Dec. 9, 1930 H. W. NEWTON 1,784,246

CLASSIFYING AND WASHING APPARATUS

Filed July 9, 1925 3 Sheets-Sheet 1

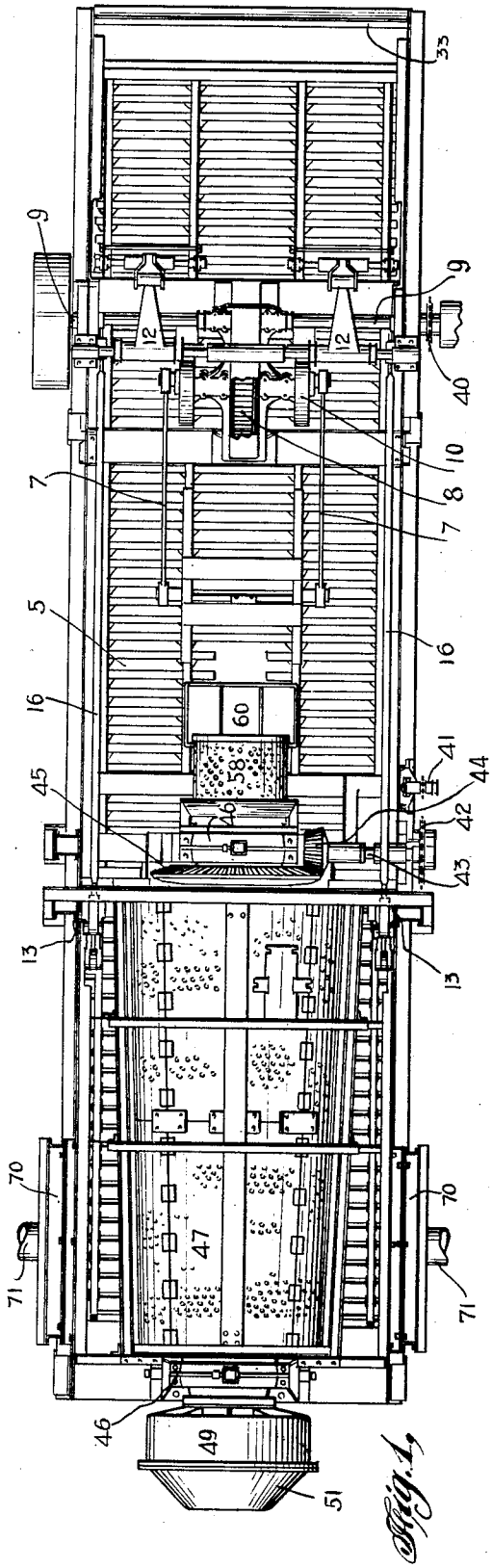

Fig. 1.

