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F. LENNARD.

METHOD OF AND APPARATUS FOR DISTILLING TAR, &c.

No. 499,557. Patented June 13, 1893.

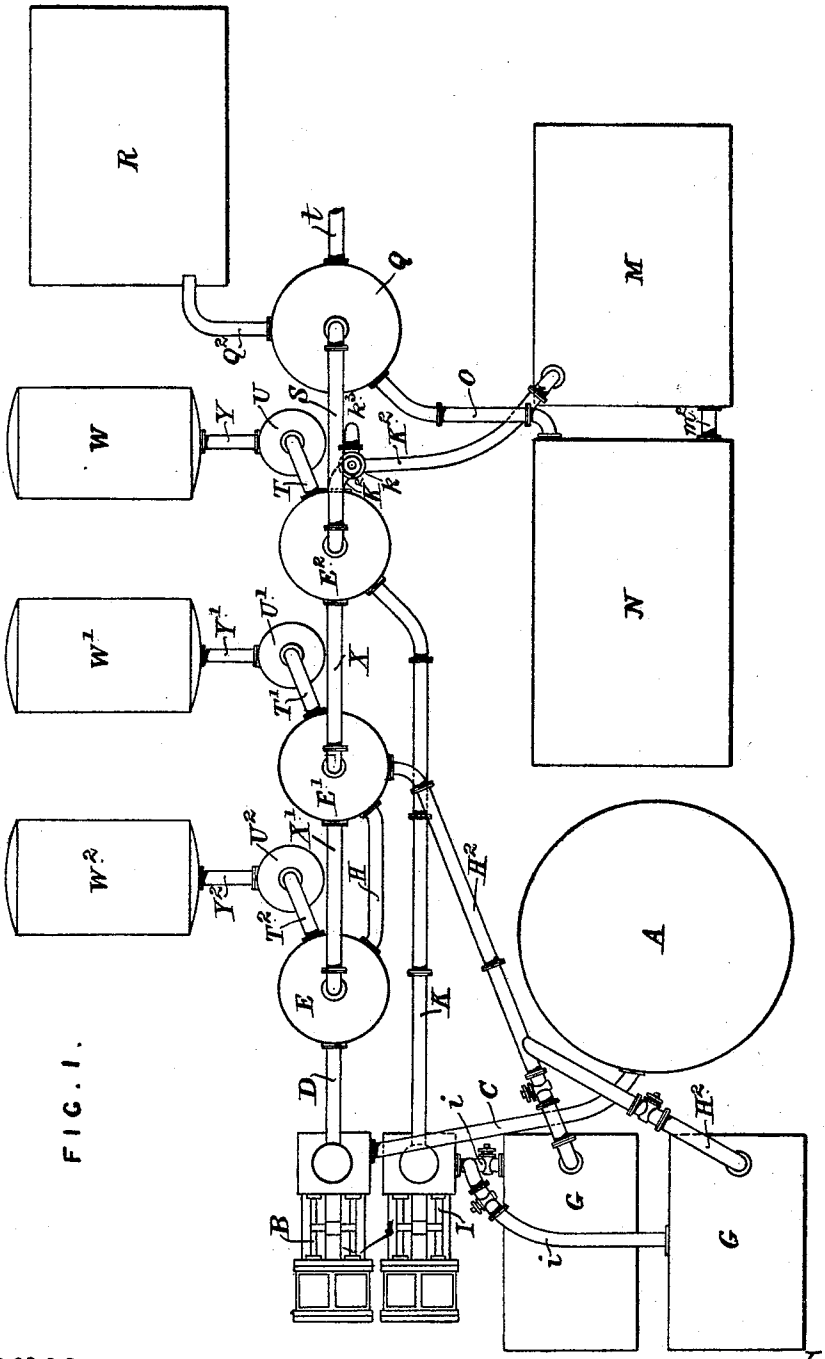

FIG. 1.

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FIG. 2.

