Aug. 15, 1961 M. PICALARGA 2,996,261

FEED AND DISCHARGE SCREEN STRUCTURES FOR ROCK CRUSHING APPARATUS

Filed July 18, 1958 4 Sheets-Sheet 1

Fig. 1

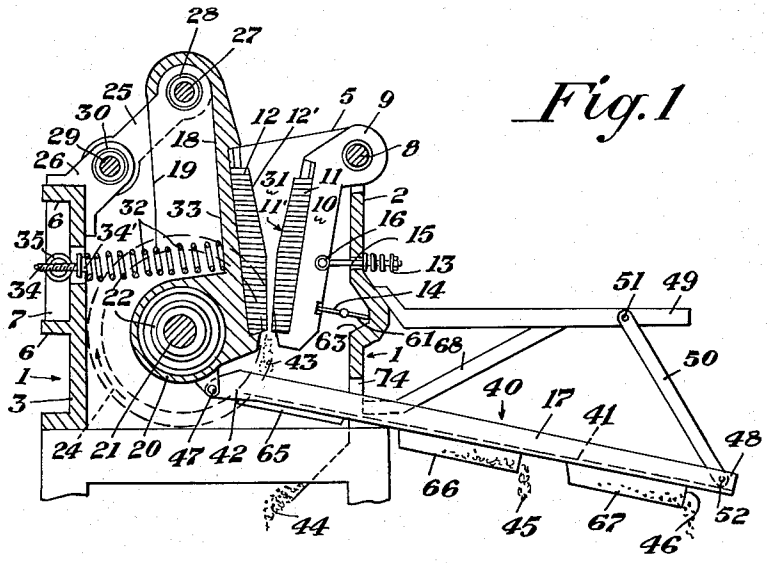
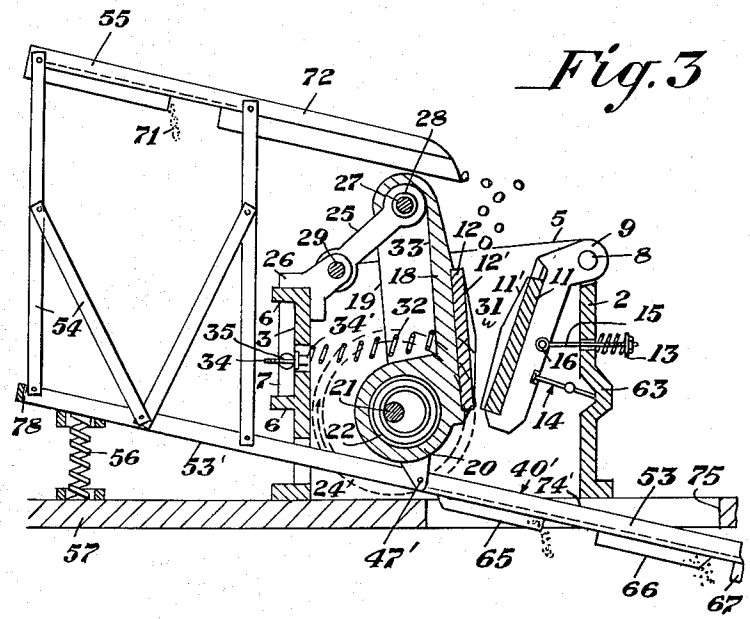


Fig. 3



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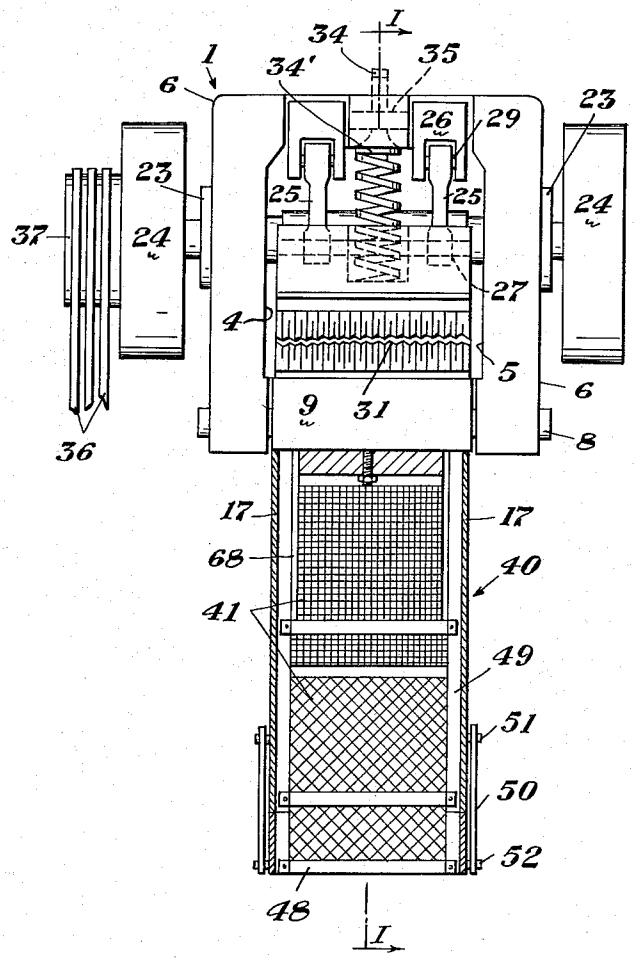
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Aug. 15, 1961 M. PICALARGA 2,996,261

