

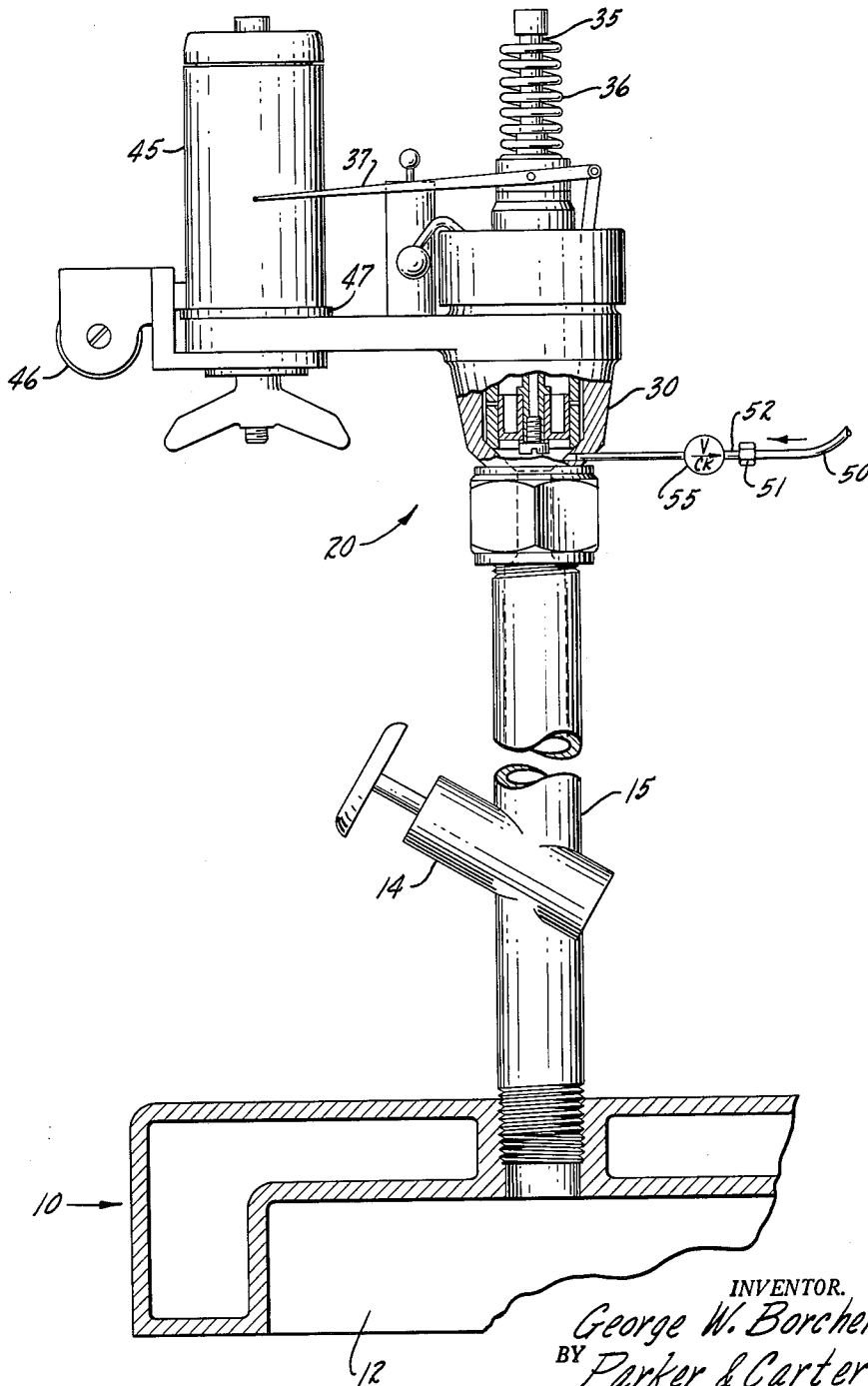
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G. W. BORCHERS

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COOLING SYSTEM FOR INDICATOR

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INVENTOR.  
George W. Borchers,  
BY Parker & Carter  
Attorneys.

