March 1, 1932. J. A. FLINT 1,847,083

CRUSHER

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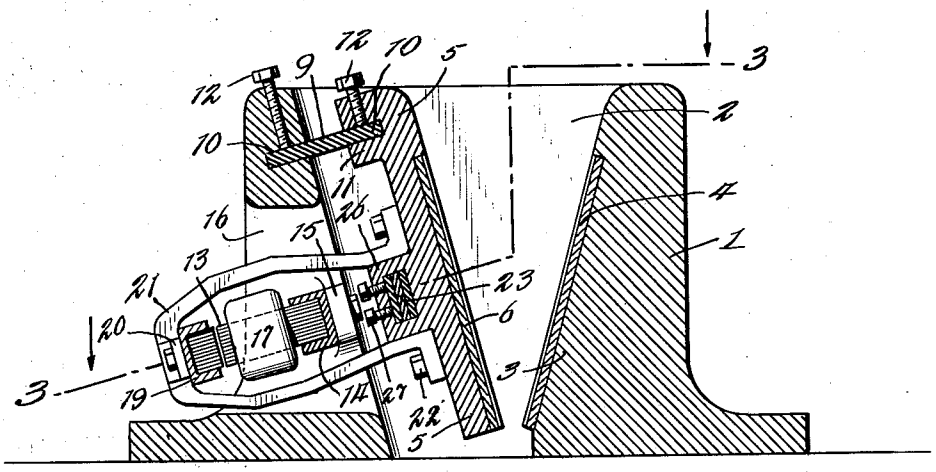


Fig. 1.

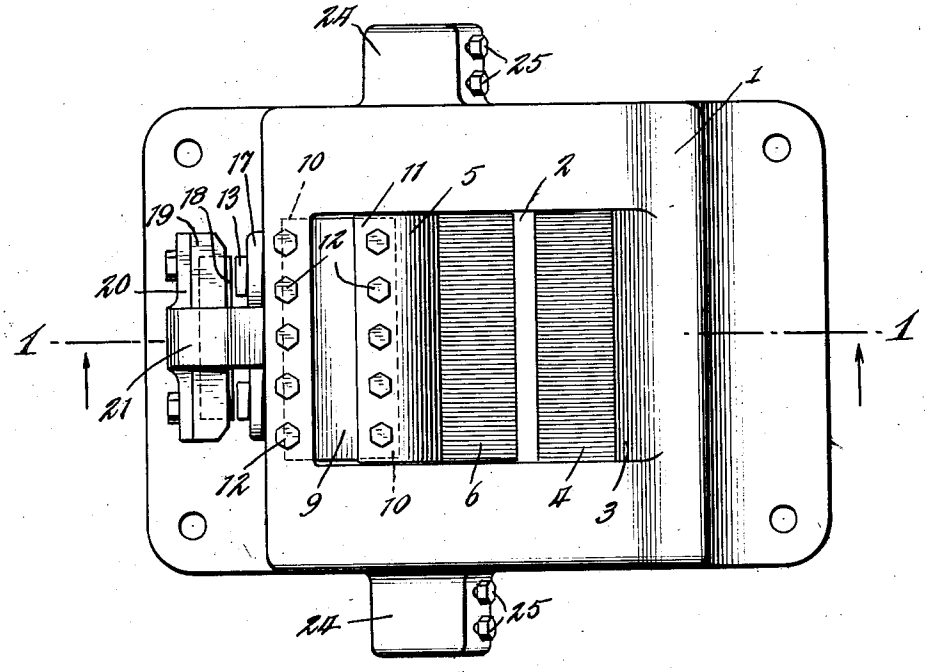


Fig. 2.

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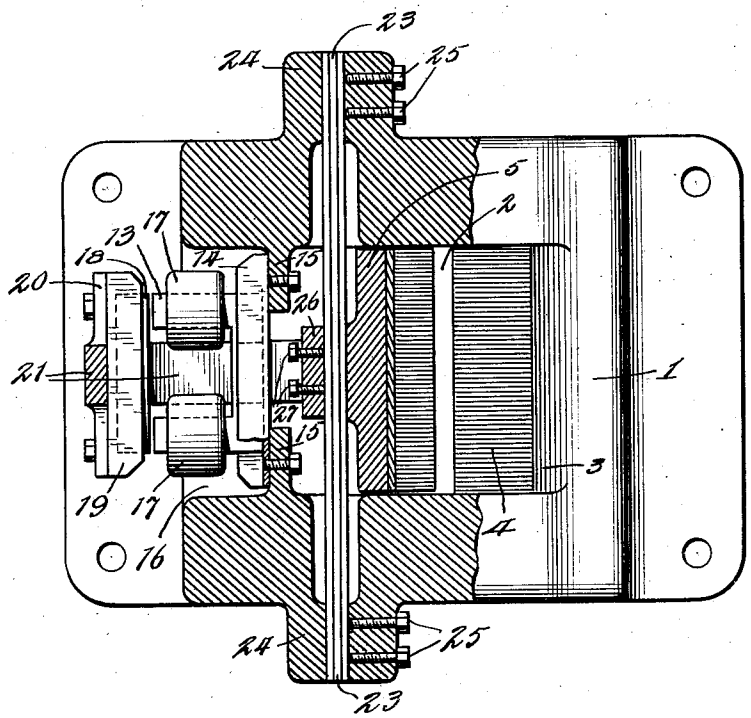
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Fig. 3.



