

No. 634,654.

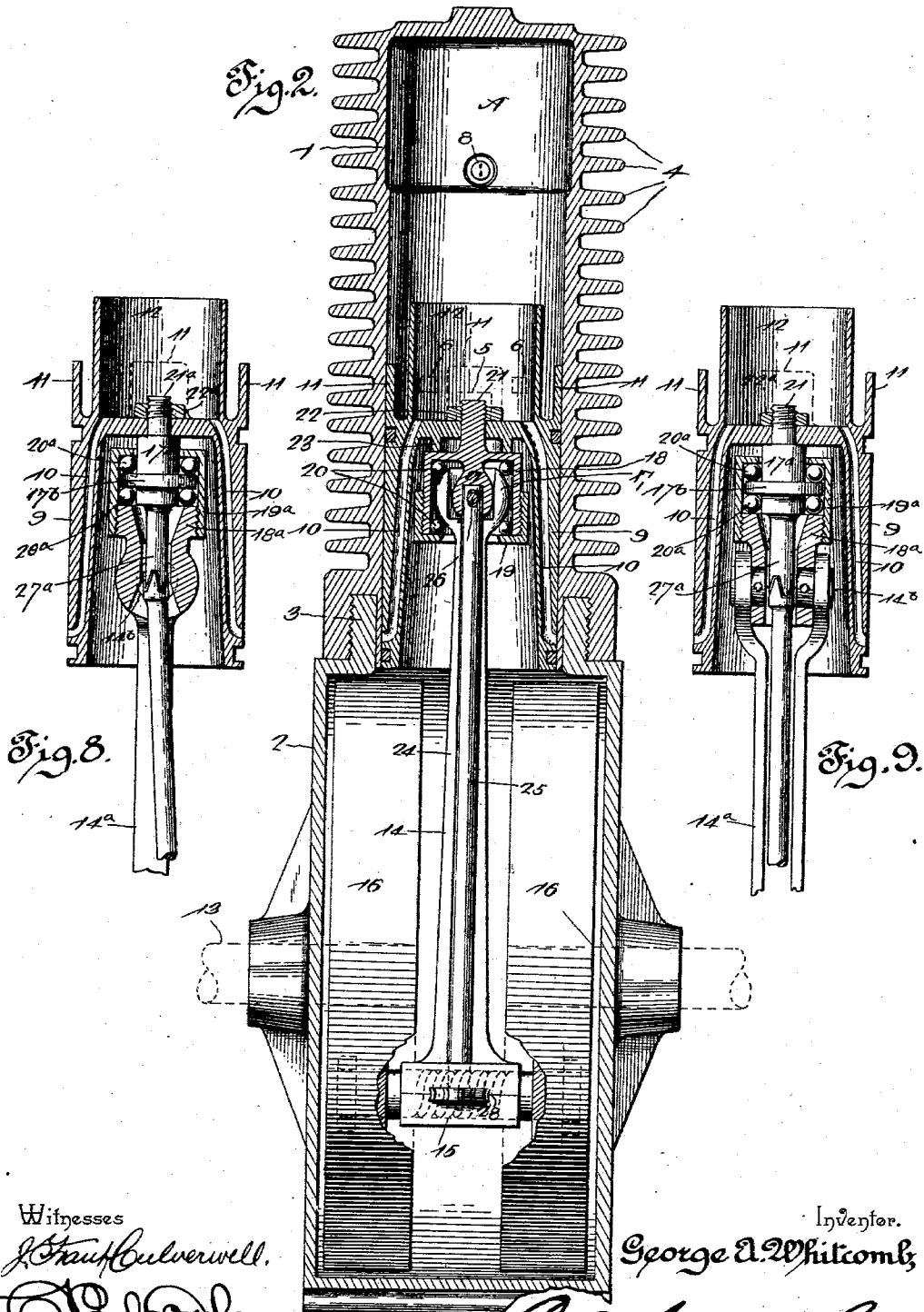
Patented Oct. 10, 1899.

