Nov. 13, 1928. 1,691,233

A. EHRLICH

VEHICLE PROPELLED BY STEPPERS

Filed April 8, 1926

Fig. 1.

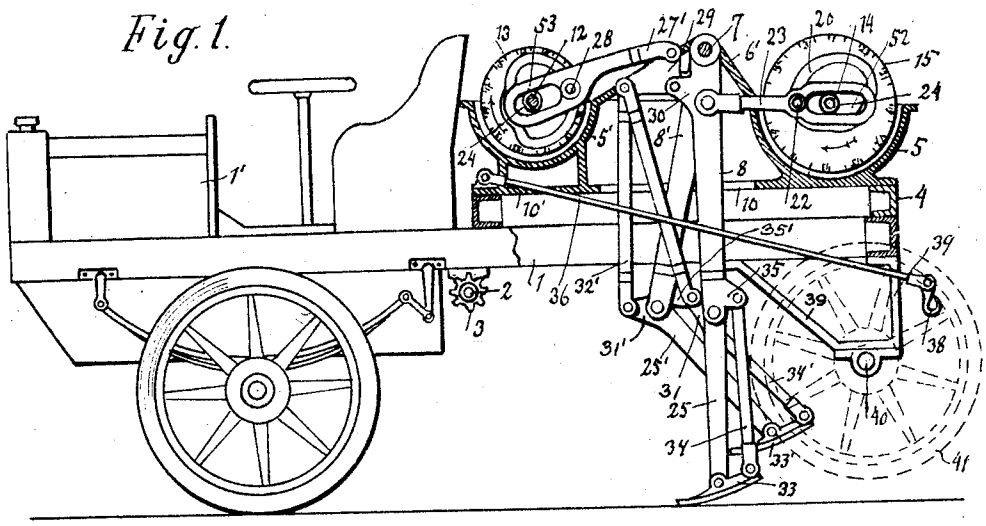


Fig. 2.

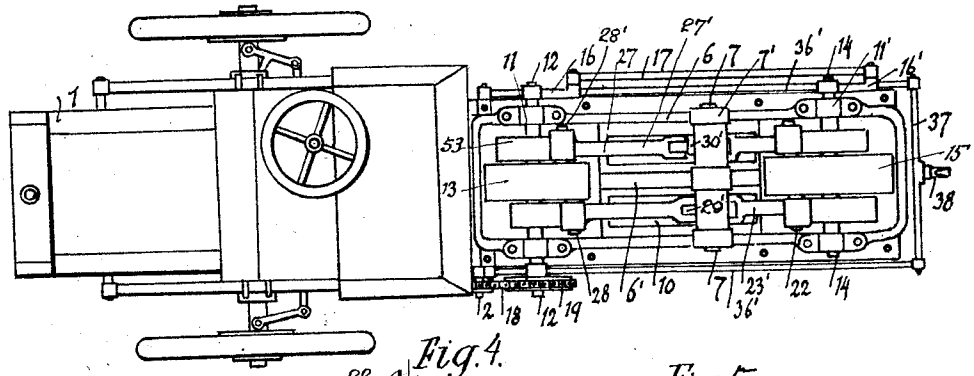


Fig. 3.

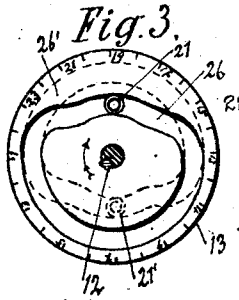


Fig. 4.

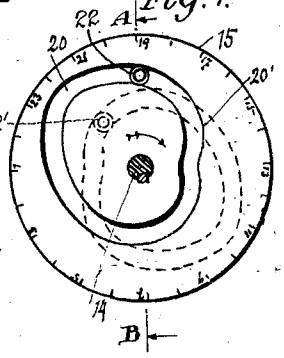
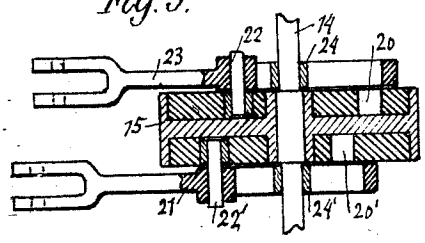


Fig. 5.



Witnesses.

Paulus R. Dimitroff

B. Reichenfeld

Inventor.

Adolf Ehrlich

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UNITED STATES PATENT OFFICE.