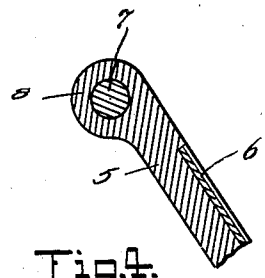


Fig. 4.

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UNITED STATES PATENT OFFICE

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CRUSHER

Application filed November 2, 1926. Serial No. 145,790.

This invention relates to crushers for crushing rock and other similar materials, and particularly to crushers of the kind in which the material to be crushed is introduced between jaws, one or both of which is or are movable and caused to approach toward and recede from each other to crush or reduce the material introduced therebetween.

The object of the invention is to provide an improved and simplified form of crusher in which the movement of the jaw or jaws is effected at a very high rate of speed as compared with existing crushers, in order to obtain a more effective crushing of the rock or other material and a greatly increased output from the crusher.

The invention essentially comprises an electro-magnetic motor or operating means and a cooperating resilient means associated with the movable jaw or jaws of the crusher, and which are designed to act together in synchronism to cause vibration or movement of the jaw or jaws, and to maintain the same in such vibration or movement, at a predetermined high frequency and with a desired or controlled amplitude of vibration.

The invention is illustrated in the accompanying drawings as applied to a more or less usual form of crusher having a fixed jaw and a movable jaw, although it will, of course, be understood that the invention may as readily be applied to crushers in which both of the jaws are movable.

In the drawings:

Figure 1 is a vertical section of the crusher taken on the line 1—1 of Fig. 2;

Fig. 2 is a plan view of the crusher shown in Fig. 1;

Fig. 3 is a sectional plan view taken on the line 3—3 of Fig. 1; and

Fig. 4 is a detail view of a modified form of mounting for the movable jaw.

The particular form of crusher illustrated comprises the usual heavy crusher frame (1) adapted to be secured in position in the usual manner and having the central downwardly tapering opening (2) into which the material to be crushed is introduced. One side of this frame constitutes the fixed jaw (3) of the crusher and is provided within the opening (2) with the usual crushing or wearing plate (4) of manganese steel or the like.

The movable jaw (5) is supported from the frame (1) within the opening (2) for movement about its upper end. This jaw also is provided with a crushing or wearing plate (6).

The jaw may be mounted for pivotal movement upon a shaft (7) extending through an enlargement or eye (8) at the upper end of the jaw and into suitable bearing apertures in the main frame (1), as indicated in Fig. 4. It is, however, preferred to mount the movable jaw in the manner indicated in Figs. 1 and 2. In this form of mounting a plate (9) of sheet metal is provided extending substantially the full width of the jaw and seated along opposite edges thereof within grooves or recesses (10) formed in the enlarged upper portion (11) of the jaw and in the adjacent portion of the main frame. The plate is held within the grooves or recesses (10) by means of screws (12) threaded into the upper parts of the jaw and frame respectively. This plate provides the necessary flexibility of mounting of the upper end of the jaw to provide for the desired movement of the jaw to effect the crushing operation.

The movement of the movable jaw (5) is effected by an electro-magnetic operating means acting in conjunction with a resilient means, both of such means being associated with or connected to the movable jaw to impart the desired movements thereto.

The electro-magnetic means, in the form thereof shown, comprises a fixed laminated core (13) of substantially C-shape, which is mounted in a core holder (14) of non-magnetic material, which is in turn suitably secured to the main frame (1), being, for example, bolted to lugs (15) projecting within an opening (16) provided in the frame to accommodate the electro-magnetic means. Energizing coils (17) are provided upon the outwardly projecting arms or poles of the core (13). Associated with the core (13) is a vibratable or reciprocable laminated armature (18) mounted in a holder (19) of non-magnetic material, which is in turn bolted or otherwise secured to the laterally

extending portions (20) of a yoke member (21). The inner ends of the arms of this yoke member are suitably secured, as by means of screws (22), to the movable jaw (5).

