July 7, 1931. W. A. BATTEY ET AL 1,813,836

HAMMER CRUSHER

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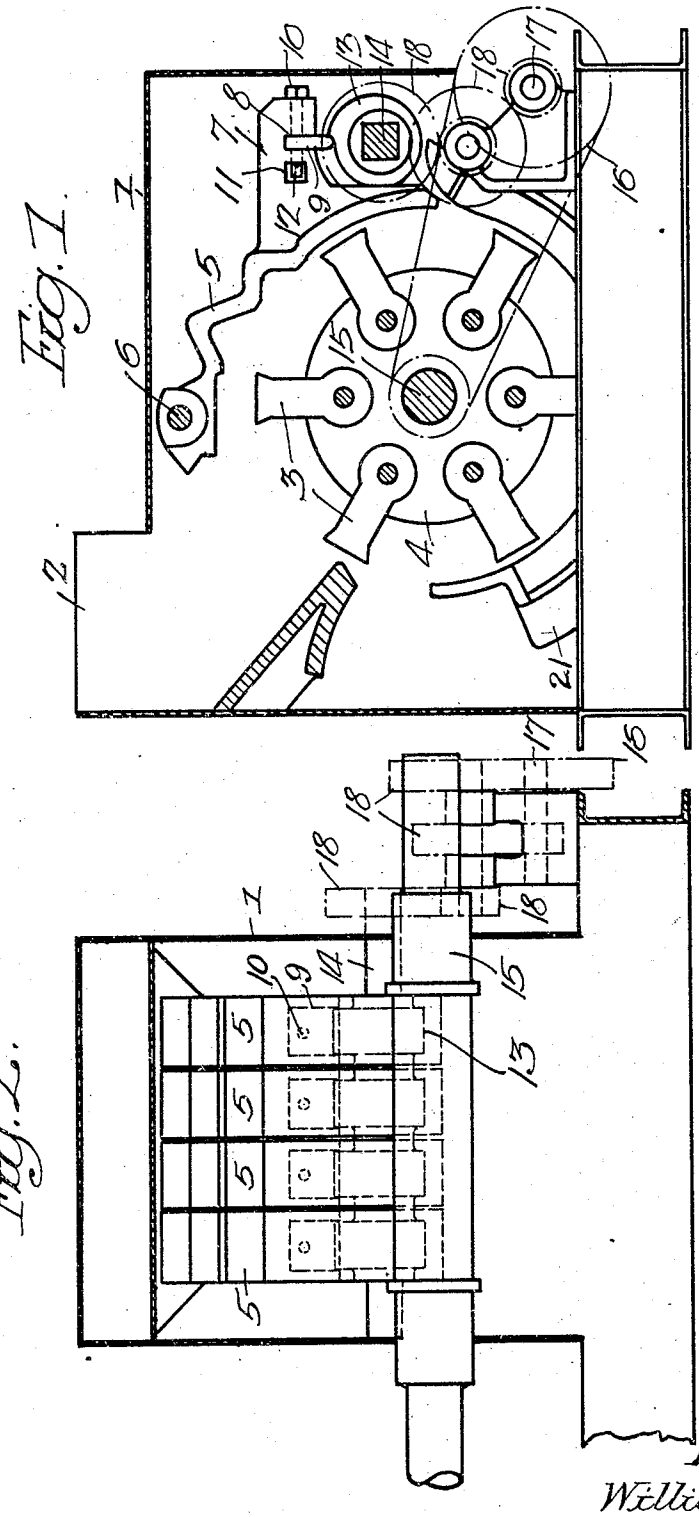


Fig. 1.

Fig. 2.

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Fig. 3.

