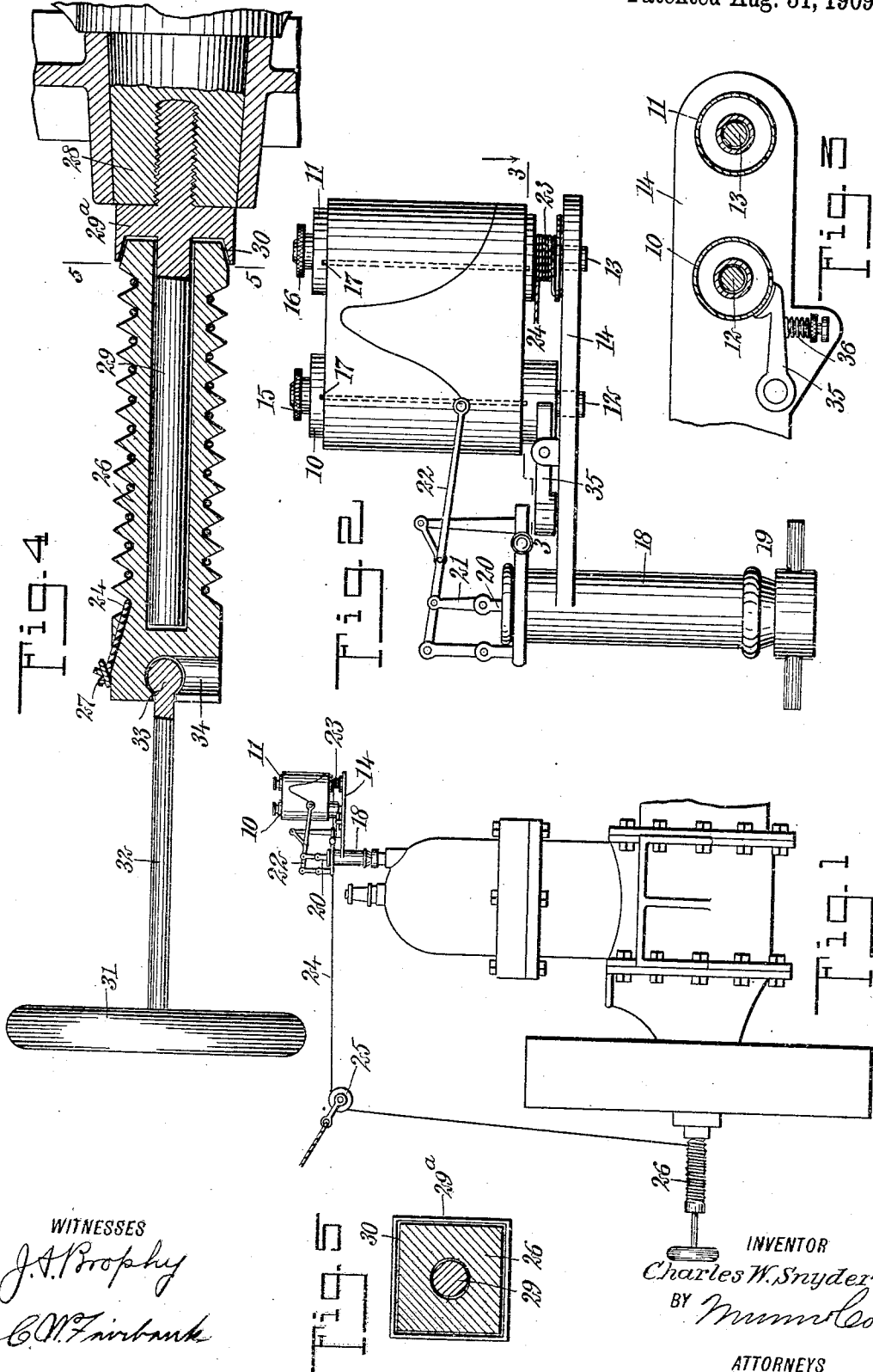


C. W. SNYDER.
INDICATOR.
APPLICATION FILED MAR. 17, 1909.

Patented Aug. 31, 1909.

932,825.



WITNESSES
J. A. Propoy
C. W. Fairbank

INVENTOR
Charles W. Snyder
BY *Mum* Co
ATTORNEYS

UNITED STATES PATENT OFFICE.

CHARLES WIGHT SNYDER, OF HUDSON, NEW YORK.

INDICATOR.

932,825.

Specification of Letters Patent. Patented Aug. 31, 1909.

Application filed March 17, 1909. Serial No. 433,942.

To all whom it may concern:

Be it known that I, CHARLES W. SNYDER, a citizen of the United States, and a resident of Hudson, in the county of Columbia and State of New York, have invented a new and Improved Indicator, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in indicators adapted for use in connection with engines, for making indicator cards to show the variations in the pressure in the cylinder during the movement of the piston.

