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A METHOD OF REMOVING HYDROCARBONS FROM THE AIR.

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Description

The invention concerns a method known from EP-A-0 079 364 for the recovery of petroleum for a mixture of air and hydrocarbons in the form of e.g., petrol vapour or of petrol vapour alone, in which e.g. the petrol vapour is partly absorbed in an absorption means by direct contact with a cooled petroleum distillate having a higher boiling point range than petrol, said petroleum distillate being supplied from a storage tank, transferred from the absorption means to a buffer tank and from the buffer tank to a stripping means in which the petrol dissolved in the petroleum is stripped, and from the stripping means to the storage tank so that the petroleum distillate circulates in a substantially closed circuit, whereby the petrol vapour is brought in direct contact with a petroleum distillate which is cooled sufficiently by heat-exchange with a cold reservoir in the storage tank to bring about a combined cooling condensation and absorption of the petrol vapour in the absorption means, the amount of cooled petroleum distillate caused to contact the petrol/air mixture being controlled so that the concentration of petrol in the petroleum distillate transferred to the buffer tank is substantially constant.

Many different processes emit considerable amounts of hydrocarbons, and this takes place not least from tank installations in the form of petrol vapour. This emission is very detrimental to the environment and moreover constitutes a considerable loss of expensive fuels, and accordingly it has long been endeavoured to solve this problem.

Thus, EP O 298 288 discloses a method and a system where the content of petrol vapour in a mixture of petrol vapour and air is first reduced under cooling in a substance exchanger, following which the residual vapour is combusted in a petrol engine. Energy of the engine is partly used to drive a cooling means which is necessary for the reduction of the vapour. However, because of the high voltage system for igniting the engine the use of this process involves safety hazards in precisely the areas where the inflammable and, under certain circumstances, explosive mixtures of air and hydrocarbons are handled, and as this should be added that the process is difficult to control and therefore frequently proceeds uneconomically, and that the resulting combustion products themselves moreover contain considerable amounts of unburned hydrocarbons.

The applicant's European Patent O 079 364 discloses a method and a system for the recovery of petrol from a mixture of petrol vapour and air. A very high degree of recovery can be obtained by means of this method, but it leaves petrol vapours which must be vented to the atmosphere or be removed in another manner.

The object of the invention is therefore to provide a method of the type stated in the opening paragraph which can strip contaminated air of a content of hydrocarbons and/or petrol vapours better than before with simultaneous utilization of these.

This is achieved by removing residual petrol vapour in the air, cleaned in said way, by supplying this air together with oil to the combustion chambers of at least one diesel engine and simultaneously supplying supplementary air to an extent where the oxygen in the cleaned air and the oxygen in the supplementary air bring the hydrocarbons in the petrol vapour and the oil to burn essentially stoichiometrically under high pressure during the working stroke when ignited by the increase of temperature during the compression stroke, wherein the energy emitted by the diesel engine is used partly to drive a petrol distillate cooling system in the storage tank and the hot gassed from the combustion process are used in a petrol distillate heating steam generator supplying steam via a condust to a heating coil connected with the stripping means.

The method of the invention is used in connection with a system of the type described in the applicant's EP Patent O 079 364. The residual petrol vapours from this process are then removed by combustion in the diesel engine, and simultaneously the recovery process fully or partly receives the energy emitted by the diesel engine during this. This results in the greatest possible recovery of the expensive petrol at the least possible cost, since the energy for the recovery is obtained partly form the combustion of the residual petrol vapours, partly from the combustion of the oil which is cheaper to use than petrol. The use of a diesel engine to burn the residual petrol vapour eliminates the danger of explosion, because this type of engine has no high voltage system for igniting. Besides the use of exhaust gases heat to heat the distillate in the stripping means allows a more complete use of the engine energy.

To obtain ignition by the compression in the combustion chambers of the diesel engine and to fully burn the hydrocarbons during the working stroke it is necessary to reduce the quantity of hydrocarbons supplied to the diesel engine. For this purpose the hydrocarbons stripped in the stripping means are transferred to a washing chamber, through which liquid petrol absorbing hydrocarbons flow via respective inlet and outlet conduits.

For the recovery process is used a cooling system which can be driven either directly from the output shaft of the diesel engine via a transmission, or indirectly by means of the current from an electric generator which is connected with the output shaft.

