Oct. 24, 1939. F. L. COOGAN ET AL 2,177,560

SHALE SEPARATOR

Filed June 24, 1937 3 Sheets-Sheet 1

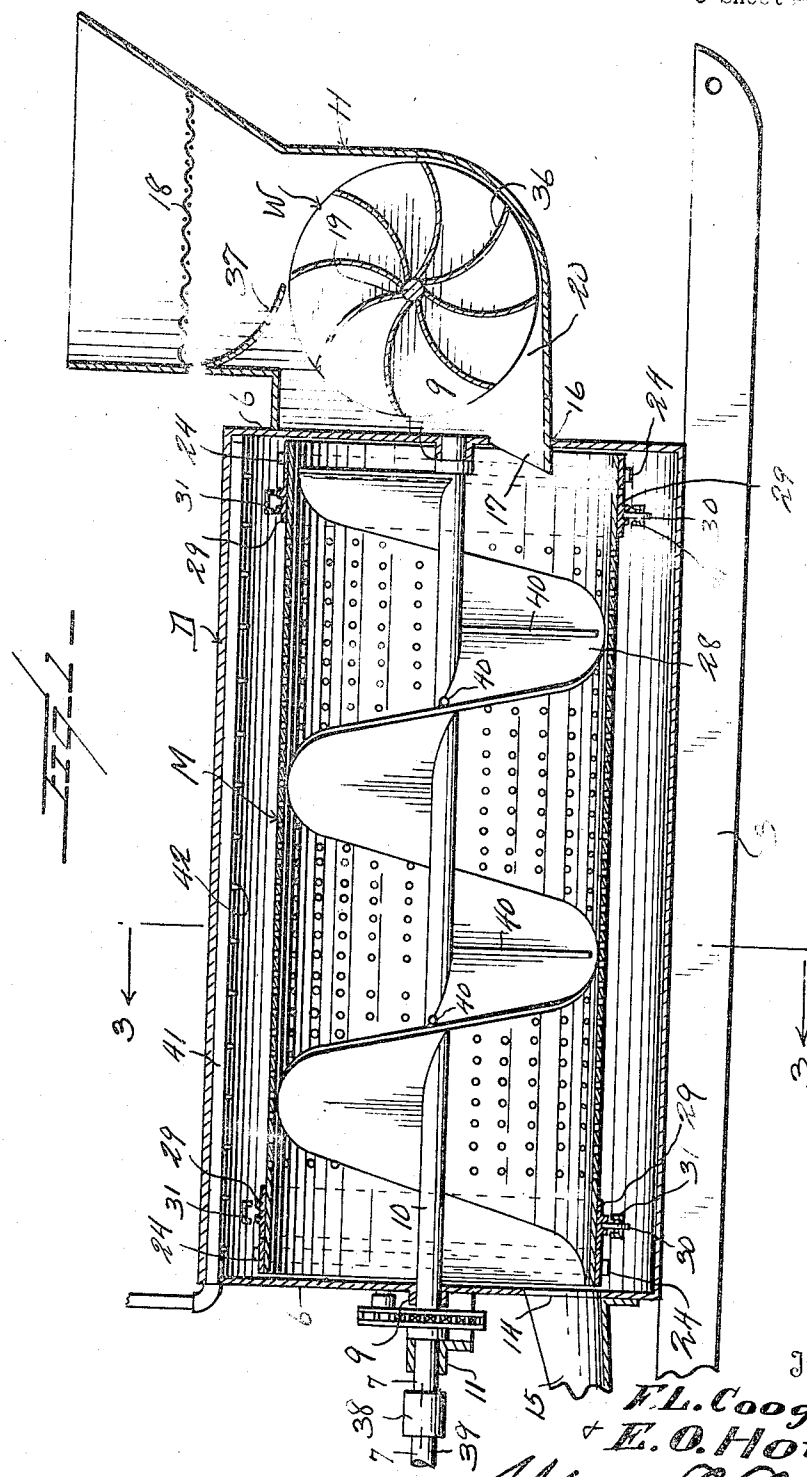


