(No Model.) 2 Sheets—Sheet 1.

F. H. PIERPONT.

STEAM ENGINE INDICATOR.

No. 467,431. Patented Jan. 19, 1892.

Fig. 1

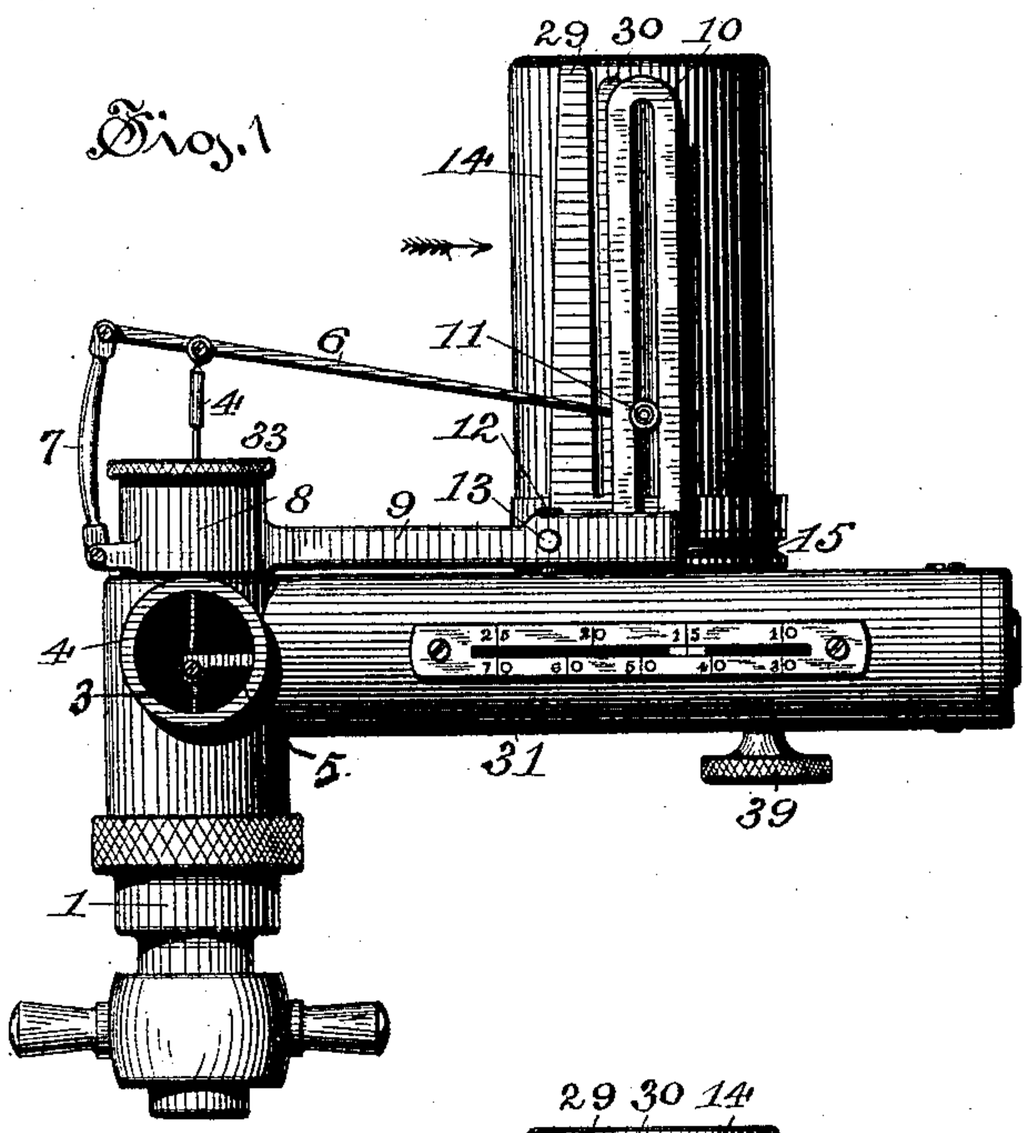
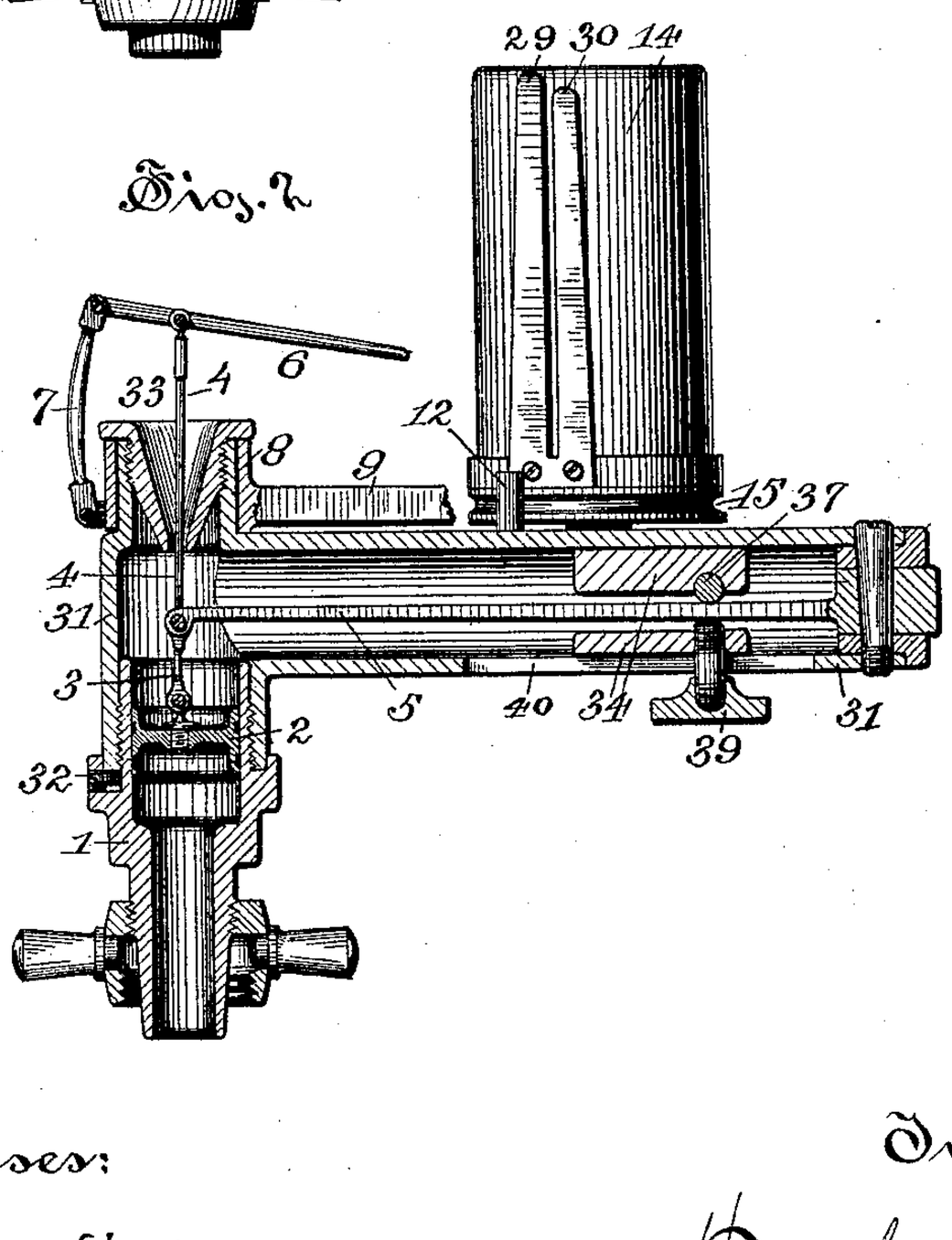