FEED AND DISCHARGE SCREEN STRUCTURES FOR ROCK CRUSHING APPARATUS

Filed July 18, 1958 4 Sheets-Sheet 2

Fig. 2

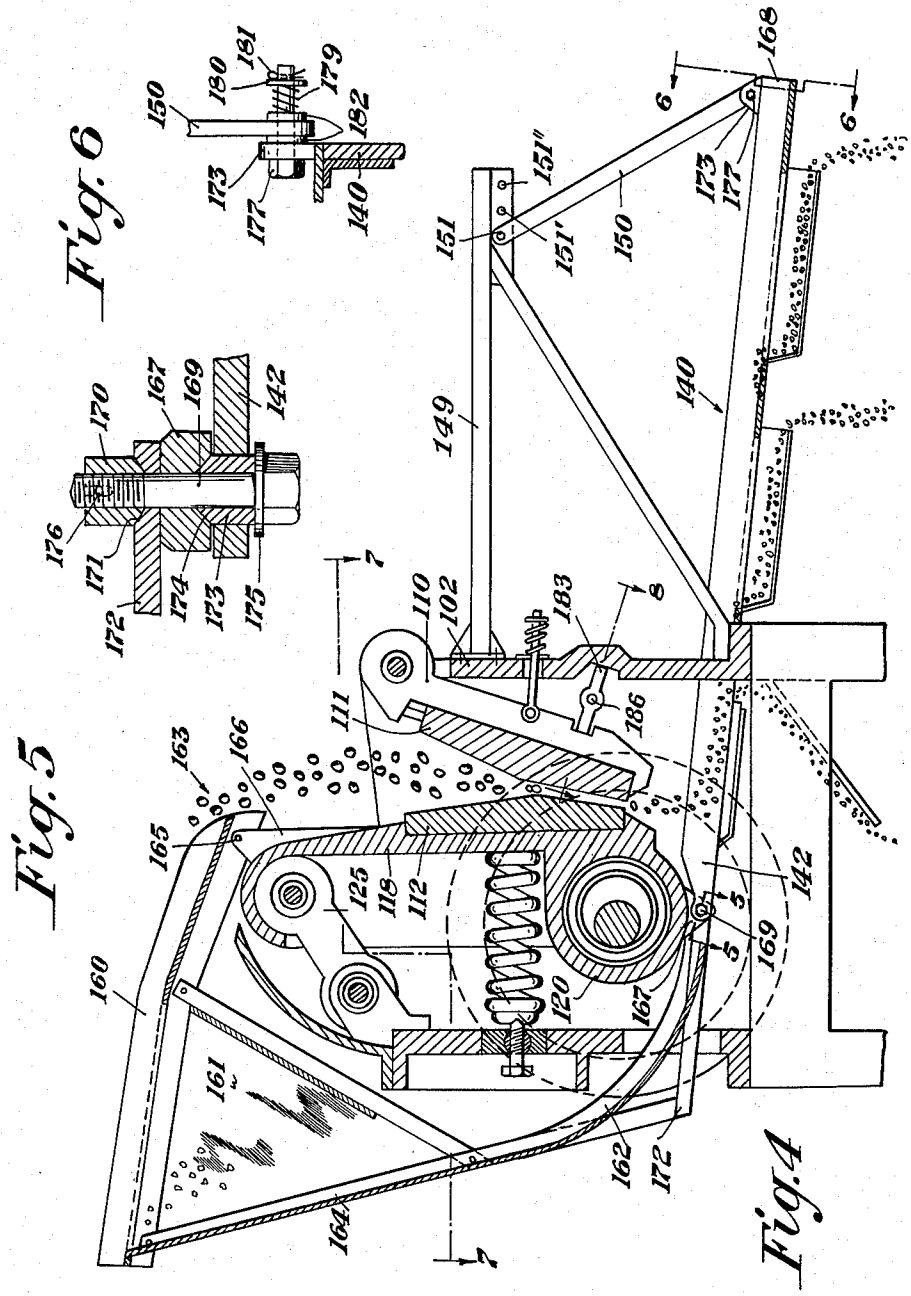


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FEED AND DISCHARGE SCREEN STRUCTURES FOR ROCK CRUSHING APPARATUS

Filed July 18, 1958 4 Sheets-Sheet 3



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FEED AND DISCHARGE SCREEN STRUCTURES FOR ROCK CRUSHING APPARATUS

Filed July 18, 1958 4 Sheets-Sheet 4

Fig. 7

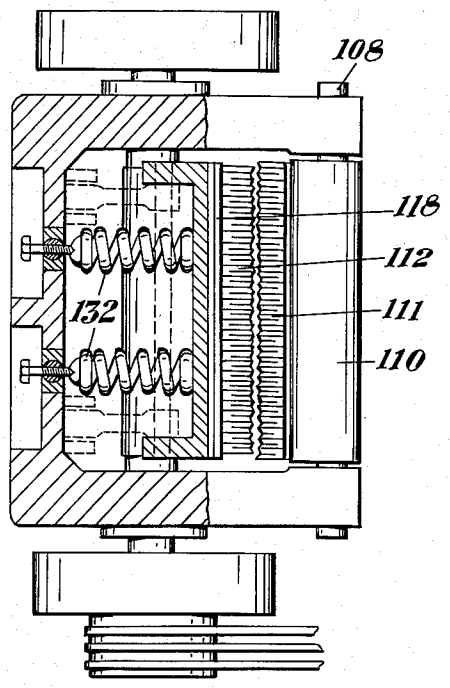
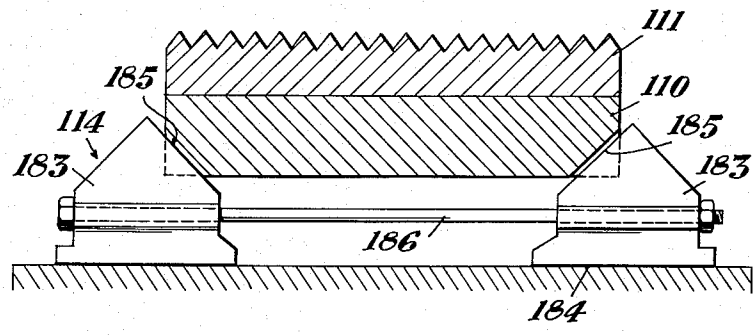


Fig. 8



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United States Patent Office 2,996,261 Patented Aug. 15, 1961

2,996,261

FEED AND DISCHARGE SCREEN STRUCTURES FOR ROCK CRUSHING APPARATUS

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Filed July 18, 1958, Ser. No. 749,436
6 Claims. (Cl. 241—77)

The present invention relates generally to the manufacture of rock crushing apparatus and similar machinery employed for reducing rocks and stones to chip and gravel form for use in road building, paving operations, etc.

More particularly, the present invention has reference to feed and discharge screen structures for machines or apparatus of the kind described. In this connection, the present application is a continuation-in-part of my copending application Serial No. 392,831, filed November 18, 1953, now Patent No. 2,921,750.

In that application, there is disclosed and claimed a complete rock crushing apparatus, including fixed and movable jaws between which the material to be crushed passes, said jaws being adapted, by reason of a novel, particularly effective interrelation of the several components of the machine, to reduce the raw material to chips or gravel of a selected size.

In the parent application referred to above, the machinery is illustrated in one form as incorporating both an overhead or feed screen assembly, through which the material passes en route to the jaw structure, and a lower, discharge screen assembly receiving the crushed material. Said screen assemblies are movable, and movement is imparted thereto by reason of connections which the assemblies have to select, movable components of the jaw means. The screen assemblies, thus, in the application referred to have a predetermined, cycling movement bearing a direct relationship to the cycle of operation of the jaw means.

In the present application there is illustrated the apparatus shown in the above-referred-to application of which the present application is a continuation-in-part, that is to say, the present application includes an illustration and description of the complete machine including the screen assemblies. The claims of the present application, however, are limited to a construction including the screen assemblies, that is, to a construction including a feed and discharge structure for crushing machines. The description of various components, that do not in and of themselves comprise part of the screen assemblies, has been included herein solely for the purpose of showing the particular mounting of the screen assemblies, the operational characteristics thereof, and the manner in which said screen assemblies are timed for operation in relation to the timed or cycling operation of the jaw means.