In some cases the hydrocarbon content of the contaminated air is rather small, and according to the invention, the stripping process can then be regulated by using several diesel engines, there being coupled a number such that none or just a single engine needs supplementary air supply.
In particular when working with petrol vapours it
may be advantageous to insert a gas mixture buffer
in front of the diesel engine. This can then always run
with optimum efficiency, since it starts only at a pre-
determined maximum filling of the buffer and stops at
another predetermined minimum filling degree.

The exhaust gases from a diesel engine are very
hot and can therefore be used for driving a vapour
generator, which can in turn supply vapour for distil-
lation of the petrol in the distillation column of the re-
covery system.

The invention will be explained more fully below
with reference to the drawing, in which

fig. 1 is a block diagram showing a first embodi-
ment of the method, used in connection with the
method according to EP-A-0 079 364,
fig. 2 is a block diagram showing a second em-
bodyment of the method used in connection with the
method according to EP-A-0 079 364 and with a gas mixture buffer inserted in front of the
diesel engine,
fig. 3 is a block diagram showing a third embodi-
ment of the method used in connection with the
method according to EP-A-0 079 364 and with
several serially connected diesel engines,
fig. 4 is a block diagram showing a fourth embodi-
ment of the method used in connection with the
method according to EP-A-0 079 634, which in
this case is showed fully.

In the block diagram in fig. 1 the diesel engine is
indicated by the reference numeral 40. The output
shaft 41 of the engine is coupled to an electric gen-
erator 42, which supplies the electric wires 43 with
electric current during operation. Instead of the elec-
tric generator, the output shaft 41 may be coupled to
another power consuming machine, e.g. the com-
pressor in a cooling system. The engine is moreover
provided with an exhaust pipe 44 leading the very hot
exhaust gases from the combustion process through
a vapour generator 45, which, via a water conduit, re-
ceives water which, via a heat exchanger (not shown)
in the vapour generator, is converted to vapour that
is supplied to a service place (not shown) via a vapour
conduit 47. The cooled exhaust gases are vented to
the atmosphere, and in this connection it is not nec-
essary to use a catalyst since the hydrocarbon con-
tent of the exhaust gases is very low. The shown en-
geine is water cooled in this case, and the coolant is
conveyed into the cooling jacket of the engine
through a coolant conduit 48 and out again through a
return coolant conduit 49. For example at a filling sta-
tion, the hot coolant may be used for heating service
water via a heat exchanger or be used directly as hot
service water. The oil for driving the engine is sup-
plied through an oil conduit 50, and the air for the
combustion is added through an air supply conduit 51.
This conduit is connected with a gas mixture conduit
52, which supplies the gas mixture which is to be strip-
ped and which may consist of a mixture of air and hy-
drocarbons in the form of e.g. petrol vapour or of pet-
rol vapour alone. The gas mixture from the gas mix-
ture conduit 52 and the supplementary air from the air
supply conduit 51 then flow together via a common
conduit 53 into the diesel engine 40 during its suction
stroke.

The hydrocarbons are combusted during the
working stroke together with the added oil and con-
sume the oxygen in the supplementary air as well as
the oxygen in the air present in the gas mixture. To
obtain optimum combustion, the total amount of air
must correspond to the amount of air which can be
duced from the combustion equation. The pressure
and the velocity of the gas mixture as well as its con-
tent of hydrocarbons and air must therefore be mea-
sured by means of probes which apply signals about
the measured quantities to a control, which adjusts
the supplementary air to the correct quantity via a
valve or a throttle in response to the signals and the
injected amount of oil. This regulation mechanism,
which is not shown in the figure, is known per se and
will therefore not be described in greater detail here.

When, as shown, the diesel engine is to drive an
electric generator, this is usually to be driven with a
constant number of revolutions and moment. How-
ever, the amount and the composition of the gas mix-
ture are not constant, but can often fluctuate greatly.
To compensate for this, the engine must be regulated
by other means, and this is obtained particularly ad-
antageously by means of a diesel engine which can
be controlled exclusively by the variable supply of oil
and thus does not need any form of throttle or lambda
control.

As mentioned, the gas mixture will often flow
rather irregularly to the diesel engine, which, how-
ever, works best with an even supply of the gas mix-
ture. With a view to obtaining this, a gas mixture buf-
fer 54 capable of collecting a suitable amount of gas
mixture is therefore inserted in the gas mixture con-
duit 52, as shown in fig. 2. Then, the diesel engine is
started only when a predetermined maximum filling
degree is achieved in the buffer 54, and runs until the
filling degree has dropped to a predetermined mini-
mum size. The diesel engine can hereby be driven op-
timally, because it is now not necessary constantly to
stop and start the engine again. As will be seen, a
constant maximum speed faster than the flame front
can thereby be maintained in the suction, thereby
eliminating the risk of back flow through the common
conduit 53.

