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(21) International Application Number: PCT/NO92/00038 (22) International Filing Date: 4 March 1992 (04.03.92) (30) Priority data: 910864 5 March 1991 (05.03.91) NO (71) Applicant (for all designated States except US): I.S. BGB [NO/NO]; Bentsen Snorre, Strandveien 5c, N-1324 Ly-saker (NO). (72) Inventor; and (75) Inventor/Applicant (for US only) : MYRVOLD, Harry [NO/NO]; Nylendveien 7, N-2010 Strømmen (NO). (74) Agent: HELGERUD, Jan, E.; Bryns Patentkontor A/S, P.O. Box 9566, Egertorget, N-0128 Oslo (NO).		(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent), US. Published <i>With international search report.</i>
(54) Title: METHOD FOR REFINING OF WASTE LUBRICATING OILS AND AN APPARATUS FOR EMPLOYING THE METHOD (57) Abstract A method for refining waste lubricating oils into high-grade lubricating oils, comprising the following steps: 1) deposition of released water, distillation of residual water and light hydrocarbons; 2) fractionated production of fuel oils; 3) cyclonic vacuum distillation of lubricating oil fractions to remove impurities, such as metallic salts, sludge and soot; and 4) final hydrogen treatment or polishing over a catalyst, followed by fractionation; wherein the cyclonic vacuum distillation is carried out in a vacuum distilling apparatus comprising a cylindrical portion (102), a conical, pointed portion (112) having an outlet pipe (114), a lower, conical, pointed portion (107) having an outlet pipe (108) and an interior skirt, the interior skirt comprising a cylindrical portion (103) running parallel to the wall (102) of the distilling apparatus and a lower, conical, pointed portion (104), provided with slits and demisters, the wall (102) being provided with heating means (105) substantially on the part covering the cylindrical portion (103) of the skirt.		

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METHOD FOR REFINING OF WASTE LUBRICATING OILS AND AN APPARATUS FOR EMPLOYING THE METHOD.

The present invention relates to a method for refining waste lubricating oils and an apparatus for employing the method.

More particularly, the invention relates to an effective and environmentally friendly method for refining waste lubricating oils into high-grade lubricating oils through the use of a vacuum distilling apparatus of the type further described below.

The general method according to the invention for refining waste lubricating oils into high-grade lubricating oils will first be briefly described with reference to Figure 1 wherein the steps are enumerated as follows:

- I comprises deposition of released water, distillation of residual water and lighter hydrocarbons and drying;
- II comprises the production of fuel oil through fractionation;
- III comprises cyclonic vacuum distillation whereby the fractions of lubricating oil are distilled to remove impurities such as metallic residue, sludge and soot; and
- IV comprises hydrogen treatment (polishing) of the lubricating oil after it has been heated in a depositional tank, and final fractionation.

In the light of the present environmental demands and the environmental policy resulting thereof, it becomes increasingly important to make sure that any discharge of harmful and anti-environmental impurities into nature are kept at a minimum.

This also applies to the cases where the discharges per se are small, but where an accumulation can lead to undesirable or even catastrophic results.

In the light of the present economic situation it is also increasingly important to work toward perfecting recovery processes in order to utilize the values which otherwise would have been wasted during the simultaneous separation of harmful substances which, for example, derive from additives used in a period when one was unaware of the undesirable side-effects of these substances.

There are a great number of known plants in the field, operating according to principles known per se and having as their object to process waste lubricating oils in order to save the values therein while simultaneously separating and depositing harmful substances in a safe manner.

These plants are all based on technical and chemical processes which are known per se, and where the individual components essentially depend upon the locality of the plant and its connection with existing plants in terms of sources of heat, sources of energy, combustion facilities and so on.

However, relatively little has been done with respect to the purely apparatus-technical construction, the result being that there is still room for perfecting the method in various areas.

One step which has not been completely satisfactory so far in the process sketched above is the cyclonic vacuum distillation under point 3 above, where the fractions of lubricating oil are distilled to remove impurities such as metallic residue, sludge and soot.

