May 14, 1957 D. M. SCHWARTZ 2,792,140

MATERIAL HANDLING MACHINE

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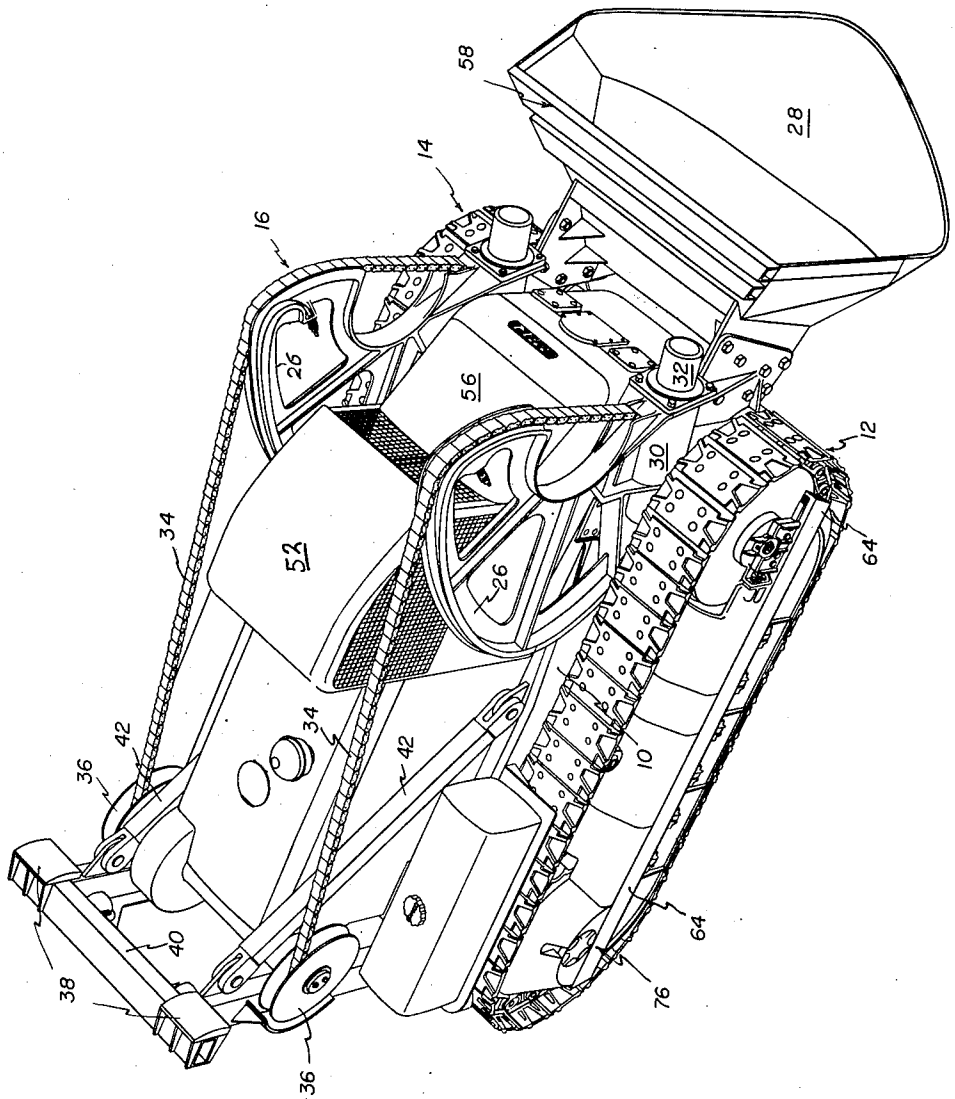


Fig. 1.

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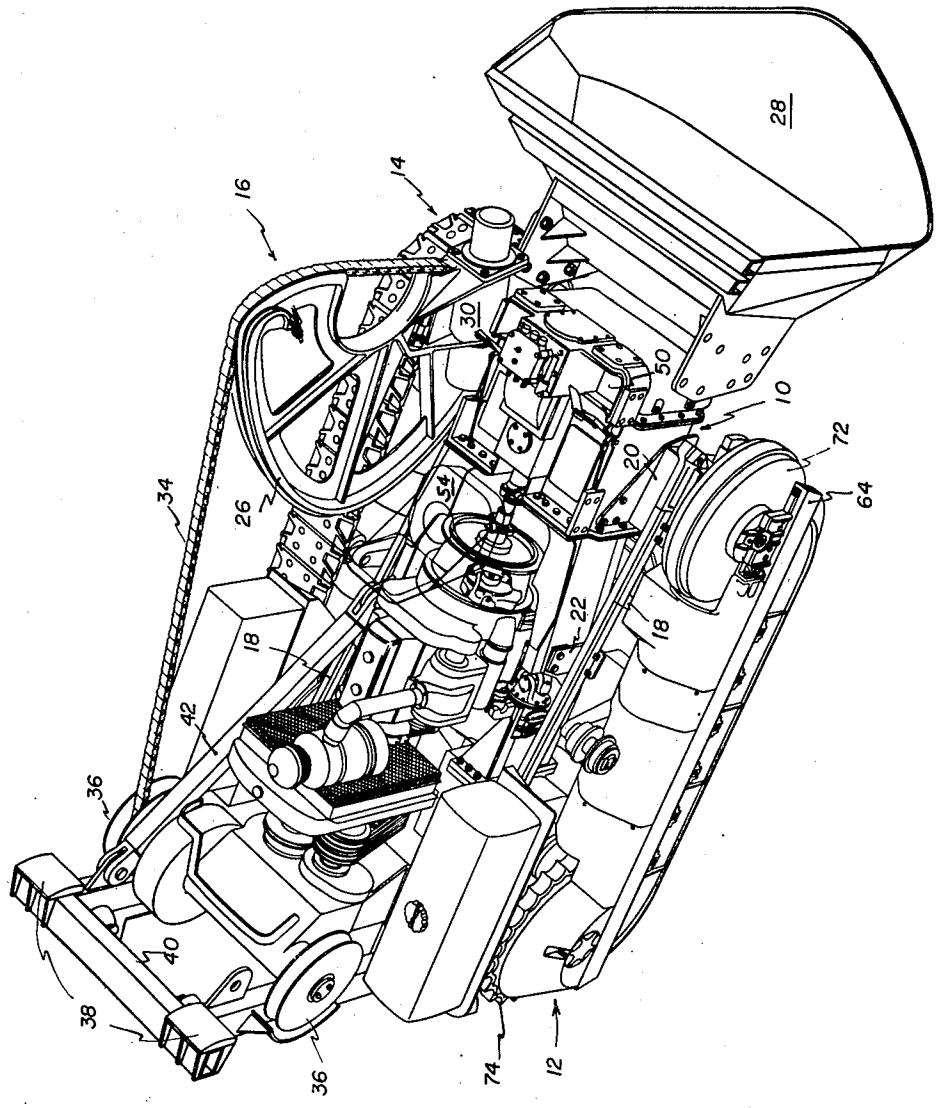


Fig 2.

