

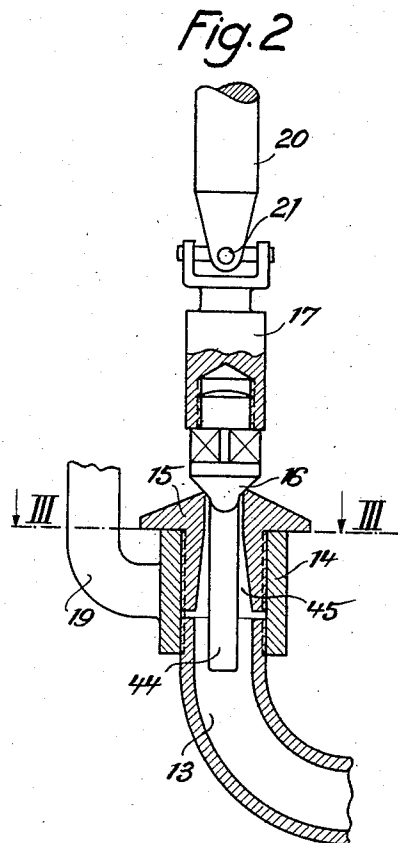
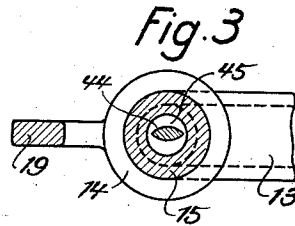
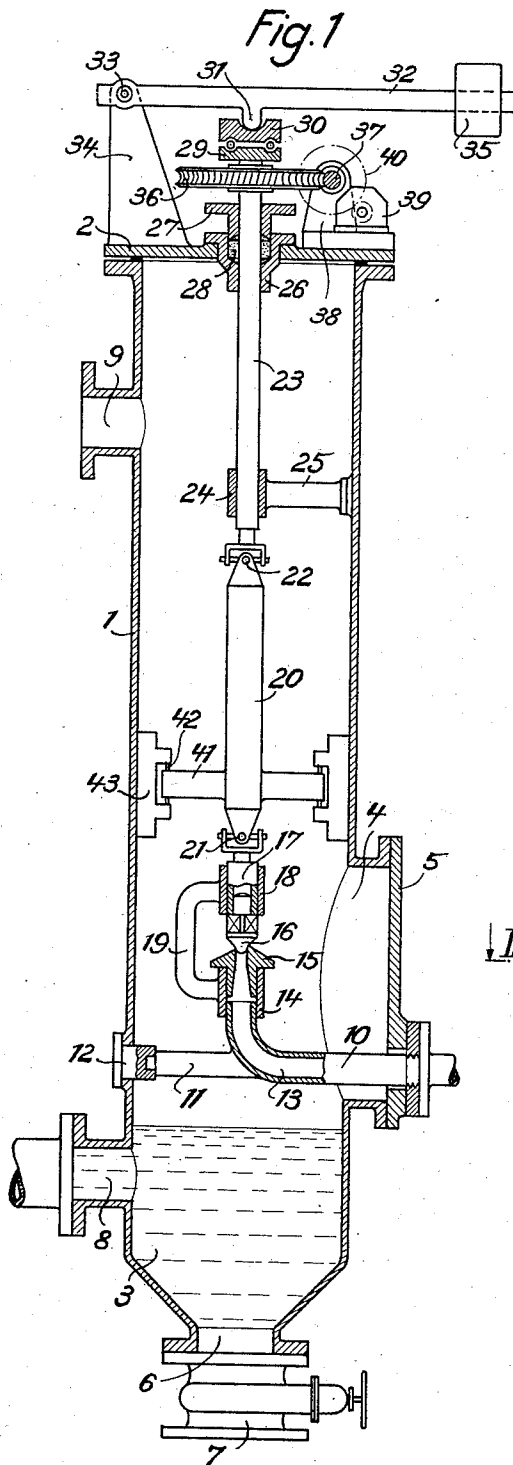
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APPARATUS FOR THE EXPANSION OF HYDROCARBONS FOR CRACKING AND DISTILLATION