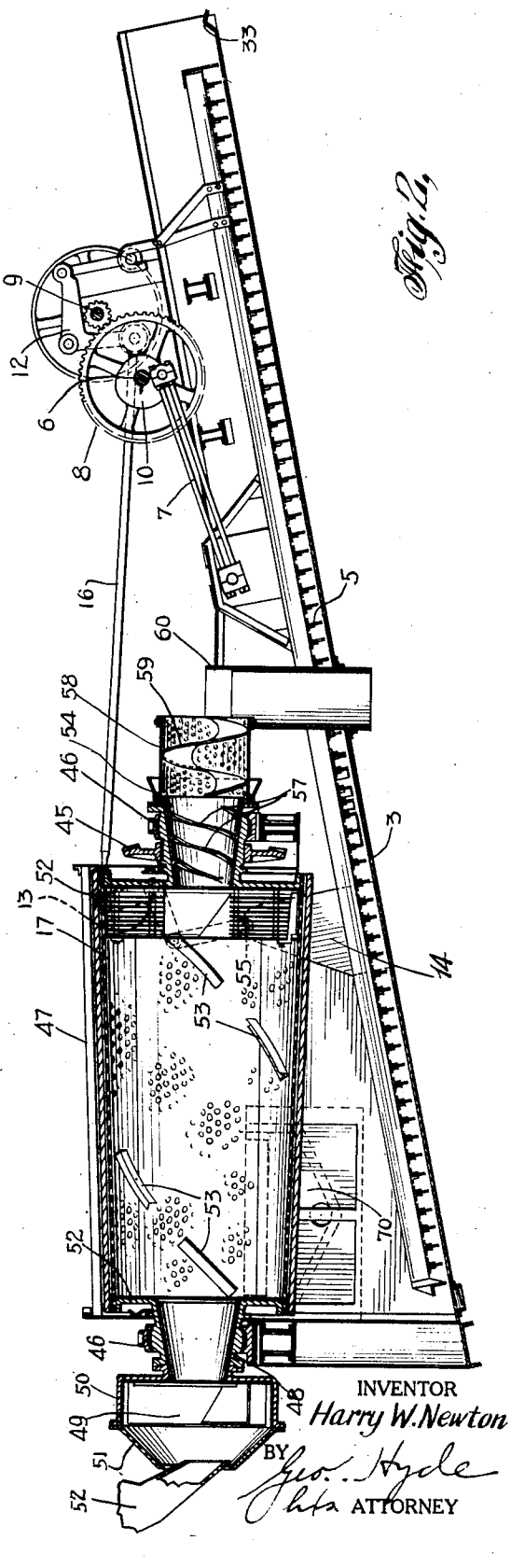

Fig. 2.

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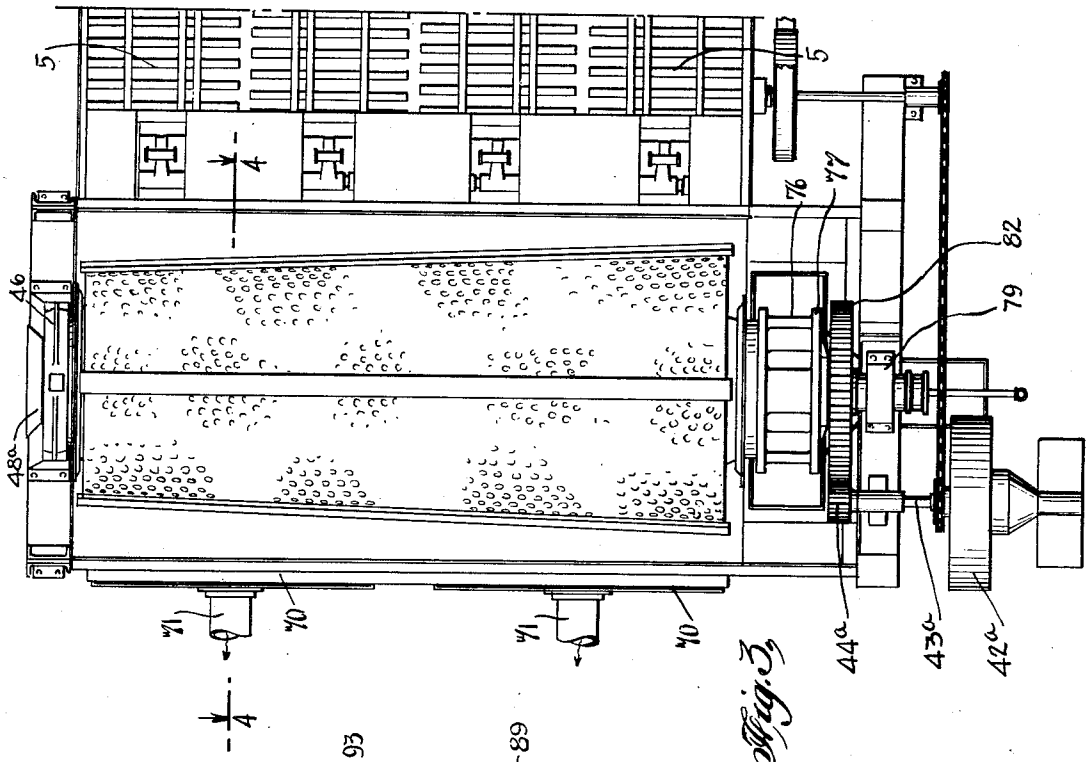

Fig. 3.

