March 18, 1930. W. S. HADAWAY, JR 1,751,148

APPARATUS FOR CRACKING OILS

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Fig. 1,

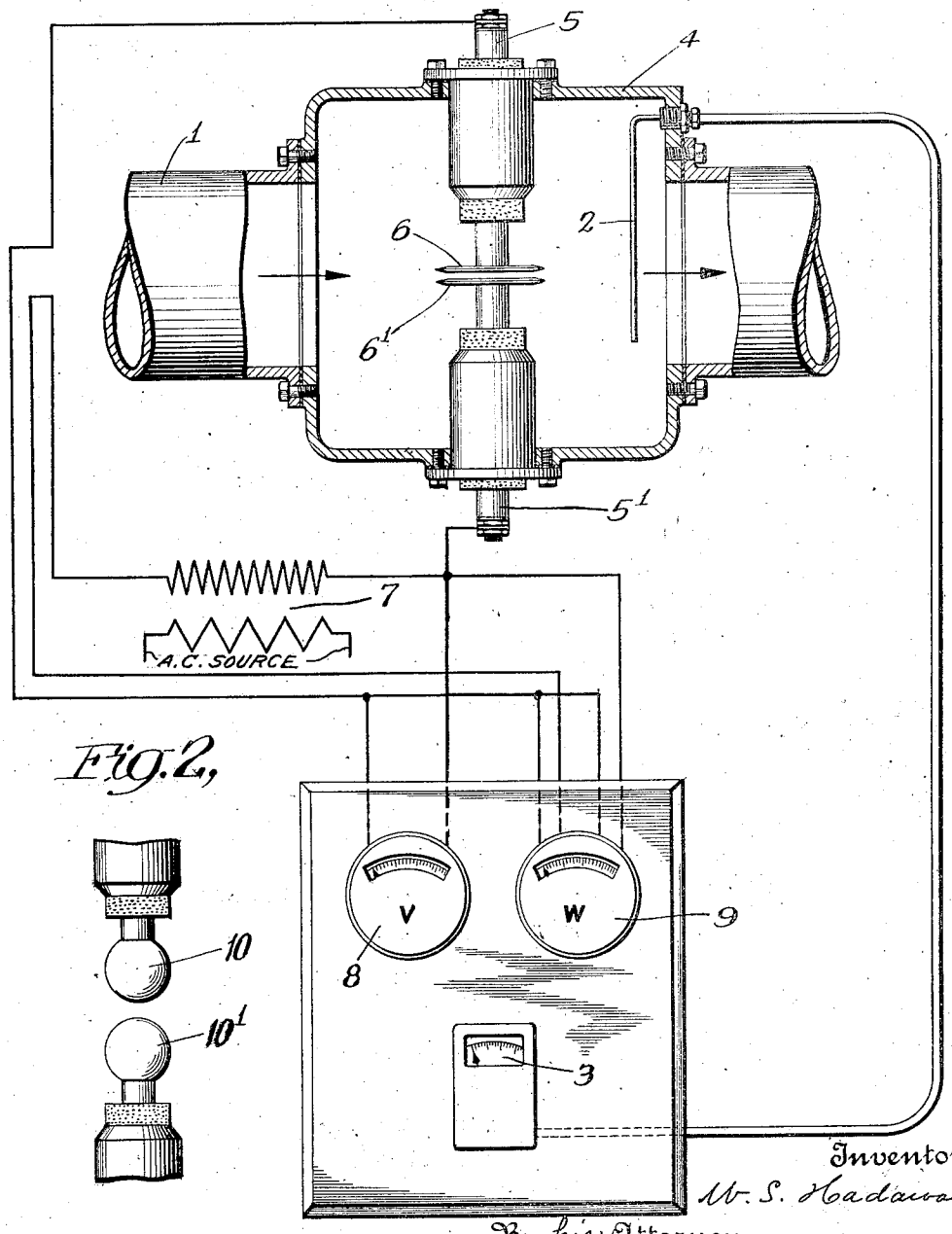


Fig. 2,

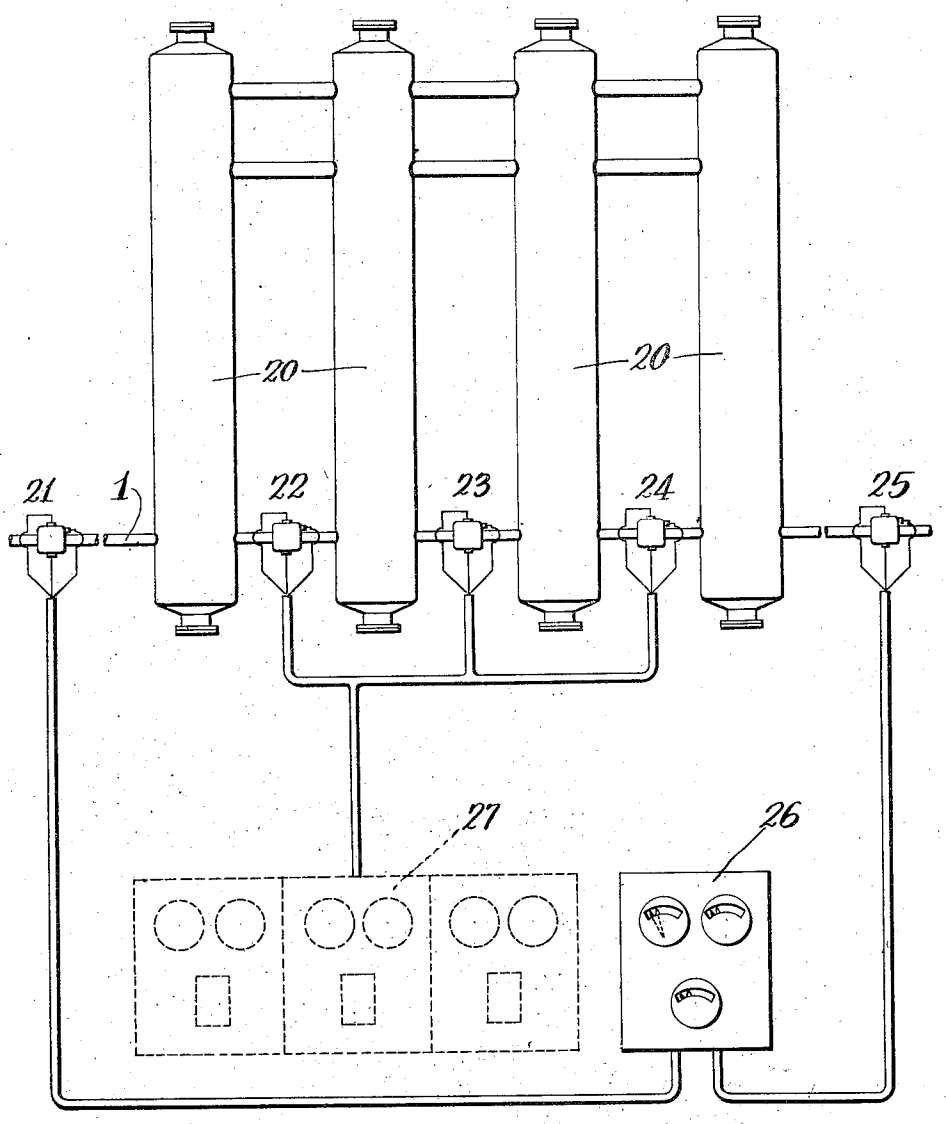
Inventor
W. S. Hadaway,
By his Attorney
R. J. Dearborn

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Fig. 3.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR CRACKING OILS

Application filed August 28, 1925. Serial No. 53,032.

This invention relates to a means for determining the progress of the operation of cracking processes whereby high boiling petroleum or other oils are subjected to decomposition for the production of lower boiling oils such as gasoline. More particularly the invention relates to a means for checking the operation of cracking hydrocarbons by a comparison of the dielectric properties of the oil before and after being subjected to decomposition and cracking in order that the cracking operation may be properly controlled and regulated.

The invention has as an object to indicate the relative quantity of free carbon suspended in the oil during its stay within the cracking system.

A further important object of the invention is to provide a means for determining the degree of cracking or decomposition which is applied to an oil in order that the quantity of free carbon thus formed may not be so great as to cause its deposition in dangerous quantities upon the metal surfaces of the apparatus.

Broadly and generally, the invention contemplates a process of and apparatus whereby the conversion of higher boiling hydrocarbon oils into lower boiling oils may be accurately indicated or determined which comprises passing the oil through a converting apparatus and measuring the dielectric properties of the oil contained therein at predetermined points.

In carrying on the cracking of oils at elevated temperatures there is formed in addition to the lighter products desired, certain heavier products including carbon. As a general rule the longer a given quantity of oil is subjected to cracking conditions, the greater will be the quantity of carbon or coke produced. The cracking operation can be carried on with certain quantities of carbon and coke present without appreciable injury to the metallic surfaces subjected to direct heat. As a run is continued, however, the accumulation of carbon and coke eventually becomes so large as to create liability of grave danger to the apparatus employed, and the difficulty in ordinary practice has been that there is no means of observing the conditions obtaining within the cracking apparatus.

