W. B. CROFTON.

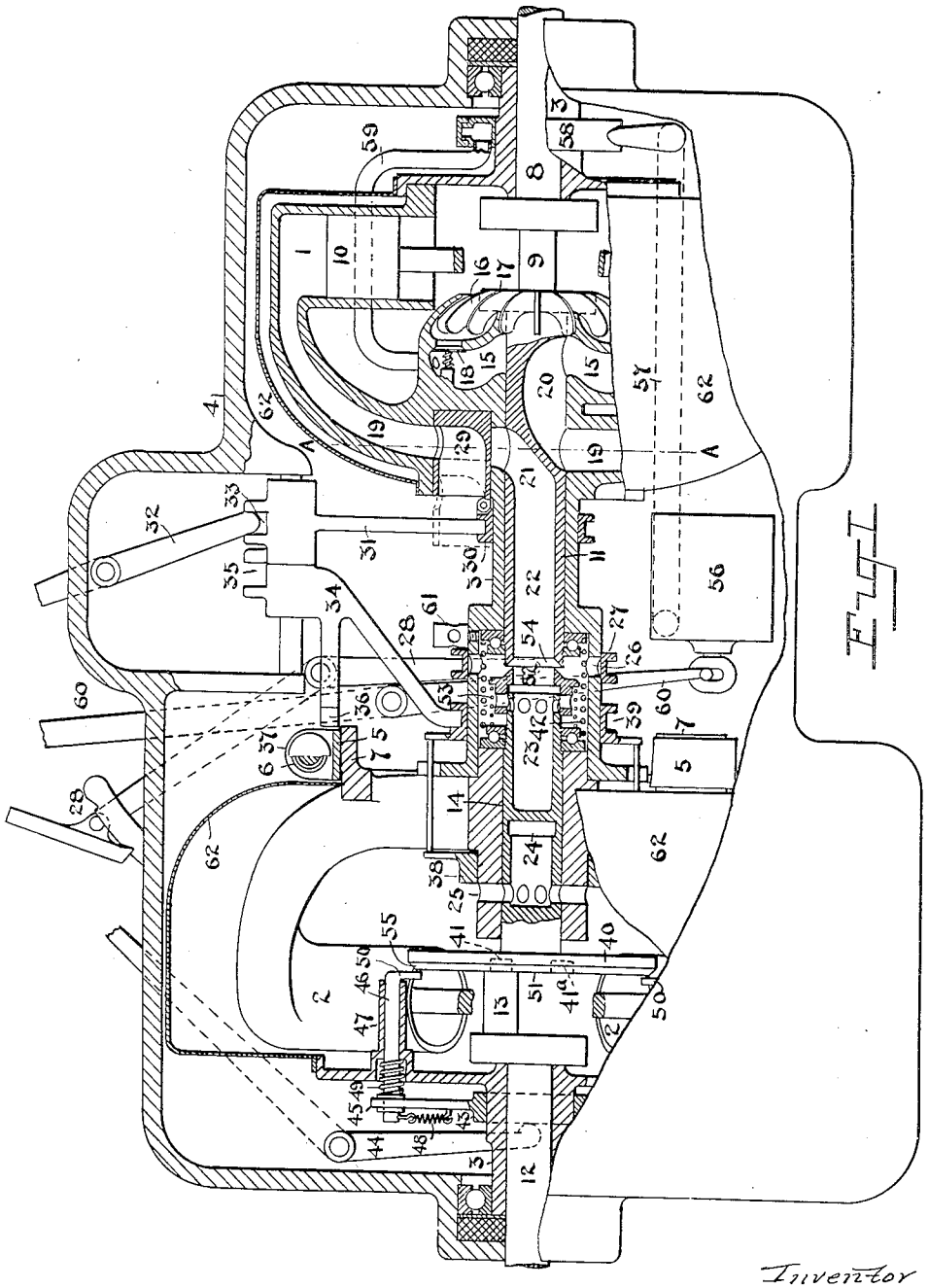
HYDRAULIC CHANGE SPEED GEAR.

APPLICATION FILED JULY 18, 1919.

1,370,290.

Patented Mar. 1, 1921.

