Feb. 19, 1924. 1,484,312

H. I. WASHBURN

SYN-MOTOR

Filed Aug. 21, 1917 7 Sheets-Sheet 1

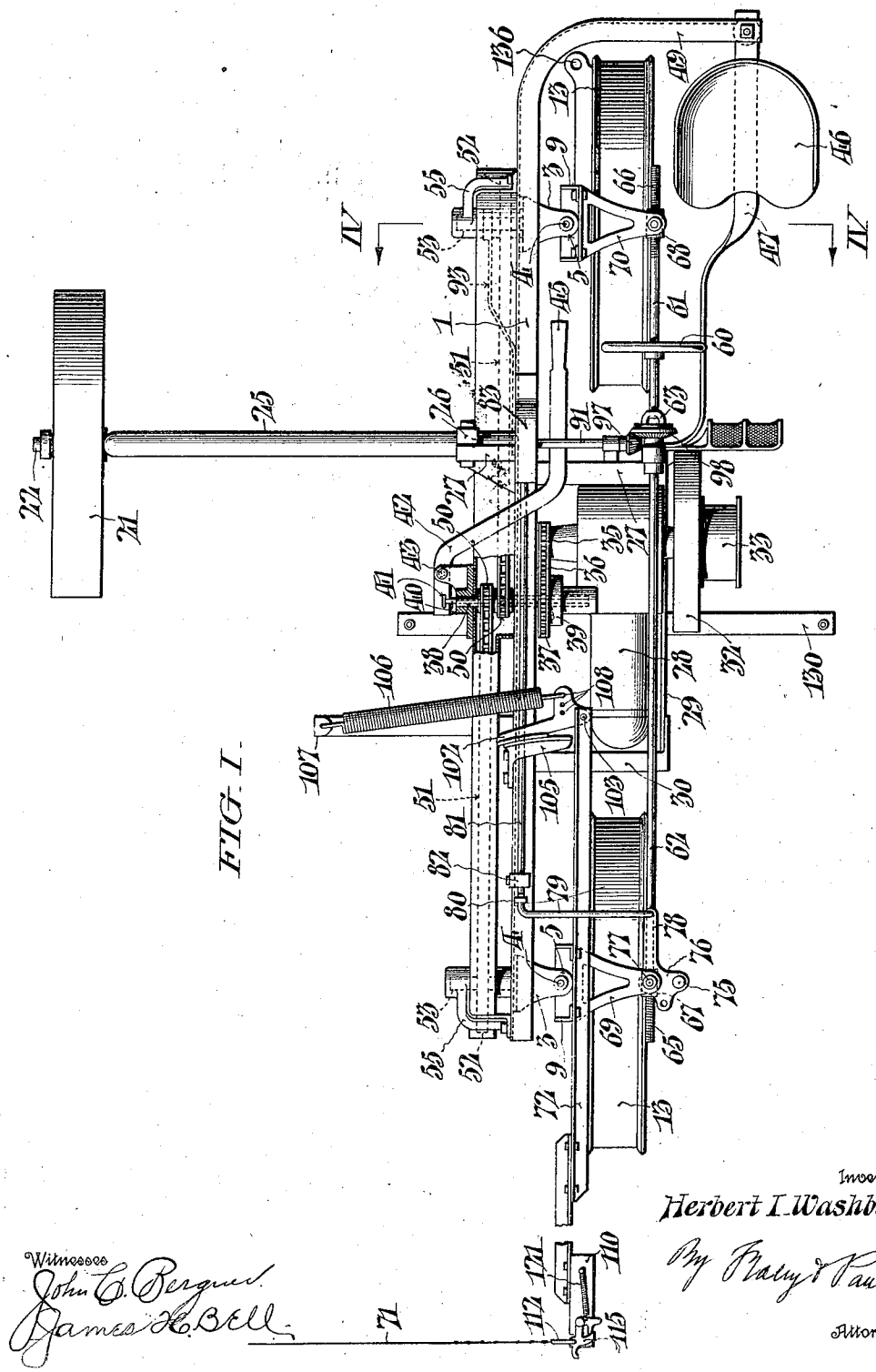


FIG. I.

