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S. F. OSSING

CRUSHING APPARATUS

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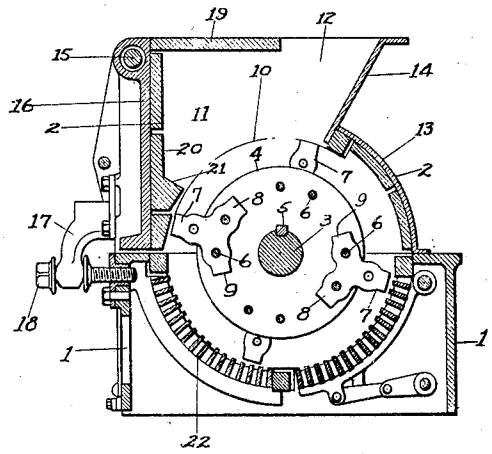

Fig. 1

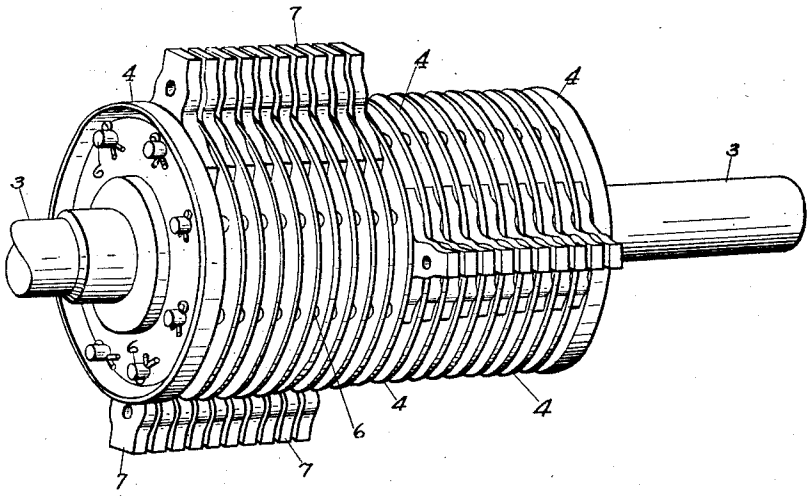

Fig. 2

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CRUSHING APPARATUS.

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The present invention relates to certain new and useful improvements in crushing apparatus adapted to reduce relatively large fragments of material to uniform fragments of smaller size without the production of excessive proportions of extremely small, or fine material.

The type of crushing apparatus to which my present invention particularly relates comprises a casing and a rotor within the casing, said rotor having radially projecting arms adapted, as the rotor revolves, to engage the material which is to be crushed.

As heretofore constructed, such machines have possessed certain inherent defects which it is the especial object of this invention to overcome.

The means whereby I attain this object are fully set forth in the following specification and illustrated in the accompanying drawing of which:

Figure 1 is a sectional view taken along a transverse vertical plane of a crushing machine embodying my present invention.

Figure 2 is a perspective view, on an enlarged scale, of the rotor element of the machine illustrated in Figure 1.

Like numerals refer to similar parts in the several figures.

As shown in the drawings, my improved crushing machine consists of a crushing element consisting of a skeleton rotor adapted to revolve about a substantially horizontal axis within a casing which is adapted to confine the material while it is being crushed. The casing comprises a main supporting frame 1 and a housing 2 which are joined together along the central horizontal plane of the rotor. The main frame 1 has end and side walls, which may be formed of a single casting or of plates securely fastened together to form a unitary structure adapted to rest upon and be secured to any suitable foundation. Along its upper edges, the frame 1 is formed to support the housing 2 which is securely bolted in place. To the end walls of the main frame are secured journal bearings in which the shaft 3 of the rotor is supported, and the shaft 3 is provided with a suitable pulley, or other power transmitting device, whereby the shaft 3 may be connected with any convenient and suitable source of rotative power to cause the revolution of the rotor. As such journal bearings and power transmitting devices are well understood by those skilled in the art, their illustration and description is not thought to be required at this time.