In this connection, one important object of the present invention is to provide feed and discharge screen structures in coactive relation to a movable jaw means, with the linkage of the movable jaw means to the screen assemblies being such that there are a specifically predetermined path and timing of movement of the screen assemblies relative to the movable jaw means, and vice versa. It is proposed, in this regard, that said predetermined path and timing of the screen and jaw motions be such as to provide a vastly improved rate and manner of feeding the raw material to the jaw structure; a preseparation of said raw material so as to cause only material above a predetermined size to be fed between the jaw means with remaining material by-passing the jaw means completely; and a particularly effective manner of removing from the apparatus material that has been reduced by the jaw means to a predetermined

smaller size, or that has by-passed the jaw means by reason of having already been of said smaller size.

Another important object is to provide feed and discharge screen or sieve devices for rock crushing apparatus having a specifically improved, novel form, mounting, and motion of the respective screens.

By way of background, it may be noted that crushing equipment for the production of gravel and similar comminuted substances, having screen arrangements for the material which leaves the crusher is, of course, well-known in and of itself. In such equipment, the screens are so arranged that the material is separated according to the size of the pieces of the material. It is customary to provide a feeder device for the return to the crusher of pieces that were not reduced to a sufficiently small size on their initial pass through the machine.

Crushing machines of the character described are equipped with swinging screens in many instances, which screens are driven through their pivotal motion from the same source of power, or prime mover, that is used to drive the crusher jaws. The drive of the screens generally employs a connecting arrangement or transmission that may include a belt, cable, or chain type of driving connection. An installation of this type, however, requires generally speaking, a relatively high overall elevation of the various components of the machine. Further, such an installation necessitates a various additional driving components or elements required in the transmission of power from the drive mechanism of the crushing apparatus to the screen assemblies. This tends to heighten the possibility of breakdowns, both of the crushing and the screening equipment.