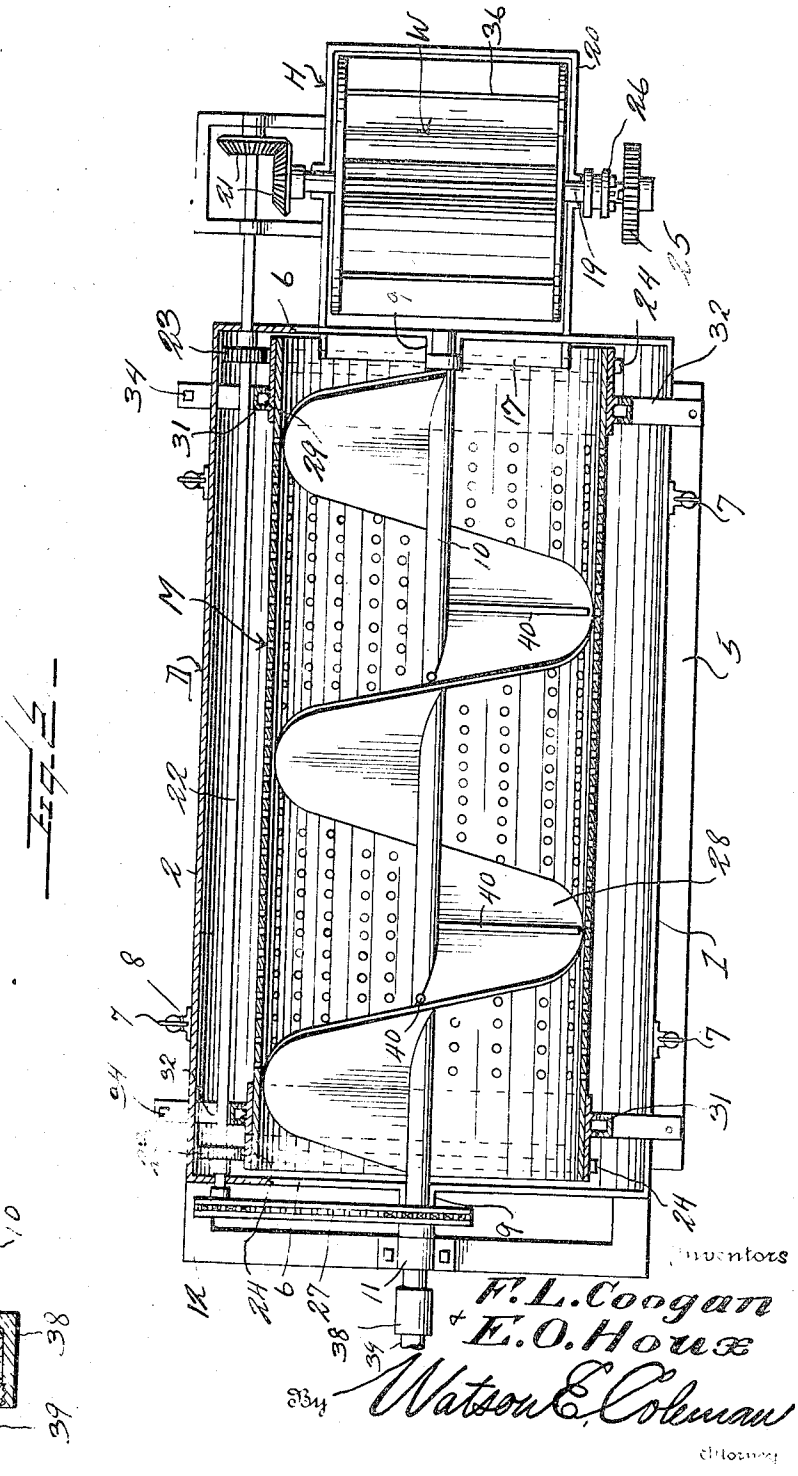
FIG. 1

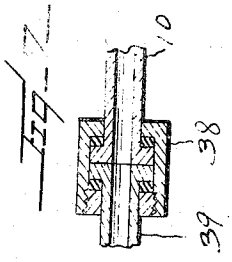
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SHALE SEPARATOR

