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[54] **MACHINE FOR WORKING METALS BY IMPULSES**

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[51] **Int. Cl.** **B26d 5/12**

[58] **Field of Search**.....83/639, 51, 623, 600, 566; 72/430

[56] **References Cited**

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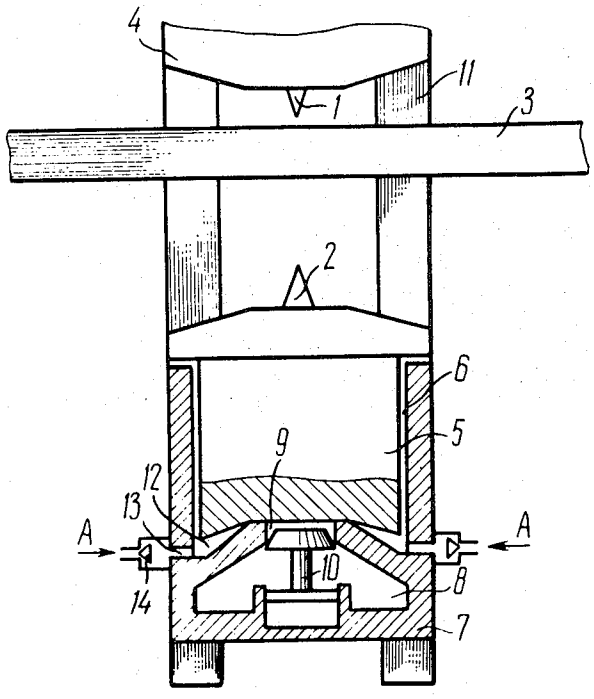
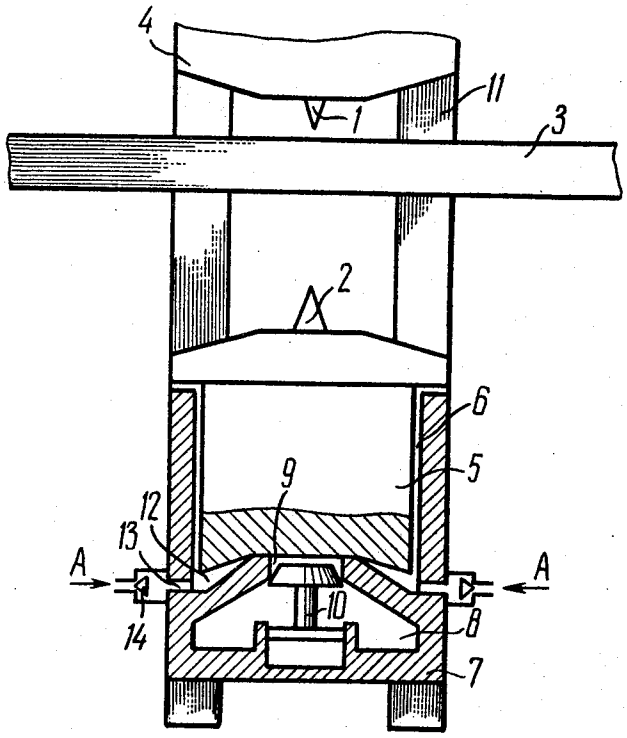
[57] **ABSTRACT**

A machine incorporating two tools, one of which is fastened on the plunger of an impulse chamber and the other fastened on an anvil connected through a rigid coupling with the impulse chamber forming a common power block. The impulse chamber encloses a guide sleeve to accommodate the movable plunger and a cavity to be charged with an energy carrier. The impulse chamber is fitted with side channels in communication with the space in the guide sleeve beneath the plunger to form a common closed conduit, running along the perimeter of the impulse chamber and being filled with fluid.

3 Claims, 1 Drawing Figure

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MACHINE FOR WORKING METALS BY IMPULSES

The present invention relates to the facilities for metal forming and more particularly to vertical machines for working metals by impulses.

The present invention is best applicable for cutting ingots formed on continuous casting machines, for forging and stamping.