1

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## COOLING SYSTEM FOR INDICATOR

George W. Borchers, Houston, Tex., assignor to Nordberg Manufacturing Company, Milwaukee, Wis., a corporation of Wisconsin

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This invention relates to a system for preventing combustion or hot spot development in engine indicators, particularly, engine indicators adapted for measuring pressures in engine cylinders of the spark fired, compressed gas type.

An object of this invention is to provide a purging and cooling system for the hot spot which develops in engine indicators.

Another object of this invention is to provide a system and apparatus which efficiently prevents pre-ignition of the combustion chamber in an internal combustion engine.

Still another object of this invention is to provide a simple and economical purging and cooling system which operates in cycles with the internal combustion engine.

Still another object of this invention is to provide a purging system for an engine indicator which intermittently operates so it does not interfere or hamper the normal operation of the engine indicator.

A further object of this invention is to provide a purging system with means to intermittently stop its operation by automatic means when the engine indicator is recording pressure within the engine cylinder.

Another object of this invention is to provide a purging apparatus and system which utilizes compressed air as a medium for cooling the hot spot and other portions of the engine indicator.

The foregoing objects and other objects which will become apparent from time to time are now realized by the following invention which will be described in detail and which is illustrated in the accompanying drawing of a more or less diagrammatic side elevation view of an engine indicator fitted on the cylinder head of an internal combustion engine.

The drawing shows a portion of a cylinder head generally designated as 10 and a portion of the compression chamber 12 within the cylinder. The engine indicator is generally designated as 20 and includes an engine conduit 15 adapted to fit a cylinder head and communicate with the interior of the cylinder, a housing 30 having within its bore a piston responsive to the pressure within the chamber of the engine cylinder, a rod 35 extending from the piston out of the housing, a calibrated spring 36 providing tension against movement of the rod, a marking stylus 37 and an oscillating drum 45 to record pressure responsive movements of the piston and rod in the housing of the indicator. Also shown is a cut-off valve 14 placed in the engine conduit to open and close the passageway of the engine conduit 10 between the engine cylinder and the engine indicator. The recording drum 45 may rotate at a constant speed or may be adapted to oscillate and record the volume within the internal combustion engine by suitable connections to the crankshaft of the internal combustion engine. Such connections are not shown in detail but are joined to a pulley 46 and to a pulley ring or equivalent means 47 placed at the base of the recording drum 45.

The cooling system and apparatus illustrated herein include a source of supply of purging fluid (not shown), a supply conduit 50 carrying the fluid from its source and joined by a coupling nut 51 to a communicating conduit 52 which empties into the interior of the housing 30. The communicating conduit 52 has a check valve 55 located somewhere along its length to provide unidirectional flow

2

of the purging fluid or a flow that is throttled from a high pressure supply of purging fluid into the housing 30, but is not permitted to flow in a reverse direction.

The purging fluid is shown in the drawing to be admitted directly into the housing 30 from where it moves into the engine conduit 15 to purge or drive the combustible gases towards the engine cylinder and thereby prevent a hot spot developing generally in that portion of the engine conduit which is close to the engine cylinder. The purging fluid has a cooling effect on the hot spot which also helps to prevent undesirable pre-ignition or combustion, and allows the engine indicator to efficiently record the pressure within the engine cylinder.

The purging system which I will describe in greater detail is useful for engine indicators which measure generally all types of internal combustion engines, but which has particular usefulness in the gas-fired, compressed gas type of internal combustion engine. The hot spot develops rapidly in the engine conduit of an indicator attached to a cylinder in this type of internal combustion engine. The rapid development of the hot spot and the increased likelihood of pre-ignition frustrates attempts to measure the pressure within the engine cylinder and may actually damage the engine indicator. The engine indicator, which has been generally described, has other working units and detailed mechanisms which drive and operate such units, but the foregoing are not essential to the practice of the present invention and will be referred to only by reference without detailed explanation or definition.

The source of the purging fluid may be any reservoir, compression chamber or container which stores or maintains such fluid under pressure. The purging and cooling fluid is fed from such a supply into the supply conduit and thereafter into the housing conduit which communicates with the interior of the housing 30. A useful and efficient purging fluid is compressed air and it can be stored in standard cylinders or can be developed by conventional vacuum mechanisms. Any gases may, of course, be used to purge, buffer or drive away the combustible gases but compressed air is economical and widely available. The fluid or the compressed air is desirably introduced into the housing at a sufficiently high pressure so that it quickly enters and scavenges, purges or drives away the hot gases in the interior of the housing and the engine conduit 15. In general, the higher the pressure of the compressed air, the more efficient will be the purging and consequent cooling effect on the hot spot and other areas in the engine indicator.