ADOLF EHRLICH, OF BUDAPEST, HUNGARY.

VEHICLE PROPELLED BY STEPPERS.

Application filed April 8, 1926. Serial No. 100,725.

My invention relates to vehicles advancing by means of three-limbed artificial legs, by means of which it is possible to convey a load suspended therefrom which is much larger in comparison with the weight thereof.

A further advantage of the machine according to the invention resides therein that it can also travel on a very steep track and the construction of the surface is of no importance. The machine can therefore be used on uneven hard and also on sinking soft ground, for example sand, snow or damp clay soil for drawing loads such as plows and other agricultural appliances.

The separate characteristic features of the invention will appear from the following detailed description in which is described one example of construction with reference to the accompanying drawing.

Figure 1 is a side elevation of the hauling machine partly in section,

Figure 2 is a plan thereof,

Figures 3 and 4 each show a side elevation of a cam disc for actuating the artificial legs,

Figure 5 is a cross section on the line A—B of Figure 4.

On the under frame 1 is mounted an internal combustion engine 1′ by which the shaft 2 mounted under the frame 1 is driven. The shaft 2 carries a toothed wheel 3 from which the separate parts of the driving mechanism are driven. At the rear part of the under frame 1 is provided an auxiliary frame 4 to which is secured a casing 5. In the middle of the two longitudinal sides 6, 6 and the middle bar 6′ of the casing 5 there are formed bearings 7′ in which is mounted a stationary transverse shaft 7. The front and rear half of the casing 5 each form a case 5′ for the reception of the lower half of the cam discs 13 and 15. In the bottom 10′ of the casing 5 there are provided between the cases 5′ parallel longitudinal slots 10 through which are passed the rods 8, 8′ and 25, 25′ forming the artficial legs.

Over the front case 5′ there is mounted in bearings 11 a shaft 12 to which is keyed a cam disc 13. The shaft 14 rotating in the rear bearings 14′ carries a larger cam disc 15. On one end of the shafts 12 and 14 there are keyed cranks 16 and 16′ of equal length connected together by a driving rod 17. The other end of the shaft 12 carries a chain wheel 19 which may be driven by a chain 18 from the chain-wheel 3 of the shaft 2.

On the shaft 7 there are mounted rotatably as near as possible together and extending through the longitudinal slots 10, rods 8. 8′ which form the upper leg portions of the artificial legs. These can swing freely backwards and forwards. The method of swinging is determined by the particular shape of the grooves 20, 20′ formed on the two side surfaces of the larger disc 15, with which the leg portions 8, 8′ engage by means of driving rods 23, 23′. The driving rods 23, 23′ are hingedly connected to the corresponding leg portions 8, 8′.

The groove 20, 20′ consists of two dissimilar large sections of which one extends through 120°, the other through 240°. On both sides of the disc 15 there engages with the corresponding grooves 20, 20′ rollers 24, 24′ carried by pivots 22, 22′ on the driving rods 23, 23′. The free ends of the link rods 23, 23′ are enlarged and in the enlarged part is provided with a recess 52 in which is located a roller 24 of the shaft 14.

If the disc 15 is rotated uniformly in the direction of the arrow the driving rods 23 and 23′ are moved alternately in the direction of their longitudinal axis whereby the upper leg portions 8 and 8′ are swung alternately forwardly and backwardly. By reason of the particular shape of the grooves 20, 20′ the swinging of the upper leg portions forwardly and backwardly is affected at a uniform speed, whilst the upper leg portions 8, 8′ swing twice as far forwardly from the vertical position, as backwardly. The swinging movement from the rearmost position to the foremost position as also from here rearwardly during the first third of the distance takes place at twice the speed to that during the last two thirds of the distance. In this manner one upperly portion carries out the whole of its forward movement and the first third of its rearward movement, whilst the other upper leg portion carries out the last two thirds of its rearward movement. This is obtained by reason of the fact that the two similarly shaped grooves 20—20′ of the disc 15 are relatively displaced by 180°.