G. A. WHITCOMB.
GAS ENGINE.

(Application filed Apr. 1, 1899.)

(No Model.)

3 Sheets—Sheet 2.



Witnesses
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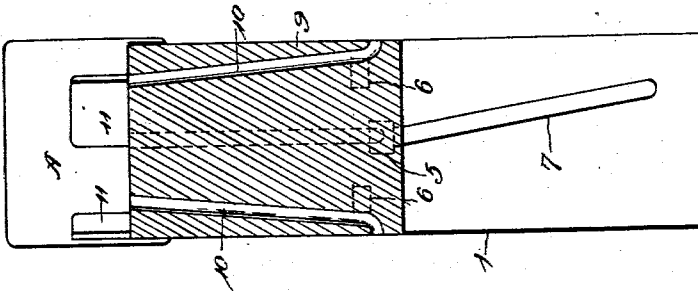


Fig. 6.

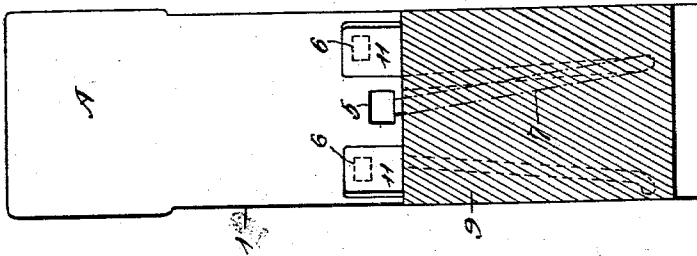


Fig. 5.

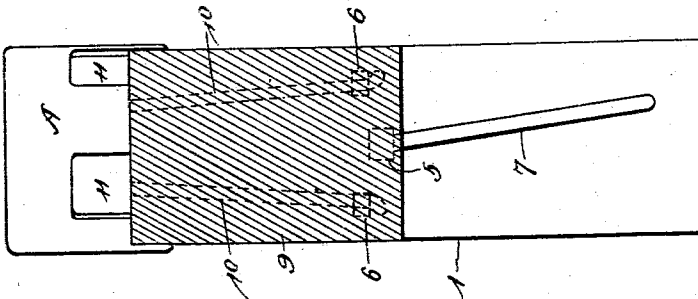


Fig. 4.

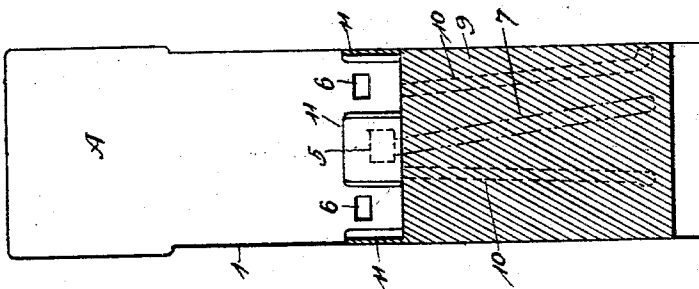


Fig. 3.

Witnesses

J. Frank Culverwell.
[Signature]

George A. Whitcomb, Inventor.
By *his* Attorneys,

Chas. Snow & Co.

UNITED STATES PATENT OFFICE.

GEORGE A. WHITCOMB, OF FRAMINGHAM, MASSACHUSETTS, ASSIGNOR OF
ONE-THIRD TO EVANS W. HODGDON, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 634,654, dated October 10, 1899.

Application filed April 1, 1899. Serial No. 711,418. (No model.)

To all whom it may concern:

Be it known that I, GEORGE A. WHITCOMB, a citizen of the United States, residing at Framingham, in the county of Middlesex and State of Massachusetts, have invented a new and useful Gas-Engine, of which the following is a specification.

My invention relates to gas-engines, particularly of the four-cycle type, and has for its objects to provide simplified and improved means for controlling the feed and exhaust ports of the piston-cylinder and also to provide means for insuring a prompt and efficient explosion of the contents of the cylinder at the proper point in the operation of the piston.