In regard to this, the present invention relates to a method

for redistilling waste lubricating oils into high-grade lubricating oils, comprising

- 1) deposition of released water, distillation of residual water and light hydrocarbons;
- 2) fractionated production of fuel oils and separation of a residue material;
- 3) cyclonic vacuum distillation of the residue from step 2) for distilling lubricating oil fractions and separating impurities; and
- 4) hydrogen treatment of the lubricating oils obtained in step 3), preceding a final treatment for their new uses;

and this method is characterized in that the cyclonic vacuum distillation in step 3) is carried out by means of a vacuum distilling apparatus as described in the characterizing clause of claim 1.

As indicated above, the invention also applies to an apparatus for carrying out step III of the method disclosed above, and this apparatus is characterized by being a vacuum distilling apparatus as described in the characterizing clause of claim 2.

The invention will be further described with reference to the enclosed drawings where

- Figure 1 is a flowchart of the complete process;
- Figure 2 shows a section through a vacuum distilling apparatus according to the invention.

The general method for reclaiming waste lubricating oils begins with collecting all types of waste lubricants in a receiving plant for classification.

Good qualities 1 are pumped to a depositional tank where there is a first heating. at 25°C.

Released water is deposited as the bottom layer and drained into a water tank whereas oil is deposited as the upper layer, and the oil there obtained is transferred to a storage tank 5. From this storage tank 5 dehydrated oil 6 is pumped to a drying plant 7 where a heat exchange is carried out with the previously obtained distillation residue 22, whereafter the total amount is fed into a mixing nozzle 8.

In the nozzle 8, the oil 6 is brought into contact with a heated dried oil 9 from the bottom of the drying plant 7. The residual water in the oil stream 6 evaporates in the mixing nozzle and is distilled together with fuel residues and gas via the pipe line 10.

This stream of material 10 is condensed and separated before it is conducted to a separate destruction plant, known per se.

The dried oil 11 from the dryer 7 is fed into a mixing nozzle 12 where heated oil 13 from the bottom of the fractionation vessel 14 is brought to the required temperature, then fed into a mixing nozzle 12 in a fractionation vessel 14 operating under a vacuum of from 100 to 500 mbar and at a temperature of from 280 to 300°C.

In the fractionating vessel 14, fuel oil 15 is evaporated, condensed and conveyed to a storage tank.

The fraction 16 of lubricating oil in the bottom of fractionation step 14 is pumped further to a mixing nozzle 17 on the vacuum distilling apparatus 18 of the invention, operating under a vacuum of from 15 to 20 mbar and at a high temperature of 345 to 350°C.

In the vacuum distilling apparatus 18 of the invention, all lubricating oils are separated from the impurities present.

The lubricating oils evaporate via 19, condense and are conducted to a depositional tank 23 and from there to a storage tank 24.

The heaviest oils and impurities, the distillation residues 20, are recirculated via an oven 21 for heating and thereafter release their energy in the mixing nozzle 17 on the vacuum distilling apparatus 18 of the invention.

The distillation residue 22 thus produced is pumped via a heat exchanger, as mentioned above, into storage.

In the depositional tank 23, the "flying particles," which accompanied the lubricant oil distillate 19 from the vacuum distilling apparatus 18 of the invention, collect, forming flakes or large particles which in turn form a sludge which is deposited in the tank.

This sludge 26' is thereafter drawn off from the settling tank 23 for combustion in the above mentioned separate destruction plant.

Oil from the settling tank 23 is conducted via the line 25 to a clarification tank 24, from which further sludge 26" is removed and burned as above.

The clarified lubricating oil 27, thus obtained, is then pumped via a heat exchanger and oven 28 to the reactor 29 for a conventional hydrogen treatment.

Hydrogen gas for this purpose is produced separately, for example in a production unit 30, by means of electrolysis of water, the production being adapted to the quantity of hydrogen 31 required by the reactor 29.

