United States Patent

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[54] **CRUSHING PLANT**
5 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **241/75,** 209/315, 241/81, 241/101 M, 241/135
[51] **Int. Cl.** **B02c 23/02,** B07b 1/16
[50] **Field of Search** 209/10, 247, 261, 311, 315, 326; 241/75, 77, 78, 81, 101, 122, 135

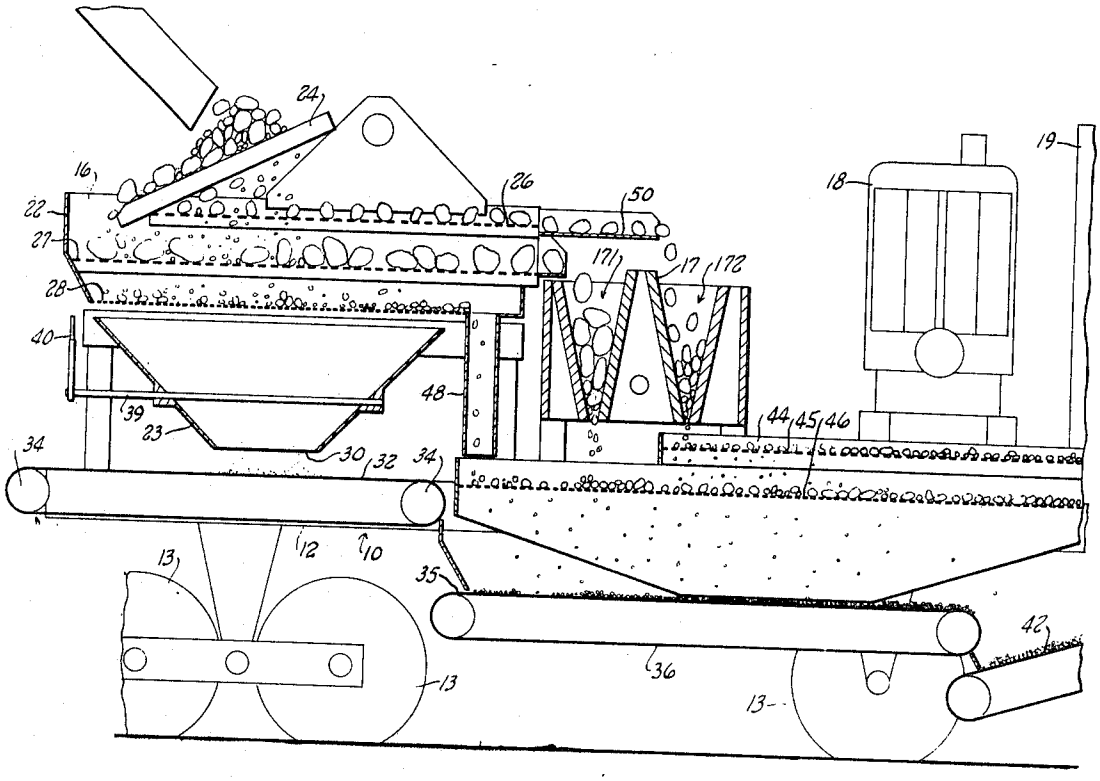
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ABSTRACT: Input material comprised of stone, gravel or other material to be crushed is screened at a receiving station to separate the largest pieces of input material into two different sizes. The largest pieces are fed into an adjacent primary crusher at one of a plurality of zones at which crushing takes place. The second largest pieces are conducted past said first designated crushing zone, in overhead relation thereto, and delivered to crushing means at another zone. Screens located under the crushing means at each crushing zone vibrationally conduct carryover material thereon of larger than finish size to an elevator, from the discharge means of which crushed but still oversize material is fed to crushing means at one of said crushing zones other than said first designated crushing zone. The crushing plant has the customary primary and secondary crushers, and either or both of them can be comprised of first and second stage crushing devices.



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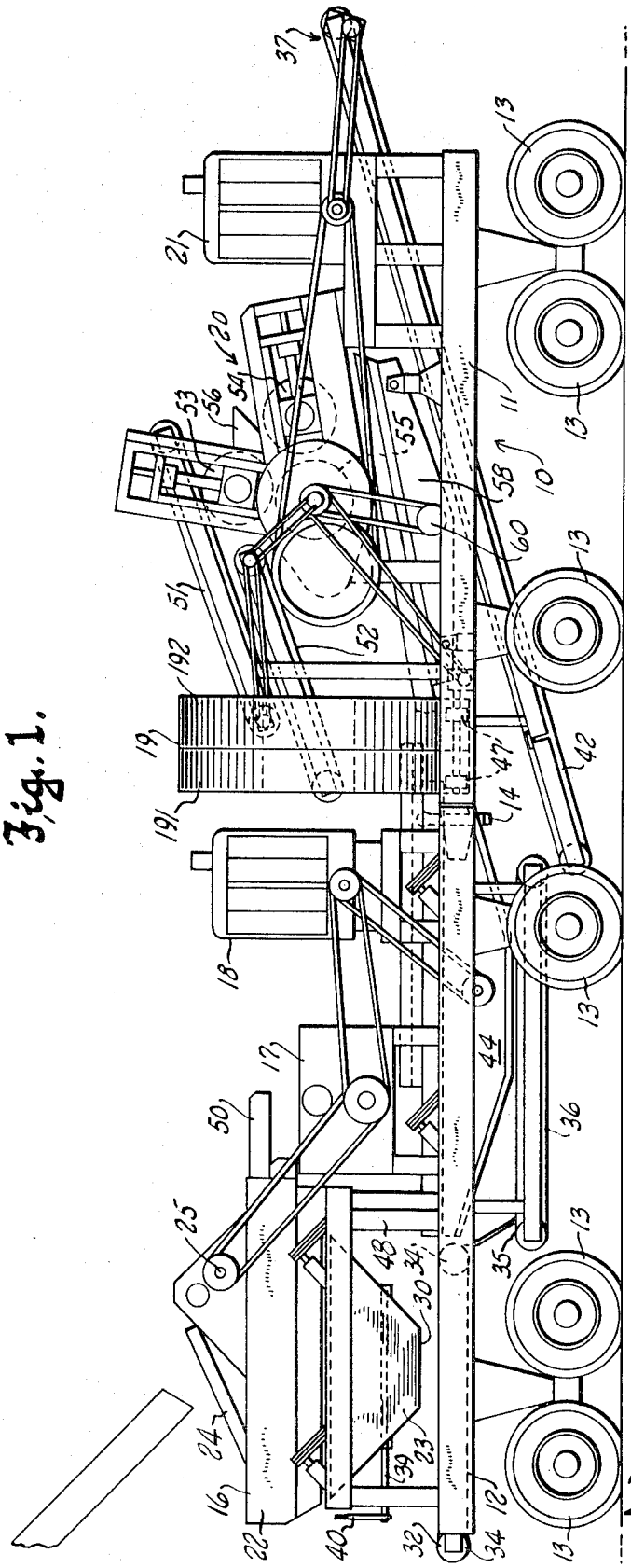