Fig. 2



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Inventor,

Frank H. Pierpont

(No Model.) 2 Sheets—Sheet 2.

F. H. PIERPONT.

STEAM ENGINE INDICATOR.

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Fig. 3

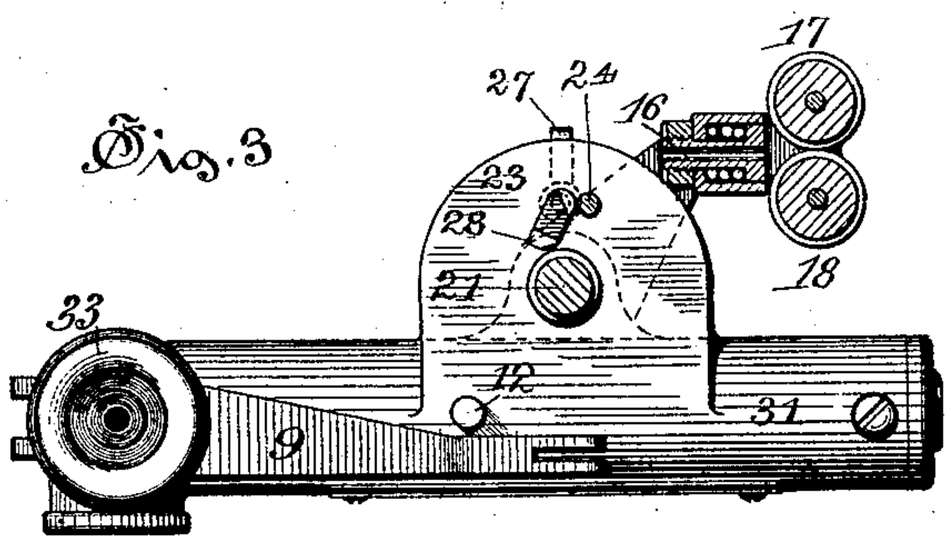

Fig. 4

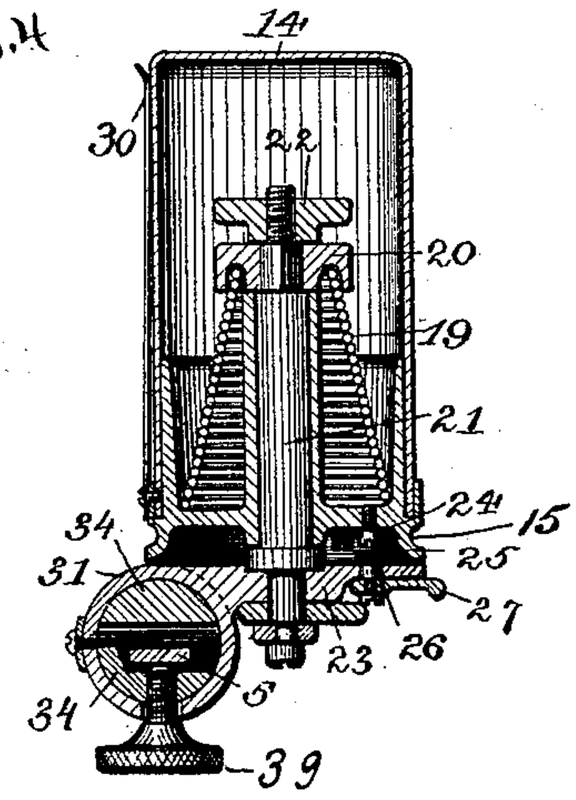

Fig. 5

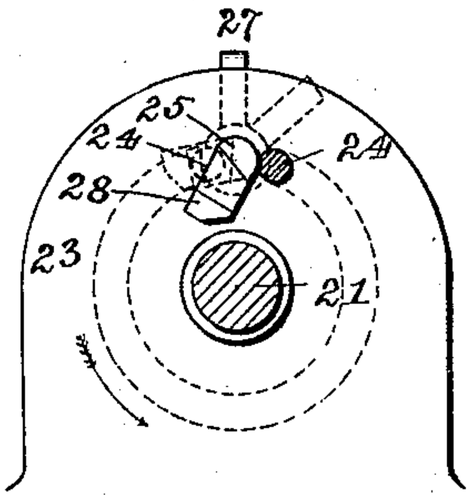

Fig. 6

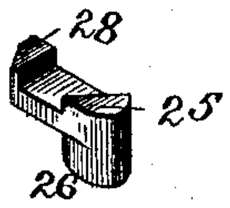

Fig. 9

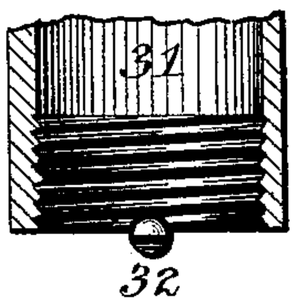

Fig. 8

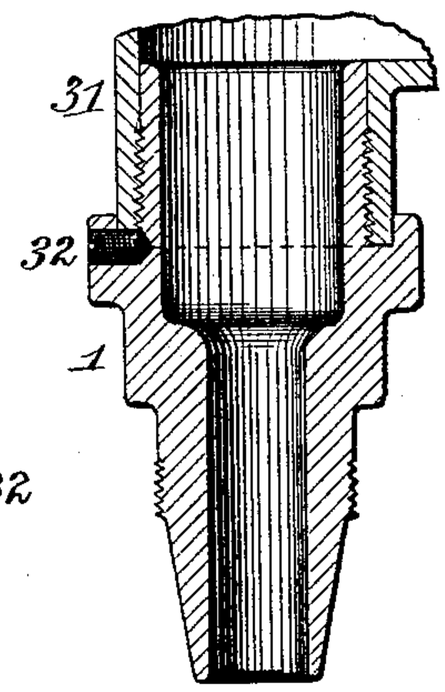

Fig. 7

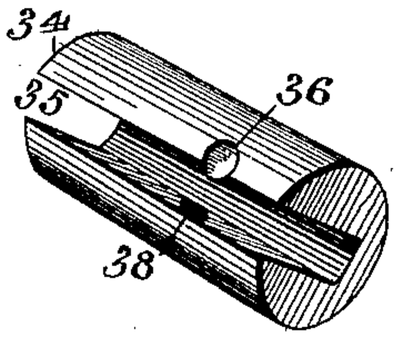

Fig. 10

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UNITED STATES PATENT OFFICE.

FRANK H. PIERPONT, OF HARTFORD, CONNECTICUT.

STEAM-ENGINE INDICATOR.

SPECIFICATION forming part of Letters Patent No. 467,431, dated January 19, 1892.

Application filed January 30, 1891. Serial No. 379,627. (No model.)

To all whom it may concern:

Be it known that I, FRANK H. PIERPONT, of Hartford, Connecticut, have invented new and useful Improvements in Steam-Engine Indicators, of which the following description and claims constitute the specification, and which is illustrated by the accompanying two sheets of drawings.

This invention embodies certain improvements in a steam-engine indicator constructed for attachment to a steam-engine cylinder, and in which the pressure of the steam in the cylinder is caused to impart a vertical reciprocating movement to a pencil adjacent to the surface of an oscillating drum, which is caused to oscillate by a suitable connection with the piston-rod of the engine. The function of the improved instrument consists in graphically indicating on the surface of the drum or on the surface of a card wrapped around the drum the variations of pressure in the steam-cylinder at the different parts of the stroke of the piston.

