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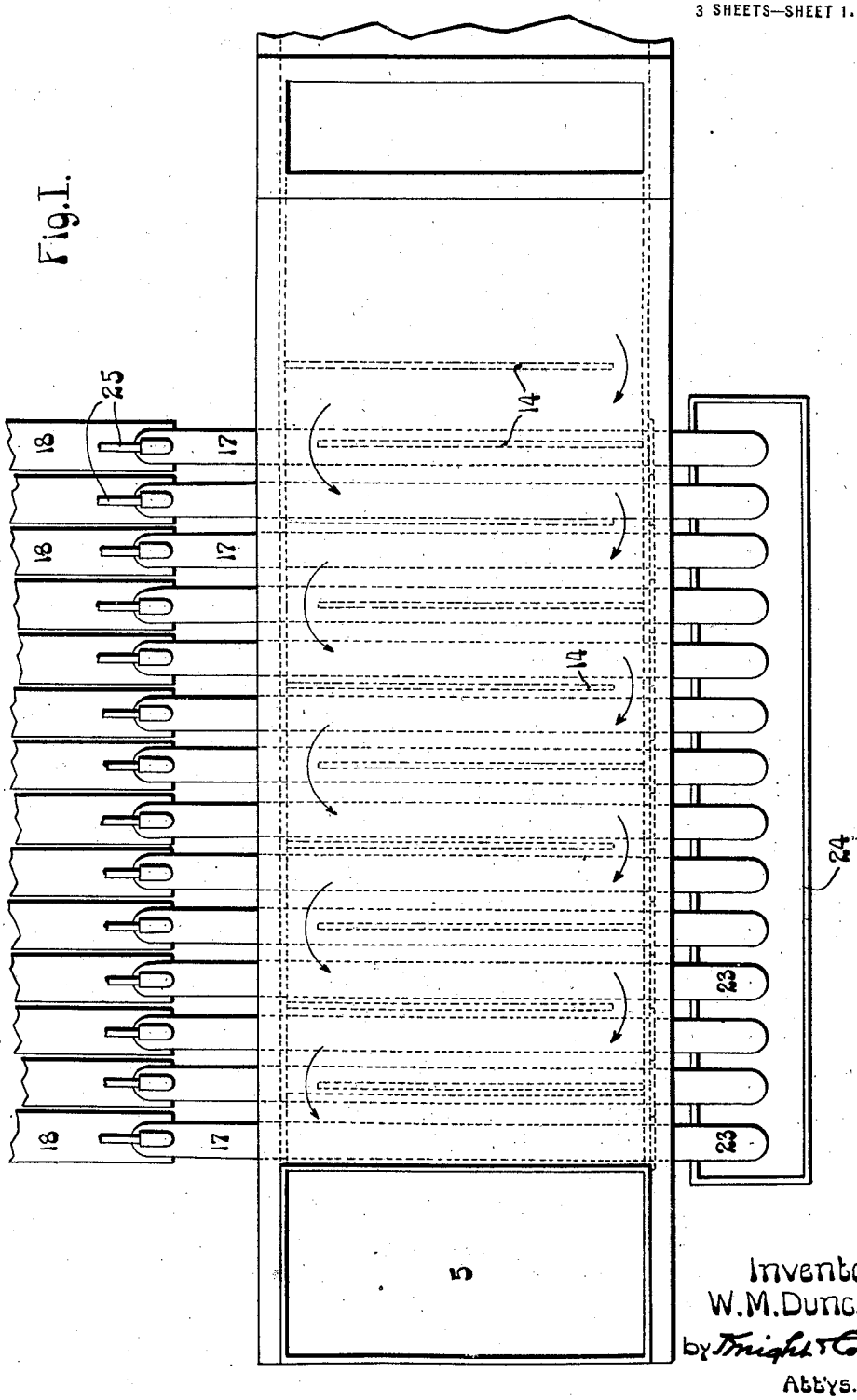
METHOD OF DESTRUCTIVE DISTILLATION.

APPLICATION FILED AUG. 29, 1918.

1,407,017. Patented Feb. 21, 1922.

3 SHEETS—SHEET 1.

Fig. I.



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3 SHEETS—SHEET 2.

