J. ROBSON.

VARIABLE SPEED HYDRAULIC TRANSMISSION.

APPLICATION FILED NOV. 14, 1913.

1,143,727. Patented June 22, 1915.

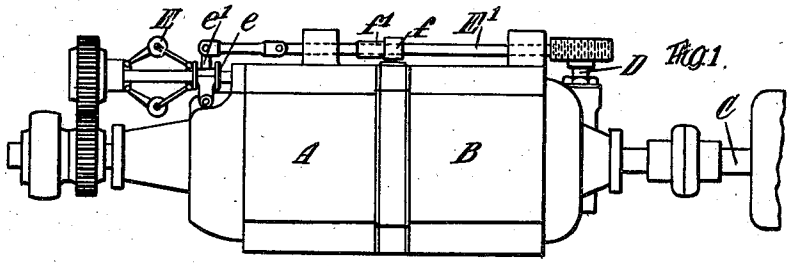

Fig. 1.

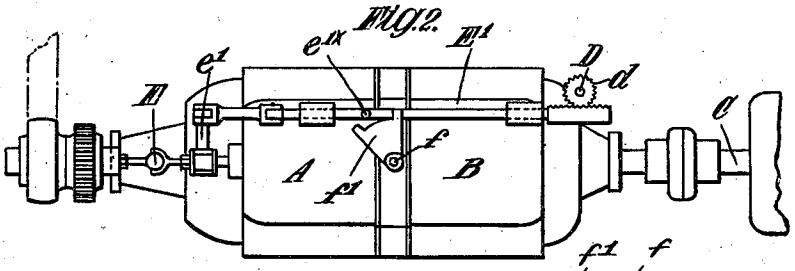

Fig. 2.

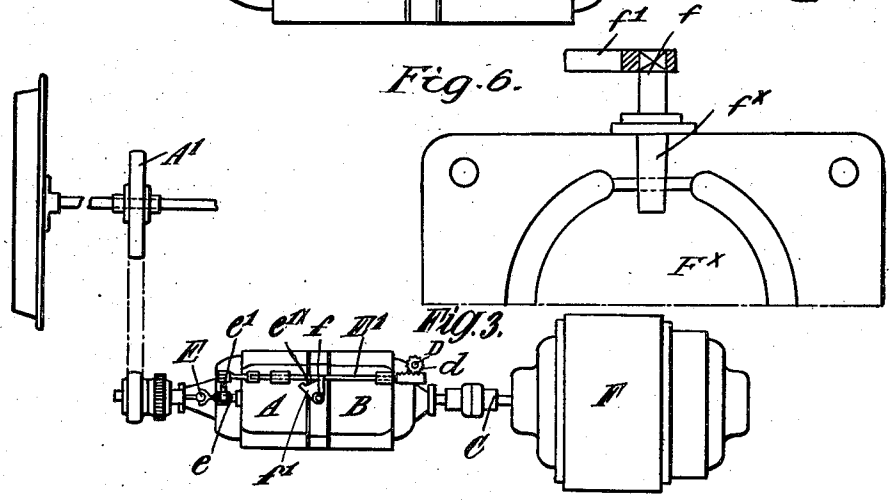

Fig. 6.

Fig. 3.

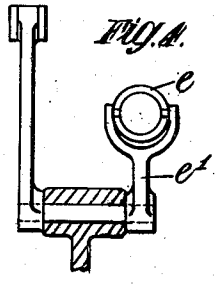

Fig. 4.

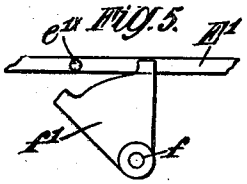

Fig. 5.

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UNITED STATES PATENT OFFICE.

JOHN ROBSON, OF WESTMINSTER, LONDON, ENGLAND, ASSIGNOR TO THE VARIABLE SPEED GEAR LIMITED, OF LONDON, ENGLAND.

VARIABLE-SPEED HYDRAULIC TRANSMISSION.

1,143,727. Specification of Letters Patent. Patented June 22, 1915.

Application filed November 14, 1913. Serial No. 800,915.

