June 20, 1944. W. M. SHELDON 2,352,127

PULVERIZING MILL ROTOR

Filed Oct. 1, 1942

Fig. 1

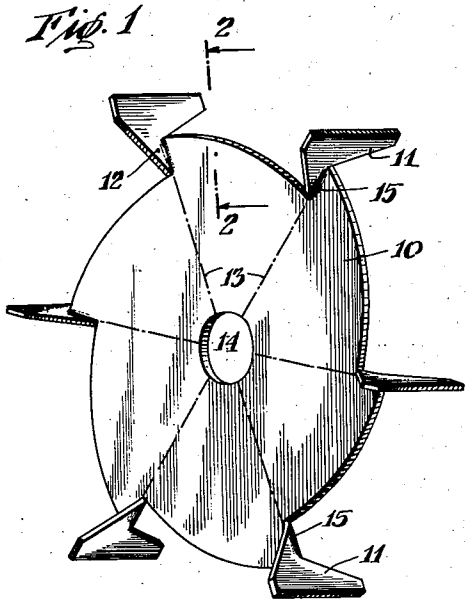


Fig. 2

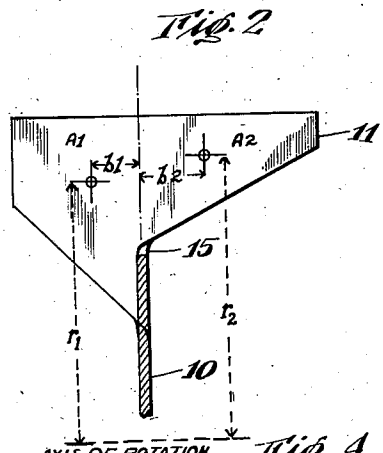


Fig. 3

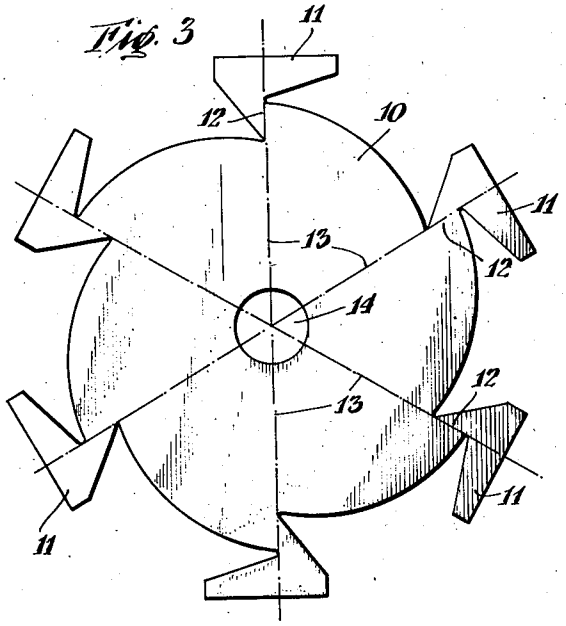


Fig. 4

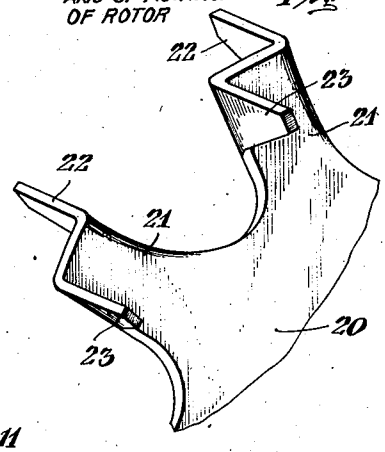
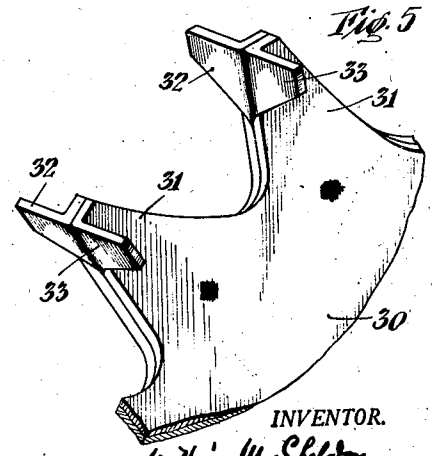


Fig. 5



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PULVERIZING MILL ROTOR

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3 Claims. (Cl. 83—11)

This invention relates to impact pulverizers of the rotary beater, or hammer mill, type, that is, mills in which a high speed rotor having a plurality of circumferentially spaced hammers, or beaters, is mounted in a mill chamber.