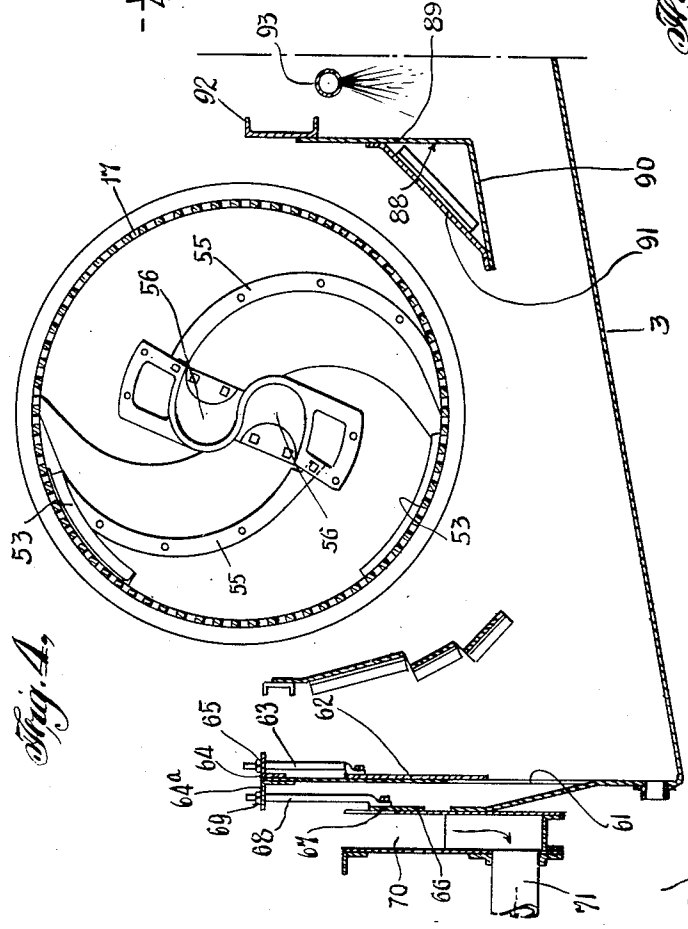

Fig. 4.

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Fig. 5.

