May 28, 1957 J. D. RUSSELL 2,793,732

MOBILE LOADING MACHINE

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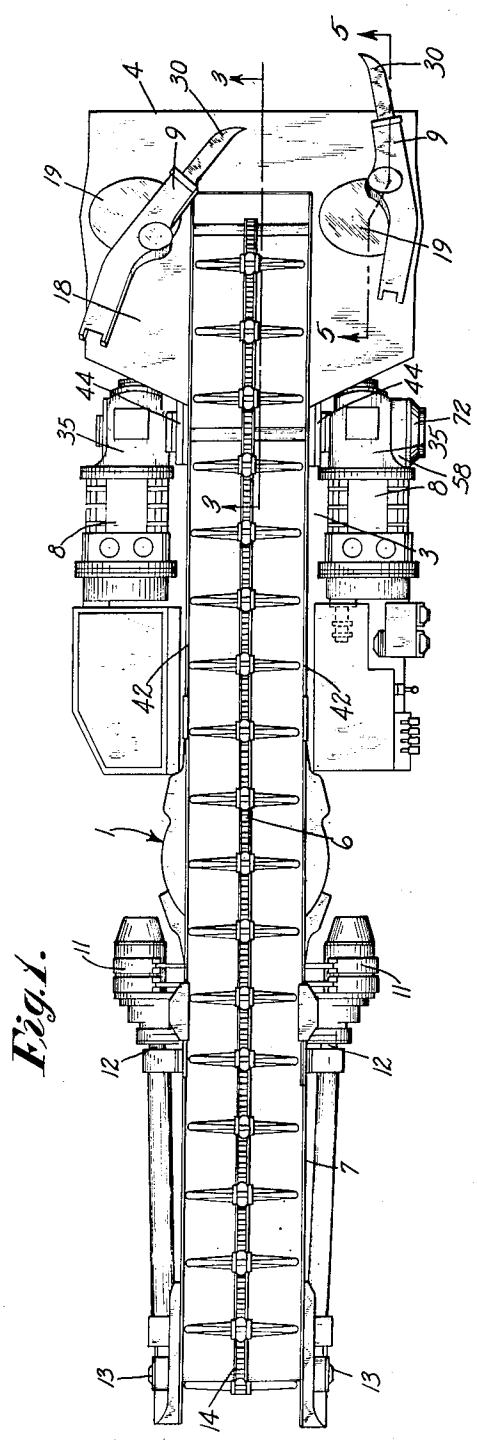


Fig. 1.

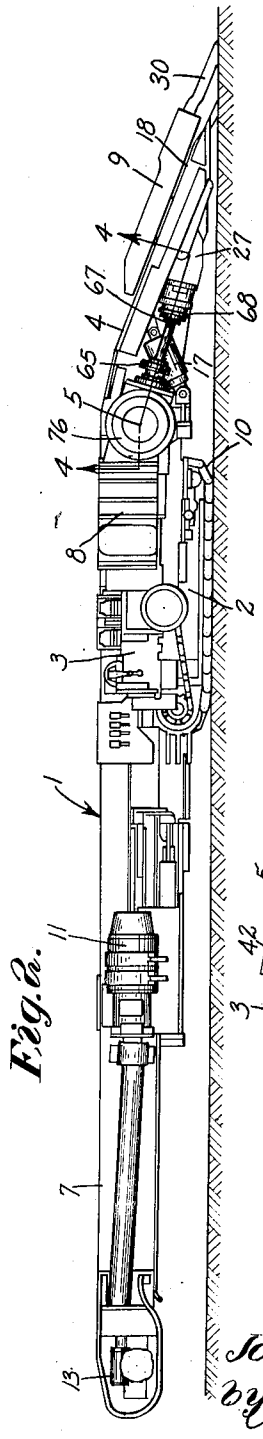


Fig. 2.