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SYN-MOTOR

Filed Aug. 21, 1917 7 Sheets-Sheet 2

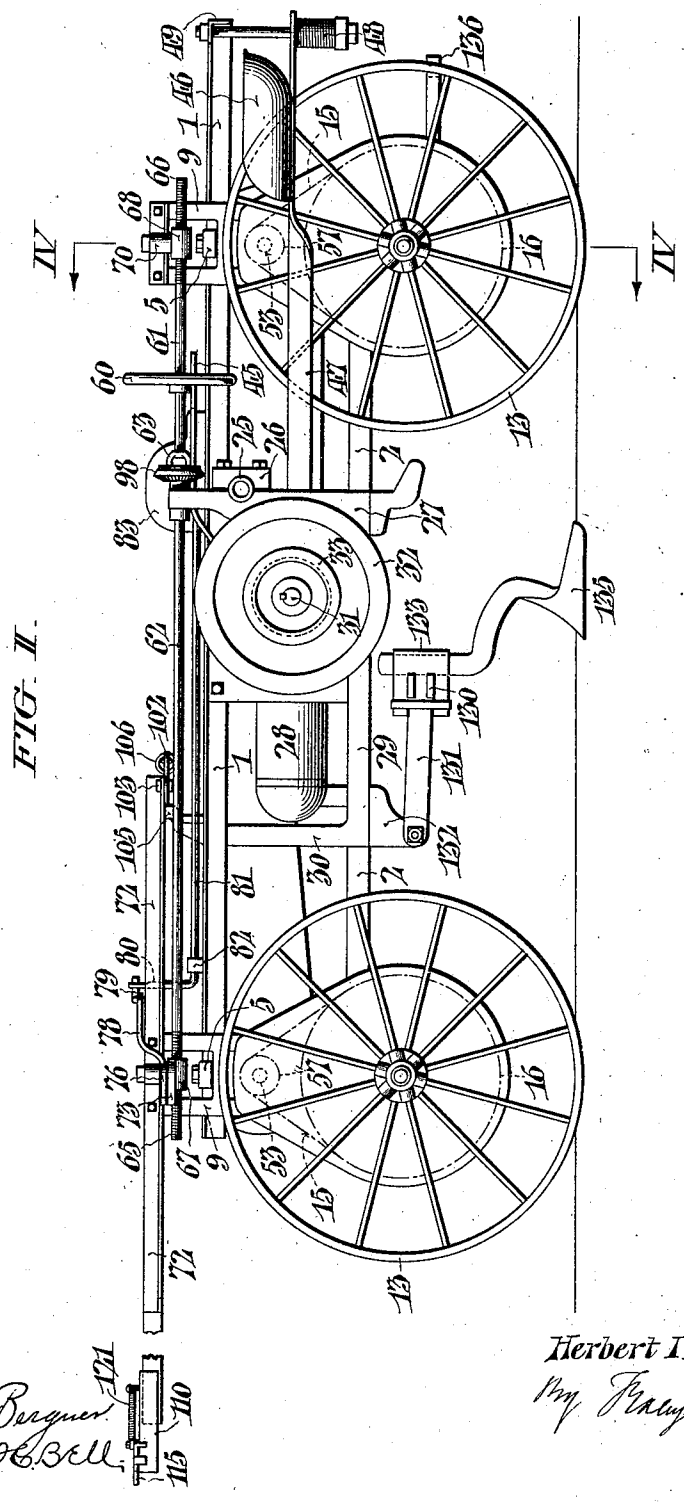


FIG. II.

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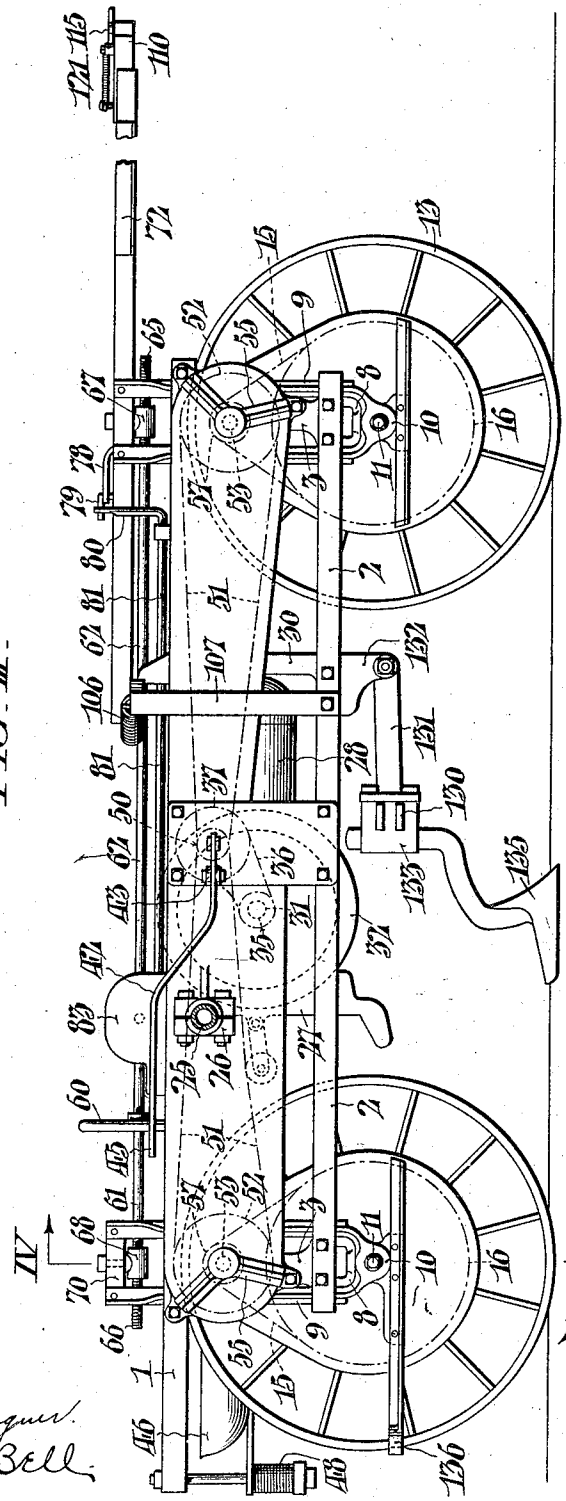
Feb. 19, 1924. 1,484,312

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SYN-MOTOR

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FIG. III.