Fig. 1.

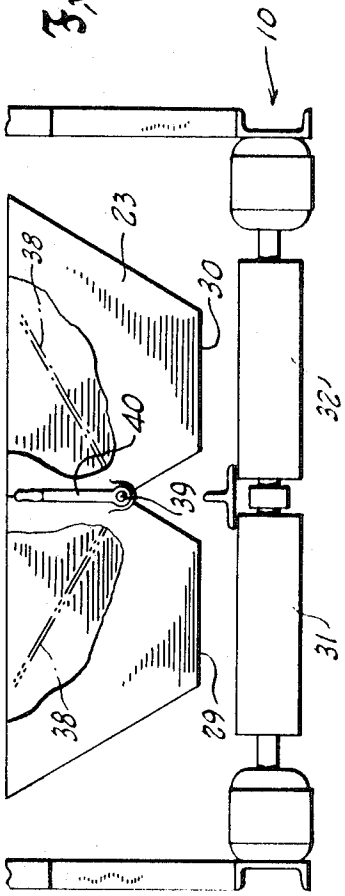


Fig. 3.

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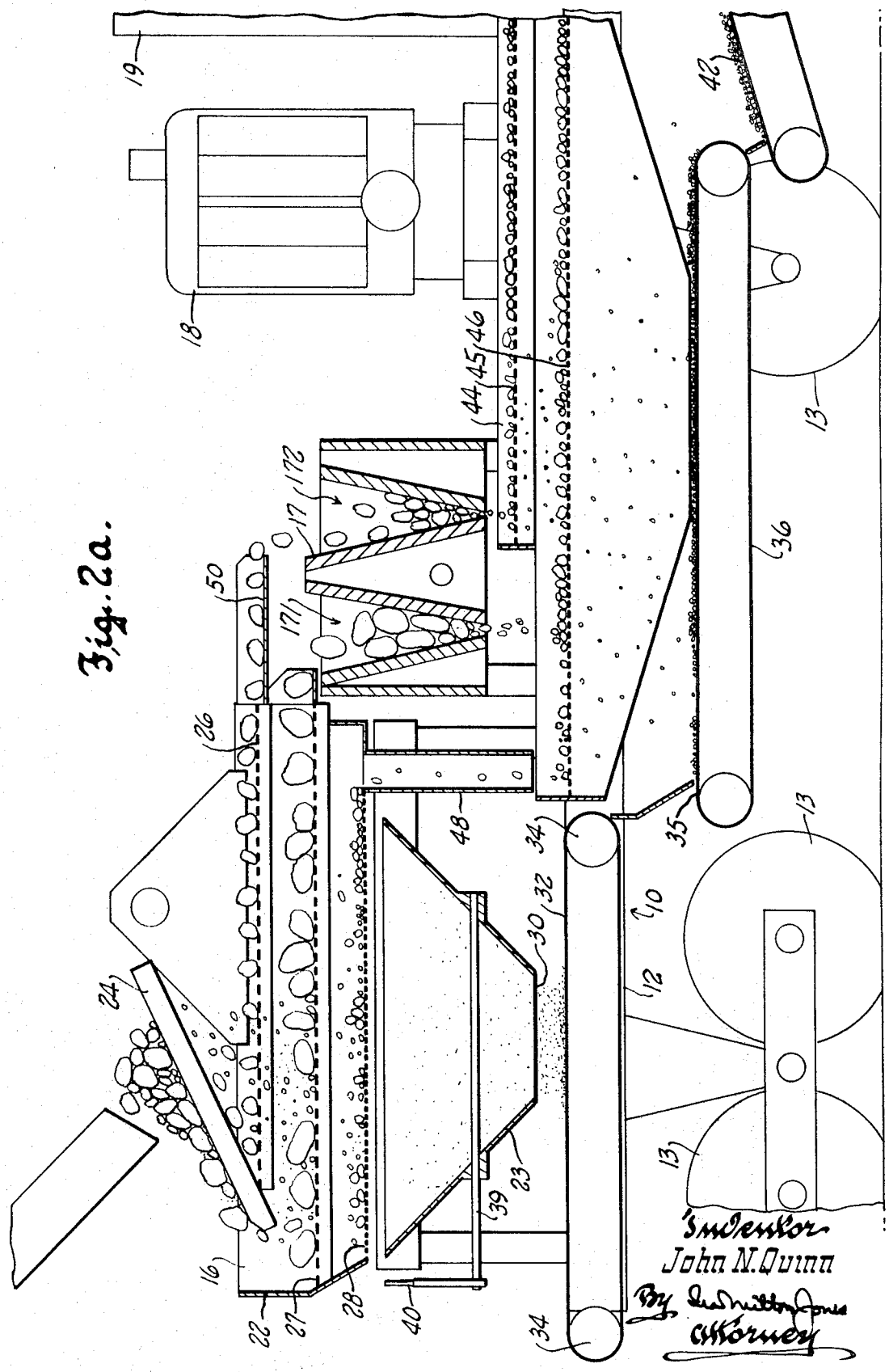
