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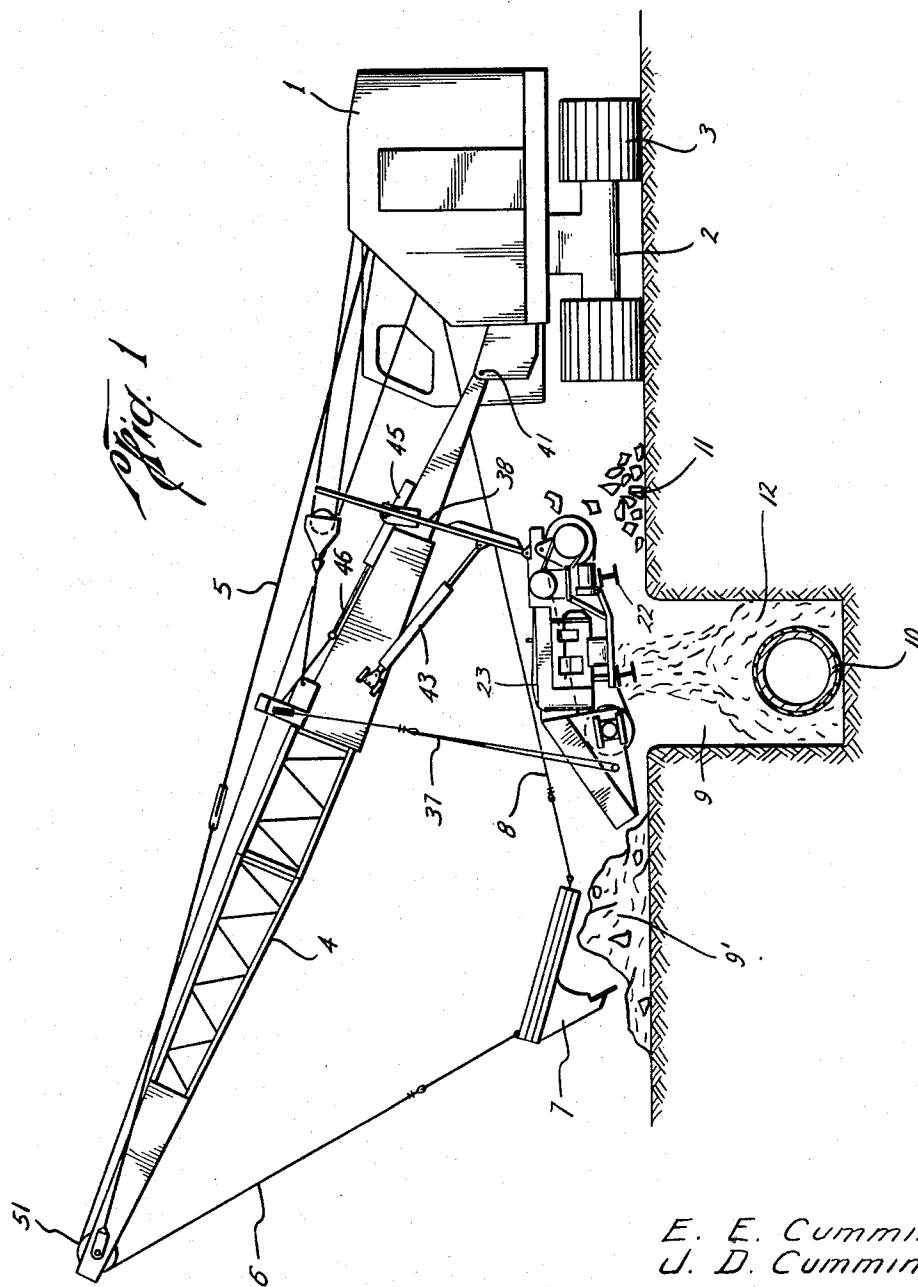
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2,947,096