In accordance with the present invention, it is proposed to construct crushing apparatus for the production of gravel, chips, and the like, with screen structures driven in such a way as to eliminate the drawbacks or deficiencies which have been described above and which have been found in machinery already in use. To accomplish this desirable end, I provide screen structures, for crushing machines of the kind referred to, which are driven directly by the movable crushing jaw of the machine, that is, there is required merely a driving connection from the power source to the movable crushing jaw, with the movable crushing jaw becoming, thereafter, a drive link or motion-translating device having a direct driving connection to the overhead and discharge screen structures.

Thus, in carrying out the present invention it is proposed to eliminate any need for mechanism generally employed for transmitting power required for the screen motion. It is further proposed, by elimination of said mechanism, to permit screens to be installed below the jaws of the crusher, thus saving considerable space and, at the same time, reducing to a considerable degree the cost of manufacture of the machine.

Since the movement of the jaws is transmitted directly to the screen equipment, it is advantageous in carrying out the present invention to construct the crushing means in a manner such that the movable crushing jaw, at its lower end, is moved by an eccentric shaft, with the upper part being pivotally connected to a link which is in turn pivoted upon the housing.

As a further improvement in screen assemblies of the character described, it is proposed in accordance with the present invention to provide another form of feed or inlet screen structure, used for separating chips that are contained in the raw material from larger pieces found in said raw material and required to be supplied to the crusher. In this improved form, the feed or inlet screen is fastened in an inclined position above the crusher to a suitable frame, that is connected with both ends of the movable jaw structure, thus to be subjected to or be otherwise given the motion of both ends of the movable jaw

structure. At its rear or intake end, the feed screen has a rigid connection to the lower end of the movable crushing jaw, so as to have a motion duplicating that of the lower end of the movable jaw, that is, travel in a circular path about a horizontal axis. The delivery end of the screen is pivotally attached to the upper end of the movable jaw to have oscillatory motion therewith about a horizontal axis paralleling the first axis.

Other objects and details of the invention will be apparent from the following description in which like reference characters designate like parts throughout the several views, and from the drawing, in which:

FIG. 1 is a longitudinal sectional view of a rock crushing apparatus equipped with a discharge screen structure formed and mounted in accordance with the invention, on line I—I of FIG. 2;

FIG. 2 is a top plan view of said apparatus and discharge screen structure;

FIG. 3 is a view similar to FIG. 1 showing a modified construction wherein the rock crushing apparatus is equipped with both a feed screen structure and a discharge screen structure, interconnected for conjoint operation;

FIG. 4 is a longitudinal sectional view of a rock crushing apparatus, equipped with another form of interconnected feed and discharge screen structures.

FIG. 5 is an enlarged detail, vertical sectional view of the connection of the feed and discharge screen structures to the movable jaw means of the apparatus, on line 5—5 of FIG. 4;

FIG. 6 is an enlarged sectional view showing the connection of the suspension rod of the discharge screen structure to the main frame of said structure, said view being taken substantially on line 6—6 of FIG. 4;

FIG. 7 is a horizontal section substantially on line 7—7 of FIG. 4, on the same scale as FIG. 4; and

FIG. 8 is an enlarged, transverse sectional view through the jaw means of the apparatus, taken substantially on line 8—8 of FIG. 4.

Referring to the drawing in detail, the apparatus shown in FIGS. 1 and 2 will be described herein substantially in its entirety, so as to obtain a full understanding of the operational and structural characteristics thereof, thus to in turn promote a better understanding of the form, mounting, and operational characteristics of the screen structures, especially in relation to the cycle of operation of the jaw means.

Thus, the apparatus of FIGS. 1 and 2 includes a stationary housing **1** of approximately rectangular form including a front wall **2**, rear wall **3**, and side walls **4** and **5**, all rigidly connected and extending upwardly from a heavy, horizontally disposed, generally rectangular base. The rear wall is integrally provided with reinforcing ribs **6**, **7** (see FIG. 1) and of course additional ribs or strengthening means can be provided on the other walls.

The housing is formed open at the top, whereby to receive the raw material that is to be crushed. Further, the housing is formed open at the bottom thereof, in order to facilitate the discharge of the material after the same has been broken or crushed in a manner to reduce the material to pieces of the desired, smaller size.

Spaced closely from the front wall **2**, and extending transversely of the housing above the front wall is a stationary, horizontal shaft **8**, the ends of which are engaged in the side walls **4**, **5**. Shaft **8** extends through a transversely, horizontally extending sleeve **9** integrally formed upon the upper end of a thick, heavy support plate **10** of a fixed jaw **11**. Jaw **11** and plate **10** together define a fixed jaw structure.

The fixed jaw **11** is in confronting relation to a movable crushing jaw **12**, and the opposed, material-engaging faces **11'** and **12'** of the jaws are ribbed or toothed in a manner described in full detail in my co-pending application, Serial No. 392,831.

The support plate **10** can pivot, together with the fixed jaw **11** that is rigidly secured thereto, about an axis defined by the horizontal shaft **8**, but said pivotal movement is prevented by the opposing action of a coil spring **13** and an adjustable member **14**. These components have also been described in full detail in my co-pending application, Serial No. 392,831. For the purpose of the present application, it is sufficient to note that the member **14** comprises a rectangular plate **61**, engaged by a notch formed in the adjacent surface of the plate **10**. The opposite edge of the plate **61** extends into a channeled casing that extends horizontally, transversely of the front wall **2** in a transversely disposed recess **63** formed in said front wall.