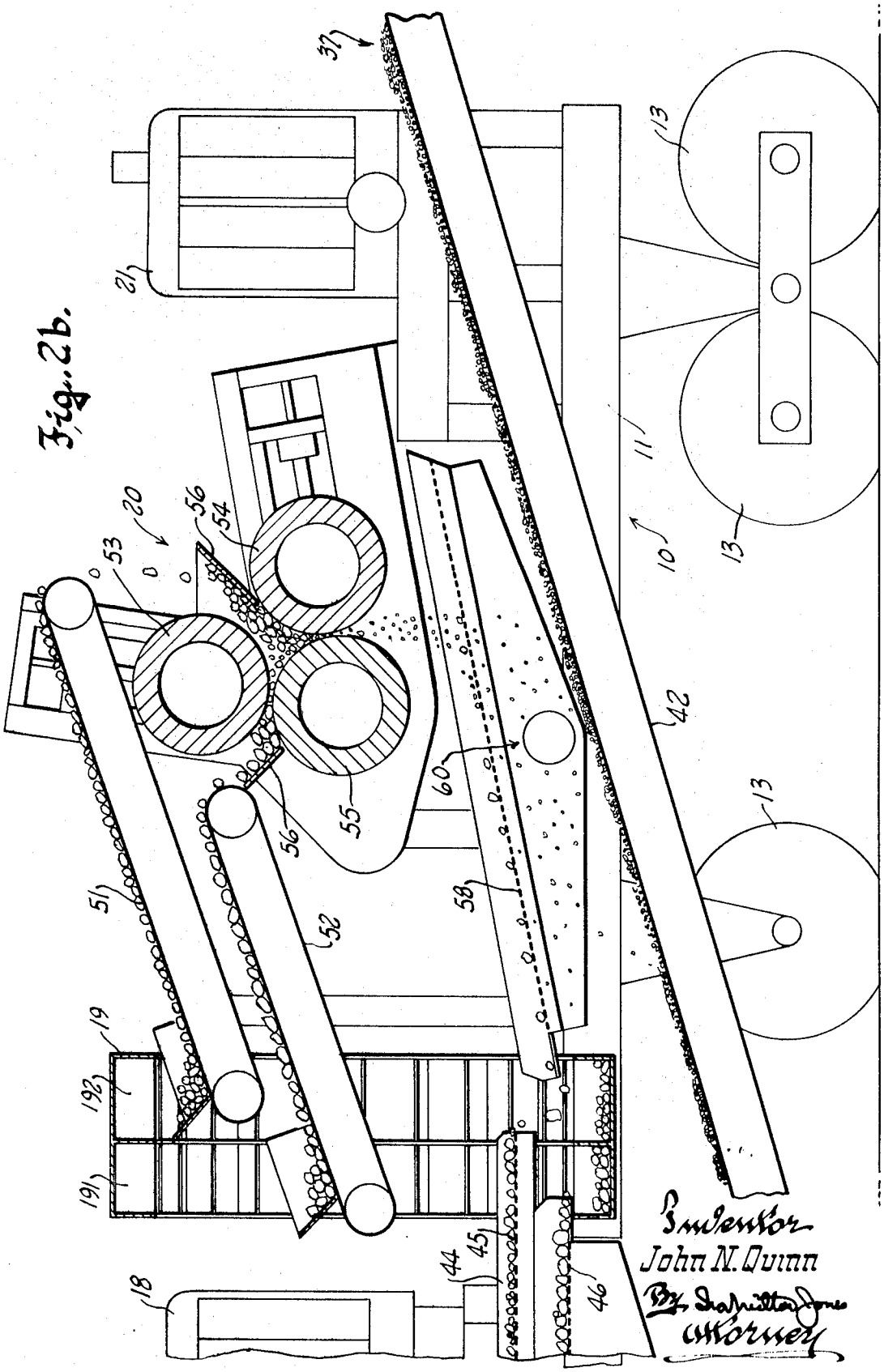

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17b
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Fig. 2a.

Fig. 2b.


