

- [54] **MATERIAL CLASSIFYING APPARATUS**
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 [73] Assignee: **Simplicity Engineering Company**,
 Durand, Mich.
 [22] Filed: **July 9, 1973**
 [21] Appl. No.: **377,592**

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Primary Examiner—Robert Halper

Attorney, Agent, or Firm—Learman & McCulloch

- [52] U.S. Cl. 209/405; 209/363
 [51] Int. Cl.² B07B 1/46
 [58] Field of Search 209/315, 363, 364, 403,
 209/405, 408, 409, 365 A, 365 B, 365 C,
 367, 329, 325, 404; 198/220

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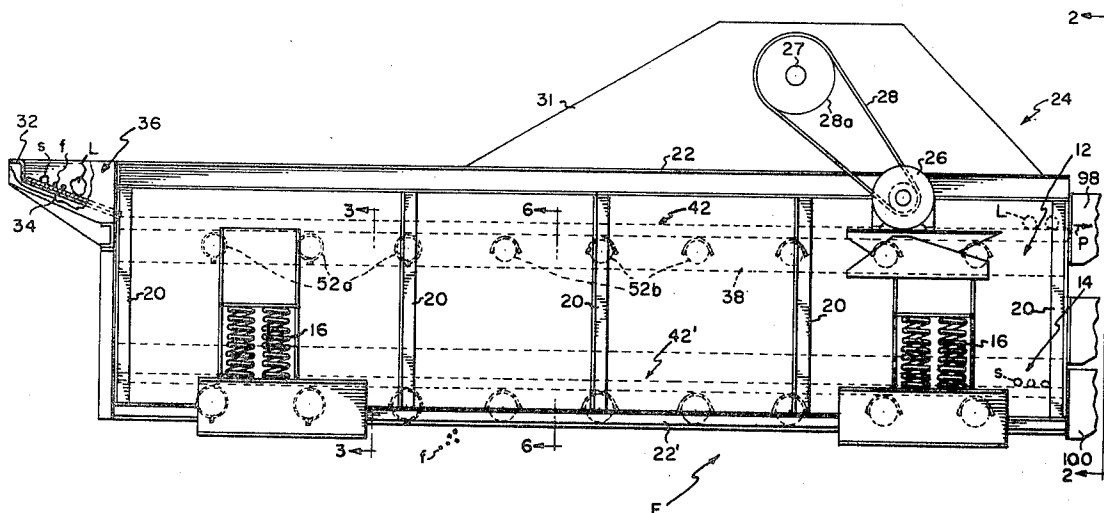
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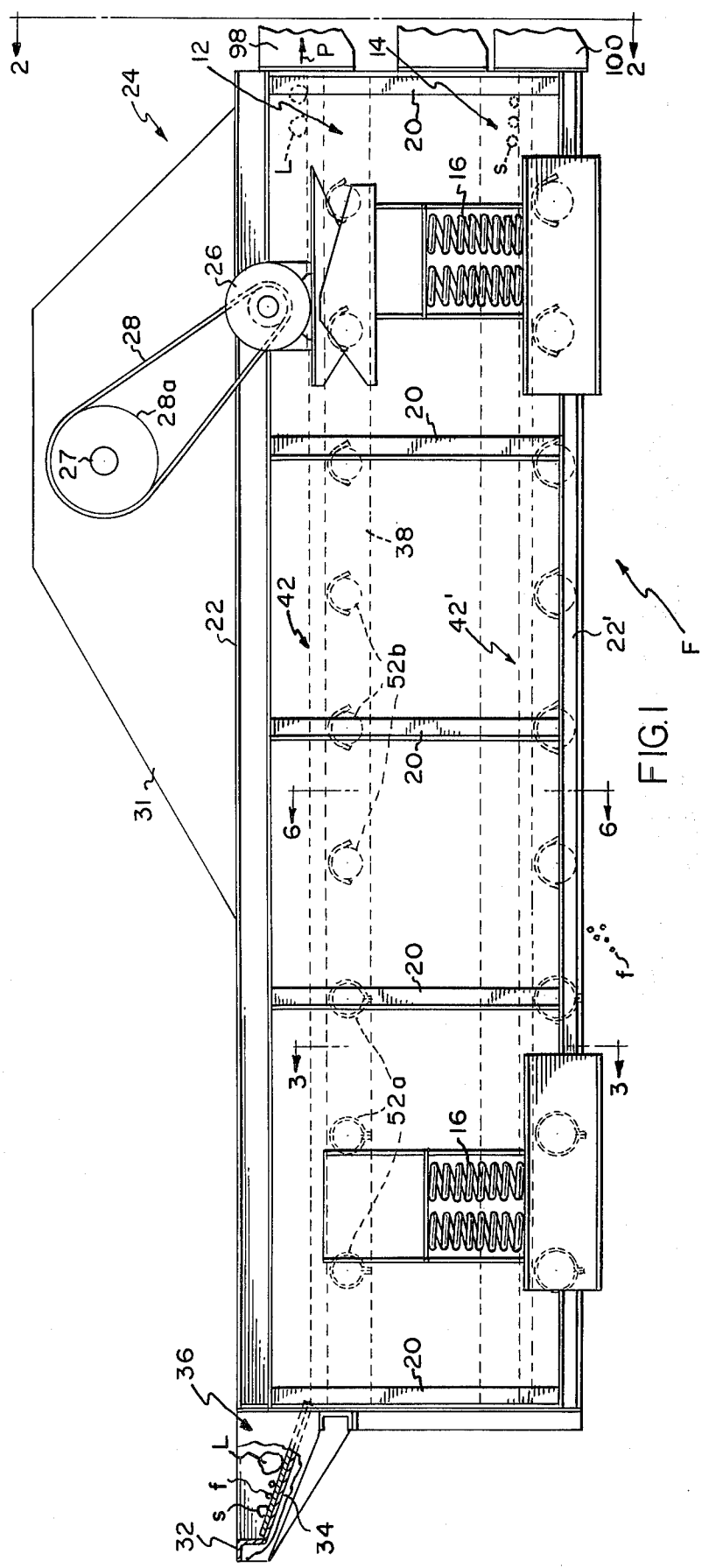
