Dec. 16, 1958 F. H. MORK 2,864,561

MATERIALS HANDLING PROCESS AND APPARATUS

Filed Jan. 10, 1952

2 Sheets-Sheet 1

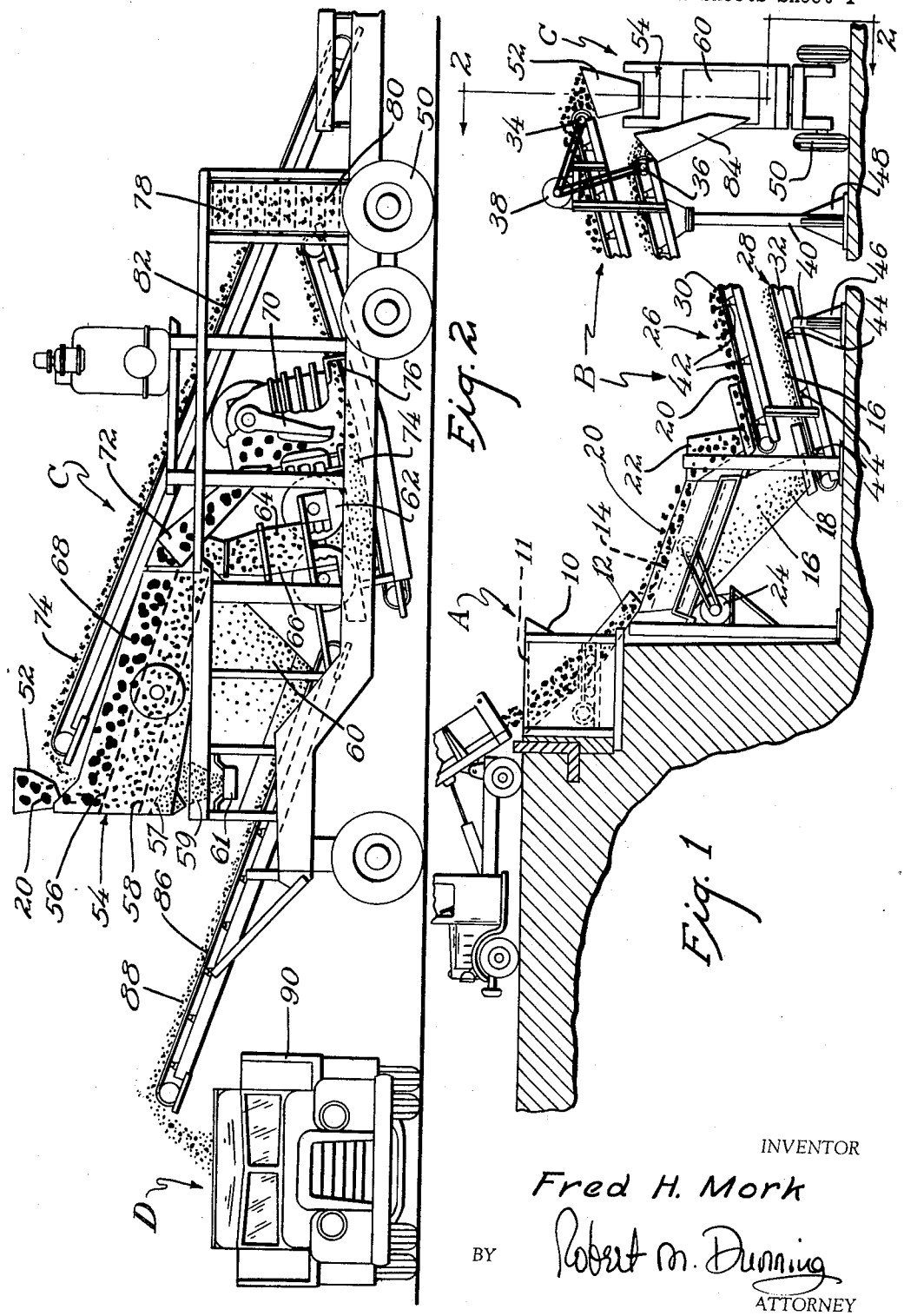


Fig. 1

Fig. 2

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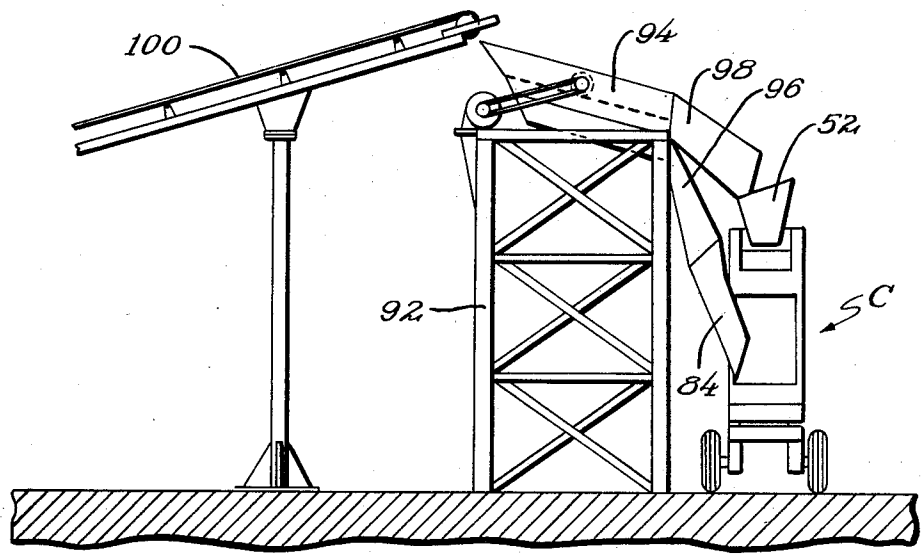


Fig. 3

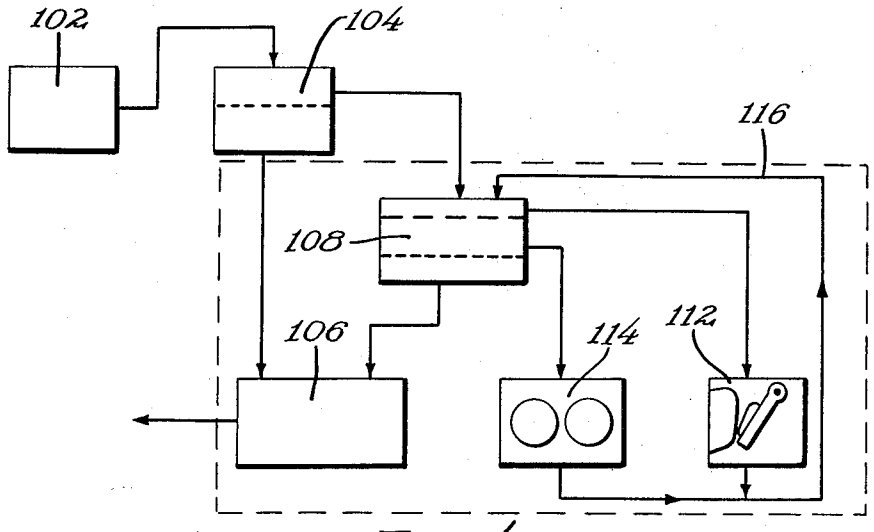


Fig. 4

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United States Patent Office 2,864,561 Patented Dec. 16, 1958

2,864,561

MATERIALS HANDLING PROCESS AND APPARATUS

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Application January 10, 1952, Serial No. 265,748

4 Claims. (Cl. 241—24)

This invention relates to a new design material feeder for portable crushing and screening plants, and also includes a method of feeding material to a plant of this type.

For at least the past twenty years, material has been fed to portable crushing and screening plants in much the same manner. The material to be processed is conveyed by a main conveyor to a main screen which separates the materials to be crushed from that which is already sufficiently small in particle size. This main screen structure may also separate the largest material which must be acted upon by a jaw crusher from the smaller material which may be crushed by a roll crusher. After crushing, the product is returned to the main conveyor and returned to the main screen.

At the present time the capacity of a typical portable crushing and screening plant is ninety to one hundred and twenty cubic yards per hour of three-quarter inch material, based on an average of twenty-five percent crushing. The main screen (a four by ten foot two and one-half deck vibrating screen) has a capacity of one hundred twenty to one hundred forty cubic yards per hour. The ten by thirty-six inch jaw crusher handles forty-three to fifty-eight cubic yards per hour. The thirty by eighteen inch roll crusher handles fifty cubic yards per hour.