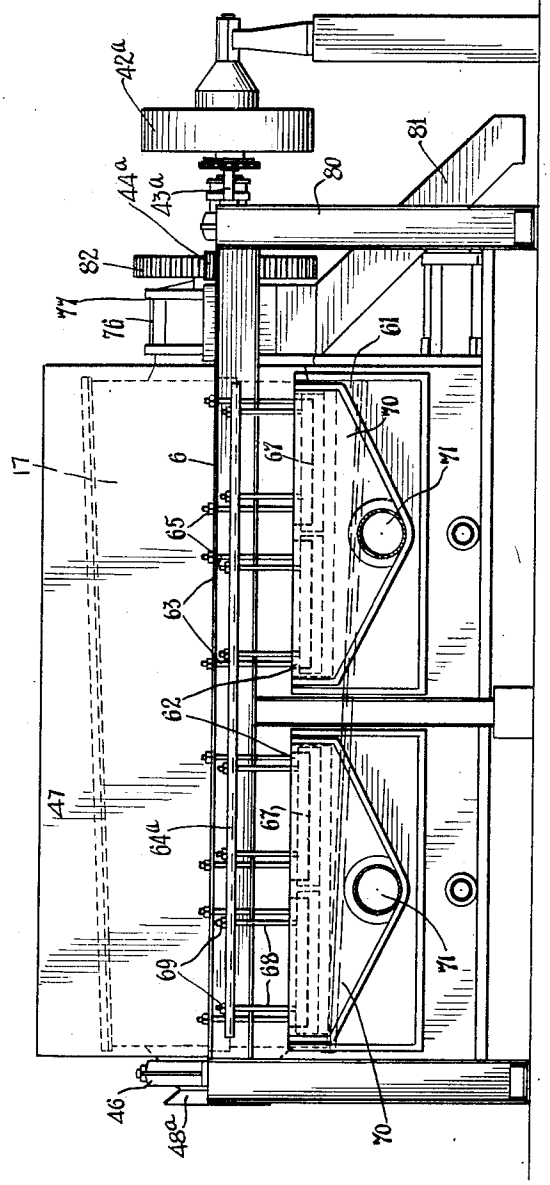
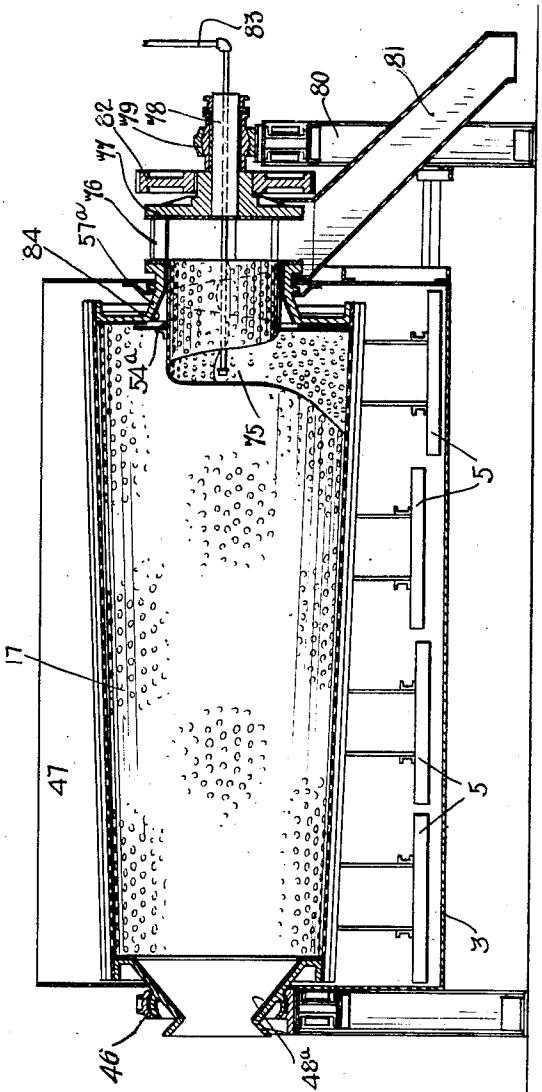


Fig. 6.



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UNITED STATES PATENT OFFICE

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CLASSIFYING AND WASHING APPARATUS

Application filed July 9, 1925. Serial No. 42,338.

This invention relates to machines for the wet classification of solids and is particularly directed to improvements in machines of the type employing a trommel or the like to remove the larger particles, such as the apparatus shown in United States Patent No. 1,445,007.

These machines are usually termed "washers" as they are employed extensively in washing low grade iron ore, though they are adapted to a wide variety of uses. In general, such machines separate the solids into three classes. The largest particles are removed by the trommel, their sizes being determined by the mesh or aperture diameter of the trommel screen. The particles passing through the trommel are again separated into a coarse and a fine product by a suitable wet classification apparatus.

In the practical operation of these machines numerous difficulties in construction and operation have arisen; and a principal object of this invention is to improve the construction in such a way as to eliminate the difficulties, and further to provide a machine which is more efficient both mechanically and from an operating standpoint.