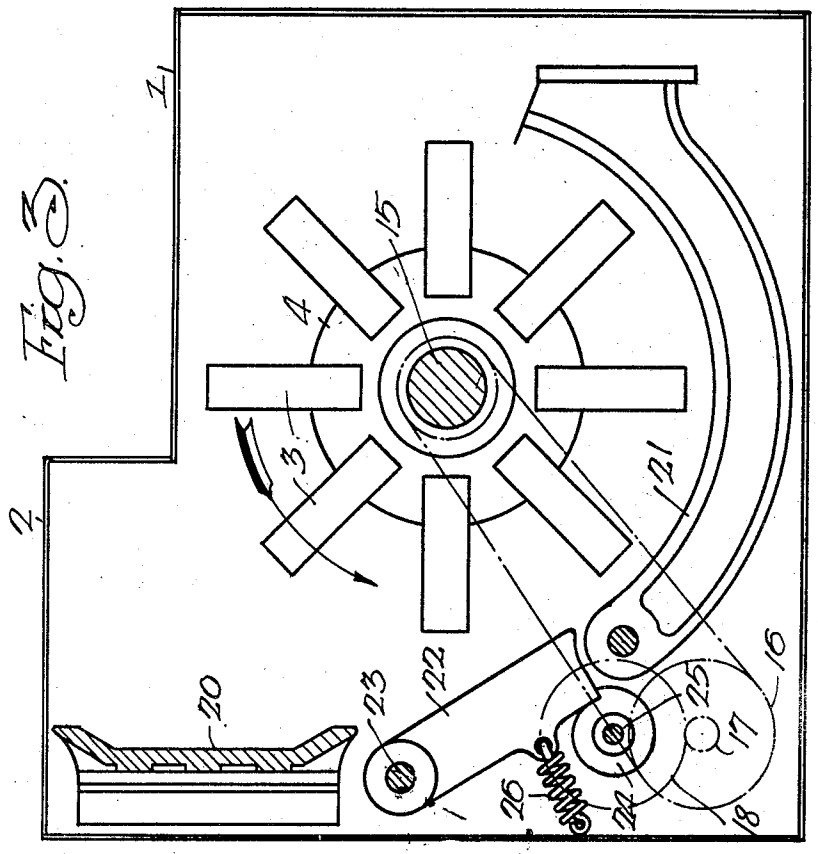
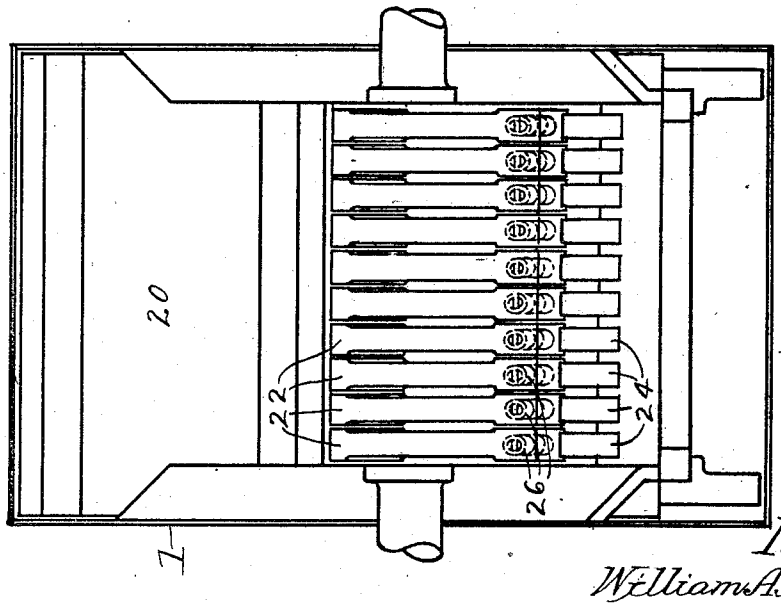


Fig. 4.



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Fig. 5.