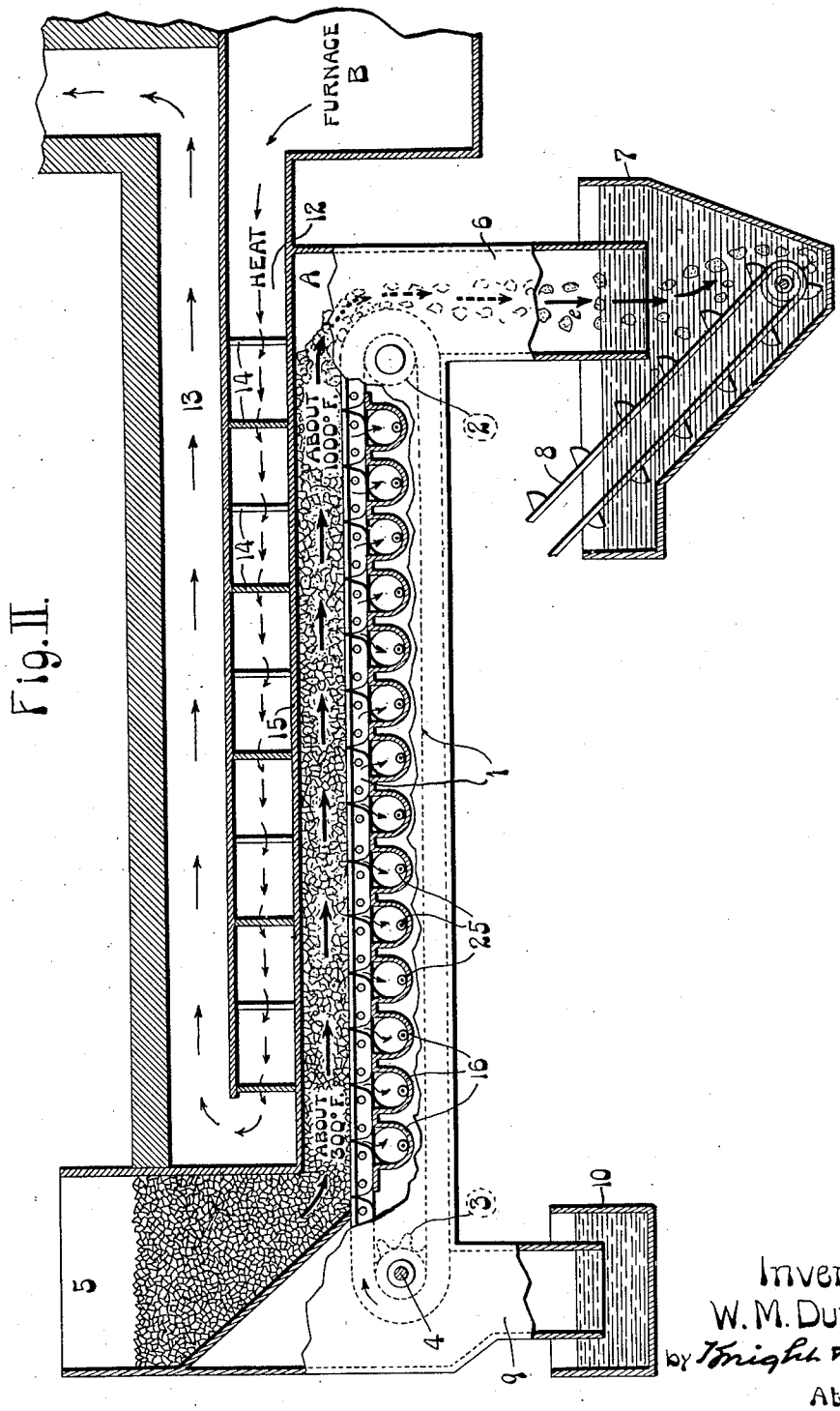


Fig. II.

