(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 273 463**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87200001.3**

(51) Int. Cl.⁴: **B08B 3/08**

(22) Date of filing: **02.01.87**

(43) Date of publication of application:
06.07.88 Bulletin 88/27

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: **ARFAZ EQUIPMENT**
Puntweg 3
NL-3208 LD Spijkenisse(NL)

(72) Inventor: **Lapre, Arnold M.**
Groenedijk 62
NL-3311 DC Dordrecht(NL)

(74) Representative: **Kooy, Leendert Willem et al**
OCTROOIBUREAU VRIESENDORP & GAADE
P.O. Box 266
NL-2501 AW The Hague(NL)

(54) Method for cleaning oilfield product storage tanks.

(57) A method and equipment to remove sediment and settlements from storage tank bottoms (1) is composed of tank mixers (2), hydroclones (5) and a centrifuge (15) to remove the sediment from the tanks (1), separate the oil and further dehydrate the solids. The method is effective in reducing costs for waste disposal and tank cleaning and recovers 95% of the oil contained in the waste. The method produces semi-dry solids.

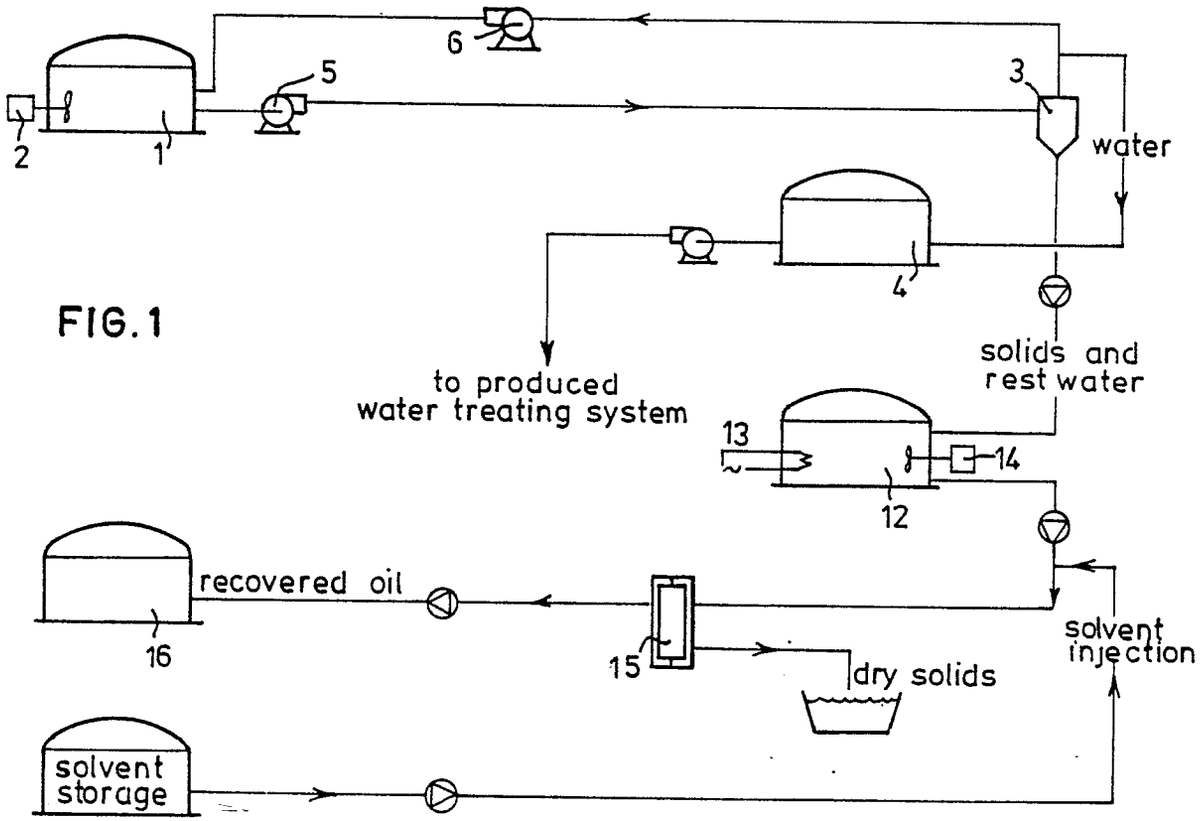

FIG. 1

EP 0 273 463 A1

Method for cleaning oilfield product storage tanks

Introduction

The problem of efficient waste removal is faced by many industries today and the oil industry is no exception. The removal of waste generated by cleaning sediment from storage and holding tanks is of particular concern. Problems relating to adequate disposal sites as well as added governmental environment restrictions are placing an increasing constraint on oilfield operations. The use of disposal sites, if available, has become very expensive and in many cases these sites are far away from actual oilfield operations. In addition to the cost associated with the disposal of tank bottom waste, there are other not so obvious costs. Two examples of these are:

the tank bottom waste is partly crude oil which should be valued to market price; and

the requirement that it takes 1, 2 barrels of flush water per barrel of waste to remove the sediment from the tank, which more than doubles the amount of waste material.

Thus it is the object of the invention to provide a method which removes the sediment from the tanks, recovers 95% of the oil, and dries the solids. The water and oil are to be returned to the main plant inlet for separation. The dried and cleaned solids can be sent to acceptable disposal sites, so that

tank bottom sediment waste disposal costs are reduced,
waste disposal volumes are reduced, and
the oil can be recovered from the sediment.

Summary of the invention