Mounted upon the shaft 3 are a plurality of discs 4 which are secured to the shaft in any preferred manner as by the key 5, to revolve therewith. Disposed longitudinally of the shaft 3 and supported in suitable apertures of the disc 4 are a plurality of rods 6 upon which the arms 7, designed to engage and reduce the materials are supported. The end discs 4 are preferably flanged, as shown in Figure 2, as this stiffens them and gives rigid end members for the assembly. Furthermore, if the stiffening flanges are at the periphery, and outwardly turned, as shown in the present illustration, they serve to house and protect the ends of the rods 6 and their fastenings. The arms 7 are preferably formed of a refractory alloy of iron, fashioned to provide three radial projections 7, 8 and 9, preferably equally spaced and extending from a common center, each of said arms being pierced by an aperture adapted to receive one of the rods 6. When in operative position upon the rotor two of the arms 8 and 9 project into the space between adjacent discs 4 in such position that two of the rods 6 may extend through their apertures to rigidly hold the third arm 7 extending radially beyond the periphery of the disc 4. The radially projecting arms or crushing elements 7 are arranged in straight rows, which are circumferentially spaced and longitudinally staggered sets, preferably, and as here shown, equally spaced circumferentially. Each row consists of spaced arms and extends, in the present example, half the length of the rotor. In the drawing, I have shown four rows of arms, but the number of rows may be varied, it being a factor of the size and proportions of the machine.

With this arrangement of arms there will be provided, when the rotor is in motion, a substantially continuous supporting surface, the circumference of which is conventionally indicated by the dotted line 10 in Figure 1. When the rotor is at speed the surface thus generated will substantially support, or float, the material under reduction, holding it in suspension and in freely mobile condition in

the reducing chamber 11 of the housing 2. Reduction of the material will be affected by the action of the arms 7 as they revolve against the surface of the mass, and the action being a steady and uniform one, a uniform product will result. The relation of the rotor with its engaging elements 7 to the housing 2 is such that the material under treatment is reduced principally by the action of the arms 7 as they strike the mass, as distinguished from its being dragged down into and crushed between the rotor and opposing elements, as in the usual type of crushing machine.

The housing 2 is above and encloses substantially the upper half of the rotor, and contains the reducing chamber 11 in which the principal reducing operation occurs. The housing 2 has the end walls 12 secured to the base frame, and joined together at the rearward side of the reducing chamber by the casing plate 13 and the hopper plate 14. At the forward side of the housing 2, the end walls 12 are held by the draw bolt 15 from which is suspended a plate 16 to close the forward side of the reduction chamber. A gooseneck bracket 17 attached to the lower side of the plate 16 is engaged by the rotary adjustment screw 18 threaded into a suitable aperture in the main frame. Manipulation of the screw 18 affects the adjustment of the lower edge of the plate 16 towards and from the rotor. A plate 19 serves to close the upperside of the reducing chamber 11 and to intercept flying fragments of material thrown off by the rapidly revolving rotor. Where hard material is being reduced, and the interior surfaces of the housing 2 are exposed to the abrasive action of flying fragments coming from the mobile mass held in the reducing chamber by the action of the rotor, they are protected by suitable lining plates formed of any suitable material such as, for example, a refractory alloy of iron, and the plate 16 is protected by the lining 20 having at its lower edge a shelf 21. The upper surface of the shelf 21 extends along lines which are substantially radial to the rotor, to points in close proximity with the path of rotation of the ends of the arms 7, and forms an abutment which engages advancing material and acts to prevent the passage of oversize fragments downward from the reducing chamber into the lower part of the casing under the action of the rotor and its reducing arms 7, and so insures a floating condition of the material upon and above the rotor.

The casing is closed beneath the rotor by a semi-cylindrical screen, concentric with and in close proximity to the path of travel of the ends of the arms 7, and this screen is adapted to prevent the fully reduced material to pass out of the casing and to retain the small percentage of oversize fragments which may have passed down through the rotor and are too large to pass through the screen, within the influence of the arms 7. This screen may take various forms, but, preferably, is formed of a series of longitudinally disposed bars 22, the spacing of which determines the size of the maximum fragments of the product.