Fig. 3 shows an embodiment of the method with
several diesel engines which are connected in series
by means of a connecting conduit 55. This embodi-
ment is useful in particular when gas mixtures con-
taining a considerable constituent of air, i.e. relatively
deluted mixtures, are to be handled. When the strip-
ning process is to be initiated, the first engine is then
initially started. If this engine requires no supplementary air in addition to the air already present in the gas mixture, the next engine in the series is started, and this continues until an engine requiring addition of supplementary air for working optimally is reached. The engines are coupled successively, a valve 56, which receives a control signal via an electric control wire 57, being opened for each individual engine.

Finally, fig. 4 shows one embodiment of the method according to the invention, which is worked in cooperation with method and the system described in the applicant's EP Patent 0 079 364. The total process sequence will be described briefly below, the details of which being described more fully in said European patent.

The gas mixture to be cleaned is passed to the system via a conduit 11 after having first passed various non-return valves, etc. The gas mixture is first stripped off by far the greatest part of its water content in the heat exchanger 1, from which the mixture is conducted to an absorption means 2 which also receives cooled petroleum distillate via a controllable valve 15. In the absorption means 2 the petrol vapour is absorbed in the petroleum distillate, which is passed to a buffer tank 3, while the cleaned cold air is discharged into a conduit 52 via the heat exchanger 1, so that the cold air provides the cooling effect required to condense water. The petrolcontaining petroleum distillate is conducted from the buffer tank 3 to a stripping means, in the shown system a distillation column 5 where the petroleum distillate is stripped of petrol by heating and is then passed to a storage tank 7, in which the petroleum distillate is cooled before being recircled to the absorption means 2. The heat exchanger 4 reduces the power consumption of the system since the cold petroleum distillate from the buffer tank 3 is preheated before being transferred to the distillation column 5, while the hot petroleum distillate from the distillation column 5 is precooled before being transferred to the storage tank 7. It is observed that the heat exchanger 4 provides optimum savings in energy, because it can be dimensioned to a predetermined flow volume, which is substantially constant under all operating conditions owing to the presence of the buffer tank 3. The petrol vapours given off by the distillation are transferred to a washing chamber 8, e.g. a packed column, through which liquid petrol absorbing the petrol vapours flows via conduits 9, 10. Alternatively, the vapours may be condensed or compressed in a manner known per se. The numerals 13 and 14 represent a cooling system and a heat exchanger, respectively, for cooling the petroleum distillate in the storage tank.

By means of this process it is possible essentially to recover the expensive petrol, but the cold air flowing out into the conduit 52 from the heat exchanger 1 will still have a content of petrol vapours unacceptably high under certain conditions. The air thus still contaminated to a certain degree is therefore conducted via the conduit 53 into the diesel engine 40, in which the residual petrol vapours are combusted as described before, thereby cleaning the air optimally and utilizing the petrol vapours for generating various forms of energy.

This energy is now used advantageously in the preceding recovery process. The electric current, transmitted by the generator 42 into the electric wires 43, is thus caused to drive an engine 58 which drives the cooling system 13, this, however, may also be driven directly by the output shaft 41 of the diesel engine 40 via a suitable transmission. Correspondingly, the vapour, generated in the vapour generator 45 and fed through the vapour conduit 47, is used for heating the petroleum distillate in the distillation column 5 via a heating coil 59.

Finally, if desired, a catalyst and optionally also a soot filter may be inserted in the exhaust pipe of the engine with a view to restricting the pollution from the exhaust gases additionally and keeping it within the prescribed threshold values.