Plate **61** is designed to oppose pressure tending to shift the fixed jaw structure toward front wall **2** during normal operation of the machine, and it will be noted that the plate in effect constitutes a rigid spacer means between the front wall and the fixed jaw structure. However, the plate is adapted to bend or yield when certain materials that resist crushing, as for example, pieces of iron and the like, accidentally move into the crushing gap **31**.

Meanwhile, the coil spring **13**, tending to expand, exerts force upon a fixed jaw structure tending to move the same toward the front wall **2**, since the spring acts upon a bolt **15** which is pivotally connected at **16** to the fixed jaw structure and which passes loosely through an opening formed in the front wall **2**.

The previously mentioned movable breaking jaw **12** is rigidly mounted upon a support plate **18**, strengthened by longitudinal ribs **19** integrally formed upon the back surface thereof. Jaw **12** and support **18** together constitute what may be appropriately termed a movable jaw structure.

The support **18** is provided, near its lower end, with a sleeve or stub **20** through which extends an eccentric shaft **21** carried by roller bearings **22**. The eccentric shaft passes through bearings **23** provided in the side walls **4** and **5**, and the exteriorly projecting ends of the eccentric shaft are secured to fly wheels **24** (FIG. 2), one of which is driven by a belt drive **36** and pulley **37**.

The eccentric shaft **21** carries and therefore also drives the support **18** of the movable jaw **12**.

Links **25** and ears **26**, which connect the upper end of the support **18** to the rear wall **3** of the housing, act as guides during the raising and lowering of the movable jaw relative to the fixed jaw in its motion toward and away from the fixed jaw. The links are pivotally connected at one end to the upper end portion of the movable jaw support **18** by means of a pin **27**, and at their other ends are pivotally connected to the ears **26** by means of a pin **29** journaled in ball bearings **28** and **30** respectively. The ears **26** are fixedly secured to the upper end wall of the back wall **3**.

During the motion of the movable jaw, which is effected by the eccentric shaft **21**, the links swing in an angle of about 45 degrees to the vertical. The guidance and actuation of the movable support **18** by the lower eccentric shaft and the upper guide links have the result that the width of the gap **31** in which the stones are broken varies increasingly from top to bottom. This increase in the movements of the movable breaking jaw relative to the fixed jaw leads to the production of a more uniform ballast, and to a more uniform shape than has heretofore been obtainable with known stone breaking machines.

The movable support **18** is continuously pressed, by means of a strong helical spring **32**, toward the fixed jaw **11**. Spring **32** abuts at one end against the rear wall **3** and at its other end abuts against the back surface **33** of the movable jaw structure. The tension of the spring can be adjusted to a selected extent through the medium of a threaded bolt or stud **34**, which is threadedly engaged in a sleeve **35** and which terminates at its inner end in an abutment or support plate **34'** for the spring **32**. Spring **32** is tightened, that is, placed under increased compression when the movable jaw structure moves away from the fixed jaw structure. The spring expands when the movable jaw moves toward

the fixed jaw during the actual crushing of material in the gap 31. The spring thus acts as an equalizing means, equalizing the load of the eccentric shaft, in a manner such as to result in a reduction of the power that would otherwise be required for the crushing operation.

In FIGS. 1 and 2 there is shown a first form of screen structure according to the present invention. In these figures of the drawing, there is provided only a discharge screen structure, which structure is adapted to receive the gravel dropping out of the crushing gap 31. In the form shown in FIG. 3 there is a discharge screen structure in combination with a feed screen structure, with the latter structure being adapted to effect a preliminary screening or separation of the raw material.

The crushed material gravitating from gap 31 falls onto a discharge screen structure generally designated at 40. This includes an elongated, generally planiform screen support frame 17 declining forwardly from the jaw structures of the device through an opening 74 in wall 2 as shown to particular advantage in FIG. 1. Frame 17 is of a width substantially coextensive with the width of the jaw means, as will be noted from FIG. 2. Supported upon the frame 17 and removably, fixedly connected to said frame in end-to-end relation over the full length of the frame, is a series of screens designated 65, 66 and 67, respectively, each of which may comprise a plate having a plurality of perforations therein, said perforations being of a selected size.

The first screen 65, which is that onto which the gravel 43 falls directly from the crushing jaws, has extremely small apertures, so that only dust 44 can pass through said apertures.

The gravel now travels to the screen 66 which may be termed the intermediate screen. The apertures or perforations of this screen are larger than those of the first screen but are still quite small so as to permit the passage only of gravel 45 of a prescribed, small size.

The material traveling along the screen structure 40 to the lower, discharge end thereof now passes to the screen 67. Here the larger pieces, designated at 46, are permitted to pass through the openings of the screen, since the openings of the last screen are of substantial size.

At its intake end, the discharge screen structure 40 is pivotally connected to the lower end portion 20 of the movable jaw structure, by means of a pin 47. Therefore, the discharge screen structure at its inlet has a movement duplicating exactly the movement of the portion of the movable jaw to which it is directly, pivotally connected. The inlet end of the discharge screen structure thus has up-and-down movement, as well as movement in the direction of its own length. This combination of movements has been found to produce a particularly effective screening action, that promotes the steady, uniform discharge of the material over the full length of the screen structure, with the material being distributed evenly and to a comparatively uniform depth over the whole width and length of the screen. Further, said combined movements of the discharge screen structure have a desirable effect of imparting a force to the material flowing therealong effective to drive the material through the apertures of the several screens.

