March 1, 1966

R. J. MILLER

3,237,794

TRACTOR MECHANISM

Filed Sept. 15, 1964

3 Sheets-Sheet 1

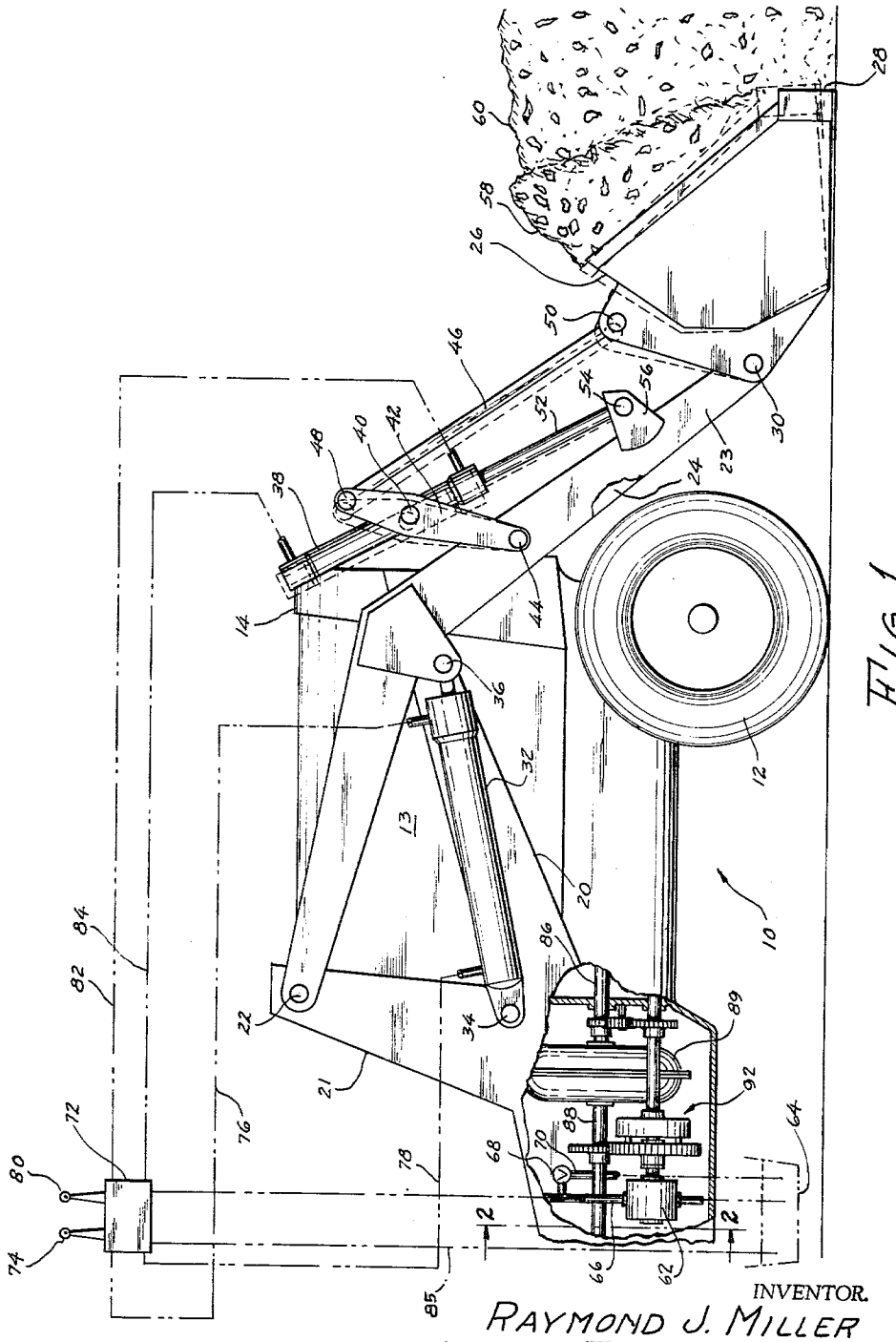


FIG. 1

INVENTOR.

RAYMOND J. MILLER

BY

Emerson B Donnell ATTY.

Robert D. Goddard AG'T

March 1, 1966 R. J. MILLER 3,237,794

TRACTOR MECHANISM

Filed Sept. 15, 1964 3 Sheets-Sheet 2

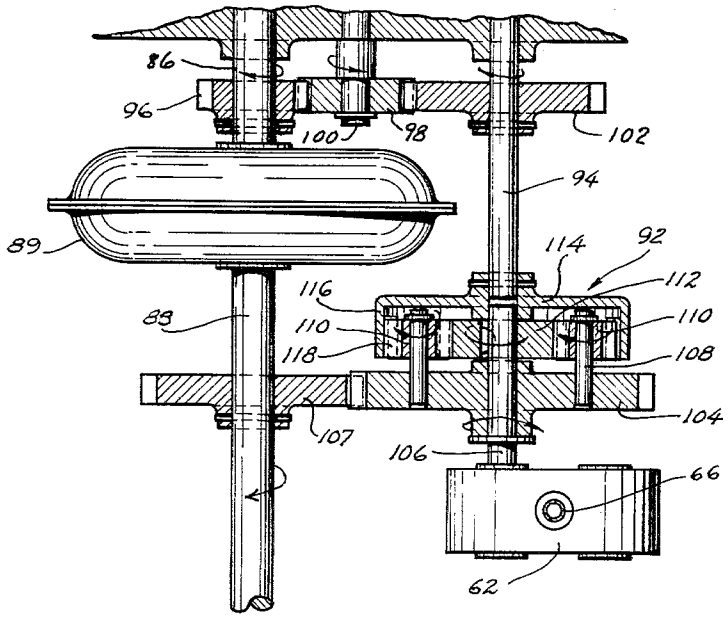


FIG. 3

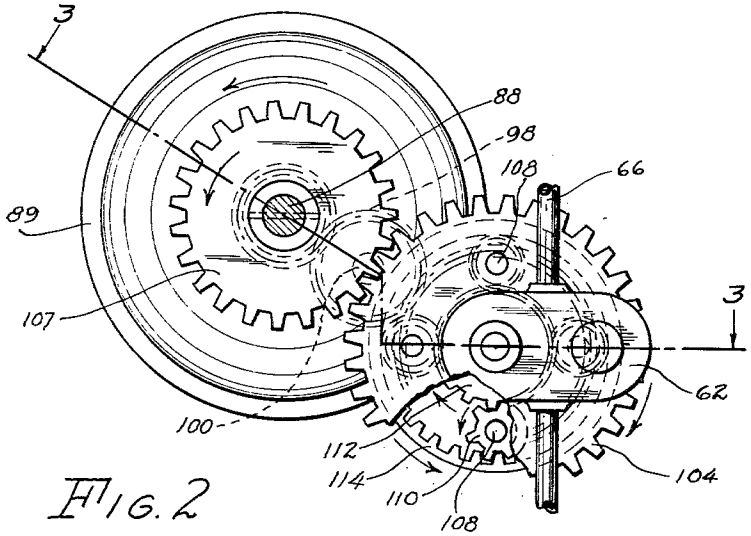


FIG. 2

INVENTOR.
RAYMOND J. MILLER
BY
Emerson B Donnell ATT'Y.
Robert O. Goddard AG'T

March 1, 1966 R. J. MILLER 3,237,794

TRACTOR MECHANISM

Filed Sept. 15, 1964 3 Sheets-Sheet 3

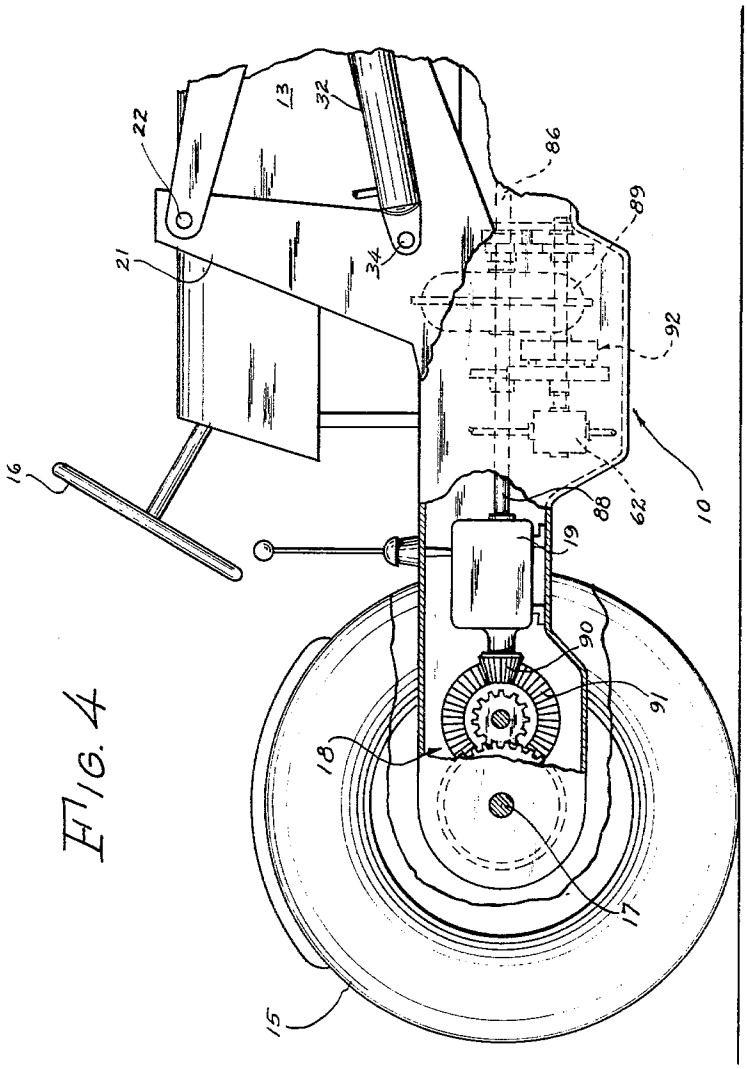


FIG. 4

INVENTOR.
RAYMOND J. MILLER
BY
Emerson B Donnell ATT'Y.
Robert D. Sedard AG'T

United States Patent Office

3,237,794

Patented Mar. 1, 1966

3,237,794

TRACTOR MECHANISM

Raymond J. Miller, Racine, Wis., assignor to J. I. Case Company, Racine, Wis., a corporation of Wisconsin

Filed Sept. 15, 1964, Ser. No. 396,497
16 Claims. (Cl. 214 —140)

The present invention relates to tractor mechanism, and an object thereof is to generally improve the construction and operation of mechanism of this class.

Tractors, of course, are used for many different purposes, and the present invention relates to a tractor particularly as adapted to earth moving, and equipment to form what is known in the trade as a tractor loader in which a shovel or bucket is mounted on the front of the tractor to be raised and lowered by appropriate mechanism, and also to be tilted as required into the correct attitude for the work being performed at the moment. Such adjustments of the bucket are commonly made by hydraulic cylinders or motors supplied with pressure fluid from a suitable source, and the invention deals generally with this source of fluid pressure. Commonly, a suitable pump is driven from the mechanism of the tractor, and supplies the fluid under pressure, the excess being discharged through a suitable relief valve. While such systems have been reasonably satisfactory, they have left something to be desired, and it is to avoid or remedy certain defects that the present invention has been devised. The pump, if it varies in speed, delivers a varying volume of fluid, and with the common arrangement of a tractor engine which runs at a governed speed, the pump, if run from the engine directly, will always pump its maximum volume of fluid, regardless of the needs of the moment, and therefore use or absorb from the engine the full amount of power of which the pump is capable. Much of the time, such full volume of fluid is not necessary, and the greater part of the power being absorbed is merely wasted in heating the pressure fluid, and incidentally, causing unnecessary wear in the relief valve.

One expedient to help this situation would be to run the pump from a portion of the usual transmission so that its speed will vary generally with the rate of movement of the tractor. This arrangement in a tractor loader has serious disadvantages in the usual operation of a tractor loader.

A common mode of operation of this type of loader is to drive the tractor with the bucket sliding along the ground into a pile of material until the resistance of the bucket going into the pile, stops the movement of the tractor. Under these conditions, the traction elements are stopped, as also is the power output element of the usual transmission. If the pump is driven from this output element, it also stops and there is no fluid pressure available for adjusting the bucket. However, at this time, it is desirable to have a high pressure available for a limited upward tilting of the bucket to break a portion of the material loose from the rest of the pile, so such an arrangement would seriously handicap the device for this type of service. A solution of this difficulty would be to drive the pump at a varying rate in relation to the engine.

If it were possible to drive the pump at a rate which was a compromise between the engine speed and the speed of the output element of the transmission, the above difficulties would be avoided, and certain advantages would be realized, particularly under the type of operation just described.

The pump, at times when the tractor was stopped by the aforesaid pile of material, would run considerably slower, and therefore use, or actually waste substantially less power than if it were running at high speed. However, it could still be running fast enough to supply ample pressure to perform the breakout operation, particularly since a large volume of fluid is not needed under these conditions. Accordingly, the principal object of the invention is to provide a pump drive which will result in a minimum operative speed of the pump under stalling conditions, and desirably higher speeds under most other conditions, to deliver the necessary larger volume of fluid which is then needed.

Further objects and advantages will be apparent from the following specification and the annexed drawings, in which:

FIGURE 1 is a side elevation partly diagrammatic in character of so much of a tractor as necessary to illustrate the invention, parts being broken away to show what lies beneath, and others omitted to avoid undue complication of the drawing;

FIG. 2 is an enlarged vertical section through the tractor on the line 2—2 of FIG. 1, with parts removed;

FIG. 3 is a development in a horizontal plane of a section of the mechanism of FIG. 2, taken on the line 3—3; and

FIG. 4 is a side elevation with parts broken away, showing the traction means.

The tractor as seen in FIGS. 1 and 4 includes a body portion **10**, having a front wheel **12**, prime mover or engine **13**, and a radiator **14**. It also has traction wheels **15**, a steering wheel **16**, and the other usual well-known tractor parts, which have been omitted to avoid complication of the drawing, and which parts it is not necessary to show and describe.

Traction wheels **15** are fixed to axles **17** driven through the usual bull gear mechanism **18**, which in turn is driven from engine **13** through a transmission **19** of well-known type.

A frame **20** is disposed about the tractor and has upstanding columns or arms as **21**, to which is pivoted on a pin **22**, bucket or loader arms **23** and **24**, it being understood that frame member **20**, and column **21** are duplicated on the other side of the tractor; a bucket **26** having a reenforced front shearing edge **28**, being carried on a pivot **30** on loader arm **23**; it being again understood that pivot **30** is duplicated on the other side of the tractor on arm **24**.

Loader arms **23** and **24** are raised and lowered by hydraulic cylinders or motors, as **32**, only one of which is shown, which are pivoted on pins, as **34**, to columns **21** and on pins, as **36** to loader arms **23** and **24**, so that extension of motors **32** will cause counterclockwise swinging of arms **23** and **24** about pivots **22**. This will raise or lower bucket **26**.

A tilt cylinder or motor **38** acts to control the position of bucket **26** on pivot **30**, and in the present instance, is carried by means of a trunnion **40** on a swinging lever **42**, pivoted on a pin **44** on loader arm **23**. A link **46** is pivoted on a pin **48** on lever **42** and pivotally connected to bucket **26** on a pin **50**. It will be understood that cylinder **38** and its attached parts is duplicated on loader arm **24** so that a strong symmetrical arrangement is provided for controlling bucket **26**. Cylinder **38** has a piston rod **52** anchored to loader arm **23** on a pivot **54** carried on a suitable bracket **56** fixed on loader arm **23**.

It will now be apparent that actuation of cylinder **38** in a generally upward direction will throw lever **42** in a counterclockwise direction and, through link **46** will tilt bucket **26**, also in a counterclockwise direction to loosen a section **58** of the pile of material **60**; and while this may take a very substantial force, for example if the material is frozen, the movement is very slight, approximately to the dotted position indicated. However, in view of the aforesaid substantial resistance, the fluid pressure necessary to actuate cylinder **38** will be high, or in

the neighborhood of the maximum pressure which the pump, to be described, can deliver.

As stated, the fluid is supplied by a pump **62** which draws fluid from a sump or tank **64** and delivers it through a discharge pipe or conduit **66**. Pipe **66** has a relief valve **68** through which fluid may be discharged when delivered in excess of the requirements of cylinders **32** and **38**, valve **68** discharging through a suitable conduit **70** back into sump **64**. Thus, whenever pump **62** is running, full pressure is available in pipe **66**, provided only that pump **62** is operating fast enough to be above the normal operating speed of such pumps. It is well known that pumps of various types have a certain amount of unavoidable leak or "slip," and a minimum speed is necessary to maintain normal pressure, while supplying the amount of fluid which normally leaks back through the pump. Thus, a certain minimum speed is necessary to maintain the pressure in conduit **66**, and the device of the invention is constituted to maintain this minimum speed at all times that engine **13** is running at its normal rate.

Conduit **66** leads to a control valve **72** having an actuating handle **74** which directs fluid to and from cylinder **32** through conduits **76** and **78**. Valve **72** also has a handle **80** which directs fluids to and from cylinder **38** by means of conduits **82** and **84**. It will now be apparent that, assuming pump **62** is to be running, loader arms **23** and **24**, and bucket **26** may be swung up and down around pivot **22** by manipulation of handle **74**. In similar manner, bucket **26** may be tilted about pivot **30** by manipulation of handle **80**.

Commonly, although not necessarily, valve **72** would be of the type which provides an open by-pass for fluid at such times as no work is being performed, the fluid delivered by pump **62** being returned to sump **64** through a conduit **85**.

It will be understood that the tractor is propelled, and the motion controlled in any suitable or well-known manner, and the desired work may be accomplished by driving the tractor where desired, and manipulating bucket **26**.

Engine **13** has an output shaft or element **86** which drives through any suitable type of ratio varying transmission, in the present instance illustrated as a turbine type coupling or torque converter, an output shaft **88**. The torque converter in the present arrangement is designated **89**. The latter is of a particular advantage in the type of operation described, since when bucket **26** is embedded in pile **60**, and the forward motion is blocked, engine shaft **86** may continue to run substantially at governed speed, while output shaft **88** is stopped, or nearly so. The rotation of shaft **86** is permitted by "slip" in the coupling or converter **89** so that engine **13** may develop its full power, even with shaft **88** stalled, the full torque of shaft **86** or such torque multiplied by the ratio in converter **89** being applied to shaft **88** during such operation, to maintain the forward thrust of the tractor against bucket **26**.

Shaft **88** extends rearwardly into transmission **19** and transmission **19** has a driving gear **90** meshing with a driven gear **91**, the latter forming a part of bull gear mechanism **18**, through which the power is transmitted to traction wheels **15**.

However, when traction wheels **15** are stalled, high pressure but low or limited volume of fluid is needed in cylinder **38** for breakout operation.

Such operation is attained by driving pump **62** partly from shaft **86** and partly from shaft **88** through a differential gear generally designated as **92**. Differential gear **92** has a first shaft or input element **94**, in FIG. 3, driven from shaft **86** by means of a gear **96** fixed thereon, and driving, through an idler **98**, journaled on a pin **100**, a gear **102** fixed on shaft element **94**. Differential gear **92** also has a second input element **104**, in the present instance, constituting a gear which is journaled on a shaft **106** forming the power input element of pump **62**. Gear **104** is driven from a gear **107** fixed on output shaft **88** of converter **89**, and is therefore driven at a rate proportional to the speed of shaft **88**. Gear **104** also has pins **108** fixed thereon on which are journaled planetary gears **110** which are engaged with a sun gear **112** fixed on above-mentioned shaft **106**. Fixed on shaft **94** and preferably piloted on shaft **106**, is a shell-like element **114** which has a rim **116** providing internal gear teeth **118** meshing with above-mentioned planetary gears **110**, and constituting an internal gear fixed on shaft **94**.

The operation of the device should be generally apparent from the foregoing, but will now be described in detail. Shaft **68** normally runs at a governed engine speed, and the operation may be more readily understood if we start with the situation where bucket **26** is stalled in a pile of material before the aforementioned break-out operation. Under these conditions, shaft **86**, as stated, will be running at engine speed, while shaft **88** connected with traction wheels **15** will be stalled or stationary; gear **96**, fixed on shaft **86** will be running and driving idler **98** which, in turn, will drive gear **102** on shaft **94**. Shaft **94** will therefore run in the same direction as engine shaft **86**.

Shaft **94** being fixed to shell **114** will drive the latter in the same direction as itself, and at the same speed.

As stated, shaft **88** under these conditions is stationary, and therefore gear **107**, and accordingly gear **104** are also stationary. This being true, pins **108** do not move and gears **110** act merely as idlers. All of gears **110** act in the same manner, and for facility in understanding, the action of only one will be described in detail. Rotation of shell **114** (see also FIG. 2) will cause similar rotation (in the same direction) in gear **110**. Gear **110**, meshed with gear **112**, drives the latter in a clockwise direction or opposite to the direction of shell **114**, and the sizes of the gears are readily chosen so that gear **112** and shaft **106** to which it is fixed will rotate at a speed sufficient to overcome the slip in pump **62**, maintain substantially the full working pressure, and supply the limited volume of fluid needed for the break-out operation. At this time, the break-out operation is all that would ordinarily be required of the hydraulic system.

The other gears **110**, as will be apparent, simply operate in the same manner as the first-mentioned gear **110**, all acting as stationary idlers to transmit the motion of shell **114** in reverse to gear **112**.

In this way, pump **62** is kept in operation at a minimum rate so as to absorb only a limited amount of the power from engine **13**, leaving a larger proportion thereof in shaft **88**, to be transmitted to the traction wheels **15** than would be the case if pump **62** were operated at or near its full capacity. This full capacity would ordinarily be a fairly substantial amount of power, and would be enough to materially affect the possible forward thrust obtainable from the tractor engine and its attached mechanism.

Once the break-out operation has been accomplished, the tractor is normally backed away from the pile commonly by virtue of transmission **19**, and driven the necessary distance to discharge the contents of the bucket **26**. Meantime, it is usually necessary to raise bucket **26** substantially, often to its maximum height which requires activating cylinders **32**, which demand a large volume of pressure fluid. Driving the tractor entails the rotation of shaft **88**, after a gradual start, at a rate comparable to that of shaft **86**, the difference being attributable to normal slip in coupling or torque converter **89**.

Shaft **88** rotates in the same direction as shaft **86**, even through slightly slower. This rotates gear **107** which rotates gear **104** in the opposite direction to gear **107** and shell **114**.

Referring now particularly to FIG. 2, and returning to the stalled condition of shaft **88**, gear **104** and pin **108** are stationary and gear **110** is acting as an idler. Now as shaft **88** begins to rotate, gear **104** starts to rotate in a

clockwise direction and translates pin **108** in a path opposite to the rotation of shell **114**. This, in effect, causes increased rotation or a higher rate of rotation of gear **110** about pin **108** and, gear **110** being meshed with gear **112**, a correspondingly higher rate of rotation of gear **112**. This causes a faster operation of pump **62**.

This action continues as shaft **88** builds up speed, until shaft **88** is running close to the rate of shaft **86**, whereupon pump **62** will be operating at or close to its maximum capacity. At this time the maximum possible traction power of the traction is not usually needed, and on the contrary, the maximum possible output of pump **62** may be needed for rapid handling of bucket **26**. Such maximum capacity is thus available during the rapid movement of the tractor toward the point of disposition of the load in bucket **26**.

It will be apparent from the foregoing that each time the tractor is used to shove bucket **26** into the pile, the power consumed by pump **62** will drop to a minimum, making available more power for the shoving process while, as soon as the tractor is moving at normal speed, the full capacity of pump **62** will be available.

Variations on the details of the gearing for driving pump **62**, and of other details of the device will doubtless occur to those skilled in the art, a variety of different types of differential gears being known, and which could be adapted to such operation. For example, the usual bevel gear type used in automotive rear axles, the planetary type in which double diameter planetary gears revolve about the periphery of juxtapositioned spur gears, and others which will readily occur to those familiar with gearing, are contemplated as within the invention, and it is to be understood that all of these variations are considered to be within the scope of this application. The invention is not intended to be taken as limited by the embodiment described and illustrated, nor in fact in any manner except as defined in the claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A hydraulically actuated tractor loader having an engine, an impositive type of main drive having an output, traction means driven from the output, a bucket on the tractor for moving material, a hydraulic motor on the tractor for raising and lowering said bucket and hydraulic motor on the tractor for tilting said bucket, control means on the tractor for regulating the flow of fluid to said hydraulic motors, and conduit means for carrying said fluid, means for supplying hydraulic fluid under pressure comprising a

differential gear driven in part from said engine and in part from the main drive output, and a

fluid pump arranged to be responsive to said differential gear whereby said pump is driven so as to supply fluid at a rate which is a function of the difference between the speed of said engine and the speed of said output of said main drive.

2. A hydraulically actuated tractor loader having an engine and an impositive type of main drive having an output, a bucket on the tractor for moving material, a hydraulic motor on the tractor for raising and lowering said bucket and a hydraulic motor on the tractor for tilting said bucket, control means on the tractor for regulating the flow of fluid to said hydraulic motors, and conduit means for carrying said fluid, means for supplying hydraulic fluid under pressure comprising a

differential gear driven in part from said engine and in part from said output of said main drive, and a

fluid pump driven from said differential gear whereby said pump is driven at a speed which is a function of the difference between the speeds of said engine and said output of said main drive, to avoid excessive power consumption by said pump.

3. A hydraulically actuated tractor loader having an engine and a main drive including a turbo hydraulic torque converter, a bucket on the tractor for moving material, a hydraulic motor on the tractor for raising and lowering said bucket and a hydraulic motor on the tractor for tilting said bucket, control means on the tractor for regulating the flow of fluid to said hydraulic motors, and conduit means for carrying said fluid, and an output, means for supplying hydraulic fluid under pressure comprising a

differential gear driven in part from said engine and in part from said output, and a

fluid pump arranged to be responsive to said differential gear whereby said pump is driven so as to supply fluid at a rate which is a function of the difference between the speeds of said engine and the output of said main drive.

4. A hydraulically actuated tractor loader having an engine and a main drive including a turbo hydraulic torque converter, a bucket on the tractor for moving material, a hydraulic motor on the tractor for raising and lowering said bucket and a hydraulic motor on the tractor for tilting said bucket, control means on the tractor for regulating the flow of fluid to said hydraulic motors, and conduit means for carrying said fluid, and an output, means for supplying hydraulic fluid under pressure comprising a

differential gear driven in part from said engine and in part from said output, and a

fluid pump driven from said differential gear whereby said pump is driven at a speed which is a function of the difference between the speeds of said engine and said output of said main drive.

5. A hydraulically actuated tractor-loader having an engine and a turbo-hydraulic main drive, means connected with said engine and with said main drive for driving said main drive from said engine, an output for said main drive, traction means, and means connected with said output and with said traction means for driving said traction means at a rate proportional to that of said output, a bucket on the tractor for moving material, supporting means pivotally connected to the tractor and to the bucket, fluid motors pivotally connected to the tractor, to the supporting means, and to the bucket for raising, lowering, and tilting said bucket, control means on the tractor for regulating the flow of hydraulic fluid to said fluid motors, and conduit means on said tractor connected to carry said fluid, means for supplying hydraulic fluid under pressure, while avoiding excessive power consumption, comprising a

differential gear,

means constituting a first input for said differenital gear,

means constituting a second input for said differential gear,

means constituting an output for said differential gear, a fluid pump,

means constituting a power input for said fluid pump, and

driving means connected with said engine and with said first input,

driving means connected with said output for said main drive and with said second input, and

driving means connected with said output for said differential gear and with said power input for said fluid pump for driving the latter at a rate which is a function of the difference between the speed of said engine and that of said output for said main drive.

6. A tractor-loader including a bucket constituted to be forced into a pile of material by the motion of the tractor, support means pivotally connected to the tractor and to the bucket, a fluid motor connected to the tractor and to the support means for raising and lowering the bucket and a fluid motor connected to the support means and to the bucket for tilting the bucket to break material away from the pile, a control valve on the tractor for regulating the flow of fluid to said fluid motors and con-

duit means on the tractor connected to carry said fluid, said tractor-loader also including a prime mover and a turbo-hydraulic power transmission having a power input element and a power output element, a pressure fluid supply for said fluid motors including a

differential gear having a first power input, a second power input, and a power output element, a pressure fluid pump having a power input element, conduit means connected to said control valve and to said pump, power transmitting means connected to said prime mover and to said power input element of said transmission, driving means connected with said power input element and with the first power input of said differential gear, driving means connected with the power output element of said transmission and with said second power input of said differential gear, and driving means connected with the power output element of said differential gear and with the power input element of said pump whereby said pump is driven at a speed which is a function of the difference between the speeds of said prime mover and the output of said transmission, and whereby excessive power consumption is avoided.

7. An earth-working implement including a bucket constituted to be forced into a pile of material by the motion of the implement, support means pivotally connected to the implement and to the bucket, a fluid motor connected to the implement and to the support means for raising and lowering the bucket and a fluid motor connected to the support means and to the bucket for tilting the bucket to break material away from the pile, a control valve on the implement for regulating the flow of fluid to said fluid motors and conduit means on the implement connected to carry said fluid, said implement also including a prime mover and a ratio changing power transmission having a power input element and a power output element, a pressure fluid supply for said fluid motors including a

differential gear having a first driven element, a second driven element, and a driving element, a pressure fluid pump having a driven element, conduit means connected to said control valve and to said pump, power transmitting means connected to said prime mover and to said power input element, driving means connected with said power input element and with the first driven element of said differential gear, driving means connected with the power output element of said transmission and with said second driven element of said differential gear, and driving means connected with the driving element of said differential gear and with the driven element of said pump whereby said pump is driven at a speed which is a function of the difference between the speeds of said prime mover and the output element of said transmission.

8. An earth-working implement including a bucket constituted to be forced into a pile of material by the motion of the implement, support means pivotally connected to the implement and to the bucket, a fluid motor connected to the implement and to the support means for raising and lowering the bucket and a fluid motor connected to the support means and to the bucket for tilting the bucket to break material away from the pile, a control valve on the implement for regulating the flow ow fluid to said fluid motors and conduit means on the implement connected to carry said fluid, said implement also including a prime mover and an impositive type ratio changing power transmission having a power input element and a power output element, a pressure fluid supply for said fluid motors including a

differential gear having a first power input, a second power input and a power output element, a pressure fluid pump having a power input element, conduit means connected to said control valve and to said

pump, power transmitting means connected to said prime mover and to said power input element of said transmission, driving means connected with said power input element and with the first power input of said differential gear, driving means connected with the power output element of said transmission and with said second power input of said differential gear, and driving means connected with the power output element of said differential gear and with the power input element of said pump whereby said pump is driven at a speed which is a function of the speed of said prime mover at such times as said power output element of said transmission is in a stalled condition.

9. A tractor loader including a bucket constituted to be forced into a pile of material by the motion of the tractor, support means pivotally connected to the tractor and to the bucket, a fluid motor connected to the tractor and to the support means for raising and lowering the bucket and a fluid motor connected to the support means and to the bucket for tilting the bucket to break away material from the pile, a control valve on the tractor for regulating the flow of fluid to said fluid motors and conduit means on the tractor connected to carry said fluid, said tractor loader also including a prime mover and a turbo-hydraulic torque converter having a power input element and a power output element, a pressure fluid supply for said fluid motors including a

differential gear having a first power input, a second power input and a power output element, a pressure fluid pump having a power input element, conduit means connected to said control valve and to said pump, power transmitting means connected to said prime mover and to said power input element of said torque converter, driving means connected with said power input element and with the first power input of said differential gear, driving means connected with the power output element of said torque converter and with said second power input of said differential gear, and driving means connected with the power output element of said differential gear and with the power input element of said pump whereby said pump is driven at a speed which is a function of the difference between the speeds of said prime mover and the output of said torque converter, and the speed of the pump is a function of the speed of the prime mover at such times as said power output element of said torque converter is in a stalled condition.

10. An earth working implement including a bucket constituted to be forced into a pile of material by the motion of the implement, support means pivotally connected to the implement and to the bucket, a fluid motor connected to the implement and to the support means for raising and lowering the bucket and a fluid motor connected to the support means and to the bucket for tilting the bucket to break material away from the pile, a control valve on the implement for regulating the flow of fluid to said fluid motors and conduit means on the implement connected to carry said fluid, said implement also including a prime mover and a turbo-hydraulic torque converter having a power input element and a power output element, a pressure fluid supply for said fluid motors including a

differential gear having a first power input, a second power input, and a power output element, a pressure fluid pump having a power input element, conduit means connected to said control valve and to said pump, power transmitting means connected to said prime mover and to said power input element of said torque converter, driving means connected with said power input element and with the first power input of said differential gear, driving means connected with the power output element of said torque converter and with said second power input of said

differential gear, and driving means connected with the power output element of said differential gear and with the power input element of said pump whereby said pump is driven at a speed which is a function of the difference between the speeds of said prime mover and the output of said torque converter, and whereby excessive power consumption is avoided.

11. A tractor loader including a bucket, bucket arms pivotally connected to the tractor and to said bucket, bucket cylinders connected to said bucket arms and to said bucket for tilting the bucket, lift cylinders connected to the tractor and to said bucket arms for raising and lowering the bucket, a valve on the tractor connected for controlling the operation of the cylinders and conduit means connecting the cylinders and the valve, said tractor loader also including an engine having an output element, a torque converter having a power input element and a power output element, a transmission connected with said torque converter output, element traction means connected with said transmission,

means for providing a pressure fluid supply for said cylinders, while avoiding excessive power consumption, comprising a sump for containing fluid, a pressure fluid pump connected for receiving fluid from said sump and for moving said fluid, conduit means connected to said pump and to said valve, conduit means connected to said pump and to said sump, and conduit means connected to said valve and to said sump, a power input element for said pump, a differential gear having a first power input element, a second power input element, and a power output element, driving means connected with said engine and with said first power input element, driving means connected with said torque converter output element and with said second power input element, and driving means connected with said differential gear power output element and with said power input element for said pump, whereby said pump is driven at a rate which is a function of the difference between the speed of said engine and said torque converter power output.

12. A tractor loader including a bucket constituted to be forced into a pile of material by the motion of the tractor, support means pivotally connected to the tractor and to the bucket, a fluid motor connected to the tractor and to the support means for raising the bucket and a fluid motor connected to the support means and to the bucket for tilting the bucket to break away material from the pile, a control valve on the tractor for regulating the flow of fluid to said fluid motors and conduit means on the tractor connected to carry said fluid, said tractor loader also including a prime mover and a ratio changing power transmission having a power input element and a power output element, a pressure fluid supply for said fluid motors including

a differential gear having a first power input, a second power input and a power output element, a pressure fluid pump having a power input element, conduit means connected to said control valve and to said pump, power transmitting means connected to said prime mover and to said power input element of said transmission, driving means connected with said power input element and with the first power input of said differential gear, driving means connected with the power output element of said transmission and with said second power input of said differential gear, and driving means connected with the power output element of said differential gear and with the power input element of said pump whereby said pump is driven at a speed which is a function of the difference between the speeds of said prime mover and the output of said transmission.

13. A tractor loader comprising the combination of a tractor having an engine, said tractor also having an impositive ratio changing mechanism driven from the engine and traction means driven from the ratio changing mechanism, a differential gear having a first and a second input element and an output element, a fluid pump driven from the output element, a fluid motor activated by fluid pumped by said pump, a material moving bucket connected to be moved in relation to the tractor by reason of activation of said fluid motor, means connected to said engine and in driving relation with said first input element, and means connected to said ratio changing mechanism and in driving relation with said second input element, whereby said pump will be run at a relatively fast speed at such times as said traction means and said ratio changing mechanism are running and the need for pressure fluid is relatively large, and at a relatively slow speed at such times as said traction means and said ratio changing mechanism are stalled and the need for pressure fluid is limited, thereby saving for application to the traction means the power which would be otherwise wasted in the fluid pump.

14. A tractor loader including the combination of a bucket constituted to be forced into a pile of material by the motion of the tractor,

support means pivotally connected to the tractor and to said bucket, a fluid motor pivotally connected to said suport means and to said tractor for raising and lowering the bucket, a fluid motor pivotally connected to said support means and to said bucket for tilting the bucket to break material away from the pile, control means on the tractor for directing fluid to said fluid motors, an engine and a turbo-hydraulic power transmission having a power input element and a power output element, a pressure fluid supply for said fluid motors including a differential gear having a first power input, a second power input, and a power output element, a pressure fluid pump having a power input element, conduit means connected to said pressure fluid pump, to said control means, and to said fluid motors for carrying fluid, power transmitting means connected to said engine and to said power input element of said transmission, driving means connected with said power input element and with the first power input of said differential gear, driving means connected with the power output element of said transmission and with said second power input of said differential gear, and driving means connected with the power output element of said differential gear and with the power input element of said pump whereby said pump is driven at a speed which is a function of the difference between the speeds of said engine and the output of said transmission.

15. A tractor loader including a

bucket for moving material, loader arms pivotally connected to the tractor and to the bucket, a plurality of fluid motors pivotally connected to the tractor and to the loader arms for raising and lowering the bucket, a plurality of fluid motors pivotally connected to the loader arms and to the bucket for tilting said bucket, a control valve on the tractor for directing the flow of fluid to and from said fluid motors, an engine and a torque convertor, said convertor having a power input element and a power output element, a pressure fluid pump having a power input element, conduit means connected to said control valve and to said fluid motors for carrying fluid therebetween and conduit means connected to said control valve and to said pressure fluid pump for carrying fluid therebetween, drive means for said pressure fluid pump including a differential gear having a first power input, a second power input, and a power output element, driving means connected to said engine and to said first power input element, driving means connected to

said torque convertor output element and to said second power input, and driving means connected to said differential gear power output element and to said power input element for said pressure fluid pump, whereby said pump is driven at speeds proportional to the sums of the speeds of said engine and said torque convertor and thereby avoiding excessive power consumption by said pump.

16. A tractor loader including the combination of an engine having a power output, a

ratio changing transmission having an input connected to the engine output and also having an output, a traction element, said transmission output being connected to said traction element, a differential gear having three elements, one element connected to the engine output, one element connected to the transmission output, a pressure fluid pump, said pump being connected to the third element of said differential

gear, a fluid motor on the tractor, a control valve on the tractor for regulating the flow of fluid to said fluid motor, conduit means connected to said pump and to said control valve, a bucket on said tractor for moving material, and conduit means connected to said control valve and to said fluid motor, whereby said engine and said transmission drive said differential gear and, in turn, said pump at a speed which is proportional to the sums of the speeds of said engine and said transmission.

References Cited by the Examiner

UNITED STATES PATENTS

2,807,379	9/1957	Pilch	214—140
2,959,070	11/1960	Flinn.	

HUGO O. SCHULZ, *Primary Examiner.*