United States Patent

MacDonald

[15] **3,680,233**

[45] **Aug. 1, 1972**

[54] **CONTINUOUS EXCAVATING LOADER WITH PIVOTAL DISCHARGE CONVEYOR**

[72] Inventor: **Raymore D. MacDonald,** Hinsdale, Ill.

[73] Assignee: **International Harvester Company,** Chicago, Ill.

[22] Filed: **March 17, 1970**

[21] Appl. No.: **20,314**

[52] **U.S. Cl.** **37/108,** 37/8, 198/9

[51] **Int. Cl.** **E02f 5/00**

[58] **Field of Search**.....37/4, 8, 92, 89, 93, 108; 172/734, 744, 276; 198/9

[56] **References Cited**

UNITED STATES PATENTS

3,083,479	4/1963	Knight	37/126 A
3,507,060	4/1970	Gee et al	37/8
3,308,563	3/1967	Danek	37/8 X
2,696,289	12/1954	Lehman	198/9
2,851,143	9/1958	Rosetz	198/9
3,332,249	7/1967	Idoine	37/95 X
2,582,538	1/1952	Flynn	172/276 X
3,059,356	10/1962	Lorang	172/804
3,452,462	7/1969	Martin	37/126 R
3,392,464	7/1968	MacDonald	37/101
2,595,398	5/1952	Lewis	198/9 X
3,011,273	12/1961	Stumpf	37/8 X
3,391,776	7/1968	Hancock et al.	37/4 UX
3,523,699	8/1970	Sinkule et al.	172/311 X
3,272,559	9/1966	Haynes	37/8 X

FOREIGN PATENTS OR APPLICATIONS

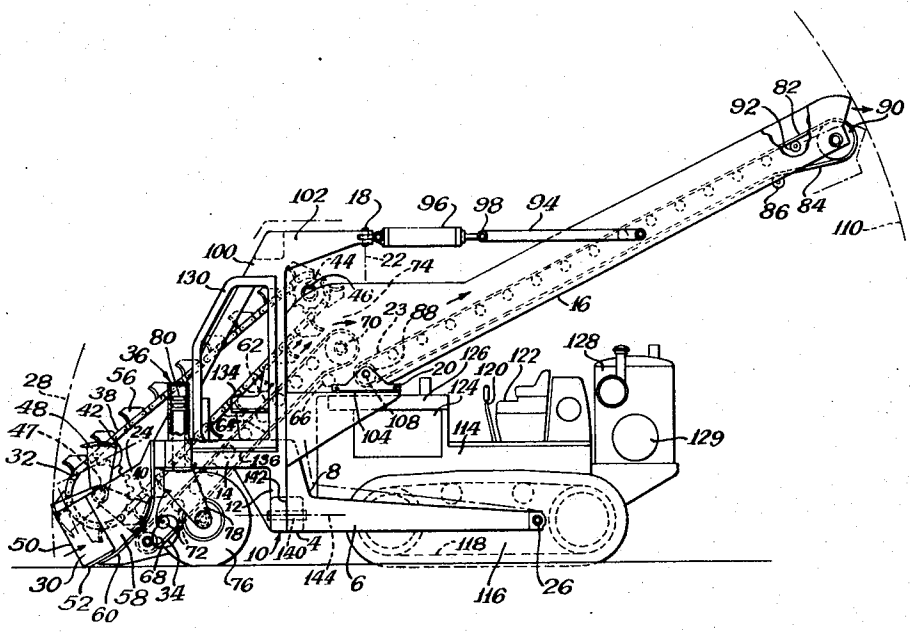
257,227	9/1967	Austria	172/276

Primary Examiner—Robert E. Pulfrey
Assistant Examiner—R. E. Suter
Attorney—Floyd B. Harman