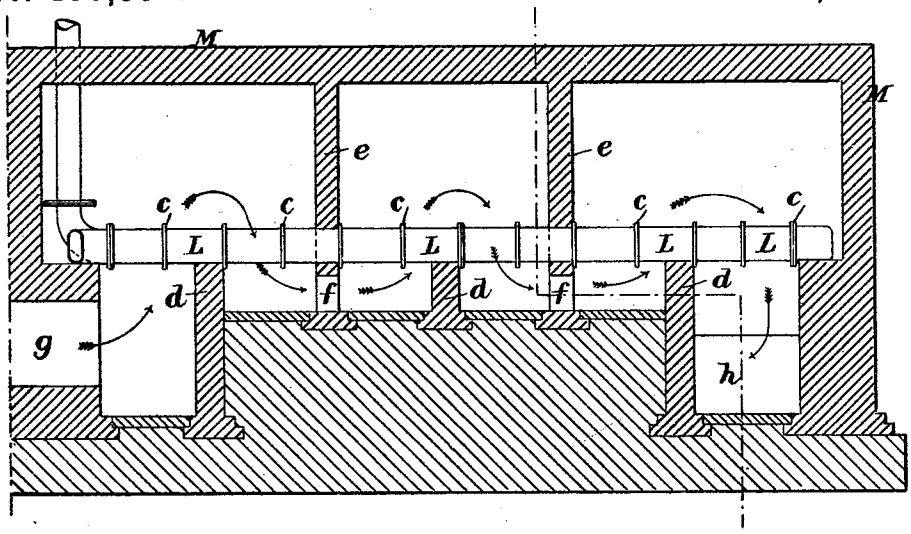

FIG. 3.

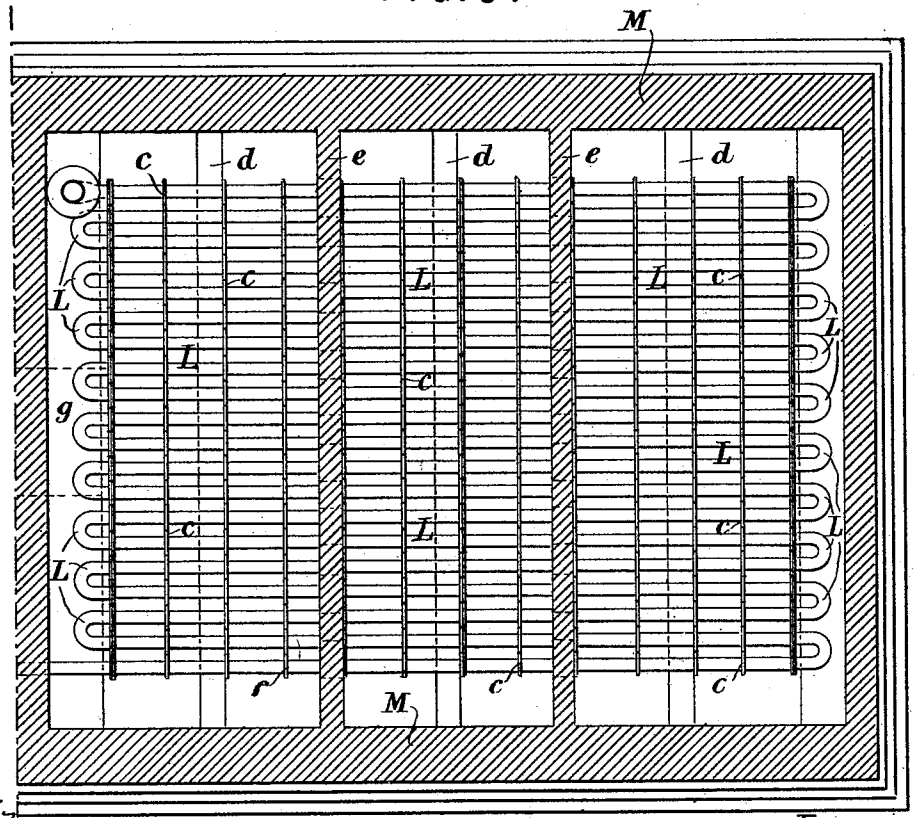

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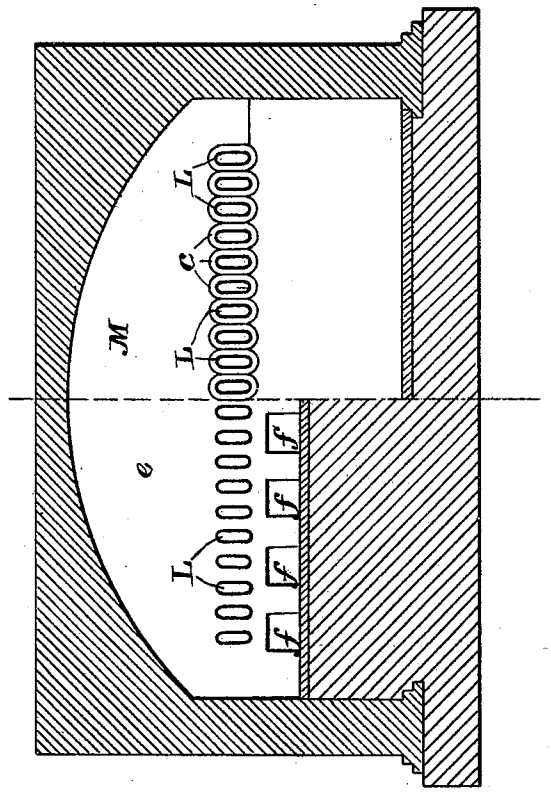
FIG. 4.