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## APPARATUS FOR THE EXPANSION OF HYDROCARBONS FOR CRACKING AND DISTILLATION

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For carrying out cracking and distillation of liquid hydrocarbons, such as petroleum and petroleum products, tars and tar oils from lignite and pit coals etc., it is usual to heat the oils in heating tubes under pressure to cracking or distillation temperature, and after they have left the heating furnace to expand them, by means of a valve having a suitably loaded valve cone, to low pressure. Such expansion valves when in operation have the drawback that at the moment of expansion of the oils heated under pressure, separation of carbon occurs which settles particularly in the immediate vicinity of the valve opening as a coke-like deposit and thereby chokes the passage openings of the pressure piping closed by the valve cone and also prevents the free movement of the valve cone.

The object of the invention is to overcome the aforesaid drawbacks and this is done by the valve cone being designed as a member capable of being set in rotation about its centre axis. One form of construction consists, for instance, in that the valve cone is prolonged into a spindle which is in the form of a rotatable shaft and on which the load for pressing the valve on to its seat acts. In this arrangement the shaft may be prolonged to such an extent that its end remote from the valve cone is carried out of the expansion chamber and outside the latter is connected with gearing which maintains the rotation.

In a modified embodiment of the invention, on the valve cone extending in the direction of its centre axis, there is fitted a knife-like scraping device which protrudes slightly into the valve seat and into the connected pressure piping.

According to another embodiment of the invention, the housing forming the expansion chamber, in the region of the valve at the places where the impinging expansion jet tends to produce tightly adhering deposits of carbon, etc., is in the form of a rotating member concentric with the axis of the valve, for instance a circular cylinder, and on the shaft carrying the valve cone scrapers are fitted in such a manner that they constantly scrape the aforesaid parts of the inner sides of the wall of the housing and thereby keep them clear.

Fig. 1 of the drawing shows a vertical axial section of an example of one construction of the apparatus according to the invention;

Fig. 2 represents mainly a part of the apparatus according to Fig. 1 on an enlarged scale, and

Fig. 3, which is a horizontal section along the line III—III of Fig. 2, shows a modification.

In Fig. 1, 1 denotes a vertical cylindrical housing

closed at the top by the lid 2, and having a lateral manhole 4 closed by a lid 5. In the bottom 3 of the housing is an opening 6 adapted to be closed by a stop valve 7. At the bottom part of the housing 1 there is provided a pipe connection 8 for the supply of liquid hydrocarbons and at the upper part a further pipe connection 9 for the discharge of mainly vaporous expansion products.

At the manhole 5 there is attached the delivery piping 10 for the supply of the liquid hydrocarbon oils coming from the heating oven and which are under high pressure. An extension 11 on the pipe 10 engaging with the member 12 inserted in the housing 1 serves to secure and exact support on the side opposite the lid 5. Inside the housing 1 the delivery pipe 10 is bent round vertically upwards so as to form an elbow 13, at the upper end of which (see also Fig. 2) the jacket 14 which carries the valve-seat member 15 is fitted. The centre axis of this valve seat 15 is located centrally in the cylindrical housing 1. On the valve seat 15 there rests the actual valve cone 16 which is screwed into the lower tubular end of a short shaft 17 in such a manner as to be exchangeable, and for this purpose its middle part is square, as can be seen in Figs. 1 and 2. The shaft member 17 is guided in a bearing 18 which is firmly connected to the sleeve 14 by an arm 19 and thereby held exactly in central position.

The upper part of the shaft member 17 is connected with a shaft 20 in line with its axis by a universal joint 21. The upper end of the shaft 20 is connected by a similar universal joint 22 with a further shaft 23 forming the upper prolongation of the valve spindle.

The lower part of this shaft is supported by the bearing 24 which is attached to the housing 1 by means of the arm 25. The upper part of the shaft 24 is supported and guided by the member 26 of a stuffing box fixed in the lid 2. The member 27 of this stuffing box packs the shaft or spindle 23 and seals the opening at this point by means of the packing 28. The top end of the shaft 23 which protrudes from the lid 2 is in the form of a ball bearing 29, on the non-rotatory upper disc 30 of which there presses the projection 31 of the one-armed lever 32, the pivotal axis 33 of which is supported on the bracket 34 mounted on the lid 2, and which is loaded at the opposite, free end by the adjustable weight 35.