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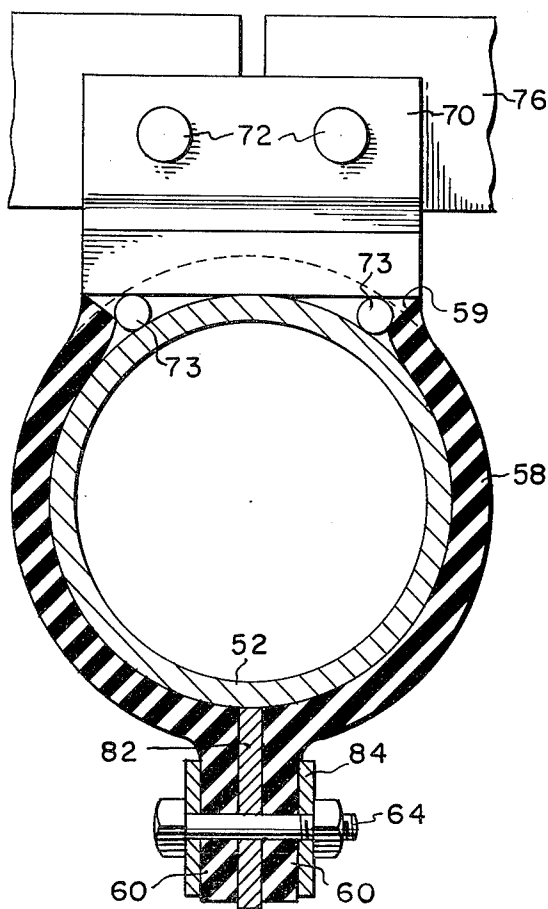
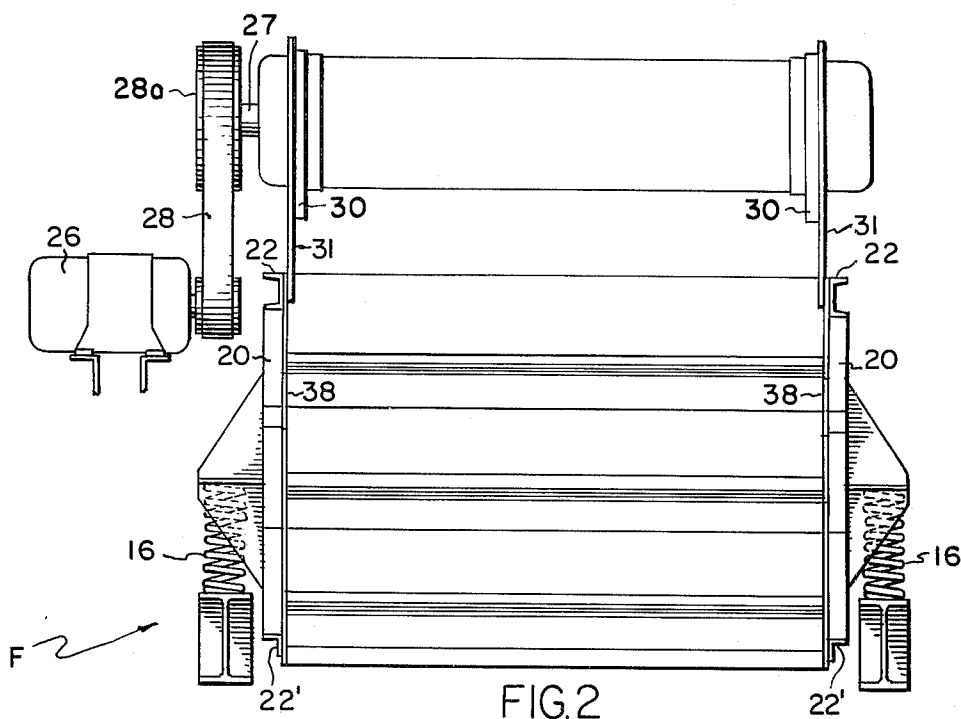
[57] ABSTRACT

Apparatus for grading or classifying fine and coarse crushed ore particles and the like comprising a frame, at least one oscillatable shaker screen for separating the fine and coarse ore particles, an oscillatable, screen support deck, including support members underlying the screen and spaced to define passages which permit the fine ore particles to vertically pass, and shield members shielding the support members from abrasion by the fine ore particles passing through the screen.

