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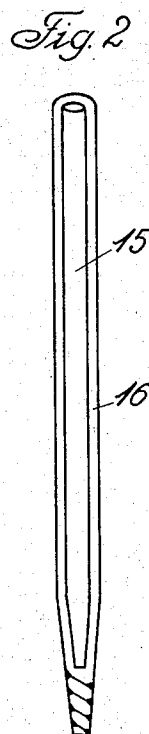
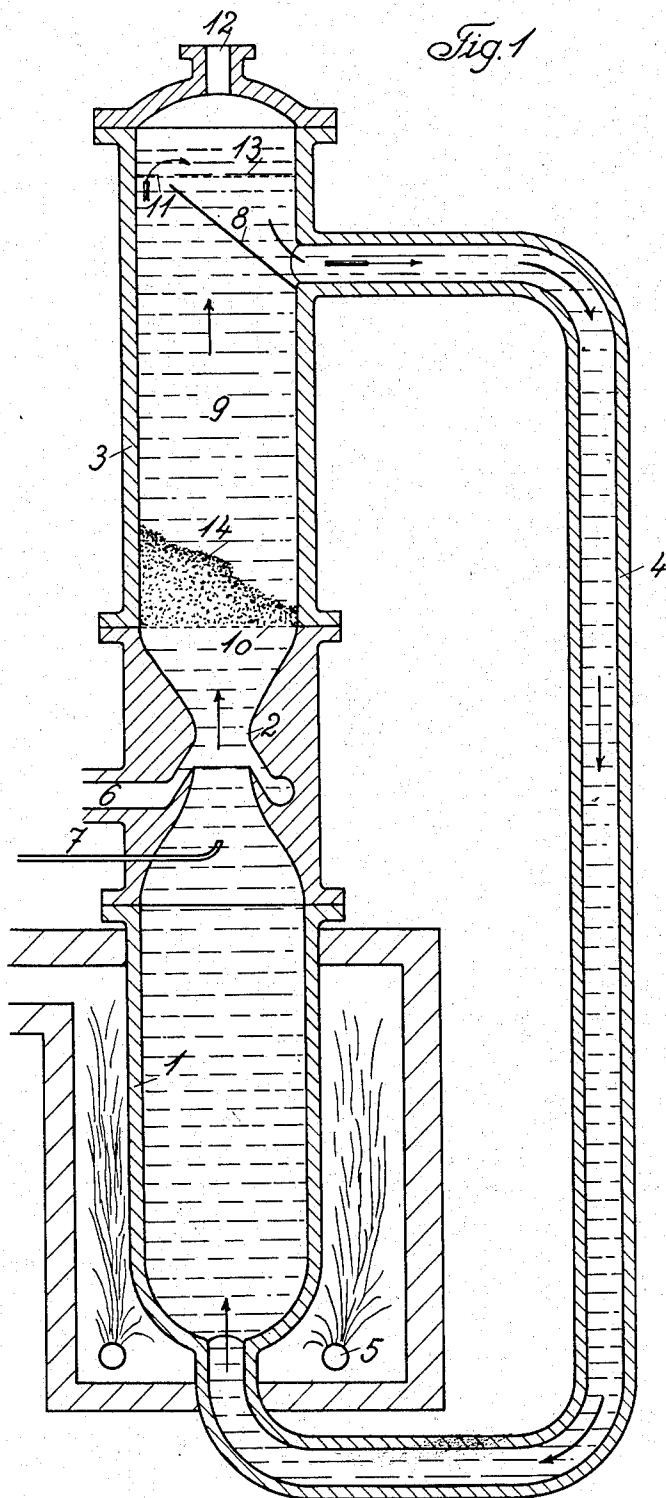
T. SEIFER

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METHOD OF AND MEANS FOR CRACKING HYDROCARBONS IN A METAL BATH

Filed Sept. 25, 1928

4 Sheets-Sheet 1



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Sept. 12, 1933.

