S. WELCH & J. W. GOYETTE.

HORIZONTAL CYLINDER ENGINE.

APPLICATION FILED OCT. 10, 1914.

**1,133,518.** Patented Mar. 30, 1915.

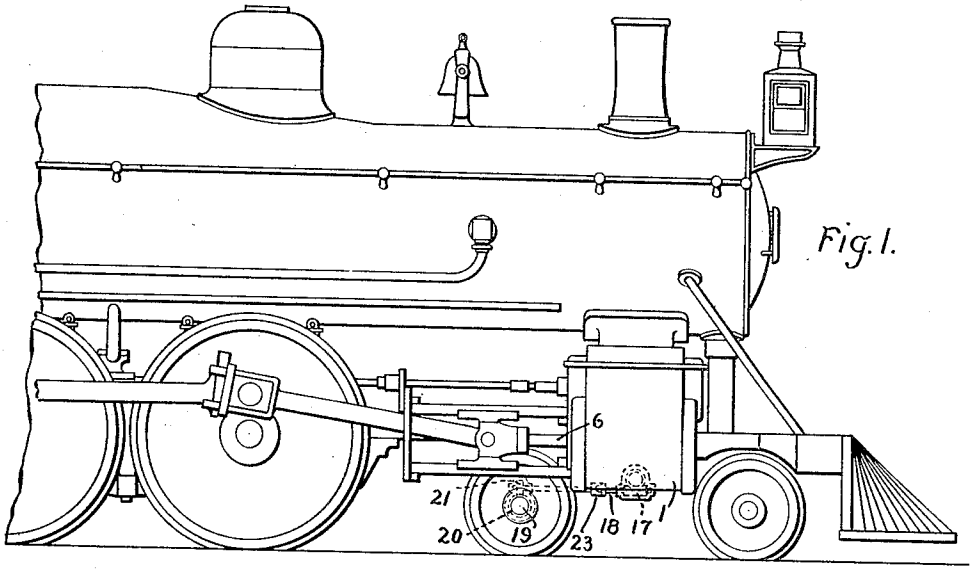


Fig. 1.

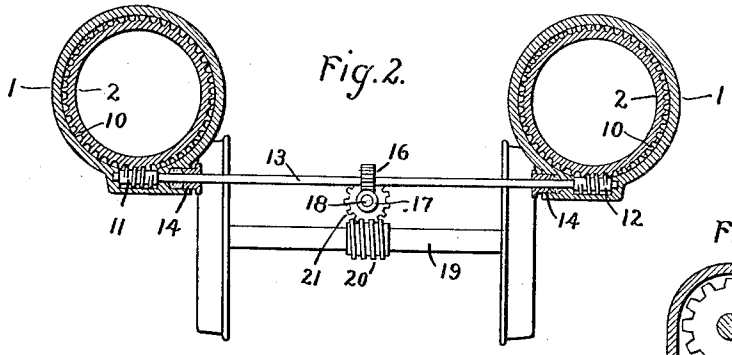


Fig. 2.

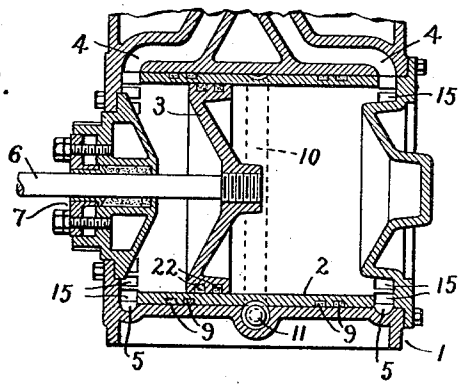


Fig. 3.

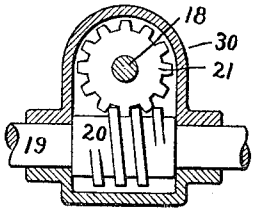


Fig. 4.