11 Claims, 9 Drawing Figures







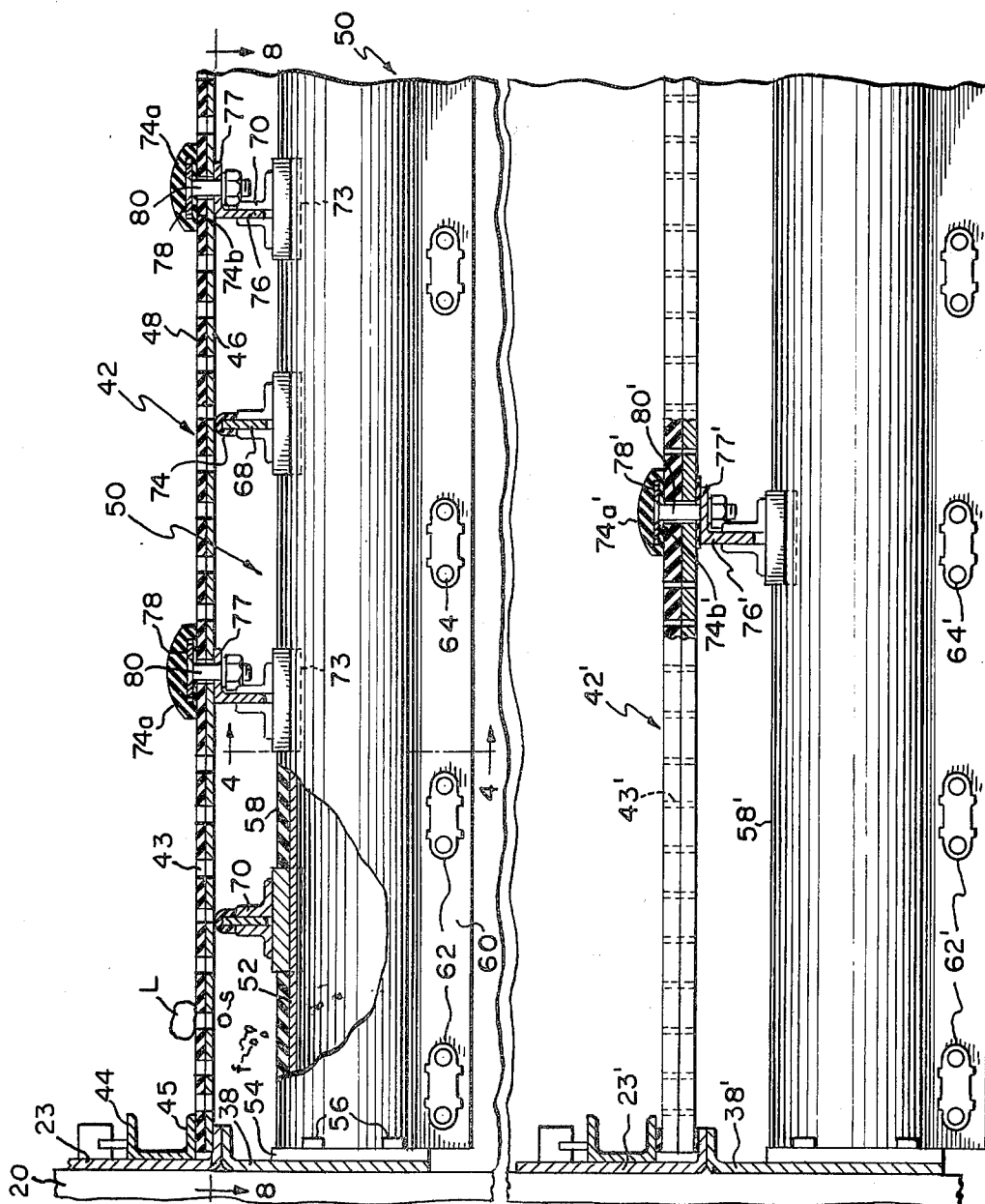


FIG. 3

