PATENT SPECIFICATION

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2595

COMPLETE SPECIFICATION.

Improvements in and relating to Plants for Carrying Out Gaseous Catalytic Reactions at High Temperature and Pressure.

I, GEORGES LÉON EMILE PATART, Civil Engineer, 50, rue Spontini, Paris, France, a citizen of the French Republic, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Since the recent development of the synthetic manufacture of ammonia, numerous systems have been brought out wherein the reacting gases, employed at high temperature and pressure, may be subjected to the action of the catalyzers. Following the recent discovery that like synthetic methods can be employed for the obtainment of methanol and of other organic compounds containing oxygen, by the reduction of oxides of carbon, the construction of numerous plants of an analogous nature is to be expected. But the plants which have been hitherto constructed offer numerous drawbacks concerning the cost of erection as well as the difficulties inherent in the handling and regulation, or in short in the general operation of the plant.

This invention relates to a plant for carrying out such gaseous catalytic reactions at high temperature and pressure chiefly adapted for the synthesis of methyl alcohol and other compounds which can be obtained by reduction of the oxides of carbon.

The plant according to the invention comprises one or more substantially horizontal tubes containing the contact mass and in which the catalytic reaction takes place and a row of gas burners for each tube for heating outwardly over the whole or a suitable part of their length, the inlet pipe conveying the reacting gases to each tube being wound around the latter in contiguous spiral turns so as to constitute a conducting envelope for protecting the tube from the direct contact of the flame of the burners.

The advantage afforded by the horizontal disposition is that all parts of the apparatus are accessible from the ground floor of the building; this greatly reduces the height of the building and the cost of the installation, and rolling cranes at a great height as is the case when vertical tubes are used are no longer needed; further the heating is facilitated—as will be further set forth—and the plant can be operated in a much more convenient manner.

It has been contended against this disposition that an unequal distribution of the contact mass within the tubes results therefrom and it is apprehended that the mass will collect by its own weight at the lower part of the tubes, and that the gas will thus flow solely through the upper part of the latter. But it has been stated that this apprehension of an imperfect contact between the catalyzer and the gas, which latter would too easily flow through the upper part of the chamber, is quite unfounded in view of the high speeds of diffusion of the hot gases.

The use of an external gas combustion device to maintain the proper temperature if the catalyzing chamber also affords important advantages. The electric heating devices in current use, which are almost the only ones employed with the vertical catalyzing tubes, are of a very expensive operation. If they are disposed within the catalyzing tube there is a great difficulty in the electric insulation at the inlet and the outlet of the high pressure chamber; it is further noted that the wear or rupture of the insulation is of frequent occurence, and the plant must be frequently stopped for such reasons. Further the electric heating means are little adapted for

the intense heating which is required to start the plant, so that this is a slow operation.

In order to obviate local overheating of the catalyzing tube, the plant is so arranged that the admission piping for the reacting gas shall entirely surround the catalyzing tube upon which it is wound. It will thus form a heat recovery device, provided the gas is circulated in the said conduit in the contrary direction to the one which it follows in the catalyzing tube. Since the various spiral turns of the conduit or pipe are wound in close contact with one another, the tube will be entirely protected against local overheating, due to the great speed of flow of the gas in the said pipe. The gas admission conduit, before entering the catalyzing tube, is preferably disposed in worm shape in the chimney serving for the discharge of the heating gas, whereby the major part of the heat of the discharge gas will be recovered.

It has been already proposed to provide an apparatus for carrying out catalytic reactions, wherein the vapour produced by heating one of the reacting bodies in a boiler or evaporator, is passed to a horizontal burner tube or tubes containing catalytic material, and provided with regulatable inlet ports to admit the other reacting gaseous body for admixture with such vapour at a point adjacent to the catalytic material, and characterised in that a helical coil or coils of piping is or are arranged to surround the burner tube or tubes at a section or sections thereof at which heat is produced in operation of the apparatus, and through which coil or coils the vapour aforesaid is constrained to pass on its way to the burner tube or tubes. But, in this known apparatus, the spiral turns of the coil are not contiguous and no gas burners are provided. The coil tube in which the vapor is caused to flow is adapted to afford the pre-heating of the vapor by means of the heat developed in the tube. In the plant according to the invention, the coil tube comprises contiguous spiral turns so as to protect the catalytic tube from the direct contact of the burner flame.