Filed June 24, 1937 3 Sheets-Sheet 2





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SHALE SEPARATOR

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Fig. 3

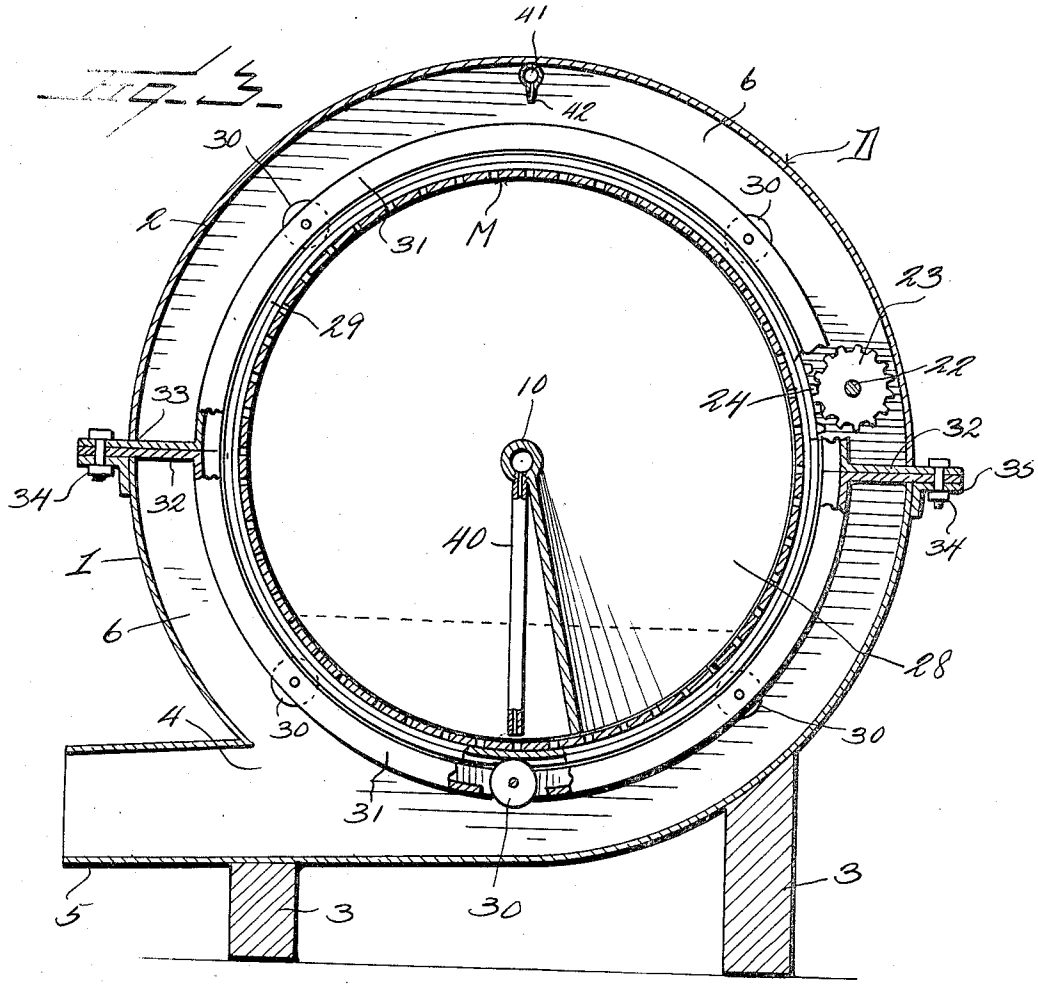


Fig. 6

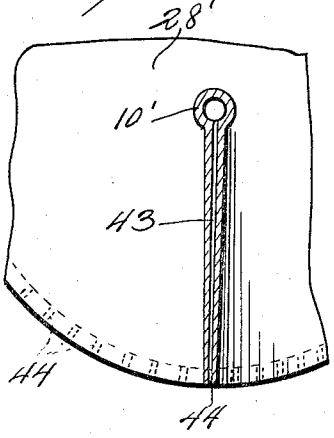


Fig. 5

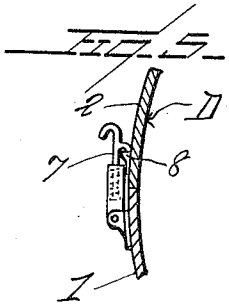
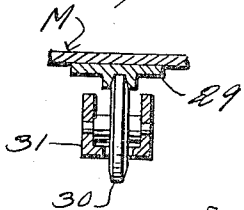


Fig. 4



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Patented Oct. 24, 1939 2,177,560

UNITED STATES PATENT OFFICE

2,177,560

SHALE SEPARATOR

Frederick Leon Coogan and Earl Ollie Houx,
Sayre, Okla.

Application June 24, 1937, Serial No. 150,212

2 Claims. (Cl. 210—199)

This invention relates to a shale separator, and it is primarily an object of the invention to provide an apparatus of this kind especially designed and adapted to be employed with the water and mud liquid used in connection with a rotary drilling rig and more particularly for coaction with such liquid or fluid before it is delivered to the "slush pit".

In drilling a well with a rotary rig, a string of hollow drilling pipe is rotated and fed into the ground as fast as the hole is being deepened. At the bottom of this drill pipe various kinds of drilling bits or cutters are used in accordance with the formations but all of these tools have water courses or outlets at the bottom and as water and thin mud is forced down by high pressure "mud hog" pumps this liquid or fluid is conveyed to the inside of the drill pipe by flexible hose and passes out through perforations in the bit or cutting tool. This fluid, due to its force, is of great assistance in tearing up and liquefying the formation as such formation is being torn up by the cutting bit. These cuttings now become a part of the water and mud liquid being sent down and come to the surface of the well outside of the drill pipe, for which there is ample space, due to the cutters making a larger hole than the drill pipe itself. As the water and mud liquid with the cuttings reaches the