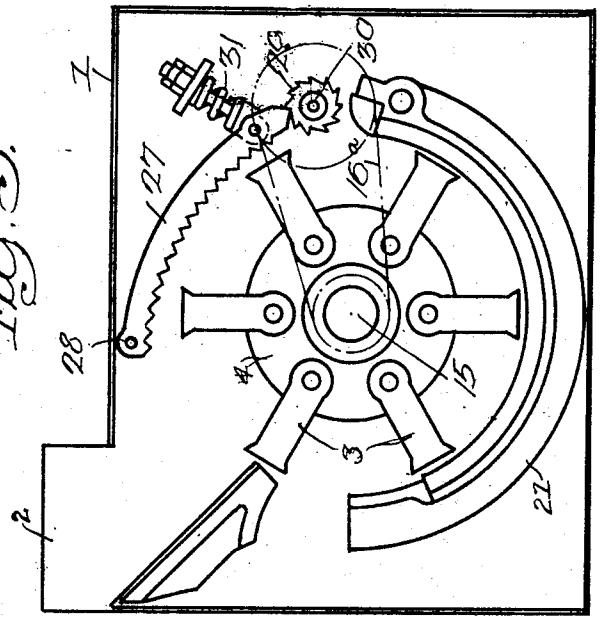
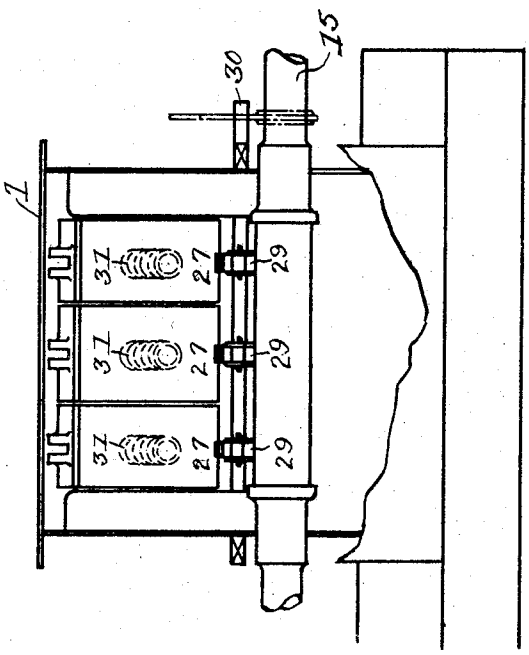


Fig. 6.



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Fig. 7.

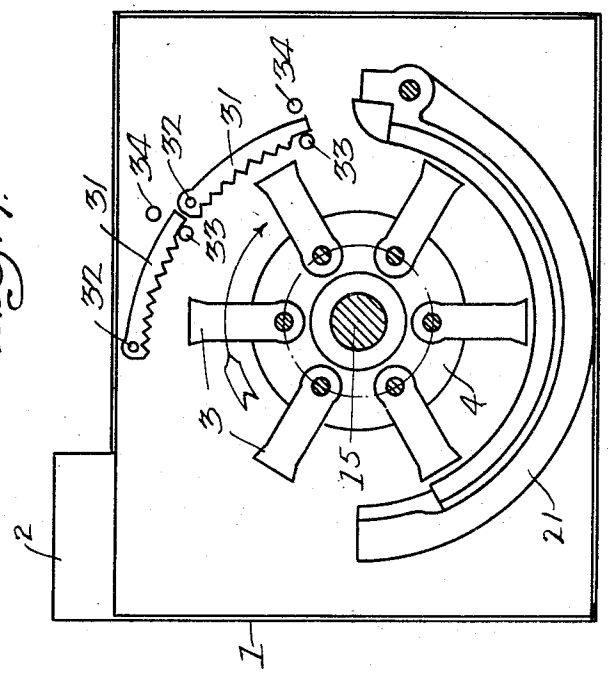
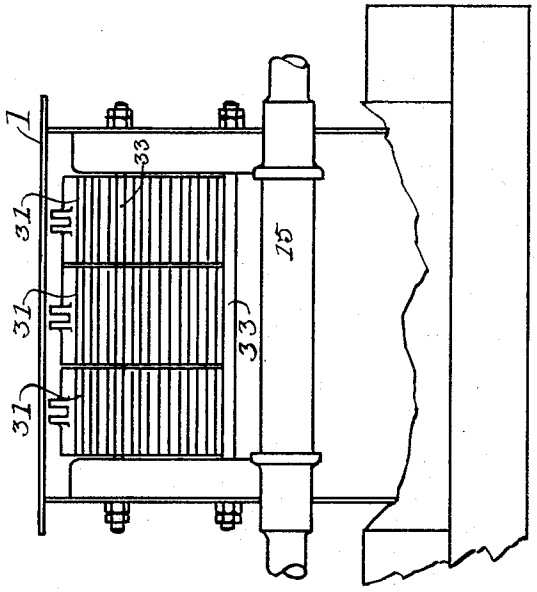