DRAGLINE DITCH PADDER ATTACHMENT

Filed Oct. 18, 1957

4 Sheets-Sheet 1



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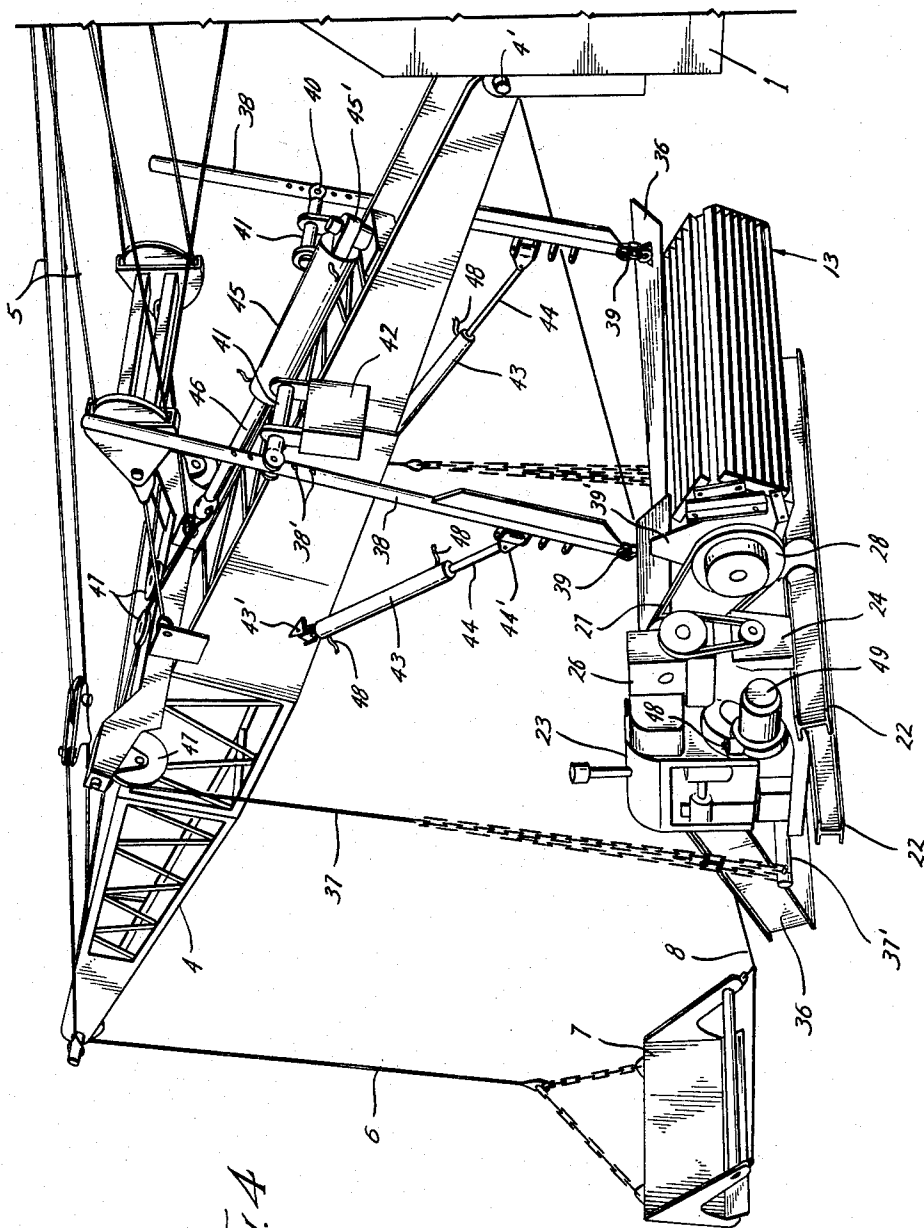