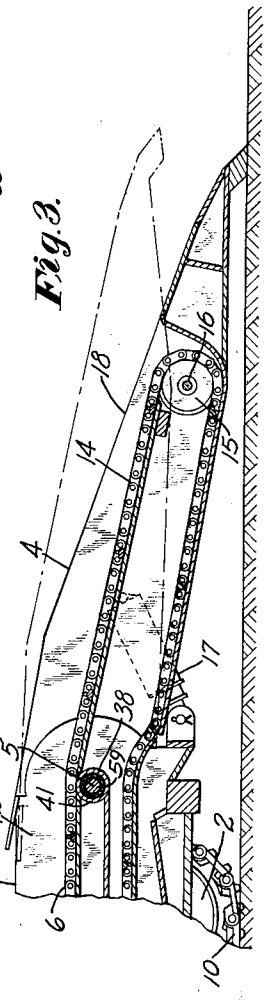


Fig. 3.

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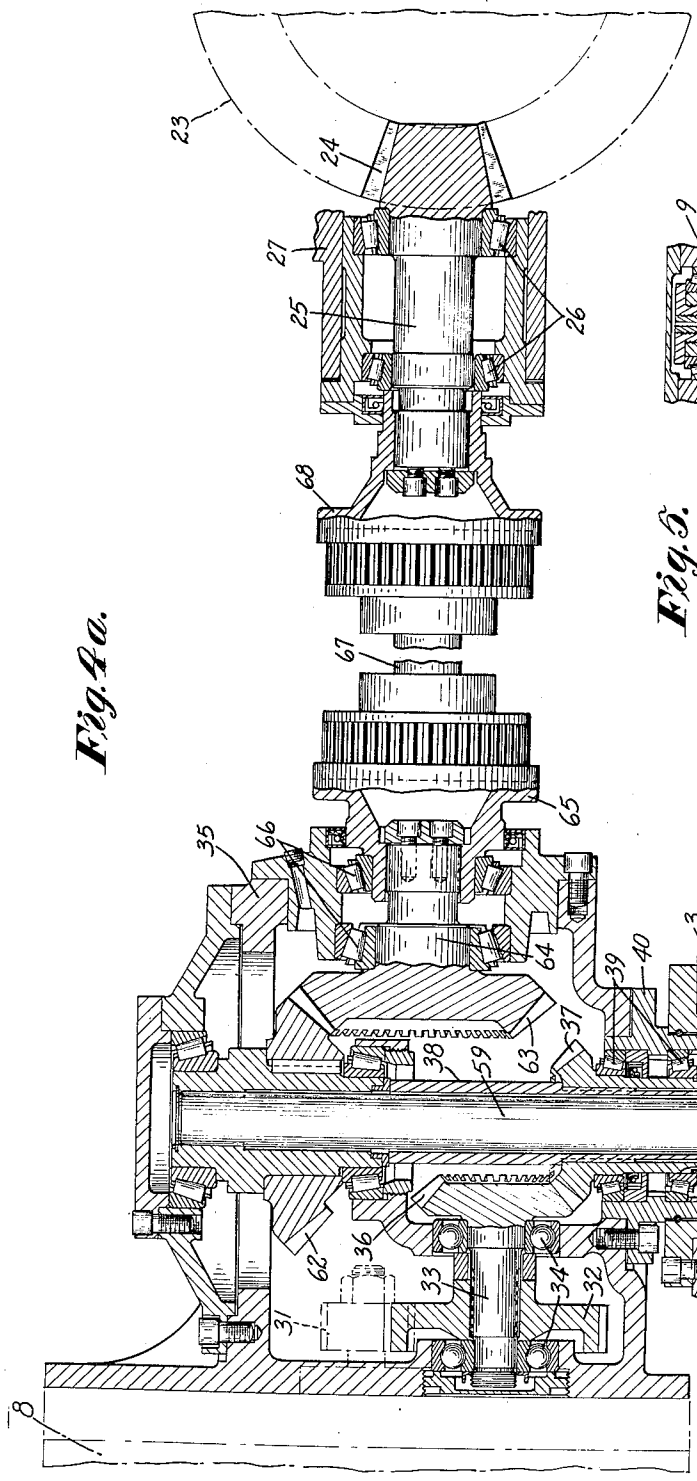


Fig. 4a.