The invented method for removing bottom sediment slurry from oilfield product storage tanks is characterized in that after discharge of the oil the oil tank is filled with water to a level which is about five times the thickness of the slurry, in that the slurry is suspended in the water by mixing, in that the mixture is circulated through hydroclones which remove the suspended sediment from the water, so that the water is drained to a process tank and the sediment to a relatively small sediment tank, in that the sediment is heated to approximately 200° F in the sediment tank and then pumped to at least one centrifuge which separates dry solids from the oil and water which oil and water gravitates into an oil tank for recovered oil.

The mixing in the oil tank is preferably effected by Jensen side entry mixers.

The hydroclones preferably are centrifugal separators similar to drilling mud desanders and desilters.

Suggest, the thruput at a station avereges 90,000 bbls (billion barrels liquid) per day of 13.2 - 13.4° API crude oil, 900,000 bbl per day water and 135,000 bbls. per year of tank bottom sediment. Over 80% of this sediment settles in the tanks during the storage and deposits accumulate in all tankage. As shown in the table I below, there would have to be hauled 586 bbls. of tank bottom waste to disposal sites (including flush water and oil).

TABLE 1

WASTE DISPOSAL EXAMPLE

Thruput crude	90,000 bbl per day	
water	900,000 bbl per day	
sediment	370 bbl per day	(eq. 135,000 bbl per year)

Settlement in washtank:

80% of 370 bbl per day	= 296 bbl sediment per day	
required flush water 1.2 x 296	= 355 bbl water per day	
Total	651 bbl per day	
To disposal site 90%	= 586 bbl per day	
Oil in settlement = 0.09 x 586	= 53 bbl oil per day	
of which 95% recoverable = 0.95 x 53	= 50 bbl oil per day	

Eq. to be recovered : about 18,300 bbl oil per year

Description of the drawings

The invention will be further elucidated on the basis of the accompanying drawings showing in
fig. 1 a schematic illustration of equipment to carry out the invented method,
fig. 2 a schematic illustration of a tank mixer,
fig. 3 a schematic illustration of a hydroclone,
fig. 4 a schematic illustration of a centrifuge.

The tank cleaning system is divided into two separate systems which are depicted in fig. 1:

I The tank cleaning system consisting of tank mixers and hydroclones to remove the sediment from the tank.

II The sediment processing system consisting of a centrifuge to dry the solids and recover the oil.

I TANK CLEANING SYSTEM

In the tank cleaning system three methods can be used:

a. Mixing and circulating the tank with Jensen side entry mixers.

b. Conventional method using vacuum trucks.