Fig. 4

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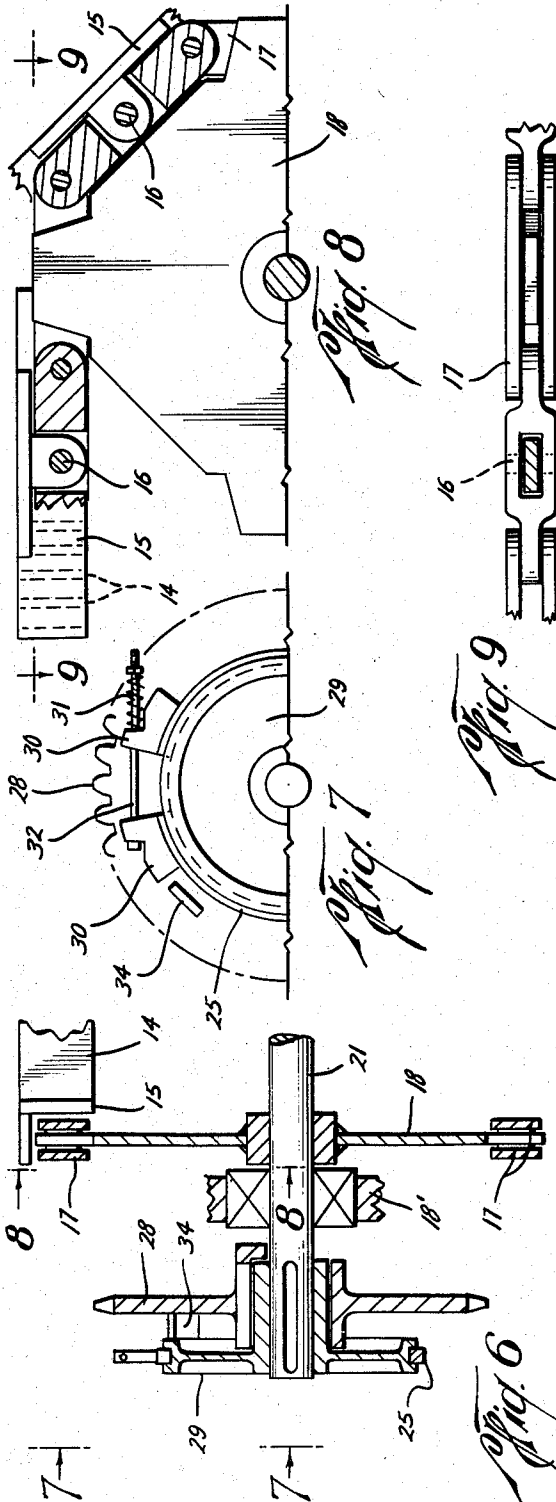
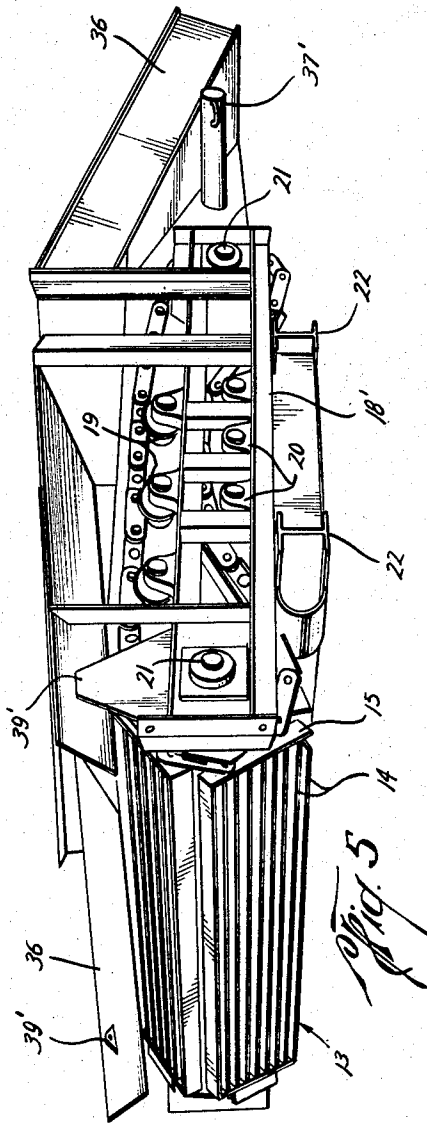
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DRAGLINE DITCH PADDER ATTACHMENT

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Filed Oct. 18, 1957, Ser. No. 691,020

8 Claims. (Cl. 37—144)

This invention has to do with an evacuation backfilling operation whereby an object to be buried underground is protectively encased within a padding or cushioning layer of fine earth particles.

A subterranean cross-country pipe line as commonly installed for transmission of liquids or gases consists of a succession of steel pipe sections welded in end to end continuity and coated with bitumen or other corrosion resistant material within a paper or other wrapping, and in the construction of a pipe line the coated pipe is lowered to the floor of a prepared open trench and is then buried by backfilling the diggings. Depending on subsoil depth in any given region, the excavated earth often contains large and heavy stones or hard chunks of rock whose return to the trench can damage the pipe and the effectiveness of its relatively soft coating sheath which can become dented or scored through impact often concentrated by small areas of contact of falling boulders dropping with force against the pipe.