Some material crushed by the jaw crusher must also be crushed by the roll crusher in order to have the entire volume pass the smallest screen of the main screen unit. For the purpose of illustration, this finished size screen is considered to be of three-quarter inch size, as this size material is most commonly used for maintenance and construction of secondary roads. It is generally conceded that, with the gradation in the pit being most irregular, the production of the two crushers to obtain three quarter inch material would be at least sixty cubic yards per hour and could be one hundred cubic yards per hour with the gradation in the pit exceptionally adaptable to the crushers. The amount of material crushed is more dependent upon the ability of the main screen to sort the incoming material than upon the ability of the crushers to crush the sorted materials.

An object of the present invention lies in the method of pre-grading the material and introducing the smaller particles which are already of proper size directly into the surge bin or under screen hopper at the outlet of the machine. As the average material processed contains seventy-five percent of material of proper finished size, only twenty-five percent of the material would be introduced on the main screen, thus greatly speeding the separation, and increasing the capacity of the plant up to four hundred percent. Thus from two hundred forty to four hundred cubic yards per hour could be processed.

A feature of the present invention lies in the provision of a feeder for use with portable crushing and screening plants which includes a grizzly or screen capable of separating the material of proper finished size from the material which must be crushed. Only this material which requires crushing, together with any small amount

of smaller material which clings to the larger pieces due to moisture or lack of crushing need be introduced on the main screen of the portable plant. The finished size material is introduced directly to the surge bin or under screen hopper. Because of the large screen area on the main screen, and the pre-plant separation, the small material entering the plant with the material to be crushed is readily separated therefrom.

In moving portable plants of this type to a new or different situs, it is frequently necessary that the equipment be transported over public highways. As is well known, various states have passed laws imposing maximum load limits per axle which may not be exceeded. While weight limits tend to preserve the highways, nevertheless such limits present serious difficulties with respect to heavy machinery. Where large scale crushing and screening operations must be efficiently performed, the aforesaid laws have been an especial detriment and handicap.

In portable crushing and screening plants it is usual practice to recirculate the crushed material to the main screen until the crushed material passes through the screen. The crushed material is deposited onto the receiving conveyor with the incoming material, and is handled therewith.

One of the most crucial difficulties encountered with an arrangement of the foregoing character is that for a given handling rate, the conveying and screening devices must be designed to handle the maximum amount of material which constitutes the output rate. For example, it will be appreciated that the receiving conveyor must transport a quantity of material per unit of time which is equal to the average output plus whatever material is recirculated via the crushers. Not only is the above true, but the screening mechanism must be similarly designed to withstand such amounts.

Accordingly, one important object of my invention is to employ an auxiliary vibrating screen or sifting device with a pair of superimposed auxiliary conveyors or chutes, the purpose of which auxiliary equipment is to effect an initial separation of the material. From actual experience, I have discovered that, in certain specific cases, sixty to ninety percent of the material to be processed may be diverted from the conveying and screening apparatus contained on the portable unit. Under these average conditions, which incidentally may differ in individual and specific instances, only ten to forty percent remains to be handled by the conveying and screening devices on the portable unit, thereby resulting in a corresponding decrease in the weight of these parts for the given amount of material to be processed. Similarly, for a machine of the same weight, a considerably greater volume of material may be handled.

Another object of the invention is to effect a concomitant reduction in the manufacturing cost of the portable unit where the volume of material handled remains the same.

Still another object is to secure the preceding desirable aims without the use of specially designed equipment, the basic auxiliary equipment envisaged by the invention usually being available at or near the mine or quarry which basic equipment is easily adapted for use with the portable unit.

Other and further important objects and advantages of this invention will be apparent from the following description taken in connection with the drawings forming a part of the specification and in which:

Figure 1 is a schematic elevational view of the apparatus forming the subject matter of my invention, the view showing one side of the auxiliary equipment and one end of the portable crushing and screening unit,

Figure 2 is a schematic view taken in a direction nor-

mal to that of Figure 1, showing one side of the portable unit and its contained apparatus.

Figure 3 is a view similar to Figure 1 showing a modified arrangement of apparatus.

Figure 4 is a diagram of the process employed in feeding the material to be crushed and screened, during processing thereof.

Referring now to the drawings, it will be observed that in practice a complete processing operation may be carried out with the following equipment: A material loader A, auxiliary apparatus B, a portable unit C and a hauling vehicle D.

