Jan. 7, 1936. A. P. ARMINGTON 2,027,218

AXLE UNIT

Filed Aug. 18, 1933 3 Sheets-Sheet 1

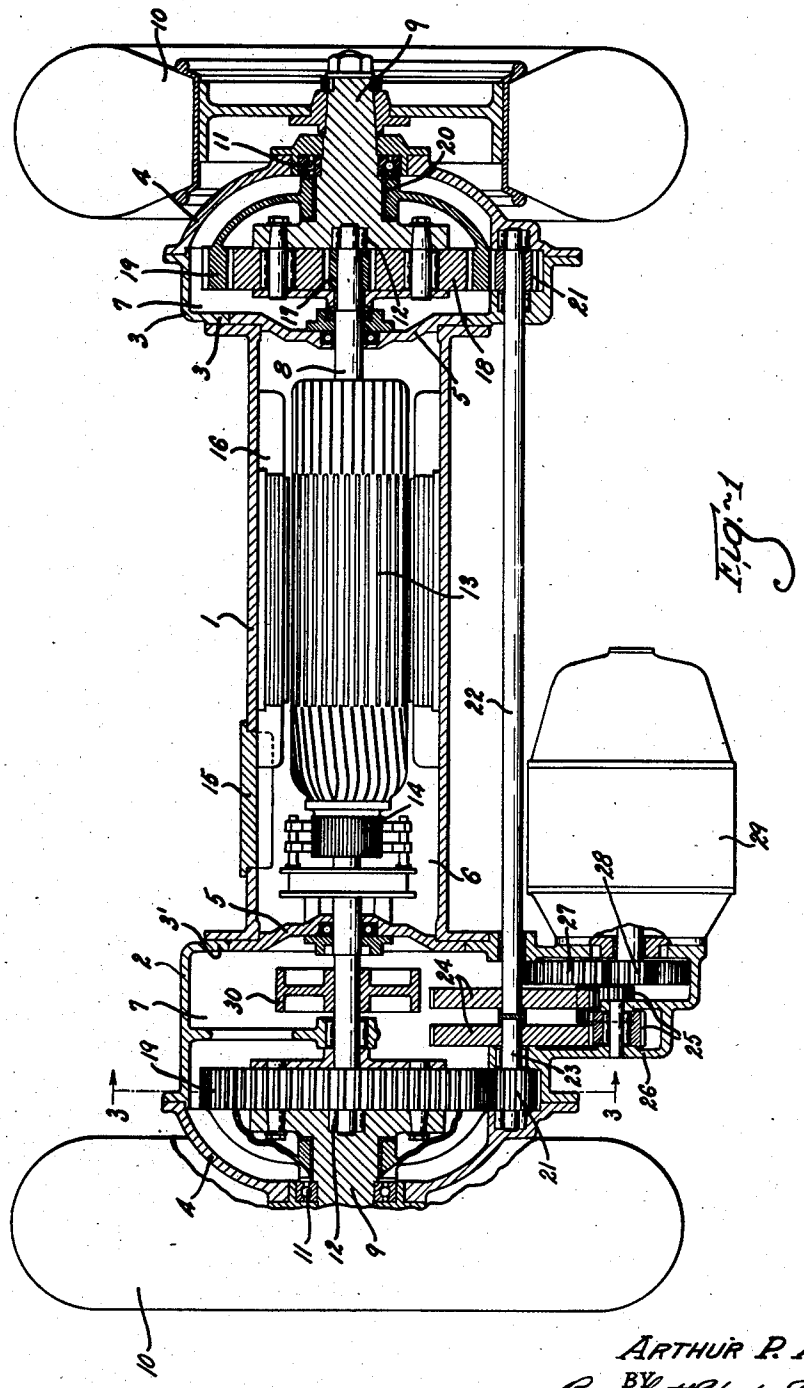


Fig. 1

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AXLE UNIT

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