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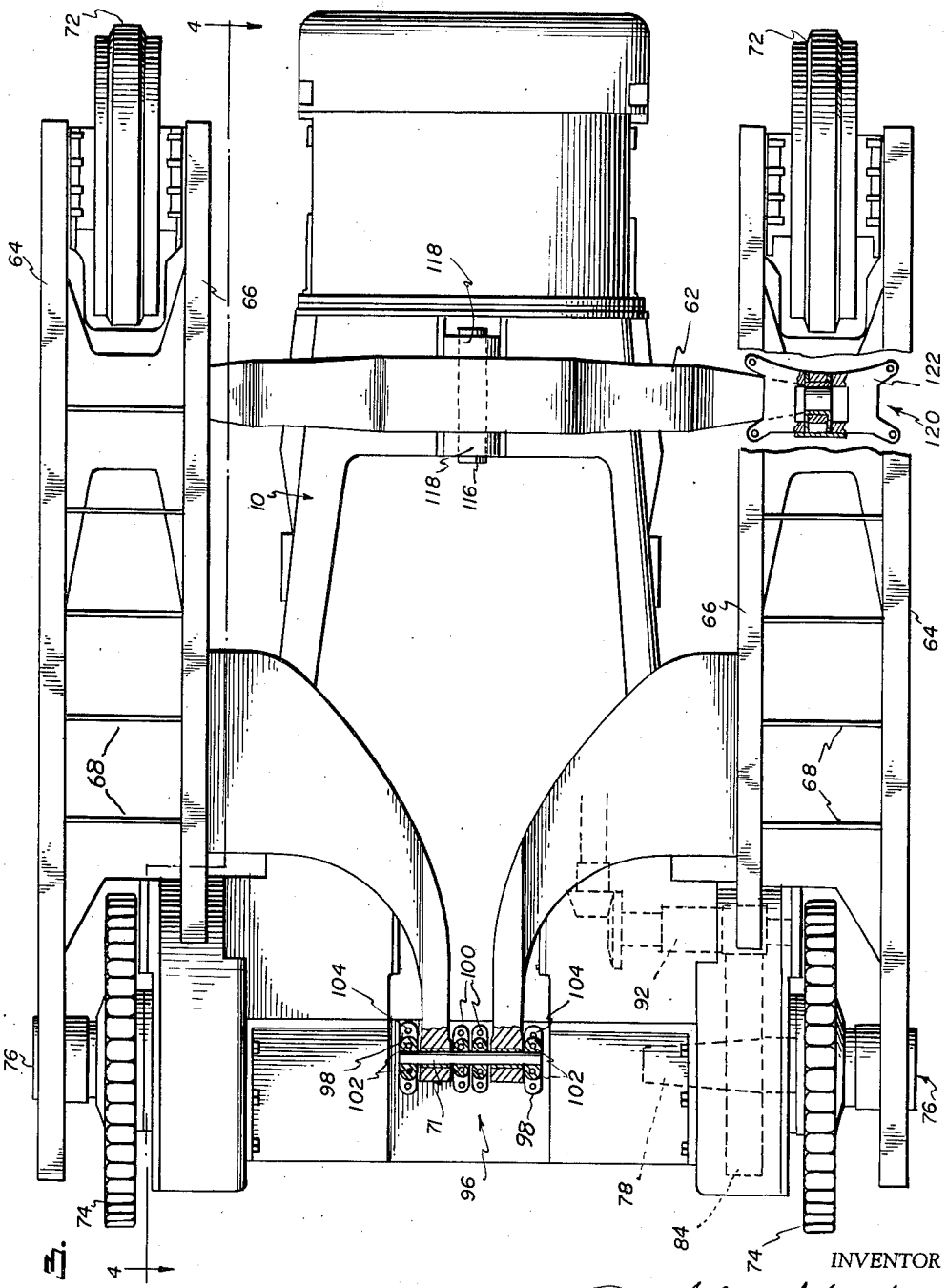


Fig. 3.