Below the ball bearing 29, on the shaft 23 is attached a worm wheel 36 which meshes with a worm 37 which is mounted in a bracket 38 on the lid 2. The drive is provided by a small elec-

tro-motor 39 (likewise supported by the bracket 38) by means of the spur-wheel gearing 40.

The aforesaid vertical shaft 20 arranged between the universal joints 21 and 22 carries a plurality of arms 41 to which by means of hinges 42, scrapers 43 are fitted in such a manner that they rest against the inner wall of the housing 1 and thus when rotated scrape off any deposit which may tend to be firmly attached to this inner wall. The height of these scrapers 43 is so selected that they sweep over the parts of the housing wall struck by the expansion jet ejected from the valve seat 15, as these are the parts where deposits are particularly liable to be formed.

The modification according to Figs. 2 and 3 is characterized in that the valve cone 16 in its downward axial prolongation, carries a scraper 44 which in cross-section, as shown in Fig. 3, is formed as knife-like, double-edged member. This scraping knife 44, as may be seen in Fig. 2, protrudes a certain distance into the central channel 45 of the valve seat 15 and into the delivery pipe 13, in prolongation of it, and on rotation of the valve cone 16, serves to keep continuously clear of deposit this part of the passage-way for the highly compressed oils from the heating oven which is located immediately in front of the opening closed by the valve cone 16.

After detachment of the valve cone 16 from the shaft member 17, made possible by the screw-threaded connection between them, the entire valve assembly 15, 16 (together with the delivery pipe 10, 13) may be removed through the man-hole 4 and, if necessary be replaced.

In operation, the loading exercised by the weight lever 32, 35 on the shaft 23 and, therefore, finally on the valve cone 16, is adjusted to such a value that under the valve cone 16, i. e. in the delivery piping 13 and in the valve seat 15 the pressure under which the hydrocarbon oils to be treated are to be constantly kept is maintained. When cracking is effected, pressures of about 50 atm. and more, for instance up to approximately 80 atm., may be used.

Now while the oils heated, for instance, to 400 to 500° C., under the aforesaid pressure are delivered through the piping 10, 13 to the valve 15, 16 for the purpose of expansion, the valve cone 16 is kept in continuous rotation by means of the worm gearing 36, 37 by the motor 39 and the intermediate gearing 40. The insertion of the two universal joints 21 and 22 ensures that any slight deviations of the centre axis of the valve shaft 17 and the upper shaft 23 shall not produce any disadvantageous effects on the free movement of the valve cone both in respect of its vertical movement and also its rotation. The highly compressed oils which are delivered are expanded by the valve 15, 16 for instance to atmospheric pressure, whereby the major part thereof is vaporized and a residue of liquid oil constituents and of solid carbon-like constituents are carried over in vapour form. The vapour jets impinge on the inner wall of the housing 1 approximately at the places which are swept by the scrapers 43. The latter ensure that deposits, mainly of carbon or viscous pitch-like constituents, are removed. The mixture of expansion products consisting of vapours and mist, is carried off through the pipe connection 9 for further treatment, for instance fractionation. Such non-vaporous constituents which fall by gravity to the bottom of the housing 1 are collected in

the lower space 3 of the housing below the man-hole 4 and are discharged periodically through the opening 6 and the valve 7.

The above-described continuous rotation of the valve cone 16 according to the invention ensures that deposits of carbon are prevented from forming at the outlet of the valve seat 15 and in the immediate vicinity of the valve cone 16, or if they have already been formed, that they are removed. This effect can be further improved by the modification shown in Figs. 2 and 3 by means of the scraper 44, as the latter keeps the inner channel 45 and the delivery pipe 13 free from deposits of carbon. When the liquid which has collected in the bottom part 3 of the housing 1 has reached such a level that it covers the valve seat 15, the injector-like suction action of the expansion jets can then be utilized to drive, through the lower lateral pipe connection 8 from a storage vessel (not shown in the drawing), any liquid hydrocarbons, for instance fresh raw material or products of the aforesaid fractionation of the expansion products, into the expansion chamber. The cooling and rinsing effect produced by such additional oils on the valve 15, 16 is suited to assist in keeping the latter free from deposits of carbon. The oils which are sucked in injector-wise are in this case discharged partially together with the expansion vapour and mists through the pipe connection 9.