My improved indicator is especially adapted for use with internal combustion engines, and is so constructed that the pressure in the cylinder during a large number of consecutive strokes may be indicated consecutively and in succession on the card.

In my improved indicator I provide means for moving a strip of paper lengthwise at a rate directly proportional to the speed of rotation of the engine shaft and provide a marker movable back and forth across the strip in accordance with the pressure within the cylinder. In my improved device the card or paper strip when in operation, always moves in the same direction, there being no reversal of the paper and no dead points. There is an equal advance of the card for equal angular advances of the crank shaft, and each card is separate and distinct from its predecessor, so that the results obtained by varying operating conditions may be noted.

The device is very easily attached to the engine and can be used at any speed.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures, and in which—

Figure 1 is a side elevation of a portion of an engine provided with my improved indicator; Fig. 2 is an enlarged view of the indicator *per se*; Fig. 3 is a transverse section on the line 3—3 of Fig. 2; Fig. 4 is a longitudinal section through one form of drum-rotating means; and Fig. 5 is a transverse section on the line 5—5 of Fig. 4.

In my improved indicator I employ two drums 10 and 11, mounted adjacent each other upon parallel axes and so constructed that a long strip of paper may be unwound from one drum and wound upon the other.

The two drums in the specific form illustrated are mounted on spindles 12 and 13 rigidly secured to a bracket or arm 14. The two drums are of substantially the same diameter and may be held on their respective spindles by suitable thumb-nuts 15 and 16, at the outer ends of the latter. The ends of the strip of paper may be secured to the drums in any suitable manner, but preferably each drum is provided with a slot 17 extending longitudinally thereof and into which the end of the strip of paper may be inserted. By inserting the end of the paper through the slot and rotating the drum through a little more than one revolution, the end of the paper becomes firmly held in place during the winding or unwinding of the remainder of the strip, while the complete unwinding of the paper permits the end of the strip to become readily detached from the drum without liability of tearing. The bracket or arm 14 may be formed integral with a small cylinder 18 of the type ordinarily used in steam engine indicators. This cylinder 18 is provided with connections 19 at the lower end whereby it may be readily secured to the cylinder of an internal combustion engine, so that the pressure of the gas in the engine cylinder may be communicated to the interior of the cylinder 18. The connections 19 may be made at the petcock of the engine cylinder, or in place of the second spark plug with which engines are commonly provided. Within the cylinder 18 is a piston, and a calibrated spring against which the pressure within the engine cylinder reacts. These are not shown as they are old and well-known and constitute no portion of my present invention. The piston rod 20 extending outwardly therefrom is connected by a link 21 to a pointer or marker 22 of any common and well-known form. The end of the marker comes closely adjacent the outer surface of the drum 10, and the marker is movable longitudinally of the drum by the movement of the piston within the cylinder 18. As the drum rotates and the gas pressure in the engine cylinder varies, the pointer will be caused to move back and forth across the strip of paper on the drum to make a wavy or zigzag line.

For rotating the two drums and for causing the paper to travel at a speed directly proportional to the engine speed, I cut away the drum 11 at one end thereof to form a reel 23 about which a cord or string 24 may be

wound. One end of the cord is secured to the drum in such a way that when the cord is entirely unwound it may become readily detached, and the opposite end of the cord
 5 extends over one or more suitable guiding pulleys 25 to a worm 26 which is rotated at a speed directly proportional to the speed of the engine. The helical groove in the outer
 10 surface of the worm 26 is adapted to receive the string or cord, so that as the worm is rotated the string becomes wound on the worm in regular and evenly spaced turns. The end
 of the string is secured to the worm in any suitable manner; for instance, by extending
 15 through an opening and terminating in a knot 27.

It is, of course, desirable that the worm remain stationary while the device is being adjusted even though the engine itself be in
 20 operation, and it is thus necessary to provide suitable clutch mechanism for throwing the worm into or out of operation. Various different forms of clutch mechanism may be provided, and I do not wish to be limited to
 25 the specific form shown, but I have found that this form works very effectively in practice. In the specific form illustrated, the engine shaft 28 is provided with a spindle 29 threaded into the end of the shaft in
 30 axial alinement therewith, so as to be rigid with the shaft. The spindle is provided with a collar 29^a abutting against the end of the engine shaft, and this collar is provided
 35 with a non-circular recess 30 in its outer face. The worm 26 is rotatably mounted on the spindle 29, and the worm at its inner end is adapted to enter the recess 30 and become
 40 locked against rotation in respect to the spindle. At its outer end the worm is provided with any suitable means for moving the same longitudinally to bring the opposite
 end into or out of operative engagement within the recess 30. The inner end of the worm and the coacting portion of the collar
 45 will be hereinafter referred to as a clutch. In the specific form of clutch-operating means shown, I provide a handle 31, and from this handle extends a rod 32 normally
 50 in axial alinement with the worm and spindle. The end of the rod is provided with an enlarged head 33, which, when in operation, occupies a recess in the end of the worm, and said rod may be moved into or
 55 out of position through a suitable slot 34. By pulling outwardly or pressing inwardly upon the handle, the clutch may be brought out of or into operation whenever desired.

