

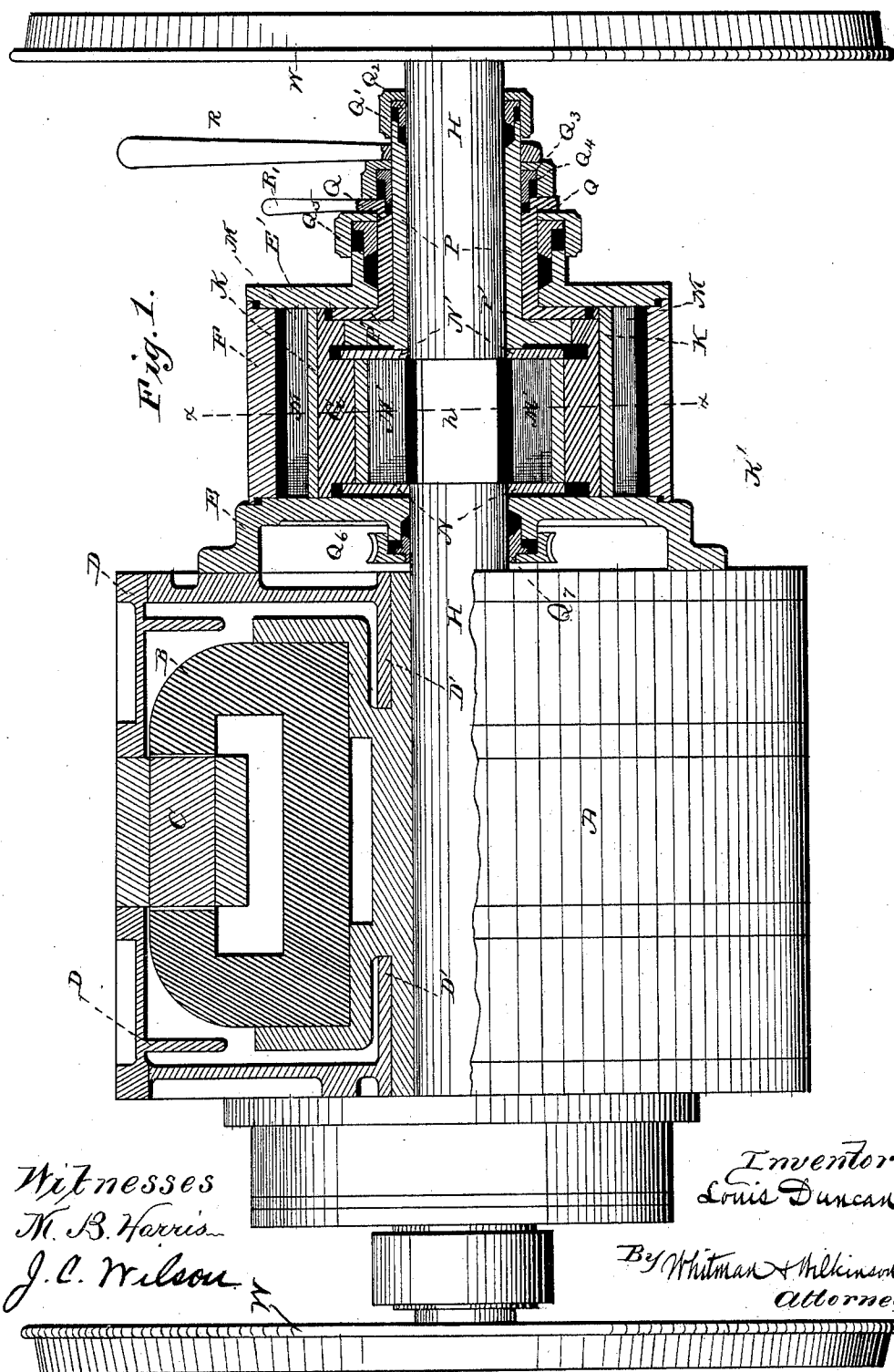
(No Model.)

4 Sheets—Sheet 1.

L. DUNCAN.
HYDRAULIC VARIABLE SPEED GEAR.

No. 466,662.

Patented Jan. 5, 1892.