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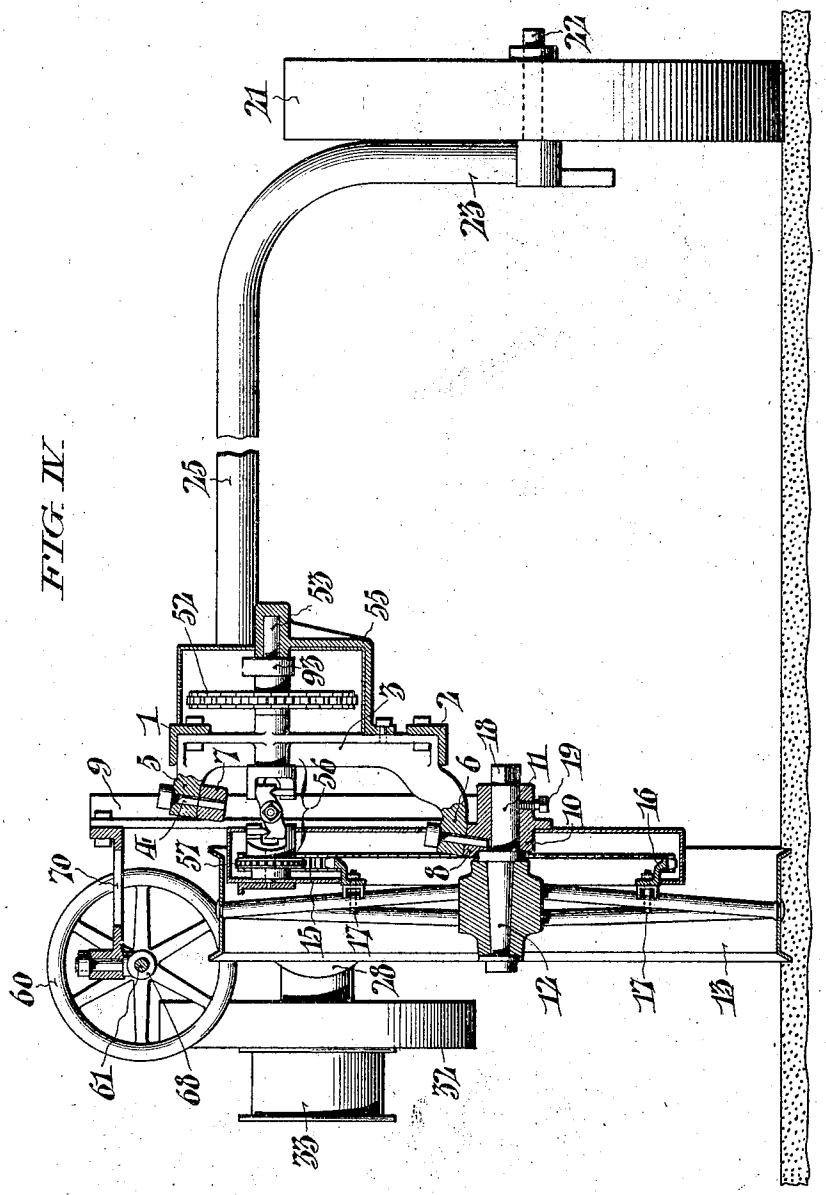
Feb. 19, 1924. 1,484,312

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SYN-MOTOR

Filed Aug. 21, 1917 7 Sheets-Sheet 4

FIG. IV.




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SYN-MOTOR

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FIG. V.

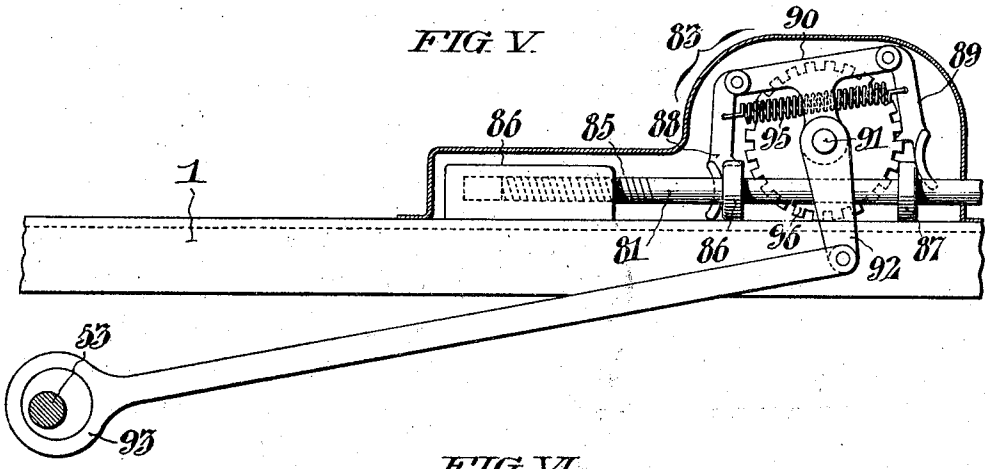
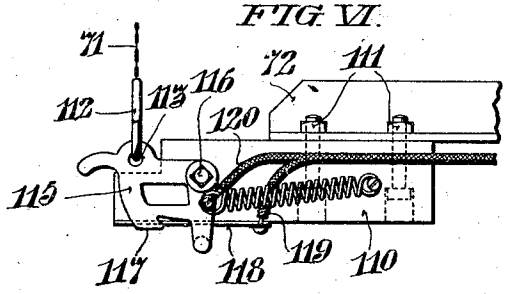



FIG. VI.




IX

FIG. VII.

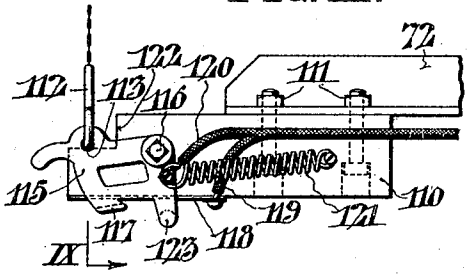



FIG. VIII.

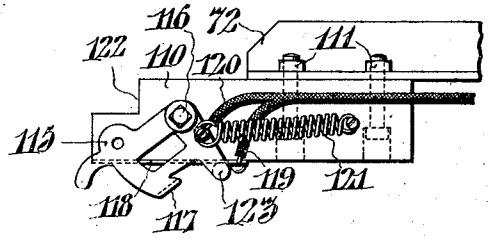
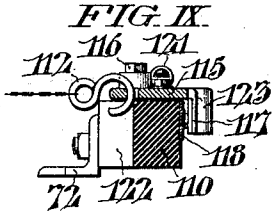



FIG. IX.




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SYN-MOTOR

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FIG. X.

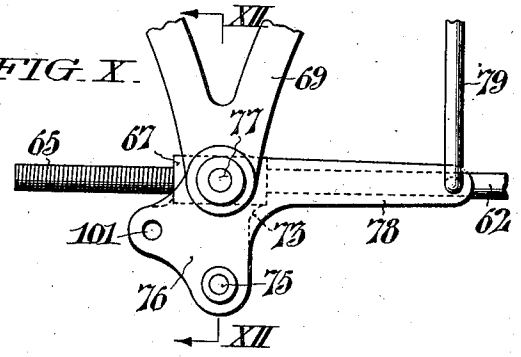



FIG. XI.