The compressed air is admitted into the housing only during a period which will be referred to as the "purging cycle." During this purging cycle, the admitted compressed air does not interfere with the pressure responsive operation of the cylinder within the housing because the pressure in the engine cylinder is at its low point, which coincides generally with the suction stroke and the exhaust stroke of the engine cylinder. During the compression stroke in the engine cylinder, the pressure builds up, and this pressure must be recorded by the engine indicator without interference from the purging fluid admitted into the engine indicator. Such accurate recording is made possible by placing a check valve 55 or equivalent means in the housing conduit to automatically close off or block the purging fluid during such pressure build-up, which shall be referred to herein as the "recording cycle." The check valve 55 may be of the spring ball type or the trap door type or any equivalent type, which is designed to automatically close at a particular pressure which is reverse to the flow of the purging fluid. Thus, the unidirectional check valve will allow the purging fluid or compressed air to enter the housing at pressures, say of 250 pounds per square inch during the purg-

ing cycle, and the compressed air will be freely admitted into the housing and the associated engine conduit. In the recording cycle, the pressure will increase until it exceeds a pressure of 250 pounds per square inch. At such a time the calibrated check valve will close and block any further passage of compressed air from the supply source and the supply conduit. The piston within the housing will be free to accurately measure the pressure within the engine cylinder without having its operation interrupted by the compressed air from the compressed air supply. The piston will be displaced in response to the pressure from the engine cylinder and the rod fixed to the piston will accurately move in relation to such displacement. The calibrated spring providing tension against movement of the piston rod permits relatively short movements which are translated and amplified along the recording stylus onto recording cards attached to the recording drum. Such recordings will, of course, sketch a pressure curve that is meaningful in terms of accepted pressure units. It is understood that the magnitude of the purging air pressure will be limited by the compression and firing pressures in the engine cylinder. The purging pressure should not unduly dilute the air-fuel mixture in the combustion chamber. Purging pressures as low as 175 p.s.i. have been found effective on indicators attached to engines having a compression of 560 p.s.i.

If desired, the action of the purging air may be supplemented by external cooling means such as a jacket of circulating water fixed to the housing. Also, the purging gas may be routed to externally placed tubes which are jacketed by cooling means. Ordinarily, there is no need for such external cooling because the purging gas may be properly set and controlled to effectively reduce the hot spot. Adapters may be designed to fit existing indicators and such adapters may have entry ports and fittings to receive a communicating conduit from a pressurized supply of purging gas. Such adapters may be formed as a threaded annulus with appropriate ports and fittings. Other forms and modifications are possible. While the purging gas has been described as introduced into the housing holding the recording piston, this is not necessarily the only point of entry. The purging gas may be introduced into the indicator at other points either directly or by using an appropriate adapter and such purging gas need only be directed to the passageway in the engine conduit intermittently so it can flow against the hot air-gas combustible mixture from the engine cylinder.

The use and operation of my invention are as follows:

My invention allows an engine indicator to accurately record pressures developed within internal combustion engines, such as the spark fired, compressed gas type. The engine indicator is attached in communicating relationship with the interior of the engine cylinder, a zero pressure base line is traced on the recording and, the purging gas is introduced and the communication between the engine cylinder and the pressure responsive piston in the housing of the indicator is completed by opening a cut-out valve 14. The pressure of engine compression is recorded in the usual manner. The hot spot which develops in the engine conduit of the engine indicator is prevented or kept at below pre-ignition levels by the purging system and apparatus.

During the recording cycle, the pressures in the engine cylinder are increased and such increased pressures automatically close the check valve in the communicating conduit 55 so as to effectively block any compressed air or other purging gas from a pressurized supply. Such action prevents any externally introduced purging fluid from interrupting or interfering with the pressure responsive operation of the piston within the housing. The piston now freely and accurately records the pressure from the engine cylinder and the movement of the rod accordingly translates such displacement into acceptable pressure units on the recording rod.

