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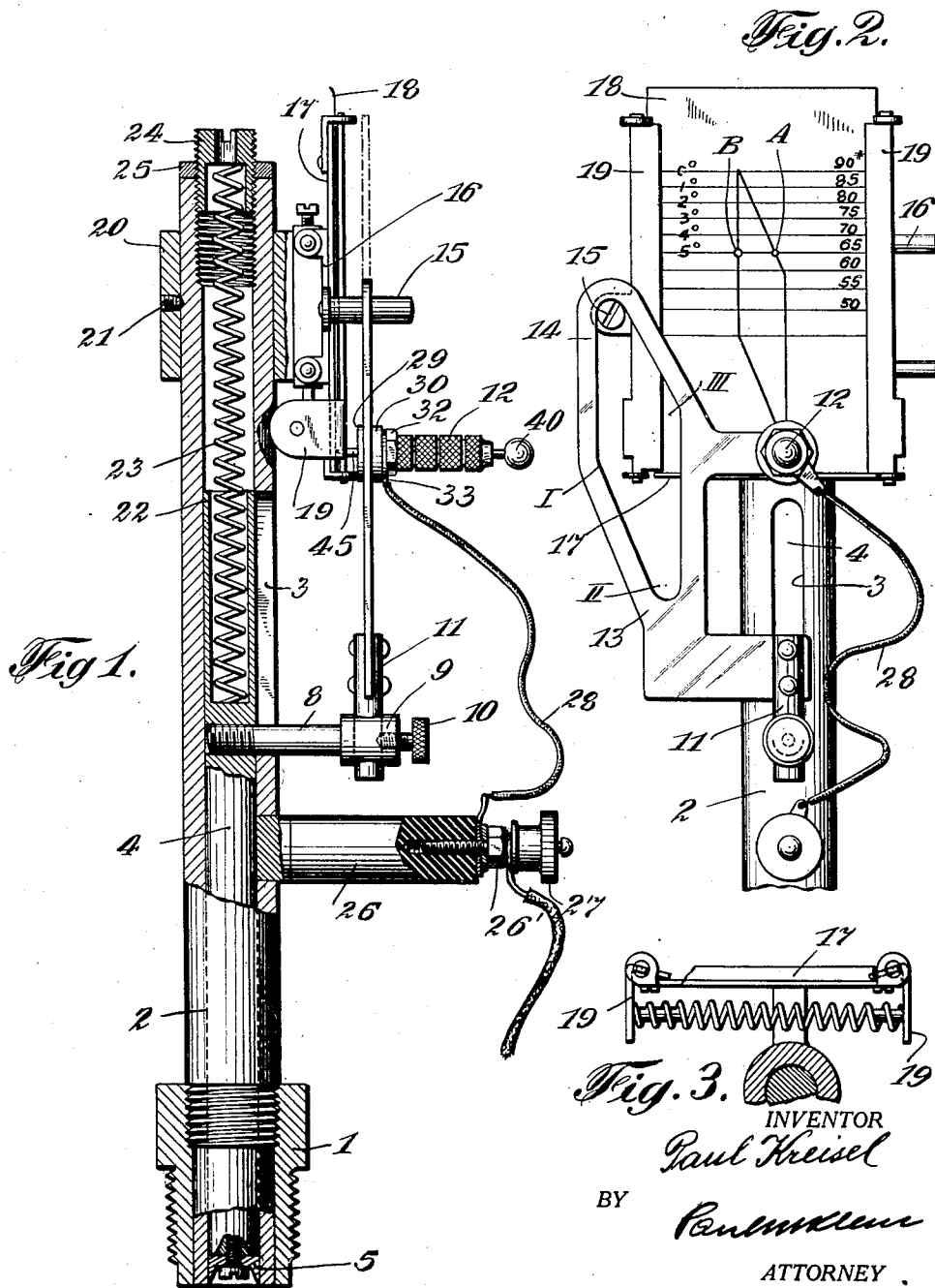
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P. KREISEL