The small cam disc 13 serves to bend and stretch the lower leg portions 25 and 25′ hingedly connected to the upper leg portions 8 and 8′. On the two side surfaces of the disc 13 are provided two similar grooves 26 and 26′ which are relatively displaced by 180°. With these grooves engage rollers 21

and 21′ respectively mounted on pivots 28 and 28′ projecting at right angles from the inclined driving rods 27 and 27′. The enlarged ends 53 and 53′ of the driving rods 27, 27′ embrace rollers 24, 24′ mounted on the shaft 12. The other ends of the driving rods 27 and 27′ are hinged to the upper points of bell crank levers 29, 29′ rotatably mounted in projections 30, 30′ of the upper leg portions 8, 8′ adjacent the upper ends of the leg portions. The front points of the bell crank levers 29, 29′ are connected to the upper ends of the rods 32 and 32′. The rods 32 and 32′ are hinged at the lower ends to extensions 31, 31′ of the lower leg portions 25, 25′. With a uniform rotation of the disc 13 the driving rods 27, 27′ are moved alternately forwards and backwards whereby the bell crank levers 29 and 29′ alternately move the rods 32 and 32′ connected thereto, upwardly and downwardly. In this manner the lower leg portions 25 and 25′ in relation to the corresponding upper leg portions 8 and 8′ are at predetermined intervals of time, bent, then stretched or held stretched. By reason of the shape of the grooves 26 and 26′, illustrated, one lower leg portion 25 is stretched in relation to the corresponding upper leg portion 8 whilst this upper leg portion is passing through the last two thirds of its rearward movement, that is to say whilst the foot end of the stretched leg is resting on the ground and the shaft 7 rigidly connected to the vehicle body 1 together with the load attached thereto moves forwardly over the ground. Towards the end of the rearward movement of the upper leg portion the lower leg portion 25 is again bent and during the whole time of the forward movement thereof is kept bent and in this manner holds the foot portion raised from the track as illustrated in Figure 1 in connection with the rods 8′ and 25′. The stretching only takes place during the first third of the rearward movement of the upper leg portions 8, 8′, whilst the lower leg portions 25, 25′ comes into the vertical position at the time the upper leg portion is in the foremost position.

The foot portion in 33, 33′, is also hinged to the lower end of the lower leg portion 25, 25′. The bending and stretching of these feet portions in relation to the corresponding lower leg portion is effected by link rods 34, 34′ which at the top are hinged to a projection 35, 35′ of the upper leg portions 8, 8′ and at the bottom to the heel end of the corresponding foot portion. By means of the said link rods and by reason of the connection used the foot, in relation to the corresponding lower leg portion in the stretched position of the leg is held stretched but bent in relation to the lower leg portion when this is bent in relation to the upper leg portion. The foot portion of the unloaded leg moving forwardly in the bent position is thereby raised still further from the ground and thus uninterrupted operation is still more ensured in uneven and sinking ground. The unobstructed movement is also rendered possible by reason of the fact that in consequence of the shape of the grooves 26′ of the disc 13 the foot portion is always placed vertically on the ground and is raised vertically therefrom.

The parts of the grooves 20, 26 which produce the simultaneous movements of the upper leg portions 8, 8′ in relation to the shaft 7 and of the lower leg portions 25, 25′ in relation to the corresponding upper leg portions are indicated at the periphery of the discs 13 and 15 by the same numerals. The two cam discs are connected to the corresponding driving and actuating means in such a manner that both driving rods actuating the same leg always engage simultaneously with such portions of the respective grooves which on the circumference of both discs in the radial line are marked with equal numerals which indicates that the movements dependent upon one another are taking place correctly.

The rods 36, 36′ are connected at both sides, as high and forwardly as possible in relation to the shaft 7, to the casing 5. The rear ends of the rods carry a transverse beam 37 from which is suspended a hock 38. The pulling force therefore always acts at such angle that the vertical components thereof press the front part of the machine against the ground and a lifting of the front part is thus avoided.

If desired the artificial legs may be disengaged, for this purpose there is mounted on supports 39, 39′ an auxiliary shaft 40 on which wheels 41 may be fitted.

If the front steering wheels are replaced by small sledges a draft sledge is obtained.

The operation of the machine is produced in that the driving rod 23 alters the angle formed between the stretched artificial leg to the horizontal. The alteration is produced when the front half of the machine is of sufficient weight either when the shaft 7 together with the attached load gets forward over the ground or when the foot portion of the leg slides backwardly on the ground.