Known at present are horizontal impulse machines for cutting ingots, comprising two movable blades, one of which is fastened on the plunger of an impulse chamber containing a guide sleeve in which the plunger is travelling, and a cavity in communication with the above sleeve at regular intervals, the above cavity being filled with an energy carrier to execute detonation, while another, the counter blade, is secured on an anvil connected through a rigid coupling with the impulse chamber to form a common power block so that upon detonation in the impulse chamber the blades advance towards the ingot (see U.S. Pat. No. 3,466,960.

In the known machines between the plunger and the cavity for executing the explosion in the impulse chamber there is a space beneath the plunger which is not utilized as a working volume when the working substance of the energy carrier is allowed to expand. The above space is undesirable and leads to inefficient loss of energy. In addition, a clearance in the guide sleeve, necessary for the free travel of the plunger results in a leakage of the working substance of the energy carrier.

Moreover, peculiar to the known machines is dry friction of the plunger on the walls of the guide sleeve, which is likely to cause wear on the rubbing surfaces.

It is an object of the present invention to provide a machine for processing metals by impulses, capable of increasing the efficiency of utilization of the energy accumulated in the energy carrier.

Another object of the present invention is to provide a machine for reducing wear on the rubbing surfaces of the plunger and the walls of the impulse chamber.

Still another important object of the invention is to provide a machine ensuring a reduction in the noise level during the exhaust of the spent working substance of the energy carrier.

These, as well as other objects, are achieved by the provision of a machine incorporating two movable tools, of which one is fastened on the plunger of an impulse chamber enclosing a guide sleeve to accommodate the travelling plunger, a cavity communicating at regular intervals with the above sleeve and being primed with an energy carrier to execute detonation within the aforesaid cavity, while the other tool is secured on an anvil connected through a rigid coupling with the impulse chamber to form a common power block upon detonation in the impulse chamber both tools advance towards the metal stock to be processed, with the impulse chamber fitted, according to the invention, with side channels communicating with the space beneath the plunger within the guide sleeve to form a common closed conduit located along the perimeter of the impulse chamber and filled with water fed via the said channels.

With the above construction principle an increase in the efficiency of usage of the energy contained in the working substance of the energy carrier may be attained due to the absence (within the space beneath the plunger) of the dead space which results in inefficient expansion of the working substance. In addition, leakage of the working substance through the clearance between the plunger and the walls of the impulse chamber guide sleeve is substantially decreased because the fluid, forced by the energy carrier working substance is likely to fill the said clearance keeping the above substance from leaking, due to an increased hydrodynamic flow resistance. Also, the fluid which fills up the clearance tends to prevent the plunger from rubbing dry over the guide sleeve walls and to thus provide a decrease in the noise level in exhausting the spent working substance which may be attributed to the fluid evaporation.

It is preferred to make the common closed conduit tapering from the circumference to the center in a radial direction so that its expanded portion will approach in an axial direction the cavity primed with the energy carrier. This will contribute to almost complete displacement of the fluid from the closed conduit through the clearance between the plunger and the walls of the guide sleeve. As a result an adequate amount of the fluid will be admitted through the clearance to cause the plunger to move through the working stroke. With the above conceptual design accumulations of the abrasion products as well as the hard products of the working substance may be localized in one and the same zone to keep them from being entrained into the detonation cavity and to contribute thereby to the most complete removal of these products by the fluid during the working stroke of the plunger.

To prevent the fluid from being forced out as well as to keep the working substance from leaking via the side channels it is sound practice to equip these channels with non-return valves.

The nature of the present invention will become more clear from a consideration of the following description of an impulse machine for cutting ingots taken in conjunction with the accompanying drawing which is a fragmentary cut-away front view of the above machine.

The machine under consideration comprises two blades **1** and **2**, separated by ingot **3** to be cut, with blade **1** fastened on anvil **4** while the counter blade **2** is secured on plunger **5**. The plunger **5** is enclosed in guide sleeve **6** of impulse chamber **7** having cavity **8** to be charged with an energy carrier. As for the energy carrier, use may be made of combustible mixtures of liquid or gas fuel and an oxidizer or compressed gases. Detonation cavity **8** communicates at regular intervals with guide sleeve **6** via hole **9** closed by means of the valve - type locking appliance **10**. With the aid of tighteners impulse chamber **7** is rigidly coupled with anvil **4** forming a power block. Enclosed in guide sleeve **6** is space **12** beneath the plunger. The walls of impulse chamber **7** are fitted with side channels **13** in communication with space **12** so that a common closed conduit is formed along the perimeter of the impulse chamber. The conduit is filled with the fluid admitted via channels **13**. The closed conduit is tapering from the circumference to the center in a radial direction with its expanding portion approaching in the axial direction cavity **8**, as shown in the drawing.