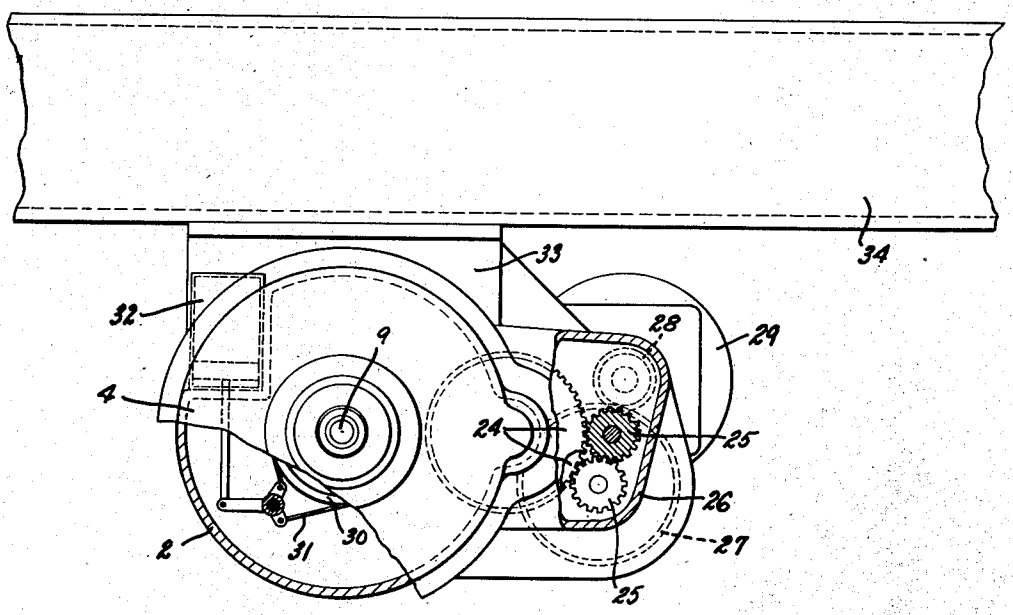


Fig. 2.

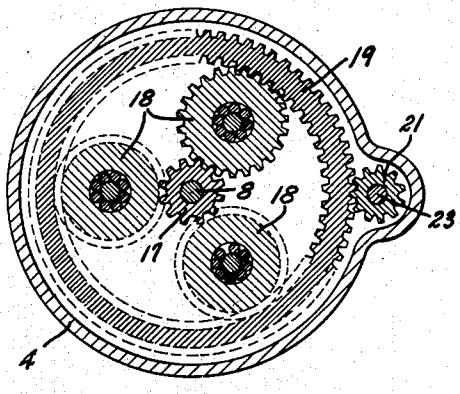


Fig. 3.

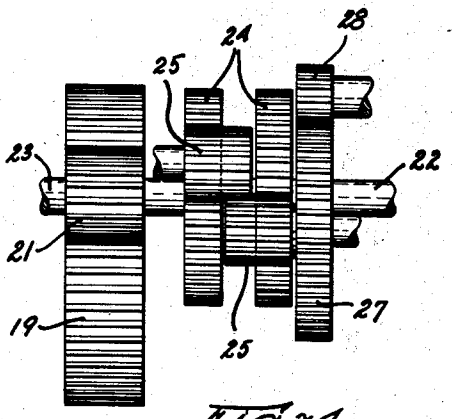


Fig. 4.

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Filed Aug. 18, 1933 3 Sheets-Sheet 3