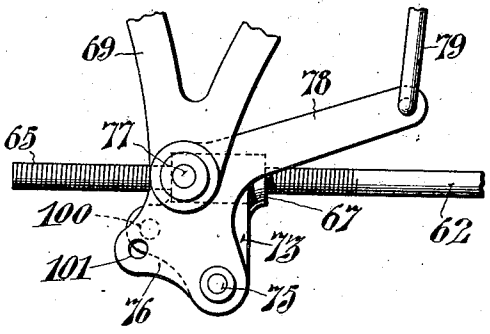



FIG. XII.

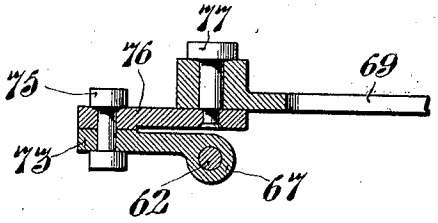
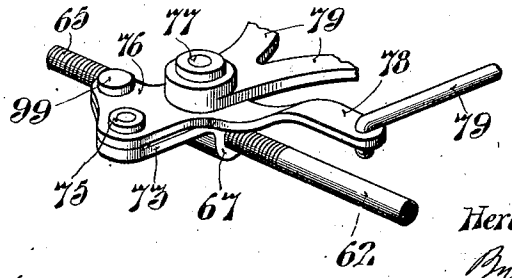



FIG. XIII.




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Feb. 19, 1924. 1,484,312

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SYN-MOTOR

Filed Aug. 21, 1917 7 Sheets-Sheet 7

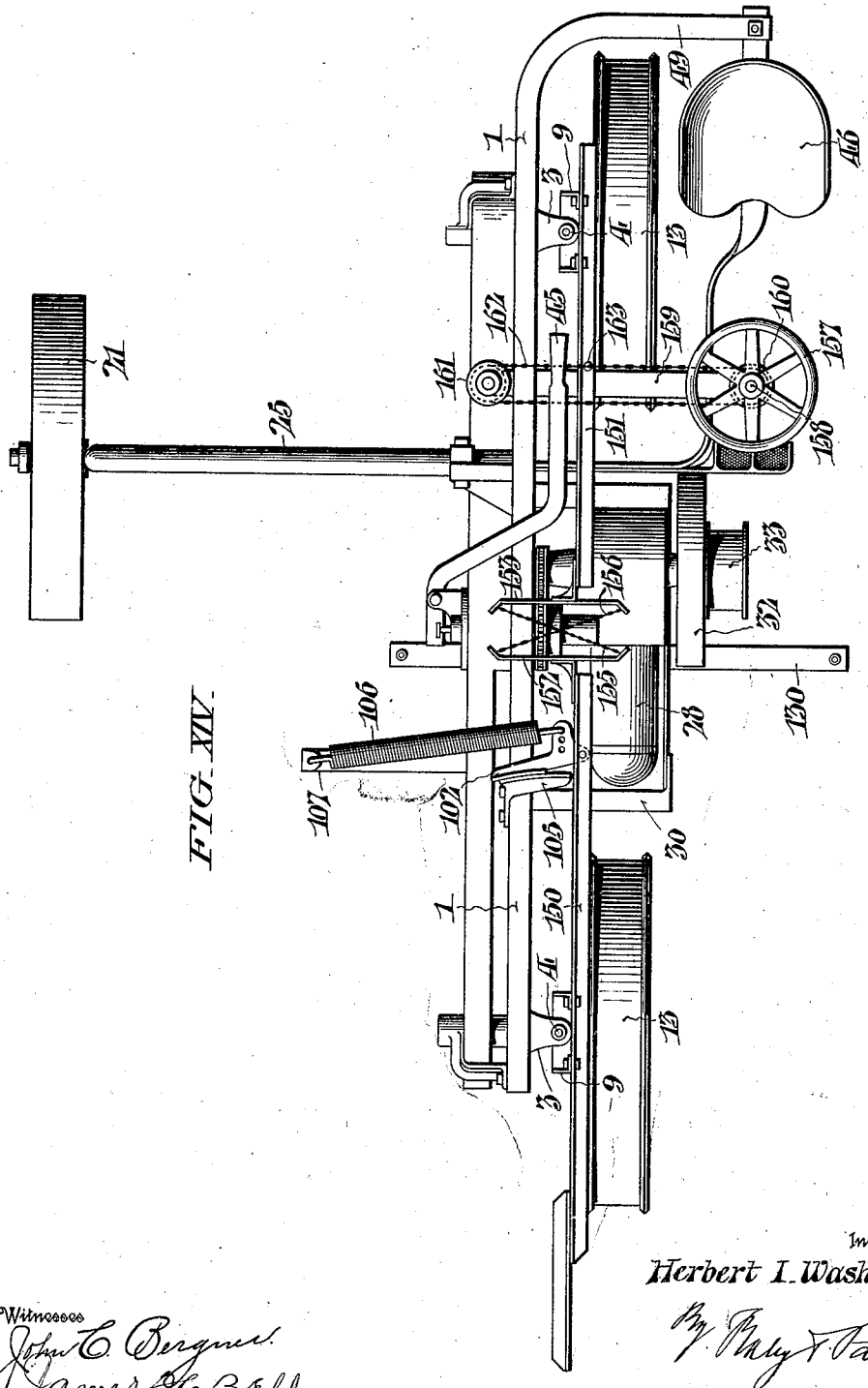



FIG. XIV.

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Patented Feb. 19, 1924. 1,484,312

# UNITED STATES PATENT OFFICE.

HERBERT I. WASHBURN, OF LAUREL SPRINGS, NEW JERSEY.

## SYN-MOTOR.

Application filed August 21, 1917. Serial No. 187,494.

*To all whom it may concern:*

Be it known that I, HERBERT I. WASHBURN, of Laurel Springs, in the county of Camden and State of New Jersey, have invented certain new and useful Improvements in Syn-Motors, whereof the following is a specification, reference being had to the accompanying drawings.