RECORDING AND TIMING DEVICE FOR COMBUSTION ENGINES

Original Filed June 3, 1923

4 Sheets-Sheet 1



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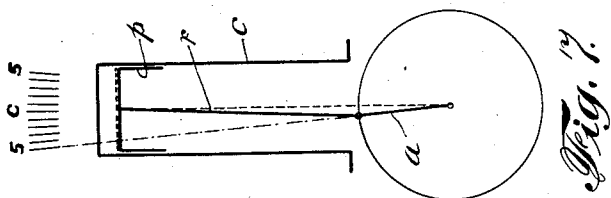
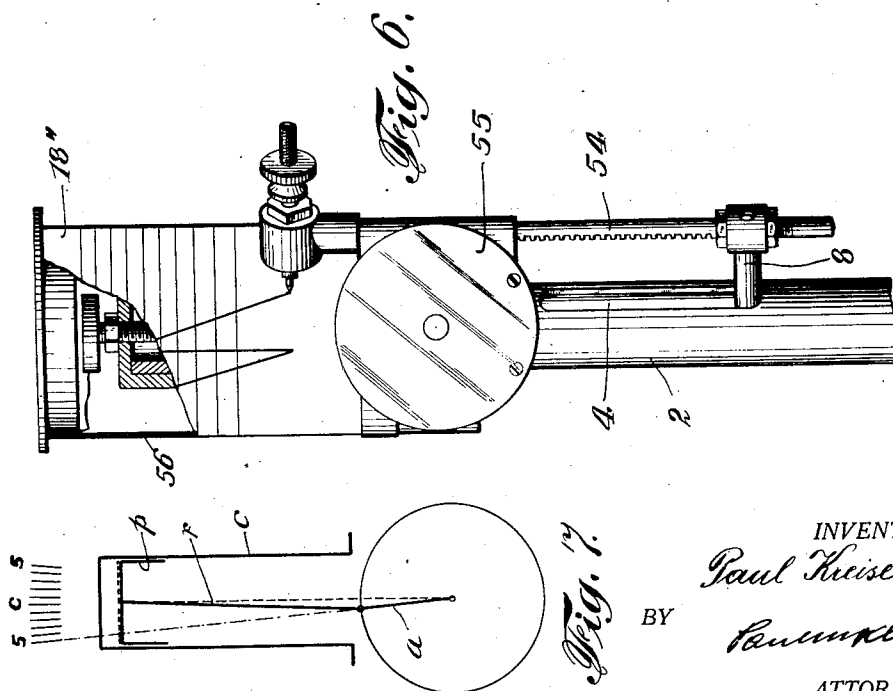
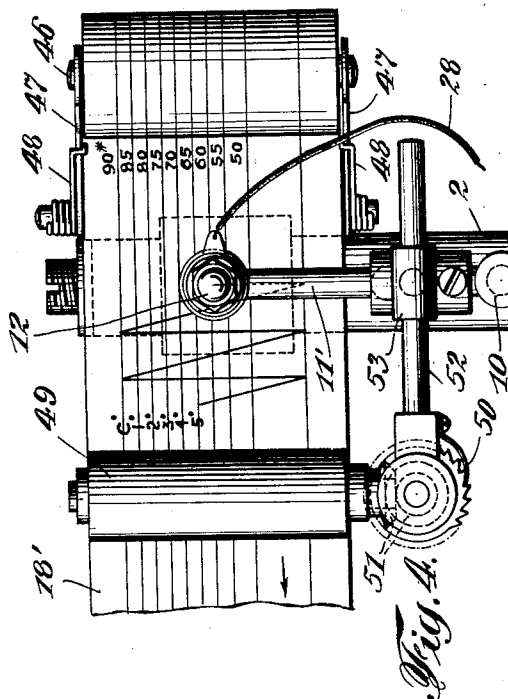
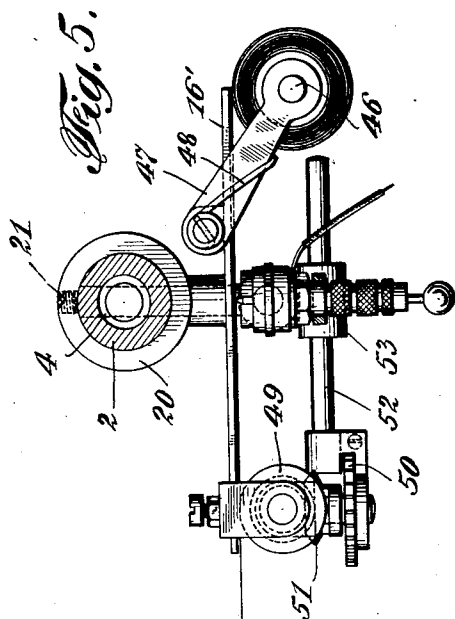
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RECORDING AND TIMING DEVICE FOR COMBUSTION ENGINES

Original Filed June 3, 1923

4 Sheets-Sheet 2



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RECORDING AND TIMING DEVICE FOR COMBUSTION ENGINES.