Witnesses

M. B. Harris

J. C. Wilson

Inventor
Louis Duncan

By Whitman & Wilkinson
Attorneys

(No Model.)

4 Sheets—Sheet 2.

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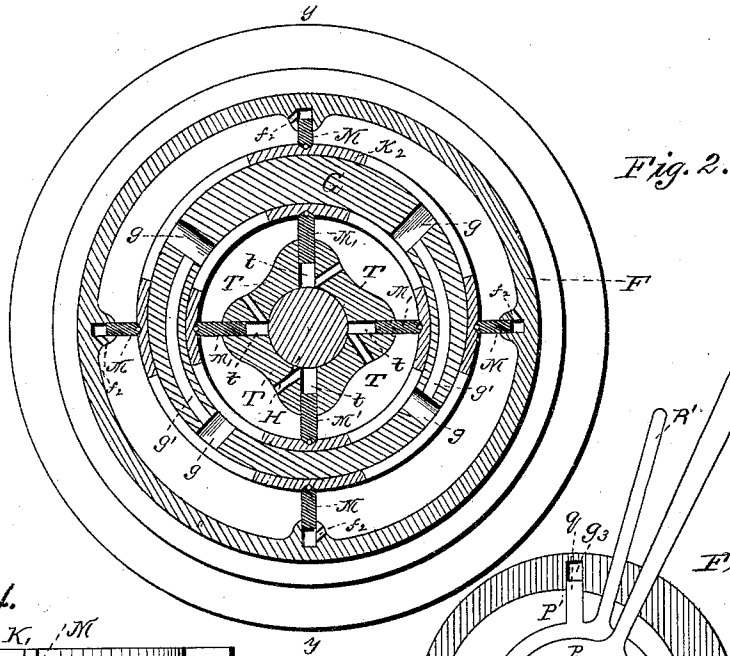


Fig. 2.

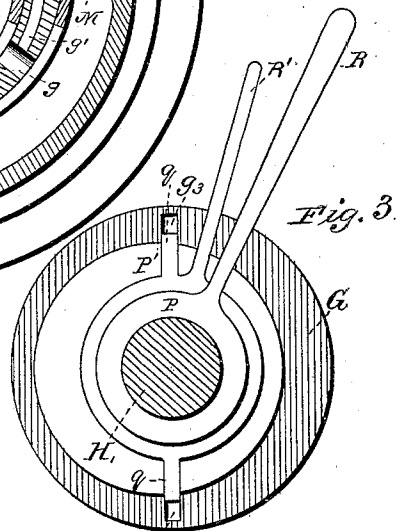


Fig. 3.

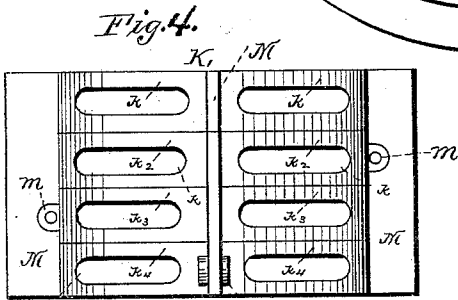


Fig. 4.

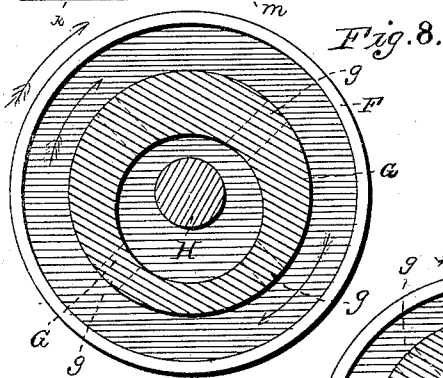


Fig. 8.

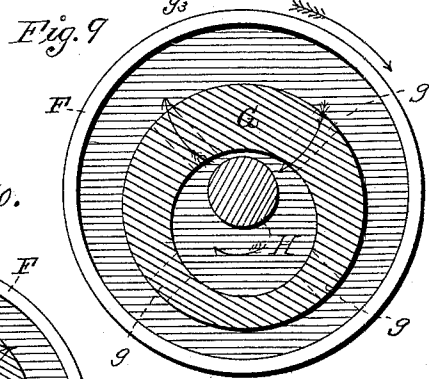


Fig. 9.