The invention relates to improvements in syn-motors and more particularly to devices of this class employed for agricultural purposes.

The invention comprehends a device of the above type which is automatic in operation in connection with a field center guiding apparatus such as shown and described in my co-pending application Serial No. 187,495, filed August 21, 1917. By this combination the syn-motor constructed as hereinafter set forth, may be guided in a spiral or curved path in automatically ploughing or otherwise cultivating a field.

To this end, my invention includes means for simultaneously shifting the tractor wheels through corresponding angles in following a predetermined curvature of traction.

The invention is further directed to steering organization such as the above comprising means whereby the syn-motor may be adapted for either automatic or manual operation.

The present improvement also comprehends means for automatically suspending the operation of the syn-motor in the event of failure or rupture in the guiding element.

In the drawing, Fig. I is a plan view of an agricultural syn-motor conveniently embodying my improvements.

Fig. II is a side elevation of the same as viewed from the bottom of Fig. I.

Fig. III is an elevation as viewed from the side opposite to that illustrated in Fig. II.

Fig. IV is a transverse sectional elevation along the line IV—IV in Figs. I and II.

Fig. V is a detail of a portion of the automatic steering mechanism.

Figs. VI, VII, VIII and IX are detail views of an automatic electrical cut out functional in rendering the device inoperative upon the breaking of the guide wire.

Figs. X to XIII inclusive, are details of the mechanism whereby the syn-motor may be set either for automatic or manual steering.

Fig. XIV is a plan view of a tractor similar to that illustrated in Fig. I but disclosing a modified steering apparatus.

The syn-motor herein shown, comprises a structural frame work including a pair of parallel, horizontally disposed angle irons, 1 and 2, united at their ends by rigidly bolted brackets 3—3. As best shown in Fig. IV, brackets 3 are each provided with a pair of spaced lugs 5 and 6, which are pivotally engaged by a pair of bosses 7 and 8, respectively formed integrally with yoke pieces 9. These yoke pieces 9 are further provided at their lower ends, with enlarged bosses 10, for the reception of the eccentric cylindrical extensions 11, of the tapered axles 12 for the tractor wheels 13—13. Said wheels are driven by sprocket chains 15—15 which engage sprocket rings 16, attached to the spokes of the wheels by suitable U bolts 17. The slack of these chains may be taken up by turning the axles 12 about their concentric mountings 11, which are squared at 18, for this purpose and the adjustment fixed by set screws 19, threaded in the bosses 10.

The syn-motor is stabilized by an outrigger wheel 21, mounted upon an axle 22, fixed in the outer down turned end 23 of a beam 25. Said beam is adjustably held in a clamp 26, formed on a bracket 27, of the structural frame. By this construction, the wheel 21 may be spaced from the syn-motor proper in adapting the same to various uses.

Mounted upon the structural frame at a point about midway between the tractor wheels 13, is an internal combustion engine comprehensively indicated at 28, and supported upon a cradle 29, held between bracket 27 and a similar bracket 30, both of which, as best seen in Figs. I and III, are bolted to the parallel angle irons 1 and 2. Shaft 31, of the engine carries at its outer end, the usual fly wheel 32, which in this instance is supplemented by a pulley 33, whereby any auxiliary apparatus may be driven when the organization is simply employed as a power plant. To the inner end of engine shaft 31, is fixed a sprocket pinion 35, which, through a chain 36, drives a sprocket 37. This sprocket is mounted on a counter shaft 38, and may be disconnected therefrom by means of a clutch conventionally indicated at 39, and controlled through a pin 40, extending axially through shaft 38. Pin 40, is headed at 41, for engagement with the end of a shifting lever 42, pivoted at 43, and provided with an operating handle 45.

Handle 45 is located at a point convenient to the seat 46 for the operator. As shown in Figs. I and II, this seat is supported on a bar 47, pivotally secured at the inner end to the framework, and cushioned at the other end by coiled spring 48 suspended from the laterally turned end 49, of angle bar 1.

Counter shaft 38 also carries a pair of sprocket pinions 50—50, which by means of chains 51—51, serve to drive sprocket wheels 52—52, mounted upon stub shafts 53—53, which are journalled in fixed brackets 55, bolted to the structural framework, see Figs. I, III and IV. A universal coupling 56 is interposed in each of the shafts 53, so as to permit steering as hereinafter specified. The outer end of said shafts find their bearings in cross pieces of the yokes 9, and each of these is further provided with a sprocket pinion 57, whereby motion is transmitted through the chains 15, to the sprocket rings 16, on the tractor wheels 13, already referred to. The tractor wheels are thus driven through the sprocket system just described, from the engine 28, and the operation of the device controlled manually by means of clutch 39 operable by handle 45.

Steering of the syn-motor is effected by simultaneously swinging the tractor wheels through equal corresponding angles and this according to my invention may be accomplished either manually or automatically.

In manual operation the apparatus is guided under the control of a hand wheel 60, located at a point near seat 46, so as to be readily accessible to the operator. Wheel 60 is mounted upon a longitudinal line shaft comprising sections 61 and 62, united by a universal coupling 63. These sections are threaded oppositely at their outer ends as indicated at 65 and 66, to respectively engage nuts 67 and 68, swivelly mounted in the ends of arms 69 and 70 projecting from yoke pieces 9—9, for the tractor wheels 13—13. Said wheels may thus be simultaneously swung about their yoke pivots 4, through similar angles in either direction corresponding to the direction of rotation of shaft 61—62 under control of hand wheel 60.

When employed for automatic operation, the syn-motor is adapted for use in connection with a guiding apparatus such as shown and described in my co-pending application hereinbefore referred to. The device therein disclosed, is located in a field center and comprises mechanism for automatically taking up a guide wire to the end of which the syn-motor is attached, so that the same is obliged to follow a constantly decreasing spiral path. This guide wire is represented at 71, in Fig. I, and is connected, through an interposed mechanism, to be described later, to an extension 72 bolted to the wheel yoke 9, at the forward or left hand end of the machine (Figs. I and II). The tension constantly maintained upon the wire (due to the tendency of the syn-motor to travel in a straight path under control of a brake mechanism also to be later described) causes a pull upon extension 72, thereby coincidently turning the forward tractor wheel about its pivot 4.