Figure 1 of the drawings is a front elevation of the instrument. Fig. 2 is a central vertical section of the body of the instrument. Fig. 3 is a plan view of the instrument with the oscillating drum removed. Fig. 4 is a central vertical section through the body of the instrument and through the oscillating drum. Fig. 5 is an enlarged view of the base upon which that drum oscillates. Fig. 6 is a perspective view of an oscillating hook which serves to hold the oscillating drum in position under some circumstances hereinafter explained. Fig. 7 is a perspective view of a bushing which slides inside of the body of the instrument. Figs. 8, 9, and 10 are enlarged view of parts, showing how the steam-cylinder of the instrument is secured and fixed within the body of the instrument.

The numeral 1 indicates the steam-cylinder of the instrument, which is fitted for connection with the cylinder of the steam-engine in the usual manner, while the numeral 2 indicates the usual piston in the steam-cylinder 1. Pivoted to the center of the upper side of that piston is the link 3, and the upper end of that link is pivoted to the lower end of the link 4 and also to the free end of the flat steel spring 5. The upper end of the link 4 is pivoted to the lever 6, and the shorter arm of that lever is pivoted to the upper end of the link 7, while the lower end of that link is pivoted to the sleeve 8. The arm 9 is integral with that sleeve, and its outer end supports and carries the vertical guide 10. The end of the longer arm of the lever 6 carries the pencil 11, and that pencil moves up and down in the guide 10 whenever the lever 6 rises and falls, respectively.