Through the appropriate inclination of the discharge screen structure 40 in relation to a horizontal plane, the continuous flow of the material to be screened is assured from the delivery point, that is, the point directly below the crushing gap 31, over the full length of the series of screens 65, 66 and 67, until said material reaches and passes off the discharge point.

The angle of inclination must be so regulated that the vibratory action imparted to the mass of gravel will not exercise any disturbing influence upon the crushing action of the jaw 12. This is accomplished in the present instance by adjustment of a connection which the screen has at its discharge, lower end to an overhead support bracket 49.

The support bracket 49 is fixedly secured to and projects forwardly, horizontally from the front wall 2. In actuality, there are two brackets 49 transversely spaced in a common horizontal plane. In close proximity to the front, distal ends of the brackets 49, suspension rods 50 are pivotally connected at 51 to said brackets. The suspension rods, at their lower ends, are pivotally connected at 52 to the lower, discharge end of the structure 40. One or more inclined struts 68 can be provided to take up the stresses imposed by the shaking sieve or screen upon the bracket 49 through the articulated or suspension rods 50.

The suspension rods support the discharge end 48 of the screen 40 at a slightly lower level than the intake end 42 of said screen, in order to allow a slow descent, by gravitational action, of the crushed material toward the discharge end of the screen. In this connection, the support means for said discharge end 48 described above is so designed as to alter as little as possible the motion imparted to the intake end 42 by the co-operating eccentric shafts 21 and links 25.

Referring now to FIG. 3, in this form of the invention, the discharge screen structure has been generally designated 40' and includes a frame 53 analogous to frame 17. Frame 53 is provided with a rearwardly projecting, longitudinal extension 53' coplanar with the portion of the frame 53 that is disposed forwardly of the pivotal connection of the discharge screen to the movable jaw.

The screen structure 40' includes the screens 65, 66, 67 as in the form shown in FIG. 1, having progressively larger size perforations. Thus, so far as the separation and discharge of gravel after crushing is concerned, the form of the invention shown in FIG. 3 operates identically to the discharge structure 40 shown in FIG. 1.

In the form shown in FIG. 3, an overhead or feed screen structure is connected to the discharge screen structure 45 for conjoint movement therewith, so that both screen structures are driven directly by the movable jaw structure. In this form of the invention, the extension 53' of the frame 53, which extension comprises parallel, straight, rearwardly extending rails, is pivotally connected to an upwardly projecting frame 54 which can comprise vertically extending members braced by inclined members or struts. Frame 54, as will be readily seen from FIG. 3, thus in effect constitutes a rigid, upstanding support structure projecting upwardly from the extension 53'.

Connected to the upper end of the frame 54 is a feed screen structure 55. In this connection, it will be noted that the rails comprising the extension 53' are connected, at their rear ends shown at the left in FIG. 3, by a transverse bar 78 which is fixedly secured to and extends between said rails. The open space bounded by the rails and by the member 78 can be utilized wholly or partially for a sloping sheet, not shown, which would collect the crushed material gravitating from the upper shaking sieve or screen 55.

The support frame 54 can be and preferably is formed of a plurality of vertical bars and cross bars, welded, bolted, and otherwise fixedly secured to both the rails that constitute the extension 53' of the lower discharge screen 40'. The vertical members of the frame 54 are connected to side rails 72 of the upper shaking sieve 55.

The upper shaking sieve 55 is supported in such a manner by the frame 54 as to be disposed at an angle of inclination corresponding to that of the discharge screen structure. The upper and lower screens, thus, are in parallel relation. By reason of the position in which the sieve 55 is supported, it has been found that initially large stones or rocks, roughly broken in a preceding crushing stage in a stone crusher of the usual type, not shown, will be supplied to the crushing gap 31 as shown in FIG. 3. The hole or mesh size of the upper sieve can be so de-

signed as to separate from the raw material that is to be fed to the crushing gap small pieces **71**, which are already of a size and shape corresponding to the desired final product that is to drop out of the crushing gap after being acted upon by the fixed and movable jaws.

In the form shown in FIG. 3, the assembly comprising the lower sieve **40'**, having the frame **53** and frame extension **53'**, the middle frame **54**, and the upper sieve **55**, is carried by the lower sleeve **20** for pivotal movement about a horizontal pin **47'** passing through the center of gravity of this assembly. In this manner, said assembly is balanced about the pivot **47'** so as to follow closely the movements imparted to said pivot by the coactive motions or actions of the eccentric shaft **21** and links **25**.

In order to prevent said assembly from becoming unbalanced by displacements of the varying weights carried on the lower and upper sieves **40'** and **55**, respectively, spring members **56** or the like can be provided, these comprising coil springs extending generally vertically and abutting at their upper ends against the frame extension **53'**. At their lower ends, the springs **56** abut against base plates **57** or the like.

The housing **1**, and the above mentioned base plates **57**, are provided with passages **74'** and **75**, respectively for the lower shaking sieve **40** or **40'** as the case may be, and for the projecting frame extension **53'** of the lower sieve or screen.