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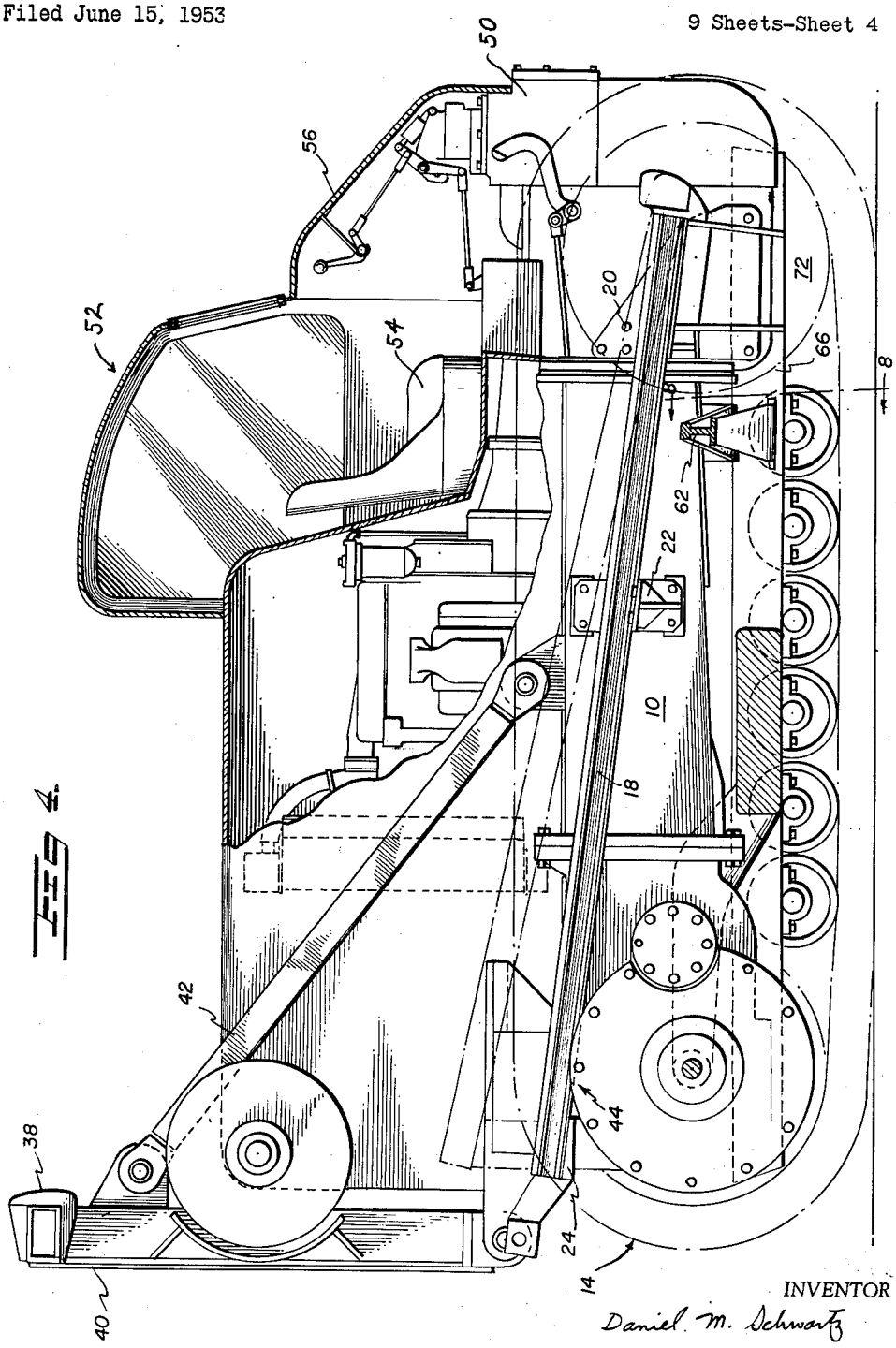


Fig. 4.

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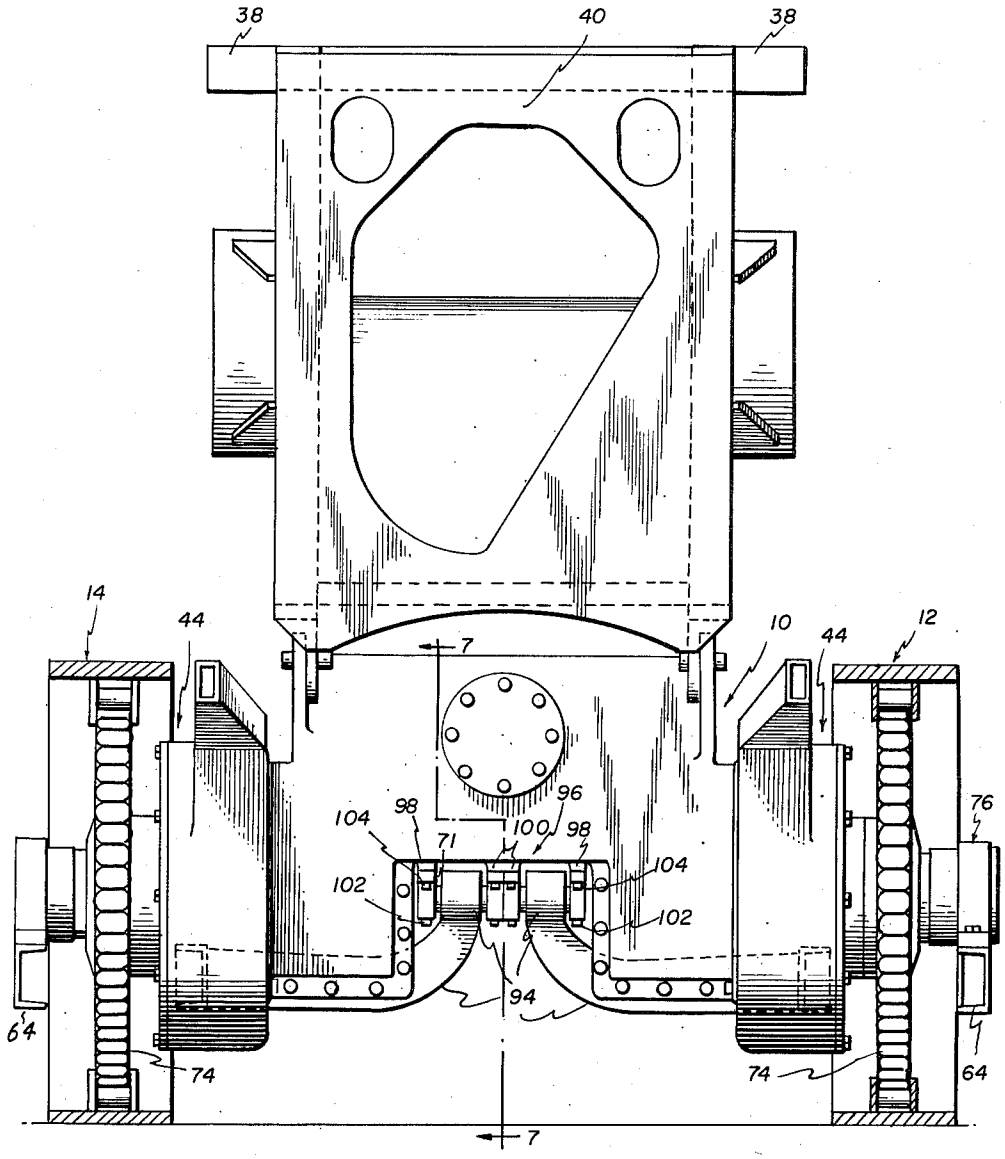
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Fig 5.



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Fig 6.