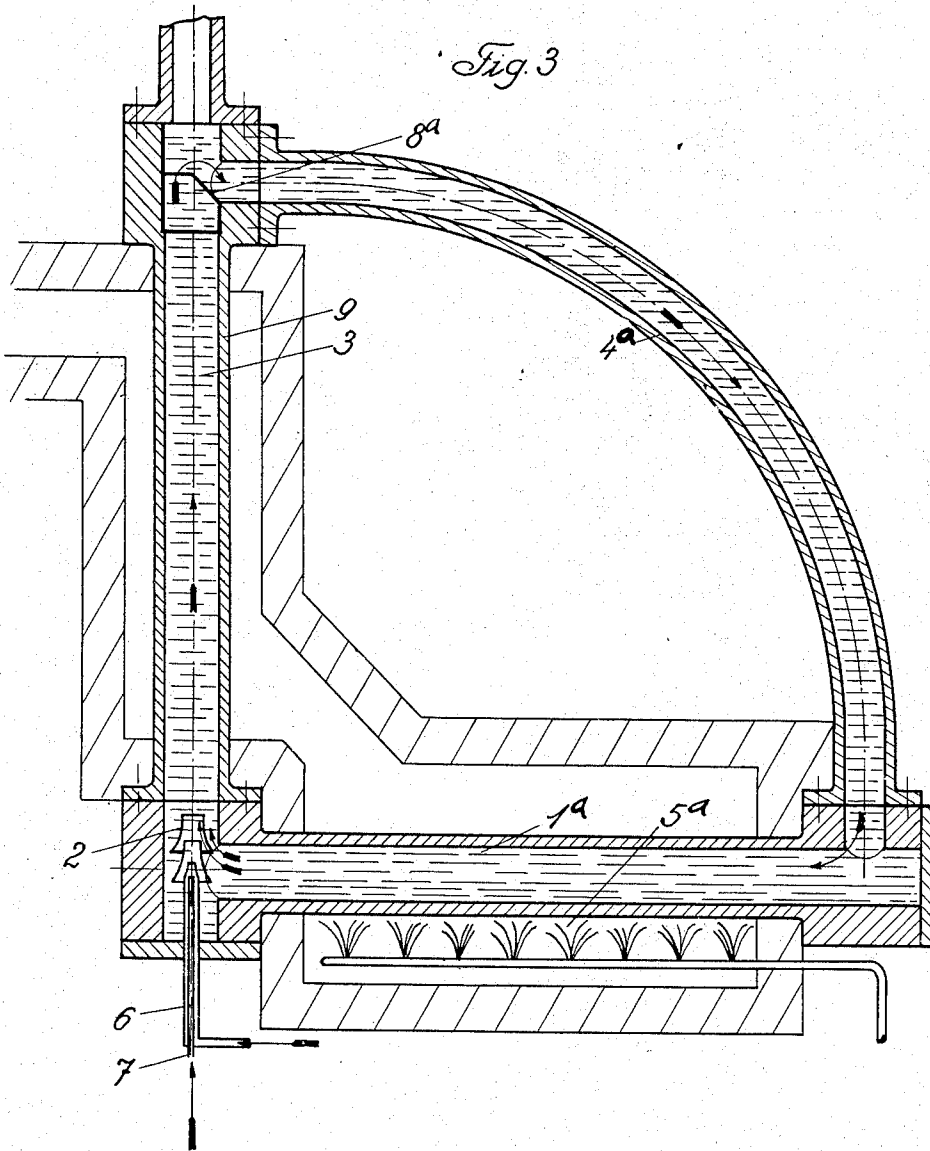
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Fig. 4