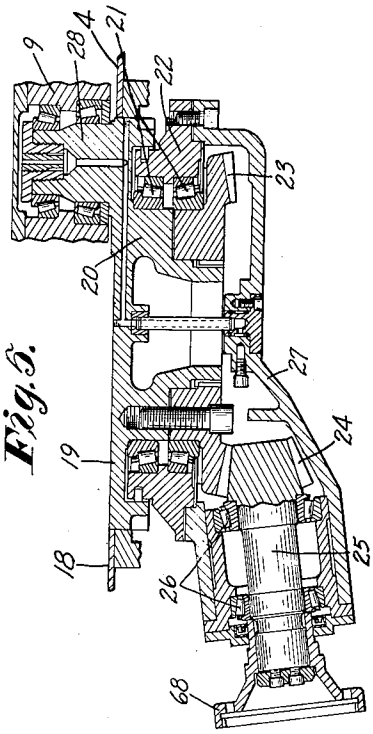


Fig. 5.

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MOBILE LOADING MACHINE

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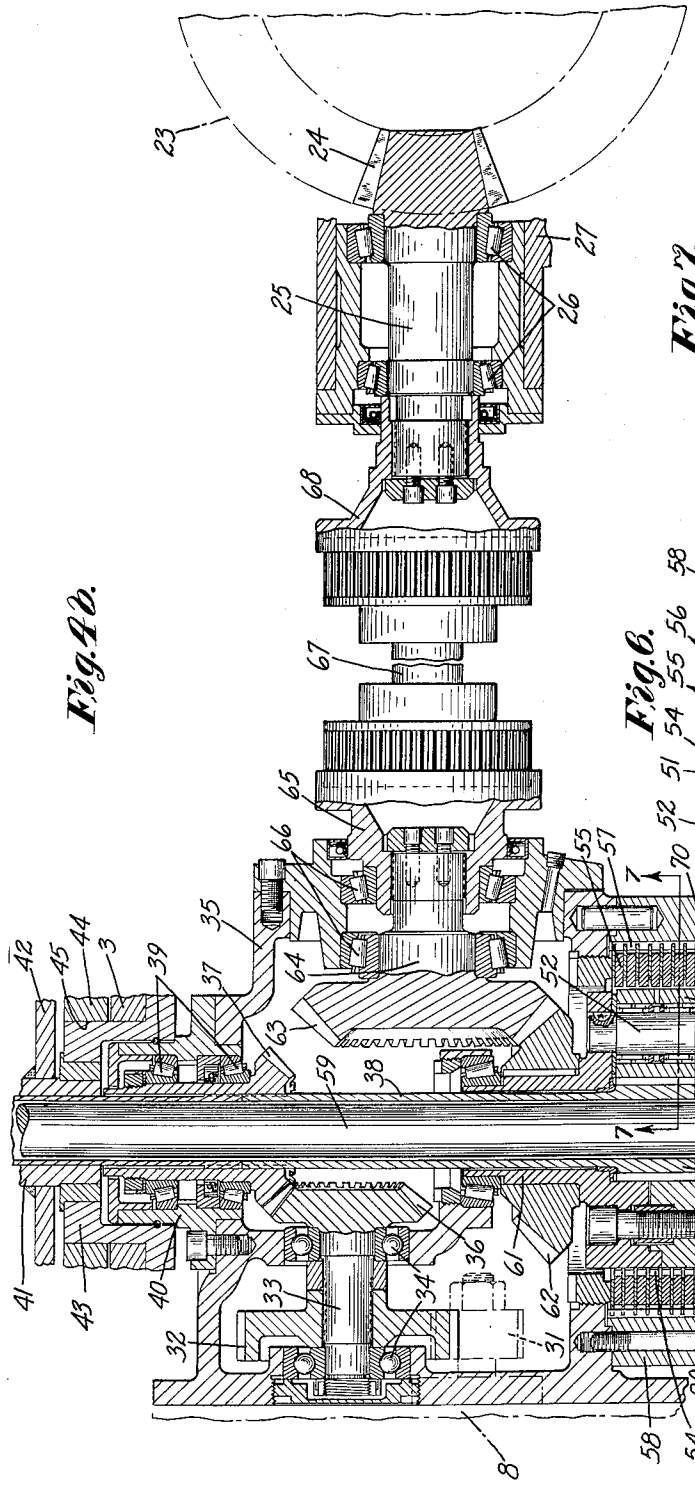


Fig. 4a.