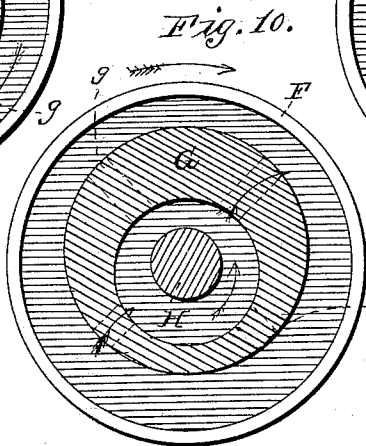


Fig. 10.

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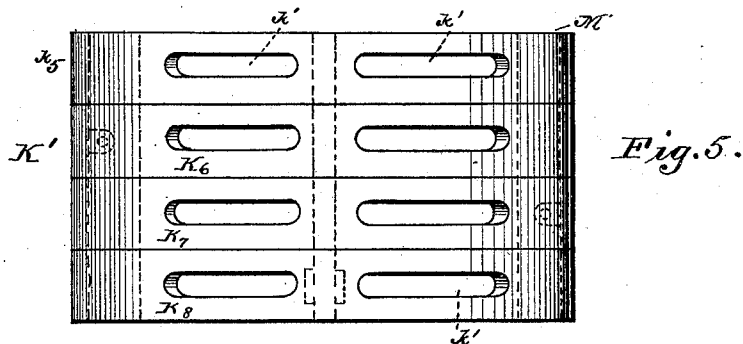


Fig. 5.

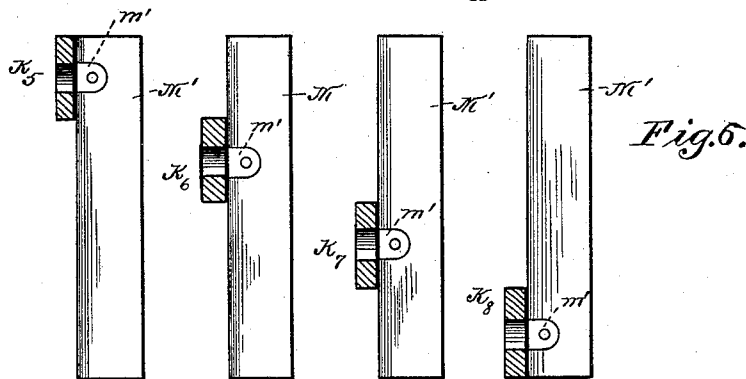


Fig. 6.