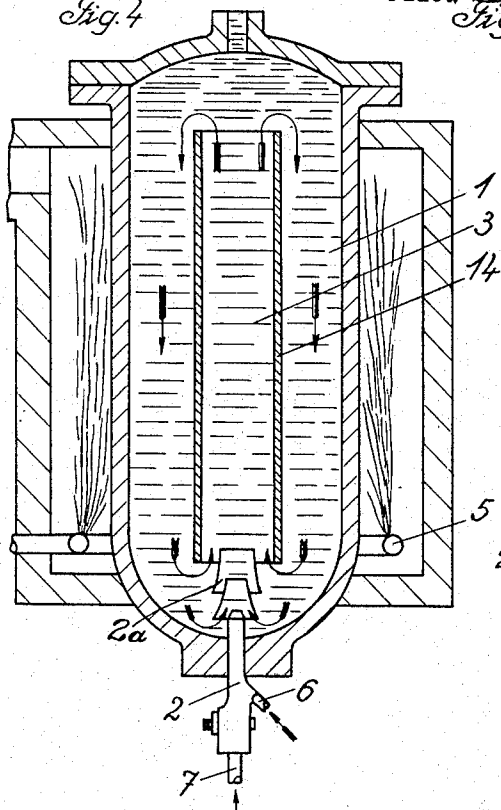


Fig. 5

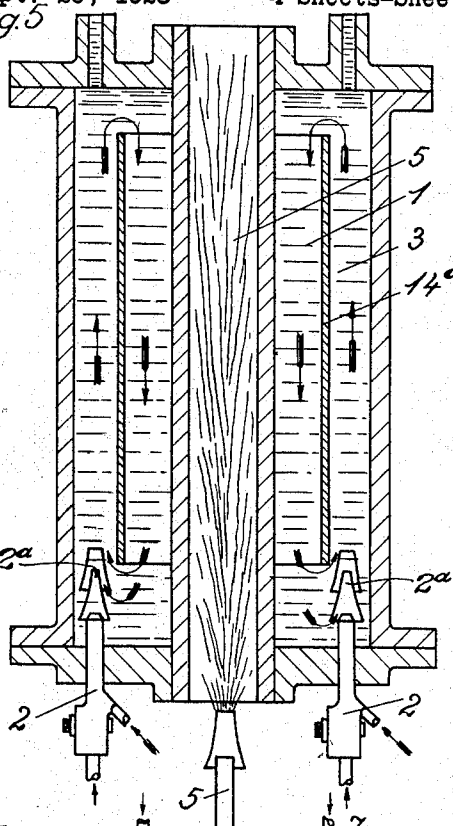


Fig. 6

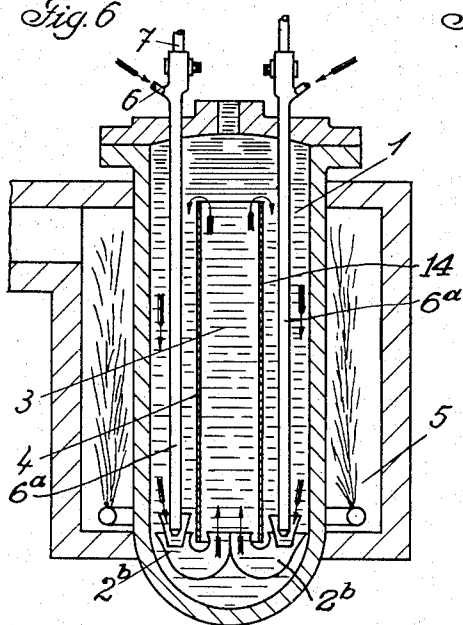
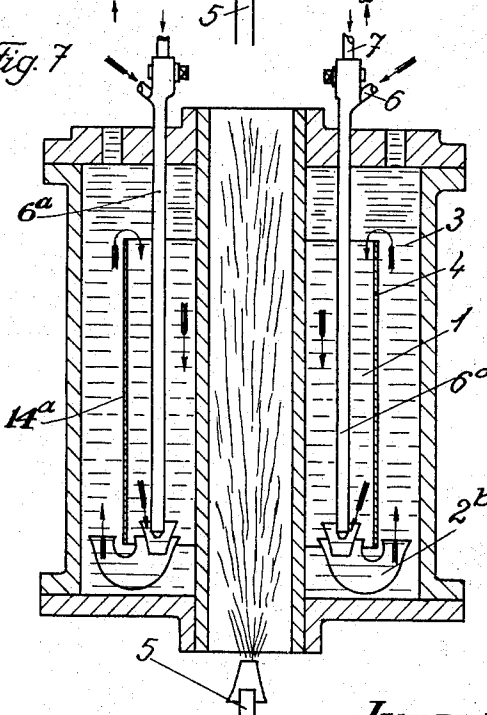