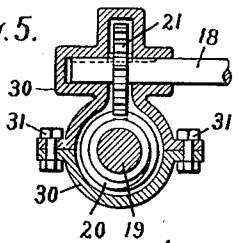


Fig. 5.

Witnesses

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# UNITED STATES PATENT OFFICE.

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## HORIZONTAL-CYLINDER ENGINE.

1,133,518. Specification of Letters Patent. Patented Mar. 30, 1915.

Application filed October 10, 1914. Serial No. 866,134.

*To all whom it may concern:*

Be it known that we, STEPHEN WELCH and JOSEPH W. GOYETTE, citizens of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Horizontal-Cylinder Engines, of which the following is a specification.

Our invention relates to those steam, gas and analogous engines, particularly locomotives, where pistons reciprocate in horizontal, or substantially horizontal, cylinders.

One object of our invention is to provide means for preventing the unequal wear to which horizontal cylinders have heretofore been subject and thereby reduce the consequent loss of power and the maintenance expenses.

Another object of our invention is to provide an improved locomotive wherein the wear of the cylinder is uniformly distributed about their interior circumferences and the loss of power and the maintenance expenses reduced thereby.

It has long been observed that the interiors of horizontal and substantially horizontal, cylinders wear with use from the true circular cross areas which are originally given them, to more nearly elliptical forms, the vertical dimensions increasing more rapidly than the horizontal dimensions. This is due to the fact that the lower half of each cylinder carries the whole or a part of the weight of the reciprocating piston and its parts, whereas the upper half of the cylinder carries none of the piston weight. This unequal wear of the cylinders is of serious consequence, since once the interior of a cylinder is no longer circular, the piston rings which should prevent the escape of the steam or whatever other fluid is employed, from one side of the piston to the other, and which normally tend to expand circularly, no longer engage the cylinder walls uniformly throughout the circumferences of the rings, and hence more or less of the fluid is allowed to pass them. The only remedy for the resultant loss of power is reboring the cylinders to circular shape. The greatest difficulties have probably been experienced in locomotives. The difficulty lies not so much in the aggregate wear as in the nonuniformity of the wear of the cylinder as has been indicated. Were a cylinder to wear uniformly over its interior surface, so that its interior remained substantially circular though the aggregate wear were the same as that which now requires reboring, the consequences could be of little or no seriousness, for the piston rings through their normal, circular expansion would continue to closely engage the walls of the cylinder and completely perform their functions. We propose therefore to prevent this unequal wearing of horizontal cylinders. To this end we propose, in effect, to rotate the cylinder; to accomplish this effect we prefer to provide the horizontal cylinder casing or frame with a rotatable interior bushing to directly receive the piston, and further provide means, preferably driven by the engine itself, for rotating the bushing at a speed great enough to uniformly distribute the wear over the entire inner surface of the bushing. Preferably the rotation takes place only whenever and so long as the piston reciprocates and at a rate proportional to the rate of piston reciprocation, though none of these features are essential. A few rotations of the bushing per day at a uniform rate in a constantly driven engine will often be sufficient; in the embodiment of our invention later described in detail, six rotations per hour with the locomotive at full speed is simply obtained; a slow rotation is preferable since the slower the rotation, the less the power that is required to drive the bushing, but otherwise the rate of rotation is substantially immaterial so long as it is great enough to provide for uniform wear of the bushing. The bushing and cylinder casing must be so arranged that no fluid can pass between them from either end of the cylinder; this may be done by packing rings, which may be more or less analogous to any of the heretofore common piston rings. In general it is immaterial by what means the bushing is driven, but in one of its aspects our invention contemplates the driving of the bushing with the piston working within it; in that way a definite relation is established between piston movement, and hence wear, and the compensating rotation of the bushing. And in its application to locomotives our invention preferably contemplates the driving of the bushing from one of the axles thereof, preferably an axle of a pony truck, since as locomotives are at present commonly constructed, this arrangement requires little rearrangement of the parts now generally employed.

In the accompanying drawing we have illustrated our invention as embodied in a locomotive.