Further objects and advantages of this invention will appear in the following description, and the novel features thereof will be particularly pointed out in the appended claims.

In the drawings, Figure 1 is a sectional view in a plane transverse to the axis of the crank-shaft of an engine constructed in accordance with my invention. Fig. 2 is a similar view taken at right angles to the plane of Fig. 1 or parallel with the axis of the crank-shaft. Figs. 3, 4, 5, and 6 are diagrammatic views, respectively, showing the positions of the piston at the ends of the several strokes thereof. Fig. 7 is a detail view of the piston detached. Figs. 8 and 9 are detail sectional views in planes at right angles to each other of a piston, showing a modified construction of connection between the same and the piston-rod or pitman.

Similar reference characters indicate corresponding parts in all the figures of the drawings.

In the drawings I have shown a preferred embodiment of my invention, wherein the cylinder 1, which is closed at its upper end, is suitably attached at its lower open end to a casing 2, preferably of cylindrical construction, forming a crank-pit. In the drawings the casing is shown provided at its upper side with a threaded collar 3, with which the lower end of the cylinder is engaged; but it will be understood that other means of attachment may be preferred and adopted. Furthermore, in the drawings I have shown the cylinder provided exteriorly with radiating ribs 4, designed for maintaining the cylinder at a suitably low temperature; but it will be un-

derstood that the ordinary water-jacket may be substituted therefor.

Communicating with the cylinder at an intermediate point is an exhaust-port 5 and one or more feed-ports 6, two of such feed-ports being shown in the drawings and arranged upon opposite sides of the exhaust-port and slightly above the plane thereof. Communicating with the exhaust-port and extending downward therefrom or in a direction from the explosion-chamber A, which is formed by the portion of the cylinder between its closed end and the piston, is an exhaust-channel 7, which is obliquely or spirally disposed for a purpose hereinafter explained, the same terminating short of the lower or inner end of the cylinder. Also arranged at a suitable point in the wall of the cylinder is an igniter 8, which may be of any preferred construction and forms no part of my present invention.

The piston 9 is hollow, the same being open at its lower end and closed at its upper end, with the exception of the extremities of a plurality of relief-channels 10, which extend downward through the wall of the piston and terminate near the lower edge thereof, said feed-channels being adapted for successive communication at their lower or outlet extremities with the exhaust-channel 7. The piston is mounted in the cylinder for reciprocatory and rotary movements and is provided with cut-off valves 11, preferably of rigid construction and consisting of ears extending upward from the head or upper end of the piston and in contact at their outer surfaces with the wall of the cylinder. These cut-offs, of which any desired number may be employed, are spaced apart around the periphery of the upper end of the piston, and thus are arranged in an annular series for successive location in operative relation with the feed and exhaust ports in the cylinder-wall; also, the relative location of the ports and widths of the cut-offs are such that when a cut-off is located to close the exhaust-port the adjacent feed-ports are exposed and are in communication with the cylinder in advance of the piston. On the other hand, when the cut-offs are disposed to expose or open the exhaust-port the feed port or ports are closed, and in this way I am enabled to alternately open the feed and exhaust ports, the one being closed when the other is open,

whereby the escape of explosive mixture through the exhaust-port during its admission to the feed-ports is prevented. In this connection I have also provided a deflector 12, of cylindrical construction, extending upward from the piston, preferably outside of the adjacent extremities of the relief channels or passages 10, and adapted to occupy a position in front of the feed-ports 6 when the piston is in such a position as to expose said ports for the admission of the motive agent. The function of this deflector or shield is to form between itself and the wall of the cylinder an annular pocket, which first receives the explosive mixture and which retains a portion of that explosive mixture uncontaminated with remains of exploded mixture from the preceding charge. Obviously as the feed-ports are exposed to admit a new charge of the explosive mixture any remains of the previous charge will be expelled from this pocket, and thus as the piston rises to compress the contents of the cylinder this annular pocket will retain a supply of the unadulterated mixture, which will be brought into direct contact with the igniter before the spark is produced. Thus the efficient explosion of the charge is assured.