It is an object of the present invention to provide for preservation against injury of a subterranean conduit during and after its entrenchment by first returning to the trench the small soil particles to serve as a padding around pipe laid on a trench bottom and screening off the larger pieces for later deposit on top of the soil padding or pipe protective overlay. The finer soil padding not only saves the pipe against stone impact but also insures against surface scrubbing of hard rocks such as might scratch and dig through the protective covering under load and relative movement incident to pipe line creep from temperature change or other disturbance after installation.

A further objective of the invention is to provide screening equipment especially adapted for use with a conventional dragline normally employed for backfilling operations and which equipment is conveniently and adjustably suspended as a unit assembly with the dragline boom and is variously positionable in relation to the boom for customary operational performance of the dragline bucket including the transfer of spoil into a trench with the optional placement of the screening equipment to straddle the trench and receive spoil from the bucket and for dropping smaller dirt particles downwardly directly into the trench in padding relation to the pipe and for sifting out and depositing rocks, boulders and broken shale on the ground beside the open trench and opposite to the spoil bank.

Another object of the invention is to provide a compact dirt and stone separating unit having a power driven grid assembly arranged for circuit travel across a trench at a low height in relation to an adjacent spoil bank and in the operating path of the drag bucket so that spoil can be quickly transferred with little or no requirement of power expenditure for high elevation of the spoil and which traveling grid shakes down and permits loose dirt and sand to drop out by gravity and form a cushion around the pipe line while larger pieces are held back and carried beyond the trench area in temporary storage until the pipe line is sufficiently overlaid with loose soil.

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A still further object of the invention is to provide a traveling separator with a power drive incorporating a torque limiting or slipping clutch which disengages drive transmission in response to overload or resistance above a given value so as to guard against breakdown should the traveling conveyor grid become bogged or jammed.

Other objects and advantages will become apparent during the course of the following specification having reference to the accompanying drawings wherein Fig. 1 is a side elevation of the backfilling mechanism in operative relation to a trench and pipe line shown in section; Fig. 2 is a top plan view showing the parts of Fig. 1 with the suspension boom omitted for clarity; Fig. 3 is a side elevation of a fragment of the boom with the separator unit suspended in a full line raised position suitable for transit of the dragline and in a broken line alternate position suitable for dragline bucket operation without the functioning of the separator unit; Fig. 4 is a perspective view showing the rear and one side of the separator unit suspended from the pivoted dragline boom; Fig. 5 is a perspective view of the separator unit showing its discharge end and the side opposite to that of Fig. 4; Fig. 6 is a fragmentary transverse section illustrating a slip clutch drive for the traveling grid; Figs. 7 and 8 are elevations on lines 7—7 and 8—8 respectively of Fig. 6; and Fig. 9 is a top plan of a drive chain fragment as viewed on line 9—9 of Fig. 8.

The dragline shown in the drawings has the usual cab 1 housing the operator's control station and the power plant and transmission mechanisms and being mounted to swing about a vertical axis on the supporting frame 2 having traction treads 3 of the endless crawler type for self-propulsion of the dragline as a whole. Mounted to swing with the cab 1 is an outwardly projected boom 4 in the form of a box section and latticed structural steel beam usually made up in sections and pivotally joined at one end to the cab by a fulcrum pin 4' providing a horizontal axis about which the free end of the boom 4 can be swung in a vertical path as controlled by standard power drum and cable connections 5. Another power transmitting drum connected cable 6 is entrained over a sheave 5' at the free end of the boom 4 and is terminally harnessed to a drag bucket or scoop 7 to suspend and guide the same and to draw the bucket outwardly away from the cab 1. Forwardly projected arms on the bucket 7 are bridled to a pull cable 8 running back to still another windup drum in the cab 1.

For backfilling as heretofore performed with such conventional dragline structure, the dragline rides on the ground alongside the previously dug trench 9 and opposite to the spoil bank or continuous pile 9' of excavated dirt and the cab 1 is swung to place the boom 4 across the ditch for guiding the path of the scoop bucket 7 as it is reeled in and out for successive bites into the spoil bank 9' and the return of the excavated earth over the conduit 10 bottomed in the trench. Boulders and rocks in the spoil drop indiscriminately into the hole and are liable to strike and often damage the pipe. To decrease the likelihood of injury by screening out the large bulky spoil components, at least in the initial return of the spoil and until after the small dirt particles have dropped around and afforded a protective padding for the pipe, it is here proposed to employ a power driven riddle or separator unit for co-operation with the dragline, as will now be explained.

