Dec. 13, 1949 W. E. URSCHEL 2,491,064

WALKING TRACTOR

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Fig. 1.

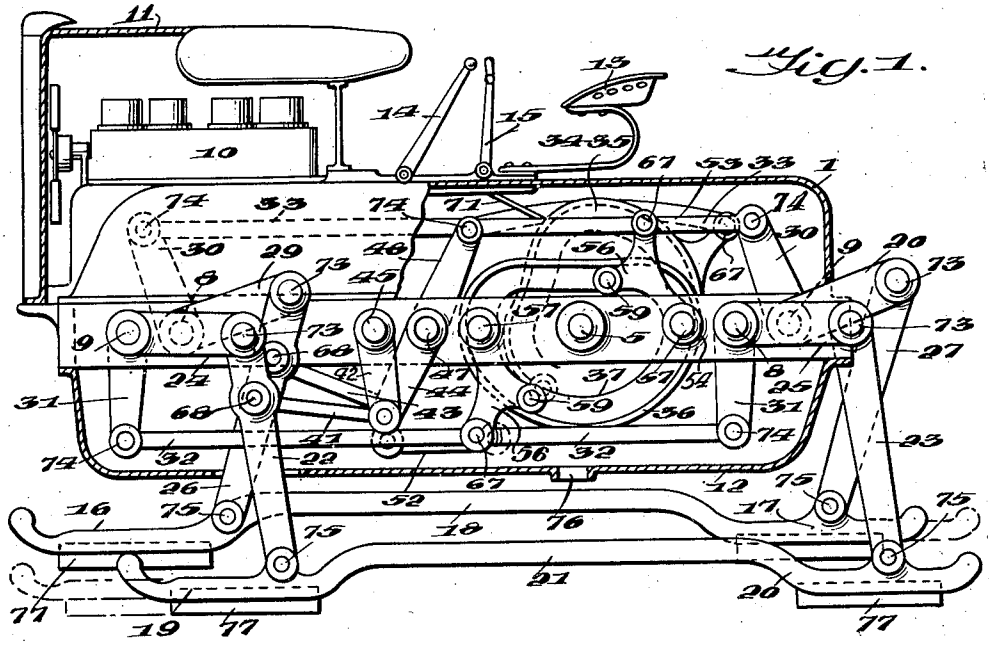
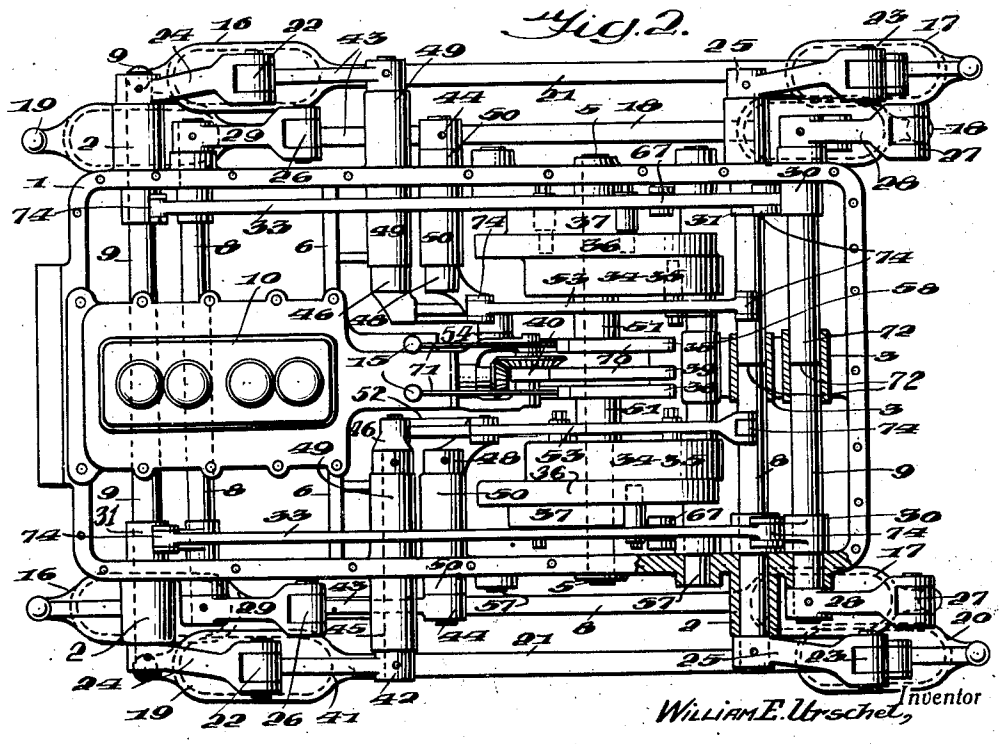


Fig. 2.