The object of the invention is to provide an improved rotor for such mills for pulverizing relatively soft materials which shall have the advantages of low cost and ease of cleaning together with good durability and safety in operation. Rotors according to the invention have a central disc portion and a plurality of circumferentially spaced beater portions, formed of sheet metal cut and bent to shape as hereinafter more particularly described. Such rotors have been found eminently suited for pulverizing relatively soft materials such as wheat and other small grain, granular material such as sugar, soft filter press cakes, and pigments. They have been found on test to pulverize equally as well as the usual swing-hammer type of rotor and with equal efficiency. The rotors are made of bendable but suitably stiff metal of suitable thickness, such as 16 gauge cold-rolled low carbon steel untempered, or 18–8 steel-chrome nickel alloy, or a suitable bronze, and the beaters and their connecting necks are so shaped that the beaters will have the necessary strength to withstand the normal operating stresses without bending but will bend without fracture under abnormal stresses, with the result that if the beaters in operation encounter any sufficiently hard substance, such as tramp metal, the blades will bend without rupture of any part of the rotor. A rotor so bent needs only to be removed from the mill and have its bent parts bent back to their original form.

The rotors are so designed that when operating at the necessary high rotative speed the centrifugal forces set up in the rotor do not set up unbalanced moments of a magnitude to distort the rotor sufficiently to cause it to strike the side or periphery of the mill chamber.

A full understanding of the invention can best be given by a detailed description of a rotor according to the invention and certain modifications, and such a description will now be given in connection with the accompanying drawing, in which:

Fig. 1 is a perspective view of a rotor embodying the invention in the form now considered best;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a view of the sheet metal blank from which the rotor of Figs. 1 and 2 is formed;

Fig. 4 is a perspective view of part of a rotor embodying certain features of the invention; and

Fig. 5 is a perspective view of part of a rotor of another modified form.

Referring first to Figs. 1, 2 and 3, the rotor shown in Figs. 1 and 2 is made of one piece of bendable sheet metal cut to form a blank such as shown in Fig. 3. The blank has a central disc portion 10 and a plurality of circumferentially spaced beater portions 11, each beater portion being connected to the disc portion by a short neck portion 12 and each beater portion extending on both sides of a line extending through the neck portion radially from the center of the disc, such radial lines being indicated by the dotted lines 13. The part of the beater portion on one side of such line extends further from said line than the part on the other side of the line, and the inner edge of the longer part of the beater portion joins the neck at a point on said line and the inner edge of the shorter part of the beater portion joins the neck at a point on said line nearer to the center of the disc than the point of joining of the inner edge of the longer part. The disc portion has a central opening 14 for the shaft on which the rotor is mounted.

To form the rotor shown by Figs. 1 and 2 from the blank of Fig. 3, the necks 12 are bent on the radial lines 13, which extend between the inner ends of the inner edges of the two parts of the beater portion, so that each beater portion shall then extend in a radial plane perpendicular to and on each side of the plane of the disc portion. The right angle bends 15 between the inner ends of the inner edges of the two parts of the beater as shown extend on lines radial from the center of the disc. Obviously, however, the lines on which the beaters are bent to position, although most desirably radial, need not be exactly radial, but they should extend in a direction approximating the radial.

The beater portions of the rotor are so shaped and proportioned that the centrifugal forces set up in the two parts of the beater when the rotor is driven at high speed will exert a substantially equal bending moment on the disc, the centrifugal force moments of the two parts of the beater being equal and acting oppositely on the disc; thus avoiding any axial tilting of the beaters due to bending of the disc or connecting portions between the disc and the beaters resulting from unbalanced centrifugal force moments when the rotor is operating at high rotative speeds.

The centrifugal moment of each of the two beater parts will be proportional to the product of its area, the radial distance of its center of gravity from the axis of rotation, and the axial distance of its center of gravity from the plane of the disc portion of the rotor. Therefore, for the centrifugal moments of the two differently shaped parts of the beater to be equal, and if the areas of the two parts are represented by A_1

and A_2, respectively, and the radial distances of their centers of gravity from the axis of rotation by r_1 and r_2 and the axial distance of their centers of gravity from the plane of the disc portion by b_1 and b_2, then the two parts of the beater should conform to the following formula: $A_1r_1b_1=A_2r_2b_2$. For example, in an actual rotor having beaters as shown in Figs. 1 and 2, 5" in diameter, A_1 is .335 sq in., A_2 is .214 sq. in., r_1 is 2.23", r_2 is 2.37", b_1 is .234", and b_2 is .36". Substituting these values in the above formula, gives $.335\times2.23\times.234=.214\times2.37\times.36$, which is correct within less than .008.