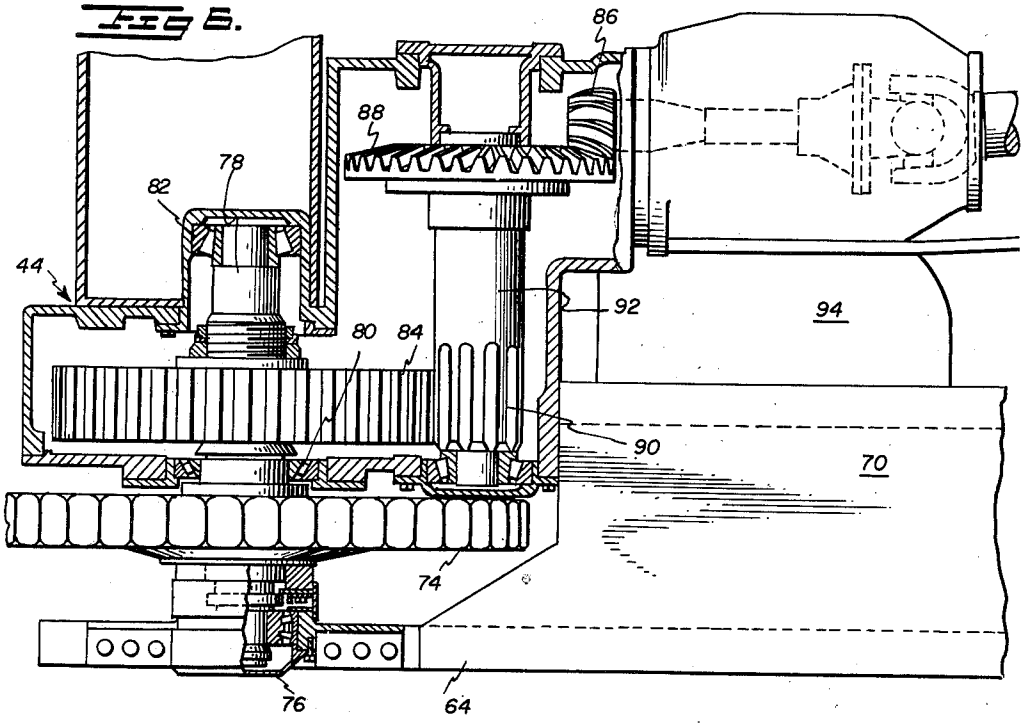
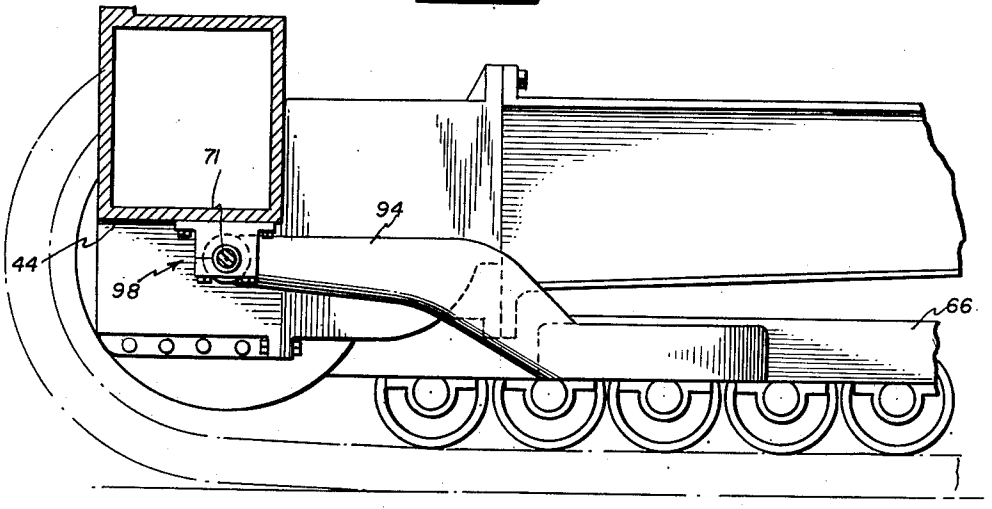


Fig 7.



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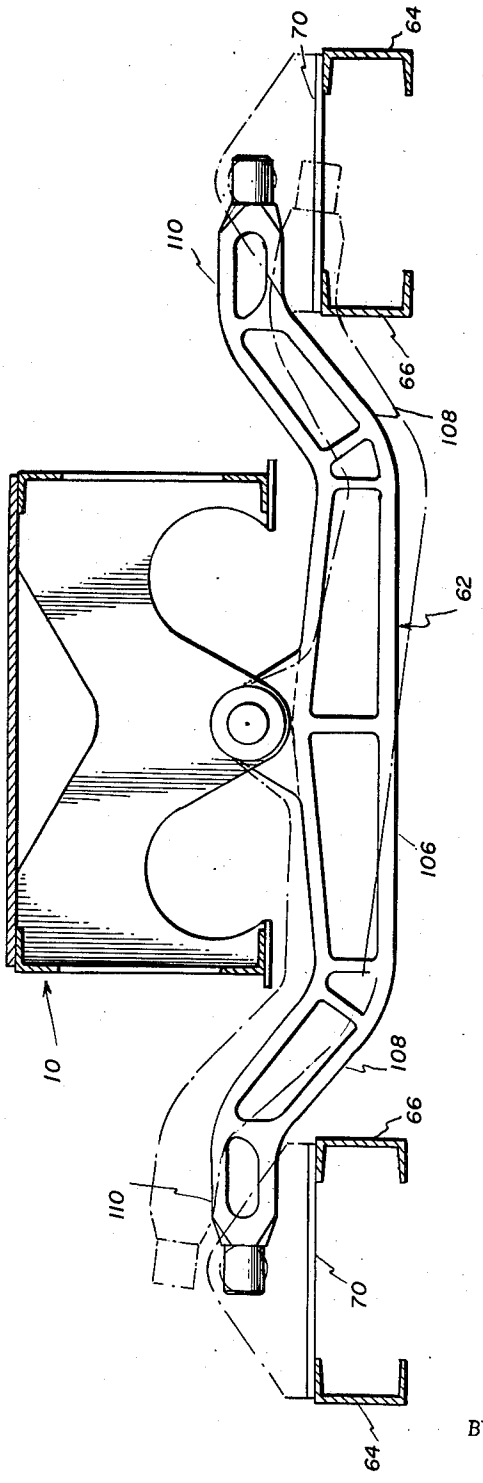


FIG. 8.