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METHOD OF AND APPARATUS FOR DISTILLING TAR, &c.

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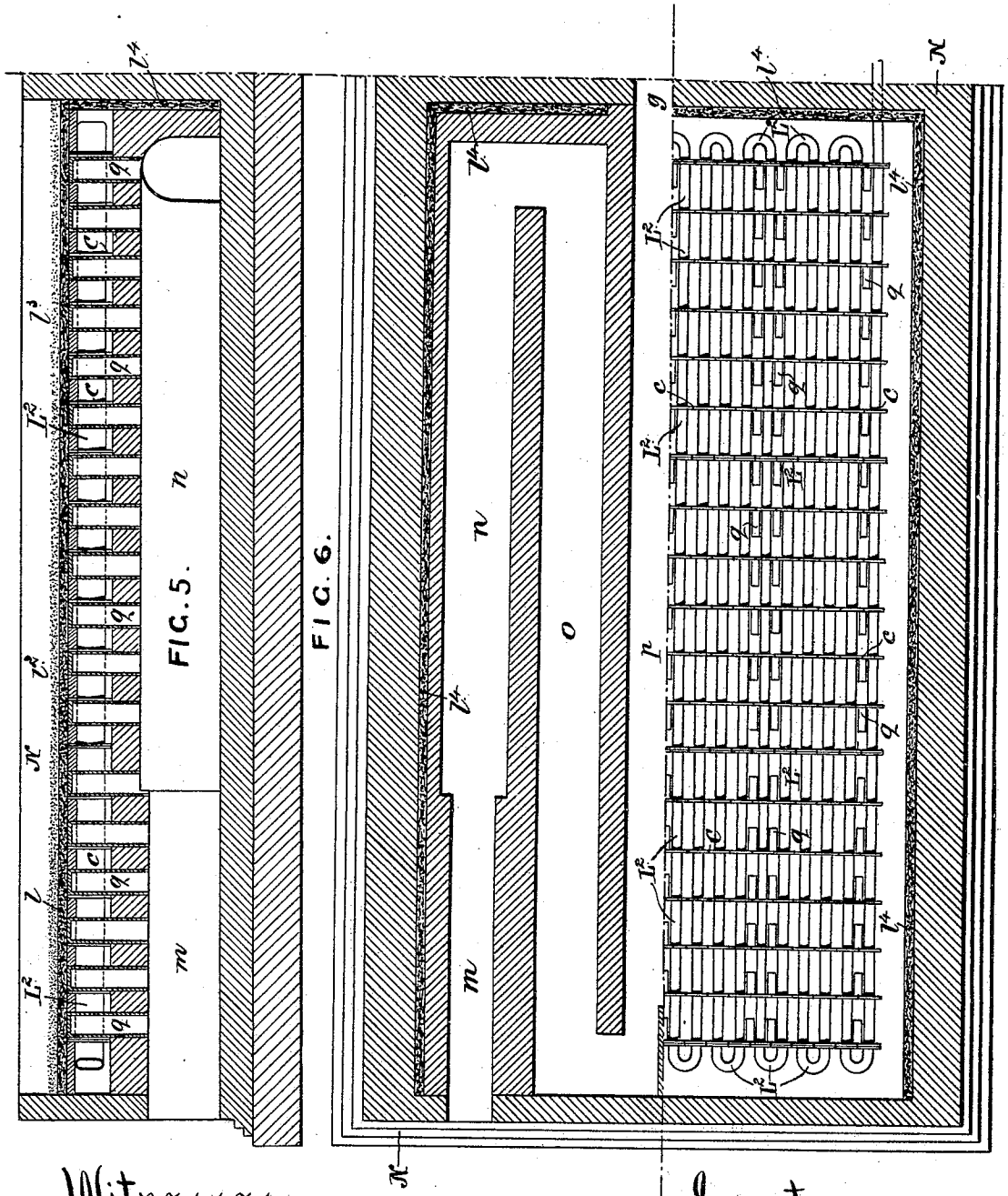