To prevent both the fluid and the working substance of the energy carrier from leaking from space **12**, side

channels 13 are equipped with non-return valves 14 communicating with a hydraulic system. The direction of the water feed is indicated in the drawing by arrow A.

The machine functions as follows:

The fluid fed passes from the hydraulic system via non-return valves 14 and channels 13 into space 12 beneath the plunger, filling the closed conduit through the perimeter of chamber 7. The fluid is allowed to run off through the clearance between plunger 5 and the walls of guide sleeve 6 of impulse chamber 7 over the external walls of the chamber into a drainage system (not shown).

Cavity 8 is charged with a combustible mixture burning, on ignition, at an increasing pressure which results in the opening of locking appliance 10. The working substance in the form of high-pressure combustion products penetrate under plunger 5 and as both guide sleeve 6 and space 12 are filled with the fluid there is no dead space contributing to inefficient gas expansion. Under the influence of gas pressure, plunger 5 together with lower blade 2 moves upward with a high speed. As soon as plunger 5 starts travelling, the gases tend to escape through the clearance between the plunger and the walls of guide sleeve 6. However, free outflow of the gases is possible only after they force out all the available fluid and the fluid typically has a low rate of discharge due to a relatively higher toughness and hydrodynamic flow resistance as compared with the gases. An adequate amount of the fluid in space 12 beneath the plunger keeps the products of combustion from leaking through the working stroke of plunger 5. The plunger moves in guide sleeve 6 without dry friction as the fluid filling the clearance tends to assist in sliding over a thin film of the fluid. When plunger 5 with lower blade 2 moves upward (upstroke), impulse chamber 7 and anvil 5, connected to it through a rigid coupling, together with upper blade 1 move downward (downstroke) under the action of repercussion. The cutting of ingot 3 is executed by means of blades 1 and 2 hitting the ingot synchronously from both sides with plunger 5 located in the extreme upper position with respect to sleeve 6. When the plunger occupies the above position, exhaust gases are discharged through the clearance with the remainder of the fluid being simultaneously forced out from sleeve 6 which is likely to decrease the exhaust noise level due to a reduction in the pressure of the gases whose temperature tends to decrease on account of heat consumption on heating and evaporation of the fluid. Next both plunger 5 and power block 4, 7, 11 return to their original position. During the downstroke of plunger 5 non-return valve 14 opens under the pressure of the fluid and the latter is admitted into sleeve 6. At the moment plunger 5 is in the extreme lower position, its speed decreases due to a hydrodynamic resistance of the fluid forced out through the clearance which provides for shock-free positioning of the plunger. The fluid flowing out from the working cylinder carries off both the products of abrasion and solid particles entrained by the exhaust gases.

The cycle is then completed and a new one may be started with all the operations repeated in the same sequence.

What is claimed is:

1. A machine for working metals by impulses which comprises: an impulse chamber having a guide sleeve and a cavity charged with an energy carrier disposed within the chamber; a plunger enclosed in said guide sleeve; means for allowing the cavity to communicate with the remaining portion of the chamber at regular intervals; an anvil connected through a rigid coupling with the said impulse chamber, forming a common power block; a plurality of tools of which one is fastened on the plunger of the impulse chamber and the other on the said anvil; the said guide sleeve forming a space beneath the plunger; the said impulse chamber fitted with side channels in communication with the said space beneath the plunger and forming along the perimeter of the said impulse chamber a common closed conduit filled with a fluid fed via the said side channels; the said tools being advanced towards the metal to be processed upon detonation in the impulse chamber.

2. A machine of claim 1, in which the common closed conduit is tapering from the circumference to the center in a radial direction and its expanded portion approaches in the axial direction the cavity filled with the energy carrier.

3. A machine of claim 1, in which the side channels of the impulse chamber are equipped with non-return valves to keep both the fluid and the working substance of the energy carrier from leaking from the space beneath the plunger.

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