One of the principal problems encountered in operation has been the provision of a suitable construction for discharging the larger solids from the trommel with a minimum of moisture, as a relatively dry product without further treatment is often of the greatest importance commercially. Another problem, also connected with the trommel discharge, has been the removal from the larger solids of such fine solids, slimes, etc., as may adhere to or be entrapped by the larger particles, a condition which is objectionable both from the standpoint of efficiency and of sightliness of the trommel product. This invention includes arrangements suitable for solving both problems in an efficient and practical manner.

Another object is to permit the simultaneous feed of dry solids and liquid at the feed end of the trommel, with suitable means of assuring the wetting of the solids by the time they encounter the trommel screen, as it has been found, though apparently not recognized heretofore, that such wetting improves substantially the efficiency of the operation.

Other features of the machine have been improved, such as the method of taking off the overflow; but these features will be apparent to those skilled in the art, from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a plan view of one improved type of machine,

Fig. 2 is a longitudinal median section taken vertically through Fig. 1,

Fig. 3 is a plan view of the trommel end of another form of machine,

Fig. 4 is a transverse section on line 4—4 of Fig. 3 but showing details of trommel construction corresponding to Fig. 2,

Fig. 5 is an end elevation taken from the overflow end of Fig. 3 and,

Fig. 6 is a vertical transverse section through Fig. 3 along the central line of the trommel.

The washer is composed in general of a rotary trommel with its lower portion immersed below the fluid level in a mechanical wet classifier, which may be of any preferred type, one particularly effective form being the Dorr classifier such as is illustrated in the above mentioned patent. This construction includes a classifier 2 with sloping bottom 3 and overflow 4 (described in detail hereafter) sand discharge 33, rakes 5, actuating shaft 6, pitmen 7, gearing 8, drive shaft 9, cams 10 and levers 12. The lower rake ends are supported from rocker shaft 13 connected to hangers 14 through suitable bellcranks which are rocked by rods 16. The latter parts are advantageously arranged at the sides of the trough to provide suitable space for the trommel. These parts are all embodied in the standard Dorr classifier and are described in the above patent.

The trommel may be of any desired type, preferably arranged with means for feeding at one end and for discharging the oversize at the other end. For convenience of description the material which is too large to pass the trommel screen will be termed oversize; the coarse material passing through the screen but removed by the mechanism of the classi-

fier will be called sand while the finer solids passing off with the overflow will be referred to as fines.

In the embodiment illustrated in Figs. 1 and 2 the trommel is arranged longitudinally of the classifier, and includes a foraminous member or screen 17, circular in cross section and suitably mounted for rotation about a central axis. Various methods of supporting and rotating the trommel are possible, the form shown being driven from a sprocket 40 on the drive shaft 9 through a suitable chain passing over idler 41 and around sprocket 42 on jackshaft 43 which carries a bevel pinion 44 meshing with a bevel gear 45 mounted on the end of the trommel frame. The ends of the trommel may be supported by bearings 46 which envelop the feed and discharge spouts of the trommel respectively, the latter serving as hollow shafts for the trommel. If desired a suitable housing 47 may be provided over the trommel to protect it and prevent splashing in operation.

In arranging the trommel in the classifier it is difficult to provide a construction which is convenient both for feeding and for handling the trommel discharge. In the above mentioned patent the discharge is conveniently handled; but it has been found objectionable to feed the trommel at a point within the limits of the classifier, partly because of difficulty in arranging the feed conveyor, and partly because of the necessity for preventing any of the feed from entering the classifier directly. The present invention therefore involves a trommel arrangement in which the feed enters the trommel directly from the outside of the classifier; and two arrangements for handling trommel discharge under these circumstances are shown in Figs. 1 and 3 respectively.