To all whom it may concern:

Be it known that I, JOHN ROBSON, a subject of the King of Great Britain, residing at Broadway Court, Westminster, in the county of London, England, have invented certain new and useful Improvements in Variable-Speed Hydraulic Transmission, of which the following is a specification.

This invention relates to variable speed hydraulic transmission gears for use with mechanism which it is desired shall be driven at an approximately constant speed, notwithstanding variations in the speed of the pump unit of the said gear. Such a result is desirable, for example, in the electric lighting system of railway carriages or other vehicles in which a dynamo is driven from the axle or other rotating part of the vehicle.

According to this invention means are provided whereby as the speed of the pump unit alters, the relative stroke of the pump unit pistons and the motor unit pistons is automatically varied so that the motor unit moves at an approximately constant speed irrespective of the alterations in the speed of the pump unit. The said variable hydraulic transmission gear may be of the kind, for example, wherein each of the units comprises a cylinder barrel having a number of cylinders which are arranged parallel to the axis of rotation of the barrel and which receive pistons whose rods are pivotally connected thereto and to an inclined plate. The inclined plate of one of the units is carried by a tilting box which can be displaced so that the stroke of the pistons can be varied, this tilting box being controlled by a governor driven by the pump unit or a part that operates it.

In the preferred constructional form of the invention the inclined plate of the motor unit is the one that is carried by the tilting box so that the stroke of the motor unit pistons can be varied, and the inclined plate of the pump unit is at a fixed angle to its shaft so that the stroke of the pump unit pistons is not variable.

In order that the said invention may be clearly understood and readily carried into effect the same will be described more fully with reference to the accompanying drawings, in which:—

Figures 1 and 2 are respectively a side elevation and a plan showing a constructional form of the invention. Fig. 3 is a view similar to Fig. 2 showing the invention employed for train lighting, and Figs. 4, 5 and 6 are views of details hereinafter described.

A is the pump unit, B the motor unit and C the shaft driven by the latter.

D represents the control shaft that actuates the tilting box of the motor unit B, and E represents the governor that controls the inclination of the said tilting box.

The governor E is shown as being of the centrifugal type and is driven in any suitable manner from the shaft of the pump unit A, for example by means of spur gearing as shown. The usual sliding sleeve *e* of the governor is connected to a forked or other suitably formed lever *e'* (Fig. 4) which is pivotally attached to one end of a sliding rod E'. The other end of this rod is in the example shown formed with rack teeth that gear with a pinion *d* on the control shaft D of the tilting box. By these means the position of the tilting box is directly influenced by the speed at which the governor is driven.

When the pump is being driven at its maximum speed the tilting box of the motor unit B will be at the same angle to its shaft as the inclined plate of the pump unit A, and the shafts of the pump and motor units A, B will then be running at the same speed. If the speed of the pump is reduced, the governor E will operate the tilting box so as to bring the latter to an angle nearer the neutral position *i. e.* a position at right angles to its shaft. The stroke of the motor unit pistons will then be less than the stroke of the pump unit pistons, and consequently the shaft C driven by the motor unit B will rotate at a higher speed than the shaft of the pump unit A. In this manner the speed of the motor unit shaft can be kept constant for any speed of the pump unit shaft.

In order to lessen the internal fluid resistance of the pump and motor units when the pump unit A is starting from rest—in which condition the tilting box of the motor unit B is in its zero position,—the valve plate F^x (Fig. 6) may be provided with a by-pass valve f^x the stem of which is indicated by *f* in the drawings. This

stem carries a plate f' having two projections arranged at a suitable distance apart, one or the other of these projections being engaged by a pin $e'^{\times}$ on the sliding rod E' during the movement of the latter. The by-pass valve is opened by the said sliding rod during the final movement thereof after the speed of the pump unit has fallen below a predetermined limit and is closed when the speed of the pump unit exceeds this limit. By means of this valve the liquid is allowed to flow through the by-pass between the two ports in the valve plate for a short period immediately before the stopping and after the starting of the pump unit. During this period after the starting of the pump unit the tilting box is moved by the action of the governor E until it reaches a position corresponding to the minimum speed of the pump unit at which it is desired to drive the shaft C. The starting resistance in the apparatus is thereby considerably lessened, owing to the pistons in the motor unit B having an appreciable stroke before the load is applied.