Referring now to FIGS. 4 to 8, the rock crushing apparatus, that is, the apparatus including the eccentric, fixed and movable jaw structures, links, etc., is essentially similar to that described and claimed in my co-pending application, Serial No. 392,831.

In these figures of the drawing, according to the present invention, the crusher is provided with an inclined feed screen structure **160** adapted to separate from the raw materials that are to be fed between the jaws any chips that are already of a sufficiently small size to permit their passage directly to the discharge screen structure without first passing through the crushing gap. These chips are discharged from the screen structure **160** through a hopper **161** and a curved chute **162**, so as to pass directly to the intake end of the discharge screen structure **140**. The coarser material **163** falls into the crushing gap, so as to be crushed between the movable jaw **112** and the fixed jaw **111**.

The screen **160** is secured to a frame **164**, which is connected at its upper end by means of a pin **165** to a projection **166**, rigid with and extending upwardly from the movable jaw structure **118**. The frame **164** is fixed at its lower end to a projection **167** of the lower hub or sleeve **120** of the movable jaw structure **118**. In this way the frame **164**, and hence the screen **160**, is caused to duplicate or follow the rocking movement of the movable jaw structure **118** so as to cause the proper feeding and screening of the material. In other words, the rear or intake end of the screen **160** has a motion identical to that at the lower end of the movable jaw structure **118**, and this is true also of the intermediate or mid-length portion of the screen **160**. At its forward or discharge end, the screen **160** has a motion identical to that which is imparted to the upper end of the movable jaw structure by the links **125**.

Referring now to FIG. 5, a particular, detailed showing of the connection to the projection **167** is here provided. A threaded bolt **169** is screwed into a nut **170** having a lower conical surface **171** engaging in a complementary cavity of the lower rod **172** of the frame **164**. At the opposite side of the projection **167**, the bolt **169** extends through a sleeve **173** having a conical surface **174** engaging in a complementary recess of the projection **167**.

The frame **142** of the lower screen **140** (corresponding to the frame **17** of FIG. 1) receives and is freely pivoted upon the sleeve **173**, being held thereon by a washer **175** biased against the sleeve **173** by the head of the bolt **169**.

By tightening the bolt **169** and the nut **170**, and by thereafter engaging the bolt and nut against relative rotation through the medium of a cross pin **176** extending through the bolt into a groove of nut **170**, the rod **172** is tightly clamped against the projection **167**. This results from the pressure exerted by the opposed conical surfaces **171** and **174**. However, the frame **142**, and hence the entire screen **140**, may freely pivot or rotate about the sleeve **173**.

From this it will be seen that the frame **164**, and hence the rear and intermediate portion of the feed screen **160**, are lockably engaged with the projection **167** so as to have every movement that the projection **167** will have, including any oscillating movement of the projection **167** as well as the up-and-down motion thereof.

At the same time, however, the front end of the screen **160** has a pivotal connection at **165** to the upper end of the movable jaw, and the discharge screen has a pivotal connection to the lower end of the movable jaw.

Referring now to FIG. 6, there are here shown the details of a connection of a suspension rod **150** to the outlet or discharge screen **140**. As will be noted, a pin **177** extends through the opening of an ear or bracket **173'** rigid with and projecting upwardly from the frame **142** of screen **140**. Pin **177** passes through the lower end of suspension rod **150**.

The pin **177** projects beyond the suspension rod **150**, and on its projecting end extends through a coil, compression spring **179**, which is abutted against a washer **180** held in place by a cotter pin **181**.

Washers **182** are used as spacers at opposite sides of the suspension rod **150**, to provide relative rotation of the various connected components illustrated.

The type of suspension illustrated is particularly effective because of the movement obtained. It is to be noted, in this connection, that the fixed overhead support arm or bracket **149** has a plurality of openings **151**, **151'**, **151''**, etc. any of which may receive a connecting pin that passes also through the upper end of the suspension rod **150**, thus to provide adjustments in the inclination of the discharge screen **140**.

Referring now to FIGS. 4 and 7, it will be seen that certain improvements in the jaw crushing assembly are here shown. In this form, as distinguished from the form shown, in FIG. 1, there are two springs **132** for the absorption of the impacts and for recovering the pushing force. This has been found to obtain a better stress distribution.

Referring to FIG. 8, as will be noted there is here shown an additional improvement in the rock crushing apparatus, separate and distinct from the screen structures. In this figure there is shown a wedge device generally designated at **114** for adjusting the position of the fixed jaw structure **110**. The wedge device **114** includes two flat, transversely and horizontally spaced members **183** each of which has a smooth inner edge **184** engaging in a complementary recess provided in the back surface of the front wall **102** of the crusher. The outer edge **185** of each member **183** is beveled, at an angle of preferably 45 degrees, the edges **185** of the respective members **183** being oppositely beveled and bearing against correspondingly beveled or inclined surfaces of the fixed jaw structure **110**.

The two members **183** are connected by a suitable bolt-like rod **186** extending between the same and passing through bores provided in the members **183**. The members **183** can be moved longitudinally of the rod **186** toward and away from each other, when said rod is tightened or unloosened, respectively, so as to either raise or lower, whichever is desired, the fixed jaw structure **110**, thus to adjust the gap between jaws **111** and **112**.