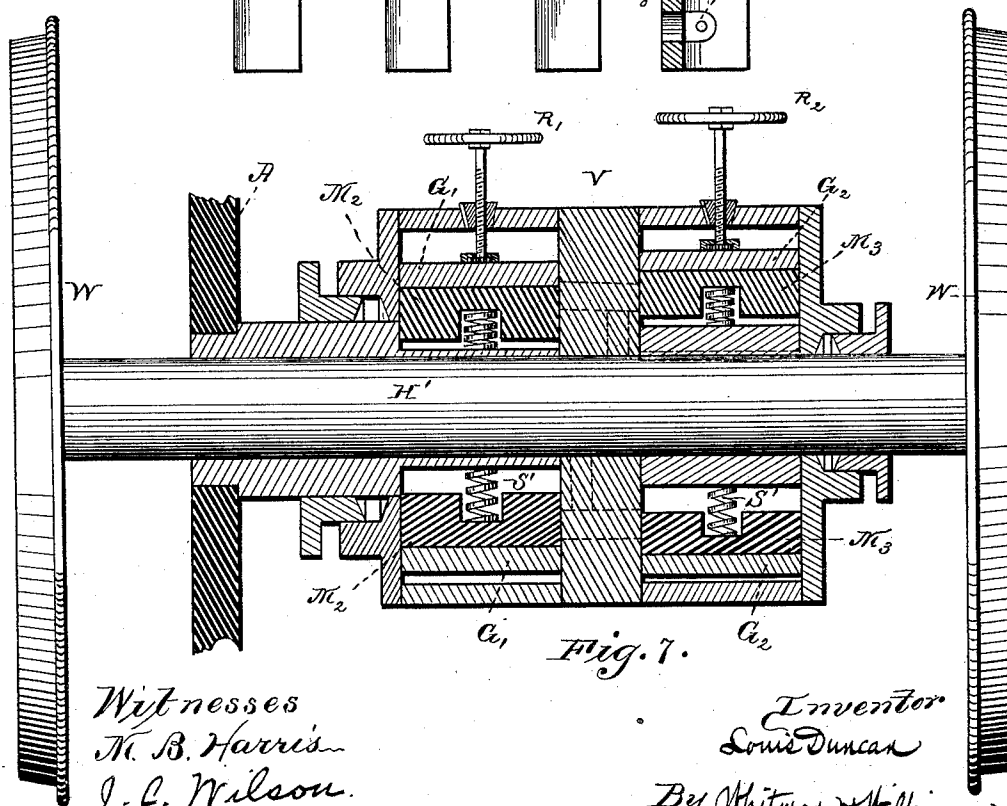


Fig. 7.

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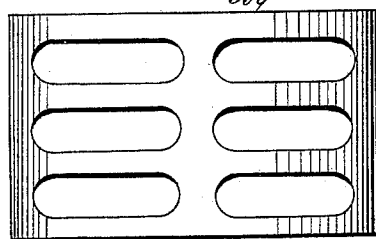
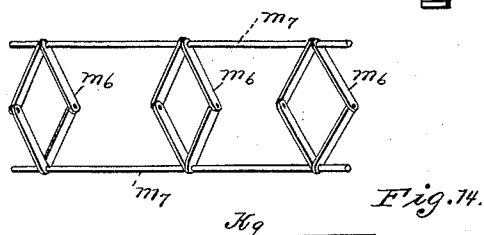
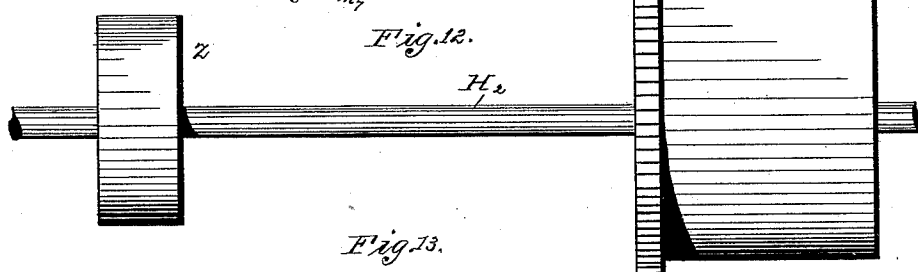
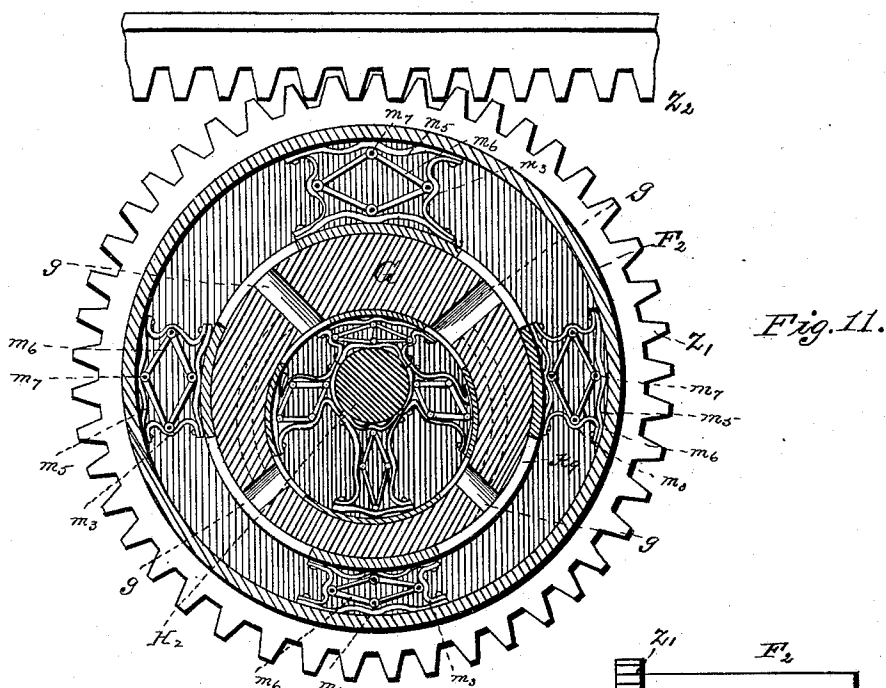
(No Model.)