The governor E may be placed in any convenient position either parallel or at right angles to the longitudinal axis of the pump and motor units, and may be of any suitable type. The control shaft D operating the tilting box of the motor unit B may if desired be operated directly from the sliding rod E' or from the lever e' and the shafts of the pump and motor units may be arranged with their axes either in alinement with or at any desired angle to each other.

The improvements are as aforesaid particularly intended for use in an electric lighting system for trains or other vehicles. Fig. 3 shows the improvements employed in this connection, the pump unit A being driven by a belt from a pulley A' on the vehicle axle. The shaft C that is operated by the motor unit B drives a dynamo F employed for lighting the vehicle. The necessary switch apparatus for placing into and out of operation the storage batteries usually provided, can be worked simultaneously with the opening and closing of the by-pass valve by means of the sliding rod E'.

Although there has been described as the preferred constructional form of the invention an arrangement in which the inclined plate of the motor unit is adjustable and that of the pump unit is at a fixed angle with respect to its shaft, the inclined plate of the pump unit may be made adjustable, that of the motor unit being then at a fixed angle. In this case the inclined plate of the pump unit would, when the vehicle is running at full speed be approximately midway between its zero and maximum positions, the inclined plate of the motor unit being parallel to that of the pump unit. When the speed of the vehicle is reduced, the aforesaid governor operates to move the inclined plate of the pump unit toward its maximum position.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a variable speed hydraulic transmission gear, the combination with the pump unit and the motor unit, of means operated by the pump unit for automatically maintaining the speed of the motor unit constant notwithstanding variations in the speed of the pump unit.

2. In a variable speed hydraulic transmission gear, the combination with the pump unit and the motor unit, of means under the influence of the speed of the pump unit for automatically maintaining the speed of the motor unit constant notwithstanding variations in the speed of the pump unit.

3. In a variable speed hydraulic transmission gear, the combination with the pump unit and the motor unit, of means under the influence of the speed of the pump unit for automatically varying the relative piston strokes of the said units during variations in the speed of the pump unit.

4. In a variable speed hydraulic transmission gear, the combination with the pump unit and the motor unit, of means under the influence of the speed of the pump unit for automatically varying the piston stroke of the motor unit during variations in the speed of the pump unit.

5. In a variable speed hydraulic transmission gear the combination with the pump unit and the motor unit, of a governor driven from the pump unit, a control member for the motor unit, and means for actuating said member from the governor during the movements of the latter under the influence of variations in the speed of the pump unit.

6. In a variable speed hydraulic transmission gear, the combination with the pump unit and the motor unit, of means for automatically maintaining the speed of the motor unit constant notwithstanding variations in the speed of the pump unit, and means for short circuiting the fluid pumped by the pump unit, for any desired period after the starting of the pump unit.

7. In a variable speed hydraulic transmission gear, the combination with the pump unit and the motor unit, of means for automatically maintaining the speed of the motor unit constant notwithstanding variations in the speed of the pump unit and means for short circuiting the fluid pumped by the pump unit, for any desired period before the stopping and after the starting of the pump unit.

8. In a variable speed hydraulic transmission gear the combination with the pump unit and the motor unit, of means for automatically maintaining the speed of the mo-

tor unit constant notwithstanding variations in the speed of the pump unit, a by-pass valve for short circuiting the fluid pumped by the pump unit, and means for opening said valve for any desired period before the stopping and after the starting of the pump unit.

9. In a variable speed hydraulic transmission gear, the combination with the pump unit and the motor unit, of a control member for the motor unit, a governor driven by the pump unit, a device for actuating said member from the governor during the movements of the latter under the influence of variations in the speed of the pump unit, a by-pass valve for short circuiting the fluid pumped by the pump unit, a plate on the stem of said valve, two projections arranged on said plate at a suitable distance apart and a pin, on the aforesaid device, for co-operating with one or other of said projections to open and close the by-pass valve.

In testimony whereof I affix my signature in presence of two witnesses.

JNO. ROBSON.

Witnesses:
T. SELBY WARDLE,
THOS. F. HARGREAVES.