It has been found as already indicated that with certain materials it is of substantial value to have the materials thoroughly wetted before they are subjected to the action of the trommel screen, since the latter does not operate efficiently upon solids which are not wetted. Means for producing this wetting action is most advantageously incorporated with the trommel for the sake of simplicity; and one convenient arrangement includes the use of a scoop feeder attached to and rotating with the feed spout 48 of the trommel. This feeder may be of any well known type, the form illustrated including a spiral 49 mounted in a cylindrical drum 50 closed at both sides, except for the central opening at one side registering with the mouth of spout 48, and the opening along the marginal portion of the other side registering with the end of the outer run spiral 49. A conical hood 51 may advantageously be mounted on the outer end of the feeder, so arranged that material fed in, as by feed chute 52, will be retained in the lower part of the hood until is passes into the entrance of spiral 49. It has been found that the rolling and mixing action to which the feed is subjected in the scoop is effective in practice to wet the solids thoroughly before they are discharged into the trommel through spout 48.

Any suitable trommel construction or screen material may be employed, in accordance with the requirements of different sizes of machines and types of material. In the machine shown the screen sections are simply mounted on drum ends 52 carried by the feed and discharge spouts and connected by suitable longitudinal frame members if desired.

Material entering the trommel through spout 48 falls to the bottom, which is substantially submerged beneath the fluid level in the classifier, and is there subjected to the usual trommel action, being conveyed gradually to the opposite or discharge end of the trommel by any suitable means, such as spirally arranged conveyor flanges 53, and, if desired, by a suitable slope of the bottom, as by employing a slightly conical trommel with its wider end at the discharge, giving a downward slope to the bottom of the trommel. The oversize which reaches the discharge end is picked up and carried outwardly through the discharge spout 54.

Means are provided for draining the oversize as completely as possible before finally discharging it from the machine. For this purpose it is preferred to employ foraminous lifting scoops 55, which in Fig. 2 are shown as comprised of a series of narrow bars forming a grid. These scoops, which are shown in detail in Fig. 4 are so curved as to pick up the oversize, and permit it to drain while it is being carried above the fluid level to the axis of rotation, where it passes along suitably inclined curved plate 56 into the spout 54. This spout may have suitable feed spirals 57, discharging into a perforated cylinder 58 also having a feed spiral 59. A suitable chute 60 is located beneath the end of the discharge screen 58, and carries the oversize downwardly through the bottom of the classifier and out of the machine. This arrangement is possible in a classifier of the Dorr type, since the chute may be suitably narrow where it passes through the zone of rake action, and the rakes are cut away so that they clear the sides of the chute. It will be apparent that with this arrangement the oversize is given a substantial opportunity to drain, the excess liquid passing through screen 58 into the body of the classifier. Various modifications of the specific arrangement shown are possible, one of which is described hereafter; and this invention contemplates the employment of any such modifications within the scope of the claims.

The solids passing through the trommel

into the body of the classifier are subjected to the action of the latter in substantially the usual manner, the solids which settle more readily passing to the bottom and being raked up the sloping deck 3 to a point a sufficient distance above the water level to allow for drainage. The remaining solids, which are kept in suspension by the flow of feed and the agitation of the rakes and trommel, assisted if desired by the addition of wash water, are discharged as fines through a suitable overflow, which with this particular arrangement is located at the sides of the deep end of the classifier. The overflow may simply pass over a suitable weir if desired; but the arrangement shown in Fig. 4 has been found advantageous under certain conditions. This arrangement is based upon the fact that where the conditions of agitation and flow are suitable, it is frequently possible to obtain a more accurate classification at a desired size or mesh if the overflow is taken at a point a predetermined distance below the surface of the pulp in the classifier. An arrangement for the purpose, which may be adjusted readily to determine the exact depth from which the overflow is drawn, is shown in said Fig 4, and includes a horizontal slot 61 in a side wall of the classifier, extending below the lowermost point of the zone from which the overflow will be taken and at least to the uppermost portion of such zone. A flat vertically sliding gate 62 is adjustably supported to vary the upper edge of aperture 61, as by mounting gate 62 on threaded rods 63 passing through a support plate 64 with adjusting nuts 65 on the rods.