Fig. 7



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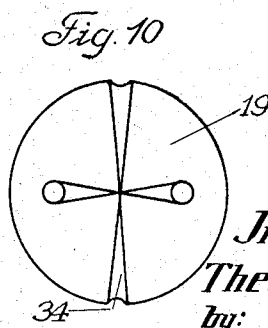
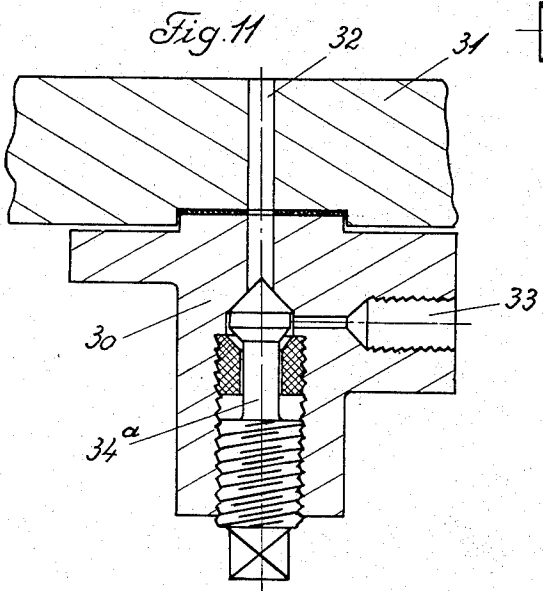
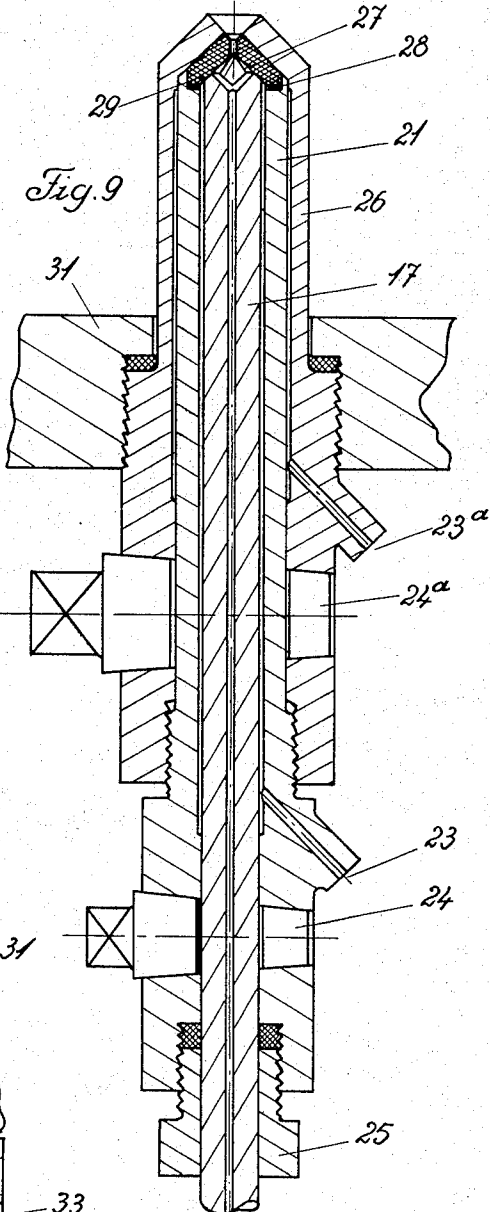
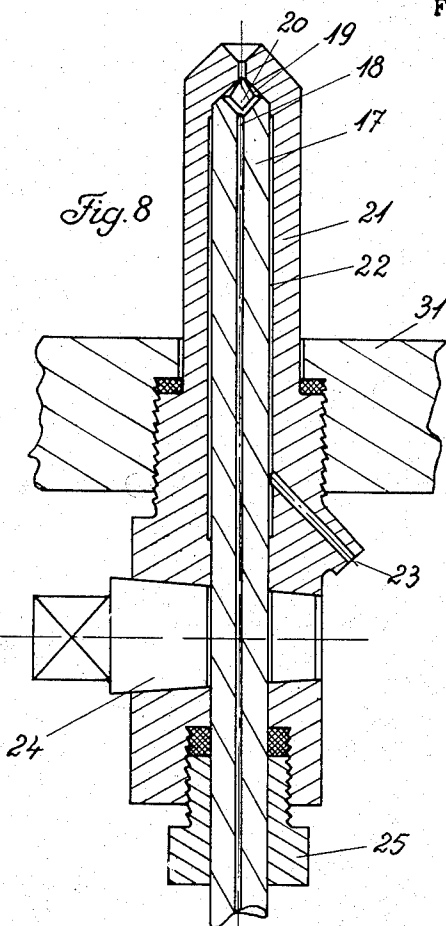
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UNITED STATES PATENT OFFICE