Cleaning by mixing and circulating the tank 1 consists of suspending the sediment in water in the tank using a tank mixer 2 and circulating the tank contents through hydroclones 3 to remove the sediment from the water. The conventional method consists of flushing the sediment with high pressure water and hauling it by vacuum truck to a process tank 4.

c. The "Shovel" method. No need to explain that this includes many manual laborers. Thus, its many drawbacks include high cost, possible worker exposure to fumes, long downtime for the tank, no recovery of valuable products, and no reduction in the volumes of oily sludge present in the tank.

Tank cleaning by mixers consists of closing in the tank 1 and floating off the oil pad leaving 16-18 feet of water and 3-4 feet of sediment in the tank. The sediment is then suspended in the water by using a vari angle tank mixer 2. The tank is mixed for four hours to loosen the sediment on the bottom, but complete suspension is not obtained in this time. After mixing for four hours, the tank contents are circulated at a rate of 1,000 bbl. per hour by pump 5 driven by a 40 hp motor, through hydroclones 3 also using a recirculation pump 6 driven by a 40 hp motor. The pump 5 pulls suction off of the bottom of the tank through 3-8" bottom drain lines 7 as shown in Figure 2. The hydroclones, which will be discussed later, remove the suspended sediment from the water. This method is over 90% effective in cleaning the thank and requires 48 hours to clean a 10,000/bbl. tank with approximately 4 feet of sediment on the bottom. The water is then drained into the the 10,000 bbl. process tank 4 and the real tank 1 is put back into service. Any remaining sediment in the water is allowed to settle in the process tank 4 before the water is returned to the produced water treating system.

The hydroclones 3 are centrifugal separators very similar to drilling mud desanders, used to remove the sediment suspended in the water. Figure 3 is a diagram of a typical hydroclone. The fluid enters through a tangential opening 8 in the large end of a cone-shaped housing 9. This results in a whirling motion or cyclone action of the fluid. A short pipe 10 called the "vortex finder" extends down into the cone body from the top, forcing the whirling stream downward toward the small end (apex or underflow) of the cone body. Larger and/or heavier particles are thrown outward toward the wall of the cone while lighter and/or smaller particles remain in the center with the moving fluid. The larger particles and a small amount of fluid will pass out the apex 11.

The remainder of the fluids is sucked up through the vortex finder by the vacuum created in the eye of the cyclone.

Two types of hydroclones are used in the tank cleaning system:

Desanders - consisting of two 12 inch hydroclones operating in parallel. These units handel 500 gallons a minute each and will remove particle sizes down to 25-30 microns.

Desilters - consisting of twelve 4 inch hydroclones operating in parallel. These units handle 83 gallons a minute each and will remove particle sizes down to 10-15 microns.

Ninety per cent of the solids in the tank bottom sediment slurry are greater than 30 microns and are therefore removed by the desanders. The desilters are approximately 90% effective in removing the remaining 10 per cent of the solids.

II SEDIMENT PROCESSING SYSTEM:

The sediment is accumulated in a 500 bbl. sediment tank 12 which can be heated to approximately 200° F by a heating means 13 to aid in the oil recovery process. As shown in Figure 1, the sediment is pumped, using a progressive cavity pump 14, with 3hp motor and variable speed drive, to a centrifuge 15. Condensate or cutter stock is injected into the pump suction to act as a solvent to aid in recovering the oil. The cleaned solids accumulate in a storage area and the oil and water gravitate into a recovered oil tank 16.

Condensate is more commonly known as casing blow oil in steam flood operations. It is the ligt-ends which are released from the crude oil by steaming the formation. The condensate is recovered by condensing the steam and hydrocarbon vapors bled off producing well casings. Condensate is 30° API oil and is a good, inexpensive cutter stock for the sediment processing system. The system requires approximately 1 barrel of condensate per 2 barrels of heavy oil recovered.

