June 5, 1934. R. S. WALKER 1,961,467

MATERIAL SCREENING APPARATUS

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Fig. 2

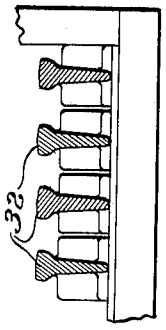


Fig. 1




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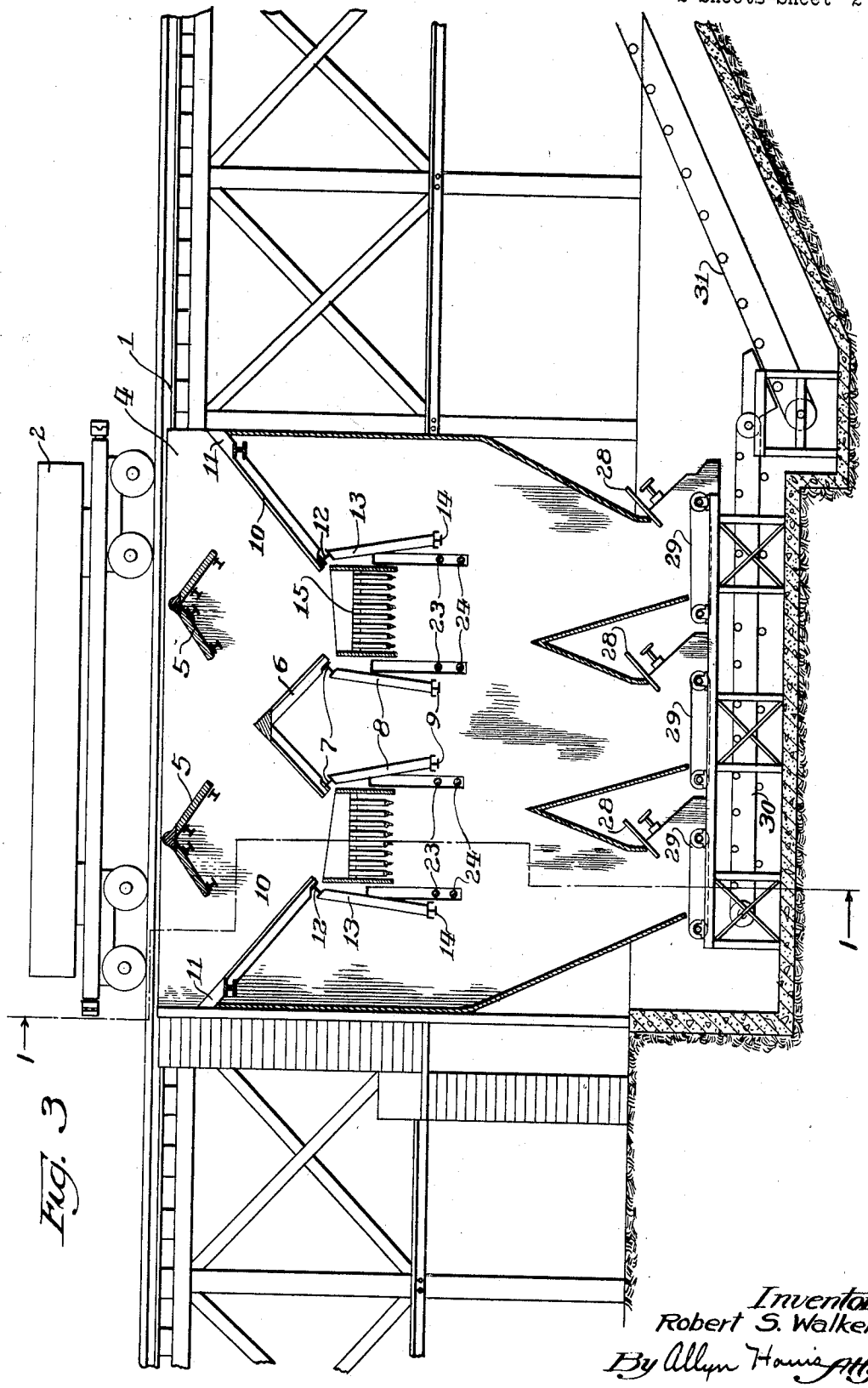


Fig. 3

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## MATERIAL SCREENING APPARATUS

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6 Claims. (Cl. 209—243)

This invention is concerned with a method and apparatus for screening iron or other ore, or other materials involving like service conditions.