As the distance between the points of engagement of the driving rod 23, 23′ from the shaft 7 in the form of construction illustrated is about an eight of the distance of the foot end of the stretched leg from the shaft 7, the resistance occurring at the shaft 7 may be eight times larger than the adhesion resistance at the foot end before slipping of the foot end 33, 33′ on the ground occurs. From this is explained the great draft capacity of the artificial leg in relation to the known driving wheels. On steep tracks the component of gravity parallel to the track

behaves similar to the resistance to the suspended load. Both resistances are overcome more easily by the motive force of the artificial legs than by driving wheels.

The machine can also travel rearwardly if the two cam discs 13 and 26 are rotated in the reverse direction. Both legs then swing alternately in the bent condition rearwardly in relation to the shaft 7 and in the stretched position move the vehicle rearwardly.

I am aware that other modifications besides those shown in the drawing may be found useful and lie within the scope of my invention.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In a drive means for a motor vehicle, a motor, a casing, drive shafts at the front and rear ends of the casing, means for driving said shafts from the motor, cams on said shafts, a nondriven shaft intermediate said first shafts, jointed legs hingedly mounted on said second shaft, a bell crank on the upper part of each leg, means operatively connecting one arm of the bell crank with the lower part of the leg, means operatively connecting the other arm of the bell crank with said front cam, and means operatively connecting the said rear cam with the upper part of said leg.

2. In a drive means for a motor vehicle, a casing, drive shafts at the front and rear ends of the casing, groove disks on said drive shafts, means for rotating said shafts with equal frequency, a nondriven shaft intermediate said first mentioned shafts, three limbed jointed legs, each comprising an upper leg part, a lower leg part, and a movable foot portion, hingedly mounted on said second shaft, a bell crank pivoted on the front side of said upper leg part, an inclined driving rod operatively connecting the front groove disk with the upper point of said bell crank, and a solid link rod connecting the lower point of the bell crank with an extension on the top of the lower leg part, a driving rod operatively connecting the rear groove disk with the upper leg part, a spur on the rear side of said upper leg part adjacent to its lower end, a movable foot portion linked to the lower leg part, a solid link rod parallel to said lower leg part hingedly connecting the spur on the upper leg part with the heel end of said movable foot portion.

3. In a drive means for a motor vehicle, a motor, a casing, drive shafts at the front and rear ends of the casing, means for driving said shafts from the motor with equal frequency, groove disks on said drive shafts, a nondriven shaft intermediate said first shafts, jointed legs hingedly mounted on said second shaft, a bell crank on the upper part of each leg, a solid rod connecting one arm of the bell crank with the lower part of the leg, means operatively connecting the other arm of the bell crank with the front groove disk, a driving rod operatively connecting the rear groove disk with the upper leg part adjacent to its top end, the arrangement owing to the peculiar shape of the groove formed on the rear disk being such as to swing the upper leg part from its temporary vertical position at about twice the angular distance forwardly than backwardly, and that one upper leg part performs its entire forward swinging and the first third of its rearward swinging while the other upper leg part performs the two latter thirds of its backward swinging.

4. In a drive means for a motor vehicle, a motor, a casing, drive shafts at the front and rear ends of the casing, groove disks on said drive shafts, and means for driving said shafts with equal frequency, a nondriven shaft intermediate said shafts, jointed legs hingedly mounted on said nondriven shaft, a driving rod operatively connecting the rear groove disk with the upper leg part adjacent to its top end, a bell crank on the upper part of each leg, a solid rod connecting one arm of the bell crank with the lower part of the leg, means operatively connecting the other arm of the bell crank with the front groove disk, the arrangement owing to the peculiar shape of the groove formed on the front disk being such that the foot end of the striding leg is always placed vertically on the ground and is raised vertically therefrom.

5. In a drive means for a motor vehicle, a motor, a casing, drive shafts at the front and rear ends of the casing, means for driving said shafts from the motor with equal frequency, groove disks on said drive shafts, a nondriven shaft intermediate said first shafts, jointed legs hingedly mounted on said second shaft, a bell crank on the upper part of each leg, a solid rod connecting one arm of the bell crank with the lower part of the leg, means operatively connecting the other arm of the bell crank with the front groove disk, a driving rod operatively connecting the rear groove disk with the upper leg part, the control of the right cooperation of the front and the rear groove disk being rendered possible thereby that the portions of the different grooves having to produce coordinated, i. e. simultaneous, movements of the lower and upper leg part respectively.

In testimony whereof I have signed my name to this specification this 24th day of March, 1926.

ADOLF EHRLICH.