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191
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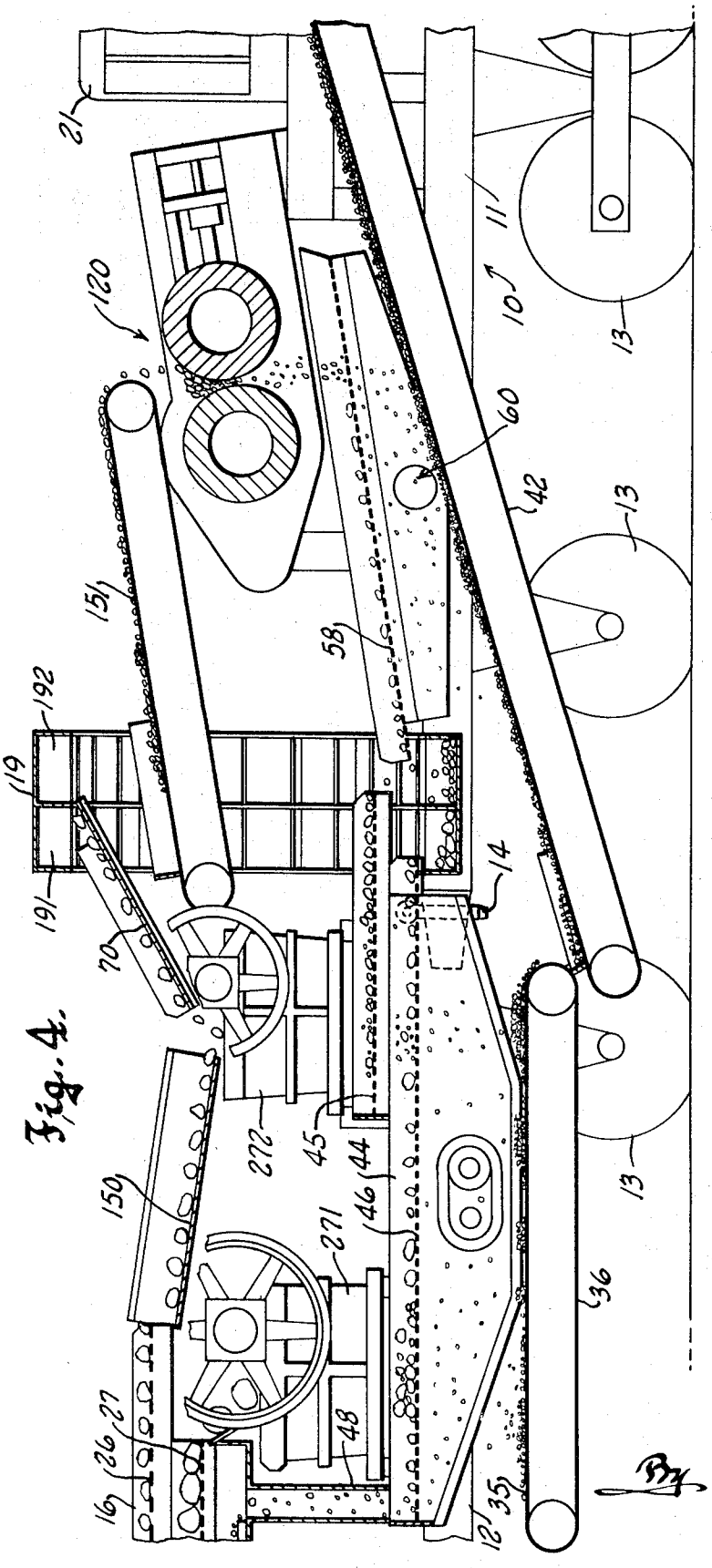


Fig. 4.

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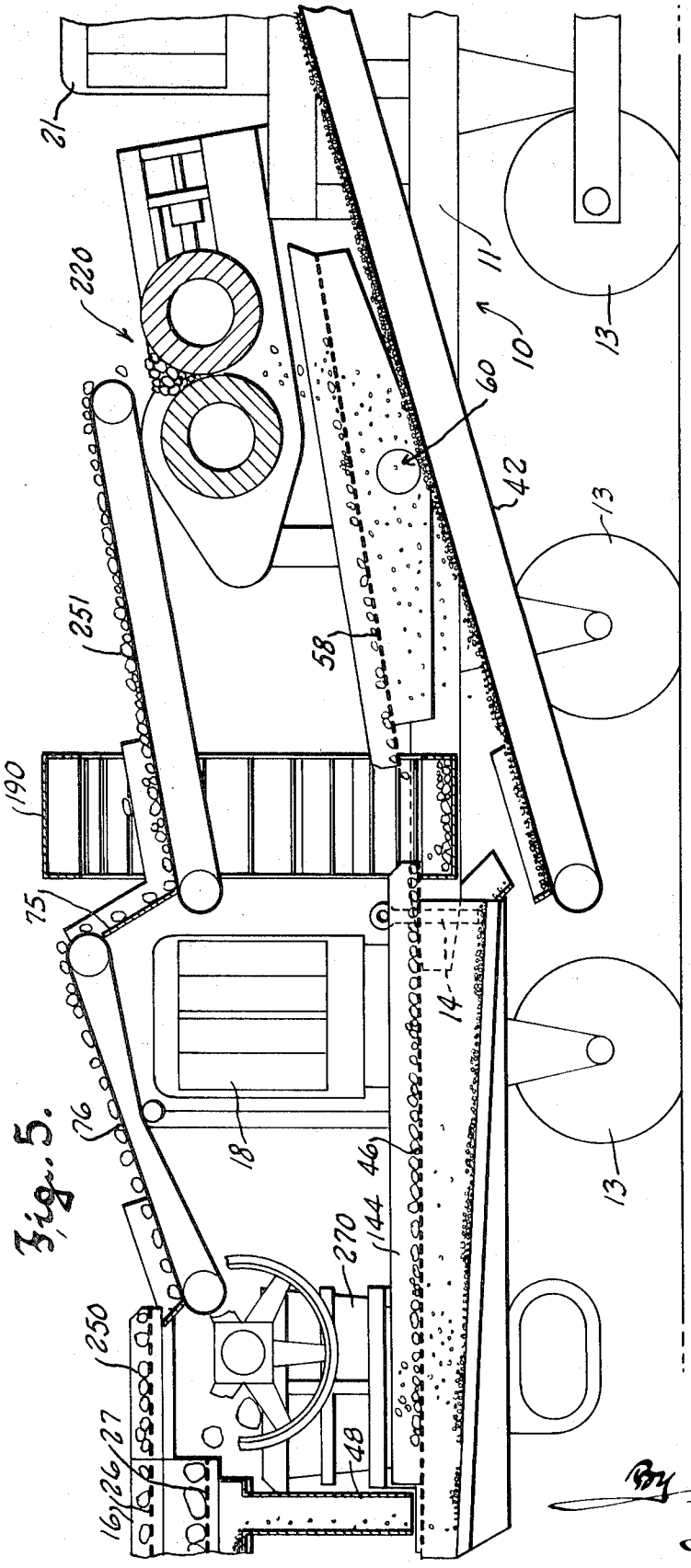