4 Sheets—Sheet 4.

L. DUNCAN.
HYDRAULIC VARIABLE SPEED GEAR.

No. 466,662.

Patented Jan. 5, 1892.



Witnesses
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UNITED STATES PATENT OFFICE.

LOUIS DUNCAN, OF BALTIMORE, MARYLAND.

HYDRAULIC VARIABLE-SPEED GEAR.

SPECIFICATION forming part of Letters Patent No. 466,662, dated January 5, 1892.

Application filed March 26, 1891. Serial No. 386,585. (No model.)

To all whom it may concern:

Be it known that I, LOUIS DUNCAN, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Hydraulic Variable-Speed Gear; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to certain attachments to hydraulic motors. Its object is to provide a variable-speed gear for transmitting power; and it consists of a rotary pump and hydraulic motor, both of variable eccentricity, connected together by a liquid circuit and driven by some external power.

Reference is had to the accompanying drawings, wherein the same parts are indicated by the same letters.

Figure 1 represents a sectional elevation of one form of my device where the variable motor and variable pump are mounted one within the other, and as applied to a car-axle on an electric car. Fig. 2 represents a cross-section of the same along the line $x x$. Fig. 3 represents an end view of my device for altering the eccentricity of the ring shown in Fig. 2 as regards the motor-shaft. Fig. 4 represents a plan view of four parallel perforated rings, each carrying one of the pump-paddles. Fig. 5 represents a plan view of four perforated parallel rings, each carrying one of the motor-paddles. Fig. 6 represents the four motor-paddles detached. Fig. 7 represents another form of device where the variable pump and variable motor are not mounted one within the other, but are parallel or side by side, with liquid connections through a vertical disk between the two. Figs. 8, 9, and 10 represent three positions of the eccentric apertured guide-ring, illustrating the use of my device as a reversing-gear. Fig. 11 represents a vertical transverse section of one form of my device as adapted for a variable saw-mill feed-gear or any variable reciprocating gear, the pump being inside the motor. Fig. 12 represents a profile view of the same and reversing-gear, and other parts being omitted. Fig. 13 represents a perspective view of the rods used in my improved exten-

sory-paddle. Fig. 14 represents a plan view of the perforated ring used in the above device.

A represents the electric motor driving the pump.

B represents the fixed field-magnets, and C the revolving armature, shown in the form of a Gramme ring. This armature is rigidly connected to the frame-work or "spider" D, which is connected to sleeve D', revolving on the shaft H. It is evident that the field could revolve and armature be fixed.

Rigidly attached to the spider D are two disks E and E', connected together by the ring F and revolving independently of the shaft H. The interior of the ring F inclosing the pump-chamber is concentric with the shaft H, and is divided by a ring G of uneven thickness, as shown in Figs. 2, 8, 9, and 10, so that when the eccentricity of the inside of the pump-chamber with respect to the exterior surface of the apertured guide-ring G is zero the motor-chamber will have a positive eccentricity. The cylinder formed by the ring F and disks E and E' is divided more or less unequally by the ring G, separating the outer or pump section from the inner or motor section of the said cylinder. The eccentricity of the interior and exterior surfaces of this ring G with regard to the shaft may be varied, as will be hereinafter described. This ring G may be moved a short distance in the line of one of its diameters, but is held against revolving in any convenient way. For holding the ring G, I have provided a sleeve Q, attached to the fixed arm R'. This sleeve has two arms $q q$, which are fitted in slots $g^3 g^3$ in the ring G. The said ring G has four ports $g g g g$, connected in opposite pairs by the channels g' , as shown in Fig. 2. On the exterior of the said ring G four parallel perforated rings K', K², K³, and K⁴, each carrying one of the pump-paddles M, are revolubly fitted, and on the interior of the said ring G the rings K⁵, K⁶, K⁷, and K⁸, each carrying one of the motor-paddles M', are revolubly fitted. The said perforated rings K' K⁸ are cut away between the paddles, as shown at k , to allow the liquid to pass through. The ring G thus forms a circular guide for the rings K' K⁴, bearing the pump-paddles, revolving outside of it, and