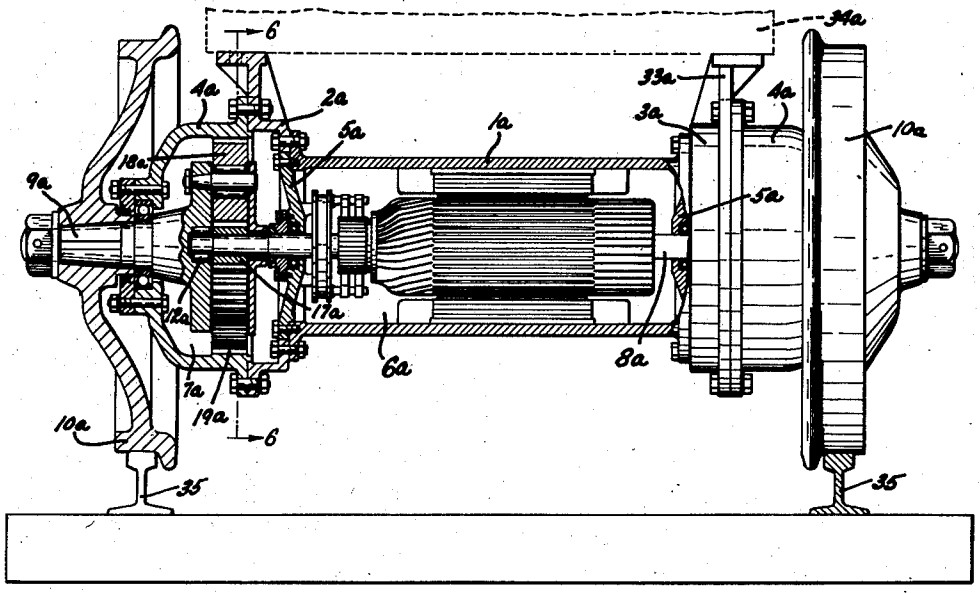


Fig. 5.

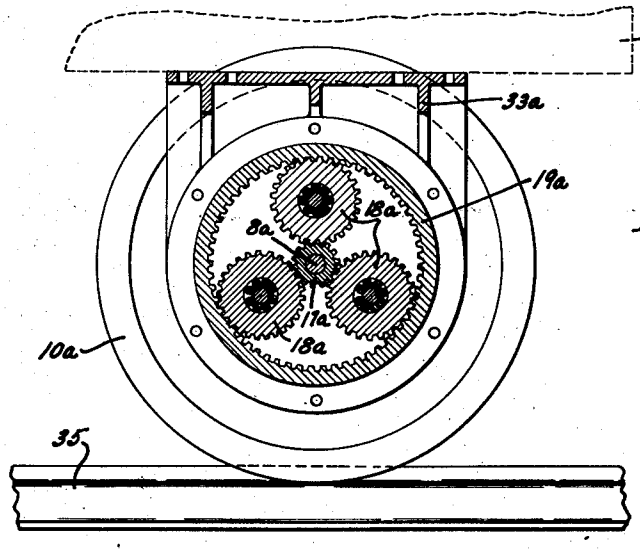


Fig. 6

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UNITED STATES PATENT OFFICE

2,027,218

AXLE UNIT

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Application August 18, 1933, Serial No. 685,770

3 Claims. (Cl. 180—17)

This invention relates to self-contained driving axle units, electrically powered, and which may be adapted for the operation known as steer by drive.

Such a unit is shown in my copending application, Serial No. 685,771, filed of even date herewith, and the general objects of this invention are to provide a unit adapted for higher speed and of somewhat simpler construction than the one there shown. A particular object is to incorporate the driving motor as an integral part of the axle structure, located centrally thereof and enclosed by the housing and frame structure of the axle itself.

The exact nature of this invention together with further objects and advantages thereof will be apparent from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a sectional view of the assembly taken as in a central horizontal plane; Fig. 2 is an end elevation of the same, parts being broken away to show details of construction and the near wheel being removed; Fig. 3 is a transverse section as in the plane of line 3—3, Fig. 1; Fig. 4 is a detail in side elevation of the gearing by which steering actuation and inertia locking of the wheels is had; and Figs. 5 and 6 illustrate a modification adapted for railway service, Fig. 5 being a side elevation partly in section and Fig. 6 being a section as in the plane of line 6—6, Fig. 5.

With reference now to Figs. 1 to 4 of the drawings, the rotating parts to be described are correlated by, and for the most part housed within, a housing and frame structure having five principal members, a cylindrical central member 1, housing members 2 and 3, one at either end thereof, and similar end covers 4 for the housing members 2 and 3. These parts are rigidly connected together as by bolts, not shown, but passing as usual through the abutting flanges illustrated. The housing members 2 and 3 have inwardly turned flanges 3'. These, together with end shields 5 form partition walls which form in effect three cavities or enclosures, a central cavity 6 and end cavities 7.