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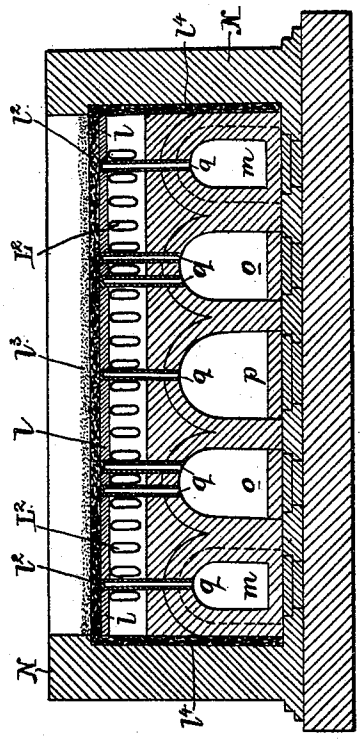

FIG. 7.

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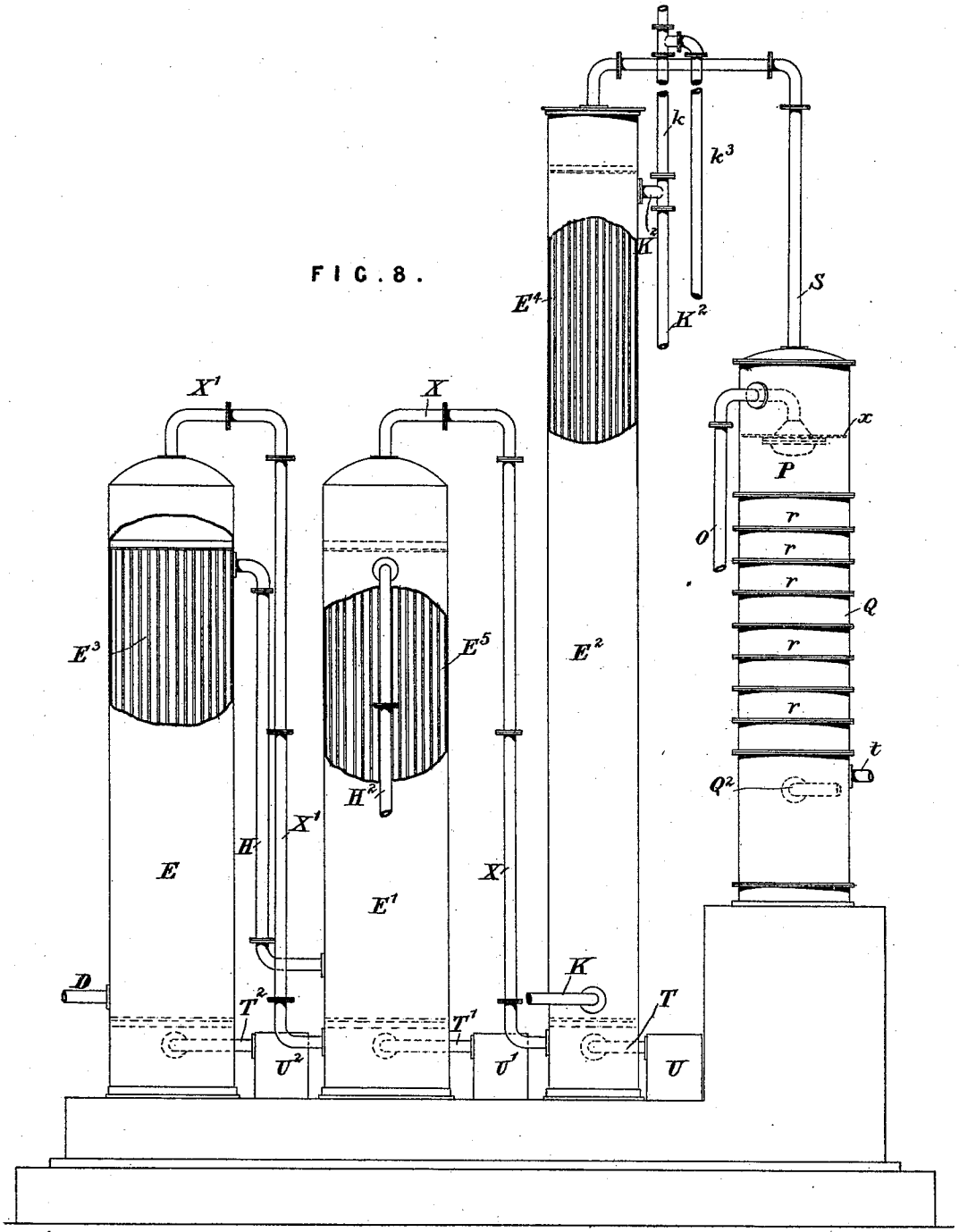
FIG. 8.