ground surface such fluid is conveyed to the "slush pit" or reservoir where the fluid is again picked up by the pumps and sent back to the bottom of the hole. This process goes on to the completion of the well although fresh water must be added to the "slush pit" from time to time as the fluid is constantly being thickened by the adding of fresh cuttings coming out with the returns.

During the drilling operation many sorts of formations are encountered, some of which will easily dissolve and liquefy and become a part of the water and mud liquid and under such conditions no trouble is given to the drilling operation. However, often formations are run into which the bit will pulverize but not dissolve and when this sort of formation gets into the circulating fluid the fluid becomes hard to handle and gives trouble in circulation. Therefore, in order to keep the circulation fluid in advantageous liquid state the "slush pit" must be cleared of these heavier formations which is often done by blowing the formations out into a reserve pit or siphoned out.

It is an object of the invention to avoid this heavier formation by separating the harder substance from the water and mud liquid but before the water and mud liquid reaches the "slush pit" or reservoir, allowing the water and mud liquid to return to the "slush pit" or reservoir to be again picked up and sent back into the well while the shale or hard formations are diverted away from the "slush pit" or reservoir where such shale or hard formations can give no trouble.

A still further object of the invention is to provide an apparatus for separating shale or kindred hard matter from the water and mud liquid comprising a hollow cylindrical screening element into which is discharged the fluid returned from the well, together with means within the screening element for carrying off the formations separated from the water and mud liquid, said means also providing a medium to eliminate clogging of the screening element.