When the interior of the housing 1 is made sufficiently large to ensure a marked reduction of the speed of flow of the expansion jet, this alone can cause from the outset a reduction of the deposit of carbon and pitch constituents on the walls of the housing 1 and assists them to fall into the bottom part 3 of the housing.

In such cases the scrapers 43 provided on the valve shaft 20 are unnecessary.

The continuous rotation of the valve cone, which is an essential feature of the invention, can naturally be produced by means other than those described above without departing from the scope of the invention. Thus, for instance, instead of the worm mechanism 36, 37 a ratchet mechanism or a friction wheel mechanism may be used. Further, the rotation mechanism may be fitted inside the housing 1, for instance by providing a turbine fitted to the shaft 20 which is driven by the jets of expanding vapours from the valve 15, 16.

What I claim is:

1. Apparatus for the expansion of hydrocarbons after heating under pressure for cracking and distillation thereof, comprising in combination an expansion chamber, an inlet and outlet therefor, a pipe connected to said inlet and supported in said chamber, a valve seat in said pipe, a valve member adapted to rest on said seat to close said inlet, a spindle connected to said valve closure member and slidably supported in said chamber, an intermediate shaft section, a universal joint connecting said spindle and said intermediate shaft section, a driving shaft, a universal joint connecting said intermediate shaft section and said driving shaft, means for rotatably supporting said driving shaft in said chamber, means for loading said valve member and driving means connected to said driving shaft to effect rotation thereof.

2. Apparatus for the expansion of hydrocarbons after heating under pressure for cracking and distillation thereof, comprising in combination an expansion chamber, an inlet and outlet therefor, a pipe connected to said inlet and sup-

ported in said chamber, a valve seat in said pipe, a valve member adapted to rest on said seat to close said inlet, a spindle connected to said valve closure member and slidably supported in said chamber, an intermediate shaft section, a universal joint connecting said spindle and said intermediate shaft section, a driving shaft, a universal joint connecting said intermediate shaft section and said driving shaft, means for rotatably supporting said driving shaft in said chamber, means for loading said valve member, driving means connected to said driving shaft to effect rotation thereof, and a knife-edged scraper fixed to said valve member and protruding into said pipe.

3. Apparatus for the expansion of hydrocarbons after heating under pressure for cracking and distillation thereof, comprising in combination an expansion chamber, an inlet and outlet therefor, a pipe connected to said inlet and supported in said chamber, a valve seat in said pipe, a valve member adapted to rest on said seat to close said inlet, a spindle connected to said valve closure member and slidably supported in said chamber, an intermediate shaft section, a universal joint connecting said spindle and said intermediate shaft section, a driving shaft, a uni-

versal joint connecting said intermediate shaft section and said driving shaft, means for rotatably supporting said driving shaft in said chamber, means for loading said valve member, driving means connected to said driving shaft to effect rotation thereof, and scraper members fixed to said shaft to rotate therewith, said scrapers engaging with the sides of said chamber.

4. Apparatus for the expansion of hydrocarbon after heating under pressure for cracking and distillation thereof, comprising in combination an expansion chamber, an inlet and an outlet therefor, a pipe connected to said inlet and supported in said chamber for conducting hydrocarbon under pressure to said chamber, a valve seat on said pipe, a valve member adapted to rest on said seat to close said inlet, a freely slidable shaft rotatably supported in said chamber, a universal joint connecting said shaft and said valve member, a scraper fixed to said valve member and protruding into said inlet pipe, and driving means connected with said shaft to effect rotation of the shaft, valve member, and scraper whereby said valve seat and inlet pipe are kept free from residual deposits.

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