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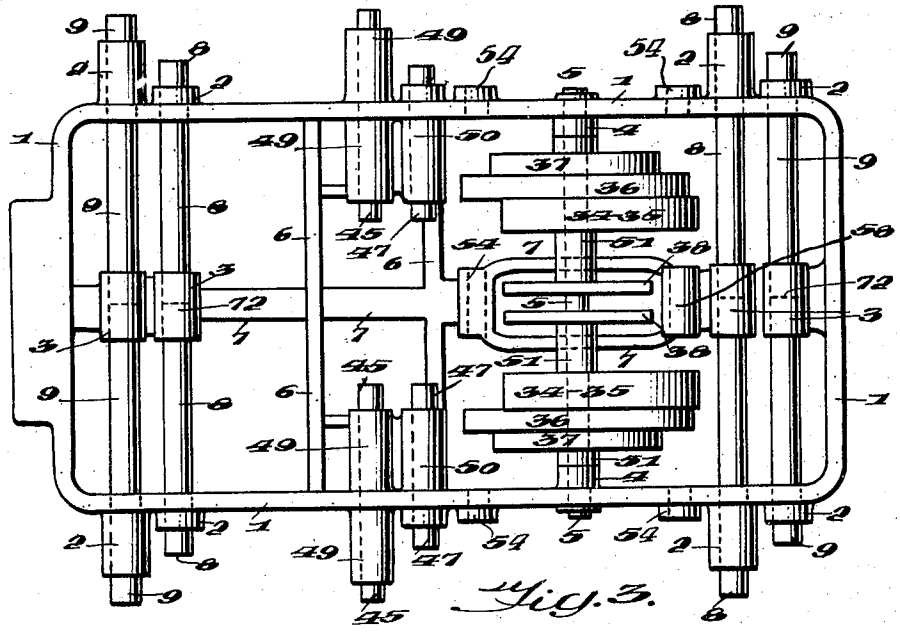


Fig. 3.

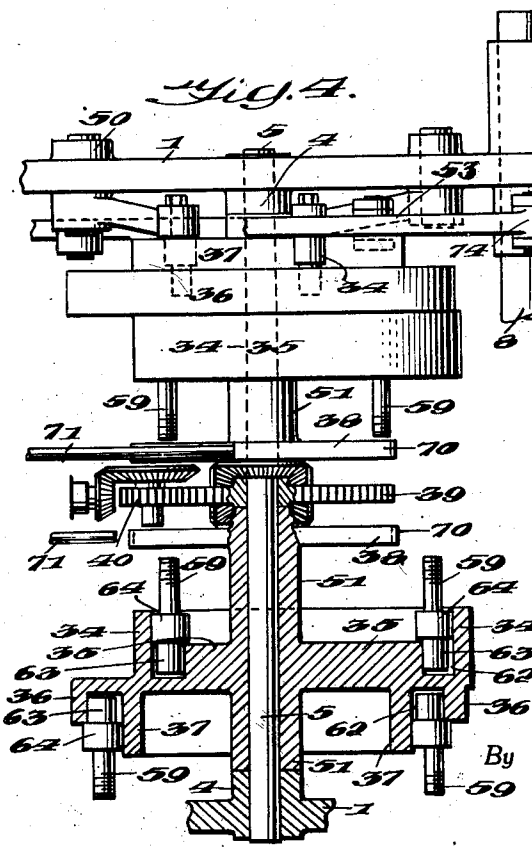


Fig. 4.