The invention consists in the details of construction and in the combination and arrangement of the several parts of our improved shale separator whereby certain important advantages are attained and the device rendered simpler, less expensive and otherwise more convenient and advantageous for use, as will be hereinafter more fully set forth.

The novel features of our invention will hereinafter be definitely claimed.

In order that our invention may be the better understood, we will now proceed to describe the same with reference to the accompanying drawings, wherein:

Figure 1 is a vertical sectional view with portions in elevation taken lengthwise through a separator constructed in accordance with an embodiment of our invention;

Figure 2 is a view partly in horizontal section and partly in top plan of the structure as illustrated in Figure 1 with certain of the parts omitted;

Figure 3 is a transverse vertical sectional view taken substantially on the line 3—3 of Figure 1;

Figure 4 is a detailed sectional view illustrating one of the supporting wheels for the rotating screening element;

Figure 5 is a fragmentary view partly in section and partly in elevation illustrating one of the latches for holding the sections of the drum in assembled relation;

Figure 6 is a fragmentary view partly in section and partly in elevation showing a modified form of spiral conveyor;

Figure 7 is an enlarged fragmentary sectional view taken substantially on the line 7—7 of Figure 1.

As disclosed in the accompanying drawings, D denotes a substantially cylindrical drum of de-

sired dimensions and which is preferably divided longitudinally to provide a lower section 1 and an upper section 2. As herein disclosed, the lower section 1 is mounted upon a pair of skids or runners 3 whereby the apparatus in its entirety may be conveniently transported when desired from one locality to another. However, we do not wish to limit ourselves to the use of such skids or runners as other ground engaging means may be employed with equal advantage and under certain circumstances it may be preferred to have the apparatus constitute an immovable structure.

The lowermost part of the section 1 is provided therealong with a discharge opening 4 continued by an outstanding spout 5. The water and mud liquid is discharged out through this spout 5 after such liquid has been subjected to a separating action. The liquid thus discharged is returned in any preferred manner to the "slush pit" or reservoir.

The ends of the sections 1 and 2 are closed by the plates 6 so that when the sections 1 and 2 are in superposed or assembled relation a substantially closed drum D is provided. These sections 1 and 2 may be maintained in working assembly in any desired manner but, as herein disclosed, one of the sections, as 1, carries a plurality of snap clamps or hooks 7 each of which engaging a suitably positioned lug or keeper 8 on the second section, as 2. The central portions of the butting straight edges of the end plates 6 of the sections of the drum D are formed to provide bearings 9 for the opposite end portions of a shaft 10. This shaft 10, as illustrated in the accompanying drawings, extends axially through the drum D with an end portion of said shaft extending beyond an end of the drum and rotatably engaged with an outboard bearing 11. This outboard bearing 11 is comprised in a bracket structure 12 or the like welded or otherwise secured to an adjacent end plate 6 preferably of the lower section 1.

This shaft 10 is also disposed axially of a tubular cylindrical separating member M open at both ends and of a length substantially equal to the interior length of the drum D. The peripheral wall of this member M is perforated for the free passage outwardly therethrough of the water and mud liquid but sufficiently small in diameter to separate from the water and mud liquid the shale or other hard cuttings included in the fluid returning from a well during a drilling operation so that when the returning water and mud liquid is delivered to the "slush pit" or reservoir such liquid will be free of these hard and relatively large particles whereby the liquid when again forced down through the drill pipe will be of proper consistency. This separation of the shale or other kindred particles from the water and mud liquid also eliminates the cleaning out of the "slush pit" or reservoir as would be required from time to time if no separating means were employed.

The particles separated by the member M are discharged out through an opening 14 in an end plate 6 of the lower section 1 of the drum, such slag or culm passing over a chute 15 leading from the opening 14. The lower margin of the opening 14 is positioned above the lower plane of the opening 4.