The cross-sectional area of the connecting necks at the bends from which the beaters extend should be great enough to withstand the shearing force induced in them by the centrifugal force exerted by the beaters at high speed rotation; and the cross-sectional area of all parts of the beaters in planes perpendicular to the beater faces and running in any direction should be such that the strength will be sufficient to withstand the normal stresses to which the beaters are subjected in operation without producing any bending of the beaters. The cross-sectional area required will depend on the kind of metal used and the thickness of the sheet. The metal sheet must be of sufficient stiffness so that the beaters will resist normal bending stresses, and sufficiently ductile to avoid fracture when bent under abnormal stresses. For a 5" diameter rotor of the shape and proportions shown, 16 gauge cold-rolled low carbon steel untempered is suitable and has been found entirely satisfactory in use. The rotor may be secured on its shaft by any suitable means.

Such a 5" rotor has been found, when used for pulverizing material of the kind herein referred to driven at speeds of from 9000 to 15000 R. P. M., to withstand without bending the normal operating stresses and to bend without fracture under abnormal stresses; and, as stated, the rotor has been found to pulverize equally as well as the usual swing-hammer type rotor and with equal efficiency. If bent in operation, the bent portions of the beaters may be readily bent back to their original form.

Fig. 4 illustrates a modified form of rotor made of one-piece of sheet metal embodying some of the features of the invention. In this rotor, the central disc 20 has a plurality of circumferentially spaced radially extending necks 21 and two beaters extending in radial planes normal to the plane of the disc portion from each of the necks, a beater 22 extending in one direction from one radial edge of each neck, and a beater 23 extending in the opposite direction from the other radial edge of each neck.

A further modified form of rotor is illustrated in Fig. 5. This rotor is made of two pieces of sheet metal, and comprises a central disc portion 30 having a plurality of circumferentially spaced radially extending necks 31, the disc portion and necks consisting of two plates secured together face to face by spot welding or in other suitable manner. From a radial edge of each of the necks of one of the plates a beater 32 extends in a radial plane normal to the plane of the disc portion, and from the corresponding radial edge of each of the necks of the other plate a beater 33 extends normal to the plane of the disc portion.

In the rotors of Figs. 4 and 5, the two beaters of each pair are of the same shape from their inner edges outward and of the same size, or otherwise relatively proportioned so that the centrifugal forces set up in the two beaters of each pair will at high rotative speed exert an equal bending moment on the disc portion of the rotor. These rotors will pulverize equally as well as the rotor of Figs. 1 to 3, but are more liable to destruction by tramp metal because of the greater resistance to bending offered by the radial arms or necks from which the beater portions extend.

What is claimed is:

1. A rotor for an impact pulverizing mill, formed of one integral piece of bendable sheet metal, the rotor comprising a disc portion and a plurality of circumferentially spaced beaters, each beater being an integral plate which extends in a radial plane normal to and on both sides of the plane of the disc portion, the radial dimension of the part on one side of the plane of the disc portion being greater and its lateral dimension less than the corresponding dimensions of the part on the other side of the plane of the disc portion, and each beater being connected to the disc portion by a right angle bend extending between the inner ends of the inner edges of the two parts of the beater and the two parts being relatively proportioned to exert on the disc portion at high rotative speed substantially equal and opposite moments of centrifugal force.

2. A rotor for an impact pulverizing mill, formed of one integral piece of bendable sheet metal, the rotor comprising a disc portion and a plurality of circumferentially spaced beaters, each beater being an integral plate which extends in a radial plane normal to and on both sides of the plane of the disc portion, the radial dimension of the part on one side of the plane of the disc portion being greater and its lateral dimension less than the corresponding dimensions of the part on the other side of the plane of the disc portion, and each beater being connected to the disc portion by a right angle bend extending between the inner ends of the inner edges of the two parts of the beater, the bends between the disc portion and the beaters extending on lines radial from the center of the disc and the two parts of each beater being relatively proportioned to exert on the disc portion at high rotative speed substantially equal and opposite moments of centrifugal force.

3. A blank from which to form a rotor for an impact pulverizing mill, said blank being cut from bendable sheet metal and having a central disc portion and a plurality of circumferentially spaced beater portions, each beater portion being connected to the disc portion by a short neck portion and extending on both sides of a radial line from the center of the disc, the part of the beater portion on one side of said radial line extending further from said line than the part on the other side of the line, and the inner edge of the longer part of the beater portion joining the neck at a point on said line, and the inner edge of the shorter part of the beater portion joining the neck at a point on said line nearer to the center of the disc than the point of joining of the inner edge of the longer part.

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