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METHOD OF AND APPARATUS FOR DISTILLING TAR, &c.

No. 499,557. FIG.10. Patented June 13, 1893.

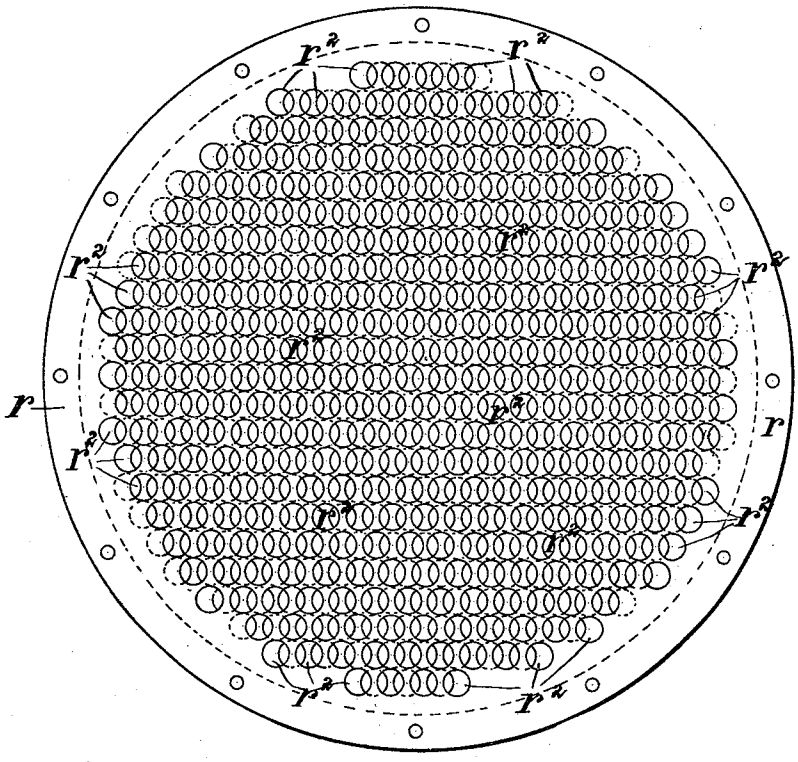
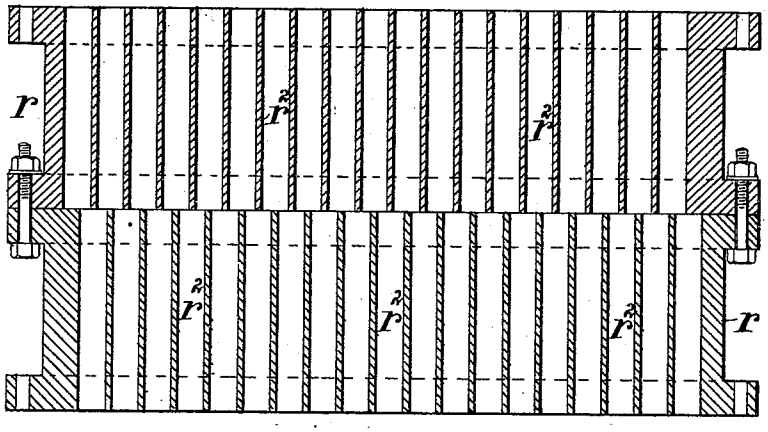


FIG.9.



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UNITED STATES PATENT OFFICE.

FREDERIC LENNARD, OF LONDON, ENGLAND.

METHOD OF AND APPARATUS FOR DISTILLING TAR, &c.

SPECIFICATION forming part of Letters Patent No. 499,557, dated June 13, 1893.

Application filed June 8, 1892. Serial No. 435,967. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC LENNARD, manufacturing chemist, a subject of the Queen of Great Britain and Ireland, residing at Ordnance Wharf, Blackwall Lane, East Greenwich, London, in the county of Kent, England, have invented certain Improvements in Methods of and Apparatus for Distilling, more especially intended for distilling tar, of which the following is a specification.

The object of my invention is to provide means by which distillation can be carried on economically and expeditiously and so as to obtain, in a manner readily under control, the various products of distillation, the heat of the vapors of distillation being used to effect the partial heating of the matter to be distilled which assists the condensation of the said vapors.