The end plate 6 of the section 1 of the drum opposite to the end plate having the opening 14 is provided in its upper portion with an opening 16 having its lower margin positioned above the lower margin of the opening 14 and through which extends a spout 17 arranged at the lower portion of a hopper H into which is discharged the return fluid from the well. The lower portion of this hopper H extends within the adjacent end portion of the separating member M. The upper or receiving end portion of this hopper H is preferably intersected by a screen fabric 18 of relatively large mesh. While it is not generally expected to have any particles come up with the return fluid from the well that would be too large for free passage down through the apparatus, yet this screen fabric 18 serves to separate from the fluid any such large particles such as a wooden peg or relatively large size pieces of wood which at times do come up with the return fluid and if not separated would give trouble to the separating apparatus.

Mounted within the lower portion of the hopper H is an overshot wheel W including an axle 19 which is rotatably supported by the side walls 20 of the hopper. This shaft 19 extends beyond opposite sides of the hopper H and one extended portion is in driving connection through the meshing gears 21 with a shaft 22 which extends lengthwise through the drum D and rotatably supported, as herein disclosed, by the end plates 6 of the upper section 2. The shaft 22 within the drum and at desired spaced points thereon has fixed thereto the pinions 23 each of which meshing with a rack 24 extending circumferentially around the separating member M so that upon rotation of the shaft 22 the member M will be caused to rotate at desired speed.

As the return fluid passes down through the hopper H the weight of such return fluid will coact with the wheel W, as is believed to be obvious, in a manner to rotate the shaft 19 so that desired operation of the apparatus as herein embodied will be effected by the power derived from such return fluid. We do not, however, wish to limit ourselves to this source of power because obviously the shaft 19 may be coupled to any suitable driving element as generally indicated at 25 in Figure 2 of the drawings. As illustrated, this driving member 25 has associated therewith a clutch member 26 which is in neutral position of course when the wheel W is used as the driver.

The shaft 22 extends beyond both ends of the drum D and the extended end portion thereof remote from the hopper H is in driving connection through the medium of the sprocket wheels and chains, as at 27, with the shaft 10 so that the shaft 10 will be rotated in unison with the separating member M but in an opposite direction. This shaft 10 within the member M carries a conveyor screw or spiral 28. This conveyor closely approaches the inner face of the peripheral wall of the member M to provide a scraping action to all particles or formations too large to pass through the openings of the member M and force the same out through the opening 14.

In the present embodiment of our invention the opposite end portions of the member M are surrounded by grooved tracks 29 in which are engaged the rollers 30 carried by the supporting members 31 for the member M. Each of these members 31 surrounds the member M and is concentric to the trackway 29. Each of these supporting members 31 is also divided into two semi-circular sections, the extremities of which are provided with the outstanding radially disposed arms 32 with the adjacent arms of the sections in close contact with each other as particularly illustrated in Figure 3. These contacting arms 32 extend outwardly beyond the drum

D, the meeting edges of the sections 1 and 2 being suitably notched or recessed, as at 33, to allow for such assembly. The extended end portions of the arms 32 are bolted, as at 34, or otherwise securely anchored to the outstanding brackets 35 carried by the lower section 1. Through the medium of the members 31 and the coaction between the rollers 30 and the trackways 29 the separating member M is effectively maintained in desired assembly and in a manner to permit said member M to be rotated with a minimum of frictional resistance.

To eliminate back wash of the return fluid upon the blades 36 of the wheel W, the back wall of the hopper H above the wheel W is provided with an inwardly disposed plate 37 terminating directly over the vertical center of the wheel W so that as each blade 36 passes the plate 37 the return fluid will impact the blade and thus eliminating hold back or resistance to the wheel.

We also find it of advantage to have each of these blades 36 of a scoop-like structure to better hold the fluid as it passes down into the hopper H.