The numeral 12 indicates a stud, which limits the backward swing of the arm 9, while the numeral 13 indicates a hole in that arm, into which a wooden handle may be thrust and used when the arm is to be swung forward.

The numeral 14 indicates the oscillating drum, the lower end of which is provided with a concave groove 15, from which a cord extends through the way 16 (see Fig. 3) and between the pulleys 17 and 18 to the cross-head or other part moving with the piston of the engine. The oscillating drum is provided in its interior with the reactive spring 19, the lower end of which is fixed to the floor of the interior of the drum and the upper end of which is fixed to the cap 20. The square hole in the center of that cap incloses the corresponding square part of the upright rod 21, and is held in position by the nut 22 on the upper end of that rod, while the lower end of that rod is fixed to the horizontal bracket 23. The spring 19 is so coiled and placed as to tend to make the drum 14 turn in the direction of the arrow shown in Fig. 5; but the stud 24 projects downward from the under side of the floor of the drum and limits the oscillation of the latter by coming in contact with the oscillating stop 25, as shown in Figs. 3, 4, and 5. That oscillating stop turns on the pivot 26 and is turned by the handle 27, and is provided with the hook-like projection 28.

The numerals 29 and 30 indicate a pair of flat vertical springs, the lower ends of which are fixed to the lower end of the periphery of the drum 14 and the bodies of which extend upward close to that periphery and serve to hold the ends of a card or other paper which may be wrapped around the drum.

The general mode of operation of this instrument is as follows: The pressure of steam below the piston 2 in the cylinder 1 varies at

different parts of the stroke of the piston in the cylinder of the steam-engine, and those variations are graphically represented on the card on the periphery of the drum 14, because the steam-pressure forces the piston 2 more or less upward against the resistance of the spring 5, according as that pressure increases or diminishes, and because the stroke of the piston in the steam-engine cylinder simultaneously causes the drum 14 to oscillate, and because, therefore, the pencil 11 makes a mark on the card on the periphery of the drum which will correspond in the degree of its elevation above a base-line drawn on that periphery at each particular part of the length of that mark with the pressure of the steam in the steam-cylinder and at the corresponding part of the stroke of the piston in that cylinder. The hollow T-shaped case 31 has the lower end of its transverse part fastened around the cylinder 1 by the indicated screw-thread in the interior of its lower end and the corresponding screw-thread on the exterior of that cylinder and by the screw 32, as hereinafter more particularly described. The upper end of the transverse part of the case 31 is surrounded by the sleeve 8 and is surmounted by the hollow conical nut 33, the flange of which keeps the sleeve 8 from rising and the body of which closes the upper end of the case, except that the opening through the center of the hollow nut is large enough to enable the rod 4 to move freely upward and downward.

The horizontal body of the case 31 is provided with the horizontal bracket 23, projecting therefrom and carrying the drum 14, as before described. The flat steel spring 5 works in the horizontal body of the case 31, its free end being pivoted to the upper end of the link 3 and the lower end of the link 4 and its fixed end being rigidly fastened to the case 31, as shown in Fig. 2.

The split bushing 34 is adjustably placed within the body of the case 31 and is provided with the longitudinal recess 35 for the reception of the spring 5 and with the horizontal cylindrical hole 36 for the reception of the hardened steel pin 37 and with the vertical threaded hole 38 for the reception of the set-screw 39, and the lower side of the body of the case 31 is provided with the longitudinal slot 40, through which the body of the set-screw 39 passes and along which it is moved when the bushing 34 is adjusted. The hard-steel pin 37 and the set-screw 39 impinge upon the spring 5 at opposite places, and those places are so narrow and so small that the portion of the spring 5 which is permitted to vibrate can be adjusted to any desired length with absolute precision. If a broad bearing were employed in place of the pin 37 or in place of the set-screw 39, or both of them, this accurate adjustability of the length of the vibrating part of the spring would be unattainable.