A preferred but not necessarily the only embodiment of the separator unit consists of a perforate bed plate or grid having sized openings of selected dimension and being arranged to bridge the trench in co-operative relation with the dragline bucket 7 for reception of bucket transferred spoil and the screening out from loose dirt and sand drippings of those pieces which are in excess

of the size of the grid or riddle openings and which screened out pieces drop off of the grid end remote from the spoil bank to the ground beyond the trench and on the side opposite that of the spoil bank. Thus, as best seen in Fig. 1, a row of separated boulders is indicated at 11 and a covering of soft earth padding the pipe is indicated at 12.

To assist and accelerate gravity separation and to enable placement of the entry end of the grid close to the ground level of the spoil bank, the grid is made up of a number of long and narrow sections 13 in side by side succession throughout an elongated endless loop of low over-all height and for circuit travel with the upper reach moving away from the spoil receiving end of the loop assembly. Relative travel imparted to the grid sections 13 causes loose dirt to spread and shake through the openings for building up the padding 12 and conveys the screenings to temporary storage at 11 on the ground beyond the trench.

To withstand wear and heavy loading, each grid section 13 consists of a number of spaced apart steel straps or bars 14 (see Figs. 6 and 8) set on edge and welded at opposite ends to side supporting angle irons 15. Co-regions of the two side irons 15 and are pivotally received within openings of adjoining links of a pair of transversely spaced endless drive chains 17 for travel in an elongated loop circuit having upper and lower reaches interconnected by opposite end return bends entrained on sprocket wheels 18 which are rotatably carried by a main frame 18'. Between the opposite end sprockets 18—18 the upper chain reaches (see Fig. 5) extend and are supported on straight lines by a series of frame bracketed guide rollers 19 and for vertical compactness and a height reduction the lower chain reaches are centrally humped or arched upwardly to run in close parallelism with the upper reaches and are guided by a set of supporting rollers similar to those shown at 19 and mounted in frame brackets 20. In the straight reaches of chain travel the grid sections 13 are held against tilting from a common plane by engagement of the chain links with lateral flanges of the side angle irons 15 fore and aft of each trunnion pin (see Fig. 8) and there is sufficient clearance provided between the parts to accommodate a relative tilting of individual grids as they negotiate the bends or curved portions of the path of the chain at each return bend.

Alternate links of each chain 17 receive grid trunnions 16 and the remaining or intervening links are for interlocking reception of the teeth of the end sprockets 18. Only one pair of end sprockets needs to be driven but the sprockets of each set are preferably keyed for unison rotation to a transverse shaft 21 supported in the main frame assembly 18'. The frame assembly 18' for the traveling grid includes a pair of spaced apart and transversely extended I-beam girders 22 located partly within the space saving clearance under and afforded by the upwardly humped lower reach of the chain grid assembly. The bottom flanges of the I-beams 22 are located below the remainder of the separator unit and constitute bearings or runners when the unit is rested on the ground. To one side of the unit, as seen in Fig. 4, the bottom runners 22 project laterally beyond the side members of the frame assembly 18' where they carry a power plant 23, such as an internal combustion engine, for supplying motive power for driving the traveling grid and also hydraulic pump mechanism 49 which controllably effects the suspended and adjusted position of the unit, as will be described.

Engine drive to the traveling conveyor grid can be through any standard mechanical or hydraulic transmission system, such as the usual clutch and selective speed gear box indicated at 24 in Fig. 4. A belt drive connects the output shaft of the transmission 24 with the input shaft of a gear reduction unit 26 whose output shaft is drive connected by a chain 27 with a driven sprocket