The decanting centrifuge 15 illustrated in Figure 4 and driven by a 15hp motor is basically a rotating cone-shaped drum 17 that turns at high speeds, and an auger 18 within the drum that moves the coarse particles to a discharge port 19. The rotation creates forces of 600-800 G's giving a very efficient particle size separation. The larger or heavier particles are thrown to the outside of the drum. The auger which rotates a few RPM's slower than the drum, scrapes the particles off the side of the drum and out the discharge port 19. The fluids in the center of the bowl discharge through the liquid discharge ports 20 at the

opposite end. The centrifuge is capable of removing particle sizes to 5 microns, thereby removing 99% of the particles in the sediment.

The solids generated by the processing system are all within regulatory limits for toxicity and therefore qualify for classification as non-hazardous wastes. See Table II below:

TABLE II

ANALYSIS SOLID WASTE

CONSTITUENTS	EP TOXICITY CONCENTRATION - mg/l	EPA LIMITS
Arsenic, As	0.13	5.0
Barium, Ba	0.34	100.0
Cadmium, Cd	* 0.01	1.0
Chromium, Cr	0.08	5.0
Lead, Pb	0.40	5.0
Mercury, Hg	.007	0.2
Selenium, Se	.046	1.0
Silver, Ag	* 0.10	5.0

* Less than

The extraction procedures described in the Federal Register Volume 45, no. 98, May 19th, 1980 were used to determine lechate toxicity.

The oil generated by the processing system is 16-17° API gravity consisting of 5-10% very fine solids by volume with some emulsion. It is blended slowly into the gathering system upstream from the dehydration plant inlet. Injecting it too fast into the system creates treating problems in the oil phase at the plant. A separate treating system and new chemicals are being investigated to treat this oil along with other waste oil. Sodium silicate has been used successfully in batch treating the oil.

To clean a tank 1, the suspension of the sediment and water is dumped in the 10,000 bbl. process tank 4. If this is only 50% effective in cleaning the tank, increasing of mixing times and correct Jensen mixer operating will reduce this 50% of the sediment settled out before the tank is completely dumped. Recirculating the process tank through the hydroclones will be over 90% effective in removing the sediment.

Excessive heat (200° F plus) in the process tank may cause the release of fine asphaltine particles into the water phase. If dumped into the production gathering system, it would contaminate the oil phase, making it more difficult to treat. Filters are the solution to this problem.

The solids in the sediment may cause various wear problems in the equipment. The hydroclones have to be rubber-lined for easy replacement and wear reduction. Replacement parts for the pump have to be kept in store. The centrifuge would pack off at the solids discharge chamber. A wiper can be installed to solve this problem. Very little wear has been noted in the centrifuge.

Claims

1. Method for removing bottom sediment slurry from oil field product storage tanks, characterised in that after discharge of te oil, the oil tank is filled with water to a level which is about five times the thickness of the slurry, in that the slurry is suspended in the water by mixing, in that the mixture is circulated through hydroclones which remove the suspended sediment from the water, so that the water is drained to a

process tank and the sediment to a relatively small sediment tank, in that the sediment is heated to approximately 200° F in the sediment tank and then pumped to at least one centrifuge which separates dry solids from the oil and water, which oil and water gravitates into an oil tank for recovered oil.

2. Method as in claim 1, characterised in that mixing in the oil tank is effected by Jensen side entry mixers.

3. Method as in claim 1 or 2, characterized in that the hydroclones are centrifugal separators similar to drilling mud desanders and desilters, comprising a cone-shaped housing and a short pipe extending down into that housing.

4. Method as in claim 3, characterized in that two 12-inch hydroclones are operated in parallel, and twelve 4-inch hydroclones as well.

5. Method as in claims 1-4, characterised in that the centrifuge is of the decanting type, comprising a rotating cone-shaped drum and an auger within that drum that moves the coarse particles to the discharge.

6. Method as in claims 1-5, characterized in that filters are provided to avoid contamination of the recovered oil in case of excessive heat (200° F plus) in the process tank.

7. Method as in claims 1-6, characterized in that the hydroclones are rubber-lined.

8. Method as in claims 1-7, characterised in that the centrifuge is provided with a wiper to avoid packing off at the solids discharge.