The mixture hydrogen gas 31/oil 27 is fed into the reactor 29, passed through the catalyst mass, for example in the form

of a firm layer mass, and out through the bottom of the apparatus.

The gas/oil mixture 32 is then fed to a separator 33, which *separates the lubricating oil 34 from the surplus of hydrogen 35, which is pumped back to the hydrogen gas feed pipe 31.

The reaction gas 36 is burned off in the above mentioned separate destruction plant.

The obtained lubricating oil 34 is further conducted to a fractionating/drying tower 37 for separation of the oil fractions according to viscosity, where one generally obtains 300 N-oil at 38, 150 N-oil at 39 and fuel oil/water at 40.

The fractions 38, 39 and 40 are then pumped to storage tanks while the water is pumped to the above mentioned separate destruction plant.

The destruction plant is not described separately, but comprises generally a plant for combustion and destruction of streams of waste material by means of heat treatment, for example at 1200°C from 3 to 5 seconds.

These streams of waste material are in the present case, exhaust gases from vacuum pumps, uncondensed gases from the drying process 10, fuel residues 10, reaction gas 36, deposited water 3, distilled water 10, distillation residue 22 and deposited sludge 26.

The secondary air for this destruction plant is preferably drawn off from the atmosphere of the process halls and is combusted via a water seal and fire mesh in the destruction oven.

For optimal utilization of the heat balance existing in the plant, the energy source in the combustion chamber of the destruction oven in the destruction plant is based on the hot-oil plant in the form of a doubly coiled pipe circuit; further, the flue gases are dump cooled for exhaust purification.

Finally, the cleansed flue gas is emitted to the atmosphere via a chimney.

The vacuum distilling apparatus according to the invention is shown in Figure 2.

It comprises a mixing nozzle inlet or a mixing pipe 101 for feeding the material into the vacuum distilling apparatus which is delimited by a wall 102 of the distilling apparatus having an interior wall or a skirt 103.

Below the skirt 103 is a conical, split demister 104.

At its exterior, the vacuum distilling apparatus is heated by means of an electrical heating tape 105.

At its exterior, the vacuum distilling apparatus is further provided with mounting means, such as a foot 106 for positioning and lugs 111 for lifting.

The middle portion of the vacuum distilling apparatus, delimited by the wall of the distilling apparatus 102, is essentially cylindrical, whereas the upper portion has the form of an upwardly pointed conical top 112 and the lower portion has the form of a downwardly pointed conical section 107, merging into the essentially cylindrical outlet channel 108 for distillation residues, and is connected, by means of a flange 115, to an extended cylindrical outlet channel 109, which subsequently, via transfers and flanges, passes into conventional pipe equipment.

At the top, the conical portion 112 is provided with a distillate outlet 114 which, in turn, is provided with a drip ring 113 at its bottom end - the end which is inside the skirt 103 within the vacuum distilling apparatus.

In the vacuum distilling apparatus according to the invention, the mass to be distilled is blown in through the inlet/mixing pipe 101 tangentially to the wall of the distilling apparatus 102 and in the upper portion of the annular space which is formed between the wall 102 of the distilling apparatus and the skirt 103.

This annular space according to the invention constitutes, preferably, at least half of the cylindrical portion of the vacuum distilling apparatus.

The lower portion of the skirt is formed as a downwardly pointed cone provided with slits 104a.

The top surface of this reversed truncated cone is preferably placed at approximately the same level as the lower portion of the cylindrical part of the wall of the distilling apparatus.

The distillation residue 16 from step 2, see Figure 1, enters the vacuum distilling apparatus of the invention via the inlet/mixing nozzle 101 in which it also meets heated distillate residue from the oven 21.

The fractionated oil from step II evaporates immediately, for example at 347°C and 0.02 bar absolute pressure and is thereby cracked into about 85% distillate and about 15% distillate residue.

Because of the enormous increase in volume in the inlet/-mixing nozzle and the tangential feeding owing to the

position of the inlet nozzle on the vacuum distilling apparatus, the vacuum distilling apparatus according to the invention has a separating effect already when the injection into the annular space occurs.