The resilient means which coacts with the electro-magnetic means in effecting and maintaining the vibratory movement of the jaw (5) comprises, in the particular form thereof shown, a flat bar element (23) which is anchored at its ends and is connected to the jaw at its middle portion. This bar element may comprise a plurality of flat bars, three of such bars being shown in the drawings. The ends of the bar element are received in correspondingly shaped openings formed in bosses (24) extending laterally from the sides of the main frame, and the ends of the bar are securely fixed by means of screws (25) threaded into said bosses and bearing at their inner ends against the bar element. At its central portion the flat bar element passes through a boss (26) projecting rearwardly from the jaw member (5), the boss and bar element being firmly clamped together by means of screws (27) threaded in the boss and bearing against the bar element.

The coils (17) are connected with a suitable source of alternating or pulsating current, whereby the armature (18) is intermittently attracted toward the poles of the core (13), this attractive movement of the armature being transmitted to the movable jaw (5) through the yoke (21) which carries the armature and is connected to the jaw. The resilient means or flat bar element (23) normally tends to hold the armature and jaw in the neutral position indicated in the drawings, but when the armature is attracted toward the core (13), the bar element is deflected from the neutral position and thus a restoring force is built up within the bar element which, when the attraction of the armature toward the poles of the core ceases between the alternations or pulsations of current, tends to restore the parts to the neutral positions thereof. Due to the inertia of the jaw and parts connected thereto, the jaw and parts will be carried beyond the neutral position, thereby causing a deflection of the flat bar element in the opposite direction, again building up a restoring force in the bar element tending to bring the parts back again to the neutral position. The restoring force in this direction will be assisted by the succeeding attractive force of the core (13), and as the parts reach the neutral position again this attractive force and the inertia of the parts will again cause deflection of the bar element (23) in the first direction. This operation will be repeated as long as current is supplied to the coils (17) of the core (13) with the result that the jaw (5) will be vibrated or moved relatively to the fixed jaw (3) at a high frequency.

It will be understood that the attractive forces are intermittently applied to the armature (18) in such a manner as to cause the same and the jaw to vibrate or move at a predetermined frequency, and that the resilient means constituted by the flat bar element (23) is so constructed or designed as to the material, length and cross-section thereof, as to also maintain the jaw in vibration at this predetermined frequency during the operation of the crusher. That is to say, the bar element is so designed that when deflected from the neutral position in the manner described, restoring forces are built up therein of the necessary magnitude to return the jaw and parts associated therewith to the neutral position in the same time as taken to move the jaw and parts from said position. Thus the electro-magnetic means and the flat bar element properly cooperate in synchronism with each other to maintain the jaw in vibration or movement at said predetermined frequency. The amplitude of vibration or movement of the jaw may be varied by varying the strength of the current supplied to the energizing coils.

It will, of course, be understood that more than one flat bar element may be associated with the jaw and electro-magnetic means if so desired.

It will also be understood that the invention may be readily applied to a crusher construction in which both of the crusher jaws are movable. For example, each of the crusher jaws may be mounted and operated in the manner described with reference to the movable jaw (5). Alternatively each of the movable jaws may have a resilient means associated therewith, and a common electro-magnetic means may be provided for the two jaws, the core, for example, being mounted on one of the jaws while the armature is carried by the other jaw.

It is preferred to design or arrange the vibrator elements so that the natural vibration thereof will be slightly out of synchronism with the frequency of the electro-magnetic impulses, but such that the vibratory movement of said elements will be brought into synchronism with the current frequency by the attractive forces of the electro-magnet. This enables the operation of the machine to be more accurately controlled.

What I claim and desire to secure by Letters Patent is:—

1. A crusher, comprising in combination, a frame, crusher jaws, including a movable jaw, a vibratory element mounted on said frame with a portion thereof free to vibrate and with the vibratory portion thereof rigidly connected to said movable jaw, said element being constructed and arranged to be inherently capable in itself of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means mounted on said

frame in electro-magnetic connection with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency.

2. A crusher, comprising in combination, a frame, crusher jaws, including a movable jaw, a vibratory element mounted on said frame with a portion thereof free to vibrate and with the vibratory portion thereof rigidly connected to said movable jaw and supporting and maintaining the same normally in a predetermined position with respect to the other jaw, said element being constructed and arranged to be inherently capable in itself of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency to opposite sides of said predetermined position and electro-magnetic means mounted on said frame in electro-magnetic connection with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency.

3. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element anchored at the ends thereof in the crusher frame and capable of vibrating at its middle portion, rigidly connected at said middle portion to said jaw, and designed so as to be capable of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means associated with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency.

4. A crusher, comprising in combination, a frame, crusher jaws, including a movable jaw, a vibratory element mounted on said frame with a portion thereof free to vibrate in the direction of movement of said movable jaw and with said vibratory portion thereof rigidly connected to said movable crusher jaw, said element being constructed and arranged so as to be capable in itself of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means mounted on said frame in electro-magnetic connection with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency, said electro-magnetic means being controllable to determine the amplitude of vibration of said jaw.

5. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element in the form of a flat bar element anchored at the ends thereof in the crusher frame and capable of vibrating at its middle portion, rigidly connected at said middle portion to said jaw, and designed so as to be capable of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means associated with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency.

6. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element in the form of a plurality of juxtaposed flat bars anchored at the ends thereof in the crusher frame and capable of vibrating at the middle portion thereof, rigidly connected at said middle portion to said jaw, and designed so as to be capable of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means associated with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency.

7. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element mounted for vibratory movement in the crusher frame and rigidly connected with and supporting said jaw in a normally neutral position, and electro-magnetic means associated with said vibratory element and arranged to apply intermittent attractive forces to said element at a predetermined frequency, said element being arranged to be deflected to opposite sides of said neutral position by the attractive forces of said electro-magnetic means and the inertia of said jaw respectively, and being designed with respect to the vibratory weight of said jaw when so deflected to develop restoring forces approximately proportional to the deflection thereof, tending to bring said jaw to rest and to restore it to neutral position in the same time as taken to move it from said position.

8. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element fixedly mounted at the ends thereof in the crusher frame and capable of vibrating at its middle portion and at said middle portion rigidly connected with and supporting said jaw in a normally neutral position, and electro-magnetic means associated with said vibratory element, said element being arranged to be deflected to opposite sides of said neutral position by the attractive forces of said electro-magnetic means and the inertia of said jaw respectively, and being designed with respect to the vibratory weight of said jaw when so deflected to develop restoring forces approximately proportional to the deflection thereof, tending to bring said jaw to rest and to restore it to neutral position in the same time as taken to move it from said position.

9. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element mounted for vibratory movement in the crusher frame and rigidly connected with said jaw, said element being

designed with respect to the vibratory weight of said jaw to maintain said jaw in vibratory movement at a certain frequency, and electro-magnetic means connected with said vibratory element and designed to produce electro-magnetic impulses at a predetermined slightly different frequency and operative to maintain said element in vibratory movement at said predetermined frequency.

10. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element supported by the crusher frame and rigidly connected with said jaw and designed with respect to the vibratory weight of said jaw so as to be capable under repeated deflection of developing restoring forces such as to maintain said jaw in vibration at a predetermined frequency, and electro-magnetic means associated with said vibratory element and operative to cause repeated deflection thereof at said predetermined frequency.

11. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element supported by the crusher frame and rigidly connected with said jaw and designed with respect to the vibratory weight of said jaw so as to be capable under repeated deflection of developing restoring forces such as to maintain said jaw in vibration at a predetermined frequency, and electro-magnetic means associated with said vibratory element and operative to apply repeated attractive forces thereto to cause repeated deflection thereof at said predetermined frequency, said means being so arranged that said attractive forces are applied to said element in the direction of the crushing movement of said jaw.

12. A crusher, comprising in combination, a frame, crusher jaws, including a movable jaw, means for supporting said movable jaw to permit vibratory movement thereof, comprising a plate member extending widthwise of the jaw connected at its edges to said jaw and frame respectively and capable of a flexing movement, electro-magnetic means mounted on said frame in electro-magnetic connection with said movable jaw, and resilient means mounted on said frame and connected with said jaw, said electro-magnetic means and said resilient means acting jointly and in synchronism with each other to cause said jaw to vibrate and to maintain it in vibration at a predetermined frequency.

13. A crusher, comprising in combination, crusher jaws, including a swingingly mounted and movable jaw, a vibratory element connected to said movable crusher jaw and arranged to vibrate in a plane parallel with the axis of swinging movement of said jaw, and designed so as to be capable of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means associated with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency.

14. A crusher, comprising in combination, crusher jaws, including a movable jaw, a vibratory element normally lying in a plane substantially parallel to the plane of the movable crusher jaw and mounted for vibratory movement in a plane transverse to said parallel planes, said element being rigidly connected to said movable crusher jaw and designed so as to be capable of maintaining the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means associated with said vibratory element and operative to maintain said element in vibratory movement at said predetermined frequency.

15. A crusher, comprising in combination, a frame, crusher jaws, including a movable jaw, a vibratory element mounted on said frame with a portion thereof free to vibrate in the direction of movement of said movable jaw, and with said vibratable portion thereof rigidly connected to said movable crusher jaw, said element being predesigned with respect to its material length and cross-sectional dimensions, so as to be inherently capable in itself of maintaing the vibratory weight of said jaw in vibratory movement at a predetermined frequency, and electro-magnetic means mounted on said frame in electromagnetic connection with said vibratory element and adapted when energized to produce repeated actuating forces effective to maintain said element in vibratory movement at said predetermined frequency.

In testimony whereof I affix my signature.

JAMES A. FLINT.