2 SHEETS—SHEET 1.



Inventor

Wilfred Brereton Crofton,

By Glenn S. Noble

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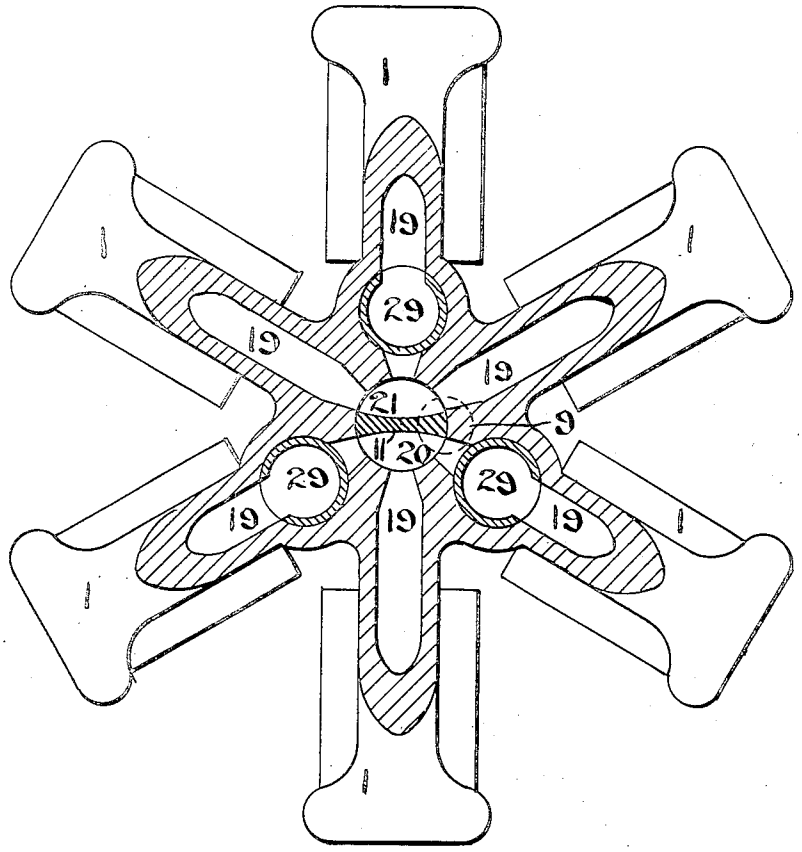


Fig. II

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UNITED STATES PATENT OFFICE.

WILFRED BRERETON CROFTON, OF YEOVILLE, JOHANNESBURG, TRANSVAAL, SOUTH AFRICA.

HYDRAULIC CHANGE-SPEED GEAR.

1,370,290. Specification of Letters Patent. Patented Mar. 1, 1921.

Application filed July 18, 1919. Serial No. 311,877.

To all whom it may concern:

Be it known that I, WILFRED BRERETON CROFTON, a British subject, residing at 56 Harley street, Yeoville, Johannesburg, Transvaal, Province of the Union of South Africa, have invented certain new and useful Improvements in Hydraulic Change-Speed Gears, of which the following is a specification.

The present invention relates to speed changing gear suitable for motor vehicles, of the kind in which a set of radial cylinder pumps driven by the engine delivers liquid to a radial cylinder motor set driving the propeller shaft; different velocity ratios being attained by varying the amount of liquid delivered to the motor cylinders.

An object of the invention is to provide such a construction which affords ample and fairly direct communication from the pump cylinders to the motor cylinders. Another object is to provide for direct drive when the speed ratio is unity.

The invention is illustrated in the accompanying drawings in which Figure I is a longitudinal section and Fig. II a cross section on A, A, Fig. I.

1 indicates a set of radial pump cylinders and 2 a set of radial motor cylinders, said sets being rigidly connected by a hollow shaft 3, and the whole being mounted to revolve within a fixed casing 4. They are free thus to revolve at unity ratio, but otherwise they are held from rotation with respect to the casing by a brake which, as shown, comprises a band 5 fitted with a spring 6 which causes it to grip the drum 7. In the example shown there are six pump cylinders and four motor cylinders, the volume of the former being less than that of the latter to the extent that when all the pump cylinders are delivering to all the motor cylinders, the propeller shaft is driven at second speed. The next lower speed is attained by cutting out half the number of pump cylinders; and neutral position is attained by short circuiting all the pump cylinders.