The invention was developed with particular reference to the conditions peculiar to the handling and treatment of iron ore and has been successfully applied to this class of service. Consequently, the invention may be best explained in connection with this use, but it should be understood that the method and apparatus are not restricted to such use.

One of the outstanding problems in the treatment of iron ore has been that of efficiently screening or separating the fines from the rock and oversize chunks of ore. This is a particularly vexing problem on ranges where large rock is encountered with the ore. Consider, for example, the destructive effect of dumping ore containing chunks of rock ranging in weight up to a ton or more, directly onto a screening apparatus of ordinary design. Heretofore, it has been practically impossible to efficiently screen this class of ore.

The principal object of this invention is to provide an efficient method and apparatus for screening materials of the classes mentioned.

More particularly, it is an object of the invention to provide a method and apparatus whereby all classes of iron ore may be screened most efficiently and without danger of undue breakage of the apparatus.

The new method and a representative form of apparatus for practicing the same are illustrated in the accompanying drawings, wherein,

Figure 1 is an end elevation of the apparatus, with parts in section,

Figure 2 is a sectional view illustrating the construction of both the fixed and shaking bars, and

Figure 3 is a diagrammatic front view, with parts in section, illustrating the complete apparatus.

According to the layout shown, the screening apparatus is located beside an elevated railway trestle 1, on which ore carrying side dump cars 2 are adapted to run. The apparatus is built into and in reality forms a part of a dump hopper 4. It consists of a combination of fixed deflectors, fixed screens and shaking screen, all so arranged as to subject the material to the maximum screening action, and at the same time to handle the most difficult class of material without excessive shock or strain on the apparatus. In the particular design shown there are two solid deflectors 5 extending transversely of the hopper from one side wall to the other. These deflectors are inverted V shaped members, but their inside angles are preferably slightly obtuse rather than acute. The particular angle, however, is not vitally important and may be varied within certain limits. The deflectors are preferably supported by a series of I beams arranged as shown, to give great strength to the structure.

In a plane beneath the deflectors and positioned substantially centrally with respect to the two deflectors, there is a third inverted V shaped member 6 extending transversely of the hopper between opposite side walls thereof. The member 6, however, is not solid, but is constructed of a series of bars of the general character illustrated in Figure 2 and is designed to serve as a screen as well as a deflector. It will be noted that there is a slight overlap between screen 6 and the solid deflectors 5. The screening deflector 6 may be supported by a framework consisting of I beams 7, uprights 8, and I beams 9.

Additional screening deflectors 10 occupy the spaces between opposite end walls of the hopper and adjacent edges of the respective solid deflectors 5 and extend transversely between opposite side walls of the hopper. The screening deflectors 10 have solid portions 11 which are attached to the end walls of the hopper at points approximately in the horizontal plane of the lower edges of solid deflectors 5, and these deflectors 10 extend downwardly and inwardly from such points of attachment. The lower edges of deflectors 10 are supported by I beams 12, uprights 13, and I beams 14. Except for solid portions 11, the screening deflectors 10 are made up of a series of bars, as shown in Figure 2.

Directly beneath the spaces beneath screening deflector 6 and the respective screening deflectors 10 are two shaking screens 15, the bottoms of which are formed of a plurality of bars of the character shown in Figure 2. The rear closed ends of shaking screens 15 are supported by suitable rollers 17 which engage tracks 18 secured to or formed on the screens, while the front ends of the screens are pivotally suspended from the framework by hangers 19, as shown in Figure 1. It will also be noted from Figure 1 that these screens extend laterally with respect to the hopper and are inclined downwardly. Additional shaking screens 20 of similar construction are arranged in alignment with the respective screens 15, in overlapping relation and with adjacent ends spaced vertically. The screens 20 are pivotally suspended from the framework by hangers 21, and are also inclined downwardly, as shown.

The outer ends of screens 20 are arranged to discharge rock and oversize ore into an adjacent rock car 22, as illustrated in Figure 1.