Fig. 8.



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Fig. 9.

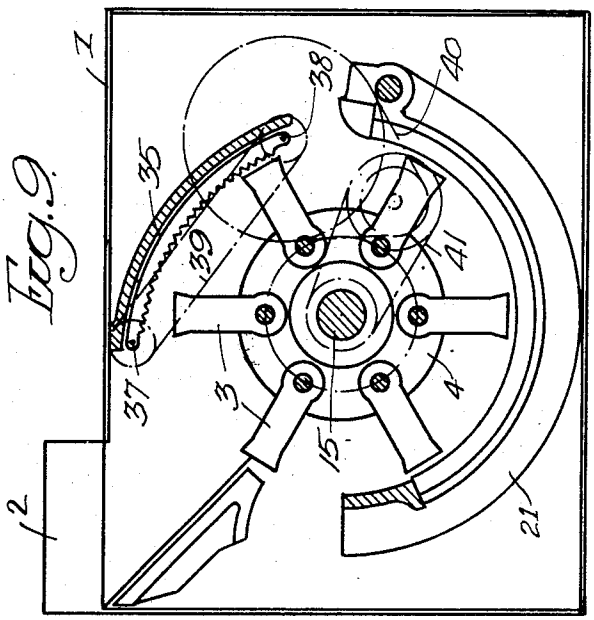


Fig. 11.

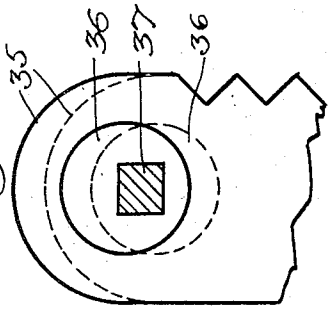


Fig. 12.

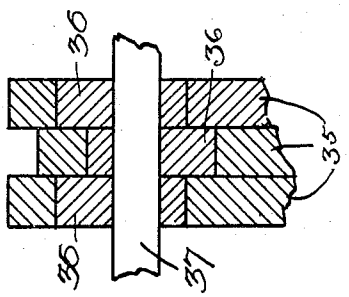
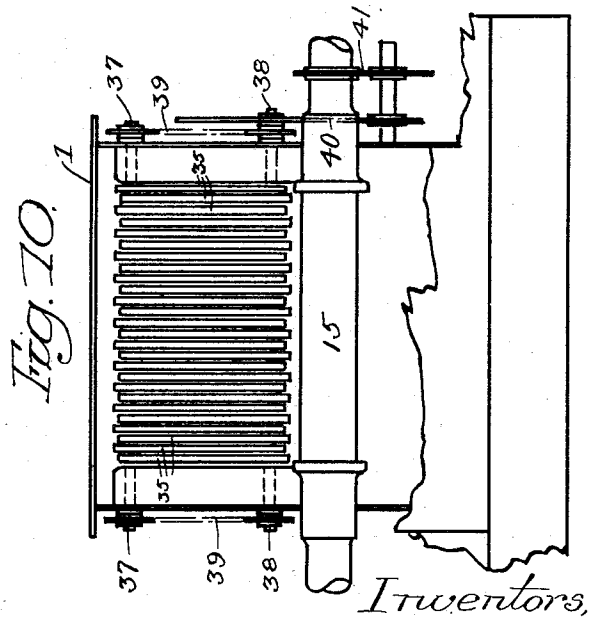


Fig. 10.