Substitution for application Serial No. 643,899, filed June 3, 1923. This application filed July 9, 1927.
Serial No. 204,630.

This application is filed as a substitute for application Serial No. 643,899, filed June 3, 1923.

This invention relates to recording and timing devices for combustion engines.

Its prime object is to provide an effective apparatus, by means of which not only the various amounts of pressure may be gaged and recorded, but which will simultaneously indicate the exact moment of firing within the cylinders of an engine, and indicate such moment upon a record taking element, and furthermore indicate the cycle periods of an engine, showing the respective relations between the periods of compression, ignition and intake.

Apparatus known as indicators are generally used. There are also so-called spark gages, but neither of these devices can effectively give a complete record of the working of an engine, making it impossible to time such engines exactly.

It is my endeavor to provide a device particularly useful for manufacturers of engines, for repair shops and individual experimenters, who require a true and combined record of the operation of an engine in order to successfully adjust the same for the most effective operation.

I accomplish this result by providing an indicator element, which will not only mark the chart or diagram of the periods of compression, explosion, exhaust, and intake, but which will also mark the exact point of ignition upon a record taking element.

My indicator element in short is a conductive, easily adjustable device, which normally presses against a non-conductive record taking element, which latter is supported by a conductive frame. The frame is grounded, while my recording element is connected with the ignition system of the engine.

At the moment of ignition a hole is pierced through the non-conductive record taking element by the spark jumping from my recording element to the frame of the indicator. Thus an unmistakable mark will be impressed in the chart marked by my indicator element.

The advantages and further objects of my

invention will be more readily understood from the following description of the accompanying drawings, which illustrate various designs of my recording timing device, but accomplishing the primarily desired effects of indicating simultaneously the various periods of the cycle in a combustion engine, while at the same time marking the moment of ignition.

In the drawings, Figure 1 shows a simple construction of my device in side elevation, partially in section.

Figure 2 is a partial front elevation of my device.

Figure 3 is a partial bottom view thereof showing the arrangement of attachment of the recording sheet.

Figure 4 is a front elevation of a modified form of my device, with a continuous record taking element.

Figure 5 is a top view thereof.

Figure 6 is another modified form of my device.

Figure 7 is a diagrammatical view of an engine.

Figure 8 shows a similar arrangement of my device as shown in Figure 4, with some additional features.

Figure 9 is a detail cross sectional view through a cylinder having its spark plug aperture at the side, and showing an arrangement of attachment of my device.

Figure 10 is a cross sectional detail view of my recording element.

Figure 11 is a record sheet showing a diagram.

Figure 12 illustrates a piston rod arrangement for either one of the timing devices shown.

Figures 13 and 14 illustrate modified forms of such piston rod arrangement.

Referring to the drawings, numeral 1 denotes a socket for any one of my devices, which is inserted into the aperture usually occupied by the spark plug of an engine.

Inserted into the socket 1 there is a tubular member 2, employed also in all of my designs.

This tubular member 2 is provided with a longitudinal slot indicated at 3, and in the tube is reciprocatingly mounted a piston rod

4, the end of which may be equipped either with an air tight piston, shown at 5 in Figure 1, or a rod adapted to contact with the piston of the engine, as shown at 6 and 6' in Figures 8 and 9.

In Figure 8 there is also shown a roller 7, the application of which is optional.

Associated with piston rod 4 there is, in either case, a pin 8 provided, which protrudes through slot 3 of tubular member 2.

At the end of pin 8 there is seen a head 9, provided with a set screw 10. The head 9 is drilled and is adapted to accommodate a support 11 having my recording element, indicated at 12, which is identical for each of the modifications shown.

Support 11 may be changed in its form and design for accommodation in its application to either one of the modified forms shown.

The support illustrated in Figures 1 and 2 is equipped with an angular extension 13 provided with a rhomboidal frame 14 adapted to engage a pin 15 connected with a reciprocating device 16, to which is attached a record sheet support 17. The latter holds a non-conductive record sheet indicated at 18, which is firmly held by spring controlled clips 19.