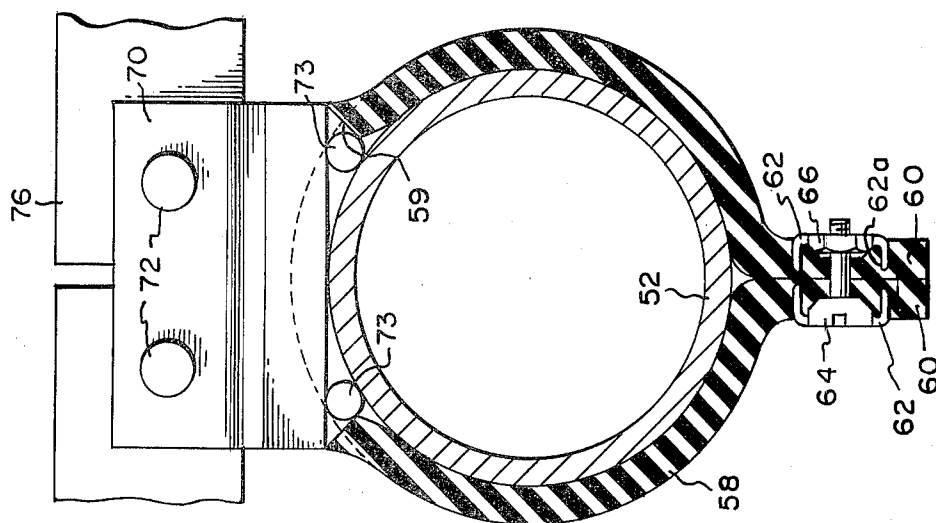
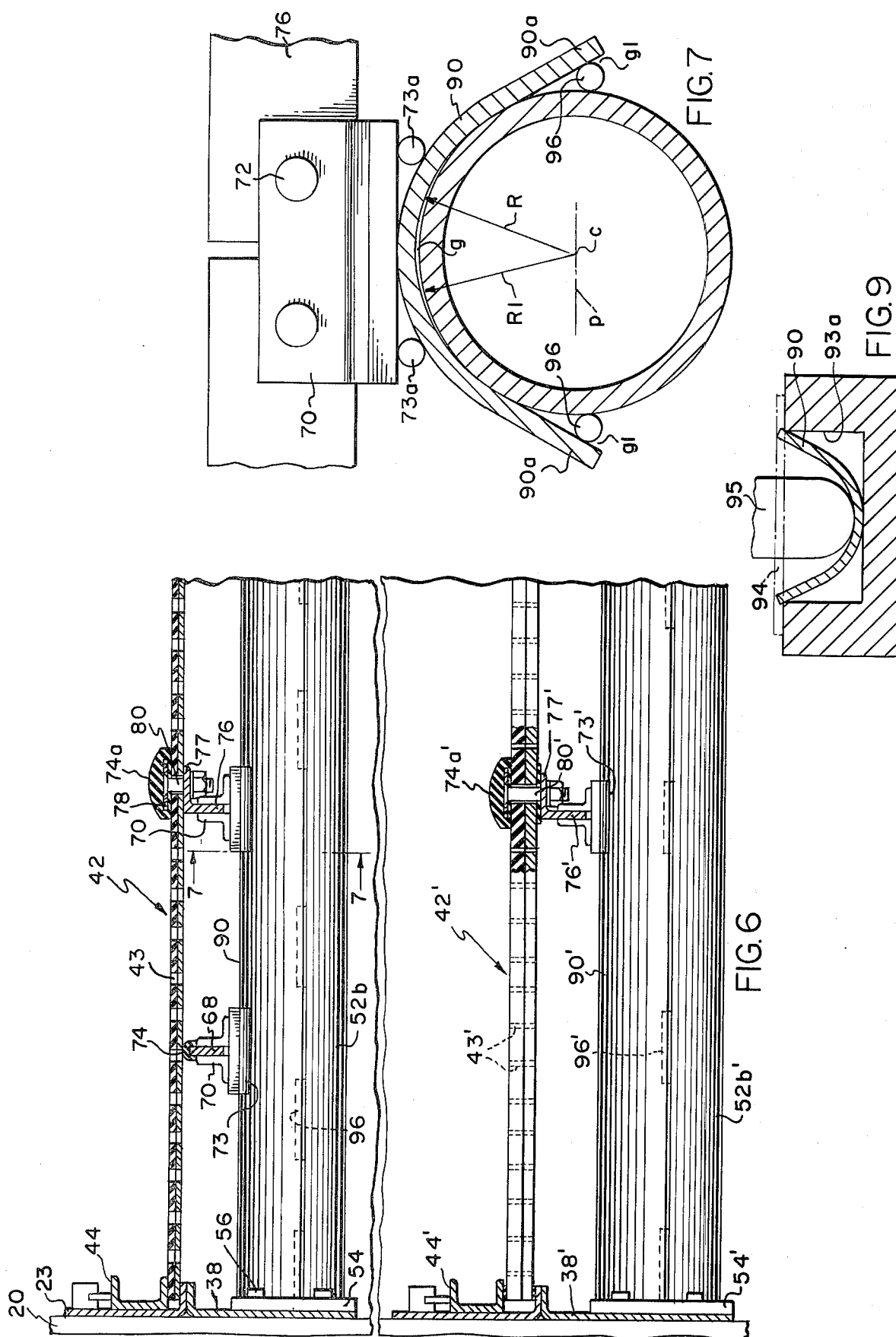