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Patented July 7, 1931 1,813,836

UNITED STATES PATENT OFFICE

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HAMMER CRUSHER

Application filed October 15, 1927. Serial No. 226,439.

This invention relates to hammer mills and crushers, and the principal object of the invention is to provide a machine adapted for crushing wet, damp and sticky material, such as wet clays and wet coal.

The invention further resides in certain novel and useful structural features hereinafter clearly set forth and illustrated in the attached drawings, in which:

Figure 1 is a longitudinal sectional view of a preferred embodiment;

Fig. 2 is a transverse section of the embodiment shown in Fig. 1;

Figs. 3 and 4 are, respectively, longitudinal and transverse sections illustrating the invention as applied to a hammer mill of the "bottom running" type;

Figs. 5 and 6 are, respectively, longitudinal and transverse sections illustrating a modification within the invention;

Figs. 7 and 8 are, respectively, longitudinal and transverse sections illustrating a further modification;

Figs. 9 and 10 are, respectively, longitudinal and transverse sections illustrating a still further modification, and

Figs. 11 and 12 are, respectively, fragmentary side and sectional views illustrating details of the mechanism shown in Figs. 9 and 10.

The usefulness of hammer mills in crushing or pulverizing wet, damp and sticky materials has been seriously handicapped by a tendency of these materials to accumulate on the various parts of the mechanism, and particularly on the crushing, breaking and screening surfaces. This has been particularly true in crushing or pulverizing wet coal, the wet or damp coal fragments and dust adhering to and blocking up the crushing and screening surfaces and materially curtailing the capacity of the mills. This curtailment in capacity has in some instances been so great as to make the use of the hammer mill commercially impractical.

We have discovered that by using flexible, movable, or vibratory crushing and breaking surfaces in place of the relatively fixed and solid surfaces heretofore employed, we are able to overcome the aforesaid difficulty and prevent the blocking-up of the surfaces by the wet material.

Numerous methods may be employed for obtaining the necessary movable or vibratory characteristic in the crushing, breaking and screening surfaces, and for the purposes of description, we have illustrated in the attached drawings a number of embodiments of the invention which are particularly well adapted for the purpose, although it will be understood that we do not limit ourselves to the herein described and illustrated embodiments.

With reference to the drawings, and particularly to Figs. 1 and 2, we have therein illustrated a well known form of hammer mill comprising the usual housing 1 having at the top an intake opening 2 through which the material to be crushed is introduced into the housing. From the intake opening, the material is deflected by a suitable guide to the hammers 3 pivotally mounted in well known manner upon a rotor 4, the inducted material being caught by the hammers and projected violently against a suitable crushing surface. This surface, instead of as in mills of the usual construction being fixed or stationary, is capable of sufficient movement to provide for dislodgment of the wet, damp or sticky material which may tend to adhere thereto. In the present instance, the crushing surface is formed by a plurality of bars 5 arranged side by side and each suspended or supported at the top in pivotal manner upon a transverse bearing bar 6, the inner or under face of these bars, of which in the present instance there are four, constituting the aforesaid crushing surface. Each of the bars is provided, as shown in Fig. 1, with a rear extension 7 having in the under side a slotted recess 8 for a bearing member 9 which is adapted to fit neatly in the said slot 8, as well shown in Fig. 1, and which is secured in place by means of a bolt or pin 10 mounted in the said projection 7 and projecting through the recess 8 and through a suitable aperture in the member 9. In the present instance, the inner end of the pin 10 lies in a transverse opening 11 in the projection 7, and the pin is re-

tained in place by means of a cotter pin 12 passed through that portion which projects into the transverse opening 11.