In other words, the surfaces **185** comprise cam surfaces which, when moved toward each other in a horizontal path extending transversely of the front wall, exert a biasing action against the complementary cam sur-

faces of the jaw **110**, tending to shift said jaw **110** about the pivot represented by the support bar **108** of said jaw **110**. If the members **183** are moved toward each other, the jaw **110** is caused to move toward the jaw **112**, traveling clockwise in FIG. 4 about the bar **108**. Movement of the jaw **110** away from the jaw **112** results when the members **183** are moved away from each other. In any position to which the fixed jaw is moved, it will be maintained against movement toward the housing wall **102**, since the members **183** at all times constitute rigid spacers between the jaw **110** and the wall **102**.

The rod **186** is also a safety device, in that it is adapted to shear under certain circumstances to deliberately permit movement of the jaw **110** toward the housing **102**. In the event a hard material such as iron or the like, falls into the crushing gap, the fixed jaw structure, forced under the pressure of the crush-resistant material against the members **183**, biases said members away from each other by a cam action and shears the rod **186** by tensile stress in correspondence with a predetermined stress value, said rod **186** having suitable sizes and hence suitable tensile stresses for this purpose.

It will be apparent to those skilled in the art that many modifications and alternations of the structure shown and hereinbefore described can be made without departure from the essence and spirit of my invention which for that reason shall not be limited but by the scope of the appended claims.

I claim:

1. In a crushing machine including a frame, a fixed jaw, a movable jaw, a link member pivotally connected with its one end to the upper part of said movable jaw and with its other end to said frame; and an eccentric shaft passing through the lower part of said movable jaw so as to actuate the latter rotatably, the combination of a screen assembly comprising a discharge screen having a material receiving end and a delivery end and being located below a gap formed by said jaws, said discharge screen slanting downwards from said receiving to said delivery end, said receiving end being directly and pivotally connected to said lower part of said movable jaw below said eccentric shaft so as to travel in a complete circular path about a horizontal axis, link means movably connected to a stationary part, said discharge screen being connected to said link means for limiting oscillation of said delivery end to a predetermined arcuate motion about said lower part of said movable jaw in such a manner that the vertical component of the rotary movement has a maximum at the material receiving end of the discharge screen where the variety in the sizes of the material is greatest, said vertical component decreasing towards the delivery end of the screen, a second screen structure having a delivery end disposed directly above the crushing jaws for feeding the materials to be crushed to said jaws, and a framework rigidly connecting said second screen structure to the receiving end of the discharge screen structure, so as to hold said second screen structure permanently substantially parallel to said discharge screen whereby said second screen structure will be moved by said lower part of said movable jaw conjointly with said receiving end of the discharge screen structure through a cycle duplicating that of said receiving end of the discharge screen structure.

2. A screen assembly as in claim 1 wherein said framework comprises a longitudinal extension projecting from and rigid with said receiving end of the discharge screen structure, and a member fixedly secured to and extending upwardly from said extension, the second screen structure being fixedly connected to the upper end of said member.

3. A screen assembly as in claim 2 wherein said extension declines in a direction toward said receiving end of the discharge screen structure and constitutes a chute along which materials may gravitate into confluence with materials falling onto the discharge screen structure from the jaws, the second screen structure including a screen upstream from the delivery end of the second screen structure and disposed above said extension, said screen being of a mesh such that raw materials of a predetermined size requiring no crushing will pass through said screen to gravitate to the extension and thence into confluence with materials crushed between and falling from the jaws.

4. In a crushing machine including a frame, a fixed jaw, a movable jaw, a link member pivotally connected with its one end to the upper part of said movable jaw and with its other end to said frame, and an eccentric shaft passing through the lower part of said movable jaw so as to actuate the latter rotatably, the combination of a screen assembly comprising a discharge screen having a material receiving end and a delivery end and being located below a gap formed by said jaws, said discharge screen slanting downwards from said receiving to said delivery end, said receiving end being directly and pivotally connected to said lower part of said movable jaw below said eccentric shaft so as to travel in a complete circular path about a horizontal axis, a link pivoted to a stationary part, said delivery end of said discharge screen being articulated to said link so as to oscillate in an arcuate motion whereby the vertical component of the rotating movement has a maximum at the material receiving end of the discharge screen where the variety in the sizes of the material is greatest, said vertical component decreasing towards the delivery end of the screen, said screen assembly further comprising a feed screen structure including a feed screen having a material receiving end and a material delivery end located above the gap formed by the jaws to deliver material thereto for crushing between the jaws, said feed screen slanting downwards from said receiving to said delivery end, means for pivotally connecting said delivery end of the feed screen to the upper part of said movable jaw and means rigidly connecting the lower part of said movable jaw with the material receiving end of the feed screen.

5. A screen assembly as in claim 4, wherein the last-named connecting means is rigidly connected to the lower part of said movable jaw at the point at which said receiving end of the discharge screen is pivotally connected to said lower part.

6. A screen assembly as in claim 4, wherein the last-named connecting means has mounted thereon below the feed screen and intermediate its ends a chute slanting toward the receiving end of the discharge screen, said chute receiving from the feed screen materials of sufficiently small size to require no crushing and transporting the latter materials by gravity to the receiving end of the discharge screen.

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