The reciprocating member 16 is glidably attached to a bushing indicated at 20 and held in proper relation to tubular member 2, by means of a set screw 21. Bushing 20 possesses an extension which is drilled horizontally in two places forming two horizontal bearings or guides for the pair of rods seen at the right side of Figure 2. These rods are held at one of their ends in lugs provided at the rear of the reciprocating member and are fastened to those lugs by set screws shown in Figure 1. Thus when pin 15 is operated by the rhomboidal frame 14, the two guide rods play back and forth in their bearings.

Piston rod 4 in this case is hollow, as shown at 22, providing a seat for expansion spring 23, which is held within the tubular member 2 by means of cap 24 and lock nut 25.

The spring is adjusted to correspond with the compression within an engine cylinder, corresponding to about 90 pounds which is the usual amount of compression in automobile engines.

Arranged below slot 3 is an insulator 26 to which is attached a binding post 26' having a nut 27, by means of which an electric conductor from the ignition system may be firmly attached.

The binding post is connected by means of a loose cable 28 to indicator element 12. The latter is shown in detail in Figure 10 attached to the indicator support 13, and insulated therefrom by beads 29 and 30.

These beads are held together by a tubular screw member 31, which is flanged at its outer end and is held in place by means of a

nut 32, which latter also holds a perforated connecting plate 33, to which cable 28 is attached.

Adjacent to nut 32 there is a housing 34 of my indicator element, which is hollow as seen at 35 and adapted to receive a lead holder 36, which is broadened at 37 and prevented from slipping out of tubular screw member 31.

In the head 37 fits a threaded spindle 38 which is reduced to a pin like extension 39 provided with a ball or handle 40.

The reduced end 41 of housing 34 is provided with an internal thread indicated at 42, registering with the thread of spindle 38. Against head 37 of the lead holder 36, bears a spring 43 and pushes the lead holder constantly toward the record slip. As will be seen, this lead holder is slit at 44 so as to accommodate a lead 45.

When it is desired to withdraw the lead 45 from the record sheet, spindle 38 is pulled outwards by means of ball 40 and is then turned so that it engages with its thread, the thread 42 of reduced housing extension 41.

It will be proper to follow the operation of the device shown in Figures 1, 2, and 3 as its function is basic to all the other modified devices illustrated.

My apparatus is attached by means of bushing 1 to any engine head, instead of a spark plug. When the compression within the cylinder reaches a sufficient degree, for instance one pound above the atmospheric pressure, piston rod 4 is moved in an upward direction, whereby indicator element 12 is also caused to move in an upward direction.

The frame 14 also moving in the same direction causes pin 15 to travel in right-hand direction as soon as the obtuse angle I of the rhomboidal frame has passed the pin, and causes to move thereby the entire support 16 of the non-conductive indicator sheet 18 until pin 15 is reached by point II of the frame 14.

Assuming that the upward motion of rod 4 was caused by the compression in the cylinder, the next downward stroke following the latter indicates the explosion period in the engine.

The frame 14 now permits the sheet support 16 to remain in its last assumed position until obtuse angle III has passed pin 15. At this point, the pin is again deflected, and therethrough the entire support is caused to travel in left hand direction.

The combination between the upward travel of rod 14 and the reciprocating motion of support 16, causes the marking of a diagram shown plainly in Figure 2. In this figure is also shown the non-conductive recording sheet 18 which rests against the conductive and grounded support 16, while indicator element 12 is supplied with current from the ignition device of the engine.

When the spark is advanced the ignition

moment will be marked at the upper oblique side of the diagram, as indicated by circle A. That means that before the uppermost point of compression is reached within the cylinder, the ignition has taken place.

When the ignition is retarded, it will take place at the moment the piston has passed its uppermost position and is beginning its downward or explosion stroke, and will be marked at the upper vertical leg of the diagram, as for instance shown by circle B.

I have marked the recording sheet (Figures 2 and 11) with a plurality of lines numbered at the right hand from 50 to 90, indicating pounds of pressure, while the left hand side is marked C, at the uppermost line, and each successive line below is marked from one to five. This latter marking corresponds to the degree of advance or retard of the spark relative to the compression of the fuel charge and consequently relative to the position of the piston compared with its uppermost position within an engine cylinder.

Reference is made to Figure 7 where a diagrammatical view of an engine is shown having a crank —a— and a piston rod —r—, piston —p— and a cylinder —c—.