8 is the engine shaft which is cranked at 9 to operate the pump pistons 10. Said shaft is thereafter extended at 11 axially into the shaft 3 to act as a rotary distributing valve as hereafter described. The propeller shaft 12 is similar, being cranked at 13 to co-act with the pistons of the motor cylinders 2 and extended at 14 to form a distributing valve.

The casing 4 is charged with oil which is taken in by the motor cylinders at the intake 15. In order to insure the cylinders being properly filled at high speeds, the oil is fed centrifugally to the intake by vanes 16 formed on the crank cheek 17. It enters the intake by way of a number of light valves 18 which automatically close outward and which are light enough not materially to impede the inward flow of oil.

Each cylinder is formed with a port 19 and the ends of said ports open around the bore of the hollow shaft 3 as appears in Fig. II. The rotary valve 11 is formed with a D port 20 which connects the cylinder ports 19 with the intake 15 when the pump cylinders are filling, and with a second port 21 which, when the cylinders are discharging, connects the cylinder ports 19 and the open ended bore 22 of the valve. The rotary valve 14 of the propeller shaft 12 is similarly formed with a port equivalent to port 21 forming the left hand termination of the longitudinal bore 23 of said valve and connecting said bore to the intaking motor cylinders. The oil is exhausted from the motor cylinders by a port 24 which delivers it to outlet orifices 25 in the shaft 3, whence it returns to the casing 4.

The adjacent ends of the rotary valves 11 and 14 are separated so that oil can pass from the passage 22 to an orifice 26 in the hollow shaft 3. Said orifice is controlled by a sleeve 27 sliding fluid tight on the outside of the shaft 3 and moved back and forth by the clutch pedal 28.

With the sleeve 27 fully to the left, the outlet 26 is open; all the pump cylinders 1 are short circuited, so that no power is transmitted to the motor cylinders and the gear is in the neutral position.

Upon shifting the sleeve to the right as shown in Fig. I the outlet 26 is closed. All oil delivered by the pump cylinders 1 to the valve passage 22 is accordingly passed to the motor cylinders 2.

In three of the pump cylinder ports 19 are sliding valves 29 which, when in the position shown in Fig. I, cut out said three cylinders by connecting directly and only to the oil reservoir of the casing 4. Said cylinders therefore do not contribute to the

delivery of oil to the motor cylinders and accordingly low gear is attained. Upon shifting the valves 29 to the left as indicated by the dotted lines, said cylinders deliver like the other pump cylinders and the next higher gear is reached.

Said valves 29 are actuated by a sleeve 30 sliding on the shaft 3. The sleeve 30 is slid to right or left by a striking rod 31 actuated by a hand lever 32 engaging in a slot 33.

The next gear is unity and is attained by stopping the exhaust of oil from the motor cylinders and at the same time releasing the whole of the cylinder block to revolve freely. For this purpose there is provided a second striking rod 34 having a slot 35 for the reception of the end of the lever 32. When said lever has thrust the striking rod 31 fully to the left, the slots 33 and 35 are in line. The lever 32 is then moved laterally to transfer its end from slot 33 to slot 35 and upon its endwise movement being continued, it thrusts the striking rod 34 to the left. Said striking rod 34 is provided with a wedge 36 which passes between the ears 37 of the brake band 5, forces said ears apart against the spring 6 and so releases the brake from the drum 7. At the same time the outlet 25 is closed by the sliding sleeve 38 which is rigidly connected to the sliding sleeve 39 and which latter is engaged by the striking rod 34. The oil being thus stopped from circulating, causes the crank shaft 8, the pump cylinders 1, the motor cylinders 2 and the propeller crank shaft 12 to revolve solidly.

Reverse is attained by reversing the position of valve 14 relatively to the propeller crank shaft 12.