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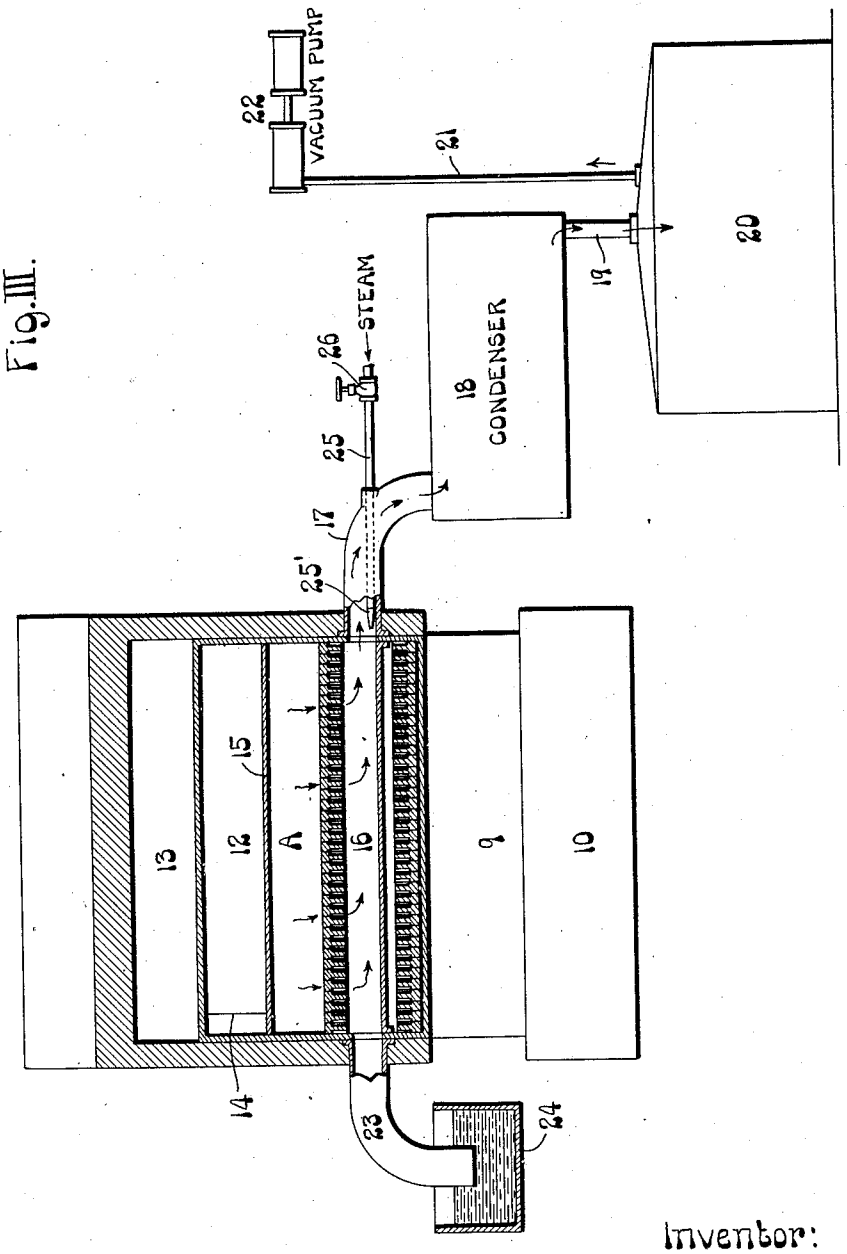
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3 SHEETS—SHEET 3.

Fig. III.



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UNITED STATES PATENT OFFICE.

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METHOD OF DESTRUCTIVE DISTILLATION.

1,407,017. Specification of Letters Patent. Patented Feb. 21, 1922.

Application filed August 29, 1918. Serial No. 251,972.

To all whom it may concern:

Be it known that I, WILLIAM M. DUNCAN, a citizen of the United States of America, a resident of Alton, in the county of Madison, State of Illinois, have invented certain new and useful Improvements in Methods of Destructive Distillation, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to improvements in methods of distillation and more particularly to the destructive distillation of solid substances such as coal, shale, wood, etc.

The objects of the invention are to increase the yield of liquid products, to economize in the use of fuel, to save labor in the operation of the retort, to provide an improved method of fractional distillation, and to enable the distillation to be carried out continuously for an indefinite period of time.

In the preferred form of the invention, different portions of the retort are maintained at different temperatures to provide low, intermediate and high temperature zones for the vaporization of the different fractions to be obtained from the charge of solid material. The charge is preferably delivered from a source of supply to an endless conveyor whereby the fresh charge is caused to travel continually from the low temperature zone, through the intermediate zone and thence through the zone of highest temperature, the residual product being continually discharged from the last mentioned zone. By continually admitting a fresh charge and continually discharging the residual products while the substance to be distilled is traveling through the retort, I enable the operations to be carried out continually. Furthermore, the traveling charge can be handled mechanically with very little labor and attention on the part of the operator.