for the rings K^5 K^8 , bearing the motor-paddles, revolving inside of it, the two cylindrical surfaces bounding the interior and exterior guide-faces of the said ring being eccentric to each other. The pump-paddles M are each permanently attached to their respective rings K^1 K^2 K^3 K^4 on one side and engage in slots f in the ring F on the other side. These slots f may be deepened by having projecting ribs f' on the interior surface of the said ring F, as shown in Fig. 2.

In order to allow the paddles to move freely in the slots f , the vent-holes f^2 are cut from the said slots f into the liquid-space to allow the free ingress and egress of the liquid to and from the part of the slot not filled by the paddle. These slots f are made deep enough to allow for the maximum variation in the eccentricity of the pump. In similar manner the motor-paddles M' are secured on one side to their respective rings K^5 , K^6 , K^7 , and K^8 , and are free to move in slots t in the sleeve T, keyed to the shaft H. The said shaft H may be turned down at h and the sleeve T cast thereon and then fitted with slots t and vent-holes t' , leading to the cavities in rear of the sliding paddles. It will be seen that as the eccentricity of the ring G is changed the paddles will vary slightly in their distance apart, and at the same time the slots f and t will not be radial as compared to the ring G. In order to allow for this slight change in the relative position of the paddles, I attach each paddle to its own ring, and so have the paddles enter their respective rings, as shown in Fig. 2.

To move the ring at right angles to the axis of the shaft H, and so alter the eccentricity of both pump and motor, I provide an eccentric-cam P' , engaging in said ring G, said eccentric-cam P' being attached to or integral with a sleeve P, connected to a lever R. The ring G is turned down so as to be itself eccentric with the eccentric-cam P' , as shown in Fig. 4. In this way the eccentric-cam P' and ring G may be so arranged as to obtain a motion in the ring G proportional to either the sum or the differences of their eccentricities when the lever R is moved.

Q is a sleeve which furnishes a bearing for the revolving disk E' , and which itself is held against turning by the fixed arm R' , carrying arms q , engaging in slots q^3 in the ring G. It also keeps the said ring G from turning by means of the said arms q , engaging in the said slots q^3 .

Q^1 , Q^2 , Q^3 , Q^4 , Q^5 , Q^6 , and Q^7 are followers and other attachments for stuffing-boxes, it being desirable to keep the outer ends of all the joints very tight.

N and N' are two disks attached to the shaft H, and revolving with it they form the flat ends for the revolving motor-chambers.

Oil is preferably used as the regurgitating fluid, and this oil entering the various crevices of the interior of the mechanism and, being always in contact with many of the bear-

ing-surfaces, acts as a lubricant at the point which could not be conveniently reached by oil-cans.

The waste of fluid due to leakage, &c., may be supplied by a device similar to that in use for oiling the interior of the cylinders of steam-engines.

When the ring E, driven by the electric motor, is revolving, it drives the pump-paddles M and forces a supply of liquid into the hydraulic motor dependent upon the eccentricity of the rings K^1 , K^2 , K^3 , and K^4 with respect to the pump-chamber, while the force exerted upon the motor will depend upon the eccentricity of the rings K^5 , K^6 , K^7 , and K^8 with respect to the motor-shaft.