Fig. 5.

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CRUSHING PLANT

This invention relates to crushing plants of the type disclosed in my U.S. Pat. Nos. 3,073,536 of Jan. 15, 1963, and U.S. Pat. No. 3,409,235 Nov. 5, 1968, and its object is to effect improvements in plants for crushing stone, gravel or other crushable materials, for the purpose of achieving speedier processing of input materials and substantially increased output.

In general, it is an objective of this invention to provide a stone or gravel crushing plant of the type referred to in my aforesaid patents, but which features an improved receiving unit for input material, along with associated structure by which any desired percentage of the fines that comprise a substantial part of the input material can be separated from the remainder thereof and either discarded or conducted to a delivery zone along with other finish material processed by the plant.

Another object of the invention is to provide a crushing plant of the type referred to, wherein materials can be crushed at a plurality of zones either forwardly or rearwardly of a rotary lift, or at both sides of the lift if desired, to greatly increase the output of the crushing plant.

With these observations and objectives in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings which exemplify the invention.

The accompanying drawings illustrate several complete examples of embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

FIG. 1 is a side elevational view of a crushing plant embodying this invention;

FIGS. 2*a* and 2*b* are enlarged side views of the rear and front portions, respectively, of the plant seen in FIG. 1, and partly in section;

FIG. 3 is a more or less diagrammatic rear end view of the plant;

FIG. 4 is a side view of a crushing plant of modified construction, but having its receiving end portion removed to avoid duplication; and

FIG. 5 is a view similar to FIG. 4 of a further modified embodiment of the invention.

Referring now to the accompanying drawings, the numeral 10 generally designates the elongated horizontal frame upon which all of the components of a crushing plant of this invention are mounted. In a portable plant such as shown, the frame consists of front and rear frame sections 11 and 12, respectively, each provided with pairs of wheels 13 so as to be capable of support independently of the other. The adjacent end portions of the frame sections are pinned together, as at 14, to enable them to be easily disconnected and transported separately from one location to another.

Input material to be processed is loaded into a receiving unit 16 mounted on the frame section 12 at its extreme rear end portion. Also mounted on the rear frame section but at a location forwardly of the receiving unit, is a primary crusher 17. The primary crusher is located just behind the prime mover 18 from which it is driven. The prime mover 18 is here shown as an internal combustion engine mounted on the front of the rear frame section 12.

Mounted on the front frame section 11, reading from rear to front thereof, is a rotary elevator or lift 19, a secondary crusher 20, and another prime mover 21, again shown as an internal combustion engine.

It is to be understood, however, that the prime movers referred to above could be provided by electric motors receiving power from an off-plant diesel electric unit, if desired.

The receiving unit 16 is comprised of superimposed upper and lower hoppers 22 and 23, respectively, each open at its bottom. A grizzly 24 extends forwardly and upwardly out of the top of the upper hopper 22, and it is positioned so that all input material loaded into the receiving unit will fall onto the bars of the grizzly. The upper hopper 22 comprises part of a vibratory screen device having an eccentric mechanism driven

by a cross-shaft 25 which in turn is driven from the prime mover 18 in a conventional way. The vibratory screen device has three superimposed screens 26, 27 and 28 that are vibrated in the fore and aft direction by the eccentric mechanism to cause carryover material of greater than finish size which fails to pass through the screens, to be vibrationally advanced in the forward direction toward the primary crusher 17.

The uppermost screen 26 is positioned horizontally beneath the grizzly 24 to receive material that passes down between its bars. All but the largest pieces of input material dumped onto the grizzly pass through it to fall onto the vibratory screen 26 there beneath. The largest pieces of input material are directed downwardly and rearwardly by the inclined bars of the grizzly to fall onto a portion of the intermediate vibratory screen 27 that extends rearwardly beyond the upper screen 26. All the fines, such as sand and the like small particle size material, plus materials of so-called finish size, pass through the mesh of the upper and intermediate vibratory screens 26 and 27 and drop onto the lower vibratory screen 28. The lower screen 28 can have the smallest mesh if the fines are to be rejected, but it is otherwise sized to allow all the fines and finish size pieces of input material to pass downwardly therethrough while preventing passage of larger than finish size material.