The full line position of the crank, the piston rod and the piston shown in the diagram corresponds to a position five degrees removed from its central —c— position which latter is indicated in dashed lines.

It will be seen that the crank deviates from the central position to the amount of five degrees.

The advance or retard of the spark may be adjusted corresponding to the best results obtainable within any individual engine and consequently the degree of advance or retard may greatly vary.

In Figures 2 and 11, I have assumed, for simplicity sake, that the spark will take place at a deviation of five degrees.

As has been said before, the sheet support 17 is grounded and the indicator element 12 is connected with the ignition device of the engine, the latter having taken the place of the spark plug.

At the moment the ignition takes place, a spark jumps from the lead point 45 through the non-conductive record taking element 18 to the sheet support 17, thereby piercing the sheet 18 with an unmistakable marking of the exact moment of ignition.

Similar is the operation of the timing instruments as shown in Figures 4 and 5, where the record taking sheet 18' is in a form of a strip, wound about a roller 46, which is attached to the stationary sheet support 16'.

Roller 46 is held in permanent contact with the sheet support by means of pivoted brackets 47 and spring 48.

Oppositely mounted to roller 46 is another

roller 49, preferably of resilient material, which is adapted to pull strip 18' in left hand direction during each downward movement of indicator element 12.

The movement of strip 18' is accomplished by means of a ratchet arrangement indicated at 50 and a pair of mitre gears 51.

The ratchet arrangement is operated through reciprocating rod 52, which is slidably mounted in a pivotal bushing 53 to indicator element support 11'.

In this case the diagram marked upon sheet 18' is continuous and each vertical line indicates an upward stroke of the engine piston, while each oblique line indicates a downward stroke of the engine piston.

The sheet 18' is marked similarly to that explained before and the point of ignition is marked also in the identical manner as in the aforementioned devices.

Another modified form is shown in Figure 6 where instead of indicator element support 11 and 11', toothed rod 54 is shown, which cooperates with a ratchet arrangement placed in a housing indicated at 55 and which is adapted to rotate a cylinder 56 upon which is mounted a recording sheet 18'.

Each upward stroke is again marked by a vertical line, while each downward stroke is marked by an oblique line, and the ignition is marked in the same manner as in the previously described devices.

In addition to any one of these devices there may be attached an indicator arrangement recording the period of intake within a combustion engine.

Such modified form of my device I have illustrated in Figure 8 where again the recording sheet 18' is shown being rolled upon a drum or cylinder 46 and being propelled by another cylinder 49. The arrangement of indicator element 12 and the ratchet operating mechanism for the propelling roller 49 is identical with that shown in Figure 4.

In Figure 8 there is shown a cylinder indicated at 57 provided with a spark plug opening 58, into which is mounted bushing 1 of my timing device.

Instead of using a calibrated spring corresponding to the compression in the cylinder, and instead of using a piston at the end of rod 4, a spring propelled rod 6 is employed with a roller 7 at its end, the latter adapted to contact with the upper surface of piston 59 of the engine.

Above the cylinder there is shown a lever 60 adapted to operate an intake valve 61. Connected to the lower arm of lever 60 is a hinge device indicated at 62, connected by means of rod 63 to another ratchet arrangement 64 adapted to engage the ratchet wheel operated roller 49. In this arrangement the roller 49 is caused to move at different pe-

riods, due to the operation of the ratchet arrangement connected with glidable rod 52 and at another time due to the operation of valve lever 60.

5 The diagram shown on recording sheet 18' in this figure plainly illustrates the various periods of the cycle in the engine cylinder.

Referring to this diagram, the upward stroke marked 65, corresponds to the compression stroke of piston 59. The oblique stroke 66 corresponds to the explosion stroke of piston 59. The stroke marked 67 marks the exhaust period of the engine.

At the completion of this period, intake valve 61 is to open and permit a new charge of fuel to enter the cylinder. Valve operating lever 60 therefore moves in downward direction, pressing upon valve 61, and takes with it the pivotal arrangement 62, thereby causing the operating of ratchet 64 upon the ratchet wheel of roller 49. This operation is indicated by the line 68 of the diagram and is of very short duration. Line 68 continues into line 69, representing the continuation of the intake stroke of piston 59.

The cycle is repeated again with the compression stroke 65'. The marking of the spark is accomplished in the same manner as in the previously described devices and I have marked one point showing an example of advanced ignition by circle A' and another circle B' marking the retarded ignition.