The means which I employ for communicating the reciprocatory movement of the piston to a driven shaft 13 and for communicating a rotary motion to the piston for causing the cut-offs to move in a path transverse to the cylinder or transverse to that of the reciprocatory movement of the piston embody a pitman or piston-rod 14, connected with a crank or wrist-pin 15, which in my preferred construction is carried by crank disks or wheels 16, attached, respectively, to the members of the shaft 13, said crank disks or wheels being mounted to operate in the cylindrical casing 2. The upper end of the pitman or piston-rod has a rocking and rolling connection with the piston, preferably by means of a ball-and-socket or equivalent joint. In the construction illustrated the pitman is provided with a ball 17, while the socket in which it is mounted consists of a bearing-sleeve 18, fitted with a removable bearing-cap 19 and adapted to contain antifriction balls or rollers 20. The sleeve of the bearing-socket is suitably attached to the piston, as by means of a shank or stem 21, extending through a central opening in the upper end of the piston and engaged above the same by a nut 22; but in order to prevent the excessive communication of heat to the contents of the bearing-sleeve the upper closed end of the latter is spaced from the upper end of the piston by means of spacing ribs or webs 23. The pitman is preferably channeled longitudinally, as shown at 24, to provide for the arrangement of the upper end of a spindle 25 in alinement with the axis of rotary movement of the piston, pivotal connection between said spindle and the piston being provided by means of a pin 26, engaging a hanger 27, depending from the

center of the bearing-sleeve in alinement with the stem or shank 21, and by communicating rotary motion to this spindle, which is capable of swinging movement in the plane of swinging movement of the pitman, I am enabled to rotate the piston. As shown in the drawings, the spindle 25 carries a worm-gear 28, meshing with a worm which is cut upon the crank or wrist-pin 15. Therefore as the crank turns in accordance with the reciprocatory movement of the piston, and hence turns the crank or wrist-pin, motion is communicated from the worm to the worm-gear and thence through the spindle to the piston to cause the movement of the cut-offs in a direction transverse to the reciprocatory path of the piston to control the feed and exhaust ports.

Figs. 3 to 6, inclusive, show the positions of the piston at the ends of the several strokes forming the cycle of the engine. During the outward stroke, forming the first of the cycle and shown in Fig. 3, a vacuum is created in the explosion-chamber, whereupon when the piston reaches the limit of its stroke and the feed-ports are exposed the exhaust-port being closed by the cut-off there is an influx of explosive mixture to charge the cylinder. The succeeding inward stroke of the piston, terminating, as indicated in Fig. 4, causes the compression of the charge, and upon the ignition of the charge the piston is driven, as in the ordinary practice, through the third stroke of the cycle to the position indicated in Fig. 5. When the piston reached the limit of the first outward stroke of the cycle, the cut-off was in a position to close the exhaust; but during the inward and succeeding outward strokes of the piston the cut-offs have been turned by reason of the rotation of the piston to cause the closing of the feed-ports and the opening of the exhaust-port at the end of the third stroke of the cycle, as shown. Thus when the piston reaches the limit of its third stroke the exhaust-port is open to allow the escape of the exploded charge, but the relief channel or passage 10 is also in communication with the exhaust-channel 7, and therefore during the inward or fourth and last stroke of the cycle there is a continuous communication between the explosion-chamber in advance of the piston and the exhaust-port to allow the approximately complete removal of the products of combustion from the cylinder. The continued rotary movement of the piston does not affect the communication of the relief-passages with the exhaust-channel owing to the oblique or spiral disposition of said channel. The position of the piston at the end of the fourth stroke is indicated in Fig. 6.