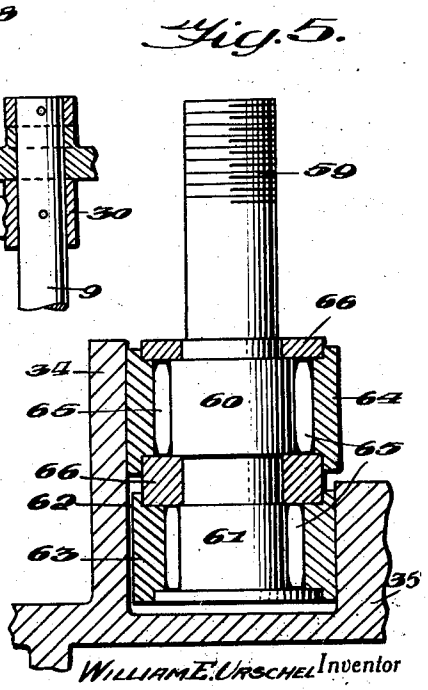


Fig. 5.

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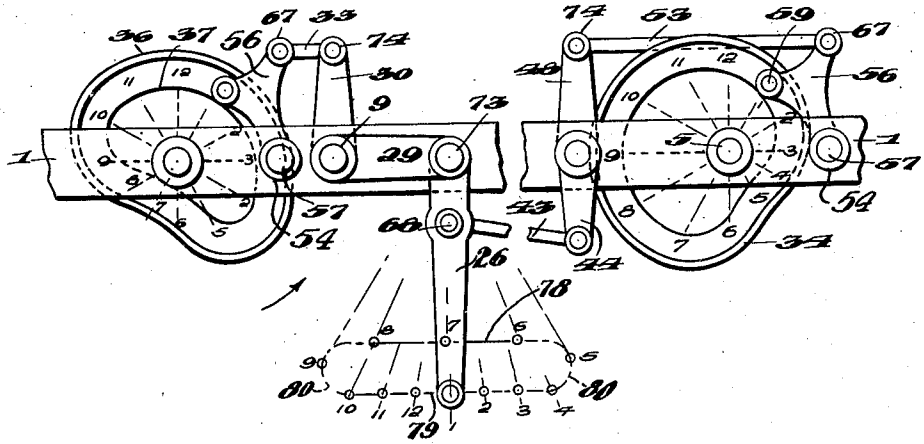
Attorney

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WALKING TRACTOR

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Fig. 6.



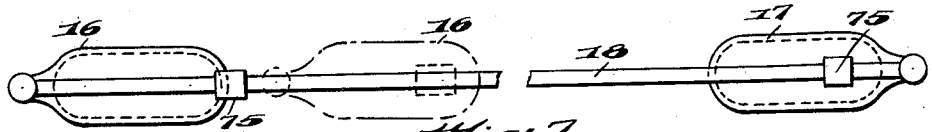


Fig. 7.

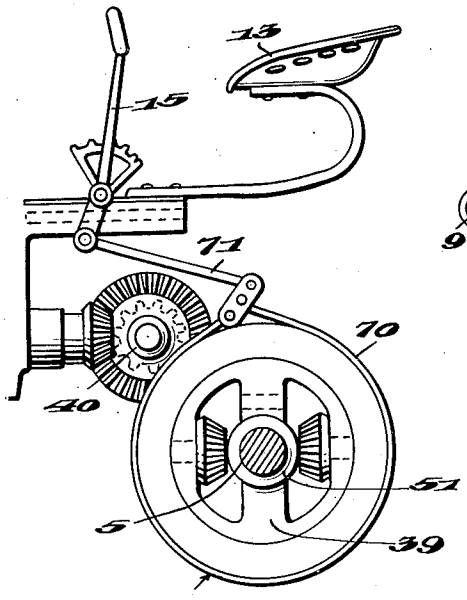


Fig. 8.

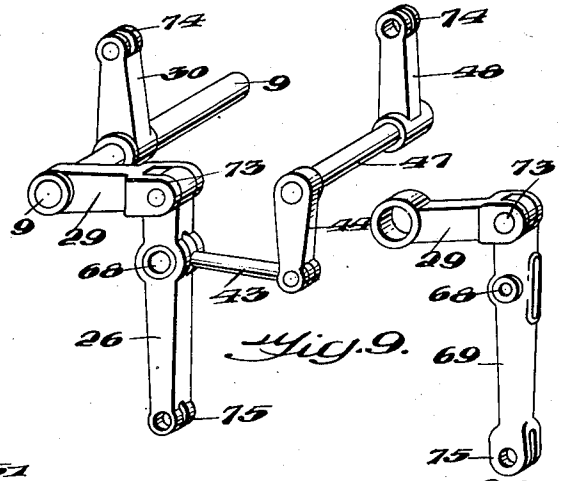


Fig. 9.