The heavy distillate residue together with the residue of the fractionated oil is whirled against the wall of the distilling apparatus, whereas the distillate gases are forced against the outer wall by the skirt 103.

Because of new feedstock, the already partially separated material is forced downward, whereby the gases, passing the point where the skirt merges into the conical portion 104, are given the opportunity to slip away through the slits 104a into the interior space of the skirt 103 and later to escape via the outlet 114.

On the outlet pipe 114, there is indicated a drip ring 113, indicated above, which gives a further fractionating effect.

During an evaporation, like the one here described, energy is required, and the oil portion on the wall 102 of the distilling apparatus is given additional energy by means of an electrical heating tape 105 mounted thereon.

The distillate residue is then transported via a path, first coiled and later more vertical, along the wall of the distilling apparatus toward the bottom 107 of the cone and, finally, runs down into the outlet channel 108.

By the construction of the distilling apparatus disclosed above the following advantages are obtained:

1. All unnecessary dead volume in the distilling apparatus is removed since the skirt runs approximately along the whole of the length of the distilling apparatus.
2. The gas flowing into the annular space between the wall 102 of the distilling apparatus and the skirt 103 receives

extra heat by means of the heating tape 105. This, together with the high velocity in the annular space, produces minimal coke formation and thereby also reduces the thermal splitting or cracking in the unit.

3. Because of the large amounts of distillation residue circulating in the distilling apparatus - it may be about 40 m³/hr. - there is less of an increase in temperature on top of the oven, at the same time as the energy required for evaporation in the distilling apparatus is continuously supplied.

The large volume of distillate residue prevents the creation of so-called dry zones on the wall 102 of the distilling apparatus and this means that any possible signs of coke formation will be washed down.

Impurities in particle form accompanying the mass into the vacuum distilling apparatus will continuously grind the wall and aid in the cleaning.

4. The fact that the skirt 103 is drawn nearly all the way down to the end of the cylindrical portion of the distilling apparatus - that is, along the whole wall 102 - makes possible a continuous high velocity of the gas in the distilling apparatus, something which, in turn, prevents the formation of coke.

Since the lower portion is conically shaped, the gas velocity will here be reduced, and slits in the conical portion of the skirt will then permit separated gas to be forced into the centre of the distilling apparatus together with gas escaping below the lower edge of the reversed truncated cone constituting the lower portion of the skirt.

Above these slits there are, as indicated in Figure 2, placed demisters 104b, preventing that oil drops or possibly distillation residue running down from the skirt are carried

along with the gases through the slits and included in the distillate. The drip rings in the lower portion of the skirt have the effect, in the same manner as the drip ring 113 on the outlet pipe 114, that the drops will become large and thereby drip down to the conical bottom 107 of the distilling apparatus.

The relatively large inner space in the skirt gives a low gas velocity toward the outlet pipe, something which also contributes to reduce the danger of entrainment of drops or flying particles. It thus contributes toward achieving a purer and greatly improved product in the vacuum distilling apparatus 18 in the plant, as shown in Figure 1. This, in turn, vastly improves the quality achieved in the products 38, 39 and 40 after their final treatment in step 4 of the process shown in Figure 1.

Patent Claims.

1.

A method for refining waste lubricating oils into high-grade lubricating oils, comprising the following steps:

- 1) deposition of released water, distillation of residual water and light hydrocarbons;
- 2) fractionated production of fuel oils;
- 3) cyclonic vacuum distillation of the lubricating oil fractions to remove impurities such as metallic salts, sludge and soot; and
- 4) final hydrogen treatment or polishing over a catalyst, followed by subsequent fractionation;

c h a r a c t e r i z e d i n that the cyclonic vacuum distillation is carried out in a vacuum distilling apparatus comprising a cylindrical portion (102), a conical, pointed portion (112) having an outlet pipe (114), a lower, conical, pointed portion (107) having an outlet pipe (108) and an interior skirt, the interior skirt consisting of a cylindrical portion (103) running parallel to the wall (102) of the distilling apparatus and a lower, conical, pointed portion (104), provided with slits and demisters, the wall (102) being provided with heating means (105) substantially surrounding the portion which covers the cylindrical section (103) of the skirt.