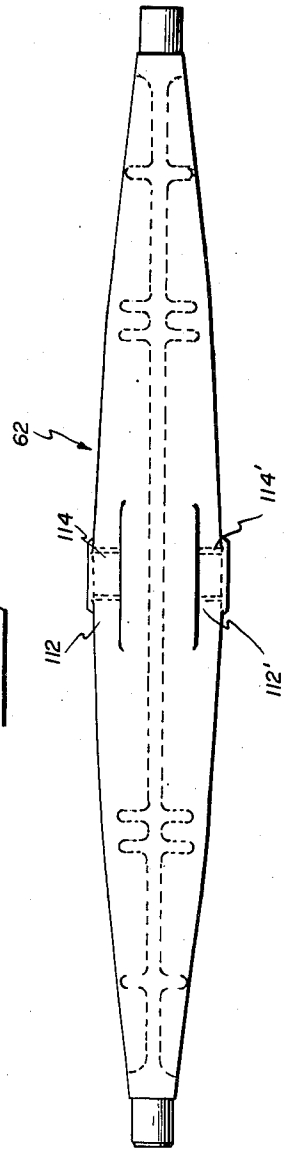


FIG. 9.

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MATERIAL HANDLING MACHINE

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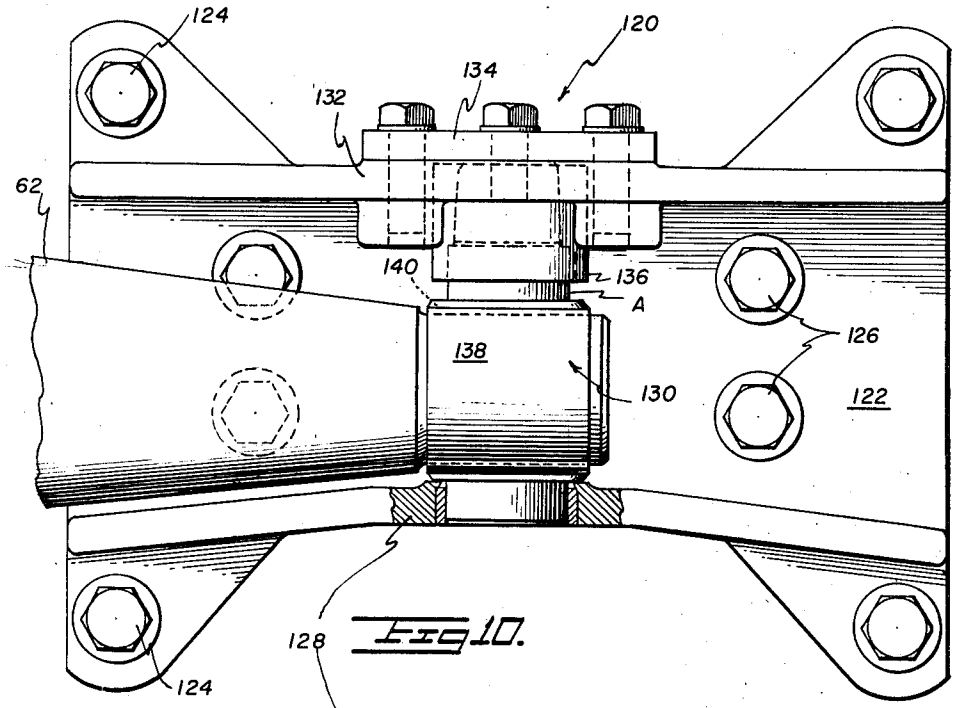


Fig 10.

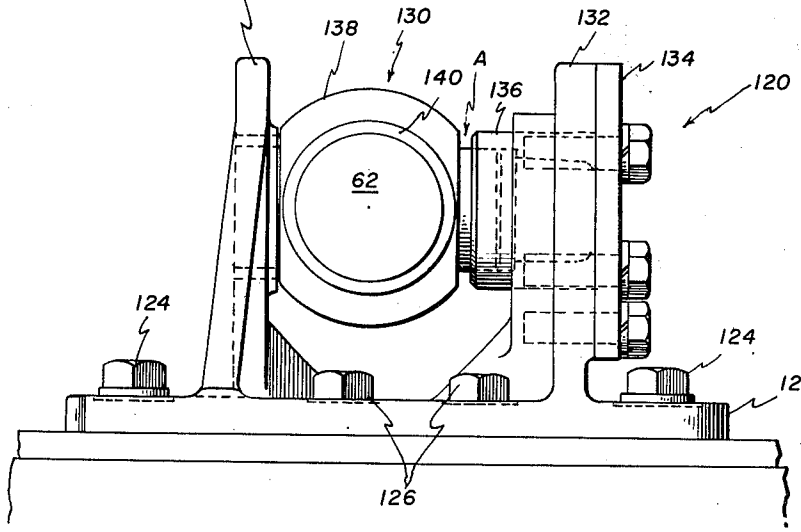


Fig 11.

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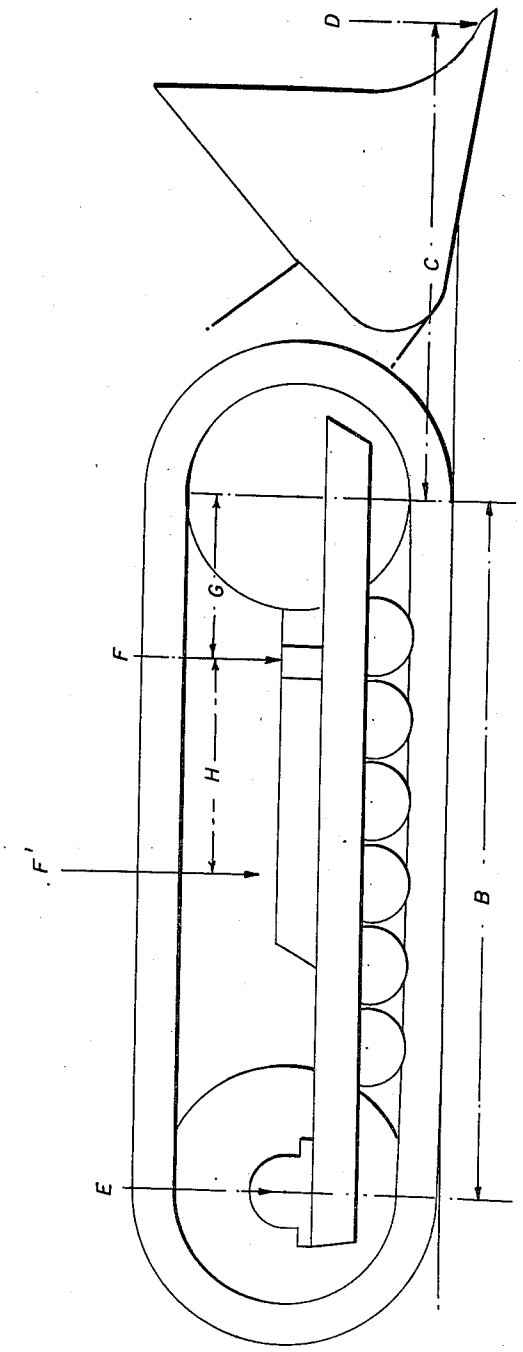


Fig 12.