[57] **ABSTRACT**

Tractor and front end continuous loader attachment for same to form continuous excavating vehicle comprising: a C-frame with legs thereon extending rearwardly; a front-mounted, mobile scraping frame secured with a fore and aft extending pivot to, and pushed by, the C-frame; a tractor included in the C-frame to push thereon by means of trunnions and in a position between the scraping frame and the ground; the scraping frame having a front-mounted elevator provided with a cooperating digger thereon, and having at the rear end a swivel conveyor effective for side discharge and provided with an inlet; an interconnecting conveyor on the scraping frame communicatively in tandem between the front-mounted elevator and rear mounted swivel conveyor; and independent wheel suspensions on the scraping frame differentially adjustable to tilt same. The vehicle avoids ponderousness of transport machines possessing large buckets such as the buckets commonly possessed by front end loaders, and the only storage capacity provided for is simply for the material currently in transit between the actual vehicle dig and vehicle discharge stations.

1 Claim, 2 Drawing Figures



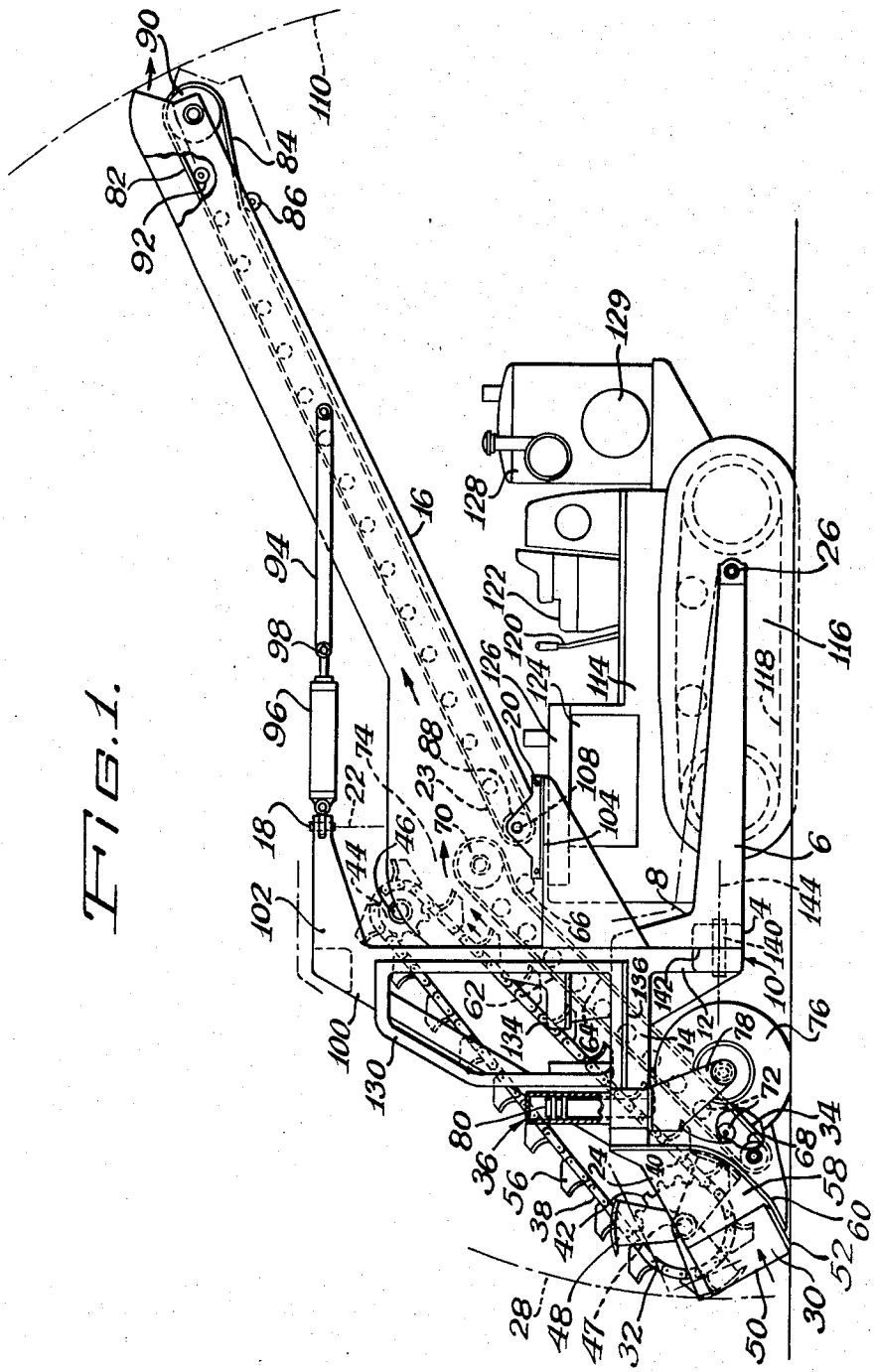


FIG. 1.

Inventor:
Raymore D. MacDonald
By John W. Haines
Atty.

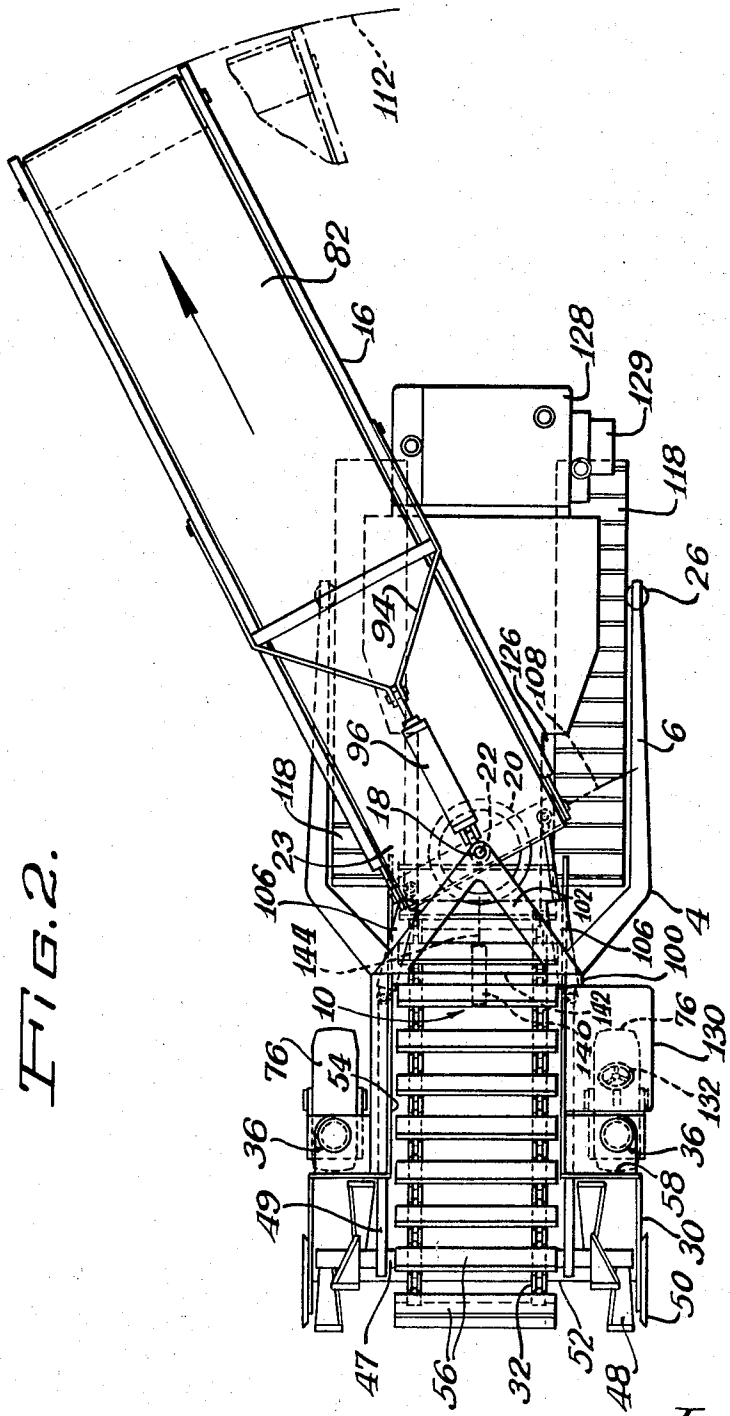


FIG. 2.