In another known plant for carrying out catalytic reactions between gases and or vapors, means are provided for heating the reaction chamber or chambers and consist of a casing and hood surrounding the horizontal chamber or chambers, and adapted to be heated by gas. Herein, no means are provided for protecting the reaction chambers from the direct contact of the combustion flame.

Another feature of the invention resides in that the catalytic substance, or contact mass, is contained in a removable cylindrical case which is loaded with the said substance in a separate workroom in which it is placed vertically; suitable amounts of the substance are successively placed in the case, these being separated from each other by partitions consisting of discs placed transversally, which are specially perforated, certain discs being perforated at the central part and other discs near the periphery, the said disc preventing all displacement of the contact mass, especially if care is taken to employ a central rod extending axially through the said case, the two end-plates being pressed by screwing at the ends of the rod. The case and its contents form a cartridge which can be inserted by easy friction into the catalyzing tube, and are held at the ends by the pressure of the two covers of the tube, so that the gas will not leak between the tube and the cartridge without flowing through the catalyzer. The said cartridges are brought, when in the horizontal position, in line with the ends of the catalyzing tube, upon a suitable rolling truck, and they are moved axially upon rollers disposed upon the said truck.

I am aware of an apparatus for carrying out catalytic reactions, which comprises horizontal tubes, contained in a housing heated by gas burners, the catalyst being disposed in semi-cylindrical troughs movable within said tubes, but I do not claim that as my invention.

The condensing apparatus consists of a horizontal rectangular chamber in which the discharge tube for the gas is disposed in an elongated worm shape; the said tube opens into a vessel serving to collect the synthesized liquid, and the said liquid can be withdrawn from the vessel by a pipe placed at the bottom.

The plant is deprived of any heat recovery device by which the reaction products are caused to leave a part of their sensible heat to the reagents. It has been observed that, all things considered, the recovery of heat from the reaction products offers less economy than what theory would lead to expect, due to the cost inherent to all recovery devices.

The appended drawing shows an arrangement which may be adopted for the above-described apparatus, this being given solely by way of example and being susceptible of numerous modifications without departing from the spirit of the invention, which latter consists in the use of the features above set forth.

In this drawing, Fig. 1 is an elevation with partial vertical section of the plant and Fig. 2 is a corresponding partial plan view.

As observed in the drawing, the reacting gases enter at 1 and flow in a worm tube 2 disposed in the chimney 21 serving for the discharge of the heating gases. The gas admission pipe is then wound in contiguous turns 4—4 upon the whole length of the catalyzing tube 7. At the end of said tube, the admission tube rises and enters at 5, 5, into the central part of the rear cover of the catalyzing apparatus; the tube then opens within the distributing chamber 6, and the gases then flow through the contact mass which is maintained at various points by the perforated discs 8, 8. The gases attain the chamber 9 at the other end of the tube, and issue therefrom at 10, proceeding directly into the worm condenser 11 and issuing at 12, thence flowing at 13 into the vessel 14 which serves to collect the liquid, the latter being withdrawn at 17. The uncondensed gas is discharged at 15.

The temperature is regulated by the row of gas burners 19 which heat directly the admission tube 4 and are disposed only upon the part of the catalyzing tube corresponding to the intake of the gas. The combustion gases therefrom are discharged at 20 and through the chimney 21 and are never in actual contact with the catalyzing tube.

The catalyzing cartridge 7 consists of a thick tube of metal or other suitable substance and is brought upon the truck 22 rolling by means of its wheels 23 on the rails 24 which may be so disposed that the cartridge will be exactly in line with its allotted space in the catalyzing tube, and it is pushed into said tube by rolling upon the tapered rollers 25 mounted on the top of the truck.

The catalyzing apparatus is mounted upon a brick foundation whose height is such as to afford an easy access to all the parts. The condenser and the liquid collecting vessel may be disposed to the side of the brick foundation. When issuing from the said vessel at 15, the gases may proceed to a circulation pump, or to a second catalyzing apparatus like the apparatus 7. The whole portion of the apparatus through which the hot gas flows may be surrounded with a heat-protecting covering. Pyrometers may be inserted through both covers of the tube to provide for the control of the admission of the heating gas to the different burners of the series so that the temperature will not differ appreciably in the tube between the inlet and outlet of the gas.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

Plant for carrying out gaseous catalytic reactions at high temperature and pressure, comprising one or more substantially horizontal tubes containing the contact mass, and in which the catalyzing reaction takes place, and a row of gas burners for each tube for heating outwardly over the whole or a suitable part of their length, the inlet pipe conveying the reacting gases to each tube being wound around the latter in contiguous spiral turns so as to constitute a conducting envelope for protecting the tube from the direct contact of the flame of said burners.