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United States Patent Office 2,792,140 Patented May 14, 1957

2,792,140

MATERIAL HANDLING MACHINE

Daniel M. Schwartz, Salt Lake City, Utah, assignor to The Eimco Corporation, Salt Lake City, Utah, a corporation of Utah

Application June 15, 1953, Serial No. 361,601

6 Claims. (Cl. 214—148)

This invention relates to an improved material handling machine of the front end bucket type and in particular to an improved material handling machine having an overhead bucket device supported on a main frame which main frame is pivotally mounted on individually operated crawlers or self-laying track units.

It is an object of the invention to provide an improved device of the type described wherein the material handling bucket device, the main frame and the crawler units are constructed to permit pivotal suspension of the main frame and its attached front end bucket device on individual crawler units; to provide means whereby the digging load is transmitted directly to the main frame and then distributed evenly on the track frames; to provide means whereby side digging loads are transmitted directly to the main frame thereby substantially reducing excessive stresses on the crawler diagonal brace and on the cantilever forward extension of the track frame; to provide means whereby the weight of the main frame and the crawler units are effective to reduce the tendency of the material handling machine from overturning during the discharge cycle when provided with an overhead bucket mechanism; to provide means for readily varying the discharge distance and the overall height of the loader without interfering with the novel suspension system of the improved machine; to provide such a machine having improved operator visibility and to provide a loader that is sturdy in construction and adaptable to many and varied working conditions.

These and other objects and advantages of the invention will appear more clearly from the detailed description in connection with the illustrative embodiments of the invention shown in the accompanying drawings in which:

Fig. 1 is a right front perspective view of the overhead material handling machine of the invention;

Fig. 2 is a right front perspective view of the loader shown in Fig. 1 with the motor, cab and transmission covers removed;

Fig. 3 is a bottom plan view of the loader shown in Figs. 1 and 2 in partial section and with the crawler treads and suspension wheels removed to more clearly show the crawler units;

Fig. 4 is a section on line 4—4 of the machine shown in Fig. 3;

Fig. 5 is a rear elevational view in partial section of the loader of the invention;

Fig. 6 is a fragmentary sectional view through the right rear tractor housing;

Fig. 7 is a fragmentary sectional view on line 7—7 of Fig. 5;

Fig. 8 is an enlarged fragmentary section on line 8—8 of Fig. 4;

Fig. 9 is a top plan view of the equalizer bar shown in Fig. 8;

Fig. 10 is an enlarged detail top plan view of one of the equalizer bar end bearings;

Fig. 11 is a side elevation of the bearing shown in Fig. 10; and

Fig. 12 is a diagrammatic view of the lower portion of the device of the invention showing typical loading of the main frame and equalizer bar.

With particular reference to Figs. 1, 2, 4 and 5 of the drawings, there is shown a material handling apparatus embodying the principles of the invention which generally comprises a main frame or body **10** pivotally mounted on individually operated crawler or self-laying track units **12** and **14**, as to be more fully described hereinafter.

The main frame **10** supports an overhead bucket assembly **16** upon parallel tracks or rails **18** secured to the main frame **10**.

Each of the tracks **18** is provided with three support bracket members generally designated **20**, **22** and **24**. Each of the bracket members starting with the forward one **20** are stepped upwardly and rearwardly so the rails **18** slope upwardly from the forward ends.

The overhead bucket structure **16** of the material handling machine is of the overhead rocker type. The side frames **26** of the rocker structure have curved surfaces for rolling engagement with the parallel rails **18**, the radius of curvature of the surfaces generally increasing from the forward to the rear ends of the curved sections. The curved surfaces have inboard and outboard grooves to receive guide cables which are connected in reverse manner to the rocker structure and the main frame, as more fully described in my copending application Serial No. 346,402 filed April 2, 1953 and now Patent No. 2,752,053.

Between the lower ends of the curved rocker arms is supported a shovel bucket **28** and each arm is also provided with a bumper **30** having a spring loaded piston **32**.

Flat cable chains **34** are attached at one end to the rocker arms just above the bumpers **30** while the other ends are secured to bucket reels **36**. Rotation of the reels **36** raises the bucket from its forward low digging position to an upper and rearward discharge position.

In the dumping position the heads of the pistons **32** contact bumper plates **38** rigidly secured to a bumper frame **40**. The bumper frame **40** and the diagonal braces **42** are pin-connected at their ends to provide an easily dismantled assembly that may be removed speedily when it is desired to use the machine without the overhead rocker structure.

The overall height of the material handling machine and the discharge distance of the loader is determined to a great extent by the height of the track members **18** at the rearward ends. The minimum height of the rails is determined by the upper surface of the rear drive transmission housing generally designated **44**, see Figs. 4 and 5.

The rails **18** as shown in full lines in the drawings rest just above the top of the housing **44**. However, where head room is not a critical factor, as it is in many mining operations, and greater discharge distance is desired, the bracket members **22** and **24** are lengthened and the angle of forward bracket **20** is slightly varied so that the rails may be positioned as shown in broken lines in Fig. 4 of the drawings.

With the raised rails the curved surfaces of the rocker arms of the overhead bucket mechanism would be modified so that correct alignment of the bracket reels **36** and the bumper frame **40** is maintained. However, the identical rocker arms may be used with both the low and high rails by merely modifying the bumper frame **40** and its bucket reels **36**.

Thus it is seen that without affecting the drive mechanism of the tractor suspension system (as to be explained hereinafter) the height and the discharge distance of the loader may be varied within wide limits.

It will also be apparent that with the overhead bucket structure carried by the main frame the digging load is transmitted directly to the main frame and then dis-

tributed evenly on the track frames. In this form of construction the side digging loads are also taken directly on the main frame. Thus severe loads which have in the past been carried by the relatively light track frames are substantially eliminated.

In the center of the main frame is the power plant generally designated **46** wherein is housed a prime mover to supply power for the shovel bucket and the self-laying tracks through transmissions **48** and **50** positioned forwardly and rearwardly of the prime mover.

