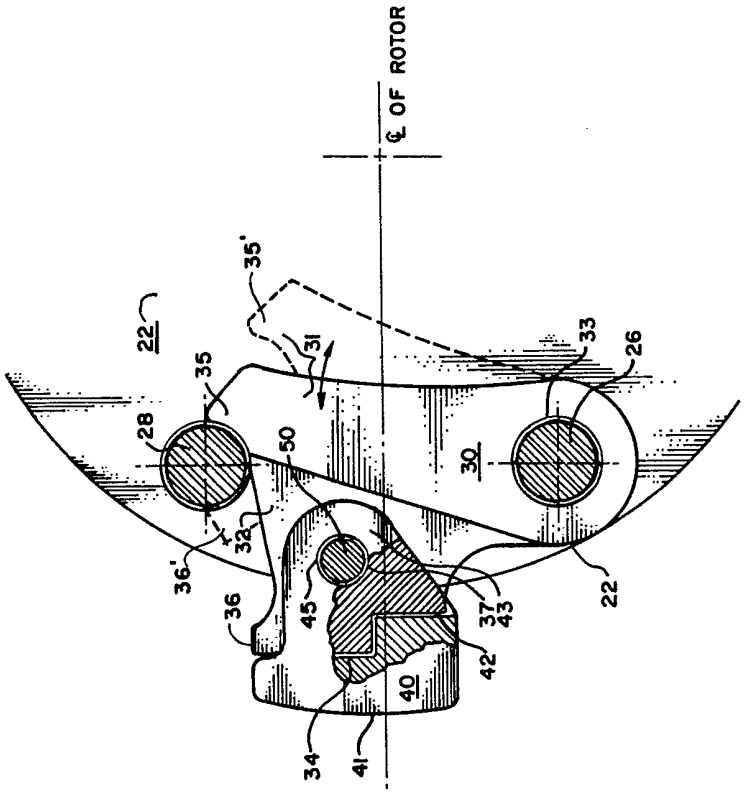

FIG. 3

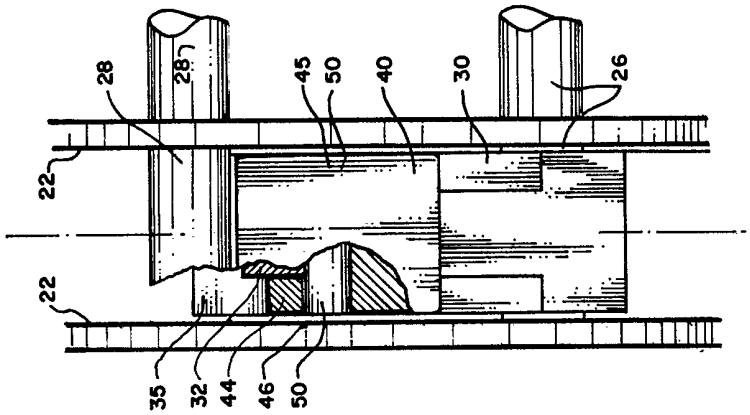

FIG. 4