An important feature of the invention lies in the peculiar manner in which the different fractions are taken from the charge and separated from each other in the retort. As the traveling charge advances through the low, intermediate and high temperature zones, the various fractions are permitted to escape freely in the form of vapor, each product being quickly removed from the zone in which it is vaporized, and this is accomplished without passing the vapor from one zone to another and without subjecting any of the fractions to a temperature higher than is necessary to free it from the charge. The most volatile and most valuable products are not injured or converted into fixed gases by subjection to high temperatures. They are quickly taken from the traveling charge in the low temperature zone. This increases the yield of the most valuable liquid products.

In addition to avoiding the production of a large percentage of gas and increasing the yield of more valuable liquid, the present invention avoids heat losses which would be incurred by subjecting the volatile fractions to unnecessary and undesirable high temperatures. Furthermore, since the different vaporized fractions are not overheated in the retort they can be more easily and more economically condensed.

Fig. I is a diagrammatical plan view of an apparatus adapted for use in following the new method.

Fig. II is a longitudinal section, partly in elevation, illustrating the retort.

Fig. III is a diagrammatical view of the apparatus, the retort being shown in section.

To illustrate the invention I have shown a retort provided with an elongated air-tight vaporizing chamber A containing an endless traveling conveyor 1 whereby the charge is transmitted through the retort. The conveyor 1 preferably consists of a number of endless chains (Figs. II and III) mounted on wheels 2 and 3, the latter being fixed to a power shaft 4 which may be rotated by any suitable mechanism to cause the conveyor to travel at any desired speed. 5 designates an intake receptacle in the form of a hopper located at one end of the air-tight vaporizing chamber, and 6 is a tubular outlet member for the discharge of residual products from the retort. The outlet member 6 extends downwardly from the vaporizing chamber, and its lower end extends into a body of water in a residuum receptacle 7, thereby forming a water seal to prevent the admission of air to the vaporizing chamber. 8 designates a conveyor arranged in the receptacle 7 to remove the coke or other residual products from the water. To provide for the discharge of fine articles of solid matter which drop through the endless chain conveyor 1, a tubular outlet member 9 ex-

tends downwardly from the intake end of the air-tight vaporizing chamber, and the lower end of this outlet member extends into a body of water in a receptacle 10, so as to form a water seal.

The endless chain conveyor 1 and the elongated air-tight vaporizing chamber A are preferably arranged horizontally, and the intake receptacle 5 extends upwardly from one end of said chamber A, while the outlet member 6 extends downwardly from the opposite end. The lower end of the intake receptacle 5 is open, as shown in Fig. II, to provide for the admission of the fresh charge to the traveling conveyor 1.

The retort herein shown is provided with a furnace B and flues 12 and 13 whereby hot gases and other products of combustion are conducted from the furnace. The flue 12 lies directly above the air-tight vaporizing chamber A, and constitutes a heating chamber for the transmission of heat to the traveling charge supported on the conveyor 1. To effectively utilize the heating medium, the flue 12 may be provided with baffles 14, staggered as shown in Fig. I to deflect and retard the hot gaseous fluid passing from the furnace. A heat radiating member 15 forms the bottom wall of the flue 12, and also forms the top wall of the air-tight vaporizing chamber A, the heat being transmitted from the flue 12 to the member 15 from which it is radiated to the traveling charge on the conveyor 1. The charge is thus heated and vaporized without being ignited, and without coming into direct contact with the products of combustion passing from the furnace.

It is important to note that the heating fluid passing through the flue 12 travels in a general direction opposite to the direction of travel of the charge on the conveyor 1. By transmitting the charge and the heating medium in oposite directions, as shown in Fig. II, I subject the outgoing portion of the charge to a very high temperature, while the incoming portion of the charge is maintained at a relatively low temperature. The exit end of the vaporizing chamber is adjacent to the incoming heating medium which passes into the flue 12 at a very high temperature, and the intake end of the vaporizing chamber is subjected to the relatively low degree of heat transmitted from the heating medium at the discharge end of the flue 12. This is a simple and convenient manner of establishing and maintaining different temperature zones in the vaporizing chamber. In the destructive distillation of coal, the low temperature zone at the intake end of the vaporizing chamber is preferably maintained at a temperature of about 300° F., while the high temperature zone at the exit end of said chamber is preferably maintained at about 1000° F., the intermediate zones being maintained at intermediate temperatures ranging between 300° F. and 1000° F.