FIG. 4



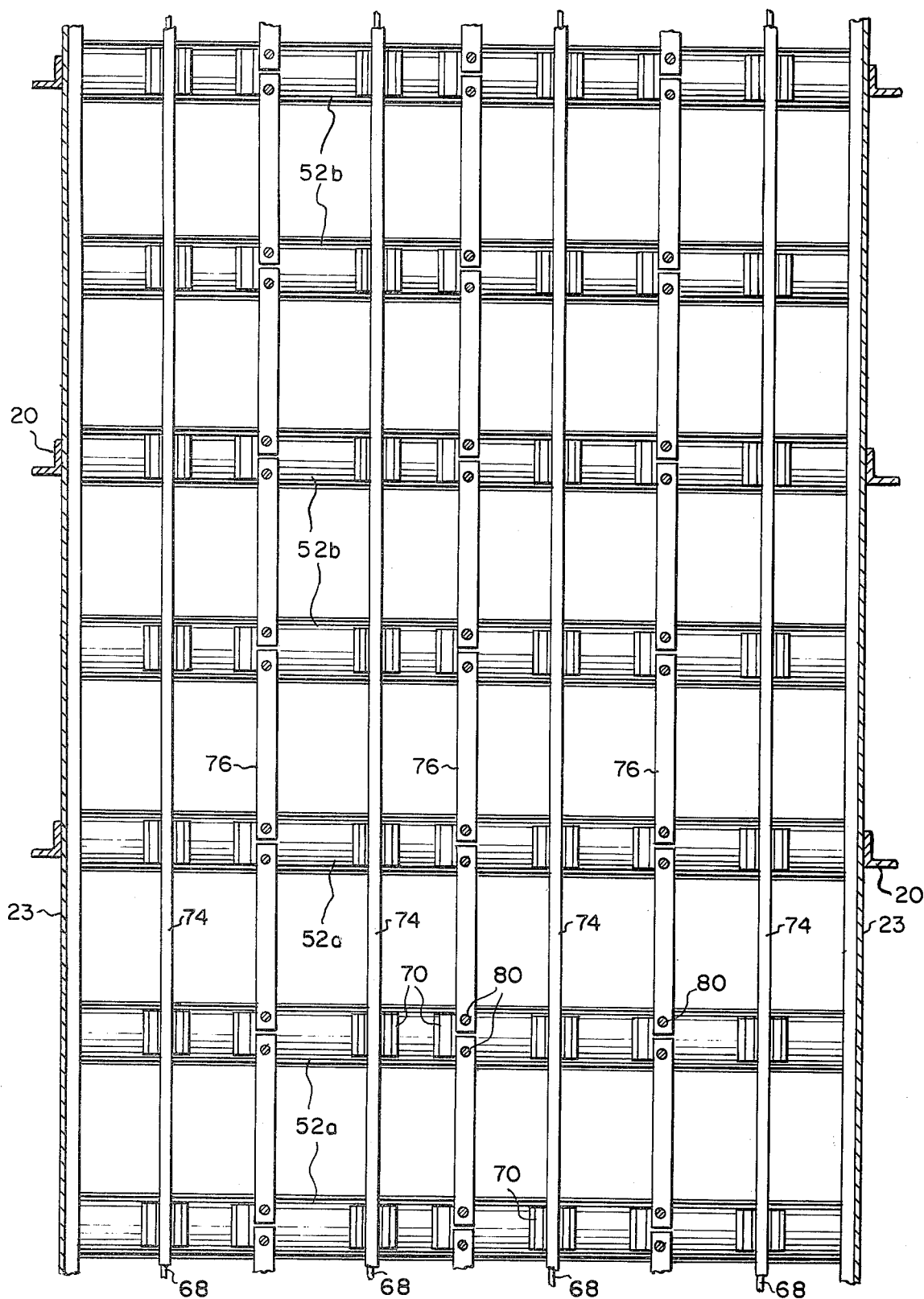


FIG. 8

MATERIAL CLASSIFYING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to material classifying apparatus for grading or classifying abrasive, particulate material, such as taconite and the like, and more particularly to ore classifying apparatus including shield mechanism for shielding portions of a screen supporting shaker deck from the abrasive effects of the material.

In ore classifying apparatus of the type including classifying screens which separate the fine ore particles from the coarse ore particles, the undersides of the screens must be structurally supported to prevent the screens from sagging under the load being classified. If the ore material passing through the openings in the classifying screen is permitted to abrade the tubes or pipes which are conventionally used as screen structure support members, the support members will wear away and fail after relatively little use. The frequent replacement of such screen supporting frame members is expensive, not only because of the parts and labor involved, but also because of the attendant reduced output when the machine is inoperative. Accordingly, it is an object of the present invention to provide grading apparatus which includes a vibrated screen support deck having such support members underlying a shaker screen, and shield mechanism overlying the support members to minimize abrasion thereof by the material passing through the screen.

In apparatus of the type disclosed herein, the screen supporting shaker deck includes a plurality of longitudinally spaced, transversely extending, cylindrical pipes fixed at their ends to a pair of side frame members. To minimize wearing of the transverse pipes by the abrasive material passing through the screen, it is important that pipe shields be provided which overlie and extend continuously the full length of the transverse pipes. If the shields are not continuous, the fine ore material will work into the gaps in the shields causing unnecessary abrasion of the shields and the pipes.

Although rubber is more abrasive resistant than most hardened steels, the use of rubber as an abrasive resistant member is relatively expensive. It has been found that approximately 75% of the fine material which eventually passes through a classifying conveyor screen passes through along the first 25% of the screen. This rapid flushing of the fine material at the supply or intake end of the classifying conveyor screen justifies the expense of a more abrasive resistant material for covering the screen support deck at the upstream end thereof than at the downstream end thereof where little flushing occurs. Accordingly, it is another object of the present invention to provide classifying apparatus of the type described including a classifying screen supporting deck having a plurality of longitudinally spaced support members which have an upstream portion thereof covered by a resilient shield and a downstream portion thereof covered by a hardened shield member.

In a wet process, the fine material, which passes through the classifying screen as abrasive silt, tends to flow or wash down along the underside of a screen supporting pipe, thus over a period of time, abrading the underside of the pipe. One further object of the present invention is to provide an umbrella-shaped, hardened wear shield, to overlie a screen supporting pipe, which has ends flaring outwardly sufficiently to intersect a horizontal plane passing through the centerline of the

pipe so that abrasive silt material is deflected outwardly and cannot flow along and abrade the underside of the pipe.