As well illustrated in Fig. 1, the bars 5 are not freely suspended from the shaft 6, but are supported at their rear ends by the said bearing members 9 which rest upon one or a plurality of cams 13 carried by and rotatable with a transverse shaft 14 suitably journaled in the housing 1. The cam or cams are preferably so formed that the bars 5 are slightly elevated and therafter permitted to drop abruptly to the depressed condition. Preferably we provide a separate cam for each of the bars 5 and so arrange them relatively to each other that the bars are not elevated and dropped in unison, but operate in opposite phases so that the bars are elevated and dropped in succession and not simultaneously. It will now be noted that the bars 5 are of irregular or corrugated form providing surfaces more or less normal to the lines of flight of the material projected towards the breaker or crusher bars by the hammers.

Although the shaft 14 may be operated from any external source of power, we prefer to operate this shaft from the rotor shaft 15 and from the same source of power which operates the mill. For this purpose, we provide a chain or belt connection between the shaft 15 and a wheel 16 journaled on a jack shaft 17 in the housing, and this wheel 16 is connected through a suitable train of gears 18 with the shaft 14.

In the operation of this device, it will be apparent that the bars 5 are successively elevated and permitted abruptly to assume the normal depressed position. By providing the detachable member 8, no part of the bars 5 is subject to wear due to the oscillatory movement, and the bearing member 8 when worn may be easily replaced.

The abrupt dropping of the bars 5 and the shock at the bottom of their movement, coupled with the oscillatory movement of the bars relative to each other, tends to dislodge any sticky or damp material tending to adhere to the working faces thereof so that the crushing surface is maintained in a clean state and the maximum efficiency of the mill maintained.

In Figs. 3 and 4, we have illustrated the invention as applied to a mill of the "bottom running" type. This mill comprises the usual housing 1, hammers 3, and rotor 4, which carries the hammers, the rotor moving in the direction of the arrow, see Fig. 3, and projecting the material introduced into the housing through the opening 2 at the top against a suitable breaker plate 20 and against the upper part of the cage 21 which extends from a point below the breaker plate 20 underneath the rotor 4 in the direction in which the rotor normally moves. In the present instance, we have mounted at the upper part of the cage 21 a plurality of independent bars 22 forming an intermediate breaker plate, these bars being pivotally suspended from a transverse shaft 23 and supported at their lower ends upon a plurality of cams 24 on a transverse shaft 25 suitably journaled in the housing. A spring 26 secured to each of the bars 22 on the under side and to the housing tends to retain the bars firmly seated against their respective cams 24. The cams 24 may be rotated in any manner, but in the present instance are operated from the rotor shaft 15 through a suitable belt or chain connected with a wheel 16 on a jack shaft 17, said shaft 17 being connected with the shaft 25 through a suitable train of gears indicated by the reference numeral 18.

The operation is substantially the same as that previously described, the cams 24 preferably being so formed as to move the lower ends of the bars 22 upwardly or outwardly and to permit them to return abruptly under the action of the springs 26 to the normal depressed position. The cams may be arranged to operate the bars in unison, or the bars may be operated in progression, the abrupt return of the bars to the normal position and the shock at the end of this travel being sufficient to dislodge the wet or sticky material tending to adhere to the crushing surface formed by the said bars 22.

In Figs. 5 and 6, we have illustrated a further modification in which the crushing surface is formed by a plurality of segmental bars 27 pivotally mounted at their upper ends in a transverse bar or shaft 28 and supported in each instance at their lower ends upon the peripheries of a toothed or ratchet wheel 29, these latter wheels being carried by a transverse shaft 30 suitably journaled in the housing 1. In this instance, we provide in back of each of the bars 27 a spring 31 which exerts a force tending to hold the lower ends of the bars downwardly upon their respective toothed wheels 29. The shaft 30 is operated from the rotor shaft 15 through a suitable chain or belt 16*a*, and rotation of this shaft 30 results in an alternate elevation and thereby depression under the action of the spring 31 of the bars 27, giving the latter a vibratory movement effectively preventing accumulation of wet or sticky material on the working faces. In this instance also, it will be noted that an abrupt interruption of the movement of the bars is provided for, the resulting shock being extremely effective in freeing the bars of material tending to adhere thereto. In this and the other modifications herein illustrated, we have employed the same reference numerals to indicate the corresponding parts of the various machines.