Figure 1 is a side view of the forward portion of the locomotive showing the location of the driving mechanism for the rotating bushings; Fig. 2 is a view partly in elevation and partly in section through the cylinders of Fig. 1, showing the driving mechanism for the bushings. Fig. 3 is a sectional view through one of the cylinders showing the rotatable bushing in position. Figs. 4 and 5 are views principally in sections at right angles to each other showing the gear boxes and carrying means for a part of the bushing driving mechanism.

The horizontal cylinder casings or frames 1 are generally circular in cross section and each carries within it the horizontal rotatable bushing 2 which provides the interior surface of the cylinder. Within the bushing reciprocates the usual piston 3 which under the influence of the steam admitted through the passages 4 drives the locomotive in the well known manner; the piston is provided with the usual rings 22 for preventing the escape of steam about the piston. The admission of steam to the passages 4 is controlled by any suitable valve in the well understood manner and the steam from the passages 4 finds its way into the interior of the bushing through the annular grooves 5 and a number of passages 15 provided in each end of the bushing. The piston rod 6 runs in the bearing 7 in a head of the cylinder. The rotatable bushing 2 is provided with packing rings 9 located preferably near the two ends of the bushing; these packing rings closely engage the cylinder casing or frame 1 and prevent the escape of steam from either end of the cylinder between the bushing and casing. Each bushing 2 is provided circumferentially on its exterior surface with a series of gear teeth 10 with which a worm 11 or 12 engages. The worms 11 and 12 are located at the bottoms of the cylinder casings and preferably between the two sets of packing rings 9; by locating the worms 11 and 12 between the two sets of packing rings 9, there is little tendency for the steam to escape to the atmosphere between the bushing and cylinder casing and along the worm shaft; the two worms are joined and operated by the shaft 13 extending across the locomotive. The cylinder casings may be provided with packed bearings 14 carrying the worm shaft 13 and aiding in preventing the escape of steam from the cylinder along this shaft.

The worm shaft 13 is provided with the gear 16 which is in engagement with the worm 17. The worm 17 in its turn is driven by a shaft 18 extending from one of the axles 19 of a pony truck of the locomotive; between the axle 19 and the shaft 18 is a worm 20 and gear 21 connection. A universal joint or joints 23 may wholly or partially take care of the movement of the locomotive frame on its springs. It will be apparent from this that the axle 19 of the pony truck as it revolves will drive the worm shaft 13 and hence the bushings 2 at a considerably reduced number of rotations per interval of time. However, the rotations of the bushings will be strictly proportional to the rotations of the axle 19, and since the rotations of the axle 19 are substantially proportional to the number of movements of the piston 3, when the locomotive is in normal operation, the number of rotations of the bushings must be substantially proportional to the number of reciprocations of the piston, be they fast or slow, and hence to the wear.

The shaft 18 may be carried in any suitable manner. We have shown it carried by the gear cases for the gears 16 and 17, and 20 and 21, see Figs. 4 and 5. These cases are substantially alike and only that for the gears 20 and 21 has been illustrated in detail. The casing 30 is made in two parts fastened together by the bolts 31, so that the casing may be easily applied or removed. The casing is kept in its position laterally by engaging the ends of the worm 20 on the axle 19 (or the gear 16 of the shaft 13) and is kept in its vertical position by the shaft 18. The shaft 18 can both slide and rotate in its bearings in the casing 30 and though keyed to the gear 21 may slide therein to a limited extent as indicated. As the locomotive frame rises and falls or swings on its springs, the casings 30 relieve the shafts 18 and 13 from all strain by rotating slightly about the axle 19 and shaft 13 while the shaft 18 slides through the gear 21. The shafts 13 and 18 are further relieved by the universal joint or joints 23. For the sake of clearness of illustration the casings 30 have been omitted from Fig. 2.

It will be understood that our invention is not limited to the single embodiment described in detail above, or to the mechanical arrangement in connection with which it has been illustrated, except as herein indicated; in general we anticipate many structural modifications in the employment of our invention in specific devices.