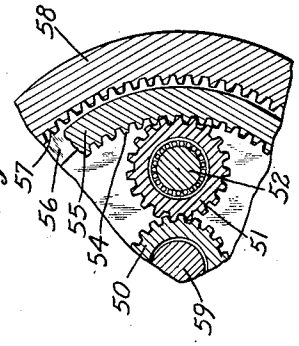


Fig. 7.

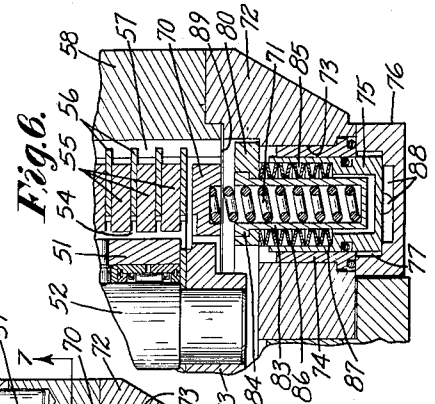


Fig. 6.

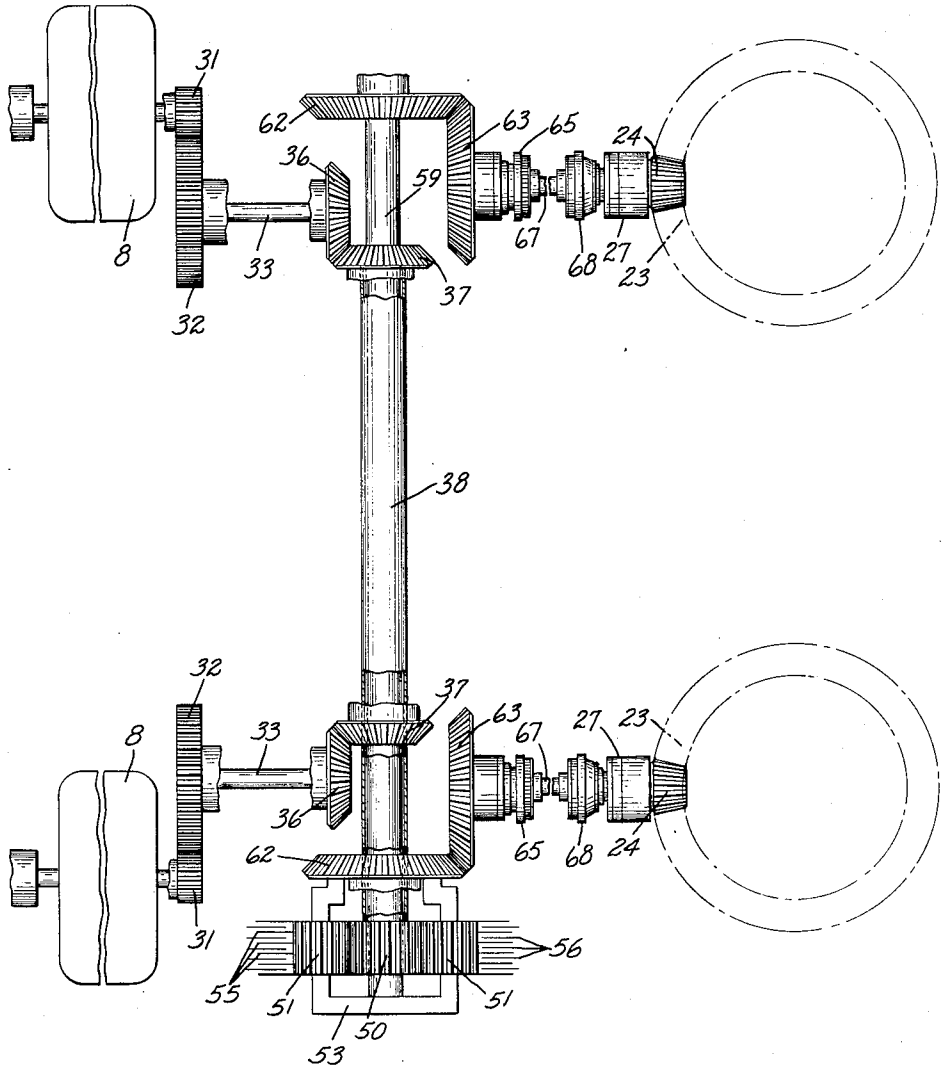
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MOBILE LOADING MACHINE

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Fig. 8.