The material loading station A represented for the purpose of illustration as a feed hopper **10** covered by a scalping grizzly **11** supplies the auxiliary equipment B with the raw material **12** which material may comprise gravel, ore or the like, the products of which are to be of an ultimate predetermined maximum size. It will be understood that the raw material **12** includes particles that are undesirably large. Therefore, my auxiliary apparatus B includes a vibrating screen **14**, grizzly, or similar separating device which is of a mesh sufficient to pass that portion of the material **12** which is already of the proper dimension. Accordingly, the material passing through the single deck screen or gizzly **14** bears the reference numeral **16**, this material **16** falling into a chute **18**. The material which is too large to pass through the inclined screen **14** is labeled **20** and is directed into a second chute **22**. The screen **14** is vibrated in any one of several known ways, as by an electric motor **24**, to effect the above mentioned separation of the material **12** into its component parts **16** and **20**.

The material thus separated is received by a pair of conveyors **26** and **28**, the material **20** being directed on the conveyor **26** and the material **16** being directed on the conveyor **28** through the respective chutes **22** and **18**. The conveyors **26** and **28** may be of any desired type and as shown include endless belts **30** and **32** trained over driving pulleys **34** and **36**, a motor **38** serving as the driving means for both of the belts **30** and **32** in their depicted superposed relationship. A suitable frame work **40** supports the belts **30** and **32** by means of the idler rolls **42** and **44**. The frame work **40** is in turn held at a preferred inclination by a pair of spaced standards **46** and **48**. The screen **14** and the conveyors **26**, **28**, along with their associated and enumerated elements, constitute what has been termed the auxiliary apparatus or equipment B.

The portable unit or plant C is rendered readily movable by a plurality of wheels **50** and contains a chute **52** which the material **20** is fed into from the conveyor **26**, the chute **52** discharging onto an inclined double decked vibrating screen **54** provided with upper and lower screen elements **56** and **58**. Positioned beneath the screen **58** is a hopper **60** into which the material passing through the lower element **58** falls and is collected. As will presently be made more apparent, the lower element **58** is approximately of the same mesh as the screen **14**. An additional screen **57** is positioned below screen **58**, substantially in alignment beneath chute **52** to separate fines from part of the troughs from screen **58** which are discharged separately by chute **59** into side conveyor **61**.

The upper screen element **56** is of a mesh such as to pass that part of the material **20** which is of a size to be adequately accommodated by a double roll crusher **62**, this material being designated by the reference numeral **64** which material is shifted from the upper side of the lower screen element **58** to a chute **66** leading to the crusher **62**. That portion of the material **20** remaining on the upper screen element **56** is given the numeral **68** and it is directed to a jaw crusher **70** via a chute **72**.

The two crushers **62** and **70** break up the respective material **64** and **72** to a size within their inherent capabilities and the crushed material thus formed is commingled together to form material **74** and permitted to fall onto a relatively short conveyor **76** which conveys this commingled material **74** to a rotary elevator **78** provided with a series of flights **80**. The elevator **78** lifts the material **74** onto another relatively long conveyor **82** which extends substantially the entire length of the unit C, the conveyor **82** discharging the material **74**, which has now been crushed, onto the upper series element **56**. The material **74** in this way becomes intermixed momentarily with fresh incoming material **20**, and it will be understood that that part of the material **74** which is now small enough to pass through the upper screen element **56** will do so, still further passage thereof being effected through the lower element **58** of that portion which has been sufficiently crushed to be sifted by the screen **58**. While there is a continual intermixture of new incoming material **20** with the crushed material **74**, it will be appreciated that there is also a continuous separating or sifting out of crushed material that is of the desired maximum size.

Considering now the material **16** being transported over the conveyor **28**, it will be realized that this material **16** is of the desired maximum size, having been screened by the screen **14**, and that no further sifting is required. Accordingly, this material **16** is discharged into a chute **84** leading directly to the hopper **60** where it is intermixed falling from the screen element **58** to produce the final product **86**, which final material has now been reduced to the proper maximum size. The chute **84** is omitted in Figure 2 of the drawings. In normal operation the material in the hopper **60** is only temporarily stored therein, there being a continuous removal of this stored material **86** by way of still another conveyor **88**. The conveyor **88** may discharge into the hauling vehicle D, illustrated as a truck **90**.

In brief, the course that the original varied size material takes is as follows: The varied size material **12** is separated into the material **16** and **20**. In that the material **16** is of the proper maximum size it is sent directly to the hopper **60**. While the material **20** is too large to pass the screen **14**, some of it will pass the upper screen element **56** and has been designated as material **64**. The part of the material **20** not passing the element **56** bears the reference numeral **68**. After the materials **64** and **68** have been crushed they are recombined and have been given the reference numeral **74**, since their physical state has been changed. The material **74** is dumped back on the element **56** along with newly arriving material **20** and those particles that will pass the element **56** will then do so and those particles small enough to pass the screen element **58** will continue their downward path into the hopper **60** from whence the material is removed as the final product **86**.