The screens 15 and 20 of each pair are arranged to be oscillated in reverse phase by pairs of drive rods 23 and 24 which are connected to pairs of eccentrics 25 and 26 set 180° apart. The shaft carrying the two pairs of eccentrics may be driven by a motor 27. This driving arrangement provides a balanced relation and also certain advantageous operating characteristics to be hereinafter mentioned. This particular drive is, of course, not essential and any suitable equivalent drive may be employed.

As pointed out above, the fixed screens 6 and 10, and the shaking screens 15 and 20 constitute, in effect, the bottom of hopper 4. The walls of hopper 4, however, extend downwardly and converge below the several screens to form a bin designed to receive the fines which pass through the screens. The lower part of this hopper is, therefore, referred to as the screenings bin and, referring to Figure 3, it will be observed that the bin is divided to provide a plurality of converging outlets for the fines. These outlets are provided with individually adjustable closures 28 to regulate the rate of flow therethrough. Directly beneath each outlet is an apron feeder 29 which receives material from the screenings bin and delivers it onto a collecting conveyor 30 disposed beneath the apron feeders. The collecting conveyor in turn discharges the material onto an inclined belt conveyor 31 which carries it up to a washing plant.

The construction and design of the bars used to form both the fixed and shaking screens is shown in Figure 2. It will be noted that the bars 32 are of peculiar cross section, substantially thickened along their upper edges to provide relatively broad and adequately reinforced impact receiving surfaces, and gradually tapered from a point beneath said thickened upper edges toward the lower edges. Thus, the shortest distance between adjacent bars is at the upper edges thereof, thereby assuring free passage of material between the several bars once it has been forced through the narrowest portion of the spaces. The supports for the bars are provided with slots suitably tapered to fit the tapered portion of the bars. With this construction the bars are merely set in place, without the necessity of being bolted down, and are permanently and uniformly spaced.

In operation, ore discharged from dump car 2 falls into hopper 4, portions falling directly onto fixed screens 6 and 10, and other portions striking the two solid deflectors 5. Those portions which strike deflectors 5 are each divided by the deflectors into two streams, the directions of which intersect the paths of travel of those portions of the material which fall directly onto fixed screens 6 and 10, respectively. Thus, the arrangement is such that the material discharged from the surfaces of solid deflectors 5 is caused to collide with the streams of material falling directly onto fixed screens 6 and 10. Also, it will be noted that deflectors 5 direct two streams of material into the path of the material which falls directly from the dump car onto screen 6. Thus, there is colliding and merging of three separate streams of material which finally passes to screen 6. By this construction, the material is divided into a plurality of streams, the direction of travel of certain of the streams is changed one or more times, thus breaking the force of the fall, and by the colliding and merging of certain of the streams the force of fall is further diminished. Thus, the forces involved are kept within practical working limits. The impact of the material on the several deflectors and screens, and the colliding and merging of the separate streams result in disintegration of ore and separation of ore from rock or other materials. In this connection, it is noted that approximately 60% of the screening is accomplished by fixed screens 6 and 10.

The material which does not pass through fixed screens 6 and 10 is discharged into shaking screens 15. Here again, there is colliding and merging of separate streams of material as they pass from screens 6 and 10 into shaking screens 15. This, together with impact of the material on the screens 15 and the shaking action of the screens, results in further screening of the material. The residue from shaking screens 15 is dropped a short distance upon shaking screens 20, which tend to impart a rolling motion to the material due to the fact that screens 15 and 20 are oscillated in reverse phase. The final residue from shaking screens 20 is discharged into an adjacent rock car 22.

From the above description, it may be understood that the method of the present invention includes suitable combinations of the following steps:

1. Dumping a quantity of material to be screened into a hopper.

2. Breaking the fall of the material one or more times, by

(a) dividing the material into a plurality of streams.

(b) changing the direction of travel of the several streams.

(c) causing certain of the streams to collide and merge.

3. Subjecting the material, during its course of travel toward the bottom of the hopper, successively to the action of fixed and shaking screens.

4. Discharging the residue from the hopper.

The screenings bin divided into a plurality of compartments, as shown, and having individually adjustable closures 28 for regulating the discharge of material onto apron feeders 29, insures uniform loading of collecting conveyor 30. Also, due to the fact that material is fed from different parts of the bin in quantities which may be regulated at will, it is a simple matter to so control the device that a uniform quality of material will be deposited on the collecting conveyor.