The charge passing from the bottom of the intake receptacle 5 is admitted to the low temperature zone where the temperature is high enough to vaporize the most volatile fractions, and as the charge travels slowly through the intermediate and high temperature zones it is subjected to gradually increasing temperatures so as to vaporize the intermediate and high boiling point fractions. To economize in the use of fuel; to avoid the production of a large percentage of permanent gas; to facilitate the condensation of the products, and to increase the yield of liquid products, I prevent the vapors from being overheated in the retort, and this is preferably accomplished by quickly removing the vapors as soon as they are evolved in the vaporizing chamber. The vapors are not permitted to pass from one zone to another and they are not conducted along any of the relatively hot portions of the retort.

16 designates vapor conductors extending entirely across the air tight vaporizing chamber A and surrounded by the endless conveyor 1, said vapor conductors being open at the top to receive the vapors passing from the traveling charge. The charge-supporting portion of the conveyor rests upon the upper edges of the vapor conductors. It will be noted that the traveling charge is interposed between and in contact with the conveyor and the heat radiating wall 15, while the charge-supporting portion of the conveyor is likewise interposed between and in contact with the charge and the vapor conductors 16.

Vapor pipes 17 lead from the vapor conductors 16 to fractional condensers 18, and each condenser is provided with an outlet pipe 19 (Fig. III) leading to a receiving tank 20. Each receiving tank 20 is preferably connected by means of a pipe 21 to a vacuum pump 22, as shown diagrammatically in Fig. III. This pump may be operated to create an induced draft in the vapor line so as to quickly and positively remove the vapors from the charge, but it is to be understood that the invention is not limited to a draft producing means of this kind, and if desired the pressure in the vaporizing chamber may be utilized to expel the vapors which are free to escape from the different zones.

It will now be readily understood that a charge of solid substances, such as coal or shale is maintained in the intake receptacle 5 from which it is discharged to the endless chain conveyor 1, the latter being driven continually so as to continually advance the charge from one zone to another, thereby gradually increasing the temperature of the

traveling charge. As soon as they are converted into vapor, the different fractions are drawn downwardly from the zone in which they are vaporized, the vapors being conducted between the links of the chain conveyor 1 and into the vapor conductors 16. The different vaporized fractions are not permitted to commingle with each other in the retort, and after being positively separated by passing into the vapor conductors 16, they are delivered to the separate fractional condensers 18 from which the several liquid products are recovered. Some gas will of course be formed, but the production will be reduced to a minimum for the reason that the vapors are not overheated, and this results in a number of other important advantages which will be readily understood by those skilled in the art.

To carry out the operation continuously, the vapor conductors 16 should be cleaned occasionally to remove the fine particles of solid substances which drop through the endless chain conveyor, and this should be done without admitting air to the vaporizing chamber. One end of each vapor conductor 16 is therefore provided with a discharge pipe 23 which extends downwardly and into a body of water in a receptacle 24, and each vapor pipe is provided with a steam pipe 25 having a valve 26 and a discharge nozzle 25′ (Fig. III), the latter being adjacent to one end of a vapor conductor 16. Whenever it is necessary to clean the vapor conductors 16, steam is admitted through the steam pipes 25 to create steam blasts whereby the particles of solid matter are projected from said conductors 16 and discharged through the pipes 23 to the water in the receptacle 24. This water seals the lower ends of pipes 23 to exclude air from the vaporizing chamber. All of the outlets of the vaporizing chamber are sealed, and this chamber is not in communication with the furnace or flues from which the heat is transmitted to the traveling charge.

The charge contained in the intake hopper 5 can usually be relied upon to prevent the admission of air through the charge inlet, and I, therefore, do not deem it necessary to show any other means for excluding air at this point.

I claim:—

In the art of distilling solid substances, the method of destructive distillation which comprises continually introducing into an air-tight vaporizing chamber a charge of the substances to be distilled, causing the charge to travel continually through said air-tight vaporizing chamber and along the bottom face of the top wall thereof, continually transmitting a heating fluid along said top wall in a general direction opposite to the direction of travel of the charge, thereby maintaining different portions of said wall at different temperatures to provide high, low and intermediate temperature zones in said air-tight vaporizing chamber and at the same time transmitting the charge from the low temperature zone, through the intermediate temperature zone and thence through the high temperature zone; drawing the resultant vapors downwardly from the bottom of said traveling charge without passing them from one of said zones to another, separately collecting the vapors at the different temperature zones so as to separate the vapors of each zone from the vapors at the other zones, and condensing the vapors.

In testimony that I claim the foregoing I hereunto affix my signature.

WILLIAM M. DUNCAN.