From Fig. IV it will be noted that the line of pivotal attachment of the yoke pieces 9 for the tractor wheels is slightly inclined to the vertical and passes through the central point of engagement of the tractor wheel with the ground. Furthermore, this pivotal center line also passes through the center of the universal coupling 56, so that as a consequence, the wheel is absolutely free to turn about its pivot without interference by its driving connections. When referred to the forward wheel, it will be seen that this method of construction obviates any tendency of the steering extension 72, to deflect either to the right or left under the pull of the motor and interfere with either the manual or automatic control of the syn-motor.

It now remains to transmit an equal corresponding angular movement to the rear tractor wheel in such a manner that the side stresses and joltings of the said rear wheel cannot be reactive upon the front tractor wheel, extension 72 or the guide wire 71. This is accomplished by the following instrumentalities:

Referring to Figs. X to XIII inclusive, it will be noted that the nut 67, cooperative with the threaded end of steering shaft section 62, is not directly attached to the arm 69, of the wheel yoke 9, but is supplemented by a horizontal wing plate 73, which is swivelly pivoted at a point 75, to an arm 76 of an interposed bell crank lever 78. This lever is directly fulcrumed at 77, to the end of arm 69, so that when arm 69, is swung in accordance to the movement of the forward tractor wheel under the automatic control, said lever is shifted to the position illustrated in Fig. XI. This movement is imparted through a link 79, to an arm 80, (Figs. I and II) formed by up-turning the end of a rock shaft 81, journalled at one end in a suitable bearing 82. Said rock shaft extends longitudinally along the top of the upper angle iron 1, of the supporting frame, to a double acting pawling mechanism comprehensively indicated at 83, (Fig. V) and its other end is threaded at 85, to engage within a fixed bearing 86. The thread 85 is of a coarse pitch so that a slight angular movement of the arm 80 causes a substantial longitudinal shifting of the rock shaft 81. Said shaft 81 (Fig. V) carries a pair of fixed collars 86 and 87, which are respectively cooperative with a pair of pawl arms 88 and 89 freely suspended from their pivotal mountings in the ends of the hori-

zontal arm of a T shaped lever 90, freely fulcrumed about a shaft 91, included in the pawling mechanism 83. Lever 90 is continually oscillated by means of an integrally formed arm 92, coupled with an eccentric 93, mounted on stub shaft 53, already described. See also Fig. IV. A spring 95, co-active with both pawl arms 88 and 89 tends to normally maintain the latter in engagement with a ratchet wheel 96 which is fixed upon shaft 91. The activity of these pawls is selectively dependent upon the shifting of rock shaft 81, as above noted, for example, if said shaft is shifted to the left as illustrated in Fig. V, pawl 88 will be rendered inactive while pawl 89 is permitted to engage with the ratchet wheel 96, to turn shaft 91.

The oscillation of lever 90 will thus be transmitted by one or the other of the pawls to the ratchet wheel to turn shaft 91 in one direction or the other. These parts are, however, so designed that a certain small amount of free play is allotted the front wheel to compensate for the ordinary vibration or swaying of this wheel owing to the irregularities in the course over which the device travels. This freedom is to the extent of about two or three degrees, within the range of which, pawls 88 or 89 will remain in a neutral position (both disengaged from ratchet) and as a consequence, inactive. Beyond this range, however, either one or the other of these pawls becomes immediately effective as hereinbefore noted.

As shown in Fig. I, shaft 91 extends laterally outward from the pawling mechanism to afford attachment for a bevel pinion 97, which engages a bevel gear 98, mounted upon the right hand end of section 62, of the steering shaft. The movements of the shaft 91 will thus be directly transmitted to the steering shaft, whereupon the rear tractor wheel will be immediately angularly shifted in accordance with the automatically directed behavior of the forward wheel.

In order to avoid confusion in comprehending the parts thus far described, a feature relating to the manual control of the device has been purposely omitted, and it will be convenient at this point to proceed with an explanation of the same. Referring once more to Figs. X to XIII, during manual operation, it is necessary to interlock wing plate 73, with arm 76 of interposed bell crank lever 78, so that the point 77 is thereby made the swivel center of nut 67, instead of permitting the complex movement illustrated in Fig. XI. To this end the respective parts 73 and 76 are pierced by apertures 100 and 101, which, when aligned, receive a removable pin 99, clearly shown in Fig. XIII where the said parts are illustrated in their fixed relation. When these parts are thus locked, the actuating pawls 88 and 89, of the steering transmission, will be permanently held in their neutral inoperative positions free from engagement with ratchet 96.

In order to absorb the shocks due to sudden accidental or spasmodic shiftings of the tractor wheels in steering, a safety device has been provided in the form of a brake which comprises a shoe 102, pivotally attached at 103, to the extension 72 of forward wheel yoke 9. Shoe 102 is co-operative with a fixed member 105, rigidly bolted to the structural frame. The abrading faces of these two brake members are segmental with respect to a radius having a center common to the pivot of the forward tractor wheel. Positive engagement is maintained by the spring 106 secured at one end to a fixed bracket 107, and at the other end, in one of a series of apertures 108, in member 102, whereby the leverage and the corresponding effect of the spring tension may be varied. Thus a tension is constantly maintained by spring 106, in opposition to the pull on wire 71, since these two elements are attached at opposite ends of the extension 72. This opposition and the pull on wire 71, are in inverse proportion in correspondence to the relative lengths of the extension 72, relative to its fulcrum 4. The maintenance of an exactly measured and even pull upon wire 71, therefore causes its outer end to follow accurately the predetermined geometrical path established as hereinbefore set forth.