28 rotatably journaled (see Fig. 6) on one of the shafts 21. Beside the sprocket 28 and keyed to the shaft 21 for solid connection with one set of conveyor drive sprockets 18, is the hub of a drum 29 around which is circularly fitted a split band 25 preferably faced interiorly thereof with friction lining for releasable clutching engagement with the drum. The adjacent ends of the split band 25 have terminal brackets 30—30 which are yieldably urged together by a coil spring 31 bearing at one end on one of the brackets and at its opposite end on an adjustable nut carried by a bolt 32 which is anchored with the other bracket and projects through the spring and both brackets. Bolt and nut adjustment will vary spring compression and enables clutch wear take-up. Spring force is set so there is a frictional drive normally present between the band 25 and the drum 29 but there can be slippage in the event of overload. A lateral lug 34 is fixed on the spring 28 and is arranged to bear on one of the brackets 30 and rotation of the sprocket 28 ordinarily carries with it the clutch drum 29 in the absence of a load in excess of clutch frictional engagement with the drum for imparting circuit travel to the chain and grid assembly. Resistance to travel such as might result from torque overload or jamming of a stone between the relatively moving parts, will cause slippage of the frictional surfaces on one another and discontinuance of drive until the difficulty is remedied.

To facilitate sweep of spoil by the bucket 7 to the leading or entry end of the separator grid, a collecting or gathering apron formed of steel plate or heavy sheet metal is mounted on the frame 18' and comprises a ramp or upwardly inclined floor 35 ending in the region of the start of the upper grid reach and having upstanding side boards or funnel walls 36 which close in the sides of the apron 35 and extend on back as retaining risers throughout the length of the traveling grid, as seen in Fig. 2. For co-operation with the action of the dragline bucket, the separator unit can be positioned across the trench and approximately in alignment with the path of the bucket and lowered so that the mouth of the gathering apron 35 rests in or adjacent the ground beside the spoil bank. The material transferred onto the traveling grid will, according to its size, either sift into the trench or be moved to the opposite side of the trench.

In order to tie the separator unit as an assembly with the boom 4 for travel with the dragline and for variously positioning the unit to fit the work in hand, an adjustable suspension system is illustrated as including a flexible variable length cable 37 suspended from the boom and tied to opposite ends of a frame bar 37' at the loading end of the separator unit and a pair of transversely spaced and universally swinging rigid struts or arms 38, each pivotally connected at opposite ends to the boom 4 and to the tail end of the separator unit. At their lower ends the struts 38, depending from opposite sides of the boom 4, terminate in eyes or hooks at 39 which interfit and are loosely engaged with mating eyes or hooks fixed at or formed in the upper ends of frame brackets 39' at both sides of the separator unit. Each strut 38 at its upper end has a number of longitudinally spaced apart sets of openings 38' any one of which can be selected, according to desired effective strut length, for reception of a pivot pin 40 carried by the forked end of a gudgeon pin 41 extending on a horizontal axis transversely of the boom and pivotally mounted in a boom carried bracket 42. The axes of the pins 40 and 41 are normal to each other and provide a universally jointed mounting for the upper end of each strut and a similar universal joint action is afforded by the lower strut connection 39 with the separator unit. Accordingly, the rigid struts can be swung in all directions in accommodating certain relative adjustments of the separator unit. To effect such adjustment, power shiftable motors are used, one for each strut, and each, by way of example, is a pressure fluid cylinder 43 and piston rod 44

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universally jointed at opposite ends; as at 43', to the boom and at 44' to the strut in spaced relation with the upper suspension pin 40. A similar power cylinder 45 is fastened at 45' to the boom 4 and has its piston rod 46 connected to an intermediate portion of the flexible cable 37 from which the two lengths of cable extend around sheaves 47-47 and downwardly on opposite sides of the boom for detachable connection through an adjustable chain with the fastening bar 37' near the entrance mouth of the separator unit.

Because of the flexibility and variable length of the suspending cables 37 and the universal joint mountings of the swingable struts 38, relative actuation of the several power cylinders will enable the separating unit to assume a wide number of different positions relative to the boom. Thus the swinging of the struts in unison parallel relation or through equal arcs between opposite limits to and from the cab 1 will maintain the longitudinal axis of the separating unit in parallelism with boom direction and place the separator at any selected distance from the cab within the operating range of the power cylinders. Additional controlled operation of the power cylinder 45 will raise or lower the front or entrance to the grid. Location of the separator unit in relation to the ground can further be varied by raising or lowering the boom itself. In some instances the tractor treads 3 will be closer to the open trench than in other situations but the separator by adjustment of its suspension connections can be set easily in relation both to the spoil bank 9' and the open trench 9. Swinging movement of the two struts 38 relative to one another or to different distances will guide the separator to an oblique or canted position in relation to boom projection. Thus, as viewed in Fig. 2, the separator unit has its longitudinal axis normal to the axis of the pipe line but relative swinging adjustment of the boom and/or the struts 38 could cant the separator unit from the position shown to one side or the other, and which may be desirable at times to fit the dirt receiving mouth in better alignment with an increment of the spoil bank to be picked up.