Another object of the invention is to provide welds, between the shields and the pipes, which extend longitudinally of the pipes so that all welds are longitudinally disposed relative to the direction of normal pipe deflection.

Other objects and advantages of the present invention will become apparent to those of ordinary skill in the art as the description thereof proceeds.

SUMMARY OF THE INVENTION

Classifying apparatus for separating ore particles comprising a shaker screen supported for oscillating movement by a support deck having transverse support members which underlie the screen, and shield members overlying the support members to protect them from being abraded by the ore material passing through the screen.

The present invention will more readily be described by reference to the accompanying drawings, in which:

FIG. 1 is a side elevational view illustrating classifying apparatus constructed according to the present invention, part of a supply chute side wall being broken away;

FIG. 2 is an end elevational view, taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged, sectional end view, taken along the line 3—3 of FIG. 1;

FIG. 4 is a still further enlarged, sectional side view, taken along the line 4—4 of FIG. 3;

FIG. 5 is a sectional side view, similar to FIG. 4, illustrating a slightly modified construction;

FIG. 6 is an enlarged sectional end view, taken along the line 6—6 of FIG. 1;

FIG. 7 is a sectional side view taken along the line 7—7 of FIG. 6;

FIG. 8 is a top plan view of the upper grading deck, taken along the line 8—8 of FIG. 3; and

FIG. 9 is a schematic side elevational view, illustrating apparatus for bending a hardened wear shield.

The apparatus illustrated in the drawing includes a frame, generally designated F, supporting upper and lower shaker beds or decks, generally designated 12 and 14, on springs 16. The upper and lower shaker decks 12 and 14 are connected together by longitudinally spaced vertical posts 20 spanning vertically spaced, longitudinal side rails 22. Apparatus, generally designated 24, is provided for oscillating the decks 12 and 14 on the frame F and includes a frame supported electric motor 26 driving a belt 28 trained around a sheave 28a fixed to a counterbalanced eccentric shaft 27 which is supported on the frame F. The shaft 27, which may be of the character disclosed in Behnke et al. U.S. Pat. No. 1,787,852, includes portions 30 (FIG. 2) which connect to vertical plates 31 fixed to the upper set of longitudinal, deck supporting, rails 22 to cause the decks 12 and 14 to be vibrated or oscillated and move material longitudinally along them.

A material supply chute, generally designated 32, is provided at the supply end of the upper conveyor deck 12 and includes a bottom ore supporting plate member 34 spanning vertical chute side walls 36 for funneling the ore material, generally designated O, to the upper conveyor deck 12. The ore material O typically in-

cludes large particles L, smaller particles S, and still smaller, fine particles *f*.

Turning now more particularly to FIGS. 3 and 4, the upper grading conveyor 12 includes a pair of side rails 23, welding to the upstanding posts 20, which are spanned by a laminated grading screen, generally designated 42, including a plurality of evenly spaced mesh openings 43 which, for example, may be $\frac{3}{8}$ inch diameter holes which pass the small ore particles S and fine particles *f*. The large particles L pass downstream on the oscillating screen 42 to a discharge conveyor 98. Clamps, generally designated 44, are provided for clamping the lateral edge portions 45 of the screen 42 to the rails 23. The laminated grading screen 42 includes a perforate steel plate 46 preferably covered by a perforate layer 48 of rubber which may be $\frac{3}{8}$ inch thick, for example.

For supporting the portion of the screen 42 between the side rails 22, a support deck, generally designated 50, is provided and includes a pair of longitudinal side rails 38, welded to the upstanding posts 20. The support deck 50 also includes a plurality of cylindrical pipes, generally designated 52, welded at their ends to mounting plates 54 which are individually bolted to the side rails 38 by bolts 56. The deck 50 may, for instance, be 7 feet long and the pipes 52 may be spaced 2 feet apart.

Apparatus is provided for shielding each of the first three pipes, designated 52a in FIG. 1, from the abrasive effects of the ore material S and *f* passing through the screen openings 43, and comprises a layer 58 of rubber or the like stretched tautly around the outside of the pipes 52a. Each layer 58 includes overlapping and confronting end portions 60 (FIG. 4), extending generally radially of the pipe 52, clamped together by clamp members 62 which are held together by bolts 64 and nuts 66. The clamp members 62 have teeth 62a which penetrate the confronting end portions 60. If desired, as illustrated in FIG. 5, a flat steel plate 82 may be welded to the underside of each pipe 52a and generally parallel, flat clamping plates or bars 84 may extend along the edge portion 60 to receive the clamping bolts 64. The resilient layer 58 may suitably comprise a rubber sheet having a durometer in the range of 35 - 40.

As is best illustrated in FIG. 6, the transverse pipes 52b, downstream of the pipes 52a, are each covered by a downwardly opening, curvilinear plate shield 90 extending the full length of the pipes 52b between the side rails 38. The shields 90 are constructed of abrasive resistant material which has a Brinell hardness number in the range of 260 - 500. Material sold by Jones & Laughlin Steel Company, as "Jalloy" steel material AR-280, 320, 360 and 400, has been found especially well suited for this purpose.