A control cab **52** is positioned on the center line of the main frame between the prime mover and the forward transmission **50** with the operator's seat **54**, shown in its correct location in Figs. 2 and 4 of the drawings, facing forwardly whereby the operator may observe the digging and crowning of the bucket. The control cab **52** is provided with a sheet steel top and metal grill work on four sides to provide visibility and protection for the operator. The forward housing section **56** of the machine slopes generally downwardly to provide a clear line of vision for the operator over the front end of the machine and the upper edge **58** of the shovel bucket in its forward position. Thus the operator is able to have an unobstructed view at all times of the material to be excavated.

When the machine is used with an overhead bucket mechanism the top of the cab and the front housing **56** are shaped to clear the path of the bucket as it travels to the rear.

The endless track units **12** and **14** generally include track or swing frames connected to the material handling machine adjacent the rear end, and which are also pivotally connected to a transverse equalizer bar **62** adjacent the front end of the machine.

With particular reference to Figs. 2, 3 and 7, each of the track frames comprises a pair of spaced side channel members **64** and **66** connected together by transverse rib members **68** and a top plate **70**. The top plates **70** are notched at the front and rear ends to provide clearance for the front idler wheels **72** and the sprocket wheels **74**, respectively.

The outer side channel members **64** are of greater length than the corresponding inner channel members **66**. Secured to these rearward extensions of the outboard channel members are self-aligning roller bearing units **76**. The inner bearing race of the units are carried by the live axle shafts **78** of each drive unit.

Each axle **78**, as more clearly shown in Fig. 6, is journalled to the rear tractor housing **44** by means of inboard and outboard bearings **80** and **82**. Also secured to each axle is the sprocket wheel **74** and gear **84**. The axle and sprocket wheel are driven through pinion **86** and gears **88** and **90** on the intermerdiate shaft **92**.

Each track frame unit is provided with a generally rearwardly extending diagonal brace member **94**. The forward and large ends of the braces **94** are secured, preferably by welding to the inner track channel members **66**, forwardly of the bearing members **76** on the complementary outer channel members.

The rearward ends of the diagonal braces **94** are each pivotally connected to the main frame of the loading machine so that the track units are free to pivot about the main frame with the outboard ends of live axles **78** forming one of the pivot points and bearing **96**, on center with the axles **78**, forming the other pivot point. Thus while the track frames are free to pivot they are effectively prevented from toeing in or out and against lateral tilting relative to the main frame **10**.

The bearing **96** generally comprises, as more clearly shown in Figs. 3 and 5, a pivot pin **71** which is supported at its ends by clamping brackets **98** and by inner clamping bracket **100**. The space provided between corresponding pairs of inner and outer brackets are slightly greater than the width of the diagonal braces at their rearward ends to provide normal "bearing clearance" therebetween.

Each of the brackets **98** and **100** are of the conventional sleeve type having only one side split and are bolted to the under side of the housing **44** by bolts **102**. The brackets are also provided with centering pins **104**. The equalizer bar **62** and its connections with the main frame and each track frame will be described with particular reference to Figs. 3 and 8 through 11. The equalizer bar has four primary functions: firstly, the weight of the forward end of the main frame and its attached structures is transmitted to the ground engaging crawler units through the bar; secondly, it transmits the substantial downward digging force from the main frame to the track frames; thirdly, it permits relative pivotal movement between the crawler units and the main frame; and fourthly, provides the means whereby the weight of the main frame and the weight of the crawler units are all effective to reduce the tendency of the loader to overturn during the discharge cycle of the overhead bucket mechanism. These four functions of the equalizer bar will become apparent from the following detailed description.

The equalizer bar **62** may comprise a rigid cast or forged steel member having, in vertical section, a substantially straight center section **106**, upwardly curved intermediate portions **108**, and substantially flat end portion **110**, the outer extremities of which have circular cross sections.

The bar or member **62** may also be constructed of spring steel, or fabricated from a plurality of spring leaves. The advantages of this form of construction would be additional cushioning of the load to absorb strains on the main and crawler frames.

Centerly positioned on the bar are upstanding bosses **112** and **112'** which are bored as at **114** and **114'** to receive a pivot pin **116**. The inner and outer ends of the pivot pin **116** are secured in brackets **118** connected to the center of the bottom of the main frame **10**.

Thus the bar is free to pivot relative to the main frame **10** about the pin **116**.

The outer circular ends of the bar are pivotally and slidably secured in substantially universal bearings generally designated **120** which bearings are fastened to their respective track frames by plates **122**. In the preferred form of the invention, with the material handling machine on level ground, the curvature of the bar and the height of the bosses **112** and **112'** are so selected that the pivotal axis of the bar with respect to the main frame and the pivotal axis of the ends of the bar and their corresponding track frames are on a straight line.

With this straight line arrangement of the equalizer bar and its end pivots, pivotal movement of the bar provides the minimum amount of sliding movement at the end bearings **120** and provides sliding movement in the same direction for movement of the bar above or below the centerline.

Each of the end bearings **120** are identical and only one will be described with reference to Figs. 10 and 11. The plate **122** is bolted by bolts **124** and **126** to the channel members and the top plate of the crawler units, respectively. At the forward end of the plate is flange or boss **128** bored to receive one end of a trunnion bearing **130**. At the rearward end of the plate a second flange or boss **132** is provided to which is bolted a cover plate **134** carrying a second bearing **136** for the other end of trunnion bearing **130**.

The center portion **138** of the trunnion bearing **130** is radially bored as at **140** to receive the circular end of the equalizer bar. The width of the center portion **138** of the trunnion bearing **130**, and the distance between the boss **128**, and the boss **132** and its bearing **136** are so selected that there is provided limited axial sliding movement for the trunnion bearing **130** in addition to its normal pivotal movement. The space provided for this sliding movement is designated A in Figs. 10 and 11.

In the preferred form of the invention the equalizer bar is positioned at the forward end of the main and track frames, for example, as shown in the drawings, the trunnion bearing supports are located just rearwardly of the front idler U-frame generally designated **73** (Fig. 3).

The importance of the forward position of the equalizer bar will be apparent from the following description of Fig. 12 which shows typical loading factors of a machine constructed in accordance with the teachings of this invention. On overhead loading machines wherein the distance B between the front and rear bearings is 95 inches and the distance between the front idler bearing and the tip of the bucket in the loading position C is 64 inches, it has been found that the following forces are applied to the crawler frames when a digging load of 20,000 pounds is applied at D:

1. portion of body weight at E 3,500 pounds;
2. portion of body weight vertically above the preferred position of the equalizer member F 5,500 pounds;
3. additional force at F due to digging load where distance G is 22½ inches, 20,000×159/72½ or 43,000 pounds.

If the equalizer member is moved rearwardly to point F′ where the distance H between F and F′ is 29½ inches, the force on the equalizer member due to digging load would then become 20,000×159/43 or 74,000 pounds.

Thus it can readily be seen that the further forward the equalizer member is placed the less will be the total load on the equalizer member and between the equalizer member and the main frame and crawler frames.

In operation of the suspension system of the invention as the material handling machine traverses uneven ground, the individual crawler units are free to pivot vertically with respect to the main frame. The pivotal axis, as hereinbefore described, is the axis of the live axles **78**. As the crawler units pivot up or down, the equalizer bar at its center connection also pivots about the pivot pin **116**, and the following motions take place between the end of equalizer bar shown in the left hand or high side of Fig. 8: the distance between the center of trunnion bearing **130** and the center of the equalizer bar increases and the end of the equalizer bar withdraws slightly from the bore **140** of the trunnion bearing **130**; the angular relationship between the crawler units and the equalizer bar changes and the end of the equalizer bar rotates in the bore **140** while the trunnion bearing **130** rotates in the bearings **128** and **136**; and the trunnion bearing **130** shifts slightly laterally relative to the bearings **128** and **136**.

It will be seen that while the bearings **120** permit substantially universal movement between the equalizer bar and the crawler units, the main frame and the crawler units are still effectively interconnected whereby the weight of the main frame is equally distributed to the crawler units, and the weight of the crawler units are always effective to reduce the overturning effect of the high discharge momentum of the overhead bucket mechanism.

While only the one form of connection between the equalizer bar and the crawler units is specifically shown in the application drawings, it is apparent that other forms of bearing means could be satisfactorily employed without depending from the scope of the present invention. For example, a ball and socket connection could be employed wherein the socket members are carried in self-centering spring urged bearing blocks attached to each of the crawler units.

It is further evident that while the particular application of the machine of the invention has been described with reference to a loader having paired endless crawlers and an overhead bucket device, such means could be modified without substantially affecting the advantages of the invention as described.

For example, the overhead bucket mechanism **16** could be replaced by a standard front end loading device wherein the bucket is loaded, elevated and discharged at the forward end. It is also apparent that the paired crawler units could be replaced by wheels supported at the forward end of the machine by means connected to the trunnion bearings **120**, and that the machine would have substantial advantages even when employed without a front end loading mechanism.

I claim:

1. A material handling machine comprising a main frame, an overhead rocker bucket device mounted for rolling engagement on said main frame from a depressed forward digging position to an elevated rearward discharge position, paired lateral crawler frames, means mounting each of said crawler frames from spaced transverse pivot points at the rearward end of said main frame, a transverse equalizer member mounted for transverse up and down pivotal movement with respect to said main frame, the outer ends of said member being circular in cross section, a sleeve bearing engaging the circular ends of the said member, cylindrical bearing surfaces extending at right angles to the bore in said sleeve bearing, bearing blocks secured to the crawler frames and engaging the cylindrical bearing surfaces of said sleeve bearing, the distance between said bearing blocks being so selected as to provide limited sliding movement of the cylindrical bearing surfaces in said bearing blocks.

2. In a crawler tractor having a main frame and paired lateral track frames pivotally mounted at the rearward end of the main frame; a transverse equalizer member pivotally mounted at the forward end of said main frame, and means universally mounting the ends of the equalizer member to said track frames comprising a trunnion bearing mounted on each of the track frames for transverse pivotal movement with respect to the main frame and sliding movement longitudinal with respect to the main frame, and bearing means mounting the ends of the equalizer member in said trunnion bearing for substantially transverse sliding movement and lateral pivotal movement with respect to said main frame.

3. In a crawler tractor having a main frame and paired lateral crawler frames pivotally mounted at the rearward end of the main frame; a transverse equalizer member mounted for transverse up and down pivotal movement with respect to said main frame, the outer ends of said member being circular in cross section, a sleeve bearing engaging the circular ends of the said member, cylindrical bearing surfaces extending at right angles to the bore in said sleeve bearing, and bearing blocks secured to the crawler frames and engaging the cylindrical bearing surfaces of said sleeve bearing, the distance between said bearing blocks being so selected as to provide limited sliding movement of the cylindrical bearing surfaces in said bearing blocks.

4. A material handling machine comprising a main frame, paired ground engaging wheels mounted at the rearward end of the main frame, a transverse equalizer member pivotally mounted at the forward end of said main frame, and means universally mounting the ends of the equalizer member to paired ground engaging wheels mounted at the forward end of said main frame comprising a trunnion bearing mounted on each of the forward ground engaging wheels for transverse pivotal movement with respect to the main frame and sliding movement longitudinal with respect to the main frame, and bearing means mounting the ends of the equalizer member in said trunnion bearing for substantially transverse sliding movement with respect to said main frame.

5. A material handling machine comprising a body portion, an overhead rocker bucket device comprising paired rocker arms mounted for rolling engagement on said body portion, a stub axle journalled in each side of the body portion at its rearward end, paired lateral crawler frames having longitudinally extending spaced frame members, the outboard frame member extending

in a rearwardly direction further than the inboard member, bearing means journalling said outboard frame members to the outboard ends of said stub axles, inwardly and rearwardly extending diagonal brace rigidly secured to each of the inboard frame members, bearing means journalling the rearward extending ends of said diagonal braces to the body portion, a transverse equalizer member pivotally mounted to the under side of said body portion at its forward end for limited up and down pivotal movement, the outer ends of said member being circular in cross section, a sleeve bearing engaging the circular ends of the member, cylindrical bearing surfaces extending at right angles to the bore in said sleeve bearing, bearing blocks secured to the crawler frames and engaging the cylindrical bearing surfaces of said sleeve bearing, the distance between said bearing blocks being so selected as to provide limited but positive sliding movement of the cylindrical bearing surfaces in said bearing blocks.

6. In a material handling vehicle including a body portion and paired lateral crawler frames pivotally mounted at the rearward end of the body portion, a transverse oscillatory equalizer bar pivotally secured adjacent the forward end of the body portion with the ends of the

equalizer bar attached to their respective crawler frames the combination with said vehicle of an overhead material handling device comprising paired rocker arms carrying a material handling structure, said rocker arms mounted for rolling engagement on the body portion from a depressed forward material gathering position to an elevated and rearward material discharge position wherein the means attaching the ends of the equalizer bar to the crawler frames provide for transverse and longitudinal sliding movement and pivotal movement between the bar and said crawler frames.

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