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United States Patent Office 2,793,732 Patented May 28, 1957

2,793,732

MOBILE LOADING MACHINE

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Application June 20, 1951, Serial No. 232,585

9 Claims. (Cl. 198—10)

This invention relates to loading machines and more particularly to a mobile loading machine of the frontal attack type especially designed for use in underground mines having low head room.

In underground mines such as coal mines the coal seams are ofttimes very narrow and due to the height restrictions, mobile loading machines of low height having large capacity were unavailable, reducing the loading speed and frequently necessitating considerable hand shoveling. The present invention contemplates improvements over known types of mobile loading machines in that a large capacity machine of extremely low height is provided, well adapted for use in mines having low head room. The machine of the present invention, as above mentioned, is of the frontal attack type and embodies oscillatory gathering arms, and the gathering arms and the machine-conveyor are separately driven to permit continued loading in case of delay of the shuttle car or other transportation means; and the conveyor can also continue to load into the shuttle car or other transportation means even if the gathering arms should jam in the face or otherwise stall. In order to obtain low height the gathering arm are driven in a novel manner through an improved arrangement of driving connections. The machine is readily mobile and low in height, is relatively rugged in design, and has relatively large capacity for its height.

An object of the present invention is to provide an improved loading machine. Another object is to provide an improved mobile loading machine especially designed for use in underground mines having low head room. Yet another object is to provide an improved loading machine of the frontal attack, gathering arm type having improved driving means for its gathering arms whereby the latter may be driven independently of the machine-conveyor. A further object is to provide an improved loading machine having a loading head pivotally mounted to tilt in a vertical direction and having improved driving means for the gathering arms arranged in a novel manner with respect to the head-pivot. A still further object is to provide an improved dual motor drive for the gathering arms and embodying a common slip clutch whereby the arms are driven in a predetermined out-of-step-relation. Another object is to provide improved driving means for the gathering means and embodying an improved driving clutch having improved clutch operating means. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings:

Fig. 1 is a plan view of the loading machine constructed in accordance with a preferred illustrative embodiment of the invention.

Fig. 2 is a side elevational view of the loading machine shown in Fig. 1.

Fig. 3 is an enlarged central longitudinal vertical section

taken on line 3—3 of Fig. 1, showing the tiltable loading head.

Figs. 4*a* and 4*b*, considered together, constitute a transverse section taken on line 4—4 of Fig. 2, showing details of the dual motor drive for the gathering arms.

Fig. 5 is a detail vertical section taken on line 5—5 of Fig. 1, illustrating a portion of the structure of one of the gathering arms.

Fig. 6 is an enlarged detail section taken on the plane of Fig. 4*b*, showing details of the clutch operating means.

Fig. 7 is a detail section taken on line 7—7 of Fig. 4*b*, illustrating details of the slip clutch and the associated planetary gearing.

Fig. 8 is a rather schematic view showing the dual motor drive for the gathering arms.

In this illustrative embodiment of the invention, as shown in the drawings, the improved mobile loading machine is generally designated **1** and includes a crawler base **2** carrying a main frame **3**, a tiltable loading head **4** pivoted at **5** on the main frame, and an elevating and discharge conveyor **6** having a laterally swingable and tiltable rear conveyor frame **7**. A pair of identical main motors **8**, **8** mounted at the opposite sides of the main frame serve in unison to drive the gathering arms **9** mounted on the loading head, and the crawler treads **10** of the tractor base are also driven by these motors. The conveyor **6** is driven by a pair of motors **11**, **11** carried at the opposite sides of the swingable and tiltable rear conveyor frame **7**.

The loading machine is of the frontal attack type and the loading head **4** is advanced into the loose coal to be loaded by the crawler treads **10** which also serve to tram the machine about the mine. The gathering arms **9** are synchronized and are driven in a predetermined out-of-step-relation by the motors **8**. The machine-conveyor **6** and the gathering arms **9** are independently driven to permit continued loading in case of delay in the movements of the shuttle car or other transportation means, and the conveyor can also continue to load into the shuttle car or other transportation means even if the gathering arms should jam in the face or otherwise stall.