The "Jalloy" or hardened wear plates 90, which are available in flat sheet form, as illustrated in chain lines in FIG. 9, are deformed to the curvilinear shapes illustrated in FIG. 7 by a male punch 95 (FIG. 9) which is brought into engagement with a flat "Jalloy" sheet 94 supported by a die 93a. The punch or ram 95 overlies an enlarged female die cavity 93 and deforms the sheet 94 from the flat position, illustrated in chain lines in FIG. 9, to the curved position illustrated in solid lines in FIG. 9. The radius of curvature R on the inside of the shield 90 is slightly less than the outside radius R1 of the tube 52 so that a slight gap *g*, i.e. $\frac{1}{16}$ inch, exists between the top of the pipe 52 and the shield 90. The

gap *g* is provided to prevent immediate abrasion of the pipe 52 should the ore material S and *f* finally abrade a hole in the shield 90. The "Jalloy" shield 90 is shaped such that the longitudinally spaced ends 90a flare radially outwardly away from the tube 52 to provide a gap *g*1 between the plate ends 90a and the tube 52. The ends 90a function as drip strips to deflect the fine ore material longitudinally away from the pipes 52, thus precluding the abrasive silt or fine ore material *f* which has passed through the screen 42 from passing along the undersides of the pipes 52. The "Jalloy" shields 90 are spaced from the pipes 52 by rods 96 which lie in the gaps *g*1 and are welded to the ends 90a and to the tubes 52 along a horizontal plane, generally designated *p* which intersects the centerline *c* of the tube 52. The rods 96 are welded substantially along the neutral axis of pipes 52 to a non-stressed area of the pipes to achieve optimum weld characteristics. In addition, because the welds extend parallel to the transversely extending pipe, the incidence of weld breakage is decreased.

Mounted on the transverse screen supporting pipes 52a and 52b by brackets, generally designated 70 and pins 72, are a plurality of laterally spaced, longitudinally extending bars 68 and L-shaped rails 76. Apertures 59 are cut in the rubber layers 58 surrounding the screen support pipes 52a to receive the brackets 70 which are welded to the steel rods 73 (FIGS. 4 and 5) which are welded to the top sides of the pipes 52a.

The brackets 70, overlying the downstream pipes 52b, are welded to the transverse steel rods 73a (FIG. 7) which are welded to the upper sides of the shields 90. Guard strips 74 (FIG. 6) of rubber, having a durometer of 35 - 40, overlie the longitudinal screen support bars 68 to shield the longitudinal support bars 68 from abrasion by the material S and *f* passing through the screen openings 43.

The rails 76 each include a horizontal flange 77 which underlies the steel screen plate 46. Mounting plates 78 overlie the screen 42 in superposed relation with the flanges 77 and receives bolts 80 which clamp the screen 42 to the rails 76. Rubber guard strips 74a, for the bars 77 and bolts 80, having a durometer of 35 - 40 are provided with intumed flanges 74b which are clamped by bolts 80. The rails 68 and 76 and the pipes 52 are well spaced to define large openings 15 (FIG. 8) through which the smaller ore particles S and fine ore particles *f* moving through screen 42 may pass.

The underlying conveyor 14 is constructed similar to the conveyor 12 and identical parts are identified with identical reference characters followed by a prime designation. The lower conveyor 14 differs from the upper conveyor 12 in that the screen openings 43 are substantially smaller, i.e. 2 millimeters in diameter, to permit only the very minute fine or particles material *f* to pass therethrough while conveying the pellets S to a discharge conveyor 100.

THE OPERATION

Crushed ore, generally designated O, typically including large ore particles L, smaller ore particles or pellets S of the desired size, and fine particles *f*, is supplied to the uppermost conveyor 12 via the chute 34. The motor 26 is operated to concurrently vibrate or oscillate the conveyors 12 and 14. The oversize material, generally designated L, will pass along the topside of the upper conveyor 12 in the direction of the arrow *p*,

to a discharge conveyor 98 to be returned for further crushing and reprocessing before being resupplied to the chute 34. The smaller size material S and fine material *f* pass through the sieve or screen 42 of upper grading conveyor 12 and are received by the lower conveyor 14. The lower conveyor 14 separates the fine material, generally designated *f*, from the desired size ore pellets S and conveys the ore pellets S, in the direction represented by the arrow *o*, to a discharge conveyor 100 for delivery to a remote station. A hopper (not shown) may be provided under the machine for collecting the fine material *f* which has passed through the lower screen 42' of the lower conveyor 14. The fine material *f* can be subsequently collected by magnetic separating apparatus (not shown) and made into pellets.

Ore material S and *f* passing through the openings 43 and 43' in the screens 42 and 42' above pipes 52 and 52', which contacts the rubber shields or sheaths 58 and 58', is deflected outwardly away from the pipes 52a and 52a', to pass through the openings 15 between the transverse pipes 52 and longitudinal rails 68 and 76 with other ore material S and *f*. At the downstream end of the conveyors 12 and 14 some of the material S and *f* passing through the openings 43 and 43' engages the "Jalloy" shields 90 and 90' respectively, and is also deflected outwardly, away from the pipes 52b and 52b' respectively. Since the upper surface of these shields 90 is completely curvilinear throughout their length, there are no "flats" on which the ore can collect. Also, since ends 90a intersect the horizontal plane *p*, all of the material S and *f* is deflected outwardly and none is permitted to engage the exposed underside of the pipes 52 and 52'.