The crank cheek 40 is formed integral with the valve 14 but the crank pin 13 merely seats in a recess 41 in said cheek. A spring 42 compressed between the rotary valves 11 and 14 normally holds said cheek 40 into engagement with crank pin 13. 43 is a sleeve sliding on the shaft 3 and actuated by a reverse lever 44. Two arms 45 project from said sleeve 44 and each arm carries a pin 46 which extends through a guide 47 between the motor cylinders 2. Said pin 46 is free to rotate but not to move endwise with regard to the arm 45. It is held in a normal angular position with regard to the arm by a spring 48 and is normally kept clear of the cheek 40 by a spring 49. At the other end of the pin is a lateral finger 50 which can make contact with the left hand face 51 of the crank cheek 40 and thereby, upon the sleeve being moved to the right, thrust said cheek in the same direction. At the end of the rotary valve 14 is a clutch element 52 which is yieldingly supported longitudinally by a spring 53, but which rotates positively with said valve 14. Said clutch element is adapted to engage the correspondingly formed end 54 of the valve 11. Accordingly when the sleeve 43 is moved to the right, the fingers 50 engage the crank cheek 40 and by moving the same to the right disengage said cheek and the valve 14 from the crank pin 13 and also clutch them to the rotary valve 11. The latter valve being in rotation, it carries the valve 14 around with it. The first small rotational movement swings up the fingers 50 and disengages them from the face 51 of the cheek 40. This device prevents the lever 44 from being operative for more than a moment and so prevents the valve 14 from being rotated too far. The edge 55 of the cheek being beveled, the finger slips over the same and so becomes inoperative. The valve 14 however is held to the right by the crank pin 13 bearing on the plain face 51 of the cheek 40, until said valve has been rotated one half of a revolution, when the crank pin 13 engages in a second recess 41a, and the valve 14 is accordingly allowed to move back to the left. It then ceases engagement with the valve 11, and resumes engagement with the crank pin 13, but displaced 180° relatively to its former position. The ports of said valve 14 are accordingly reversed and the shaft 12 is driven in the reverse direction from the shaft 8.

An engine starting arrangement is provided consisting of a pump 56 which takes oil from the interior of the casing 4 and delivers it by a conduit 57 to a hollow swivel ring 58 from which it is delivered by the pipe 59 to the pump intake 15. The non-return valves 18 are provided to prevent such oil from passing back to the casing. It accordingly passes into the pump cylinders 1 which now act as motor cylinders to drive the engine. The pump 56 is actuated by any suitable means such as the hand lever 60.

A safety valve 61 opening into the casing is provided at any suitable part of the oil circulatory system to prevent overpressure occurring therein.

The cylinders are surrounded by a light casing 62 to prevent undue churning of the oil.

I claim—

1. In hydraulic change speed gear, the combination of a supporting casing, a rigid cylinder block rotatable in the casing, and comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system whereby liquid can pass from the pump cylinders to the motor cylinders and back again, and in-

cluding an outlet from the motor cylinders, means to close said outlet and means for making the cylinder block fast with the casing, said means releasing said block when the motor cylinder outlet is closed.

2. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing and comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, connections for the flow of liquid from the pump cylinders to the motor cylinders, a hollow shaft rigid with the cylinder block and providing an outlet from the motor cylinders, a sliding sleeve on the shaft adapted to cover said outlet, a brake element on the cylinder block, a co-acting brake element adapted to clutch with the first mentioned brake element, and a manually actuated movable part arranged simultaneously to declutch the co-acting brake element and to shift the sliding sleeve to cover the motor cylinder outlet.

3. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing, adjustable means for securing the cylinder block to the casing, said cylinder block comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system between the cylinder sets, and means in said system to vary the amount of liquid delivered by the pump cylinders as compared with the amount of liquid received by the motor cylinders and thereby vary the speed ratio of the crank shaft.

4. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing, adjustable means for securing the cylinder block to the casing, said cylinder block comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system between the cylinder sets, and means in said system to short-circuit the whole of the pump cylinders and thereby effect neutral gear.

5. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing, adjustable means for securing the cylinder block to the casing, said cylinder block comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system between the cylinder sets, said system including a hollow shaft connecting the sets of cylinders, said shaft being formed with outlet means, and a sliding sleeve adapted to cover said outlet means.

6. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing, adjustable means for securing the cylinder block to the casing, said cylinder block comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system between the cylinder sets, and means in said system to render inoperative a portion of the pump cylinders and thereby effect an intermediate gear ratio.

7. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing, adjustable means for securing the cylinder block to the casing, said cylinder block comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system between the cylinder sets, and valve means in said system movable to place some of the pump cylinders directly in communication with the interior of the casing.

8. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing and comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system between the cylinder sets, said system including an outlet from the motor cylinders, means movable to close said outlet, valve means in said system movable to place some of the pump cylinders directly in communication with the interior of the casing, a brake element on the cylinder block, a co-acting brake element adapted to clutch with the first mentioned brake element, an operating lever adapted upon a first movement so to move the valve means in the circulatory system to render inoperative the pump cylinders controlled by said valve means, and upon a fur-

ther movement to close the outlet from the motor cylinders and to de-clutch the brake element.

9. In hydraulic change speed gear, the combination of a supporting casing, a rigid cylinder block rotatable in the casing and comprising a set of radial pump cylinders and a set of radial motor cylinders, the pump cylinders having an aggregate volume less than that of the motor cylinders, pistons for said cylinder sets, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system whereby liquid can pass from the pump cylinders to the motor cylinders and back again, said circulating system including an outlet from the motor cylinders, means to close said outlet, said system also including means to render a portion of the pump cylinders inoperative and further means to render all the pump cylinders inoperative, and means for making ing the cylinder block fast with the casing, said means releasing said block when the motor cylinder outlet is closed.

10. In hydraulic change speed gear, a liquid reservoir, a set of radial cylinders, a hollow shaft rigid therewith, a crank shaft rotatable relatively to the cylinders, a rotary valve in the hollow shaft and rotating with the crank shaft, the cylinders being formed with ports opening to the interior on the hollow shaft, and the hollow shaft being formed with ports in connection with the liquid reservoir, a D port in the rotary valve connecting said cylinder ports and said reservoir ports, and a second port in the valve connecting said cylinder ports to an axial bore in the valve.

11. In hydraulic change speed gear, the combination with a supporting casing, of a rigid cylinder block rotatable in the casing, and comprising a set of radial pump cylinders and a set of radial motor cylinders, pistons in said cylinders, a driving crank shaft to which the pistons of the pump cylinders are connected, a driven crank shaft to which the pistons of the motor cylinders are connected, a liquid circulatory system between the cylinder sets, said system including a hollow shaft connecting the sets of cylinders, two rotary valves one rigid with each crank shaft and arranged to distribute liquid passing to and from the cylinders, said valves being seated in the hollow shaft and having open ended bores forming the passage for flow of liquid from the pump cylinders to the motor cylinders, said circulatory system including an outlet from the motor cylinders, means to close said outlet, and means for making the cylinder block fast with the casing, said means releasing said block when the motor cylinder outlet is closed.

12. In hydraulic change speed gear, a set of radial pump cylinders and a set of radial motor cylinders, each set of cylinders having a crank shaft and a rotary distributing valve co-axial and rotating with the crank shaft, one of said valves being adjustable with respect to its crank shaft to reverse the direction of rotation of the motor crank shaft.

13. In hydraulic change speed gear, a set of radial pump cylinders and a set of radial motor cylinders, each set of cylinders having a crank shaft and a rotary distributing valve co-axial and rotating with the crank shaft, the motor cylinder valve being adapted to be disconnected from its crank shaft and connected to the other rotary valve to be rotated by the latter.

14. In hydraulic change speed gear, a set of radial pump cylinders and a set of radial motor cylinders, each set of cylinders having a crank shaft and a rotary distributing valve co-axial and rotating with the crank shaft, one of said valves being rotatably adjustable with respect to its crank shaft and said crank shaft and valve being formed with alternative interengaging means spaced 180° apart, and locking by relative longitudinal movement of said parts, yielding means tending to hold the valve in engagement with its crank shaft, means for rotating the valve when disconnected from its crank shaft, and disconnecting means for releasing said valve from its crank shaft, said disconnecting means being rendered inoperative by rotation of the valve.

15. In hydraulic change speed gear, a liquid reservoir, a pump cylinder set, a closed intake for said cylinder set, outwardly closing automatic valve means governing communication from the reservoir to said intake, and a pump adapted to deliver liquid into said intake.

In testimony whereof I affix my signature.

WILFRED BRERETON CROFTON.