A shaft 8 has bearing in the motor end shield walls 5 and extends therebeyond into the cavities 7. At each end of the assembly is a stub shaft 9 carrying a wheel 10 here indicated as rubber tired but whose tread may be flanged as for rail service or of any other suitable nature dependent upon the use to which the axle is to be put. Each stub shaft 9 has a bearing at 11 in the corresponding end cover 4 of the housing, and at 12 with the corresponding end of the shaft 8.

It will be observed that by the arrangement described the three shafts are maintained in alignment but permitted relative rotation, and the housing structure is carried by the wheels 10. The shaft 8 carries, within the housing 6, a driving motor armature 13 having a commutator 14 to which access may be had as through hand holes 15 in the central housing member 1. Field coils 16 are mounted on cores secured in the central housing member 1, the arrangement being recognizable as one wherein the central housing member 1 constitutes the frame and the shaft 8 the armature shaft, of an electric motor.

Each end of the motor shaft 8 has driving connection with its stub shaft 9 by planetary gearing, identical for each end. Such gearing includes a center pinion 17 secured on the motor shaft 8, planetary pinions 18 mounted on the stub shaft and a ring gear 19 with which the planetary pinions mesh and which is here shown as bearing, at 20, on the stub shaft 9.

It will be apparent that operation of the driving motor to actuate its shaft 8 will effect coincident and similar drive of both wheels 10 at reduced speed, the planetary pinions 18 rolling within their ring gears 19.

Means are provided for associating these ring gears 19 with the housing, for control of the former, and as here shown such means include means for interassociating the ring gears to provide steering drive of the wheels.

The ring gears are externally toothed as indicated, each to mesh with a pinion 21, each pinion being mounted upon a shaft having bearing in its enlarged housing part. One of these shafts 22 extends from the housing 3 into the housing 2 aligned with and adjacent the end of the other pinion shaft 23. At their adjacent ends these pinion shafts carry gears 24 slightly spaced from each other. Each gear 24 is meshed with a pinion 25, these pinions intermeshing between the gears 24 and being carried by shafts having suitable bearing in the indicated enlargement 26 of the housing 2.

One of the pinions 25 has an associated gear 27 which meshes with a pinion 28. It will be observed that the arrangement described prevents relative rotation of the ring gears 19 except in opposite directions.

Mass means are associated with the pinion 28 to oppose, by inertia effect, such relative ring gear rotation. As here indicated such mass means comprises the armature of a steering motor 29 mounted upon the housing part 28 as indicated, such motor being employed where the

axle unit is to have steering characteristics, as in a land vehicle. Were the axle to be employed merely for drive, that is without steering control, a mere flywheel connected as with the pinion 28 would be sufficient to provide by its mass a differential lock between the two ring gears 19 and thus between the two wheels, to oppose sudden relative rotation of the latter and thus automatically maintain traction of both during accelerating and decelerating periods, yet permit their relative rotation around curves. Such a flywheel is illustrated and described in my copending application to which reference has been made.

The functioning of the mass means to produce the described results will be apparent. Any relative rotation between the two ring gears 19 will effect rotation of the mass means at a much higher speed and in a direction dependent upon the direction of the relative ring gear motion.

By employment of the motor 29 it will be apparent that its operation will effect through the two end differentials of the unit, components of drive applied to both wheels but oppositely to each, so that the axle unit may be steered as well as driven.

A brake drum 30 is secured on the driving motor shaft 8, within the housing 2 and a cooperative brake band 31 provided, shown as connected to an actuating cylinder 32, to have decelerating effect upon the shaft 8 and consequently upon the wheels similarly as the driving motor has accelerating effect.