It is to be understood that the drawings and descriptive matter are in all cases to be interpreted as merely illustrative of the principles of the invention, rather than as limiting the same in any way, since it is contemplated that various changes may be made in the various elements to achieve like results without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. Apparatus for grading or classifying abrasive material, such as crushed ore or the like, into coarse and finer components, comprising:

frame support means;

screening means for supporting said material and having apertures therethrough of a size large enough to pass the finer components but not the coarse components;

deck means supporting said screening means on said frame support means for oscillating movement; and means for imparting oscillating movement to said deck means and said screening means;

said deck means including a plurality of hollow cylindrical screen support members underlying said screening means, and sheaths of resilient material wrapped around said screen support members to protect said screen support members from abrasion by said finer components, confronting edge portions extending radially of said screen support members, and clamp means for clamping said edge portions to each other.

2. In an apparatus for grading or classifying abrasive material, such as crushed ore or the like, into coarse and finer components having an oscillating conveyor

means including a generally horizontally disposed rectangular frame, a classifying screen mounted upon said frame, drive means for oscillating said frame and said screen to convey material across said screen from one end to the other while passing the finer components of said material downwardly through the openings in said screens;

the improvement comprising a support deck fixedly mounted on said frame and including a plurality of spaced parallel rigid tubular support members fixedly mounted upon said frame in underlying relationship to said screen with said support members extending transversely of the direction of movement of material across said screen, resilient shield means overlying a first group of said support members at the upstream end of said screen with respect to the direction of travel of material thereacross, and hardened metallic shield means fixedly to and overlying the remainder of said support members, both of said shield means being operable to protect the support members against the abrasive action of material passed downwardly through said screen.

3. The apparatus as set forth in claim 2 wherein said resilient shield means comprises a layer of resilient material wrapped around at least one support member including terminal end portions in confronting relation and extending generally radially of said support members, and means clamping said confronting terminal end portions together.

4. The apparatus as set forth in claim 3 including plate means extending generally radially of said support members and disposed between said confronting terminal end portions, and additional plate means on circumferentially outer sides of said end portions, said clamping means maintaining said plate means and said confronting terminal end portions sandwiched together.

5. The apparatus as set forth in claim 2 wherein said resilient shield means comprises sheaths of resilient material wrapped around said support members to protect them from abrasion by said finer components.

6. In an apparatus for grading or classifying abrasive material, such as crushed ore or the like into coarse and finer components having an oscillating conveyor means including a generally horizontally disposed rectangular frame, a classifying screen mounted upon said frame, drive means for oscillating said frame and said screen to convey material across said screen from one end to the other while passing the finer components of said material downwardly through the openings in said screens;

the improvement comprising a support deck fixedly mounted on said frame and including a plurality of spaced parallel elongate rigid tubular support members fixedly mounted upon said frame in underlying relationship to said screen with said support members extending transversely of the direction of movement of material across said screen, hardened metallic shield means fixedly secured to and overlying at least a portion of said support members, said shield means being of an inverted trough-like shaped upper portion smoothly curved to contact the support member along two longitudinal lines of contact and having downwardly and outwardly divergent lower side portions projecting outwardly beyond the sides of said support member.

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7. The apparatus as set forth in claim 6 wherein said side portions are rigidly connected to opposite sides of said cylinders along a plane generally intersecting the centerlines of said cylinders.

8. Apparatus as defined in claim 6 further comprising rod means extending longitudinally along opposite sides of said support member and fixedly engaged between said side portions and said support member.

9. Apparatus as defined in claim 6 further comprising rod means extending longitudinally along the upper portion of said shield means in symmetrically spaced locations such that the uppermost portions of said rod means and said shield means are tangent to a common horizontal plane, a bracket having a flat lower surface fixedly supported upon said shield means and said rod means, and support elements mounted on said bracket extending normal to said support members in underlying supporting relationship to said bracket.

10. In an apparatus for grading or classifying abrasive material, such as crushed ore or the like into coarse and finer components having an oscillating conveyor means including a generally horizontally disposed rectangular frame, a classifying screen mounted upon said frame, drive means for oscillating said frame and said screen to convey material across said screen from one end to the other while passing the finer components of said material downwardly through the openings in said

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screen; the improvement comprising a plurality of parallel rigid cylindrical screen support members fixedly mounted on said frame in underlying relationship to said screen and extending transversely of the direction of movement of material across said screen, hardened metallic shield members overlying and projecting outwardly from opposite sides of said support members to shield said support members from material passing through said screen, said shield members having outwardly and downwardly projecting skirt portions extending tangentially of the cylindrical support member at opposite sides thereof and an upper portion integrally joining said skirt portions and having a radius of curvature of less than the outer radius of said cylindrical support member whereby said shield member engages said support member along two lines of contact, and means fixedly securing said shield member to said support member.

11. The invention defined in claim 10 wherein said means fixedly securing said shield member to said support member comprises an elongate rod member seated between said support member and the underside of each of said tangentially projecting skirt portions, and weld means securing said rod members to said support members and said skirt portions.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,905,897 Dated September 16, 1975

Inventor(s) Wayne D. Jacobson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 5, change "welding" to --welded--.

Column 6, line 18, before "to" insert --secured--.

Signed and Sealed this

second Day of December 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks