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Knell et al.

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[54] **EPICYCLIC SELF-LOADING MECHANISM FOR A SCRAPER**

[75] Inventors: **Harvey A. Knell,** Joliet; **James A. Olthoff,** South Holland; **Barry A. Scoggin,** Plainfield; **Roger M. Smith,** Joliet, all of Ill.

[73] Assignee: **Caterpillar Tractor Co.,** Peoria, Ill.

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[21] Appl. No.: **42,214**

[52] **U.S. Cl.** ....**37/4,** 37/43 D, 37/126 AA, 37/189, 37/DIG. 5, 299/85

[51] **Int. Cl.** **E02f 3/04**

[58] **Field of Search**....37/4, 20, 24, 66, 87, 124–126, 37/129, 9, 93, 95, 96; 299/85, 86; 198/9, 10, 212; 172/21, 545, 546

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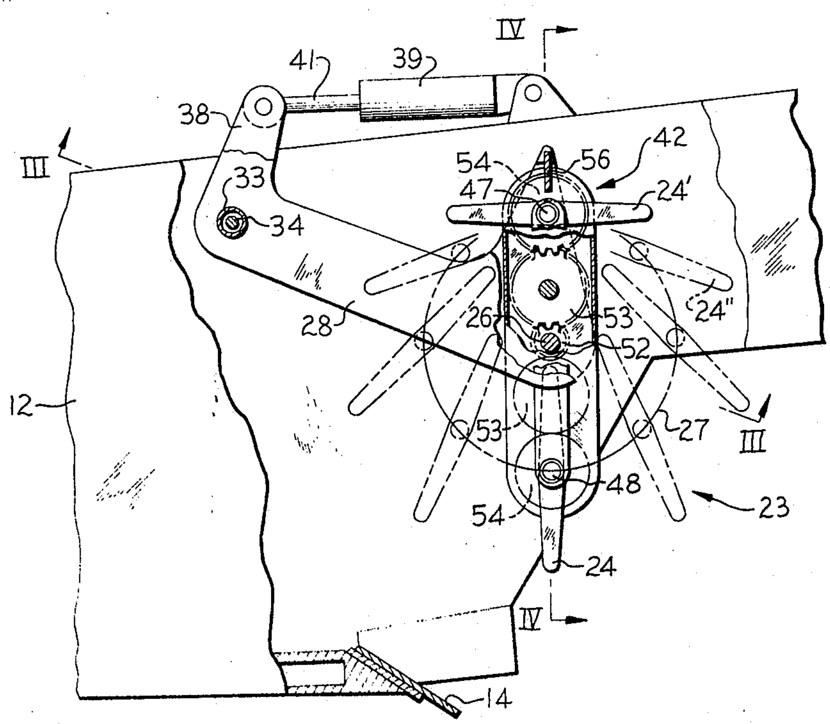
Primary Examiner—Robert E. Pulfrey
Assistant Examiner—C. W. Hanor
Attorney—Fryer, Tjensvold, Feix, Phillips & Lempio

[57] **ABSTRACT**

Movement of earth over the cutting edge of a scraper is assisted by a pair of blades which orbit about an axis of rotation which is parallel to the cutting edge and situated between the blades. Each blade also turns about an axis spaced from the orbit axis to provide a preferred inclination at each portion of the orbit. The blades are supported by the planetary gear carrier of an epicyclic gear set which drives the blades and which has a non-rotating sun gear at the orbit axis.

9 Claims, 13 Drawing Figures



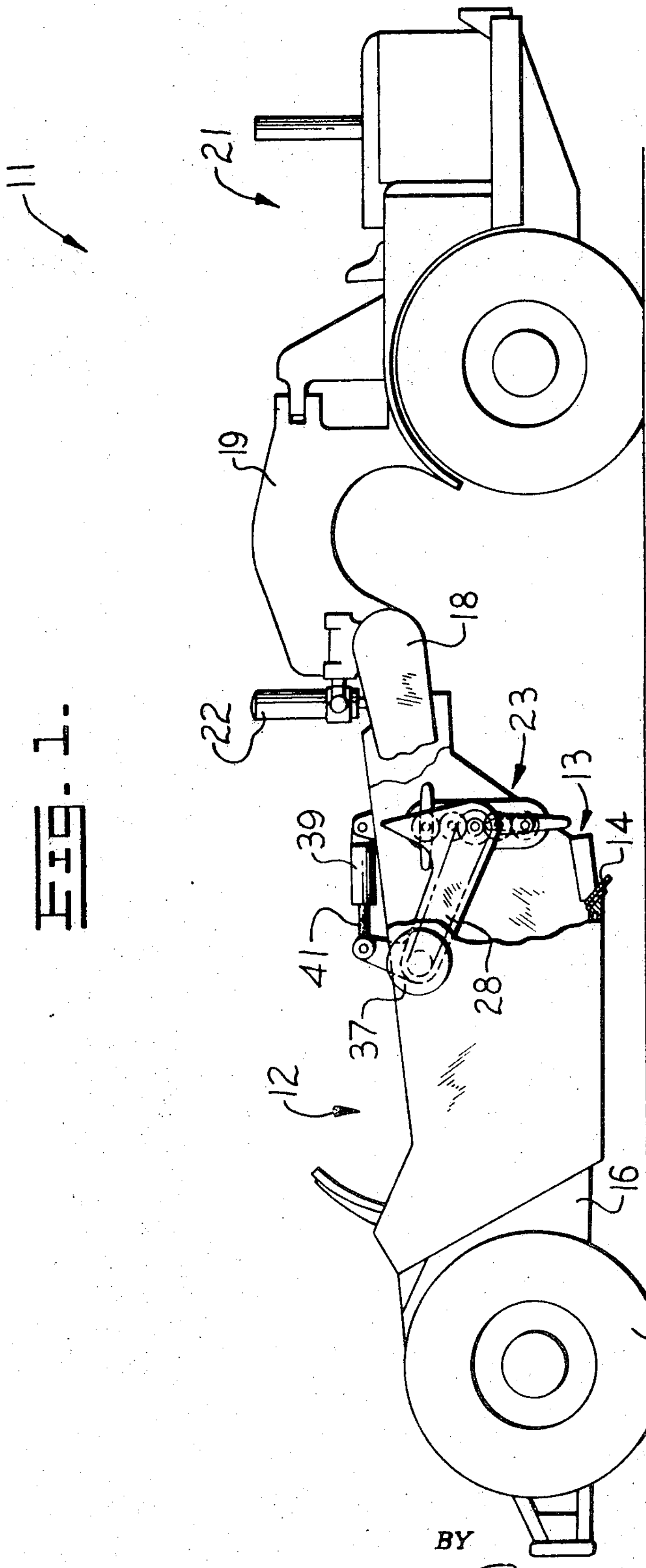


FIG. 1.

INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

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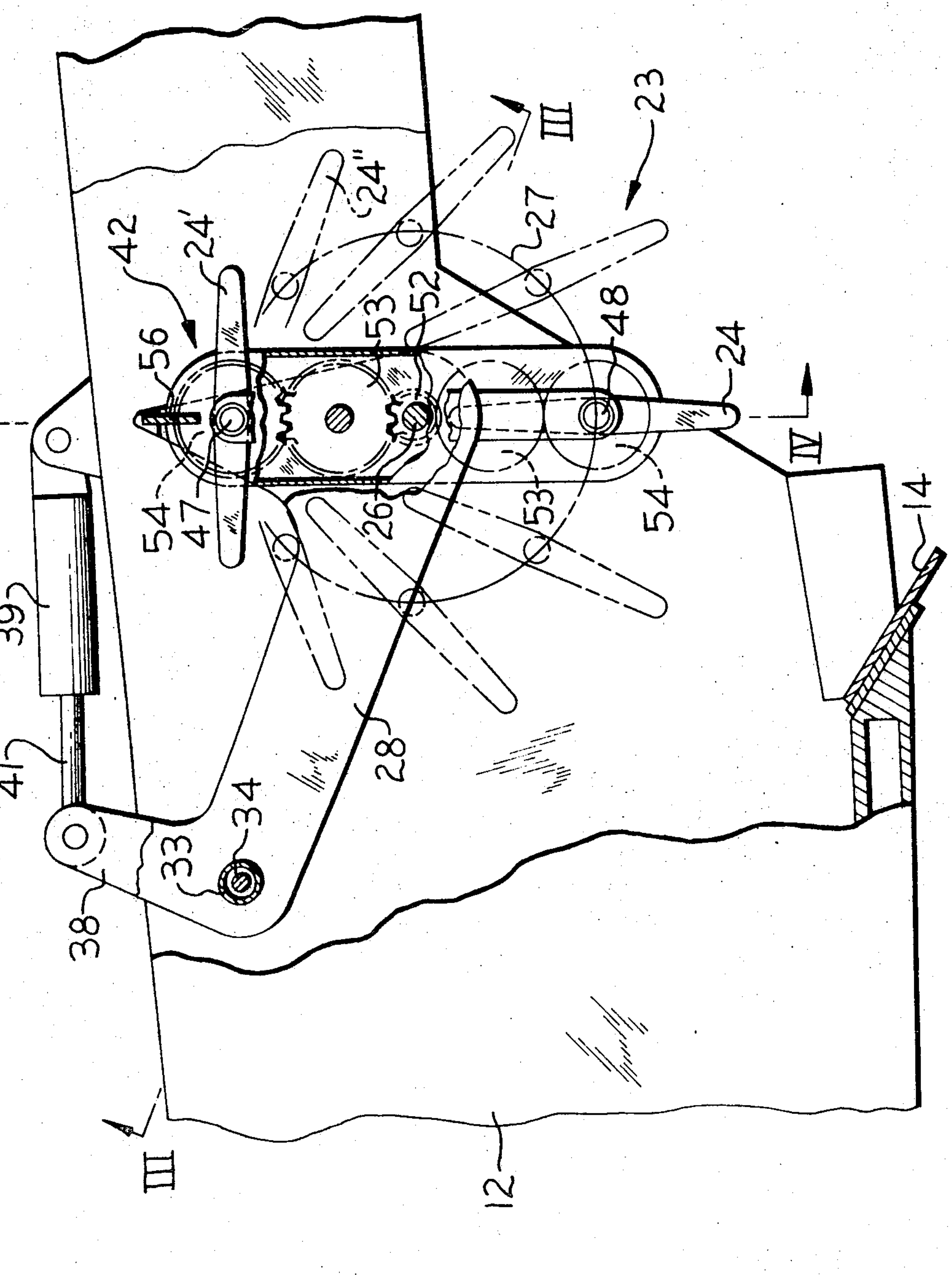
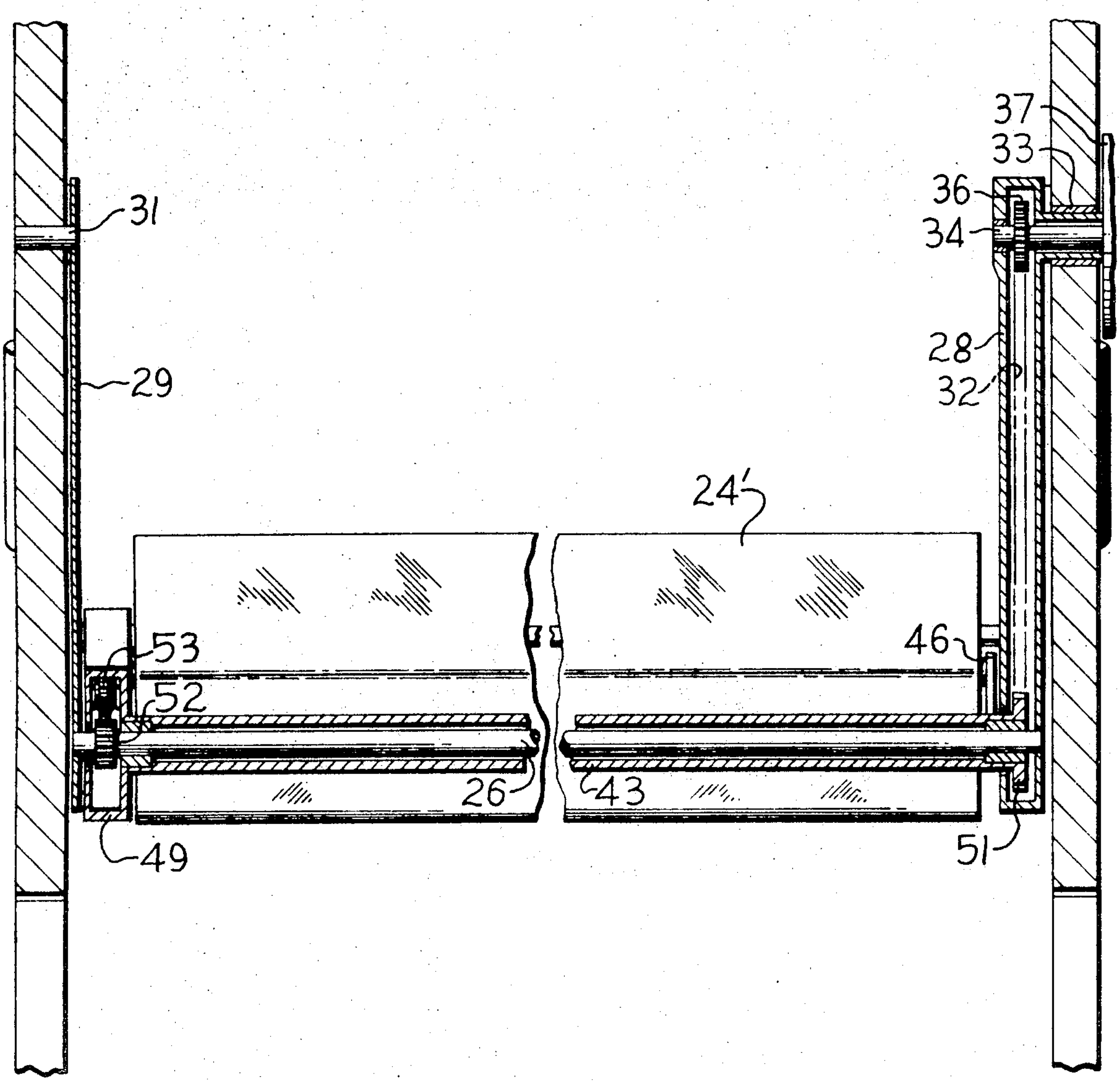


FIG. 2

INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY
Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

Fig. 3

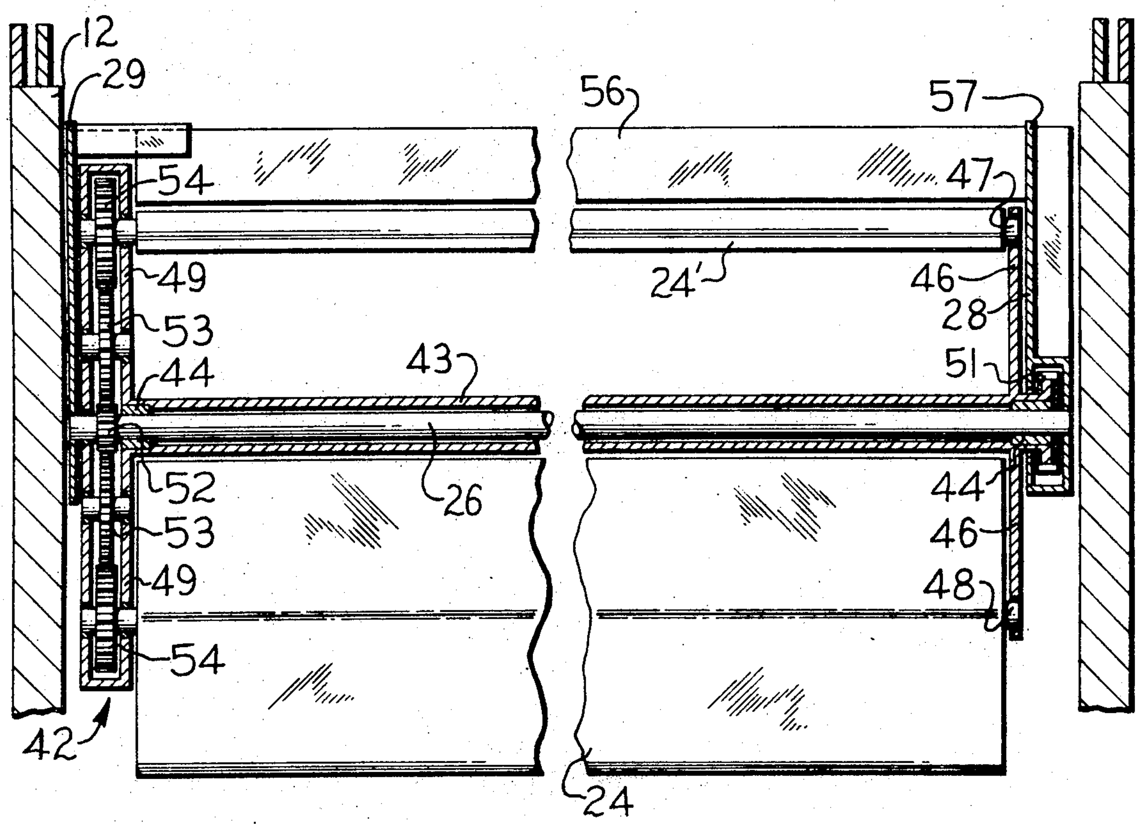


INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

FIG. 4.



INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

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ATTORNEYS

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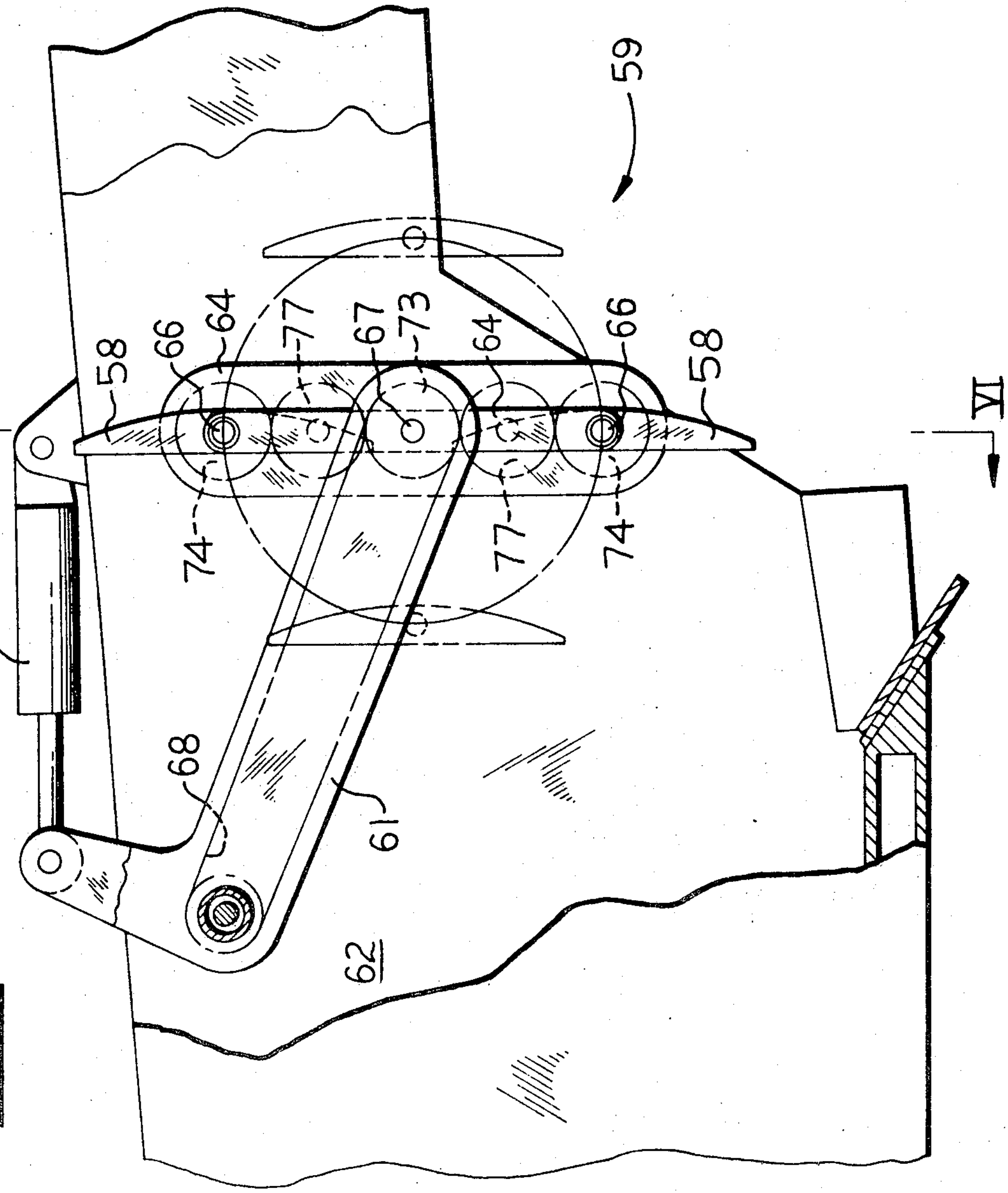


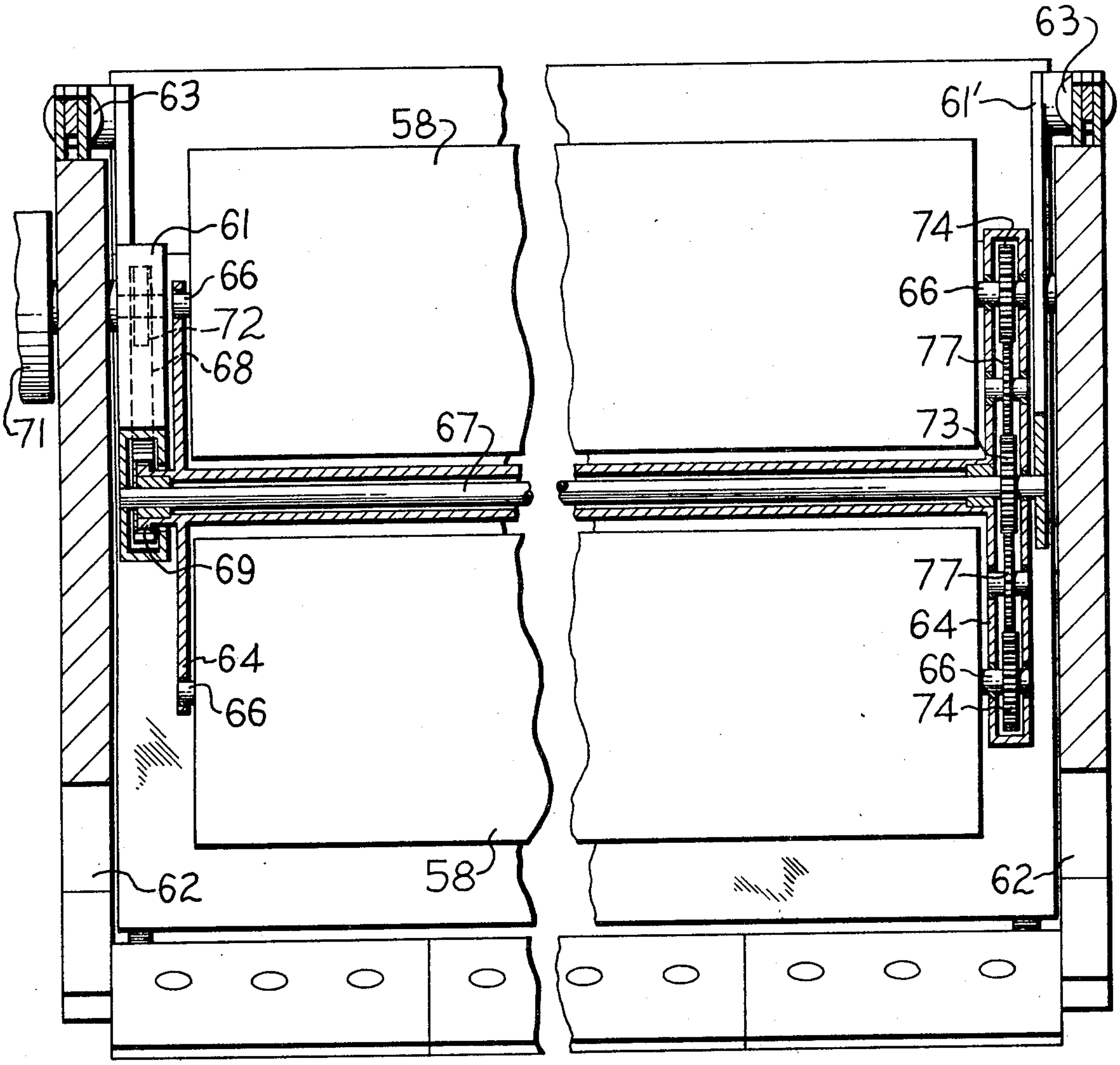
FIG. 5.

INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

Fig. 6



INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

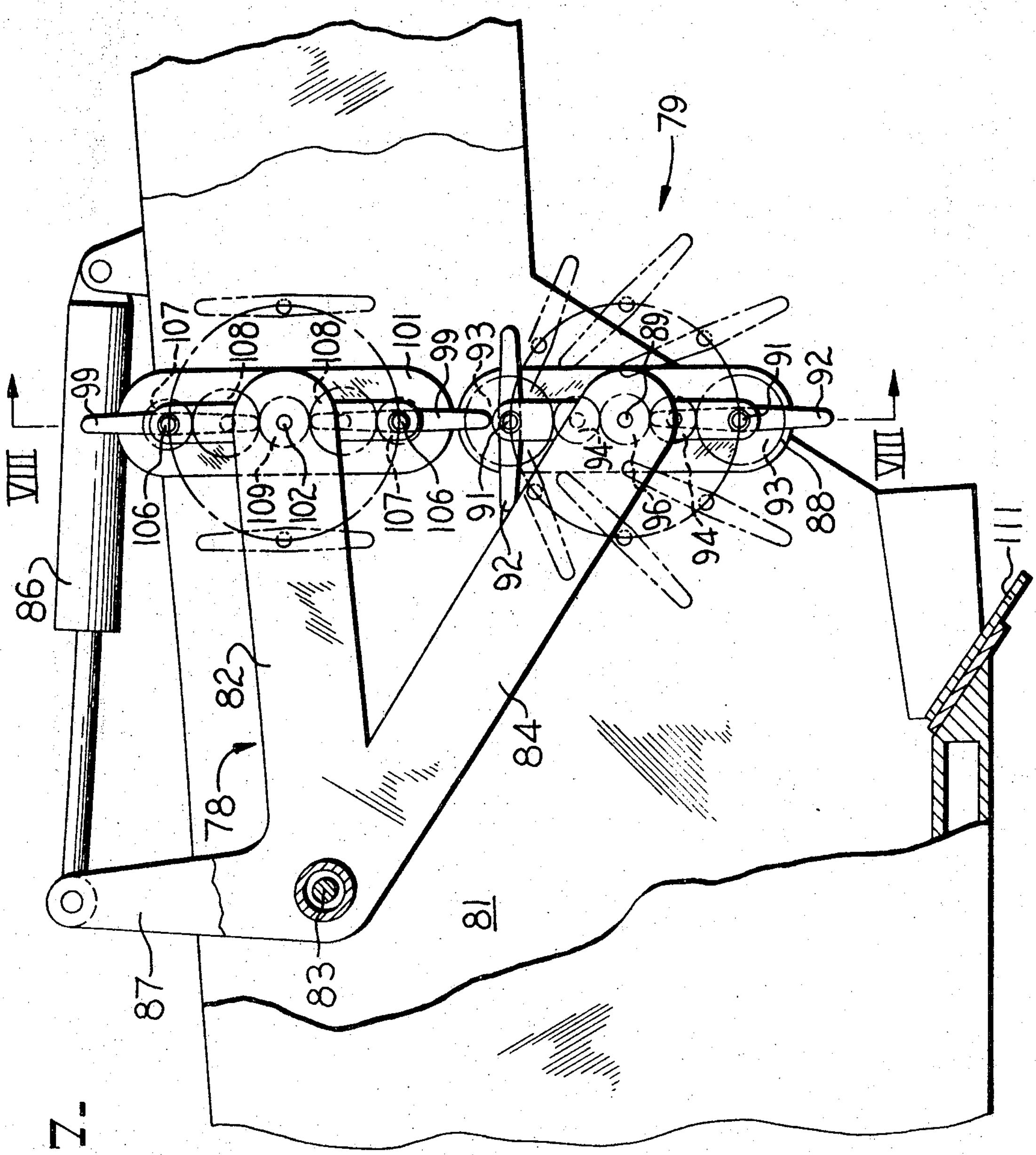


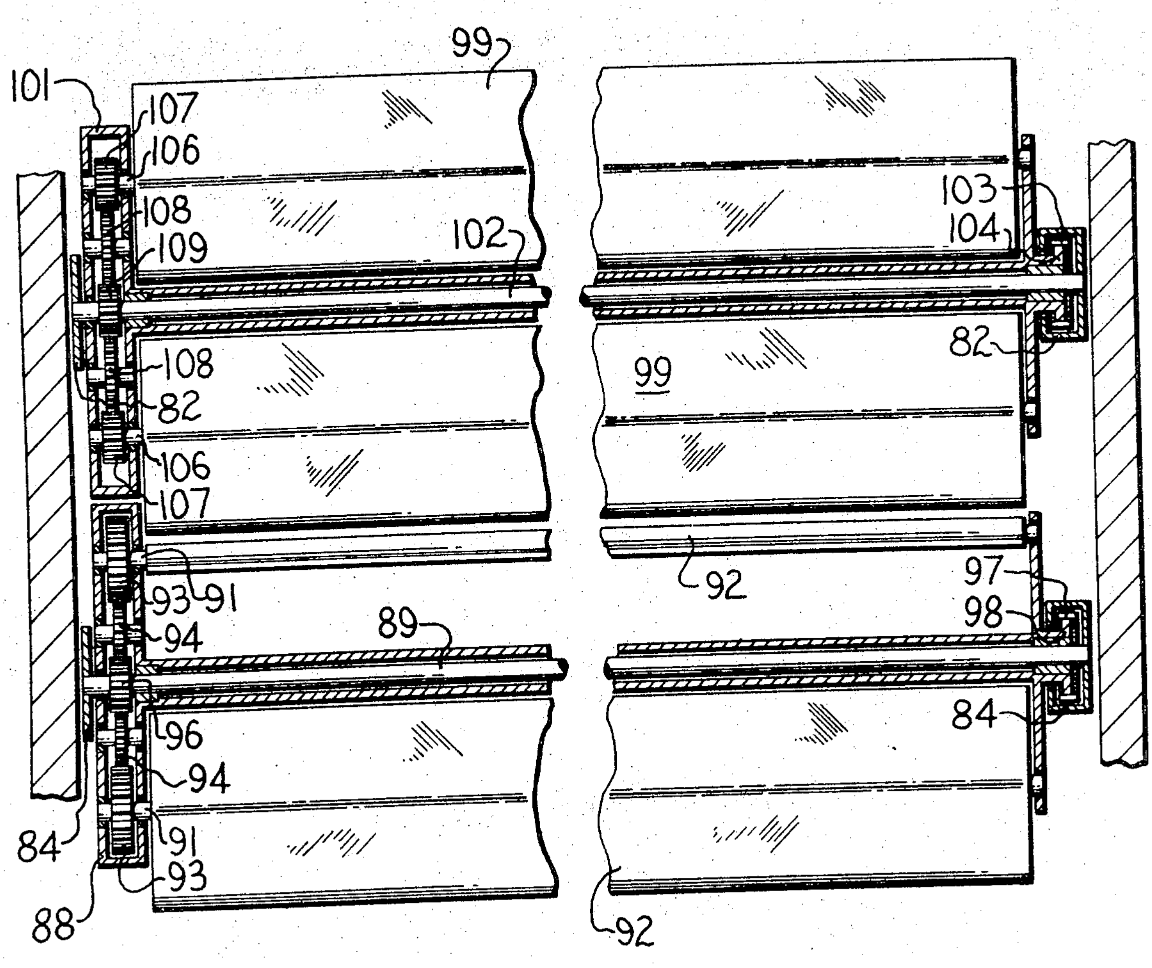
FIG. 7.

INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

FIG. 8



INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

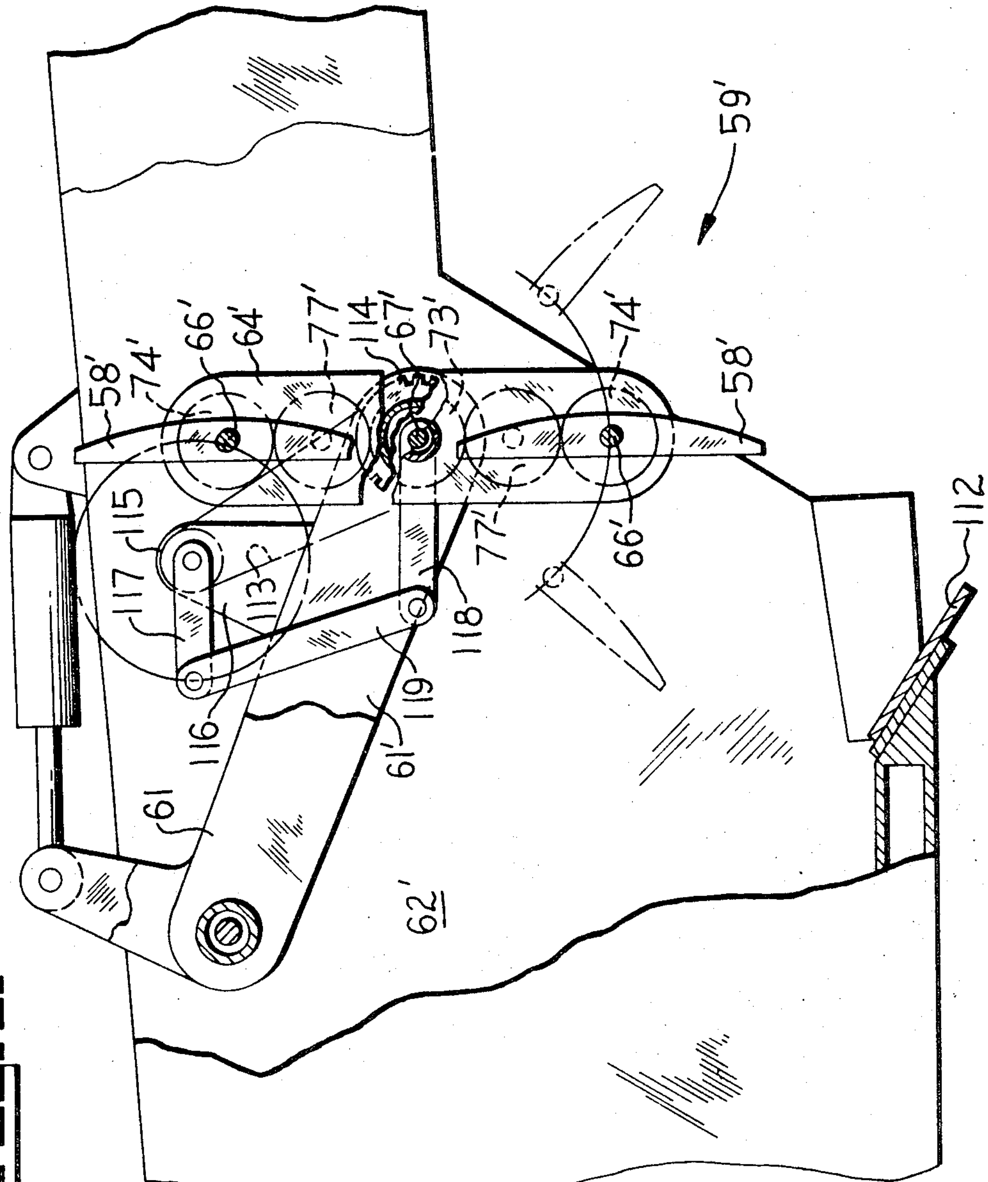


FIG. 9.

INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

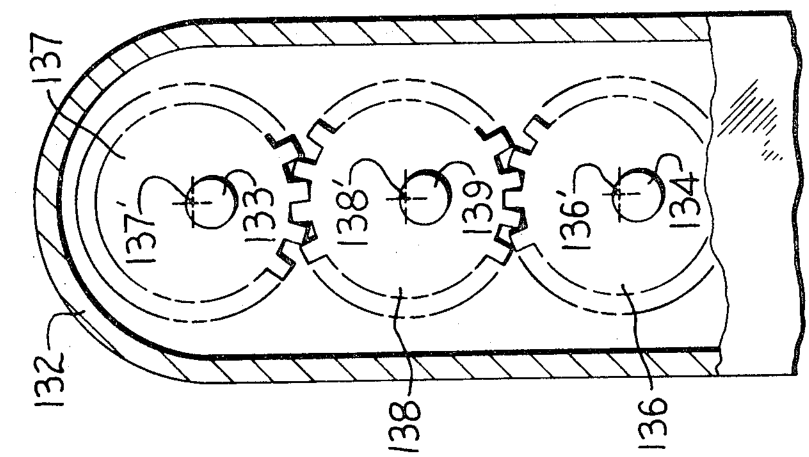


FIG. 11

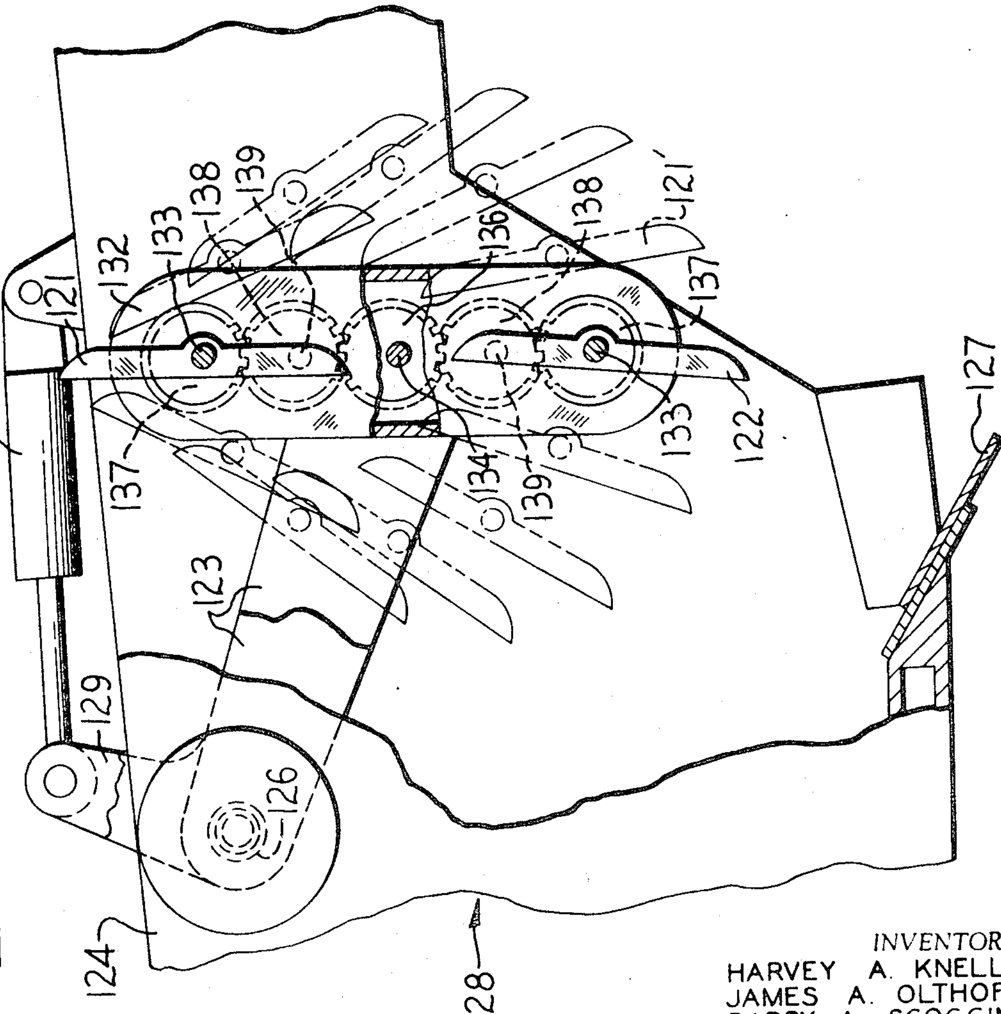


FIG. 10

INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY
Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

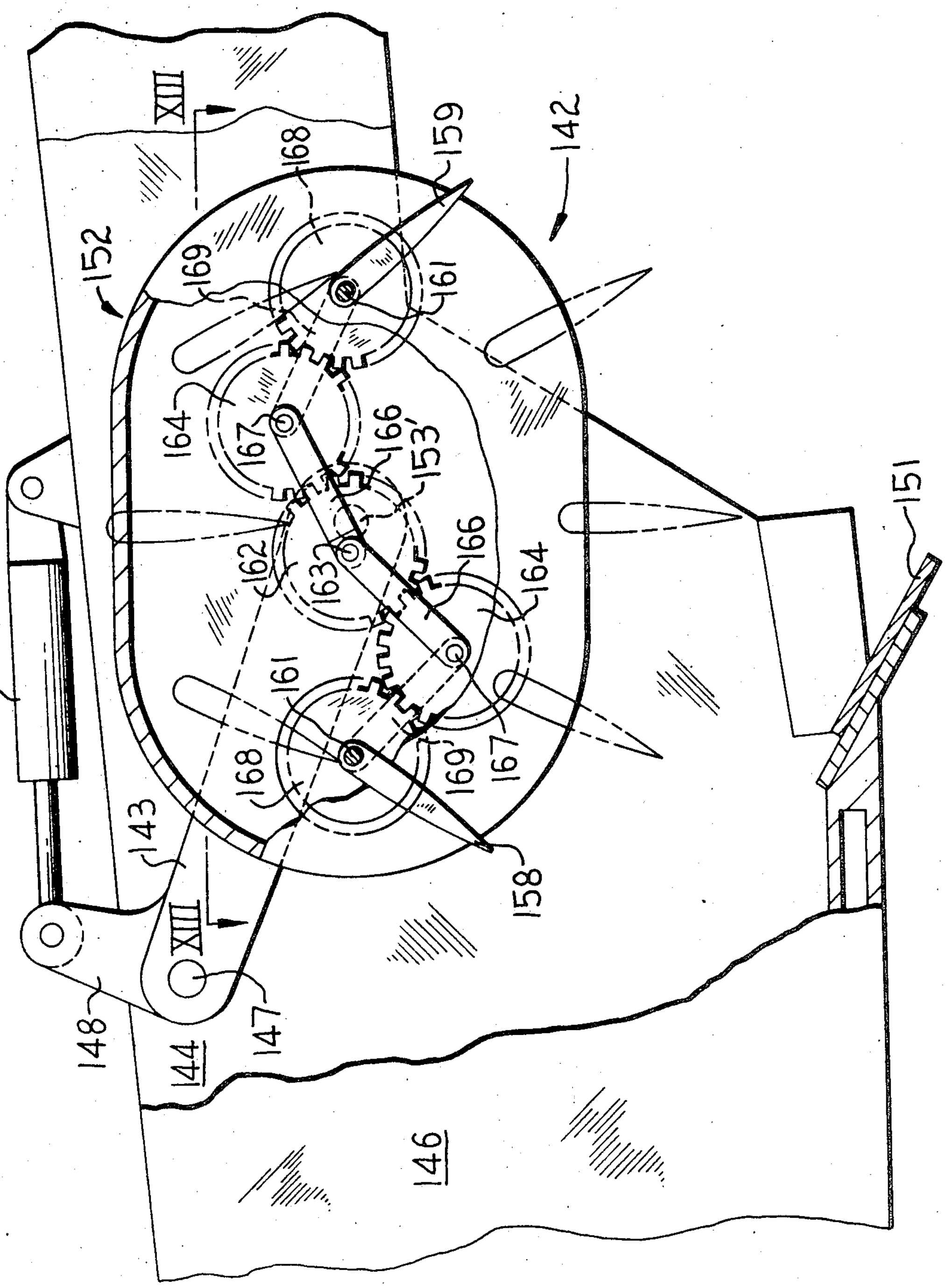


FIG. 12

INVENTORS
HARVEY A. KNELL
JAMES A. OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

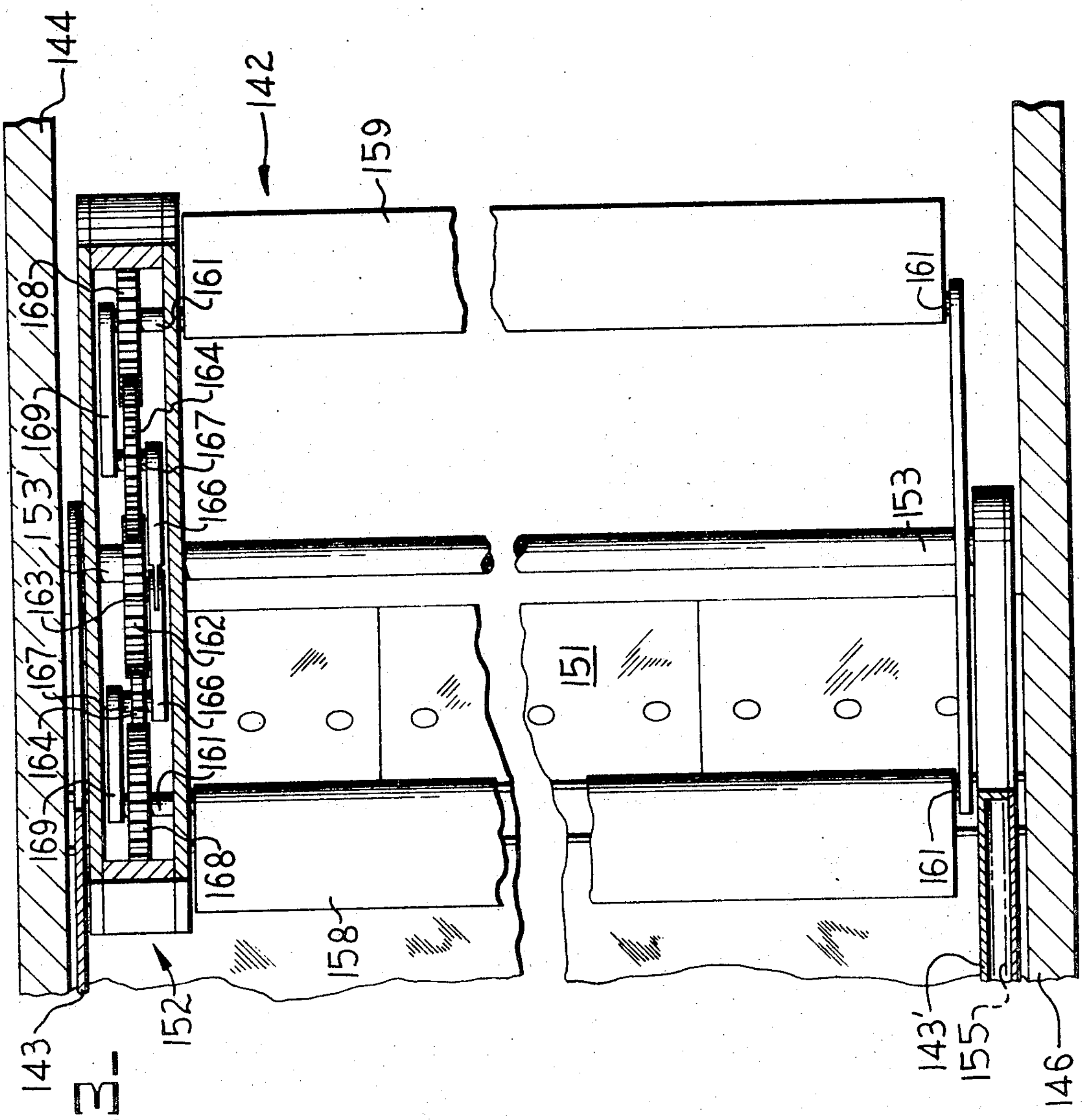


FIG. 13

INVENTORS
HARVEY A. KNELL
JAMES A OLTHOFF
BARRY A. SCOGGIN
ROGER M. SMITH

BY

Fryer, Tjensvold, Feix, Phillips & Lempio
ATTORNEYS

EPICYCLIC SELF-LOADING MECHANISM FOR A SCRAPER

BACKGROUND OF THE INVENTION

This invention relates to scrapers for cutting and moving earth and the like and more particularly to self-loading mechanism for assisting the movement of material into the bowl of a scraper.

Powered scrapers of the type having a tractive unit and a bowl with a cutting edge along an open forward face cannot be fully loaded under many working conditions unless supplementary traction is provided during the final portion of the loading cycle. The use of pusher tractors for this purpose is often necessary as the contents of a partially loaded bowl tends to resist the entrance of additional material. To avoid the need for pusher tractors, a variety of self-loading mechanisms have been developed for the purpose of forcing earth back over the cutting edge and up into the bowl. The most commonly used apparatus of this kind is a chain and flight elevator.

While elevator equipped scrapers have proven highly useful, the load carrying capacity of such a scraper is undesirably low and there are other operating disadvantages as well. An elevator does not force material back into the bowl as strongly as would be desirable and is easily stopped or damaged by large rocks or other irregular objects which may be present at certain work sites. To resolve these difficulties, still other forms of powered self-loading mechanisms have been proposed.

It has heretofore been proposed, for example, to utilize a loading device which consists of two or more blades which orbit around an axis of rotation situated above the cutting edge in parallel relationship therewith and which are maintained in a more or less upright position in the course of the orbiting motion whereby the blades cyclically sweep past the cutting edge and up into the forward portion of the bowl. Such an orbiting blade mechanism is capable of a more forcible loading action and, within limits, acts to push rocks or the like into the bowl rather than presenting an obstacle to the loading of such material.

As heretofore designed, orbiting blade loading mechanisms have tended to be bulky, complex and heavy. To support and drive the blades and to maintain the blades in the upright orientation in the course of the orbiting movement, very large gears and other complicated mechanisms have been required.

SUMMARY OF THE INVENTION

The present invention provides a compact, reliable and efficient mechanism for supporting and driving orbiting blades in a scraper self-loading mechanism of the kind discussed above. In particular, the invention provides for supporting the blades on the planetary gear carrier of an epicyclic gear system in which the sun gear defines the orbit axis and the driven gears are coupled to the blade. The planetary carrier is revolved by powered means to orbit the blades around the sun gear and to revolve the blades about the axes of the driven gears. Blade inclination is determined by the ratio of the pitch radii of the gears. In one form of the invention, the blades may be maintained upright throughout the orbital motion while in another form each blade may revolve once in the course of each orbit, with the blade being upright as it passes near the cutting edge and being horizontal as it passes around the high point of the orbit. Still other variations of blade motion hereinafter described are obtainable with the epicyclic drive structure.

Accordingly, it is an object of this invention to provide more efficient self-loading mechanism for a scraper.

It is another object of the invention to provide more compact and reliable mechanism for supporting, driving and controlling orbiting blades in a scraper loading mechanism.

It is still another object of the invention to provide orbiting blade self-loading mechanism in a scraper wherein the blades have a self-cleaning action.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation view of a scraper with a portion of the bowl sidewall broken out to expose self-loading mechanism in accordance with the invention;

FIG. **2** is a partially broken out view of the forward portion of the bowl region of the scraper of FIG. **1** further illustrating the self-loading mechanism thereof;

FIG. **3** is a section view of the mechanism of FIG. **2** taken along line III—III thereof;

FIG. **4** is a cross-sectional view of the self-loading mechanism of FIG. **2** taken along line IV—IV thereof;

FIG. **5** is a broken out view of the forward portion of a scraper having a second form of self-loading mechanism mounted thereon;

FIG. **6** is a cross section view of the mechanism of FIG. **5** taken along line VI—VI thereof;

FIG. **7** is a broken out view of the forward portion of the bowl of a scraper having a third form of self-loading mechanism mounted therein;

FIG. **8** is a cross sectional view of the self-loading mechanism of FIG. **7** taken along line VIII—VIII thereof;

FIG. **9** is a broken out view of a forward portion of a scraper having a fourth form of the self-loading mechanism mounted thereon;

FIG. **10** is a broken out view of a forward portion of a scraper showing a fifth form of self-loading mechanism in accordance with the invention;

FIG. **11** is a view of gear mechanism utilized in the scraper of FIG. **10**;

FIG. **12** is a broken out view of a forward portion of a scraper embodying still another modification of the self-loading mechanism; and FIG. **13** is a plan section view taken along line XIII—XIII of FIG. **12**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing and more particularly to FIG. **1** thereof, there is shown a typical scraper **11** of the kind to which the invention is applicable. Such a scraper **11** has a bowl **12** with an open forward end **13** with a cutting edge **14** at the lower portion thereof for guiding a layer of earth upward into the bowl as the scraper moves forward.

Bowl **12** is supported at the back end by a frame **16** riding on rear wheels **17** and is supported at the forward end by draft arms **18** connecting with two wheel tractor unit **21** through a gooseneck **19**. To provide for raising and lowering of the bowl **12**, lift jacks **22** are coupled between goose-neck **19** and the forward end of the bowl.

By operating jacks **22**, the cutting edge **14** may be lowered in to engagement with the ground, as the tractor **21** pulls the scraper forwardly to load earth. Under most conditions, a certain amount of earth can be loaded into the bowl **12** by relying on the tractive power of the tractor unit **21** alone. As the bowl fills, the pressure of the material therein resists the entrance of additional earth over the cutting edge **14** thereby tending to limit the capacity of the scraper. To avoid this problem, the invention provides a self-loading mechanism **23** which acts to force material over cutting edge **14** and up into the bowl.

Referring now to FIGS. **2** and **3** in conjunction, the self-loading mechanism **23** has a pair of substantially rectangular blades **24** and **24'** which are driven in an orbital motion about an axis defined by the center line of a shaft **26** which is parallel to the cutting edge **14** and situated above and slightly forward therefrom. By mechanism which will be described in more detail, each of the blades **24** and **24'** travels around the circular orbit **27**, centered on shaft **26**, while also being continually revolved about a parallel axis of rotation coincident with the center line of the blade whereby the blade has an upright orientation as it sweeps rearwardly above the cutting edge **14** and has a horizontal orientation as it moves forwardly at the top of orbit **27**. In FIG. **2**, blade **24** is shown in the upright position at the bottom of the orbit while blade **24'** is shown in the level orientation at the orbit high point, the dashed outlines **24''** illustrating the various intermediate positions which each blade assumes around the orbit **27**. This motion forcibly and efficiently moves earth back into the bowl and exerts a slight lifting action to relieve some of the back pressure against new earth entering over cutting edge **14**.

The blades **24** and **24'** are supported on a pair of arms **28** and **29** situated within bowl **12** and each having a back end pivoted to the bowl sidewalls above and to the rear of the cutting edge **14**. As the blades **24** are driven by means situated within arm **28** while arm **29** provides simply for support and positioning of the blades, the two arms have different constructions. In particular, one arm **29** may be a flat plate member having the back end fastened to the sidewall of bowl **12** through a pivot pin **31**. The other arm **28** is of thicker construction and is hollow to receive and enclose a drive chain **32**. Arm **28** is pivoted to the adjacent sidewall of bowl **12** by a hollow cylindrical axle **33** through which a drive shaft **34** extends to drive a gear **36** on which one end of chain **32** is engaged. Referring now to FIG. **1** in combination with FIG. **3**, drive axle **34** is operated by a hydraulic motor **37** mounted on the outside of the bowl sidewall in coaxial relationship to the drive axle.

To provide for controlled pivoting of the arms **28** and **29**, to adjust the position of loading mechanism **23** with respect to the cutting edge **14**, a short crankarm **38** extends upwardly from the back end of arm **29**, and a fluid jack **39** is fastened to bowl **12** forwardly from the crankarm and has an extensible rod **41** pivotably coupled to the upper end thereof. Thus, extension of jack **39** raises the loading mechanism **23** while contraction of the jack lowers the mechanism towards the cutting edge.

Referring now to FIGS. **2** and **4** in combination, the shaft **26** about which the blades **24** and **24'** orbit extends between the forward ends of arms **28** and **29** and is fixed thereto. Mounted for rotation on shaft **26** is a planetary gear carrier **42** having a hollow cylindrical shaft portion **43** disposed coaxially with respect to shaft **26** and journaled thereon by suitable bearing means **44**. Adjacent arm **28** the carrier **42** has two flat portions **46** which extend radially outwardly from shaft **43** in opposite directions. Each portion **46** rotatably supports an end of an associated one of a pair of blade support axles **47** and **48**. Adjacent arm **29** the carrier **42** has thicker hollow portions **49** which similarly extend in opposite radial directions from shaft **43** to receive and rotatably support the other ends of the blade axles **47** and **48**.

To revolve the carrier **42** on shaft **26**, a gear **51** is situated within arm **28** and is engaged by the previously described drive chain **32**, the gear being coaxial with shaft **26** and rigidly secured to shaft portion **43** of the carrier. Thus, operation of the previously described fluid motor **37** turns the carrier **42** about the axis of rotation defined by shaft **26**.

Axles **48** and **47** extend through the center of blades **24** and **24'** respectively, and are fixedly attached thereto whereby rotation of each axle revolves the associated blade. To revolve the blades, a sun gear **52** is secured to shaft **26** and is engaged by a pair of planetary gears **53** which are rotatably supported within carrier portions **49** on opposite sides of the sun gear. Planetary gears **53** in turn engage driven gears **54** secured to the ends of blade axle shafts **47** and **48** within carrier portion **49**. Thus, gears **52**, **53** and **54** constitute an epicyclic gearing system which acts to revolve blades **24** and **24'** about the axes of shafts **48** and **47** respectively, as the carrier **42** is rotated about shaft **26**, as previously described.

The rate of revolution of the blades **24** and **24'** relative to the rate or orbital motion is dependent on the relative pitch radii of sun gear **52** and driven gears **54**. To realize the particular pattern of blade movement which was previously described and which is illustrated in FIG. **2**, sun gear **52** has a pitch radius equal to one-half of that of the driven gears **54**.

The effectiveness of the self-loading mechanism **23** is reduced if any sizable quantity of earth sticks to the blades **24** and **24'** and accumulates thereon. To avoid this problem, a fixed wiper plate **56** extends between upward projections **57** of arms **28** and **29** in a position where the surface of each blade **24** and **24'** scrapes along the lower edge of the wiper plate at the top of the blade orbit **27**. It may be observed that opposite surfaces of each blade **24** and **24'** are cleaned in this manner during alternate orbits as each blade rotates only 180° about its axle shaft **47** or **48** in the course of making a complete orbit around shaft **26**.

While the scraper **11** may be equipped with a conventional apron for the purpose of retaining earth in the bowl once it is filled, this is generally unnecessary as the loading mechanism **23** may be operated to position one of the blades **24** or **24'** in its lower upright position and jacks **41** may be operated to lower such blade to a level immediately above the cutting edge **14**. In situations where this does not provide adequate retention of material in the bowl **12** during the carry phase of the scraper cycle, the loading assist mechanism 23 may be operated continuously at this time for the purpose of preventing loss of material.

Depending on the type of material being worked, as well as other factors, modified patterns of blade movement may be preferable. Referring now to FIGS. 5 and 6 in conjunction, there is shown a second embodiment of the invention wherein two orbiting loading blades 58 are arranged to remain upright at all portions of the orbit.

Much of the structure of the loading assist mechanism 59 of this embodiment may be essentially similar to that previously described. Thus, support arms 61 and 61' are attached to the side walls of a scraper bowl 62 and may be pivoted by means of a jack 63. Blades 58 are again mounted between epicyclic gear carrier members 64 by means of axle shafts 66 and the carrier is rotatably mounted on the arms 61 and 61' on a transverse shaft 67 extending therebetween. Carrier 64 may be rotated about shaft 67 by means of a drive chain 68 situated within arm 61 and engaging a gear 69 rigidly fixed to the carrier. Chain 68 is again driven by a fluid motor 71 coupled to a gear 72 within the back end of arm 61.

A significant difference between the present embodiment and that previously described is that the sun gear 73 within carrier 64, which is coupled to driven gears 74 of the blade axle shafts 66 through planetary gears 77, has the same pitch radius as the driven gear. The relative pitch radius of the planetary gears 77 is immaterial insofar as the pattern of movement of the blades is concerned. Thus, as shown in FIG. 5 in particular, each blade 58 revolves 360° about its associated axle shaft 76 as the blade makes a full 360° orbit about support shaft 67. Accordingly, both blades 58 remain upright throughout the orbital motion.

Referring now to FIGS. 7 and 8 in combination, a third embodiment of the invention is shown which combines the blade motion patterns of the two previously described embodiments to achieve certain highly desirable results. In particular, the embodiment of FIGS. 7 and 8 provides for more positive retention of the contents of the bowl at the upper region thereof.

In this embodiment of the invention, the arms 78 which support the self-loading mechanism 79 are angled and pivoted to the side walls of bowl 81 at the angle whereby each has an upper sub-arm 82 which extends in a generally forward direction from the pivot point 83 and a lower subarm 84 extending forward and downward therefrom. As in the previous cases, a fluid jack 86 is connected between the bowl side wall and a crank projection 87 of one arm 78 to selectively pivot the arms and the associated self-loading mechanism 79.

An epicyclic gear carrier 88 is rotatable about a fixed shaft 89 which extends between the forward ends of the lower sub-arms 84 and rotatably supports the axle shafts 91 of a pair of blades 92 in a manner similar to that previously described with reference to the embodiment of FIGS. 1 to 4. Each axle shaft 91 has a driven gear 93 mounted thereon which engages an associated planetary gear 94 journalled to carrier 88. Planetary gears 94 in turn engage a sun gear 96 secured to support shaft 89. Epicyclic gear carrier 88 is again driven by means of a drive chain 97, within one sub-arm 84, which engages a gear 98 secured to the carrier and situated coaxially with respect to support shaft 89. Accordingly, as the carrier 88 is revolved about support shaft 89, blades 92 revolve about axle shafts 91. Driven gears 93 have pitch radii twice the pitch radius of sun gear 96 whereby each blade is substantially upright at the bottommost portion of the orbit and is horizontal at the top point of the orbit.

The upper sub-arm 82 carries a pair of blades 99 arranged for the pattern of movement previously described with respect to the embodiment of FIGS. 5 and 6. In particular, a planetary carrier 101 is arranged for rotation about a fixed shaft 102 extending between the upper sub-arms 82 and is driven by a drive chain 103 within a sub-arm 82 which engages a gear 104 secured to the carrier. Blades 99 are each supported by an axle shaft 106 journalled in opposite ends of carrier member 101 and each has a driven gear 107 secured to the associated axle shaft.

Driven gears 107 are engaged by planetary gears 108, mounted on carrier 101, which engage a sun gear 109 fixed to support shaft 108 within sub-arm 82. Sun gear 109 and driven gears 107 have equal pitch radii whereby blades 99 are maintained upright at all times as carrier 101 is rotated.

Thus in operation, the lower blades 92 tend to move earth both backwardly and upwardly over the cutting edge 111 while the upper blades 99 act to hold earth within the bowl at the upper forward region thereof. By proportioning the two components of the loading mechanism 79 whereby the lower edges of upper blades 99 cyclically sweep along the surface of the lower blades 92 at the top of the lower blade orbit, a highly efficient cleaning action for the lower blades is realized.

In any of the above-described self-loading mechanisms, still more complex blade motions may be provided for where necessary. FIG. 9, for example, illustrates a further embodiment of the invention wherein an advantageous blade oscillation is superimposed upon an orbiting motion which is basically of the type hereinbefore described with reference to the embodiment of FIGS. 5 and 6. Referring now to FIG. 9, the loading mechanism 59' may include a planetary carrier 64' rotatable about a support shaft 67' carried by arms 61 and 61' having back ends pivoted to the side walls of bowl 62', all as previously described with reference to the embodiment of FIGS. 5 and 6. As in the previous instance, a pair of loading blades 58' are supported on carrier 64' by axle shafts 66' journalled thereto and each has a driven gear 74' on the axle shaft. Driven gears 74' engage planetary gears 77' in the carrier, which in turn engage a sun gear 73' mounted on support shaft 67' for oscillation thereon. Sun gear 73' has the same pitch radius as driven gears 74'. Thus, if the sun gear were fixed with respect to support shaft 67', the blades 58' would be maintained in a strictly upright position as the blades orbit about the axis of support shaft 67' as in the case of the embodiment of FIGS. 5 and 6.

To aid in the penetration of the blades 58' into material immediately above the cutting edge 112 and to increase the horizontal sweep of the blades in the region above the cutting edge, oscillatory motion is superimposed upon the basic orbiting motion as described above. A chain 113, driven by gear 114 on carrier 64', drives gear 115 supported on a bracket 116 extending upward from arm **61'**, and rotates a crank arm **117**. A second crank arm **118** projects radially from the sun gear **73'** and is coupled to the first crank arm **117** by a link **119** through pivot joints at each end of the link. Thus, as chain **113** rotates arm **117**, the sun gear **73'** is oscillated angularly on support shaft **67'**. This in turn imparts an oscillatory motion to both blades **58'**, which is superimposed on the basic orbiting movement as described above. In most instances, it is preferable to proportion the linkage and gearing whereby the blades **58'** are in a substantially perpendicular position at the lowermost portion of the orbit and are oscillated to remain in alignment with a radius of the orbit during the subsequent 45° of orbital motion before returning to an upright position at the top of the orbit.

FIGS. **10** and **11** of the drawing illustrate still another means for superimposing a somewhat similar oscillatory movement upon an orbiting motion of the blades of a self-loading mechanism wherein the epicyclic gearing is formed by eccentric gear elements.

The supporting structure for a pair of blades **121** and **122** may again be essentially similar to that previously described for the embodiment of FIGS. **5** and **6**, and as shown in FIG. **10**, includes support arms **123** which are pivoted to the inner sidewalls **124** of the scraper by pivot joints **126** situated above and slightly to the rear of the cutting edge **127** of the scraper bowl **128**. At least one of the support arms **123** has a short angled crank extension **129** and a hydraulic jack **131** is coupled between extension **129** and the bowl sidewall **124** to control the pivoting of arm **123** about the axis of pivot connection **126**. Blades **121** and **122** are again mounted on an epicyclic gear carrier **143** by transverse axle shafts **133** and the carrier is rotatable about a transverse support shaft **134** carried by arms **123** and extending parallel to axle shafts **133** midway therebetween. Carrier **132** may be rotated about as previously described, and thus the loading blades **121** and **122** are caused to orbit about the axis of shaft **134** to assist the loading of material.

Considering now means for varying the attitude of the loading blades **121** and **122** in an optimum manner in the course of the orbiting motion described above, a sun gear **136** is mounted on shaft **134** within carrier **132**. Sun gear **136** is secured to shaft **134** to be non-rotatable relative thereto and the shaft is, in turn, secured to arm **123** in a non-rotatable manner so that the sun gear does not turn with the carrier. A driven gear **137** is mounted on each axle **133** and is secured thereto whereby rotation of the driven gear turns the axle and thus revolves the associated loading blade **121** or **122**. Driven gears **137** engage planetary gears **138**, which in turn engage the sun gear **136**, the planetary gears being journalled to carrier **132** by axles **139**.

Sun gear **136**, planetary gears **138** and driven gears **137** have equal pitch radii, and thus as described to this point, the embodiment of FIG. **10** is basically similar to that previously described with reference to FIGS. **5** and **6** in that the blades **121** and **122** make one full revolution about the axles **133** in the course of one full orbiting movement about support shaft **134**. Thus, in the absence of further provisions, the blades would remain upright throughout the orbiting motion.

As previously discussed, optimum performance is realized if the attitude of the blades **121** and **122** is varied in the course of the orbiting motion whereby the lower edge of each blade is swung forward, relative to the top edge, during the upper portion of each orbit and rearward during the lower portion of the orbit. In other words, the rate of revolution of each blade about its axle **133** should not be uniform throughout the orbiting motion, but should be relatively fast at the top of the orbit and relatively slow at the bottom thereof. Referring now to FIG. **11**, this is accomplished in the present embodiment by eccentrically disposing each of the epicyclic gears **136, 138** and **137** with respect to the associated shaft. In particular, each such gear is circular but the geometrical center of the gear is displaced from the axis of the associated shaft. Thus, with the carrier **132** in its vertical position wherein shafts and axles **134, 139** and **133** are all in a vertical plane, the geometrical center **136'** of sun gear **136** is situated slightly above the axis of shaft **134** so that the sun gear is eccentrically positioned relative to the axis of rotation of the carrier. Similarly, the geometrical centers **138'** and **137'** of planetary gears **138** and driven gears **137**, respectively, are also upwardly displaced from the axis of the associated shafts **139** and **133**, respectively.

Thus, as carrier **132** rotates about shaft **134**, the effective pitch radius of sun gear **136** relative to a particular driven gear **137** decreases as the driven gear descends while the effective radius of the driven gear increases. An opposite effect occurs as the particular driven gear **137** ascends during the second half of the orbit. Thus, the rate of rotary motion of each blade **121** or **122** about its own axle **133** decreases as the blade descends and increases as the blade ascends, thereby producing the desired change in blade attitude illustrated by dashed blade outlines **121'** in FIG. **10**.

The mechanism has been herein described in a construction where the blades **121** and **122** reach a substantially upright position at the top and the bottom of the orbit. In instances where it may be desirable that the upright position be reached at some other orbital position, this is readily arranged for by merely rotating the sun gear **136** an appropriate amount and refastening the gear to support shaft **134**. Similarly, the degree to which the blades **121** and **122** deviate from an upright position in the course of the orbit may be controlled by providing different amounts of displacement of the geometric centers of gears **136, 138** and **137** from the axes of the associated shafts. An essentially similar action to that of the embodiment of FIGS. **10** and **11** may be realized by utilizing non-circular eccentric gears but the use of circular gears, with displaced axes of rotation as herein described, is preferable from the standpoint of reduced manufacturing cost.

FIGS. **12** and **13** illustrate still another modification of the mechanism for realizing a variation in blade attitude in the course of the orbiting motion. The self-loading mechanism **142** is again carried on pivotal support arms **143** and **143'** having back ends pivoted to the inner sidewalls **144** of a scraper bowl **146** by pivot couplings **147** and having a crank arm **148** coupled to the bowl sidewall by a fluid jack **149** to adjust the height of the loading mechanism relative to the scraper cutting edge **151**.

An epicyclic gear carrier **152** is rotatably supported between arms **143** and **143'**, the hollow shaft **153** situated along the rotary axis of the carrier being extended into arm **143'** for this purpose and a short axle **153'** being secured to the other arm **143** to support the opposite side of the carrier. Drive means **155**, which may be similar to that previously described, are situated within arm **143'** to turn the carrier **152**. A pair of loading blades **158** and **159** are supported by carrier **152**, each being on an opposite side of shaft **153** and each being coupled to the carrier by axles **161** whereby each blade may turn relative to the carrier while being orbited around shaft **153** by the rotary motion of the carrier itself. In this embodiment of the invention, the loading blades **158** and **159** are of less vertical extent, the axles **161** being situated adjacent the top edge of each blade.

Considering now the modified mechanism by which the attitude of the blades **158** and **159** is varied in the course of the orbital motion, a circular sun gear **162** is fixed to axle **153'** and thus does not rotate when the carrier **152** turns. The geometrical center **163** of sun gear **162** is spaced rearwardly from the axis of shaft **153** whereby the sun gear is eccentric with respect to the axis of rotation of the carrier **152**.

Two planetary gears **164** engage sun gear **162** and are situated on opposite sides thereof. Each such planetary gear **164** is held in engagement with the sun gear **162** by a link **166** which extends from the center of that particular planetary gear to the geometrical center of the sun gear, the link being coupled to the center of each gear by a pin **167** which extends axially from the gear. Thus, each of the planetary gears **164** may orbit around sun gear **162**, but may not move out of the engagement therewith. A separate driven gear **168** engages with each of the planetary gears **166** and is coaxially secured to the axle **161** of an associated one of the loading blades **158** and **159**, the two driven gears **168** being equidistant from the axis of carrier **152** and situated on opposite sides thereof. Driven gears **168** are spaced from sun gear **162** a distance less than the diameter of planetary gears **166** which are offset from a line extending through the geometrical centers of gears **162** and **168** for reasons which will hereinafter be apparent. One of a pair of links **169** extends between the axle **161** of each driven gear **168** and the pin **167** of the adjacent planetary gear **164** to hold the gears in engagement.

As the sun gear **163** if fixed to arm **143** through axle **153'**, turning of the carrier **152** as previously described causes planetary gears **164** to ride around the sun gear and to revolve about their own axle pins **167** while doing so. The rotational movement of the planetary gears **164** about their axle pins **167**, is, in turn, imparted to driven gears **168** which also turn as the carrier revolves.

The sun gear **162**, planetary gears **164** and driven gears **168** all have equal pitch radii and thus if the sun gear were not eccentrically positioned, the gearing system would maintain the loading blades **158** and **159** in a constant attitude during the course of orbital motion about shaft **153**.

However, the effect of the eccentric relationship of the sun gear **162** to the axis of the orbit described by driven gears **168** is to vary the effective pitch diameter of the sun gear at different portions of the orbit. In particular, the effective pitch diameter of the sun gear **162** relative to a particular planetary gear **164** decreases during the top half of the planetary gear orbit and increases during the bottom of the orbit. This, in turn, causes the lower edge of each loading blade **158** or **159** to swing forward relative to the top edge of the blade during the top portion of the orbit of the adjacent planetary gear **164** and to swing back during the bottom portion of the planetary gear orbit.

Each loading blade orbits in advance of the associated planetary gear **164**, due to the continuously varying angle formed by links **166** and **169**. Thus, the reversal of the swinging movement of the loading blades does not occur when the driven gears **168** first enter the top and bottom halves of the orbit, but is delayed an amount determined by the length of links **166** and **169** in relation to the diameters of the gears. In a scraper proportioned as shown in FIGS. **12** and **13**, these reversals of swinging movement occur at 119° and 313° if the highest position of the blade is considered to be 0°. The amplitude of the swinging movement is determined by the amount of offset of sun gear **162** from the rotary axis of carrier **152**. As in the previously described embodiment, the position in the orbit at which the blades **158** and **159** assume a vertical alignment, which is 0° and 180° in the present example, may be changed by shifting sun gear **162** angularly about the geometrical center **163** of the gear.

It will be apparent that various other combinations of the above-described blade motions are possible through appropriate modifications in the structure wherein the basic pattern of movement is determined by epicyclic gearing.

What is claimed is:

1. In combination with a scraper having a bowl with an opening receiving material therein, a self-loading mechanism comprising:

a. arm means comprising arms locating said mechanism in said bowl and pivoted to said bowl, one of said arms being hollow and containing drive means, one end of which is operatively connected to motor means,

b. epicyclic gear means mounted in a carrier assembly at the side of said bowl opposite said hollow arm, having a sun gear means attached to a non-rotating shaft extending between said arms and defining a first axis of rotation about which said carrier rotates, said carrier being operatively connected to said drive means by a hollow shaft coaxial with said non-rotating shaft and being rotatably connected to said arms,

c. at least one loading blade rotatably attached to said carrier by attaching means and defining a second axis of rotation spaced from and parallel to said first axis,

d. blade orientation controlling gear means operatively connected to said sun gear and said attaching means of said one blade including planetary gear means revolving around said sun gear and driven by a gear attached to said attaching means.

2. The combination defined in claim **1** wherein said carrier includes a housing substantially enclosing said epicyclic gear means.

3. The combination defined in claim **2** wherein said sun gear and said driven gear have equal pitch radii whereby said blade remains at a single predetermined attitude as said carrier revolves about said first axis.

4. The combination defined in claim **1** wherein the pitch radius of said driven gear is twice the pitch radius of said sun gear whereby said blade undergoes substantially one-half of a full revolution about said second axis as said carrier undergoes a complete revolution about said first axis.

5. The combination defined in claim **4** wherein said arm means comprises a blade wiper member secured to said arms and positioned thereon to sweep a surface of said blade as said blade orbits about said first axis and revolves about said second axis.

6. The combination defined in claim **1** wherein said sun gear means comprises means imparting a limited angular oscillation to said sun gear about said first axis of rotation as said carrier revolves therearound.

7. In a scraper having a bowl with an open end, a cutting edge at said open end, mechanism for assisting the movement of material into said bowl comprising:

a pair of support arms each being pivoted to a separate side of said bowl and extending into said open end thereof, one of said arms being hollow,

an epicyclic gear carrier rotatably supported by a non-rotating shaft between the ends of said support arms for revolution about a first axis of rotation which extends therebetween in parallel relationship to said cutting edge, said carrier having members adjacent each arm which extend radially with respect to said first axis in opposite directions,

axle means extending from said radially projecting members of said carrier on opposite sides of said first axis and in parallel relation thereto,

a pair of blades disposed between said carrier members on opposite sides of said axis of rotation, said blades being supported by said axle means

means for revolving said carrier about said first axis, said means being contained in said hollow arm, and being operatively connected to motor means, a hollow drive shaft rotatably mounted between said arms for rotation about said first axis, said drive shaft being connected to said carrier and to said means for revolving said carrier,

a sun gear disposed about said non-rotating shaft along said first axis of rotation, said sun gear being adjacent a first of said support arms,

a pair of planetary gears mounted on said carrier and engaged with said sun gear and disposed on opposite sides thereof, said planetary gears being orbited around said sun gear by said revolving of said carrier, and

a pair of driven gears mounted on said carrier, each engaging a separate one of said planetary gears and each being coupled to said axle means of a separate one of said blades for revolving said axle means and said blades about a second axis of rotation defined by said axle means as said carrier revolves about said first axis of rotation.

8. In a scraper having a bowl with an opening and a cutting edge thereat, self-loading mechanism comprising:

a. plural arm means locating said mechanism in said bowl and pivoted to said bowl, one of said arm means being hollow and containing drive means operatively connected and to motor means,

b. plural epicyclic gear means mounted in carrier assemblies at the side of said bowl opposite said hollow arm means, each epicyclic gear means having a sun gear attached to a non-rotating shaft extending between said arm means and defining upper and lower first axes of rotation about which said carriers rotate, said carriers being operatively connected to said drive means by hollow shafts coaxial with said non-rotating shafts and being rotatably connected to said arm means,

c. at least one loading blade rotatably attached to each of said carrier assemblies and defining upper and lower second axes of rotation spaced from and parallel to said respective first axes of rotation,

d. blade orientation controlling gear means operatively connected to each of said sun gears and said attaching means of each of said one blades, including planetary gear means revolving around said sun gears and driven by a gear attached to said attaching means.

9. The combination of claim **8**, wherein said gear attached to said attaching means in said lower epicyclic gear means has a pitch radius of twice that of the sun gear in said lower epicyclic gear means and wherein the gear attached to said attaching means in said upper epicyclic gear means has a pitch radius equal to that of the sun gear of said upper epicyclic gear means.

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