When transporting the dragline from place to place, the separator unit preferably is brought up fairly close to the boom 4 and the boom is lowered for clearance travel purposes. For bringing the unit close to the boom, the piston rods 44 and 46 can be retracted toward their limit, somewhat as shown in Fig. 3, by full lines. Piston rod projection can effect a disposition of the separator unit somewhat as shown by dotted lines in Fig. 3, wherein the separator unit is shifted back and out of interference with the path of the drag bucket 7 and the drag bucket can easily be used independently of the separator and without the bother of completely disconnecting the separator unit from the boom. In the event such independent bucket use is to be for a prolonged period, the suspension connections may be easily detached from the boom and the unit left resting on the ground or taken to a storage area for later reassembly and use.

Hydraulic or pneumatic power for selective actuation of the piston cylinder motors is supplied through a system of flexible hoses, fragments of which are indicated generally at 48, joining each cylinder with an engine driven pump or compressor 49 through a control box 49' located at the operator's station in the cab 1 and comprised of a bank of hand valves for governing delivery and relief of pressure fluid at opposite ends of the respective power cylinders for their responses individually to any desired degree and relation. The pump 49 can be driven from a power take-off device interposed between the engine clutch and the variable speed transmission unit and the pump can be driven either independently of or concurrently with the operation of the traveling grid 13.

In the contemplated use, when padding a pipe line is desired in a trench backfilling operation, the dragline is brought up to ride on the ground a short distance

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from the trench on the side opposite to the spoil bank and is progressively propelled to succeeding settings for transferring incremental lengths of spoil. Such increments would correspond approximately to the width of the loading apron 35 and Fig. 2 indicates by a succession of crossed lines a series of neighboring incremental lengths of spoil bank. At each setting the separator unit is lowered or brought close to the ground in trench bridging relation and is adjusted to the spoil bank by manipulating the station controls and/or the position of the boom horizontally and vertically. Generally the longitudinal axis of the separator unit will extend in the same direction as the boom outboard direction across the trench but the separator can be set in an angled position to either side by relative swing adjustment of the struts 38 as accommodated by flexing of the cable 37 and its chain length adjustment.

Operation of the drag bucket 7 through the spoil bank and apron 35 will carry and deposit a quantity of spoil onto the power driven grid, whose continuous travel spreads out the delivery and allows the smaller particles to fall down into the trench and concurrently carries the screenings across the trench for drop off at the return bend of the loop. The separation action can continue at each location until all spoil within the operating path of the bucket has been transferred, or it may be discontinued by lifting the separator unit after a given height of padding cover is laid in the trench and then transferring the rest of the spoil directly into the trench without screening. Flexibility of adjustment will permit backfilling from two or more length increments of the spoil bank upon swinging of the boom and its suspended parts with the cab about its vertical axis and without driving the traction treads to change the ground position of the dragline. Dragline position change will be effected whenever all the spoil bank within convenient reach of the bucket has been disposed of. Screened out boulders and stones laid aside, as at 11, can later be pushed into the trench above the padding by separate use of a bulldozer although optionally after each new position of the dragline has been effected, its boom can be swung with the cab to project rearwardly beside the trench and with the separator unit shifted out of interference with the drag bucket 7, the bucket can be employed to transfer screenings into the top of the trench above the previously returned dirt padding.

In compliance with the statute, only a preferred embodiment of the invention has been described in detail but the invention is unlimited in scope except as set out in the appended claims.

What is claimed is:

1. In combination with a dragline having a dirt bucket and a guide boom therefor, of a dirt separator unit for operating on dirt transferred thereto from the bucket and means suspending the separator unit from the boom including a flexible cable connected to one end of the separator unit and a pair of transversely spaced apart struts, each having vertically spaced apart pivotal connections with the boom and the other end of the separator unit, a power actuator connected with the cable to vary its effective length between the boom and the separator unit and power actuators for connection one with each strut to swing the struts relative to one another.