The liquid which is discharged through the overflow passes through opening 61 and upwardly through a suitable passage to an overflow weir, which should also be preferably adjustable so that the elevation of the liquid in the classifier may be suitably adjusted, and compensation made for different rates of flow or separation at different meshes. In Fig. 4 there is shown a fixed horizontal weir 66 with a suitable vertical plate 67 forming a sliding weir bearing against plate 66 and vertically adjustable by means of threaded rods 68 and adjusting nut 69, carried by fixed frame plate 64*a*. The liquid overflowing weir plate 67 passes into overflow box 70, which may be tapered to a central discharge pipe 71. In the drawings the overflow box has been shown on each side of the lower end of the classifier extending substantially from the end wall for a suitable distance; but obviously such an overflow arrangement may be suitably located at any desired point, as in the end wall, this construction being shown in Figs. 3 and 5.

If desired the trommel may also be placed transversely across the classifier, as shown in Figs. 4, 5 and 6. This arrangement is especially advantageous with certain materials because of the possibility of locating the trommel symmetrically with relation to the overflow and rakes. With this construction the trommel may be of the same type as is illustrated best in Fig. 2; but for convenience another type is shown, which is likewise adapted for use in the machine shown in the latter figure. The feed scoop has been omitted, a simple feed spout 48*a* being included. At the trommel discharge end a different type of draining scoop 75 for lifting the oversize to the discharge has been illustrated, this scoop being in the form of a suitable strip of perforated material which emerges into a cylindrical discharge spout 54*a* having if desired a discharge spiral 57*a*. This construction has been found highly efficient where large chunks of material are included in the oversize, as in the washing of iron ore; since a large unobstructed aperture is provided through which such chunks will pass without obstructing the smaller particles or jamming in the throat of the discharge. It is understood that the inner edge of the scoop 75 will be suitably curled or deflected if necessary so that oversize carried along the strip will pass outwardly into the field of the spiral 57*a*.

The general arrangement of the discharge end of the trommel in this embodiment is also substantially different, though the arrangement shown is equally applicable to the form disclosed in Fig. 1. In the washer of Figs. 3 to 6 the bearing at the discharge end is located beyond the solids discharge, a suitable opening or series of openings in the discharge spout permitting the oversize to drop into a discharge passage. This arrangement permits a smaller bearing with greater efficiency and durability, and which is also much easier to align.

Referring to Fig. 6, the discharge spout 54*a* opens into a cylindrical cage formed of bars 76 mounted on the periphery of a disc 77 carrying shaft 78 mounted in bearing 79 on frame 80. The apertures between the bars 76 of the discharge cage are sufficient to permit the largest size chunks to fall into the discharge chute 81 without jamming. A suitable drive pinion 82 may be mounted on the discharge end of the trommel, the form shown having the pinion on a suitable extension of disc 77.

It is sometimes valuable to wash the oversize and this may be readily accomplished by the use of a spray pipe 83 extending through a suitable bore in shaft 78 and through the center of the discharge spout 54, with suitable perforations in the pipe so located that wash water will be thrown on the oversize in the spout, but only at a distance from the discharge end of the spout sufficient to permit the water to drain off before the solids

are discharged. The water is preferably drained back into the trommel, so that the fines carried thereby may pass into the classifier. This can readily be accomplished by locating a drainage surface 84 directly under the perforated discharge spout, sloped to carry drained water back into the trommel.

Referring to Fig 4, which is a cross section of the embodiment illustrated in Figs. 3 to 6, except that the discharge scoop arrangement shown is that of Fig. 2, it will be seen that the overflow passes directly from the full length of the trommel to the end of the classifier. In order to avoid too strong a current along the surface, which might carry over some sand, a suitable baffle may be inserted, such as a staggered baffle system including plates 85, 86 and 87 extending across the classifier tank and mounted on opposite walls. These plates may if desired be foraminous. It may also be desirable with certain types of material to employ means for preventing fines from traveling too far toward the sand discharge end, which naturally increases the tendency to carry fines off with the sands. This may be prevented by employing a suitable baffle 88 at the side of the trommel opposite the overflow which may include a vertical portion 89 and if desired a connected plate 90 substantially parallel to the classifier tank bottom. A suitable plate 91 prevents solids from lodging in the bend of the baffle. All portions of the baffle preferably extend entirely across the tank and may be mounted on the tank sides and on a suitable transverse beam 92.