2. Plant according to Claim 1 wherein the initial gases are heated by the burnt gases from the burners, before circulating around the catalyzing tube.

3. Plant according to Claim 1 wherein, in each tube, the contact mass is contained in a removable case so as to form a cartridge fitting in a fluidtight manner within said tube and preferably clamped between the two end plates of the tube.

4. Plant according to Claim 3 wherein said cartridge is subdivided by perforated partitions at right angle with the axis, the spaces between said partitions being entirely filled with the contact mass.

5. Plant according to Claim 4 wherein the whole formed of the said partitions and the contact mass is maintained by screwing the end partitions upon a suitable rod extending axially through the cartridge.

6. Plant for carrying out gaseous catalytic reactions at high temperature and pressure substantially as described and as shown in the accompanying drawing.

Dated this 12th day of May, 1926.

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2nd Edition

Fig.1

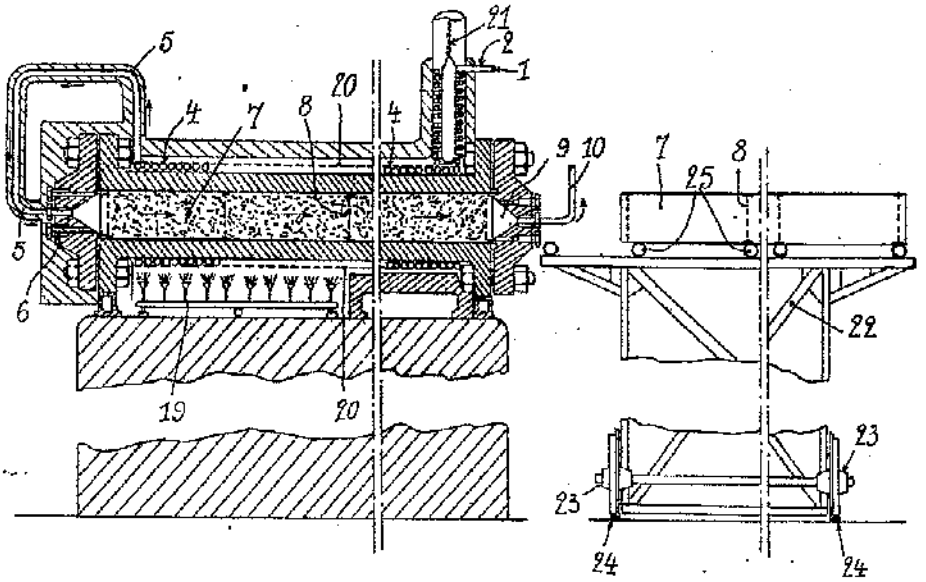
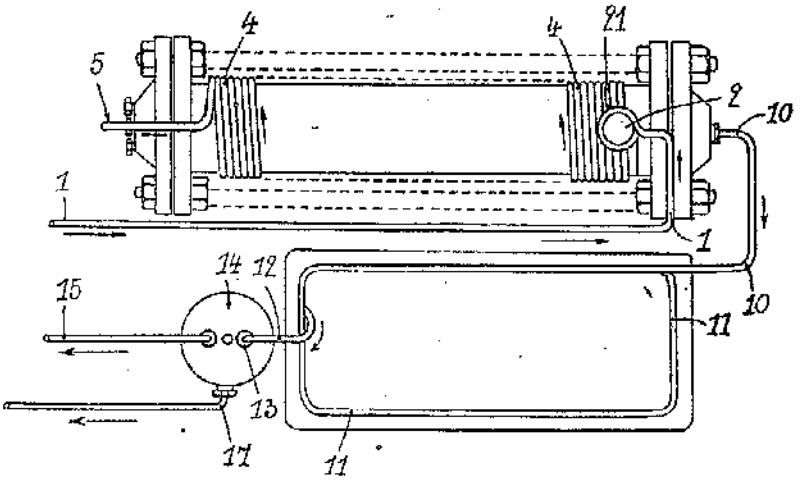


Fig.2



[This Drawing is a reproduction of the Original on a reduced scale.]

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