The main motors **8** are desirably electric motors and are connected at their rear ends through suitable transmission means with the crawler treads of the tractor base and these transmission means may include planetary gearings similar to those disclosed in the copending application to John R. Sibley, Serial No. 102,996, filed July 5, 1949, owned by the same assignee as the present invention. Since the particular drives for the crawler treads do not per se enter into the present invention further detailed description thereof is herein unnecessary.

The motors **11** are likewise desirably electric motors and connected through conventional slip clutches and shafting **12** to worm reduction gearings arranged in housings **13** carried at the rearward portion of the rear conveyor frame **7**; and these worm gearings are connected through a usual drive sprocket to the central endless chain **14** of the conveyor, all in a well-known manner. Here also, the detail drives between the motors **11** and the conveyor do not enter into the present invention and may be similar to that disclosed in my copending application, Serial No. 783,759, filed November 3, 1947, now abandoned, likewise owned by the assignee of the present invention.

The loading head, as mentioned above, is pivoted at **5** on the main frame to tilt in a vertical direction and the elevating and loading conveyor **6** is guided for circulation along the loading head, as shown in Fig. 3, and at its forward receiving portion passes around a rotary guide **15** mounted on a transverse shaft **16** suitably supported within the head frame. Arranged between the head frame and the main frame of the machine

at the opposite sides of the latter are conventional hydraulic lifting jacks 17 for effecting tilting movement of the loading head about its pivot. Recessed within the top deck 18 of the loading head are crank disks 19 rotatable about parallel axes perpendicular to the plane of the deck and each having a depending circular portion 20 journaled in bearings 21 suitably supported by a bearing bracket 22 suitably secured to the head frame. Secured, as by screws, to the depending disk portion 20 is a large bevel gear 23 with which a bevel pinion 24 meshes. The gears 24 are formed integral with parallel longitudinal shafts 25 journaled within bearings 26 suitably supported within removable bottom casing portions 27 secured to the bracket 22. Each bottom casing portion 27 is detachably secured in position, as by screws, and may be detached to obtain access to the bevel gears 23. Formed integral with the crank disks 19 are upstanding crank pins 28 which pivotally engage the gathering arms 9 respectively. As the crank disks 19 are driven in synchronism, the gathering arms are moved in out of step relation and conventional guiding means for the arms are provided, as disclosed in my above mentioned copending application, whereby the gathering portions 30 of the arms may be moved in irregular shaped orbits to effect gathering of the loose coal and to move the coal so gathered along the deck of the head frame toward the forward receiving portion of the conveyor 6. As this particular structure of the gathering arms, their driving disks and their mountings on the head frame are well-known, further detail description thereof is considered unnecessary herein.

Now referring to the improved driving means for the gathering arms it will be noted that the motors 8 have parallel longitudinally extending power shafts to which are fixed spur pinions 31 meshing with spur gears 32. The gears 32 have their hubs keyed to longitudinal shafts 33 journaled in bearings 34 suitably supported within forward gear housings 35 secured to the main frame. Formed integral with these shafts are bevel gears 36 meshing with bevel gears 37 having their hubs keyed to the opposite ends of a tubular cross shaft 38 herein arranged coaxial with the head pivot 5. Thus, the motors due to their mechanical connections with the cross shaft 38 operate in synchronism. The hubs of the bevel gears 37 are journaled in bearings 39 suitably supported within bearing brackets 40 secured to the outer sides of the gear housings 35. A tubular member 41 surrounds and houses the tubular cross shaft 38 and is secured, as by welding, to the vertical side plates 42 of the conveyor frame. Secured to the main frame 3 are cylindrical bearing supports or trunnions 43 on which the side frame portions 44 of the loading head 4 are pivotally mounted at 45. Thus, the loading head has side supporting portions pivotally mounted on the main frame intermediate the side plates 42 of the conveyor frame and the gear housings 35. The tubular shaft 38 is desirably made up in aligned sections suitably secured together to facilitate manufacture and assembly, and secured to one end of this tubular shaft is a spur gear 50 which constitutes the sun gear of a planetary reduction gearing. Meshing with this sun gear are planet gears 51 journaled on bearings supported by planet shafts 52 supported by a planet carrier or spider 53. The planet gears 51 mesh with teeth of an internal gear 54 which are formed by a series of clutch plates 55. These clutch plates are interleaved with clutch disks 56 which are keyed at 57 to an outer casing 58 rigidly secured to the outer side of the gear housing. Arranged coaxial with the tubular shaft 38 and extending centrally therethrough, likewise in coaxial relation with the head pivot 5, is a drive shaft 59 which is at one end keyed at 60 to the hub of the planet carrier or spider 53. Respectively secured to the opposite end of this shaft 59 and to the hub portion 61 of the planet carrier are bevel gears 62 meshing with bevel gears 63. The bevel gears