Operation will be apparent assuming both driving and steering motors connected with a suitable source of power subject to reversing controllers. Operation of the driving motor in either direction will cause operation of both wheels at reduced speed in the same direction. Operation of the steering motor will cause operation of both wheels at much reduced speed in opposite directions. The two motors may be operated either alone or simultaneously. If operated together each wheel will have a component of drive from each motor. Thus the axle unit may be caused to travel in a straight path, a curved path, or, under operation of the steering motor only, may be caused to rotate upon its vertical center.

For associating the axle unit with its vehicle, suitable brackets are provided on the housing and frame structure, dependent upon the relation which the unit is to have with the vehicle body. Examples of the two principal arrangements are illustrated and described in my said copending application. Fig. 2 indicates, for example, brackets 33 integral respectively with the frame housing members 2 and 3, by which the axle may be rigidly secured to frame members 34 of the vehicle.

With reference now to the modification of Figs. 5 and 6, the arrangement will be observed as generally similar to that described and illustrated in Figs. 1 to 4, with the exceptions to be noted. The frame housing has as before, a central member 1*a* and members 2*a* and 3*a*, end covers 4*a* and motor end walls 5*a*, these frame housing members forming a central cavity 6*a* and end cavities 7*a* as before. Motor means are disposed within the central cavity 6*a* with a shaft 8*a* extending into the end cavities and there carrying in each cavity a differential center pinion 17*a*, the shaft 8*a* extending beyond each pinion 17*a* and there having a bearing 12*a* with a stub shaft 9*a*. Mounted on each stub shaft is a plurality of planetary pinions 18*a* meshing with their center pinions 17*a* and with a ring gear 19*a*. The ring gear is fixed with the frame housing and here shown as integral with the end cover 4*a*.

Thus, both stub shafts 9*a* will be positively driven by the motor shaft 8*a* at the same speed with each other but at a lower speed than that of the motor. Mounted on the stub shafts are flanged wheels 10*a* to run on rails 35. Brackets 33*a* integral with the frame housing members 2*a* and 3*a* respectively, serve to connect the axle unit with the supported part of the vehicle here conventionally indicated in broken lines at 34*a*.

Of course, in operation, in both axle unit forms, the end cavities 7 and 7*a* will contain lubricant for the moving parts therewithin, whereas lubricant will be excluded from the center cavity 6, by the motor end walls 5, 5*a*.

What I claim is:

1. In a driving axle unit of the class described, a frame and housing including a central part and end parts with removable end covers, said parts being arranged to provide three enclosures, motor means in the central enclosure having shaft means extending into the end enclosures, wheel-carrying stub shafts extending through said end covers and bearing therein, gearing of planetary type arranged in each end enclosure to provide drive of its stub shaft by said motor shaft, each planetary gearing comprising a center pinion on said motor shaft, planet pinions mounted on the stub shaft, and a ring gear, and means providing for simultaneous actuation of said ring gears in opposite directions to cause steering actuation of said stub shafts.

2. In a driving axle unit of the class described, a frame and housing including a central part and end parts with removable end covers, said parts being arranged to provide three enclosures, motor means in the central enclosure having shaft means extending into the end enclosures, wheel-carrying stub shafts extending through said end covers and bearing therein, and gearing of planetary type arranged in each end enclosure to provide drive of its stub shaft by said motor shaft, each planetary gearing comprising a center pinion on said motor shaft, planet pinions mounted on the stub shaft, and a ring gear having a bearing upon the stub shaft, and means associated with both said ring gears for their simultaneous drive in opposite directions.

3. In a driving axle unit of the class described, driving motor means having a shaft, a wheel-carrying stub shaft at either end thereof, for each stub shaft driving differential gearing of planetary type having an input element driven by said motor shaft, a second input element, and an output element in driving relation with said stub shaft, housing means for said motor means and gearing and having bearing upon said stub shafts, said housing means including a central part forming a supporting enclosure for said motor means, and end parts enclosing said gearing, and means providing for simultaneous actuation of said second differential input elements in opposite directions to cause steering operation of said stub shafts, and including steering motor means carried by said housing means and located outside said enclosures.

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