1,926,563

METHOD OF AND MEANS FOR CRACKING
HYDROCARBONS IN A METAL BATH

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Application September 25, 1928, Serial No.
308,315, and in Germany September 30, 1927

5 Claims. (Cl. 196—70)

It is known to crack hydrocarbons in molten metals or molten salts.

The actions taking place in the molten substance require a constant temperature which must be possibly high, and uniform at all parts of the space in which the process is being carried out. Maintaining these conditions is, however, connected with great difficulties.

Now, according to the present invention a constant and uniform temperature can be maintained by subdividing the vessel containing the molten substance into a heating space and a treating or reaction space, and by providing a circuit on or through which the molten substance can pass from the one space to the other, and so on. The substance can be kept passing through said circuit by differences of temperature, as well as by mechanical means. In the first of these cases the heating space must lie lower than the reaction space, whereas in the other case the two spaces may lie above or below one another, or side by side, or the one may concentrically surround the other.

If the compound to be treated is introduced into the apparatus under a certain over-pressure and in that direction in which the molten mass is to pass through the circuit that over-pressure and the momentum it imparts to the mass can be used as propelling or conveying means, but it is also possible to make use of an additional propelling or conveying means, for instance of a compressed gas, which may be used either alone or together with said over-pressure. The tube or other member or means through which the compound to be treated is introduced into the molten mass already present in the spaces or chambers can be designed at its end either as a simple injection nozzle or as a jet-apparatus.

If an auxiliary propelling or driving agent is employed, such as a compressed gas, it is suited to the purpose to make use of two co-axial tubes, of which the one is located within the other and forms a tubular passage with it, the compound or mass being then supplied through the inner tube and the compressed gas through the outer tube, i. e. through said tubular passage, and in counter-current to the compound or mass. The temperature of the gas is kept on such a degree that obstruction of the orifice of the inner tube, for instance by separated carbon when oil is cracked, is prevented with perfect certainty.

It is also possible to attain an excellent cracking of the hydrocarbon when this latter is supplied under a suitable over-pressure or with the aid of an auxiliary agent under pressure; the

surface of the mass will thereby be enlarged and the transmission of the heat promoted.

If only the thermodynamic circuit is used, or if this circuit and a mechanical conveying means are used together, the hydrocarbon must be introduced into the space or chamber of the apparatus at the bottom of the same so that it rises within the molten mass contained in the respective chamber. If, however, the thermodynamic circuit is not employed, the direction of the mass in the circuit can be reversed.

With the known method the compound can be supplied through the cover of the respective chamber, and the supply tube can be straight down to its orifice, where there are provided, on the bottom of the chamber, curved guide members by which the direction of the mass is changed by about 180°, or the supply tube itself can be bent by about 180° near its orifice so that the mass assumes a corresponding other direction when it escapes from the said tube. The freshly supplied mass is also in these cases driven upwardly within the molten mass already contained in the respective chamber.

It, however, is advantageous to insert the supply tube into the apparatus, or autoclave respectively, at or near the bottom thereof, because in this case only a short piece of said tube lies in the molten mass and only little heat can pass over to the mass in the supply tube before its escape therefrom. If an auxiliary agent under pressure (compressed gas) is used and the two tubes are arranged coaxially in the manner already described (the compound passing through the inner tube and the gas under pressure through the outer one), it is possible to prevent any heating of the freshly supplied mass prior to its entering into the already molten mass, and it is in this case possible to make use of dispersing nozzles permitting a very fine distribution, but getting obstructed if even quite little solid foreign bodies are separated from out of the hydrocarbon when it becomes hot.

The heating means are, in this case, arranged preferably in such a way that that place of the autoclave where the supply tube is connected up to it lies remote from the heating means and outside of them.