My invention is more especially intended for (but is not restricted to) the distillation of coal-tar to obtain its various products of distillation and I will describe it as so applied as, from this description, its application to the distillation of other matters to which it is applicable will also be readily understood.

According to my invention the tar to be distilled passes or is forced from the store tank or like place into vessels in which the ammoniacal liquor separates owing to the heated condition of the tar. This heating of the tar is effected by forcing it (on its way to the said vessels) through one or more of the condensers so that the tar acts as the cooling medium for condensing the tar vapors therein. The tar is then passed or forced from these tanks or vessels through heated coils of pipes or like extended passages the heat being applied to the said coils or passages in any suitable way, for instance by the said coils or the like or some of them, being situated in an oven or bath which may be a sand bath. The tar passing through these coils or the like thus becomes heated to or above the point at which the vaporizable constituents thereof required to be extracted would become vaporized if not confined therein and passes into a scrubber, on admission to which its said vaporizable constituents vaporize, it being therein subjected to the action of steam or other disassociating agent the pitch depositing in the scrubber while the vapors pass therefrom into a condenser in which the various products deposit separately.

The following is an arrangement of apparatus according to my invention although I do not limit myself to the precise details. I provide a furnace with return flues preferably heated with liquid or gaseous fuel and above it an oven or bath (which may be a sand bath) in which are coils communicating with other coils situated in a chamber through which the products of combustion pass and which I call the economizer. I provide also a scrubber consisting preferably of a vertical tower having series of tubular passages, so arranged that the tar will pass downward therethrough in a somewhat circuitous manner meeting a current of steam or other disassociating agent in its descent which steam or like agent carries off the desired products from the tar the pitch which is thus formed depositing at the bottom of this tower. I provide also condensers into which the vaporized products pass and in which the several products deposit separately these condensers preferably consisting of vertical vessels provided with tubes and with outlets and inlets so arranged that the vapors pass inside the said tubes while the cooling and condensing agent passes on the outside of the said tubes. In the first condenser of the series, the condensing agent may be the tar from the ammoniacal liquor separators while in the others it may be the cold tar which is ultimately to be distilled. The tar to be distilled may be pumped through say the last of the condensers and passes around the tubes thereof and thence either direct by a pipe to the tanks or vessels in which the ammoniacal liquor separates from the tar and is retained or before passing to these tanks or vessels it may be passed through another of the condensers and around the tubes thereof. The tar is forced from these tanks or vessels by a pump into the first of the condensers and thence through the coils in the economizer and thence through the coils in the oven or bath by which the tar is heated to the degree requisite to cause the aforesaid vaporizable constituents to vaporize when the tar issues therefrom and passes into the scrubber where it meets a cur-

rent or currents of steam or other disassociating agent by which the vapors are driven to the first condenser wherein the heaviest products (the anthracene oils) deposit while the pitch deposits at the bottom of the said scrubber. The uncondensed vapors pass from the first condenser into the second condenser wherein the next products (creosote oils) deposit, the vapors which are still uncondensed passing into the last of the condensers wherein the lightest products (naphtha and light oils) are condensed. The condensers and scrubber are provided with outlets by which the deposited products run off.

Although I have mentioned three condensers any other number may be used in accordance with the number of "fractions" or products of different densities required.

The coils of the aforesaid economizer and oven or bath are preferably flattened and to provide extended heating surface they may have fins on them and to conduct heat to them there may be pipes or passages of refractory material extending from the furnace or flues (or both) to between the convolutions of the coils. Asbestus, slag-wool, or the like and sand may be used as hereinafter explained to retain the heat. By regulating the speed at which the tar is passed through the apparatus the proper degree of heat for distilling is obtained irrespective of the temperature above that required for distilling of tar at which the furnace and the oven or bath may be maintained.

In order that my invention may be clearly understood I will now proceed more particularly to describe the same with reference to the accompanying drawings premising however that I do not restrict myself to the particular details of the construction and arrangement of the parts described and illustrated as variations may be made therein without departing from the nature of my invention.

Figure 1 of the drawings is a diagrammatic plan of an apparatus arranged according to my invention. Fig. 2 is a longitudinal section, Fig. 3 a horizontal section, and Fig. 4 a transverse section of the chamber containing coils through which the tar is passed and which I call the economizer. Figs. 5, 6 and 7 are respectively a longitudinal section, a horizontal section and a transverse section of the furnace and bath or oven containing coils through which the tar passes and becomes finally heated as aforesaid before entering the scrubber. Fig. 8 shows in elevation partly in section, the scrubber and condensers through which the tar and vapors pass. Figs. 9 and 10 are respectively a vertical section and a plan of two sections of the scrubber drawn to a larger scale.