2. In combination with a dragline having a dirt bucket and a guide boom therefor, of a dirt separator unit for operating on dirt transferred thereto from the bucket and means suspending the separator unit from the boom including a flexible cable connected to one end of the separator unit, rigid strut means having a vertically spaced apart pivoted connection with the other end of the separator assembly and with the boom, power means joined to the cable to change its effective length between said boom and the separator unit and power means for swinging said strut means.

3. In combination with a dragline having a boom and

a drag bucket suspended from the boom, of a separator unit adapted to straddle a trench and to receive dirt transferred thereto from said bucket and through which separator unit the smaller dirt particles drop downwardly into the trench and on which the larger dirt particles ride to the far end thereof beyond the trench and suspension means tying said unit under and as an assembly with said boom and including a pair of transversely spaced apart rigid struts pivotally connected at their lower ends with said far end of said unit and universally pivotally joined with the boom, a pair of power motors carried by the boom and connected with said struts for effecting relative swinging movement thereof and a power actuated flexible cable dependently suspended from the boom and connected with the other end of said separator unit.

4. In a separator unit adapted for co-operation with a dragline and for padding a trench contained conduit by excluding large spoil particles from direct return in the dragline backfilling operation, a main frame having suspension connection adapted to be joined to a boom of a dragline and positioned in the path of a drag bucket, a collecting apron supported by the frame at one end thereof, a conveyor having openings therethrough for passing smaller particles while the larger particles are retained on the conveyor, said conveyor being in the form of an endless loop mounted for circuit travel on the frame with the upper conveyor reach extended from the apron as a continuation thereof to the opposite end of the frame, power means carried by the frame and power transmitting connection between the power means and said conveyor to drive the latter for carrying and dropping the retained larger particles to said opposite end of the frame.

5. In a separator unit adapted for co-operation with a dragline and for padding a trench contained conduit by excluding large spoil particles from direct return in the dragline backfilling operation, a main frame having suspension connection adapted to be joined to a boom of a dragline and positioned in the path of a drag bucket, a collecting apron supported by the frame at one end thereof, a conveyor having openings therethrough for passing smaller particles while the larger particles are retained on the conveyor, said conveyor being in the form of an endless loop mounted for circuit travel on the frame with the upper conveyor reach extended from the apron as a continuation thereof to the opposite end of the frame, power means carried by the frame and power transmitting connection between the power means and said conveyor to drive the latter for carrying and dropping the retained larger particles to said opposite end of the frame and including a slip clutch which slips under conveyor travel load in excess of a selected value.

6. In combination, a mobile dragline assembly having an overhead boom projected outwardly therefrom and a boom guided dirt bucket, a dirt separator in the operating path of said bucket to receive dirt therefrom, means adjustably hanging said unit from the boom and comprising a pair of transversely spaced rigid suspension struts, universal swing joints connecting each strut at longitudinally spaced apart portions thereof to the boom and to the separator unit near one end of the latter, means forming a part of the suspension strut connection between the boom and the unit and accommodating variation in the distance between said one end and the boom and in the strut longitudinal direction, a pair of individually adjustable variable distance rods connected to the boom and to said struts respectively and operable to swing and maintain said struts in selected relative positions about their boom connected joints and flexible suspension cable means extending between the boom and the other end of the separator unit and operable to raise and lower and to maintain the position of said other end in all relative positions of the separator unit suspension by said struts.

7. In a mobile dragline, an outwardly projected overhead boom, a dirt bucket operably connected with the boom for travel beneath and in the longitudinal direction of the boom, a dirt separator unit for co-operation with said bucket, suspension connections dependently carried by the boom and joined to the separator unit to hang the same beneath the boom and as an assembly therewith and power means connected with said suspension connections and operable to adjust the same and thereby selectively shift the suspended position of the separator unit in directions longitudinally of and toward and from the overhead boom.

8. In a dragline as in claim 7, wherein said suspension connections include a number of hanger elements joined to the separator unit at longitudinally spaced apart regions thereof and said power means operates individually on the hanger elements for their independent adjustment relative one to another in shifting the position of the separator unit.

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