Another constructional development of the apparatus consists in making the device supplying the compound to the autoclave exchangeable, or detachable respectively, in such a manner, that it can be taken out of the autoclave without the necessity of depriving the latter of its pressure or making any other change at it. This is at-

tained, according to the invention, by arranging the supply tube tightly and slidably in a hollow cylinder connected with the autoclave and provided with a shutting-off member, with the aid of which said hollow cylinder can be closed prior to withdrawing the supply pipe from the said cylinder.

It is also suited to the purpose to design the supply pipe as a spindle or a needle provided with a channel or passage, or with a plurality of such ones, that channel or channels being subdivided into finer channels or passages at the conically shaped point of the spindle or needle, these latter channels meeting again about in the axis of the needle so that the individual jets push upon one another and are very finely atomized thereby. In the hollow cylinder surrounding the spindle or needle a correspondingly shaped conical tightening face is provided against which the needle is pressed when it is in its working position.

In order to render it possible to clean and exchange said tightening face, the hollow cylinder can be arranged in another hollow cylinder of suitable size which is and remains connected with the autoclave when the supply needle and the hollow cylinder surrounding it are exchanged, and which can close the autoclave as it is provided with a separate shutting-off member which is closed before the inner cylinder is withdrawn from the outer one.

It is also possible to arrange two or more supply devices in one autoclave and to work alternately with the one and the other, while that supply device which is useless at the time being is exchanged so that no interruption of the service takes place.

If the lower part of the pressure vessel is not subjected to heating it is possible to arrange in that lower part a device for supplying and for withdrawing the molten mass, so that it is no more, as hitherto, necessary to lift the entire autoclave out of the furnace and tilt it.

The invention is illustrated diagrammatically and by way of example on the accompanying drawings on which Figure 1 is a vertical section through a device or an apparatus designed according to this invention. Figure 2 shows a detail drawn to an enlarged scale. Figure 3 is a vertical section through a modified apparatus, and the Figures 4-11 show some more modifications, all as fully described hereinafter.

Referring to Fig. 1, 1 denotes the heating space and 2 the supply device which is designed as a jet apparatus, as is the case also in the constructional forms shown in Figs. 3-7. 3 denotes the treating space, and 4 is a tube connecting the spaces 3 and 1 with one another. 5 denotes the heating means provided in the heating space or furnace, 6 denotes a passage for supplying an auxiliary conveying agent under pressure, and 7 is the pipe through which the liquid substance to be treated is introduced into the apparatus.

8 is an oblique plate by which the separation of the molten mass from the treated or, may be, not sufficiently treated liquid is promoted. 9 denotes the inner surface of the chamber 3, 10 a sieve located between this chamber and the jet apparatus 2 and supporting a filling material, as shown, and 13 is another sieve located just above the oblique plate 8. The mixture passes through the meshes of this sieve into the uppermost part of the vessel 3 in which the molten mass separates from the specifically lighter components of the mixture and gets down upon the plate 8 from

which it passes into the tube 4 and back to the chamber 1, whereas the heated oil and, may be, also the conveying agent under pressure passes away through the branch 12.

In Fig. 2 the passage and the pipe 7 of Fig. 1 are combined with each other, that is to say, the oil pipe 15 is surrounded with the pipe 16 through which the auxiliary conveying agent is supplied. The end of the pipe 16 is tapering and there are in it a groove having the shape of a few threads of a screw so that the oil carried along with, and away by, the respective agent is very thoroughly whirled through and atomized.

Another combination of the two tubes is shown more in detail and drawn on an enlarged scale in Fig. 8, in which 17 denotes a needle-like inner tube through which the oil is supplied, and 21 denotes a sleeve-like tube forming between itself and the tube or needle 17 a tubular space through which the auxiliary conveying and atomizing agent is supplied. The needle 17 is pointed at its free end 19 and there are in this pointed end a few channels 20 which first diverge and then converge. The diverging channels communicate with the bore 18 of the needle 17, and the tubular space between the members 17 and 21 communicates with a channel 23 through which the respective auxiliary agent is supplied. The needle 17 passes through the transverse bore of a plug 24 and the lower, enlarged part of the tube or sleeve 21 serves as casing for said plug. This casing-forming part and the plug form together a cock, and when the needle 17 is drawn out of the sleeve and casing in downward direction, after the stuffing box stopper 25 has been unscrewed, the plug 24 can be turned whereby the cock will be closed.