The syn-motor is rendered proof against running "wild," in the event of rupture in the guide wire, by an automatic electric cut out switch mechanism which will be best understood by reference to Figs. VI to IX inclusive taken in connection with Fig. I. To the outer end of extension 72, is fixed a block 110, of wood or other suitable electro-insulating material by means of bolts, 111. The terminal hook 112 of the guide wire is received within an aperture 113, of a swivel plate 115, fulcrumed at 116, to the insulating block 110. When in its normal position under pull of wire 71, as illustrated in Fig. VI, an integrally formed stop 117, of the plate engages a metallic contact strip 118, interposed in the engine ignition circuit by conductor 119. The return conductor 120, of this circuit is directly connected to the swivel plate 115, so that in this manner a closed circuit is maintained during the normal operation of the device.

If a rupture should occur in the guide wire, the parts will immediately assume the position illustrated in Figs. VII and IX. This is occasioned by a spring 121, acting upon the swivel plate to an extent limited by the engagement of the terminal hook within the recessed portion 122, of block

110. Contact between lug 117 and strip 118 is thus interrupted and the ignition circuit of the engine is consequently broken with the result that operation of the device is positively suspended.

When the terminal hook 112, is entirely removed and the guide wire dispensed with as in manual operation, the parts further shift to the position illustrated in Fig. VIII, where the circuit is constantly maintained under the influence of spring 121, by contact of a second integral stop arm 123, of plate 115, with metallic strip 118.

By provision of a universal gang bar 130, Figs. I, II and III, the device may be employed for propelling any number of agricultural implements. For the purpose of convenient illustration, in the present instance, a plough 135, has been shown. This implement has an extended shank which may be attached at any point along the gang bar 130 and secured in position by a clamp 133. Said gang bar is freely suspended by means of a pair of links 131, pivotally attached to depending brackets 132, of the framework. A rear hitch 136, has also been provided as a convenient adjunct for additional agricultural implement attachment.

The modified steering apparatus illustrated in Fig. XIV operates in a manner similar to that of the preferred embodiment of my invention but varies somewhat as to details. The parts in this figure which are identical with those already described are identified with the same reference numerals. In this instance, the fore and aft tractor wheel yokes are both provided with horizontal extensions represented respectively at 150 and 151. These extensions terminate in bowed members 152 and 153 respectively and are united at their extremities by crossed chains 155 and 156, or other suitable instrumentalities. This construction serves as a universal connection for transmitting opposite relative movement between the two tractor wheels in the operation of steering. Manual control is herein likewise effected through a hand wheel 157 which is fixed upon a stud shaft 158, supported on the outer end of a bracket 159, extending from the framework. Said shaft carries a pulley 160, which through an endless chain 162 is geared to an idler pulley 161. Chain 162 is secured at a point 163 to extension 151, of the rear tractor wheel yoke. The hand wheel 157 therefore directly controls the steering of the rear tractor and the movement of the latter is transmitted through the intervening elements just described, in equal degree but in an opposite direction, to the forward tractor wheel, thereby simultaneously setting these wheels in tangential positions to the path of curvature which they are to follow.

It is to be understood that I do not wish to limit myself to the precise application herein described since my invention may be readily employed for other similar purposes, and further that various changes may be made in construction and arrangement without departing from the spirit of the invention.

Having thus described my invention I claim:

1. In a device of the class described the combination of a supporting frame; a pair of tractor wheels with supporting mountings pivoted to said frame; swivel nuts carried by said mountings to enable the wheels to shift angularly with reference thereto; and a steering shaft having oppositely threaded ends engaging said nuts for simultaneously shifting said wheels through similar angles in correspondence to the curvature of traction.

2. In a device of the class described, the combination of a supporting frame; tractor wheels pivotally attached to the said frame; means for shifting one of said wheels to follow a curved path of traction; and a relay controlled and actuated by the movement of said wheel to turn the other wheel in a complementary direction in correspondence to the curvature of traction.

3. In a device of the class described, the combination of a structural frame; tractor wheels pivotally mounted upon said frame; a motor; geared driving connections between said motor and wheels with flexible connections interposed therein to permit the pivotal operation of said wheel for steering purposes; and means for irreversibly transmitting steering movements of one of said wheels to the other.

4. In an apparatus of the class described, the combination of a supporting frame; a pair of tractor wheels; mountings for the said wheels pivotally connected to the said frame; means for shifting one of said wheels to follow a curved path; means for transmitting the movement of said wheel in a complementary direction to the other of said wheels in correspondence to the curvature of traction, said means including a nut swiveled to the mounting of the secondary wheel, a threaded shaft engaging the said nut, and interposed mechanism for rotating said shaft.

5. In an apparatus of the class described, the combination of a structural frame work, a pair of tractor wheels; mountings for said wheels pivotally attached to said frames; means for shifting one of said wheels to follow a curved path; means for transmitting the movement of said wheel in a complementary direction to the second wheel in correspondence to the curvature of traction, said means including a nut swiveled to the mounting of the second wheel; a threaded shaft engaging the said nut; a

ratchet wheel carried by the said shaft; a double acting pawling mechanism for the said ratchet and interposed mechanism for controlling said pawling mechanism.

6. In an apparatus of the class described, the combination of a structural frame work, a pair of tractor wheels; mountings for said wheels pivotally attached to said frames; means for shifting one of said wheels to follow a curved path; means for transmitting the movement of said wheel in a complementary direction to the second wheel in correspondence to the curvature of traction, said means including a nut swiveled to the mounting of the second wheel; a threaded shaft engaging the said nut; a ratchet wheel carried by the said shaft; a pair of opposed pawls co-operative with said ratchet; and interposed mechanism for selectively controlling the operation of said pawls.

7. In an apparatus of the class described, the combination of a structural frame work, a pair of tractor wheels; mountings for said wheels pivotally attached to said frames; means for shifting one of said wheels to follow a curved path; means for transmitting the movement of said wheel in a complementary direction to the second wheel in correspondence to the curvature of traction, said means including a nut swiveled to the mounting of the second wheel; a threaded shaft engaging the said nut; a ratchet wheel carried by the said shaft; a pair of opposed pawls co-operative with the said ratchet; means for constantly oscillating the said pawls; a slide shaft connected to the mounting of the first tractor wheel; and a pair of collars mounted upon said slide shaft, for respectively co-acting with said pawls to selectively control the pawling of said ratchet.