In making a test of an internal combustion engine, the parts are assembled substantially as shown in Fig. 1, and a strip of thin
 60 paper of any desired length is wound upon the drum 10 and its free end secured to the drum 11. The string 24 is wound upon the reel 23 and after being connected to the
 65 worm 26 the device is ready for operation.

After the engine is started, the marker will be moved back and forth across the paper as the pressure within the engine cylinder varies, and when it is desired to take the indication, the clutch is thrown into operation
 70 and the string wound up on the worm. This causes the unwinding of the string from the reel 23 and the rotating of the drum 11 to transfer the roll of paper from the drum 10 to the drum 11. As soon as all of the paper
 75 has been transferred to the drum 1, no damage is done by leaving the clutch in operation, as the paper automatically becomes disengaged from the drum 10, and, furthermore, when all of the string or cord is unwound from the reel 23, said string or cord
 80 will become automatically disengaged from said reel. It will be noted that the extent of the longitudinal movement of the strip of paper is the same for equal angular movements of the engine shaft, so that the line
 85 made while the engine is completing one cycle of operations may be compared with that produced during the succeeding and preceding cycles, and the relative effect of varying
 90 conditions may be noted. For instance, the carbureter may be adjusted during the time the successive cards are being made, or the spark may be advanced or retarded. As the total effective circumference of the drum 11
 95 will increase as the paper accumulates thereon and will thus tend to move the paper slightly faster in respect to the engine speed, I preferably taper the worm 26 very slightly, so that the slightly reduced speed at which
 100 the string will be wound on the worm will exactly counteract the slightly increased speed at which the paper will be wound on the drum 11. After the paper has been wound on the drum 11 the unwinding of
 105 the paper will, of course, reverse the direction of this drum, and, therefore, the unwinding of the paper may be utilized for rewinding the cord on the reel. In order to hold the paper taut between the two drums
 110 and to prevent the drum 10 from rotating any faster than the drum 11, I preferably provide a brake 35 for engagement with one end of the drum 10, and normally held in position by a spring 36, as indicated in Fig. 3.
 115

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An indicator for engines, including two drums, a strip of paper or the like extending
 120 from one drum to the other and having its opposite ends wound about said drums, means connected to one of said drums for rotating the same in synchronism with the engine shaft; and a marker movable back
 125 and forth across said strip in accordance with the variations in pressure within the engine cylinder.

2. An indicator for engines, including two parallel drums, a strip of paper or the like
 130

normally wound about one of said drums and having its outer end secured to the other drum, a cord normally wound about the last-mentioned drum, means secured to the opposite end of said cord, and operating in synchronism with the engine shaft for unwinding said strip from the second-mentioned drum to rotate the latter and transfer the strip from the first-mentioned drum to the second-mentioned drum, and a marker movable back and forth across said strip in accordance with the variations in pressure within the engine cylinder.

3. An indicator for engines, including two parallel drums, a strip of paper or the like normally wound about one of said drums and having its outer end secured to the other drum, a cord normally wound about the last-mentioned drum, a brake in engagement with the first-mentioned drum, means secured to the opposite end of said cord, and operating in synchronism with the engine shaft for unwinding said strip from the second-mentioned drum to rotate the latter and transfer the strip from the first-mentioned drum to the second-mentioned drum, and a marker movable back and forth across said strip in accordance with the variations of pressure within the engine cylinder.

4. An indicator for engines, comprising two parallel drums, each having a longitudinal slot therein, a strip of paper or the like normally wound about one of said drums with its end inserted through said slot and having its opposite end extended through the slot in the other drum, means for rotating the second-mentioned drum in synchronism with the engine shaft, a brake in engagement with the first-mentioned drum, and a marker movable back and

forth across said strip in accordance with the variations in pressure within the engine cylinder.

5. An indicator for engines, comprising a drum adapted to have a strip of paper wound thereon, a reel at one end of said drum, a cord normally wound about said reel, a worm, and means for rotating the worm at a speed directly proportional to the engine speed, the free end of said cord being secured to said worm, whereby as the engine is operated the cord is wound upon said worm and said drum is rotated to wind the strip of paper or the like thereon.

6. An indicator for engines, comprising means for continuously advancing a strip of paper or the like at a velocity proportional to the angular velocity of a rotating part of the engine, a marker, and means for moving the marker back and forth across successive portions of the strip in accordance with the variations in pressure within the engine cylinder.

7. An indicator for engines, comprising a strip of paper or the like, means for continuously advancing the strip in one direction, the extent of the advancement being the same for equal angular advances for the engine crank shaft, and a marker in engagement with said strip and movable back and forth across the same upon variations in the pressure within the engine cylinder.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES WIGHT SNYDER.

Witnesses:

C. A. POWER,
E. L. SNYDER.