In Fig. 9 the members 17, 21, 24 and 25 are practically the same as in Fig. 8, but not the member 21 is inserted into the wall 31, but a separate tubular and sleeve-like part 26 is inserted into said wall, and the lower end of this part forms also a casing for a plug 24^a, the bore of which is so large that both members 17 and 21 can extend through it, as shown. When they are withdrawn, the plug 24^a is closed. The sleeve 21 is provided with a separate head 27 of conical shape, and a packing ring 28 is provided with this head and the sleeve. The head 27 is kept in proper position upon the sleeve by an annular projection 29 into which it is inserted.

Figure 3 is distinguished from Fig. 1 practically chiefly by the chamber 1^a and the burner 5^a being located horizontally instead of vertically. The members 2, 6 and 7 require no detailed description in view of what has been described with respect to Fig. 1. It is, however, to be seen from Fig. 3 that all spaces of the apparatus are filled with the molten salt or metal. The arrows indicate the direction in which the respective substance is driven through the apparatus.

Reverting to Fig. 8, a plan-view of the conical head 19 of the needle 17 is shown in Fig. 10 and drawn to a greatly enlarged scale. 35 denotes the diverging channels which communicate at their inner ends with the bore 18 (Fig. 8), and 34 denotes the converging grooves on the conical top face.

Concerning the manner of operation of the constructional forms shown in Figs. 1 and 3, the circulating molten substance, which is continually heated in the chamber 1 by the burner 5 is, in the upper part of the apparatus, cooled down by the liquid introduced through the pipe 7, in 150

consequence whereof the cooled part of the substance when arriving at the top of the apparatus and entering into the pipe 4 passes down through this tube by reason of its higher specific weight.

5 The circuit is, therefore, maintained thermodynamically. The two constructional forms illustrated in Figs. 1 and 3 can do without a separate mechanical agent under pressure, although such a one may be used, if desired, but the constructional forms shown in Figs. 4 and 5 cannot do without a separate agent for the purpose mentioned, as will be dealt with more fully when describing these modifications in detail.

10 Reverting to Fig. 8 I still mention that when the needle is to be withdrawn it is withdrawn for the first only so far that its pointed top lies just below the plug 24. Then this plug is turned so as to close the cock, and now the needle is completely removed from the device. If the construction is accurately that shown in Fig. 8, viz. with the tubular channel 22, gas under pressure may be introduced through the branch 23 while the needle is withdrawn so that the molten mass is prevented from entering into the space above the needle. If the device has no such tubular space, the molten mass will fill the space above the needle when this is being withdrawn, and is later on forced back into the apparatus when the needle is re-introduced into the device, the needle acting then like a piston and the sleeve 21 like a cylinder.

15 All this is true also of Figure 9 which, as regards the just-mentioned points, can certainly be understood without a more detailed description. The only point requiring particular mentioning is that that only the plug 24 need be turned when only the needle 17 is to be removed, and that only the plug 24* need be turned when the whole injection device is to be removed.

20 In Fig. 4 the chamber 3 is formed by a vertical tube 14 arranged centrically in the chamber 1, and the vessel forming this chamber is located in a furnace in which it is heated on all sides by the burner pipe 5. The liquid is introduced through the pipe 7 and the auxiliary agent through the pipe 6. Both pass through nozzles 2* whereby the mixture is propelled in a circuit, as indicated by the arrows.

25 In Fig. 5 the arrangement of the parts is the inverse, in that the heating takes place in the centre of the apparatus and the tube 14 which is considerably larger than in Fig. 4 is located between the outer wall of the heating tube and the inner wall of the casing enclosing all parts, as shown. There are in this case preferably at least two nozzles or sets of nozzles 2*, but also more than two may be used in order to obtain a possibly uniform circulation up and down in the circuit which is that indicated by the arrows.

30 Fig. 6 resembles Fig. 4, but there is this difference that the supply of the liquid to be treated and the auxiliary propelling agent takes place not from above, but from below. There are in this case two oppositely located supply pipes, or sets of pipes, which are considerably longer than in Fig. 4 in that they must extend nearly to the bottom of the apparatus, as shown. The same relation exists between the Figs. 5 and 7. There are in both cases (Figs. 6 and 7) provided hollow semicircular guide members by which the direction of the mixture of the liquid and the gas issuing forth from the pipes 8* is reversed, as is at the same time the direction of the molten mass propelled by the respective auxiliary agent.