63 are formed integral with parallel longitudinal shafts 64 arranged at opposite sides of the head and connected to coupling elements of flexible couplings 65. These shafts are journaled in bearings 66 suitably supported within gear housings 35. These coupling elements of the couplings 65 are connected by shafting 67 to coupling elements of flexible couplings 68, and these coupling elements are secured to the rearward portions of the longitudinal shafts 25 which drive the gathering arms 9. Thus, when the interleaved plates and discs of the clutch are loaded the motors 8 may drive the gathering arms in a predetermined out-of-step-relation through the beveled gearings 36, 37, tubular cross shaft 38, the friction clutch, the planetary reduction gearing, the bevel gearings 62, 63, the couplings 65, shafting 67, couplings 68 and the bevel gearings 24, 23 connected to the crank disks 19 which respectively drive the arms.

The improved operating means for the friction clutch comprises an annular pressure plate 70 and engaging this plate is a plurality of loading springs 71, herein six in number, arranged at equally spaced radial points about the plate. The planetary casing 58 has a detachable outer head plate 72 formed with bores 73 in which cylinders 74 are mounted, as shown in Fig. 6, and contained in these cylinders are hollow pistons 75. Secured to the outer side of the plate 72 is an annular manifold member 76 having circular-recesses 77 for receiving the outer portions of the pistons 75 and against the bottoms of which the pistons abut when the latter are retracted as shown. Studs 78 secured to the pressure plate 70 extend into the openings 79 in the casing-plate 72 and arranged between an annular plate 80 and the heads 81 of these studs are springs 82 for urging the pressure plate toward its outward released position. It will be noted that the head plate 72 may be readily released from the casing 58 to obtain access to the clutch parts without disturbing the planetary gearing within the casing.

The annular plate 80 has openings through which the studs 78 pass, as shown in Fig. 4*b*. Cup-shaped members 83 have inner flanges 84 seated against shoulders on the annular plate 80 and extend outwardly within the hollow pistons 75, and the clutch loading springs 71 react against the outer walls of these cup-shaped members and are held under compression by their engagement with the pressure plate 70. The pistons 75 have their bores enlarged at 85 and "Belleville" springs 86 in the form of flexed washers are arranged between shoulders 87 on the pistons and the annular plate 80 as shown in Fig. 6. The manifold member 76 has passages 88 for conducting liquid under pressure to the outer surfaces of the pistons 75 for moving the pistons inwardly thereby to load the spring 71 to move the pressure plate 70 into clutch applying position. As the pistons 75 are moved inwardly, the springs 86, which are considerably stronger than the springs 71, are compressed upon engagement of the annular plate 80 with a shoulder 89 on the clutch-casing so that in the event of leakage of liquid trapped within the manifold passages the springs 86 may expand within certain limits without reducing the loading of the springs 71. Thus, the springs 86 serve in effect as conventional hydraulic accumulators in that they compensate for pressure fluctuations in the system, and where space restrictions prohibit the use of such accumulators. The control valve means for controlling the flow of liquid under pressure to and from the manifold passages and for trapping liquid within the manifold passages are well-known in the art and are not disclosed herein.

From the foregoing, it is evident that the gathering arms 9 are mechanically connected with dual motors for drive in a predetermined out-of-step-relation through a common slip clutch and planetary gearing, and, in the event of overload of either or both gathering arms, the clutch automatically slips to prevent damage to the parts. Thus, due to the mechanical interconnection between the arms, any danger of the arms getting out of synchronism

is avoided. Also, the inadvertent slipping of the clutch during the loading operation due to leakage of liquid or any other cause of a drop in pressure, is automatically prevented by the auxiliary compensating springs.