Fig. 9a.

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Patented Dec. 13, 1949

2,491,064

UNITED STATES PATENT OFFICE

2,491,064

WALKING TRACTOR

William E. Urschel, Valparaiso, Ind.; Joe R. Urschel administrator of said William E. Urschel, deceased

Application June 26, 1945, Serial No. 601,673

2 Claims. (Cl. 180—8)

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My invention relates to improvements in walking tractors and it more especially consists of the features pointed out in the following description.

The purpose of my invention is to provide a tractor for special industrial services that will continue active in different kinds of terrain on which the ordinary tractor becomes bogged; that will have the minimum of parts exposed to an accumulation of earth; that provides a duplication of operating parts on the left hand and right hand side of the machine; that employs a differential power drive between the two duplicate cams, right and left, on the machine; and that it has a separate control for each side so that the power can be applied to either side alone, thus facilitating the turning of the tractor within a very short radius; and that encloses all the power mechanism and connected cams in a casing to protect it.

With these and other related ends in view I illustrate on the accompanying drawings such instances of adaptation as will disclose the broad cooperating features of the mechanism without limiting myself to the specific details shown thereon and described herein.

Fig. 1 is a side elevation of the machine.

Fig. 2 is a top plan view of Fig. 1. Parts are shown in section.

Fig. 3 is a top plan view of the frame of the machine in assembled relation only with the main parts.

Fig. 4 is an enlarged plan of the cam portion of the entire machine partly in section.

Fig. 5 is an enlarged view of the double roller cam follower, in section.

Fig. 6 is an enlarged diagrammatic view illustrating the cycle of operation of the cams and associated legs.

Fig. 7 is a top plan view of a mechanically connected front and rear foot of the tread portion of the machine.

Fig. 8 is a side elevation of the control for the differential drive.

Fig. 9 is a partial perspective view of the leg structure for different forms of legs.

Fig. 9*a* is an elevation of a modification of the leg 26 shown on Fig. 9.

In practicing my invention I may use whatever modifications of the structure or alternatives of function that the exigencies of varying conditions may demand without departing from the broad spirit of the invention.

In contrast to so called "steppers" and conventional endless tread tractors this invention includes a pair of front and rear feet on each side

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of the machine which are duplicates of each other. In operation at no time is a pair of feet entirely off from the ground. As a foot is being raised another neighboring foot has just engaged the ground.

To control the movement of the legs and connected feet two duplicate cam groups are provided each group having an outside duplicate cam and an inside duplicate cam.

Both of the outside cams control the up and down movement of all the legs and connected feet, and both of the inside cams control the to and fro movement of all the legs and their connected feet to cause the machine to travel over the ground.

The inside cams are made heavier because they have the heaviest work to do in moving the machine forward while some of the feet are in engagement with the ground and are "standing still."

The up and down movement of some of the legs and feet at the beginning and at the end of each half cycle requires less work for the lighter outside cams to do.

The cam group for one side of the tractor is operatively positioned in proper timing relation to the other cam group while both groups are free to rotate on a stationary shaft that is common to both groups. Each one of the cams has two rollers positioned at 180 degrees apart. One roller serves to raise the feet of the outside group and the other serves to raise the feet of the immediately adjacent inside group.

Between the two groups of cams there is a differential drive also loose on the stationary shaft. This enables the operator to entirely stop or variably modify the movement of all the legs and feet on one side of the machine from the legs and feet on the other side so as to permit a sharp turning of the machine to the right or left.

A detailed description of the machine follows:

The frame 1 about midway and transverse of its length has a stationary shaft 5 on which the sleeve portion 51 integral with cams 34–37 and the differential 39 are mounted. At each end of the frame and transverse thereof there is a disconnected rock shaft 9. Parallel to the shaft 9 there is a duplicate rock shaft 8. These shafts have their abutting ends 71 in bearings 3 located centrally crosswise of the frame. At the ends of these shafts there are cranks which actuate the up and down movement of the feet and their attached legs.