Inventor:
Raymore D. MacDonald
By John W. Gaines
Atty.

CONTINUOUS EXCAVATING LOADER WITH PIVOTAL DISCHARGE CONVEYOR

This invention relates to a tractor and a front end continuous loader attachment for same. It operates as a continuous excavating vehicle capable of continuously loading material being excavated thereby in situ, i.e., material being dug such as a stratum of earth being removed right from a proposed roadbed.

Machines employed hitherto for excavation are of two general types. For one, a cyclic type is used which is limited simply because it is not continuous. Some machines of that type operate on a scraping cycle whereby the scraper part or blade thereof loads a main bowl during a portion of the cycle, the rest of which is devoted to the carry, dump, and return portions of the cycle. Some, actually more analogous to the instant subject matter, are typified by a conventional tractor-mounted bucket loader. The operation of the loader is about as slow, because each cycle has sequential functions to dig, raise, carry, dump, and return, all as separate steps.

For the other, a bucket type employs a continuously moving series of excavating buckets. Some machines of that type have buckets on an endless chain as, for example, a trencher which digs ditches in a specialized way for laying pipe therein. Some carry buckets on a wheel and are used in pit mining and similar operations. But both bucket type machines are limited to a particular specialized operation or two which they do best, and are limited in their capacity to perform a continuous operation with sustained and uniform flow.

My invention materially reduces or substantially eliminates drawbacks such as the foregoing limitations, by providing continuous transfer of earth, in large volume, from a stratum to the bed of a hauling vehicle, as will now be explained in detail. While the uniqueness of the invention resides primarily in its handling of in-place earth, it has equal application in the continuous loading of material in various states, such as stock-piled sand, earth, gravel, and loose spoil.

Features, objects, and advantages will either be specifically pointed out or become apparent when, for a better understanding of my invention, reference is made to the following description taken in conjunction with the accompanying drawings which show a preferred embodiment thereof and in which:

FIG. 1 is a side elevational view (taken from the left side) of an excavating vehicle embodying the present invention; and

FIG. 2 is a view thereof in top plan.

More particularly, the central means to provide a front mounting for my loader attachment consists of a C-frame 4. The C-frame 4 is shown with legs thereon laterally spaced apart and extending rearwardly, and interconnected by a heavy, semicircular upstanding web 8. The web 8 has a flat vertically disposed front face forming a portion of a thrust bearing 10, the other portion 12 of which integrally depends from the rear of a base frame 14 of the attachment.

Rearwardly of the thrust bearing 10, the base frame 14 by means of a suitable support hereinafter described carries a so-called swivel conveyor 16, preferably cleated and secured to the support by a first mounting means comprising a vertical strut pivot 18 and a horizontally disposed anti-friction bipartite turntable 20 which are vertically spaced apart.

The spaced apart pivot 18 and turntable 20 define a common vertical axis 22 for the swivel conveyor, which axis passes downwardly through the center of the end of the conveyor which slopes diagonally forwardly and which forms a conveyor inlet 23 therefor.

A subframe 24 for scraping, which inclines diagonally rearwardly, has a fixed foremost position on the base frame 14.

By means of the trailing rear extremities of the C-frame legs 6, the base frame 14 of the attachment is connected to a hereinafter described tractor, by means of a spaced apart pair of side trunnions 26. The two trunnions of the pair defined a fixed transverse horizontal axis and the attachment undergoes up and down movement about that axis. The movement has a resulting vertical arc of swing.

The total range is between an unpivoted raised position illustrated in broken lines in FIG. 1 and a normal lower, solid line position into which the scraping subframe 24 is arranged to be pivoted, with a scraping portion thereof located below ground to dig out an in situ ground stratum.