I have discovered that the dielectric properties of oils undergoing cracking or conversion are an index of the quantity of free carbon suspended therein. Generally speaking, a partially cracked oil containing free carbon in suspension will have poorer dielectric properties than the fresh stock charged to the cracking apparatus which will be substantially free from such impurity.

In the practice of the invention by a preferred application, measurement is made of the power absorbed by a given quantity of oil placed between electrodes connected to the secondary leads of a high tension transformer. The power loss across the oil gap is more or less proportional to the free carbon content of the oil. It will be observed that the exact point at which the carbon content may become dangerous must be determined by experiment, as this will depend somewhat upon the design of the cracking apparatus and upon the characteristics of the oil used for charging stock. The invention is particularly adapted for checking the cracking operation by a differential measurement of the dielectric properties of the incoming uncracked charging stock and the partially cracked oil contained in any part of the apparatus, which will indicate most accurately the actual conditions obtaining within the cracking apparatus.

In the attached drawing is shown, more or less in diagrammatic form, apparatus within the invention and suitable for the purpose set forth. In the drawing:

Figure 1 represents, partly in elevation and partly in central vertical section, an indicator consisting of electrodes positioned within a conduit through which the oil which is to be tested is passed.

Figure 2 illustrates in elevation a somewhat different form of electrode which may, under certain circumstances, be more satisfactory than that shown in Figure 1.

Figure 3 illustrates diagrammatically an elevation of a cracking apparatus consisting of four stills connected in series. Electrode

holders are placed at suitable points of the apparatus and connected to indicating instruments upon a central panel wherein the condition of the oil in any portion of the apparatus may be seen at a glance.

Referring to Figure 1, element 1 is a conduit through which a stream of oil, the free carbon content of which it is desired to measure, passes continuously. This conduit may be positioned at the inlet or outlet of the cracking system, or between two cracking stills or at any other point at which knowledge of the carbon content of the oil contained therein is desired. A thermo element 2 serves to indicate the temperature of the oil upon a scale 3. Positioned in the conduit is a metallic casing 4 through which pass the insulated leads 5 and 5^1 which are connected to the electrodes 6 and 6^1. The electrodes are maintained under a difference of potential by being connected to the secondary leads of a step-up transformer 7, the primary of which is connected to a source of alternating current. The energy absorbed by the oil between the electrodes at the given potential difference, indicated on the voltmeter 8, is shown by the wattmeter 9. After calibration in the particular installation for which the instrument is intended, the power loss across the gap between the electrodes 6 and 6^1 is an indication of the quantity of free carbon suspended in the oil.

Referring to Figure 2, the spherical form of electrodes 10 and 10^1 shown therein may, in certain cases and in connection with certain types of cracking apparatus, be found more suitable than the flat disk electrodes shown in Figure 1.

The application of the indicator as a differential measure of the free carbon content of oils within different portions of a cracking apparatus is shown in Figure 3 where a series of connected cracking stills are represented by the numeral 20, and indicators placed at positions 21, 22, 23, 24 and 25 show the condition of the oil at the entrance to the apparatus 21 during its flow through the apparatus, between the different stills 22, 23, and 24 and finally at its exit from the apparatus at 25. The instruments at 26, consisting of voltmeters, wattmeters and thermometers indicate the power loss and the corresponding relative free carbon content of the oil before and after cracking at 21 and 25 while the instruments shown by the dotted lines at 27 indicate the condition of the oil as it flows through the successive stills.

With such an application of the invention to a cracking apparatus, the conditions of the oil within any part of the apparatus may be clearly seen at a glance and the flow of oil through the apparatus and other conditions bearing upon the operations may be so adjusted as to provide that the optimum degree of cracking may take place.

Obviously many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. An apparatus for measuring the free carbon content of oil in a cracking apparatus which comprises electrodes positioned within the cracking apparatus and submerged in the oil, said electrodes being maintained at a difference of electrical potential, and means for measuring the electrical energy absorbed by the oil between the electrodes.

2. An apparatus for measuring the relative quantity of free carbon suspended in oil contained within more or less widely separated parts of a cracking system which consists of two or more indicators positioned at predetermined points within the cracking system, each indicator comprising electrodes submerged within the body of the oil and maintained at a difference of electrical potential with respect to each other, and means for comparing the quantity of electrical energy absorbed by the oil between the electrodes of each of the indicators.

In witness whereof I have hereunto set my hand this 22nd day of August, 1925.

WILLIAM S. HADAWAY, JR.