During the suction and exhaust strokes in the engine cylinder, the pressures within the indicator are reduced to levels lower than the pressure of the purging gas from the external pressurized supply. This opens the check valve and allows the purging gas to be admitted into the housing during the purging cycle. Since the engine cylinder is at its low pressure levels during the purging cycles, there is no interruption of the recording procedure of the engine indicator. Such alternate recording and purging cycles are continued as long as desired. The intermittent flow of purging gas is directed against entry of the hot combustible gases into the engine conduit. If the characteristics of a particular internal combustion engine result in a high heat development despite the purging system, then external means may be used to cool the purging gas. In other words, the intermittent purging cycle may be supplemented by externally cooled means.

The foregoing invention can now be practiced by those skilled in the art. Such skilled persons will know that the invention is not necessarily restricted to the particular embodiments presented therein. The scope of the invention is to be defined by the terms of the following claims as given meaning by the preceding description.

I claim:

1. In an engine indicator having an engine conduit joined to a piston cylinder of an internal combustion engine on one end and joined on the other end to a housing containing a closely fitting piston, a rod extending from said piston, a spring providing tension against movement of the rod, said spring calibrated to translate rod movement in terms of pressure units and means to record such pressures in terms of units, a supply of purging fluid, means to admit the purging fluid into the engine indicator at pressures less than recording engine pressures, and means to stop the flow of purging fluid at pressures more than recording engine pressures, whereby said purging fluid does not interfere with the pressure responsive operation of the piston in the engine indicator.

2. The device of claim 1 further characterized in that the supply of purging fluid is admitted into the engine indicator generally at the housing of said indicator.

3. The device of claim 1 further characterized in that the means to admit the purging fluid into the housing consist of a closed conduit.

4. The device of claim 3 further characterized in that the means to stop the flow of purging fluid comprises a unidirectional check valve in the conduit.

5. In an engine indicator having an engine conduit joined to a piston cylinder of an internal combustion engine on one end and joined on the other end to a housing containing a closely fitting piston, a rod extending from said piston, a spring providing tension against movement of the rod, said spring calibrated to translate rod movement in terms of pressure units and means to record such pressures in terms of units, a supply of pressurized purging gas, a conduit connecting said supply on one end and communicating with the interior of the housing at the other end, means in said conduit to permit a unidirectional flow of the purging gas from the supply to the housing, said means permitting the flow of purging gas at periods which generally correspond to the exhaust and intake strokes of the engine, and said means stopping the flow of purging gas at periods which generally correspond to the compression stroke in the engine cylinder, whereby said purging gas does not interfere with the pressure responsive operation of the piston in the engine indicator.

6. The device of claim 5 further characterized in that the supply of purging gas is compressed air.

7. The device of claim 5 further characterized in that the supply of purging gas is compressed air and the means to permit unidirectional flow is a check valve in the conduit.

8. In an engine indicator having an engine conduit

5

joined to a piston cylinder of an internal combustion engine on one end and joined on the other end to a housing containing a closely fitting piston, a rod extending from said piston, a spring providing tension against movement of the rod, said spring calibrated to translate rod movement in terms of pressure units and means to record such pressures in terms of units, a supply of compressed air, a conduit connecting the supply of compressed air and the interior of the housing, a check valve disposed in the conduit, said check valve permitting a flow of compressed air into the housing during periods which generally correspond to the exhaust and intake strokes of the engine, and said check valve stopping the flow of compressed air into the housing when the pressure from the engine cylinder exceeds the pressure of the compressed air flowing in the conduit, whereby said compressed air does not interfere with the pressure responsive operation of the piston in the engine indicator.

9. A method for cooling an engine indicator which communicates with the engine cylinder, said indicator hav-

6

ing pressure responsive means and pressure recording means associated therewith, which includes the steps of cycling purging fluid by delivering purging fluid into the indicator at pressure levels to purge engine gases, introducing said purging fluid into the indicator at low engine cylinder pressures substantially occurring at cylinder intake and cylinder exhaust, automatically stopping the purging fluid when the engine cylinder pressure becomes greater than a predetermined pressure of the introduced purging fluid, said increased pressure occurring at cylinder compression, and recording the engine pressure during such compression.

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20 RICHARD C. QUEISSER, *Primary Examiner.*