SUBFRAME COMPONENTS

The subframe 24 is essentially a long straight housing carrying, as the four major components thereof, a full width digger scoop which extends clear across the front of the subframe, from one side to the other, a diagonally rearwardly inclined endless elevator 32, an interconnecting endless belt conveyor 34 (FIG. 1) preferably cleated and disposed below and parallel to the elevator 32, and a below-ground depth control means provided for the subframe and generally indicated at 36.

ELEVATOR 32

The endless elevator 32 on the subframe has undershot operation, i.e., rotates in the direction of the arrow, FIG. 1, and comprises oppositely moving upper drag chain flight 38 and lower drag chain flight 40 sections. Integral chain bights interconnect the two flight sections by wrapping around bottom and top sprockets 42 and 44 so as to keep both flights stretched taut between the sprockets.

A hydraulic motor powered shaft 46 drivingly supports the sprockets 44 at the top of the subframe 24 for rotation on a fixed transverse horizontal axis to maintain continuous undershot elevator operation. A shaft structure 47 in the mouth of and extending horizontally across the scoop 30 rotatably supports the bottom sprockets 42 on a center section of the shaft structure, and the shaft structure 47 at each end thereof carries several blades of an interrupted type auger 48.

The shaft structure 47 is supported on a floating mounting comprising a downwardly spring-loaded frame 49 (FIG. 2) which fixes the center to center distance between the respective powered shaft 46 and the shaft structure 47. The floating movement against the spring load is up and down about the fixed axis of shaft 46, enabling an intervening boulder in the scoop to temporarily upwardly displace the shaft structure 47 without breakage.

SCOOP 30

The digger scoop **30** at the mouth has transversely spaced apart sides **50** providing side cutting edges disposed in longitudinal vertical planes, and a scraper blade **52** presenting an intervening bottom cutting edge between the sides.

A relatively narrow throat **54** (FIG. **2**) at the rear of the scoop receives an up moving, endless succession of material pushers comprised of transverse cutting paddles **56** carried on the continuously moving chain of the elevator **32**. Some of the up-coming material into the scoop makes its entry centrally without change of direction. The rest enters at the opposite mouth sides **58**, which are lateral extensions curving along the arc **60** of a circle (See FIG. **1**). The continuously rotating blades **48** of the augers move the material from the sides medially to a point of confluence at which the paddles **56** change the direction of the material at right angles into a path inclining diagonally rearwardly.

INTERCONNECTING CONVEYOR 34

The interconnecting endless belt conveyor **34** has oppositely moving upper flight **62** and lower flight **64** sections. Supporting rollers for the flight sections consist of a belt take-up roller **66** near the top engaging the lower flight **64**, a lower roller **68** which idles, an upper roller **70** the shaft of which is hydraulically power-driven, and a row of support rollers **72** coextensive with and in engagement with the underside of the upper flight **62**. The upper flight **62** and the confronting lower drag chain flight **40** of the undershot elevator cooperatively discharge in the common direction of the diagonally rearwardly inclined arrows (FIG. **1**) through a discharge mouth **74** common thereto and rearwardly directed.

DEPTH CONTROL 36

For purposes of below ground depth control, the subframe **24** has identical left and right front caster suspensions provided with separate hydraulic jack control means, not shown, for the necessary independent extensible and retractive movements. Each comprises a rearwardly pivoted front caster **76**, a caster fork **78** carrying the caster in a diagonally downward and rear position, and a vertically disposed cylinder and piston jack **80** in the suspension. The piston or plunger in each jack is connected by the associated caster fork to the concerned caster suspension, and the cylinder outside of the piston is affixed to the base frame **14**, receiving the plunger for turning and sliding within the cylinder to afford relative vertical movement of the frame and relative turning movement of the caster wheel **76**. In effecting the vertical movement referred to, the stroke of the two jacks **80** moves the attachment in a preferable scoop range between about 12 inches below ground line, and about 24 inches above ground line for transport purposes and stock pile work.