2.

A vacuum distilling apparatus to be used for the method according to claim 1, comprising a wall (102) of a distilling apparatus, an upper, conical portion (112) having an outlet pipe (114) and a lower, conical, pointed portion (107) having an outlet pipe (108), and further provided with an interior skirt (103, 104), c h a r a c t e r i z e d i n that the total length of the skirt (103, 104) corresponds substantially to the total length of the cylindrical wall (102) of the distilling apparatus, the cylindrical portion (103) constituting approximately half of the height of the wall (102), in that the lower conical portion (104) of the skirt is provided

with slits (104a) and demisters (104b), and in that the wall (102) of the distilling apparatus (102) is provided with heating tape (104) substantially on the part surrounding the cylindrical portion (103) of the skirt.

FIG.1

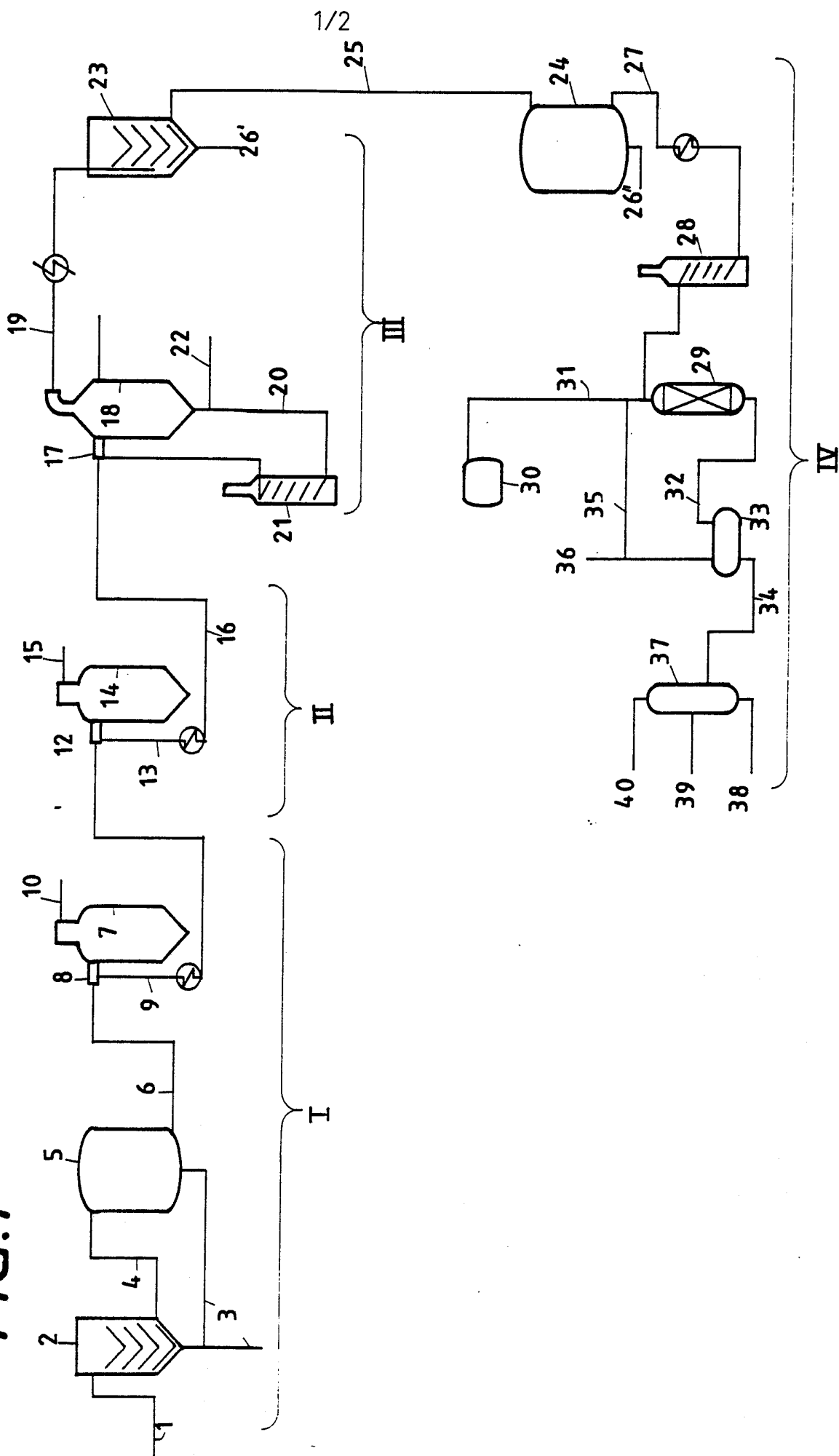
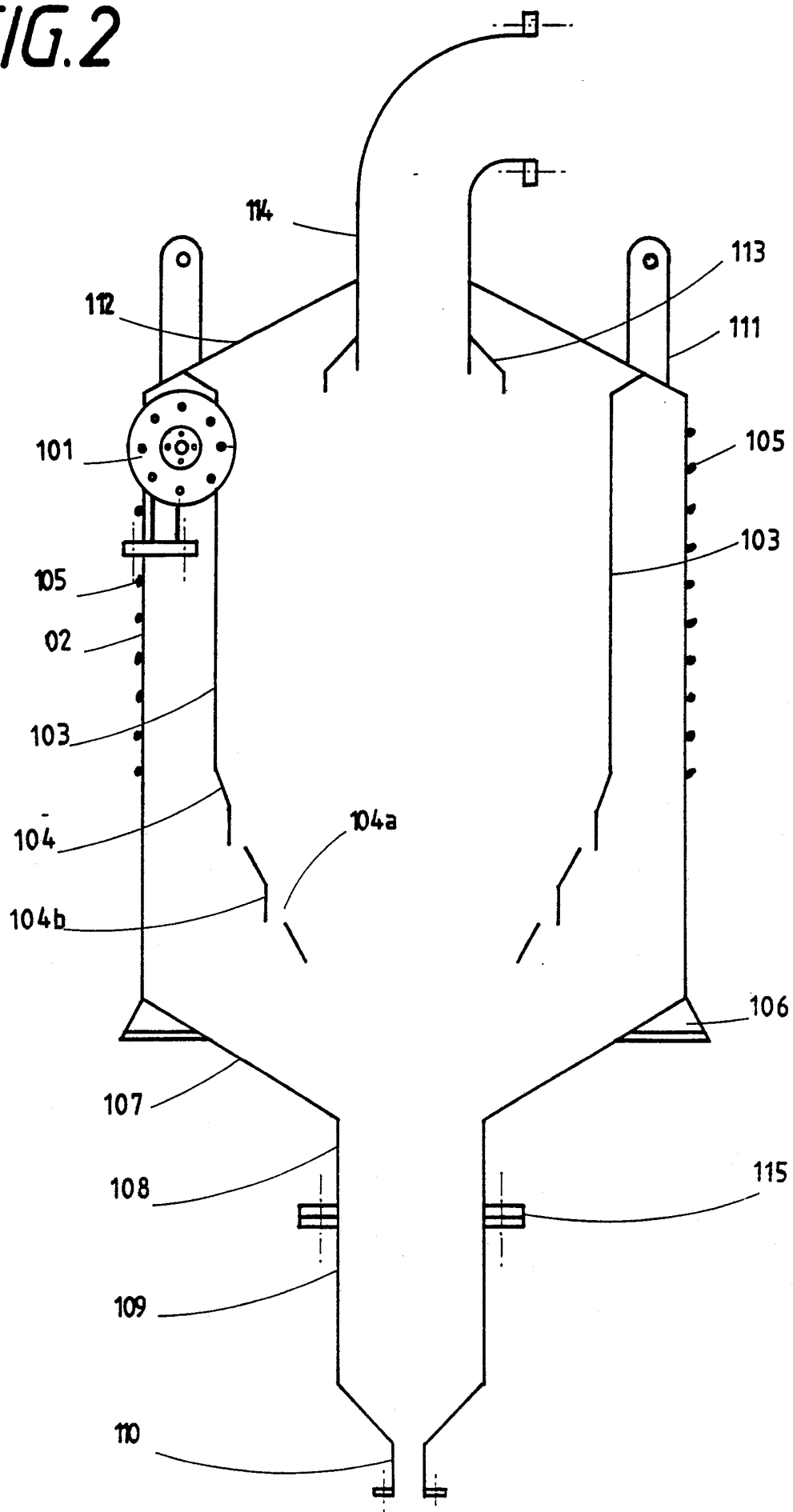


FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 92/00038

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: C 10 M 175/00														
II. FIELDS SEARCHED Minimum Documentation Searched⁷ <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 20%; padding: 5px;">Classification System</td> <td style="padding: 5px;">Classification Symbols</td> </tr> <tr> <td style="padding: 5px; height: 40px; vertical-align: bottom;">IPC5</td> <td style="padding: 5px; height: 40px; vertical-align: bottom;">C 10 M</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched⁸ SE,DK,FI,NO classes as above			Classification System	Classification Symbols	IPC5	C 10 M								
Classification System	Classification Symbols													
IPC5	C 10 M													
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹ <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 10%; padding: 5px;">Category *</th> <th style="width: 60%; padding: 5px;">Citation of Document,¹¹ with indication, where appropriate, of the relevant passages¹²</th> <th style="width: 30%; padding: 5px;">Relevant to Claim No.¹³</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 4140212 (R.H. O'BLASNY ET AL.) 20 February 1979, see figures 1,4; claim 1 -- </td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-2</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 3980551 (R.H. WOLK) 14 September 1976, see claims 1-3 -- </td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 4071438 (R.H. O'BLASNY) 31 January 1978, see figure 1; claim 1 -- ----- </td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> </tbody> </table>			Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	A	US, A, 4140212 (R.H. O'BLASNY ET AL.) 20 February 1979, see figures 1,4; claim 1 --	1-2	A	US, A, 3980551 (R.H. WOLK) 14 September 1976, see claims 1-3 --	1	A	US, A, 4071438 (R.H. O'BLASNY) 31 January 1978, see figure 1; claim 1 -- -----	1
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A	US, A, 3980551 (R.H. WOLK) 14 September 1976, see claims 1-3 --	1												
A	US, A, 4071438 (R.H. O'BLASNY) 31 January 1978, see figure 1; claim 1 -- -----	1												
* Special categories of cited documents:¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family														
IV. CERTIFICATION <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 50%; padding: 5px;"> Date of the Actual Completion of the International Search 25th May 1992 </td> <td style="width: 50%; padding: 5px;"> Date of Mailing of this International Search Report 1992 -06- 12 </td> </tr> <tr> <td style="width: 50%; padding: 5px; vertical-align: bottom;"> International Searching Authority SWEDISH PATENT OFFICE </td> <td style="width: 50%; padding: 5px; vertical-align: bottom;"> Signature of Authorized Officer Inga-Karin Petersson </td> </tr> </table>			Date of the Actual Completion of the International Search 25th May 1992	Date of Mailing of this International Search Report 1992 -06- 12	International Searching Authority SWEDISH PATENT OFFICE	Signature of Authorized Officer Inga-Karin Petersson								
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/NO 92/00038**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 28/03/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4140212	79-02-20	NONE	
US-A- 3980551	76-09-14	NONE	
US-A- 4071438	78-01-31	AU-D- 2568277	78-12-07
		BE-A- 855366	77-10-03
		DE-A- 2725132	77-12-15
		FR-A- 2353631	77-12-30
		JP-A- 53016709	78-02-16
		NL-A- 7706149	77-12-06
		SE-A- 7706427	77-12-04