Claims

1. A method for the recovery of petroleum from a mixture of air and hydrocarbons in the form of e.g. petrol vapour or of petrol vapour alone, in which e.g. the petrol vapour is partly absorbed in an absorption means (2) by direct contact with a cooled petroleum distillate having a higher boiling point range than petrol, said petroleum distillate being supplied from a storage tank (7), transferred from the absorption means (2) to a buffer tank (3) and from the buffer tank (3) to a stripping means (5) in which the petrol dissolved in the petroleum distillate is stripped and from the stripping means (5) to the storage tank (7) so that the petroleum distillate circulates in a substantially closed circuit, whereby the petrol vapour is brought in direct contact with a petroleum distillate which is cooled sufficiently by heat-exchange with a cold reservoir in the storage tank (7) to bring about a combined cooling condensation and absorption of the petrol vapour in the absorption means (2), the amount of cooled petroleum distillate caused to contact the petrol/air mixture being controlled so that the concentration of petrol in the petroleum distillate transferred to the buffer tank is substantially constant, characterized by removing residual petrol vapour in the air, cleaned in said way, by supplying this air together with oil to the combustion chambers of at least one diesel engine (40) and simultaneously supplying supplementary air to an extent where the oxygen in the cleaned air and the oxygen in the supplementary air bring the hydrocarbons in the petrol vapour
and the oil to burn essentially stoichiometrically under high pressure during the working stroke when ignited by the increase of temperature during the compression stroke, wherein the energy emitted by the diesel engine (40) is used partly to drive a petrol distillate cooling system (13) in the storage tank (7) and the hot gasses from the combustion process are used in a petrol distillate heating steam generator (45) supplying steam via a conduit (47) to a heating coil (59) connected with the stripping means (5).

2. A method according to claim 1, characterized in that the hydrocarbons stripped in the stripping means (5) are transferred to a washing chamber (8), through which liquid petrol absorbing hydrocarbons flow via conduits (9, 10).

3. A method according to claim 1 or 2, characterized in that the output shaft (41) of the diesel engine (40) drives a generator (42) supplying current to the cooling system (13) of the recovery system.

4. A method according to claim 1, 2 or 3, characterized in that the output shaft (41) of the diesel engine (40) operates the cooling system (13) via a transmission.

5. A method according to one or more of claims 1-4, characterized by providing several diesel engines (40), and coupling such a number of these during the stripping of the gas mixture that none or just a single engine needs addition of supplementary air.

6. A method according to one or more of claims 1-5, characterized by providing a gas mixture buffer (54), and starting and stopping the stripping process in response to this filling degree.

**Patentansprüche**

1. Ein Verfahren zur Rückgewinnung von Benzin aus einer Mischung aus Luft und Kohlenwasserstoffen in Form von z.B. Benzdampf oder Benzin dampf allein, bei dem z.B. der Benzdampf in einem Absorptionsmittel (2) durch direkten Kontakt mit einem gekühlten Erdöldestillat, das einen höheren Siedepunkt als das Benzin hat, absorbiert wird, wobei das Erdöldestillat aus einem Vorratstank (7) eingespeist, vom Absorptionsmittel (2) in einen Puffertank (3) und vom Puffertank (5) zu einem Ab trennmittel (5), in dem das in Erdöldestillat gelöste Benzin abgetrennt wird, und vom Abtrennmittel (5) zu dem Vorratstank (7) überführt wird, so daß das Erdöldestillat in einem im wesentlichen geschlossenen Kreislauf zirkuliert, wodurch der Benzdampf in direktem Kontakt mit einem Erdöldestillat gebracht wird, das durch Wärme austausch mit einem kalten Reservoir im Vorratstank (7) ausreichend gekühlt wird, um eine kombinierte kühlende Kondensation und Absorption des Benzdampfes in dem Absorptionsmittel (2) herbeizuführen, wobei die Menge des gekühlten Erdöldestillats, das verbraucht wird, die Benzinh/Luftmischung zu kontaktieren so gesteuert wird, daß die Konzentration Benzins in dem in den Puffertank überführten Erdöldestillat im wesentlichen konstant ist, gekennzeichnet durch Entfernen restlichen Benzdampfes in der auf diese Weise gereinigten Luft durch Einleiten dieser Luft zusammen mit Öl in die Brennkammern wenigstens eines Dieselmotors (40) und gleichzeitiger Zuführung zusätzlicher Luft in einem solchen Ausmaß, daß der Sauerstoff in der gereinigten Luft und der Sauerstoff in der zusätzlichen Luft die Kohlenwasserstoffe im Benzdampf und das Öl im wesentlichen stochiometrisch unter hohem Druck während des Arbeitshubs zur Verbrennung bringen, wenn durch den Temperaturanstieg während des Kompressionshubes die Zündung erfolgt ist, wobei die vom Dieselmotor (40) abgegebene Energie teilweise dazu ausgenutzt wird, ein Benzindestillat-Kühlsystem (13) im Vorratstank (7) anzutreiben, und die heiße Gase aus dem Verbrennungsprozeß in einem Benzindestillat-Heizdampfgenerator (45) verwendet werden, der über eine Leitung (47) Dampf zu einer Heizwende (59) liefert, die mit dem Abtrennmittel (5) verbunden ist.