Now if the ring G be moved bodily downward from its position in Fig. 8 to the position shown in Fig. 9, independently of the position of the shaft H and ring F, which latter is supposed to be revolving in the direction shown by the arrow, so that the eccentricity of the exterior of the ring G with respect to the pump-chamber F is opposite to the eccentricity of the motor-chamber with respect to the shaft, the right-hand paddles of the pump will force liquid through the ports on the right hand into the motor-chamber, which will then turn in the direction of the arrow and will force water back into the pump-chamber through the ports on the left hand. Now if the ring be raised again to a position where its exterior is concentric with the pump-chamber F, as shown in Fig. 8, the paddles will churn around in their chamber without forcing any liquid into the motor, and if the motor be previously revolving its paddles will be locked. Now if the ring G be still further raised to a position like that shown in Fig. 10, so that the eccentricity of the exterior of the ring G with respect to the chamber F is dissimilar to the eccentricity of the motor-chamber with respect to the shaft, the liquid will be driven from the pump-chamber through the ports on the left hand into the motor, driving the motor in the direction shown by the arrow. Thus it will be seen that by lowering the ring G the motor is driven in one direction, and by raising the said ring G—or, in other words, by reversing the eccentricity of the pump—the motor is driven in the opposite direction. It will be evident that by varying the eccentricity of the said ring G the flow of fluid from the pump-chamber into the motor-chamber and back into the pump-chamber through the liquid-circuit may be regulated at will, and thus maintaining a constant speed of the electric motor in one direction the hydraulic motor may be driven forward or backward at any desired speed or stopped. Thus a variable speed-gear is obtained which is readily adjustable and which avoids the great losses due to angularity and friction incident to cog-gearing.

My device also acts as a brake in slowing down, going down hill, &c. Thus when the

car is in motion and the ring G up, suppose the eccentricity of the ring to be lessened. The hydraulic motor will now act as a pump, forcing the liquid into the receiving side of the pump-chamber, and will tend to make the pump go faster. This tendency to increase in speed will be resisted by the armature of the electric motor which is rigidly attached to the pump, and the said electric motor becomes a dynamo, converting the inertia of the car into electricity and returning energy to the line.

It will be obvious that while my invention has been shown as applied to the axles of a car driven by electricity, that it may be used with any suitable mechanism and be driven by any source of power, or the relative positions of the pump and motor may be reversed. Thus the pump may be within the motor and mounted on a spindle, as in Figs. 11 and 12, where H³ is the spindle driving the pump, Z being a pulley (any other driving mechanism may be used) mounted on the same spindle. G is the apertured guide-ring separating the pump and motor chambers. On the periphery of the motor I have a spur-wheel Z', engaging in a rack Z² beneath a saw-mill carriage.

It will be seen that my invention furnishes a ready means of slowing down the carriage while the cut is being made and of "gigging" back rapidly after each cut.

The device shown on Sheet 4, while similar in principle to those shown on the first three sheets, differs in the construction of the extensory paddles for the pump and the motor and the perforated rings to which they are attached.

In Fig. 11 the extensory motor-paddles M³ are made of two side sheets m³ of corrugated steel or other resilient material riveted to the perforated ring K⁹ and to the outer ring F², inclosing the motor. In lieu of having four sliding perforated rings with the resilient paddles, I provide one perforated ring K⁹ to carry the inner ends of the motor-paddles, and a similar perforated ring K¹⁰ to carry the outer ends of the pump-paddles.

The pump-paddles M⁴ are constructed exactly like the motor-paddles M³, except that they are riveted to the inner sliding perforated ring K¹⁰ and the shaft H². Between the resilient plates m³ and m³ and m⁴ and m⁴ I provide base-plates m⁵ made of similar material, and engaging in suitable curves or recesses in these plates I provide one or more lazy-tong joints m⁶, connected to rods m⁷, as seen in Fig. 13. These lazy-tong joints and rods act as stiffeners to my corrugated paddles and transmit part of the strain to the inner and outer rings. I may use any number of rods m, as I prefer.

The construction of paddles allows the eccentricity of the pump or motor to be altered freely, gives a not too rigid surface exposed to the liquid, prevents the necessity of tight packing to the paddles, and obviates other

mechanical difficulties. It will be obvious that this form of extensory paddle may be used with the devices shown in Figs. 1, 2, 70 and 8.

There are many other methods of connecting an adjustable pump and adjustable hydraulic motor which would trespass upon my rights as an inventor.

I claim, broadly, as new—

1. A variable-speed gear consisting of a rotary pump driven by any source of power, and a hydraulic motor connected to the pump by a liquid circuit, and means for altering the eccentricity of both pump and motor, substantially as described.

2. In a variable-speed gear, the combination, with a shaft, of a rotary pump and hydraulic motor mounted thereon, and means for altering the eccentricity of both said pump and said motor, substantially as described.