35 The operation of the various lever constructions in Figure 8 may be explained as follows:

Rod 6 is provided with a pivotal bushing 53 (see Fig. 4) in which slides reciprocating rod 52 possessing at its end a pawl adapted to engage a ratchet which latter operates the mitre gears 51. When rod 5 moves in upward direction, rod 52 will swing with its bushing and glide therein without actuating the ratchet. The latter slides upon the surface of the ratchet wheel's teeth. When rod 6 moves downwards, bushing 53 will swing in opposite direction and cause rod 52 to swing clockwise, which motion, causes the ratchet to engage and operate the ratchet wheel. The valve lever 60 is connected by means of a plurality of hinged levers with the same ratchet wheel, but has its individual ratchet adapted to engage the ratchet wheel independently of the ratchet of rod 52. When lever 60 swings downwards, its ratchet will operate the ratchet wheel. The teeth of the latter will glide over the ratchet of lever 52. When lever 60 is swung in upward direction, its ratchet will glide over the teeth of the ratchet wheel.

As will be seen from the foregoing, this latest described apparatus, combines the

indication of three distinct periods of the cycle, that is, the compression period, the ignition period and the intake period, besides the explosion and exhaust periods, which are indicated in other devices of this kind.

The advantage of such an arrangement is obvious as it assures the exact reproduction of the operation of an engine and therefore enables a very precise adjustment thereof.

In Figure 9 there is shown a part of a modified form of my device, where a plain rod 6' takes place of the piston rod 4, shown in Figures 1 and 2. This arrangement is particularly desirable for engines having inclined apertures for their spark plugs, and permits application of my device also to engines designed in this manner.

Figures 12, 13 and 14, illustrate detail views of a modified arrangement for operating piston rod 4.

For the spring 23, which is calibrated to the desired pressure in an engine, a weight arrangement is substituted, as shown in Figure 12, wherein tubular member 2 a reciprocating rod 4' is shown, which is provided at its upper end with a slotted portion 70, housing a roller 71, providing a support for actuated arm 72 of weight lever 73, which is pivoted at 74 to a bracket 75.

At the end of the weight lever, there is shown an adjustable weight 75, which may be held in proper position by means of set screw 76.

When pressure is applied to piston rod 4' from the engine piston, it will push piston rod 4' upwards thereby lifting the weight 75. This weight may be readily adjusted to proper leverage so as to correspond to the desired pressure within an engine.

A similar arrangement is shown in Figures 13 and 14, where instead of a roller arrangement a gear and rack design is illustrated.

Rod 4' is provided with teeth indicated at 77 adapted to be engaged by a toothed segment 78, which is pivoted at 79 and rigidly connected to a weight which is pivoted at 79 and rigidly connected to a weight arm 80.

Upon weight arm 80 there is adjustably mounted a weight 81, which may be adjusted to its proper position by a set screw 82.

The geared segment 78 together with weight arm 80 is attached to tubular member 2 by means of a bracket 83.

The operation of this device need not be explained, as it is identical to that explained in Figure 12.

From the foregoing description of the various types of my universal timing device, it will be evident that I do not lay particular stress on their construction, since the prime object of my invention consists of indicating not only the main cycle periods of an engine,

but also, and simultaneously therewith, the moments of ignition and intake valve movement, which simultaneous recordings are the vital features of my invention.

5 Therefore, while I have shown various specific structures of my device, be it understood that still further improvements and changes may be made, without departing from the aforementioned particular principles of my idea, and I therefore reserve for myself the right to make such changes and improvements in my invention, for which I claim:

15 1. A timing device for combustion engines having a non-conductive record taking element, a conductive support for said element, a conductive record making element insulated from said support, means causing said record making element to indicate the degree of compression, means for simultane-

ously operating said support together with said record making element for indicating the intake period, and means for causing said record making element to indicate the firing period, while the compression pressure and the intake period is being recorded. 25

2. In a recording gage for indicating the periods of compression, intake and ignition in a combustion engine, a conductive indicator element comprising a conductive marking member adapted to bear against a non-conductive recording sheet and further adapted to convey electric current through said recording sheet, thus recording the moment of ignition. 30 35

Signed at New York, in the county of New York and State of New York, this 30th day of June, A. D. 1927.

PAUL KREISEL.