A Fig. 1 is the tank containing the tar to be distilled from which tank the tar is drawn through a pipe C and forced through the pipe D by the pumh B into one of the condensers for example the condenser E through which it passes outside and in contact with the surfaces of the tubes E^3 (Fig. 8) therein. From the condenser E the tar may if desired be conducted direct to tanks or vessels such as G in which the ammoniacal liquor separates from the tar two or more being used in order that the ammoniacal liquor may separate in one or more of them while the tar is being taken from the other or others of them in which the ammonical liquor has already separated from the tar bench pipes and cocks being provided as shown to enable each vessel to be put in communication with the pumps, tanks and condensers as required. The tar may however (as shown in the drawings) be conducted by the pipe H from the condenser E into another of the condensers E′ and thence by the pipe H^2 to the vessels G. The tar is drawn from the vessels G through the pipe i by a pump I and forced by the said pump through a pipe K into the condenser E^2 and thence through a pipe K^2 into a coil L (see Figs. 2, 3 and 4) in the superheater or economizer M whence it passes through m^2 into another coil L^2 (or a continuation of the coil L) contained in an oven or bath N (see Figs. 5, 6 and 7). In order to keep the said coils evenly supplied and properly filled with tar, I prefer to provide the pipe K^2 with stand pipe k into which any vapors formed in the condenser E^2 may pass and with an overflow pipe k^3 leading back to the vessels G through which pipe k^3 any surplus tar passes back to the said vessels or one of them. The tar in passing through the coils L L^2 becomes highly heated to the point at which constituents required to be obtained will vaporize when the tar emerges from the coil into the scrubber. The tar so heated is conducted by the pipe O and rose nozzle P (Fig. 8) into the upper part of the scrubber Q wherein the pitch formed and separated from the other constituents passes to the bottom of the scrubber and out therefrom by the pipe Q^2 into the tank or reservoir R. The vapors from the tar are driven (by means of steam or other disassociating agent admitted at t to the lower part of the scrubber) through a finely perforated plate x and conducted by a pipe S into the upper end of the condenser E^2 and into the tubes E^4 thereof and therein part of the vapors is condensed by the tar or condensing agent circulating through the condenser over the exterior surfaces of the said tubes so that the heaviest products (namely the anthracene oils) deposit in the bottom of this condenser and pass therefrom by the pipe T into and through a coil of pipe contained in a water tank U and therefrom by the pipe Y into a storage vessel or reservoir W. The uncondensed vapors pass from the condenser E by the pipe X into the tubes E^5 in the next condenser E′ wherein the next lighter products, namely, the creosote oils, are condensed by the circulation of the tar or cooling agent over the outer surfaces of the said tubes E^5 the condensed products passing from the con-

denser E′ by the pipe T′ through a coil in a water tank U′ and therefrom by the pipe Y′ into a storage reservoir W′. The vapors which are still uncondensed pass by the pipe X′ into the upper part of the condenser E and in passing through the tubes E^3 therein the lighter products (namely naphtha and other light oils,) become condensed, and deposit in the bottom of the condenser E from whence they are conducted by a pipe T^2 into a coil of pipe in a cold water tank U^2 and thence by the pipe Y^2 into the storage tank or reservoir W^2.

Having given a general description of the process for distilling tar according to my invention I will now describe what I consider the best construction of the apparatus for carrying out the said process.

The separating vessel or vessels G into which the tar is conducted after circulating round the tubes in the condensers may resemble ordinary boilers. The economizer through which the tar passes after leaving the settling tanks or vessels G consists of a closed chamber M containing a coil L of tubes, preferably of an oval or flattened form in cross section as shown in Fig. 4 and also preferably provided with fins, gills or flanges *c* for increasing the heating surface. This coil L is supported on brick piers *d* above the bottom of the chamber M so as to permit of the circulation beneath the coil of the products of combustion by which it and the chamber M are heated. The chamber M is divided longitudinally into compartments by transverse brick partitions *e* through which the coil passes, these partitions having therein perforations or holes *f* below the coil.