A central member 7 extends rearwardly from the engine base to the rear edge of the frame to provide rigidity. On it bearings 3, 54 and 58

are located. The center member 7 is joined to the sides of the frame by transverse members 6. Between bearings 54 and 58 the member 7 is divided into two parts, see Fig. 3.

The sides of the frame 1 have lateral bosses 2, 49 and 50 that form pivot points for separate rock arms (Fig. 2), which arms are joined by links that connect them to the respective cams 34—37.

An imaginary horizontal line 79 in Fig. 6 represents the extent of actual ground traverse of a shoe 16 or 19. A second imaginary line 78 represents the raised and reverse traverse of a shoe. The lines 78 and 79 are joined by two reverse curves 80.

I plot the contour and extent of the required radii of the cam roller positions. The center of lines 78 and 79 is taken as a starting point on the "ground." The entire length of these two lines and their connected curved ends 80 are divided arbitrarily into twelve distinct steps or positions consecutively numbered up to "twelve," parts as shown in Fig. 6. These positions are projected back through the connected levers, links, etc., to the cams where corresponding radii positions are located. From these the changing contour of the cam grooves is determined and the variations of the radii corresponding to the related points of the positions of a foot is established.

In Fig. 6 the "No. 1" position is at the center of the ground line 79. This position is also identified at "1" on the cam diagram, Fig. 6. This portion of the entire perimeter of the cam groove is the position of an actuating cam roller 63 or 64 corresponding to "1" on the ground line 79. The other roller positions on the cam grooves are similarly located from the other points on the lines 78—80.

The mechanism on one side of the tractor is a duplicate of the cooperating mechanism on the other side. For simplicity the description is now confined to the single pair of front 22 and rear legs 23 on the left side of the machine (Figs. 1 and 2). Immediately adjacent these outside legs 22, 23 there is a duplicate pair of inside legs 26, 27 positioned next to the frame 1.

There are two rigidly formed cams 34—37 forming one group to the left of the center, lengthwise of the machine, facing from the front. A duplicate cam group is positioned to the right of that center line and in axial alignment with the other cam group. On the inside of each cam group there is the cam 34, 35 which serves to control the to and fro movement of both pairs of legs 22 and 26. On the outside of each cam group there is the cam 36, 37 which only controls the up and down movement of the feet.

At the upper end of each of the legs 22, 23, 26, and 27 (Fig. 1) there are outside cranks 24, 25, 28 and 29 which simulate the thigh portion of the human anatomy. These are attached to the outer ends of the two-part rock shafts 8 and 9. On the inside of the frame there are duplicate cranks 30 and 31. The cranks 30 are on rock shafts 8 and 9, and the cranks 31 are on rock shafts 9 and 8.

On the outside of the frame, right and left, the bosses 2 serve for the rock shafts 8 and 9. The inside bosses 49 are extended on the outside of the frame and serve as a bearing for the spindles 45 and the bosses 50 serve for the spindles 47.

The free ends of the cranks 31 are connected by a link 32 at 74 and the free ends of the cranks 30 are similarly connected at 74 by links 33. The links 32 are also connected to the free end 67 of the cam roller rock arm 56 and the links 33 are similarly connected at 67 to the upper rock arm 56 (Fig. 2). The links 32 and 33 coact with the outside cam 36, 37 to produce the up and down movement of the legs and feet. The links 41, 43, 52 and 53 are connected to the inside cam roller carrying rock arms 56 to produce a to and fro movement of the legs. They are acted upon by the inside cam 34, 35. There are eight of these cam roller carrying rock arms duplicates of each other, four on the right and four on the left and they all bear the same reference numeral, viz., 56.

The spindles 47 are connected to rock arms 44 and 48 and the rock arms 44 are connected by links 43 to the inside legs 26 at 68. The rock arms 42 on spindles 45 and the rock arms 46 are connected by links 52 to the lower cam roller rock arms under the control of the inside cam 34, 35. The inside rock arms 48 are supported on spindles 47 in the bosses 50.

The inside cam roller rock arm 56, the lower one, is pivoted on a spindle 57 positioned in the bearing 54. It is connected to the link 52 and the upper link 53 is pivoted to the rock arm 48 at 74. All the pivot points of the ends of the links 32, 33, and 53 are designated by the numeral 74 and all the pivot points on such links for the cam roller rock arms are designated by the numeral 67.