The material passing through the lower screen 28 drops into the bottom hopper 23, which has a pair of side-by-side downwardly and outwardly inclined discharge compartments with mouths 29 and 30 to separately direct the material onto the upper stretches of laterally adjacent endless conveyor belts 31 and 32 therebeneath. The conveyor belts extend lengthwise of the frame, under the receiving unit 16, and each is trained over a pair of rollers 34, one of which can be driven in either direction by means of a reversible electric motor. Hence, the top stretch of either belt cab travel either forwardly or rearwardly of the frame, depending upon the direction in which its motor is operated.

In this way, either conveyor belt 31 or 32 can be run in a direction to reject materials thereon by dumping them over the rear end of the plant, when such materials are to be discarded; or when such materials are to be saved and used, said conveyor can be run in the opposite direction to discharge the material thereon onto the rear section 35 of a delivery conveyor 36, which carries the materials forwardly along the frame for discharge at a delivery zone 37 at the front end of the plant.

All of the screens 26, 27 and 28 can be of ⅞-inch or 1-inch mesh when the fines are to be retained. However, if the fines are to be rejected, the bottom screen 28 is replaced by a screen of either ¼-inch or ⅜-inch mesh, and the finish size material is advanced forwardly thereon as carryover material to be discharged onto the rear portion of a screen deck 46. The fines that pass through the screen 28 are deposited onto the conveyors 31–32 which are then run in the direction to discard the fines over the rear end of the frame.

It will be appreciated that it is possible, with the aforementioned arrangement of the conveyor belts 31 and 32, to have one belt given forwardly while the other is simultaneously driven rearwardly. Moreover, by the adjustment of a flap valve 38 mounted in the lower hopper 23 on a pivot bar 39 having a handle 40 on its rear end, different amounts of the fines can be directed onto either conveyor for keeping or for discard at the rear of the plant. This gives a wide range of choice in the retention and/or rejection of fines; all can be retained or any desired percentage thereof can be rejected, depending upon the direction the conveyor belts 31 and 32 are driven and upon the adjustment of the flap valve 38.

The rear section 35 of the delivery conveyor 36 is mounted on the rear frame section beneath the primary crusher 17, and it dumps materials on the upper stretch of its belt onto the rear end portion of the forward section 42 of the delivery conveyor. The forward section 42 is mounted on the front frame section 11, and it extends at an upward and forward inclina-

tion, under the secondary crusher 20, from a level well beneath the frame to a level a substantial distance above the frame and beyond the front thereof. This assures the discharge of finish materials at a relatively high delivery zone and facilitates loading of such finish material into trucks or other transit vehicles.

Also mounted on the frame under the primary crusher is a vibratory screen unit 44 having an upper screen deck 45, and the lower screen deck 46 mentioned hereinbefore, both located over the rear section 35 of the delivery or finish conveyor. The forward ends of both decks 45, 46 extend into the open rear end of the rotary lift 19.

The rotary lift or elevator comprises a drum open at both ends, and mounted on pairs of rollers 47 at each side of the frame. The rollers at one side can be suitably driven by the forward prime mover, as from the input shaft of the secondary crusher 20. The rotary lift is of the twin-chambered type, having axially separated but adjacent rear and front compartments 191 and 192, respectively.

The bottom deck 46 of the vibratory unit 44 extends rearwardly beyond the rear of the upper deck 45 and under the bottom of an upright chute 48 having its open upper end in position to receive carryover materials from the forward end of the bottom screen 28 of the receiving unit 16. Hence, all carryover materials from the screen 28 are deposited on the bottom deck 46 of the vibratory unit 44, for passage of any finish size material therethrough and deposit of the same on the rear section of the delivery conveyor.

The forward end of the deck 46 on unit 44 projects into the rear compartment 191 of the rotary lift 19, while the upper deck 45 extends forwardly into the front compartment 192 of the rotary lift 19, from the open rear thereof.

It will also be noted that the primary crusher 17 is comprised of first and second stage crushing devices 171 and 172, respectively. The first stage of the primary crusher is located rearwardly of the second stage, with its inlet in position to receive the largest pieces of input material vibrationally advance toward and off of the forward end of the middle screen 27 of the receiving unit 16.

Crushed material discharges from the first stage of the primary crusher onto the rearwardly extending portion of the lower deck screen 46 of the vibratory unit 44, which functions to vibrationally advance all of the pieces of material that are larger than finish size forwardly into the rear compartment 191 in the rotary lift 19.

The second stage 172 of the primary crusher is fed from the top screen deck 26 of the vibratory receiving unit 16. Carryover material on the top deck 26, as stated, is of somewhat smaller size than the largest size pieces of input material on the center deck 27. Carryover material on the top deck 26 is vibrationally advanced forwardly to a short chute 50, which is in the nature of an extension of the deck 26. This carryover material is advanced along the chute and over the top of the first stage crushing device, in bypass relation thereto, and it is directed by the chute into the upwardly opening inlet of the second stage crushing device 172. Crushed material issuing from second stage crushing device 172 discharges from the bottom thereof onto the rear portion of the upper deck 45 on the vibratory screen unit 44.

In this way, the largest pieces of input material are crushed in the first stage 171 of the primary crusher, while the second largest pieces of input material bypass the first crushing stage and flow directly into the second stage 172 of the primary crusher. Material of finish size and smaller passes downwardly through decks 45 and 46 of the vibratory screen unit 44 to drop onto the rear section 35 of the finish conveyor.