SUBFRAME OPERATION

As the vehicle advances in a forward crowding operation, the digger scoop **30** continuously removes, depending upon the height set by the depth control, loose earth, in-place earth, stock pile earth, sand, or gravel. The material so removed is expelled generally horizontally rearwardly of the subframe **24** through the discharge mouth **74**.

SWIVEL CONVEYOR COMPONENTS

The swivel conveyor **16** is straight and has oppositely moving upper flight **82** and lower flight **84** sections of an endless belt. The supporting rollers for the belt consist of a take-up roller **86**, a lower roller **88** which idles, an upper roller **90** the shaft of which is hydraulically power driven, and a row of support rollers **92** against the underside of and coextensive with the upper flight **82** of the belt. A conveyor connected fork **94** and a strut-pivot-connected hydraulic cylinder **96** have a pin interconnection **98** and provide an adjustable universal jointed two axis cantilever support for the swivel conveyor **16**.

A spaced-apart pair of upright side frames **100** on the base frame **14** provides support for the strut pivot **18** at the apex of a horizontal V-shaped cantilever frame with front legs **102** each extending forwardly and outwardly to one side of the vehicle and connected to the upright side-frame **100** at that side. Two double-acting conveyor swiveling cylinders **106** (FIG. **2**) are connected between the underside of the swivel conveyor **16** adjacent the inlet **23** of the latter and the two side frames **100** to turn the turntable.

SWIVEL CONVEYOR OPERATION

The strut-pivot-connected hydraulic cylinder **96** swings the conveyor **16** about a conveyor horizontal axis **108** (coaxial with lower roller **88**) in vertical arcs such as the conveyor vertical arc **110** as shown in FIG. **1**. The swivel cylinders **106** cooperate as indicated in turning the conveyor **16** about the vertical axis **22** so as to swing in generally horizontal planes in arcs such as the horizontal arc of movement **112** shown in FIG. **2**.

The upper flight **82** of the belt has a speed preferably about 600 ft. per minute and discharges the material in the direction of the diagonally rearwardly inclined arrow for free fall thereafter.

TRACTOR

Due to placement of the C-frame arms **6**, the tractor is an outside arm loader having a longitudinally disposed body **114**. In addition to the trunnions **26** carried at the sides, the body **114** carries two track frames **116** disposed one at each side and each carrying an endless track assembly **118**. The operator, not shown, has proximal steering-by-driving controls **120** adjacent his knees and sits on an operator's seat **122** at the rear of the tractor.

The design illustrated is a front-end tractor with an engine **124** in the customary place covered by a generally horizontally disposed hood **126**.

The design is for a so-called hydraulic loader. The hydraulic system and the pumps, motors, and valves therein are all conventional, and for the most part are omitted for simplification's sake. A rear mounted loader engine **128** behind the operator and fuel tank of the tractor is preferably of about 200 horsepower rating and drives all of the pump means generally indicated at **129** in the hydraulic system.

CAB AND CONTROLS

In actual excavating, the operator's station used is in the general area of, and above, the left front caster wheel **76** (FIG. **2**).

And in that connection, an advantageous feature present is that the wheels in turn are located immediately back of the cutting edge of the scraper blade **52**. Another feature is that the only storage capacity provided on the vehicle is the material in transit; no material is collected for transporting as a batch, such as commonly done in existing transport devices like scraping and transporting vehicles.

As more particularly provided at the operator's station, an enclosed cab **130** houses a control wheel **132** (FIG. **2**) for remote hand-steering of the vehicle by driving. A driver's seat **134** is supported by the cab to the rear of the control wheel, and the cab is suitably supported on an out rigger platform **136** (FIG. **1**) carried by the base frame.

THRUST BEARING

For accommodating to twists in the ground surface **138**, the thrust bearing **10** includes a fore and aft extending center pivot **140** about which the lubricated interfaces **142** of the thrust bearing relatively roll on the longitudinal axis **144** of the pivot.