8. In an apparatus of the class described, the combination of a structural frame work, a pair of tractor wheels; mountings for said wheels pivotally attached to said frames; means for shifting one of said wheels to follow a curved path; means for transmitting the movement of said wheel in a complementary direction to the second wheel in correspondence to the curvature of traction, said means including a nut swiveled to the mounting of the second wheel; a threaded shaft engaging the said nut; a ratchet wheel carried by the said shaft; a pair of opposed pawls co-operative with the said ratchet; means for constantly oscillating the said pawls; a rock shaft, having a threaded portion; a fixed bearing internally threaded to co-operate with the threaded portion of the said rock shaft; a pair of collars carried by the rock shaft and respectively co-operative with said pawls in selectively controlling the pawling of said ratchet; an arm secured to said rock shaft; and a link connecting said arm with the mounting of the first tractor wheel.

9. In a device of the class described, the combination of a structural frame; a pair of tractor wheels pivotally attached to said frame; means for turning one of said wheels for steering purposes; means for irreversibly transmitting steering movement of said wheel to the other wheel; and means for simultaneously driving both wheels.

10. In a device of the class described, the combination of a structural frame; a pair of tractor wheels pivotally attached thereto; means for turning one of said wheels for steering purposes; and means controlled and actuated by steering movement of said last-mentioned wheel for irreversibly transmitting such movement to the other wheel in a complementary direction, so as to increase or rectify the curvature of the path of traction.

11. In a device of the class described, the combination of a structural frame, a pair of tractor wheels pivotally attached to said frame, means for manually turning one of said wheels for steering purposes, means for irreversibly transmitting complementary movement therefrom to the other wheel, a motor for simultaneously driving both wheels, and means for automatically controlling the device independent of the manual steering means when desired.

12. In a device of the class described, the combination of a structural frame, a pair of tractor wheels pivotally attached to said frame, means for manually turning one of said wheels for steering purposes, means for irreversibly transmitting complementary movement therefrom to the other wheel, a motor for simultaneously driving both wheels, and a guide wire with an associated cut-out respectively adapted to control the device independent of the manual steering means when desired and to automatically stop the motor in case of an untoward occurrence.

13. In a device of the class described, the combination of a structural frame, a pair of tractor wheels pivotally attached to said frame, means for manually turning one of said wheels for steering purposes, means for irreversibly transmitting complementary movement therefrom to the other wheel, a motor for simultaneously driving both wheels, an ignition circuit for said motor, a spring influenced cut-out switch in said circuit, and a guide wire adapted to steer the device independent of the manual steering mechanism when desired and to release the cut-out switch when the guide wire fractures.

14. In a device of the class described, the combination of a structural frame, a pair of tractor wheels pivotally attached to said frame, means for manually turning one of

said wheels for steering purposes, means for irreversibly transmitting complementary movement therefrom to the other wheel, a motor for simultaneously driving both wheels, an ignition circuit for the motor, a cut-out switch interposed in said circuit including a fixed contact, a spring influenced movable switch member co-operative with the said contact, and a guide wire connected to said switch member for steering and controlling the device independently of the manual steering means when desired.

15. In a device of the class described, the combination of a structural frame, a pair of tractor wheels pivotally attached to said frame, means for manually turning one of said wheels for steering purposes, means for irreversibly transmitting complementary movement therefrom to the other wheel, a motor for simultaneously driving both wheels, an ignition circuit for the motor, a cut-out switch interposed in said circuit including a fixed contact, a spring influenced movable switch member cooperative with the said contact, and a laterally disposed guide wire connected to said switch member for steering the device independently of the manual steering means, said guide wire exerting a steering pull through the contact between the make-and-break parts of the switch so as to maintain the switch closed only while itself intact.

16. In a device of the class described, the combination of a supporting frame; tractor wheels pivotally attached to the said frame; means for shifting one of said wheels to follow a curved path of traction; and means for irreversibly transmitting the movement of said wheel in a complementary direction to the other of said wheels in correspondence to the curvature of traction permitting a limited independent movement of the first of said wheels.

17. In a device of the class described, the combination of a supporting frame; a pair of tractor wheels with mountings pivotally attached to the said frame; manually operable means for irreversibly transmitting steering movement to said wheels; a motor for driving the said device; a wire for automatically guiding and steering the said device attached directly to the mounting of one of said wheels independently of that of the other; and means for frictionally resisting shifting of the wheel to which said guide wire is attached, so as to protect the guide wire against shocks due to unevenness of the ground and constantly maintain an even tension upon said guide wire.

18. In a device of the class described, the combination of a supporting frame; tractor wheels with mountings pivotally attached to said frame; manually operable means for irreversibly transmitting steering movement to said wheels; a wire for automatically steering and controlling the device attached directly to one of said wheel mountings, independently of the other, to guide the corresponding wheel; and means for maintaining a constant and even tension upon said guide wire including a friction shoe fixed upon said frame work, a co-operative friction shoe pivotally attached to the mounting of said wheel, and adjustable means for maintaining the engagement between the said shoes.

19. In a device of the class described, the combination of a structural frame work; tractor wheels pivoted to said frame work by pivots whose axial lines pass through the point of engagement of the respective wheels with the ground; manually operable means for irreversibly transmitting steering movement to said wheels; and means for automatically steering the device including a guide wire extending laterally therefrom and attached to the mounting of one of said wheels; so that the inequalities of the ground traversed by the wheels are substantially without influence thereon in opposition to said guide wire.

In testimony whereof, I have hereunto signed my name at Philadelphia, Pennsylvania, this eighteenth day of August, 1917.

HERBERT I. WASHBURN.

Witnesses:
JAMES H. BELL,
E. L. FULLERTON.