Carryover material on the top deck 45 of the vibratory unit 44 is usually comprised of pieces that are smaller than those that remain on the lower deck 46 of said unit. The larger pieces are discharged into the rear compartment 191 of the rotary elevator 19, while the smaller carryover pieces are vibrationally carried forwardly by the top screen 45, through the rear compartment 191 of the rotary lift, and discharged into the forward compartment 192 of the lift.

The materials thus received in the elevator wheel 19 are lifted upwardly thereby to discharge zones at its top. There, the material from the front compartment drops down onto the rear of the upper one 51 of a pair of endless conveyors, and the material from the rear compartment drops down onto the rear of the lower one 52 of said conveyors. The conveyors 51 and 52 are of the endless belt type, and they extend upwardly and forwardly out of the open front of the rotary lift 19 to zones above the secondary crusher 20.

The secondary crusher 20 also has two crushing stages. While the primary crusher has been shown merely by wary of example as comprising a twin-chambered jaw crusher that provides first and second stage crushing devices, the secondary crusher can, for example, comprise a triple roll crusher having coarse first and fine second stage crushing rolls 53 and 54, respectively, cooperating with a common crushing roll 55.

The inlet of the first stage of the secondary crusher opens upwardly to the left of the roll 53; and the inlet of the second stage of the secondary crusher likewise opens upwardly, but to the right of the roll 53. A chute 56 can be located at each inlet, to direct material thereinto.

The upper conveyor 51 carries material forwardly over and past the top crushing roll 53 for discharge into the inlet of the second stage of the secondary crusher; while the lower conveyor 52 discharges into the inlet of the first stage of the secondary crusher, behind the roll 53.

Materials issuing from both stages of the secondary crusher discharge from its bottom onto a screen 58 beneath the secondary crusher but above the forward section 42 of the delivery conveyor.

Materials of finish size pass through the screen 58 and drop onto the forward section 42 of the delivery conveyor therebeneath.

The screen 58 extends rearwardly into the open front of the rotary lift 19, to discharge oversize carryover material thereon into the front compartment 192 of the lift. Such flow of carryover materials into the rotary lift is facilitated by mounting the screen in a downwardly and rearwardly inclined attitude on the frame. However, the screen may comprise part of another vibratory unit, generally designated 60, which can be driven from the prime mover 21 via input shaft of the secondary crusher.

It will thus be appreciated that the forward compartment 192 of the rotary lift 19 receives oversize material from both the secondary crusher and from the second stage 172 of the primary crusher; while the rear compartment 191 of the rotary lift receives oversize material from only the first stage 171 of the primary crusher 17.

The crushing plant illustrated in FIG. 4 differs from that previously described only in the arrangement and type of crushing units employed therein. However, crushing is also effected at several zones spaced apart lengthwise of the plant. For this purpose, primary crushing is again accomplished in two stages, by means of a first stage crusher 271, and a separate second stage crusher 272 spaced forwardly of the first stage crusher and substantially close to the rear of the rotary lift 19. These crushers can be individually driven by electric motors, not shown, powered from an off-plant diesel electric generator.

The secondary crusher 120 has only one stage, and it is mounted on the frame a distance forwardly of the elevator 19 but behind the prime mover 21 at the extreme front of the plant.

As before, the largest pieces of input material are sorted out by the grizzly 24 and are carried forwardly on the vibratory center screen deck 27 of the receiving unit directly into the inlet of the first primary crushing stage 271. The next largest pieces of input material are, as before, vibrationally advanced forwardly along the top screen deck 26 of the receiving unit and onto a vibrating chute 150 which in effect provides a substantial forward extension of the top screen deck. The chute 150 extends forwardly over the top of the first primary crushing stage 271, and it bridges the space between the latter and the second primary crushing stage 272. The forward end por-

tion of the chute 150 is angled downwardly somewhat, and it directs materials thereon into the upwardly opening inlet of the second primary crushing stage 272.

Again in this embodiment of the invention oversize pieces of crushed material issuing from the first primary crushing stage, along with finish size pieces of material from the lower screen deck 28 of the receiving unit, drop onto the screen deck 46 of the vibratory unit 44. All larger than finish size material remains on the screen 46 to be vibrationally advanced thereby forwardly into the rear compartment 191 of the twin-chambered rotary lift 19. Such material is discharged adjacent to the top of the rotary lift and falls onto a chute 70 supported on the plant in a position of downward and rearward inclination, so as to direct material out of the upper portion of the rear compartment in the lift to the inlet of the second primary crushing stage 272. Consequently, such oversize material is fed into the second primary crushing stage to be reduced in size by its passage therethrough.

The crushed material issuing from the bottom of the second primary stage crusher 272 drops onto the vibratory screen 45, which as before, extends into the open rear of the rotary lift, near its bottom, and through the rear compartment 191 to the front compartment 192. Consequently, materials of finish size pass downwardly through the screen 45, while oversize materials thereon are vibrationally conducted forwardly thereby and discharged into the forward compartment 192 of the rotary lift 19 along with oversize material deposited on the screen 58 from the bottom discharge of the secondary crusher 120. Such oversize material charged into the forward compartment of the rotary lift 19 is discharged adjacent to the top of the lift, onto a belt conveyor 151 similar to the conveyor 51 described previously. The conveyor 151, of course, is mounted on the plant in an upwardly and forwardly inclined attitude, with its rear end inside the upper portion of the forward lift compartment 192 and its forward end in position to discharge materials into the inlet of the secondary crusher 120.