In instruments like this it is necessary to make the cylinder 1 separable from the case 31, and it is important to provide means for locking them firmly together when they are united. To this latter end I insert the screw 32 in the position shown in Figs. 2, 8, and 9, in which position it prevents the screw-threaded union between the cylinder 1 and the case 31 from being unscrewed. When it is desired to unscrew those parts, the screw 32 is turned one-half of a revolution, so that its recessed side is upward, and in that position it interposes no obstacle to the unscrewing of the cylinder from the case.

In order that steam-engine indicators like this may be applicable to widely varying degrees of boiler-pressure, the spring 5 must be adjustable to correspondingly varying degrees of tension. To this end the split bushing 34, with its hardened steel pin 37 and set-screw 39, may be adjusted at varying positions relatively to the length of the spring, according to one or the other of the scales shown on the face of the case 31 in Fig. 1. The upper one of those scales is intended for use with a spring 5 of a suitable strength, and the lower one of those scales is intended for use with a substitute spring 5 of greater strength. Where the instrument is to be attached to a steam-engine having a boiler-pressure of from ten to twenty-five pounds, the weaker of those springs is used in the instrument and the upper one of the two scales shown in Fig. 1 is applicable, and where the instrument is to be attached to a steam-engine having a boiler-pressure of from thirty to seventy pounds the stronger of those springs is substituted for the other and the lower scale shown in Fig. 1 is available. In either case the resistance offered by the spring 5 and the upward movement of the piston 2 is increased by moving and fixing the split bushing 34 at the left and is diminished by moving and fixing it at the right. When the split bushing is moved to the proper position on the length of the spring to secure a particular tension, the screwing up of the set-screw 39 first operates to fasten the split bushing within the case 31 by pressing its sides apart against the insides of that case and then operates to clamp the spring 5 between the inner end of the set-screw and the side of the steel pin 37. The result is that the spring 5 is held with absolute rigidity within the case 31 at the precise place where the inner end of the set-screw 39 and the pin 37 are opposite to each other.

Steam-engine indicators of this class require to have an arm which vibrates and carries a pencil through a straight course on its free end; and this invention employs the positive guide 10 to cause the pencil at the free end of the lever to move in a straight course, and it employs the link 7 so that the fulcrum of the lever may be sufficiently movable to enable the free end of that lever to follow its guide.

In inventions of this class it is necessary in

removing the completed diagram and inserting fresh paper for the next diagram to hold the oscillating drum 14 at rest. This is conveniently done by holding it against the tension of the spring 19 at the extreme position to which it is drawn by the cord which acts against that spring. This can be imperfectly done by simply holding that cord in the hand; but I have added to the instrument the rotating stop 25, provided with the handle 27, and the hook-like projection 28. When it is desired to hold the drum in the extreme position to which it is turned against the resistance of the spring 19, the handle 27 of the oscillating stud 25 is turned from its direct position shown in Fig. 5 to its diagonal position shown in that figure, and that turning turns the hook-like projection 28 from its full-line position shown in Fig. 5 to its dotted position shown in that figure, where it engages the stud 24, which projects downward from the under side of the floor of the rotating drum 14, and thus prevents that drum from being drawn back by the spring 19 until the stud is disengaged by returning the handle 27 to its former position.

I attach importance to the fact that the bushing 34 is split horizontally, because that construction enables a single set-screw or pinching-screw 39 to serve both to pinch the spring and to hold it firmly to the bushing at any desired point in its length, and also by distending or separating the two parts of the bushing cause them to be set very firmly in the required position in the case 31.

I claim as my invention—

1. The combination of the case 31, the spring 5, rigidly held at one of its ends within that case, and the split bushing 34, the hard-steel pin 37, and the set-screw 39, arranged to perform the functions of holding the spring at any desired point and of rigidly holding the bushing at any particular point within the case, all substantially as described.

2. The combination of the slotted case 31, the spring 5, rigidly held at one of its ends within that case, the split bushing 34, and the set-screw 39, arranged to perform the functions of holding the spring at any desired point and of rigidly holding the bushing at any particular point within the case, all substantially as described.

FRANK H. PIERPONT.

Witnesses:
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P. A. PHELPS.