It is to be understood that the method may be practiced with the use of apparatus differing from that herein shown and that the principles of the method are of the essence, irrespective of the sequence of the several steps of the method. The particular apparatus shown has been found very satisfactory, but many variations are possible without materially affecting the results.

I claim:

1. An ore screening apparatus comprising an enclosure whereof the upper portion constitutes a hopper adapted to receive ore to be screened and the lower portion constitutes a bin adapted to receive screenings, said portions being effectively separated by screening devices arranged in a continuous, transverse series to provide an uninterrupted screening partition consisting of a shaking screen and fixed inclined screens on opposite sides of said shaking screen adapted to discharge ore into the latter, and a fixed imper-

forate deflector positioned centrally with respect to said inclined screens and above said shaking screen and extending only partially across the open top of the enclosure, said deflector serving to divide incoming material into separate streams and direct the same onto the respective inclined screens, thus protecting the shaking screen by preventing the fall of material directly thereon.

2. A material screening apparatus comprising an enclosure whereof the upper portion constitutes a hopper adapted to receive material to be screened and the lower portion constitutes a bin adapted to receive screenings, said portions being effectively separated by screening devices consisting of laterally spaced shaking screens, an inverted V shaped deflecting screen fixedly positioned above and centrally with respect to the two said shaking screens, fixed screens inclined downwardly from opposite walls of said enclosure to points adjacent the outer lateral edges of the respective shaking screens, and inverted V shaped deflectors positioned above and substantially centrally in relation to the respective shaking screens.

3. A material screening apparatus comprising an enclosure whereof the upper portion constitutes a hopper designed to receive material to be screened, and the lower portion constitutes a screenings bin, said portions being effectively separated by screening devices designed to separate fines from oversize and discharge the former into said screenings bin and the latter to the exterior of said bin, said screening devices comprising a pair of laterally spaced inclined shaking screens, an inverted V shaped deflecting screen positioned above the space between the two said shaking screens, fixed inclined deflecting screens positioned adjacent the outer lateral edges of the respective shaking screens, fixed solid deflectors positioned directly above the respective shaking screens, a second pair of laterally spaced inclined shaking screens positioned in alignment with the respective screens of the first said pair and vertically spaced with respect thereto, means supporting the several said shaking screens for oscillatory movements, and means for oscillating the respective screens of each pair in reverse phase.

4. An ore screening apparatus comprising an open topped hopper adapted to receive a quantity of ore to be screened, deflector means adjacent and extending partially across the top opening of the hopper for receiving and dividing a part only of the incoming ore into a plurality of streams and substantially changing the direction of travel of said ore, inclined screens partially below the deflector in the path of the ore from the dividing means and receiving other ore directly on said screens above the region of impact from the deflector means, the screens being oppositely inclined to the deflector means so as to deflect the direction of travel of ore after impact and being spaced from the deflector means for free impact fall of the ore from the deflector means, and a screen below said inclined screens arranged to receive all oversize from the latter.

5. An ore screening apparatus comprising an enclosure having an open top, means for dividing the enclosure transversely to cause the upper part of the enclosure to constitute a hopper adapted to receive ore to be screened and to cause the lower part to constitute a bin adapted to receive screenings, said means comprising a plurality of fixed inclined screens arranged in aligned pairs with the discharge ends of the screens in each pair being horizontally spaced to provide a plurality of discharge openings and a series of shaking screens positioned in each opening to receive ore from the fixed screens, each series of shaking screens being arranged to discharge residue to the exterior of said enclosure, and deflector means extending partially across the top opening and overlying each shaking screen to prevent ore from falling directly thereupon from the open top.

6. An ore screening apparatus comprising an enclosure having an open top, means for dividing the enclosure transversely to cause the upper part of the enclosure to constitute a hopper adapted to receive ore to be screened and to cause the lower part to constitute a bin adapted to receive screenings, said means comprising a plurality of fixed inclined screens arranged to provide two discharge spaces and a series of shaking screens positioned in said spaces to receive ore from the fixed screens, each series of shaking screens being arranged to discharge residue to the exterior of said enclosure, and an imperforate deflector positioned above the receiving end portion of each series of shaking screens to prevent the dropping of ore from the top opening directly thereon.

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