As a result of this invention an improved mobile loading machine is provided which, while retaining relatively large capacity, is extremely low in height especially adapted to use in low vein work in underground mines. The vertical compactness of the machine is, to a large extent, made possible by the novel arrangement of the driving means for the gathering arms including the dual motors and the particular location of certain of the driving elements with respect to the pivot of the tiltable loading head. By mechanically connecting the dual driving motors with the gathering arms the latter are always driven in a predetermined manner, and the common slip clutch protects the arms from overload without loss in synchronism of the arm movement. By the provision of the particular clutch loading means embodying the auxiliary loading springs, compactness is obtained while danger of the clutch loading springs becoming inadvertently released due to fluid leakage or other loss in liquid pressure, is substantially precluded. These and other advantages of the invention will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a loading machine, the combination comprising a pair of oscillatory gathering arms movable in out-of-step relation, a mechanical driving connection between said arms for tying the same together for movement in out-of-step synchronism, a pair of motors, a mechanical driving connection tying said motors together for operation in synchronism, said first and second mentioned driving connections, each including a rotatable element, said rotatable elements arranged in coaxial relation, and a slip clutch operatively connected between said coaxial elements and adapted to slip automatically upon overload of said gathering arms while the synchronism of said out-of-step drive for said arms is maintained.

2. A loading machine as set forth in claim 1 wherein a planetary reduction gear unit is arranged between the drive of said coaxial elements and includes a gear element operatively associated with elements of said clutch whereby the latter when it slips interrupts the drive through said planetary.

3. A loading machine as set forth in claim 1 wherein said gathering arms are carried by a tiltable head, and a frame pivotally supports said head, said motors being carried by said frame, and said coaxial elements of said driving connections being arranged coaxial with the head pivot.

4. In a loading machine of the type having gathering means, and driving means for said gathering means including a friction clutch for controlling the transmission of power to said gathering means, said clutch having interleaved clutch disks, hydraulically operated piston means, a pressure plate, spring means between said piston means and said pressure plate and through which said pressure plate is moved into a position to press said disks together to effect loading of said clutch upon predetermined operating movement of said piston means, an auxiliary spring means of considerably greater strength than said first mentioned spring means and movable under compression upon operating movement of said piston means as aforesaid, said auxiliary spring means adapted to expand within certain limits upon drop in pressure of the liquid acting on said piston means to maintain said first mentioned spring means in clutch loading position thereby to prevent inadvertent slippage of the clutch disks during the loading operation.

5. A clutch as set forth in claim 4 wherein said auxiliary spring means act on an annular plate disposed intermediate said pressure plate and said piston means and on which the latter act, and a shoulder is provided by said clutch for limiting inward movement of said annular plate whereby said auxiliary spring means are loaded by said piston means as the latter moves to effect loading of the clutch.

6. A clutch as set forth in claim 5 wherein spring means is provided for retracting said pressure plate when said piston means is retracted, and a shoulder is provided by said clutch for limiting outward movement of said annular plate.

7. A clutch as set forth in claim 5 wherein said first mentioned spring means includes a series of individual springs acting at spaced points about said pressure plate, and a series of cup-shaped members are seated against shoulders on said annular plate and against which said springs respectively react, said piston means including a series of hollow pistons into which said cup-shaped members extend.

8. A clutch as set forth in claim 7 wherein said auxiliary spring means are arranged within said pistons and surround said cup-shaped members.

9. In a clutch mechanism of the character disclosed, interleaved clutch disks, hydraulically operated piston means, a pressure plate, spring means between said piston means and said pressure plate and through which said pressure plate is moved into a position to press said disks together to effect loading of said clutch upon predetermined operating movement of said piston means, an auxiliary spring means of considerably greater strength than said first mentioned spring means and moveable under compression upon operating movement of said piston means as aforesaid, said auxiliary spring means adapted to expand within certain limits upon drop in pressure of the liquid acting on said piston means to maintain said first mentioned spring means in clutch loading position thereby to prevent inadvertent slippage of the clutch disks.

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