What we claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination in a horizontal cylinder, of a cylinder frame, a horizontal rotatable bushing therein providing the interior surface of the cylinder, a piston to reciprocate in the bushing and means for rotating the bushing.

2. The combination in a horizontal cylinder, of a cylinder frame, a horizontal ro-

tatable bushing therein providing the interior surface of the cylinder, a piston to reciprocate in the bushing and means driven with the piston for rotating the bushing.

3. The combination in an engine having a horizontal cylinder, of a cylinder frame, a horizontal rotatable bushing therein providing the interior surface of the cylinder, a reciprocating piston driven within the bushing and mechanism driven by said piston including means for rotating the bushing.

4. The combination in an engine having a horizontal cylinder, of a cylinder frame, a horizontal rotatable bushing therein providing the interior surface of the cylinder, and provided externally with gear teeth circumferentially placed about the bushing, a reciprocating piston driven within the bushing, a shaft driven by said piston, a worm meshing with the bushing gear teeth located parallel to said shaft and means between said shaft and worm for driving the latter from the former.

5. In a locomotive, the combination with a pair of wheels and their connecting axle thereof, a horizontal cylinder casing and a reciprocating piston therein for driving the locomotive, of a horizontal rotatable bushing within the cylinder casing providing the interior surface thereof and means between said bushing and said axle for rotating the bushing therefrom.

6. In a locomotive, the combination with a pair of wheels and their connecting axle thereof, a horizontal cylinder casing located at each side of the locomotive, the two cylinder casings being opposite each other, and a reciprocating piston in each cylinder for driving the locomotive, of a horizontal rotatable bushing within each cylinder casing providing the interior surface thereof, a shaft extending between the two cylinder casings for rotating the bushings thereof, and means between said shaft and said axle for driving the shaft from the axle.

7. In a locomotive, the combination with a pair of wheels and their connecting axle thereof, a horizontal cylinder casing located at each side of the locomotive, the two cylinder casings being opposite each other, and a reciprocating piston in each cylinder for driving the locomotive, of a horizontal rotatable bushing within each cylinder casing providing the interior surface thereof, a shaft extending between the two cylinder casings for rotating the bushings thereof, and a second shaft having a worm and gear connection with said axle and with said first mentioned shaft.

8. In a locomotive, the combination with a pair of wheels and their connecting axle thereof, a horizontal cylinder casing located at each side of the locomotive, the two cylinder casings being opposite each other, and a reciprocating piston in each cylinder for driving the locomotive, of a horizontal rotatable bushing within each cylinder casing providing the interior surface thereof, each bushing being provided externally with gear teeth circumferentially placed about the bushing, a shaft extending between the two cylinder casings provided with a worm at each end meshing with the gear teeth of the adjacent bushing, and means between said shaft and axle for driving the shaft from the axle.

9. In a locomotive, the combination with a pony truck including a pair of wheels and their connecting axle thereof, a horizontal cylinder casing located adjacent each side of the pony truck and a reciprocating piston in each cylinder for driving the locomotive, of a horizontal rotatable bushing within each cylinder casing providing the interior surface thereof, and means between said pony truck axle and rotatable bushings for rotating the latter from the former.

10. In a locomotive, the combination with a pony truck including a pair of wheels and their connecting axle thereof, a horizontal cylinder casing located adjacent each side of the pony truck and a reciprocating piston in each cylinder for driving the locomotive, of a horizontal rotatable bushing within each cylinder casing providing the interior surface thereof, a shaft extending between the two cylinder casings for rotating the bushings thereof, and a second shaft between said axle and the first mentioned shaft for driving said first mentioned shaft from the axle.

In witness whereof, we have hereunto set our hands this first day of October, 1914.

STEPHEN WELCH.
JOSEPH W. GOYETTE.

Witnesses:
ROBERT MORTON,
CHARLES ERANDT.