A single roller and attached connections from a given cam will perform one of the leg functions of the outside group of the front and rear legs and the cam roller diametrically opposite, on the same cam, at 180 degrees, will perform the same function for the adjacent and inside group of a front and a rear leg.

In order to avoid the complications of conventional parallelogram movements between the front and rear legs and their feet, I form the front and rear feet as a part of a rigid connecting link such as 18 and 21 connected respectively to the feet 16, 17 and 19 and 20. These feet are pivoted to the lower end of the legs at 75. These connected feet are shown as a detached member on Fig. 7. This construction insures that the feet will remain "flat" during their entire cycle of movement. If desired the shoes 77 of rubber may be vulcanized to the respective metal feet and the feet may be made removable from the legs so as to be replaced by different sizes to accommodate the machine to terrain that is more or less soft and soggy and if desired additional feet or shoes may be provided between the front and rear legs by stiffening the links 18 and 21 and placing attachable and detachable feet thereon.

In practically constructing the machine for actual heavy duty operation I may make the legs 22, 23, 26 and 27 of rectangular cross section or of round cross section 69 shown in Fig. 9a. When formed of round cross section the structure would be tubular to save weight.

The legs 22, 26, 23 and 27 are pivoted at their upper end at 73 to their respective cranks 24, 25, 28 and 29. The stationary shaft 5 is supported in bosses 4 on the inner face of the frame.

To protect the working parts of the machine an upper cover 11 encloses the engine 10 and with an underneath cover 12 secured to the frame forms an oil tight compartment. The lower casing has a drain outlet 76. A seat 13, Fig. 1, is for the operator and a transmission lever 14 gives him

control over the engine movement and a pair of differential levers **15**, see Figs. 2 and 8, control the progress of the tractor. These hand levers may have the usual rachet segment and interacting spring pressed teeth. They are pivoted to the engine support and a link **71** connects each lever to one of the differential brake disks **38** (Fig. 3) by means of a band **70** (Fig. 8).

The differential gear **39** is connected by a pinion **40** which in turn is connected by two bevel gears to the engine shaft. If the operator wishes to turn the machine to the right he pulls the right hand lever **15**. This action, through the differential will stop the articulated legs on the right hand side of the machine or if the lever **15** is not pulled to its maximum extent the right hand legs in their movement will be only partially stopped. By this control the machine can be readily and quickly turned to the right or left as desired. When a left turn is intended the left hand control lever **15** will be used in the same way (Fig. 2).

The cam roller rock arms **54** are pivoted on a spindle **57** positioned in the bearing **58**. A similar short spindle **57** forms a pivot for the other roller bearing rock arm **56** (Figs. 1 and 2).

In order to avoid a reversal of rotation of the cam rollers **63** and **64** I form them of different diameters. These rollers are supported by threaded pins **59** (Fig. 5) which have two different diameters **60** and **61**. On these diameters needle rollers **65** are held in place by roller cages **66**. In this construction, Figs. 4 and 5, on one set of pins **59** the large cam internal ring **34** and the smaller diameter rollers **63** roll on the external cam ring **35**. This construction leaves a clearance **62** adjacent the roller **63**. It insures that the rollers **63** and **64** do not reverse their rotation during the revolution of the cams. In contrast, on the cam **36**, **37** the small roller **63** engages the internal cam **36** and the larger roller **64** engages the external cam **37**, Fig. 4.

What I claim is:

1. In a walking tractor, a supporting frame, a source of power on the frame, a plurality of interconnected pairs of front and rear legs on each side of the frame, a separate compound cam unit for each pair of legs, each cam unit having two bearing faces, a differential drive from the source of power positioned between the cam units, one bearing face of a cam serving to control the up and down movements of both pairs of legs, and the other face of said cam serving to control the to and fro movements of both pairs of legs.

2. In a walking tractor, a supporting frame, separately connected to a source of power on the frame, a pair of separate front legs a pair of separate rear legs pivoted to the frame at each side thereof, a pair of links at each side respectively connecting a corresponding front and rear leg together, means for coordinating movements of the separate pairs of legs independently of each other to maintain a walking pace of all the legs in related steps, said means composing a pair of separate compound cams on each side of the tractor for controlling all the movements of the legs.

WILLIAM E. URSCHEL.

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