Although in the modifications of Figs. 5

and 6, we have illustrated the use of springs 31 to maintain the lower ends of the bars 27 in contact with the supporting wheels 29, it may not under some conditions be necessary to employ these springs, the weight of the bars 27 and the force of gravity being relied upon to carry the bars to the normal depressed position for elevation and release by the teeth of the wheel 29. Thus in Figs. 7 and 8, we have illustrated a breaking surface comprising a plurality of segmental bars 31 pivotally suspended at their upper ends on transverse bars or shafts 32 and supported at their lower ends upon fixed transverse bars 33. Transverse bars 34 are also provided at the opposite or upper side of the lower ends of the bars to limit their upward movement. In this instance, the action of the material projected against the bars by the hammers 3 is relied upon to vibrate the bars around their supporting shafts 32, the impact of the projected material first slightly elevating the lower ends of the bars and thereafter permitting them to drop by gravity upon their normal supports 33. It will be apparent that to some extent, the desired vibratory effect may be obtained in this manner, the abrupt interruption of the downward movement of the bars after their elevation as described tending to free the bars of any material which might adhere thereto.

Although in the preferred embodiments of our invention and as previously described, we prefer to provide a vibratory movement of the bars or elements forming the crushing surface including an abrupt interruption in the movement of the bars, particularly in a downward direction, it will be apparent that in the broader aspects the invention is capable of modification providing other freeing movement of the bars. Thus in Figs. 9 to 12, inclusive, we show the segmental bars 35 which in this instance form the crushing surface against which the material is projected by the hammers 3 as being mounted at each end upon an eccentric 36, the eccentrics being carried by and suitably secured to transverse shafts 37 and 38 suitably journaled in the housing 1. The bars 35 in this instance are arranged close together, and when the shafts 37 are rotated, the bars are given a wiping action against each other which tends to dislodge the material which might adhere to the working face. This wiping action will be readily understood by reference to Figs. 11 and 12, which illustrate the relative positions of the adjacent eccentrics 36, it being noted that these eccentrics are arranged so that their throw is preferably at an angle of 180° apart in the adjacent eccentrics. Although the shafts 37 and 38 may be operated from any source of power, we provide for their operation in the present instance from the rotor shaft 15, as clearly shown in Figs. 9 and 10, the shafts 37 and 38 being connected with each other through a suitable power belt or chain 39, and the shaft 38 being connected with the shaft 15 through a suitable train of mechanism including belts or chains 40—41 and associated elements.

We claim:

1. In a hammer mill, the combination with a rotary hammer, of a plurality of pivotally mounted elements adapted to form a crushing surface against which a material is impelled by said hammer, a fixed stop limiting the forward movement of each of said elements, resilient means tending to retain said elements against the stops, and means for alternately moving said elements against the pressure of the springs away from the stops and releasing them so that the springs are permitted to sharply return said elements to the normal stop-engaging position.

2. In a hammer mill, the combination with a rotary hammer, of a plurality of elements adapted to form a crushing surface against which a material is impelled by said hammer, said elements being mounted side by side in close proximity and being independently movable in parallel planes, and a plurality of cams engaging the respective elements and adapted to relatively oscillate said elements in the said parallel planes.

3. In a hammer mill, the combination with a rotary hammer, of a plurality of pivotally mounted individually movable elements adapted to form a crushing surface, a rotary cam supporting each of said elements, and means for rotating the cams in different phases to provide a relative oscillatory movement for said elements.

4. In a hammer mill, the combination with a rotary hammer, of a plurality of elements individually movable and arranged to form a crushing surface against which a material is impelled by said hammer, and mechanism for intermittently and successively displacing said elements with respect to each other.

5. In a hammer mill, the combination with a rotary hammer, of a plurality of elements individually movable and arranged to form a crushing surface against which a material is impelled by said hammer, springs for retaining said elements in predetermined normal positions, and mechanism for intermittently and successively displacing said elements from said normal positions.

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