35 With respect to Fig. 9 I emphasize the point that this constructional form renders it possible to provide the tube 21 with a separately manufactured pointed head such as 24 which can now be made of another material than the tube, viz. of a high-grade material having a very great natural hardness which is not in the least affected even by particularly high temperatures. The top member 24 is held fast very firmly between the needle 17 and the tube 21 on the one side and the sleeve 26 on the other side. Cutting a screwthread into it or any similar working procedure is not requisite. The tube 21 and the sleeve 26 can be manufactured, however, from an easily workable material, also if the liquid is supplied under a very high pressure, say about 300 atm. This high pressure becomes active only in the needle 17 and in the top member 27, the auxiliary propelling agent passing through the tubular spaces between the parts 17 and 21, and 21 and 26, may have a lower pressure.

40 The cylindrical member 14, Figs. 4 and 6, as well as 14*, Figs. 5 and 7, consists preferably of a refractory material or the like, which is a possibly bad conductor of heat; this is useful for promoting the movement of the molten mass in and through the circuit.

45 Concerning, finally, Fig. 11, this shows a valve 34* arranged in a member 30 attached to the bottom 31 of the apparatus and provided with passages 32 and 33. The passage 32 can be closed by said valve, it is open as long as the molten mass is introduced into the apparatus, and closed when this latter has been filled, and it is again opened when the apparatus is to be emptied.

I claim:

1. An apparatus for cracking hydrocarbons in a metal bath, comprising, in combination, a chamber adapted to receive the metal that is to form the bath; means for heating that metal and to keep it in melted state; another chamber so arranged relatively to the first-mentioned chamber as to be adapted to receive the melted metal from this chamber; a jet apparatus located between said chambers and having its delivery opening directed towards the said first-mentioned chamber; and a circuit-establishing connection between that end of the first-mentioned chamber where the cracked hydrocarbon and the liquid metal separate from one another and that end where the continually supplied fresh hydrocarbon is entering the liquid metal.

2. The method of cracking hydrocarbons in a metal bath, consisting in introducing the hydrocarbon to be cracked into the metal bath at one end thereof in the form of a jet; withdrawing the cracked hydrocarbon from the metal bath at the other end thereof; withdrawing also the liquid metal at the place where it and the cracked hydrocarbon separate from one another; and driving it by the kinetic energy of the continually supplied fresh hydrocarbon back to the place where this hydrocarbon enters into the bath.

3. The method of cracking hydrocarbons in a metal bath, consisting in introducing the hydrocarbon to be cracked into the metal bath at the lower portion thereof in the form of a jet; withdrawing the cracked hydrocarbon from the metal bath at the upper portion thereof; withdrawing also the liquid metal at said upper portion of the bath; and driving it by the kinetic energy of the continually supplied fresh hydrocarbon back to the lower portion of said bath.

4. The method of cracking hydrocarbons in a

metal bath, consisting in introducing the hydrocarbon to be cracked into the metal bath at one end thereof in the form of a jet; and introducing at the same end also a permanent gas also in the form of a jet, said two jets combined having a kinetic energy adapted to drive the liquid metal to the opposite end of the bath; withdrawing the cracked hydrocarbon from the metal bath at said other end of the same and withdrawing also the liquid metal itself from the bath at this end and driving it by said kinetic energy outside of the bath back to the place where the continually supplied fresh hydrocarbon and the likewise supplied permanent gas enter the bath.

5. The method of cracking hydrocarbons in a metal bath consisting in introducing the hydrocarbon to be cracked into the metal bath at one end thereof in the form of a jet and using the kinetic energy of the hydrocarbon as means for driving the liquid metal of the bath to the other end thereof and through a circuit commencing at said other end and terminating near the place where the continually supplied hydrocarbon is introduced into the metal bath; withdrawing the cracked hydrocarbon at the said other end of the metal bath and withdrawing at the same place also the liquid metal and driving it outside of the bath into and through said circuit, substantially as set forth.

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