In view of the fact that the material **16**, forming part of the final product **86**, does not pass over any of the conveyors **76**, **78** or **82** nor is handled by the screen unit **54**, it will be apparent that the material load that must be handled by the portable plant C has been considerably reduced, an average figure being 60% to 90% as stated in the early part of this specification.

From a different standpoint, it is apparent that a plant of given size and capacity can handle several times more material through my feeding method and apparatus, in view of the step of by-passing the finished size material directly to the surge bin or finished material storage bin.

In Figure 3 I disclose a modified form of arrangement. This structure does not have all of the advantages of the arrangement previously described, but is desirable where screening equipment is already available. The apparatus includes a portable plant C identical to that previously described. The plant C includes the inlet chute **52** designed to receive the larger material and a chute **84**

designed to accommodate the smaller finished size of material.

A scaffold 92 supports a vibrating screen or grizzly 94 capable of separating the material of finished size from the larger material which require crushing. A chute 96 directs the finished size material into the chute 84 leading to the under screen material hopper or surge bin. A second chute 98 directs the larger material into the over-screen material chute 52. A single conveyor 100, or any other similar device is provided for directing the material onto the screen 94.

Figure 4 shows diagrammatically the system or method now employed. Numeral 102 designates the supply, which is directed onto a vibrating screen or grizzly 104 capable of separating the finished material from that which must be crushed. The smaller material passes directly to the surge bin, storage bin or under-screen hopper 106. The larger material is directed to the main screen 108 of the portable crushing and screening plant.

The material is graded in the screening unit 108, the larger sizes being directed to the jaw crusher 112 and the roll crusher 114. After crushing, the product is directed to the main conveyor 116 which recirculates it to the main screening 108. This recirculation continues until all of the crushed material passes through the screen 108 and to the under screen hopper or surge bin 106.

From the diagram, it will be noted that the feeding of the material differs from previous methods. Rather than having the material go directly to the main conveyor leading to the main screen unit 108, this material is first passed through a screen or grizzly, and only perhaps one-fourth of the material is screened in the portable unit.

In accordance with the patent statutes, I have described the principles of construction and operation of my material handling apparatus, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that obvious changes may be made within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. In material handling apparatus of the class described, screen means, first and second endless conveying means, means for directing the material passing through said screen means to said first conveying means, means for directing the coarser remaining material to said second conveying means, second screen means associated with said second conveying means, said second screen means being positioned for the reception of material delivered by said second conveying means, a hopper beneath said second screen means, said first conveying means bypassing said second screen means and discharging directly into said hopper, crushing means associated with said second screen means for receiving material not passing through said second screen means, and conveying means leading from said crushing means to said second screen means for conveying the crushed material onto said second screen means.

2. In material handling apparatus of the class described, inclined screen means, first and second endless conveying means, said first conveying means being disposed for the reception of material passing through said screen means and said second conveying means being disposed for the reception of the coarser material not passing through said screen means, second and third inclined screen means positioned one above the other, a hopper beneath said third screen means, the first conveying means bypassing said second and third screen means and discharging directly into said hopper and said second conveying means discharging onto said second screen means, first crusher means for crushing the material not passing through said second screen means, second crusher means for crushing the material not passing through said third screen means, and conveying means for receiving the crushed material from said first and second crusher means and discharging said crushed material onto said second screen means.

3. In combination with a portable material handling, crushing and screening plant provided with screening means, crusher means associated with said screening means, conveyor means for conveying the crushed material to said screening means, and a hopper disposed beneath the said screening means, the combination comprising a separable unit including auxiliary first and second conveyor means, said first auxiliary conveyor means discharging directly into said hopper and said second auxiliary conveyor means discharging onto said screen means, and auxiliary screen means positioned so as to discharge screened material onto said first auxiliary conveyor means and unscreened material onto said second auxiliary conveyor means.

4. A method of producing crushed aggregate, including the steps of screening the aggregate, conveying the material passing through the screen, collecting the conveyed material, separately conveying the material not passing through the screen, grading the last mentioned conveyed material, crushing the graded material, re-screening the crushed material, the material passing through the screen in the re-screening process joining the collected material.

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