3. In a variable-speed gear, the combination of a rotary pump and hydraulic motor mounted one within the other, an apertured ring movable along one of its diameters separating the two, and a device for moving said apertured ring and so altering the eccentricity of both said pump and said motor, substantially as described.

4. In a variable-speed gear, the combination, with a shaft, of a hydraulic motor mounted thereon, an apertured ring inclosing said motor, a rotary pump inclosing said ring, and a device for moving said ring in the direction of one of its diameters and so varying the eccentricity of said pump and said motor, substantially as described.

5. In a variable-speed gear, the combination, with a shaft, of a hydraulic motor mounted thereon, an apertured ring inclosing said motor, a rotary pump inclosing said ring, an eccentric-cam for moving said ring in the direction of one of its diameters and so varying the eccentricity of said pump and said motor, substantially as described.

6. In a variable-speed gear, the combination, with a shaft, of a rotary pump and hydraulic motor mounted one within the other, an apertured guide-ring separating the pump from the motor, said ring being movable in the direction of one of its diameters, a perforated ring inclosing the said apertured guide-ring and revolubly mounted thereon, attached to extensory paddles made of corrugated resilient material and connected to the outer shell, and a second perforated ring revolubly inclosed in the said apertured guide-ring and attached to extensory paddles connected to the shaft, substantially as described.

7. In a variable-speed gear, the combination, with a shaft, of a rotary pump and hydraulic motor mounted one within the other, an apertured guide-ring separating the pump from the motor, said apertured guide-ring being movable in the direction of one of its diameters, a perforated ring inclosing the said apertured guide-ring and revolubly mounted

thereon, attached to extensory paddles made of corrugated resilient material and connected to the outer shell, and a second perforated ring revolubly inclosed in the apertured
 5 guide-ring and attached to extensory paddles made of corrugated resilient material connected to the shaft, substantially as described.

8. In a variable-speed gear, the combination, with a shaft, of a rotary pump and hydraulic motor mounted one within the other, an apertured guide-ring separating the pump from the motor, said apertured guide-ring being movable in the direction of one of its diameters, a perforated ring inclosing the said
 15 apertured guide-ring and revolubly mounted thereon, attached to extensory paddles made of corrugated resilient material and connected to the outer shell, and a second perforated ring revolubly inclosed in the said apertured
 20 guide-ring and attached to extensory paddles made of corrugated resilient material connected to the shaft, and a plurality of parallel rods and lazy-tong joints inclosed in said paddles, substantially as described.

9. In a rotary hydraulic pump or motor, a bucket or paddle made of two sheets of corrugated resilient material attached at one end to the driving-shaft or driving-ring and at the other end to a revolving ring, substantially as described.
 30

10. In a rotary hydraulic pump or motor, a bucket or paddle made of two sheets of corrugated resilient material attached at one end to the driving-shaft or driving-ring and at the other end to a revolving ring, and stiffened by two or more parallel rods attached to a plurality of lazy-tong joints inclosed within the said bucket, substantially as described.
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11. In a variable-speed gear for electric cars, the combination, with fixed field-magnets, of an armature attached to a sleeve revolving upon the car-axle, a ring inclosing a hydraulic pump rigidly attached to said armature, a plurality of extensory paddles attached to said ring, an apertured guide-ring
 45 movable along one of its diameters, limiting the inner ends of said paddles, and a hydraulic motor inclosed in the said guide-ring and having a plurality of extensory paddles connected to the car-axle, substantially as described. 50

12. In a variable-speed gear for electric cars, the combination, with fixed field-magnets, of an armature attached to a sleeve revolving upon the car-axle, a ring inclosing a
 55 hydraulic pump rigidly attached to said armature, a plurality of extensory paddles made of corrugated resilient material attached at one end to the interior of said ring and at the other end to a perforated ring, an apertured
 60 guide-ring inclosed by the said perforated ring and separating the pump from the hydraulic motor, a perforated ring on the interior of said apertured guide-ring, a plurality of extensory paddles made of corrugated resilient material attached at one end to the said
 65 interior perforated ring and at the other to the car-axle, and a device for moving the said apertured guide-ring along one of its diameters, substantially as described. 70

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

LOUIS DUNCAN.

Witnesses:

FELIX R. SULLIVAN,
 FRANK H. LONGFELLOW.