OVERALL OPERATION

In a working operation, such as doing scraper work for example, the vehicle slowly moves straightaway toward the beginning point in a line of scrape desired. At that point, hydraulic fluid flow being appropriately exhausted therefrom causes the jacks **80** to simultaneously foreshorten as the vehicle continues slow movement forwardly. The jacks **80** are stopped at the right amount of extension, and the ground surface **138** is scraped in situ to a depth down to approximately 12 inches if desired. A scraping capacity of preferably 25 to 30 cu. yd. of material per minute is preferred.

Traction and stability are important features hereof, provided by the tracks **118** (FIG. **2**) of well known large flotation and traction capacity. A 60 inch belt width for the swivel conveyor **16** is preferable, and material is loaded therefrom to the body of either a highway vehicle or an off-road vehicle, located to either side of the continuous excavating vehicle or to the rear thereof. The vehicle being loaded proceeds at the rate of movement of the continuous excavating vehicle in an adjacent position paralleling the movement and in the indicated location at the rear or either side.

The crawler tractor is freed for other work by blocking up the rear extremities of the C-frame arms **6**, disconnecting the arms at the trunnions **26**, and backing out the tractor from beneath the conveyor **16** and from between the arms **6**. Manifestly, it is a fact that the cylinder pivot point at **18**, the conveyor turn point at **22**, and the front engine **124** are vertically spaced apart and generally aligned on the common upright axis **22**. It is a further fact that the cantilever support table **104** is supported by the base frame **14** and side frames **100** in non-contacting relation at all points to the hood **126** and other parts of the tractor.

The vertical clearance is essential, but is not a constant size. Differential vertical movement of the caster wheels **76** by the control means previously indicated tilts the attachment about the fore and aft extending pivot **140** deliberately causing the attachment to be relatively higher at one side when the swivel conveyor **16** is at or to be laterally swung to that side of the tractor. Allowance is thus made for weight transfer of the swivel conveyor. In the illustrated example of the rightwardly swung position of the swivel conveyor **16** as shown in FIG. **2**, the right side of the attachment is made higher by extending the right front caster wheel **76** farther than the left front caster wheel **76**.

The caster wheels **76** function to enable the attachment to pivot about a vertical axis down through and defined by the crawler tractor as it turns due to being steered by the operator. That is, the structure conforms in its turning to the turn axis defined by the tractor depending upon its oppositely moving tracks and the relative speeds at which the tractor is driving them.

Variations within the spirit and scope of the invention described are equally comprehended by the foregoing description.

What is claimed is:

1. Front end continuous loader comprising:

a C-frame with legs thereon laterally spaced apart and extending rearwardly;

a mobile scraping frame secured by a center thrust bearing (10) to, and pushed by, the C-frame; said scraping frame inclining diagonally and rearwardly from a lower forward end, which is normally below ground, to an upper end;

said center thrust bearing defining a fore and aft extending pivot and including a flat vertically disposed front face formed on the C-frame;

a mutually confronting flat portion depending integrally from the rear of the scraping frame;

said fore and aft extending pivot (140) pivotally joining said face and portion on a single axis for relative movement between the C-frame and scraping frame;

lubricating interfaces (142) on the mutually confronting flat face and flat portion to limit relative movement to rolling motion about the single axis (144);

a tractor between the legs of the C-frame, and beneath the scraping frame at a point intermediate the ends thereof and supporting the scraping frame for up and down movement about a generally horizontal axis passing through the rear ends of the C-frame legs;

an elevator on the scraping frame provided with a cooperating digger at said lower forward end of the scraping frame;

a first endless conveyor effective for side casting, having an inlet and having adjacent said inlet means connecting the conveyor to the scraping frame to afford swinging movement of the conveyor from medially to laterally of the tractor to effect the side casting;

an interconnecting conveyor on the scraping frame having an endless belt substantially coextensive with the elevator and communicatively in tandem between the digger and the first conveyor inlet; and

independent wheel suspensions on the scraping frame carried so that each one is adjacent but behind one side of the digger, and having power means whereby the suspensions are differentially adjustable to tilt the frame about said fore and aft extending pivot so that the frame is relatively higher at one side when the first conveyor is at, or to be laterally swung to, that side of the tractor.

* * * * *