2. Ein Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die in dem Abtrennmittel (5) abgetrennten Kohlenwasserstoffe in eine Waschkammer (8) überführt werden, durch welche über Leitungen (9, 10) flüssiges Benzin absorbierende Kohlenwasserstoffe fließen.

3. Ein Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Ausgangswelle (41) des Dieselmotors (40) einen Generator (42) antreibt, der Strom für das Kühlsystem (13) des Rückgewinnungssystems liefert.

4. Ein Verfahren nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die Ausgangswelle (41) des Dieselmotors (40) das Kühlsystem (13) über eine Transmission betätigt.

5. Ein Verfahren nach einem oder mehreren der Ansprüche 1 bis 4, gekennzeichnet durch die Bereitstellung mehrerer Dieselmotoren (40) und Verkopplung einer solchen Anzahl derselben während des Abtrennens der Gasmischung, daß kein
oder gerade ein einziger Motor die Zugabe zusätzlicher Luft erfordert.


Revendications

1. Procédé pour récupérer du pétrole à partir d’un mélange d’air et d’hydrocarbures sous la forme de, par exemple, une vapeur d’essence ou d’une vapeur d’essence seule, dans lequel, par exemple, la vapeur d’essence est partiellement absorbée dans un moyen d’absorption (2) par contact direct avec un distillat de pétrole refroidi ayant une plage de point d’ébullition plus élevée que celle de l’essence, ledit distillat de pétrole étant amené d’une citerne (7) de stockage, transféré depuis le moyen d’absorption (2) vers une citerne-tampon (3) et de la citerne-tampon (3) à un moyen (5) d’extraction dans lequel l’essence dissoute dans le distillat de pétrole est extraite, et depuis le moyen d’extraction (5), à la citerne (7) de stockage afin que le distillat de pétrole circule dans un circuit sensiblement fermé, la vapeur d’essence étant amenée en contact direct avec un distillat de pétrole qui est refroidi suffisamment, par échange de chaleur avec un réservoir froid dans la citerne (7) de stockage, pour produire une condensation par refroidissement et une absorption combinées de la vapeur d’essence dans le moyen d’absorption (2), la quantité de distillat de pétrole refroidi mise en contact avec le mélange essence/air étant régie de façon que la concentration de l’essence dans le distillat de pétrole transféré à la citerne-tampon soit sensiblement constante, caractérisé en ce qu’il consiste à éliminer la vapeur d’essence résiduelle se trouvant dans l’air, purifiés de ladite manière, en amenant cet air avec de l’huile aux champs de combustion d’au moins un moteur diesel (40) et en amenant simultanément de l’air supplémentaire en quantités telles que l’oxygène dans l’air purifié et l’oxygène dans l’air supplémentaire provoquent une combustion essentiellement stoechiométrique sous pression élevée des hydrocarbures dans la vapeur d’essence et l’huile durant la course de travail lors d’une mise à feu par l’élévation de la température pendant la course de compression, l’énergie produite par le moteur diesel (40) étant utilisée partiellement pour entraîner un système de refroidissement (13) de distillat d’essence dans la citerne (7) de stockage et les gaz chauds provenant du processus de combus-

2. Procédé selon la revendication 1, caractérisé en ce que les hydrocarbures extraits dans le moyen (5) d’extraction sont transférés à une chambre (8) de lavage à travers laquelle des hydrocarbures absorbant de l’essence liquide s’écoulent par des conduits (9, 10).

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que l’arbre de sortie (41) du moteur diesel (40) entraîne un générateur (42) fournissant du courant au système (13) de refroidissement du système de récupération.

4. Procédé selon la revendication 1, 2 ou 3, caractérisé en ce que l’arbre de sortie (41) du moteur diesel (40) actionne le système de refroidissement (13) par l’intermédiaire d’une transmission.

5. Procédé selon l’une ou plusieurs des revendications 1 à 4, caractérisé par la présence de plusieurs moteurs diesels (40) et l’accouplement d’un certain nombre de ceux-ci durant l’extraction du mélange gazeux de manière qu’aucun ou qu’un seul moteur ait besoin d’une addition d’air supplémentaire.

6. Procédé selon une ou plusieurs des revendications 1 à 5, caractérisé par la présence d’un tampon (54) de mélange gazeux et par la mise en marche et l’arrêt du processus d’extraction en réponse à ce degré de remplissage.