Obviously, the fragments of material falling upon the rotor immediately in the rear of one of the reducing arms 7 will continue to fall until intercepted by the following arm, the depth of this penetration of the surface 10 being proportionate to the interval of time elapsing between the passage of one arm and the arrival of the succeeding arm. In other words, the depth of penetration varies inversely as the speed of rotation. It is also obvious that the depth of penetration, for a given speed of rotation, will depend upon the spacing of the arms 7 upon the rotor, and that the depth of penetration of the supporting surface will have a direct bearing upon the size of fragments into which the material under reduction will be broken, the action being somewhat analogous to that of a corrugated roller, the maximum size of the fragments into which the material under reduction will be broken depends upon the adjustment of the abutment 21 relative to the path of the arms 7, combined with the depth of penetration of the supporting surface 10 by the unbroken fragments of material. The speed of rotation of the rotor must be sufficiently rapid to fracture the material under reduction, without being fast enough to pulverize it, and this speed must be determined by the character of said material. For example, to reduce large fragments of moderately hard bituminous coal, the rotor should be given a peripheral speed of not less than eighteen hundred (1800) feet per minute. If a relatively coarse product is desired it is apparent that the depth of penetration of the supporting surface 10 of the rotor can be increased only by increasing the distance between the radial arms 7 circumferentially of the rotor. The maximum spacing of the arms, consistent with perfect rotative balance of the rotor, is that illustrated in the drawing, half the circumference. Experience has demonstrated, however, that when the widely spaced rows of arms extend the entire length of the rotor, the machine is subjected to highly objectionable shock and vibratory strain, and smoothness of operation can be obtained without detracting from the efficiency of the machine, only by the breaking up of the longitudinal rows of arms and dividing the circumferential space in the manner shown in Figure 2. It is obvious that for larger machines, the same operative results might be obtained by a greater number of rows of arms and by a different longitudinal arrangement of successive rows.

By the arrangement of parts above described, I have produced a highly efficient crushing apparatus adapted, at a single oper-

ation, to reduce relatively large fragments of material to uniform fragments of smaller size without the production of excessive proportions of extremely small or fine material.

What I claim is:

1. In a crushing machine comprising a casing and a rotor within the casing, said rotor comprising the combination with a shaft and a plurality of concentric discs fixed to said shaft in spaced relation longitudinally thereof, of radially projecting arms arranged in longitudinally extending rows equally spaced circumferentially of the rotor each row extending half the length of the rotor from the end opposite the adjacent row as and for the purpose set forth.

2. In a crushing machine comprising a casing and a rotor within the casing, said rotor comprising the combination with a shaft and a plurality of concentric discs fixed to said shaft in spaced relation longitudinally thereof, of radially projecting arms arranged in longitudinally extending rows equally spaced circumferentially of the rotor each row extending half the length of the rotor from the end opposite the adjacent row, the arms of each row positioned in each adjacent space between the discs as and for the purpose set forth.

3. A rotor for crushing machines of the class described, having a plurality of crushing elements spaced from one another in longitudinal rows, said rows being disposed in circumferentially spaced relation to one another, the adjacent rows being disposed in different longitudinal zones of the rotor.

4. A rotor for crushing machines of the class described, having a plurality of crushing elements spaced from one another in longitudinal rows, said rows being disposed in equally spaced circumferentially spaced relation to one another, the adjacent rows being disposed in different longitudinal zones of the rotor.

5. In a machine of the class described, the combination of a plurality of discs, crushing elements arranged between said discs in longitudinal rows, said rows being disposed in circumferentially spaced relation to one another, the adjacent rows being disposed in different longitudinal zones of the rotor, and means for securing said discs and crushing elements together to form a rotor.

6. In a machine of the class described, the combination of a series of discs, the end discs of the series being cup-shaped, crushing elements arranged between said discs in longitudinal rows, said rows being disposed in circumferentially offset and longitudinally staggered relation to one another, and tie rods having their ends housed within said cup-shaped end discs to secure said discs and crushing elements together to form a rotor.

7. In a crushing machine of the class described, a rotor comprising a shaft, and rows of radially extending crushing arms supported by said shaft, said rows comprising series of said arms aligned in the longitudinal direction of said shaft, each successive series in the longitudinal direction of said shaft being staggered relative to the preceding series.

8. In a crushing machine of the class described, a rotor comprising a shaft, and rows of radially extending crushing arms supported by said shaft, said rows comprising series of said arms aligned in the longitudinal direction of said shaft, the arms of each successive series in the longitudinal direction of said shaft being at right angles to the arms of the preceding series.

In testimony whereof I have hereunto set my hand.

STANLEY F. OSSING.