If desired, wash water may be introduced at the rear of the trommel, beyond the baffle 89 if employed, as by means of pipe 93. This arrangement produces a flow beneath the baffle system at the rear of the trommel, tending to carry to the overflow any fines which are entrapped with the sand.

The general arrangement of the transverse trommel is shown adequately in Figs. 3 and 5, the overflow being located at the end of the tank and conveniently being in two sections as shown in Fig. 5, to provide suitable slope to the bottom of the overflow compartments 70. The drive with this arrangement may be slightly different, including a spur gear 82 driven by pinion 44*a* on shaft 43*a* carrying pulley 42*a* which may be driven from a corresponding aligned pulley on drive shaft 9.

While a specific machine has necessarily been described, it will be apparent that numerous modifications in addition to those indicated may be employed within the scope of the invention as set forth by the claims. In particular, while the arrangement has substantial advantages when a Dorr classifier having a reciprocating rake is employed, the trommel may likewise be used with other forms of classifier such as the rotary and drag types including log washers.

Claims.

1. Apparatus for the classification of solids in liquids comprising a wet classifier, a trommel extending above the fluid in the classifier and having a passage for oversize solids at one end, means in said passage for washing the oversize solids, and means for draining wash water and undersize solids carried thereby into the classifier.

2. Apparatus for the classification of solids in liquids comprising a wet classifier having an overflow at one end, a trommel across the classifier, and a vertical transverse partition extending across the classifier at the side of the trommel opposite to the overflow, the lower edge of said partition being located adjacent the bottom of the classifier.

3. Apparatus for the classification of solids in liquids comprising a wet classifier including a tank, a rotary cylindrical trommel located above said tank and extending into the tank below the liquid level therein, said trommel having a cylindrical axial discharge passage at one end extending across and beyond a wall of said tank, said passage including perforated walls for the drainage of oversize solids and having a discharge opening for the solids substantially spaced from said tank wall; and bearing means for rotatably supporting the trommel including a bearing at the discharge end of the trommel engaging the discharge passage at a substantial distance beyond and outside of the walls of the tank.

4. Apparatus for the classification of solids in liquids comprising a mechanical wet classifier having an overflow at one end, a trommel across the classifier, and a vertical transverse partition extending across the classifier at the side of the trommel opposite to the overflow, the lower edge of said partition being located adjacent the bottom of the classifier, and a baffle located between the trommel and overflow to prevent direct passage of fluid from the trommel to the overflow.

5. Apparatus for the classification of solids in liquids comprising a mechanical wet classifier having an overflow at one end, a trommel extending across the classifier, and a wall across the classifier substantially parallel to and adjacent the bottom of the classifier and having an upwardly directed portion extending substantially to the liquid level at the side of the trommel opposite to the overflow.

6. Apparatus for the classification of solids in liquids comprising a classification compartment, mechanical means for agitating the pulp in the compartment and removing settled solids therefrom, said compartment having a single overflow passage with an air inlet opening thereto, and members defining said opening including a vertically adjustable member defining the upper edge of said open-

ing, the overflow passage and the opening being located outside any vertical plane through the agitating means.

7. Apparatus for the classification of solids in liquids comprising a classification compartment, mechanical means for agitating the pulp in the compartment and removing settled solids therefrom, said compartment having a single overflow passage with an air inlet opening thereto, and members defining said opening including a vertically adjustable member defining the upper edge of said opening, the overflow passage and the opening being located outside any vertical plane through the agitating means.

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