The triple vibratory screen deck receiving unit 16, with its grizzly 24, is also an important feature of the plant illustrated in FIG. 4, and is also used to advantage in the crushing plant illustrated in FIG. 5. The latter differs from those described earlier primarily in that it is provided with single stage primary and secondary crushers 270 and 220, respectively, and a single compartment rotary lift 190. In the absence of a second primary crusher stage, the upper screen deck 45 on the vibratory unit 144 can be eliminated, as only one screen deck 46 beneath the single stage primary crusher 270 is needed. In this case too, an imperforate vibratory deck beneath the screen deck 46 takes the place of the rear section of the delivery conveyor.

Also in the FIG. 5 embodiment of the invention, the second largest pieces of input material that are vibrationally conducted forwardly on the top screen deck 26 of the receiving unit, are caused to be delivered to crushing means at a crushing zone located forwardly of the crushing device closest to the receiving unit, in bypass relation to said closest crushing device and over the top thereof.

In this case, however, the single stage primary crusher provides the crushing means which is closest to the receiving unit 16, while the single stage secondary crusher 220 provides the crushing means which is located at a crushing zone spaced forwardly of the primary crusher.

To achieve the above-described flow of material, the belt conveyor 251 by which materials are conducted from the rotary lift 190 to the inlet of the secondary crusher 220 extends rearwardly through the rotary lift 190 far enough to receive all the materials elevated by the lift, and to also receive materials directed thereonto from a small hopper 75. A belt conveyor 76 which extends over the top of the prime mover 18 is mounted on the plant in an upwardly and forwardly inclined attitude, in position to dump into the hopper 75 and to receive the second largest pieces of input material from a short chute 250, like that seen in the FIG. 1 embodiment. The chute 250 bridges the space between the top screen deck 26 of the receiving unit 16 and the rear of the conveyor 76, and it can also be formed as an extension of the deck 26 to vibrate fore and aft therewith.

From the foregoing description, together with the accompanying drawings, it will be readily appreciated by those skilled in the art that this invention provides a material-receiving unit which sorts input material into a number of different sizes, and further provides means by which such material is conducted forwardly through the plant along a plurality of paths that lead to crushing devices at zones spaced lengthwise of the plant, so as to achieve faster processing of the material and greater output than was possible with crushing plants heretofore available.

Those skilled in the art will appreciate that the invention can be embodied in forms other than as herein disclosed for purposes of illustration.

The invention is defined by the following claims:

1. A crushing plant of the type having an elongated frame with lengthwise spaced first and second crushing means thereon, and having conveyor means beneath said crushing means for receiving and conducting materials of finish size to a delivery zone, characterized by:

A. material receiving and classifying means mounted on the frame adjacent to said first crushing means and comprising superimposed material screening members disposed at three different levels,

1. the topmost screening member being the coarsest and being adapted to discharge carryover materials that fail to pass therethrough onto the lower level one of the remaining screening members, in bypass relation to the upper level one of said remaining screening members,

2. said upper level screening member being positioned to receive materials which pass through the topmost screening member and having mesh no smaller than that of said lower level screening member,

3. and said upper and lower level screening members comprising decks of a vibratory unit which effects vibrational advance of carryover materials on said upper and lower level decks in a direction toward said first crushing means;

B. means for effecting discharge of carryover material vibrationally advanced along said lower level deck into said first crushing means;

C. and means extending over said first crushing means for effecting delivery of carryover material vibrationally advanced along said upper level deck into said second crushing means.

2. A crushing plant of the type having an elongated frame with crushing means thereon at a plurality of stations spaced from one another lengthwise of the frame, and having conveyor means beneath said crushing means for receiving and conducting materials of finish size to a delivery zone, characterized by:

A. material receiving and classifying means mounted on the rear end portion of the frame, behind but adjacent to a first one of said stations, comprising superimposed material screening members at three different levels,

1. the topmost screening member being the coarsest and being adapted for discharge of materials that pass therethrough onto the upper level one of the remaining screening members, and for discharge of carryover materials that fail to pass through it onto the lower level one of said remaining screening members, in bypass relation to said upper level screening member,

2. said upper level screening member having mesh no smaller than that of said lower level screening member,

3. and said upper and lower level screening members comprising decks of a vibratory unit that vibrationally effects advance of carryover materials on each of said decks in a direction forwardly of the frame, toward said first station;

B. means for effecting discharge of carryover material vibrationally advanced by said lower level deck into the crushing means at said first station;

C. and means extending forwardly over said first station for effecting delivery of carryover material vibrationally advanced by said upper level deck into the crushing means at a second one of said stations.

3. The crushing plant of claim 2, further characterized by:

A. said lower level deck extending rearwardly beyond the upper level deck and said topmost member;

B. and said topmost member having a discharge end which extends rearwardly beyond said upper level deck and over the rearward extension of said lower level deck so that carryover materials on the topmost member will discharge onto the lower level deck in bypass relation to said upper level deck.

4. The crushing plant of claim 3, wherein said topmost screening member comprises a grizzly which is tilted downwardly and rearwardly toward said rearward extension of the lower level deck so as to direct thereto carryover material that fails to pass through the grizzly.

5. The crushing plant of claim 2, further characterized by:

A. said vibratory unit having a third screen deck of fine mesh under said lower level deck to receive materials passing through the latter, said third deck being adapted to pass and thus separate fines from the material being processed;

B. a pair of side-by-side belt conveyors beneath said third deck, each extending lengthwise of the frame and adapted to either conduct fines dropping thereonto from said third deck forwardly onto said conveyor means or rearwardly off of the plant as reject material, depending upon the direction in which the conveyor is run;

C. and means providing for selectively directing the bulk of the fines passing through said third deck onto one or the other of said conveyors.

* * * * *