The heated products of combustion for heating the coil L may be supplied from any suitable source but I prefer to utilize for this purpose the otherwise waste products of combustion passing from the furnaces employed for heating the bath or oven hereinafter described. The heated products of combustion from these furnaces enter the economizer by the passage *g* and pass upward between the convolutions of the coil L and over the first brick pier *d*, thence down through the convolutions of the coil behind this pier and through the perforations in the first partition *e*. They then pass upward through the convolutions of the coil on the opposite side of this partition and over the next pier *d* and then again downward between the convolutions of the coil and through the perforations in the next partition and so on to the opposite end of the chamber they finally escaping by the passage *h* leading to the chimney. The tar passing through the said coil becomes further heated and passes from this coil into a similar coil L^2 arranged in the bath or oven shown in Figs. 5, 6 and 7, Fig. 5 being a longitudinal section, Fig. 6 a horizontal section and Fig. 7 a transverse section of the said bath or oven. In order to retain the heat the coil L^2 may be covered by fire tiles *l* and above them there may be a covering of slag wool or equivalent material l^2 and over this a bed of sand l^3 or the like. Slag wool or other non-conducting material may be placed in the walls of both the economizer and the oven or both to still further retain the heat for instance as shown at l^4 in Fig. 7. Beneath the coil L^2 furnaces *m m* are arranged and preferably heated by liquid or gaseous fuel but I do not restrict myself to the use of such fuel. The products of combustion pass along the flue *n* to the back end and then return to the front by the flues *o*, thence passing back again to the back end by the central flue *p* and out therefrom into the superheater or economizer by the passage *g* as hereinbefore described.

Projecting from the crowns of the furnaces *m* and flues *n o p* are hollow chambers *q* which extend upward between the convolutions of the coil L^2. The heated products of combustion enter these hollow chambers whereby they become highly heated and thereby in addition to the gills *c* on the coil provide a considerably extended heating surface for heating the bath or oven. The coil L^2 is thus highly heated and maintained at the required temperature by the heat from the furnaces *m* so that the tar passing through the coil becomes heated to such a degree that the constituents which it is desired to obtain are vaporized as soon as it is admitted to the scrubber.

The scrubber preferably consists of a tower composed of a number of castings *r* see Figs. 8, 9 and 10 having tubular passages r^2 therein so arranged one above another that the tubular passages in each casting do not coincide with the tubular passages in the adjacent casting or castings but so that those in one overlap or break joint with those in that or those castings next to it thereby providing a number of zig-zag passages through the scrubber over the surfaces of which the tar descends. Steam is admitted to the lower end of the scrubber by the pipe *t* the vapors from the tar being driven by this steam through the pipe S into the upper end of the condenser E^2, thence into the condensers E′ and E in succession in which condensers the various constituents are deposited as hereinbefore described.

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—

1. The process of distilling tar or the like consisting in heating it while confined in coils or passages, to a degree which would cause its required constituents to vaporize if not thus confined, and causing the said tar or the like so heated to enter and its said constituents to vaporize in a scrubber into which steam or other disassociating agent is admitted, all substantially as hereinbefore explained.

2. The process of distilling tar or the like, consisting in subjecting the said material to a preliminary heating, then passing it to a

settling tank and then heating it while confined in coils or passages to a degree, which would cause its required constituents to vaporize if not thus confined, and causing the said tar or the like so heated to enter and its said constituents to vaporize in a scrubber, into which steam or other disassociating agent is admitted, all substantially as described.

3. In a distilling apparatus, the combination of a supply pipe for the matter to be distilled, with a heating device having coils or passages in which the matter can be heated to a degree which would cause its required constituents to vaporize if not thus confined, means for keeping the said coils or passages uniformly filled and a scrubber connected with said heating device and into which scrubber the matter so heated can enter and its said constituents be vaporized and a pipe supplying steam or other disassociating agent to the scrubber, all substantially as described.

4. In distilling apparatus the combination of a settling tank into which the matter to be distilled is conducted before being heated to the distilling point, a heating device containing a coil of pipes in which the matter being treated is brought to the distilling point, with a chamber M provided with a coil of pipe connecting the settling tank and the coil in the heating device, and means for heating the coil of pipe in the chamber M by the waste products of combustion passing from the heating device, all substantially as set forth.

5. In a distilling apparatus, the combination of a supply for the matter to be treated, two or more condensers and means for conducting the matter to and through one or more of the condensers, a settling tank connected with the latter, a heating device connected therewith and having coils or passages in which the matter can be heated to a degree which would vaporize its required constituents, if not there confined, and a scrubber into which the matter thus heated can be discharged and vaporized, a pipe supplying steam or other disassociating agent to the scrubber, and piping leading from the scrubber to the condensers, all substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

F. LENNARD.

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