While the conveyor 28 provides an effective means to prevent clogging of the openings in the peripheral wall of the member M, we find it of advantage to have the shaft 10 hollow with one end portion in swiveled connection, as at 38, with a pipe line 39 leading from a suitable source of water supply under pressure. The opposite end portion of this shaft 10 is, of course, closed. Radiating from the shaft 10 and in close proximity to the convolutions of the conveyor 28 are vent pipes 40 of a length terminating closely adjacent the inner face of the peripheral wall of the member M. The water discharged through these vent pipes 40 serves to effectively wash off any formation having a tendency to hold to the inner face of the peripheral wall of the member M and which would otherwise have a tendency to clog the openings in such wall.

To further prevent clogging of the openings in the peripheral wall of the member M we extend the pipe line 41 lengthwise through the drum D above the member M, said pipe line also leading from a suitable source of water under pressure. This pipe line 41 within the drum D at points spaced therealong is provided with the depending discharge nozzles 42 through which the water is thrown from above upon the outer face of the member M and with sufficient force to expel any formations which might be retained within the openings in the wall of the member M.

Instead of using the vent pipes 40 the blade of the spiral conveyor 28' may be double walled providing therebetween a water space 43 in communication with the tubular shaft 10' while the peripheral edge of the blade is formed therealong with a series of vents 44 communicating with the space 43 so that water under pressure will be discharged in jets upon the interior face of the rotary screen member.

As particularly illustrated in Figure 1, the hopper H is also divided into two superimposed sections to facilitate the mounting of the wheel W and the hopper H may be held in proper assembly with respect to the drum D in any manner preferred.

From the foregoing description it is thought to be obvious that a shale separator constructed in accordance with our invention is particularly well adapted for use by reason of the convenience and facility with which it may be assembled and operated, and it will also be obvious that our invention is susceptible of some change and modification without departing from the principles and spirit thereof and for this reason we do not wish to be understood as limiting ourselves to the precise arrangement and formation of the several parts herein shown in carrying out our invention in practice except as hereinafter claimed.

We claim:

1. A separator of the class described comprising a drum divided longitudinally to provide a lower section and an upper section, supporting means coacting with the lower section, the lowermost part of the lower section being provided substantially entirely therealong with a discharge opening, plates for closing the ends of the drum, one end of the drum in its central part having an entrance opening and the opposite end of the drum in its lower part having a discharge opening, the end of said discharge opening being above the discharge opening extending along the lower section of the drum, annular supporting members within the drum adjacent to the ends thereof, each of said annular supporting members being composed of a pair of cooperating semi-circular members provided with outstanding arms at the extremities thereof, the arms at adjacent extremities contacting and being of a length to extend exteriorly of the drum, brackets carried by the drum exteriorly thereof, means for securing the extended portions of the arms to the brackets, a cylindrical screening element disposed through and rotatably supported by the annular supporting members, and means for rotating the screening element, the ends of the screening element being open, the entrance opening communicating with the interior of the screening element and the second discharge opening communicating with the interior of the screening element.

2. A separator of the class described comprising a drum divided longitudinally to provide a lower section and an upper section, supporting means coacting with the lower section, the lowermost part of the lower section being provided substantially entirely therealong with a discharge opening, plates for closing the ends of the drum, one end of the drum in its central part having an entrance opening and the opposite end of the drum in its lower part having a discharge opening, the end of said discharge opening being above the discharge opening extending along the lower section of the drum, annular supporting members within the drum adjacent to the ends thereof, each of said annular supporting members being composed of a pair of cooperating semi-circular members provided with outstanding arms at the extremities thereof, the arms at adjacent extremities contacting and being of a length to extend exteriorly of the drum, brackets carried by the drum exteriorly thereof, means for securing the extended portions of the arms to the brackets, a cylindrical screening element disposed thru and rotatably supported by the annular supporting members, means for rotating the screening element, the ends of the screening element being open, the entrance opening communicating with the interior of the screening element and the second discharge opening communicating with the interior of the screening element, a spiral conveyor within the screening element and rotatably supported by the ends of the drum, and means for rotating said conveyor.

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