As hereinbefore described in connection with the relation between the pitman and the piston, as illustrated in Figs. 1 and 2, one member of the rolling or rocking joint is carried by the pitman and the other by the piston, the first, in the construction illustrated,

being provided with the ball or male member of the joint or bearing, while the piston carries the socket or female member of the bearing; but this relation between the parts may be reversed, as indicated in Figs. 8 and 9, wherein a modified construction of joint is illustrated. In this modified construction the pitman 14^a is pivotally connected at its upper end, by means of pins 14^b, with the socket member of the joint, consisting of a sleeve 18^a and a cap 19^a, while the head or male member 17^a is secured, by means of a stem or shank 21^a and a nut 22^a, to the piston, said head 17^a having an annular bearing element 17^b for contact with the bearing-balls 20^a. The rotary spindle 25 is jointed to a hanger 27^a, depending from the head 17^a.

It will be seen from the foregoing description that my invention is susceptible of modification, particularly with relation to the connection between the driven shaft and the piston and the means for communicating transverse motion to the cut-offs by rotating the piston to specifically describe only two forms, and it will be understood, furthermore, that various changes in the form, proportion, size, and minor details of construction within the scope of the appended claims may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention. Having described my invention, what I claim is—

1. In a gas-engine, the combination of a cylinder having feed and exhaust ports, and an oblique or spirally-disposed exhaust-passage in communication with said exhaust-port, a reciprocatory piston having cut-offs for controlling said ports and also provided with relief-channels communicating at one end with the explosion-chamber of the cylinder and adapted at the other end for communication alternately and at times with said exhaust-passage continuously of the inward movement of the piston, and means for turning the piston to cause said cut-offs to move in a direction transverse to the reciprocatory path of the piston and establish intermittent engagement of the relief-channels and exhaust-passage, substantially as specified.

2. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston having cut-offs for controlling said ports, and provided with a pocket in communication with the explosion-chamber of the cylinder, and adapted to receive directly the explosive mixture in its passage to the cylinder proper, an igniter adapted to enter said pocket when the piston is in position to receive the initial impulse of the explosive charge and ignite the charge therein, and means for moving said cut-offs in a direction transverse to the path of reciprocatory movement of the piston, substantially as specified.

3. In a gas-engine, the combination with a cylinder having feed-ports and an exhaust-port and an exhaust-passage leading to the

latter, of a piston provided with spaced cut-off valves for controlling said ports, a relief-channel in the piston adapted to register at times with the exhaust-passage throughout the movement of the piston in one direction, and means for turning the piston to cause movement of the valves in a direction transversely to the path of the piston and cause intermittent registration of said relief-channels with the exhaust-passage, substantially as specified.

4. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston having a pocket adapted to receive directly the charge of explosive mixture, and an igniter, adapted to enter said pocket when in its passage to the cylinder proper the piston is in position to receive the initial impulse of the explosive charge and ignite the charge therein, substantially as specified.

5. In a gas-engine, the combination with a cylinder having feed and exhaust ports and an igniter, and a piston having an annular flange upon its upper end disposed inwardly from the periphery thereof to form a pocket; where, when the piston is at one end of its stroke, said pocket is in communication with the ports, and when at the other end of its stroke the igniter is arranged in said pocket, said piston being subject to direct pressure within the inclosure of said flange, substantially as specified.

6. In a gas-engine, the combination with a cylinder having feed-ports and an exhaust-port and a spirally-disposed passage leading to said exhaust-port, of a reciprocatory piston, a driven crank, a pitman with which said piston has a swivel connection, cut-off devices carried by the piston for controlling said ports, means for imparting rotary movement to the piston, and relief-channels adapted to register at times with the exhaust-passage as the cylinder is rotated, substantially as specified.

7. In a gas-engine, the combination with a cylinder having feed-ports and an exhaust-port, of a spirally-disposed passage leading to said exhaust-port, of a reciprocatory piston, a driven crank, a pitman with which said piston has a swivel connection, cut-off devices carried by the piston for controlling said ports, relief-channels in the piston adapted to register at times with the exhaust-passage, and means, including a gearing, actuated by the crank-shaft, for imparting rotary motion to the piston to cause such registration of the exhaust-passage and relief-channels, substantially as specified.

8. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston, a driven crank, a pitman with which said piston has a swivel connection, cut-off devices carried by the piston for controlling said ports, and means, consisting of a worm on said shaft, and a worm-gear meshing with the worm and having a

spindle disposed at an angle to the axis of the pitman and connected with the piston at the point of intersection of the axes of the pitman and spindle for imparting rotary motion to the piston, substantially as specified.

9. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston carrying cut-off devices for controlling said ports, a crank, a pitman between said crank and the piston, and having a ball-and-socket connection with the latter, and means, consisting of a worm, actuated by said crank, and a worm-gear meshing with the worm and having a spindle disposed at an angle to the axis of the pitman and connected with the piston at the point of intersection of the axes of the pitman and spindle for communicating rotary motion to the piston, substantially as specified.

10. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston provided with cut-off devices for controlling said ports, a crank, a pitman connected with the crank and having a ball-and-socket connection with the piston, the same consisting of a ball on the pitman, and a ball-socket mounted upon the piston with its shell spaced from the upper wall of the piston, to form an intervening air-space, and means for communicating rotary motion to the piston, substantially as specified.

11. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston provided with cut-off devices for controlling said ports, a crank, a pitman connected with the crank and having a ball-and-socket connection with the piston, the same consisting of a ball on the pitman, and a ball-socket on the piston, consisting of a bearing-sleeve, a bearing-cap detachably secured to the bearing-sleeve, and antifricition balls or rollers arranged in the bearing-socket for contact with said ball, and means for communicating rotary motion to the piston, substantially as specified.

12. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston provided with cut-off devices for controlling said ports, a crank, a pitman connected with the crank and having a swivel connection with the piston, consisting of interlocked male and female members, one of which is provided with a stem or shank passed through and engaged with the piston, and the other of which is loosely connected with the pitman, and means connected with the element of the swivel connection carried by the piston for communicating rotary motion to the piston, substantially as specified.

13. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston provided with cut-off devices for controlling said ports, a crank, a pitman connected with the crank and having a swivel connection with the piston, consisting of interlocked male and female members, one of which is provided with a stem or shank

fitted in an opening in the shell of the piston and engaged by a fastening-nut, and the other of which is carried by the pitman, and means connected with the element of the swivel connection carried by the piston for communicating rotary motion to the piston, substantially as specified.

14. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston provided with cut-off devices for controlling said ports, a crank, a pitman connected with the crank and having a swivel connection with the piston, consisting of interlocked male and female members, one of which is provided with a stem or shank detachably engaged with the shell of the piston, and the other of which is carried by the pitman, means for holding the piston-carried member of the connection out of contact with the shell of the piston, and means connected with the element of the swivel connection carried by the piston for communicating rotary motion to the piston, substantially as specified.

15. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston provided with cut-off devices for controlling said ports, a driven shaft, crank-disks carried by terminally-separated members of the shaft, a wrist-pin connecting said disks, and provided with a worm, a channeled pitman mounted at its inner end upon said wrist-pin with its axis intersecting the axis of said pin and having a swivel connection at its outer end with said piston, and a worm-gear, meshing with said worm, and a spindle for said gear arranged in the channel of the pitman and at an angle to the axis thereof and terminally connected with the piston at its intersection with the axis thereof, substantially as specified.

16. In a gas-engine, the combination with a cylinder having feed and exhaust ports, of a reciprocatory piston provided with cut-off devices for controlling said ports, a driven shaft, crank-disks carried by terminally-separated members of the shaft, a wrist-pin connecting said disks, and provided with a worm, a channeled pitman mounted at its inner end upon said wrist-pin and having a swivel connection at its outer end with said piston, a spindle arranged in the channel of the pitman, and pivotally connected at its outer end to an axial hanger on the piston, at its point of intersection with the pitman, said spindle lying at an angle to the pitman and a worm-gear upon the spindle engaging said worm and forming a direct connection between the spindle and wrist-pin, substantially as specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

GEORGE A. WHITCOMB.

Witnesses:

FRED. G. WILLIAMS,
LORENZO W. PROUTY.