9. Method and equipment as shown in the drawings and/or discussed on the basis thereof.

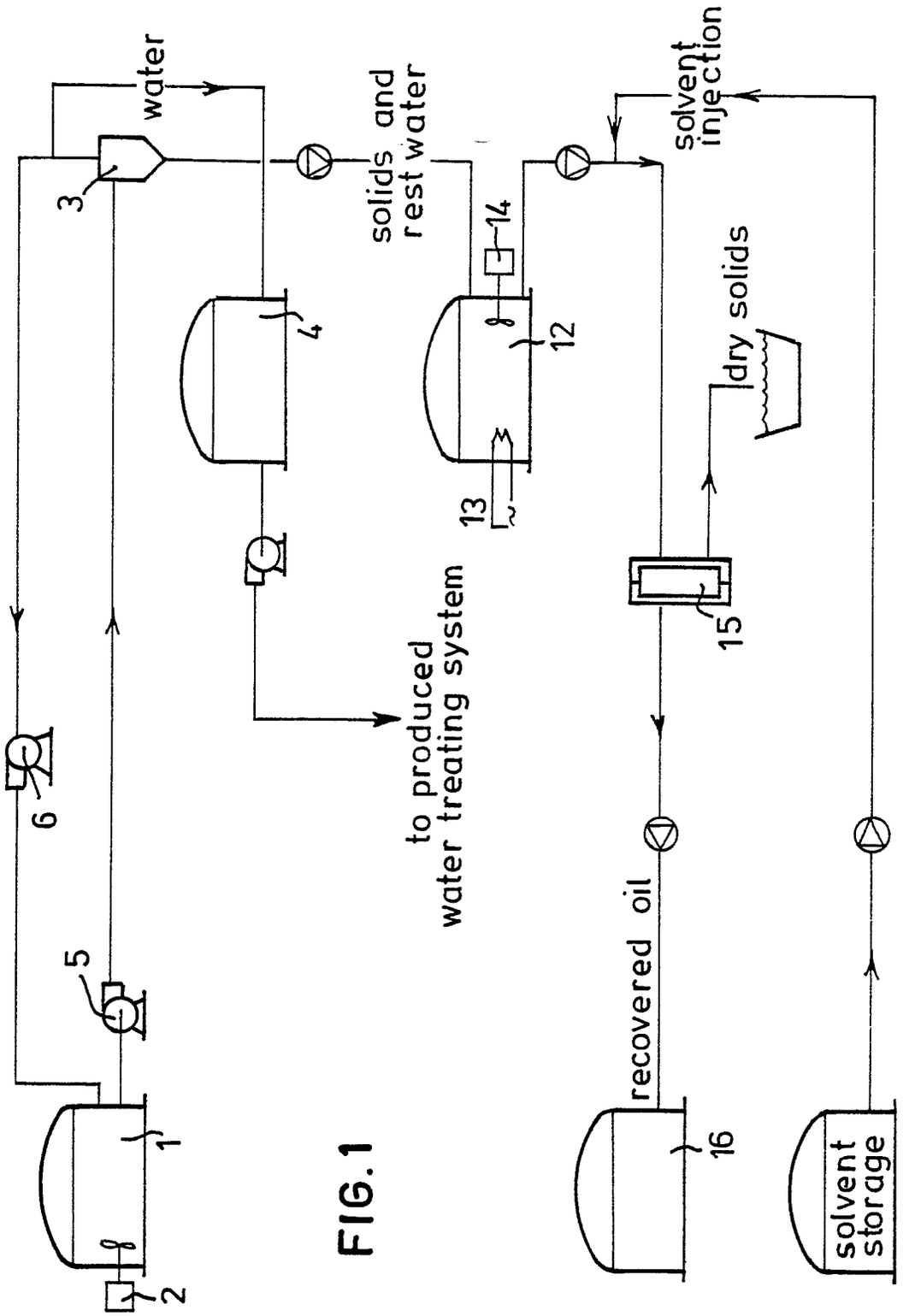
water
3
4
solids and
rest water
14
12
13
solvent
injection
dry solids
6
5
to produced
water treating system
15
recovered oil
16
solvent
storage
1
2

FIG.1

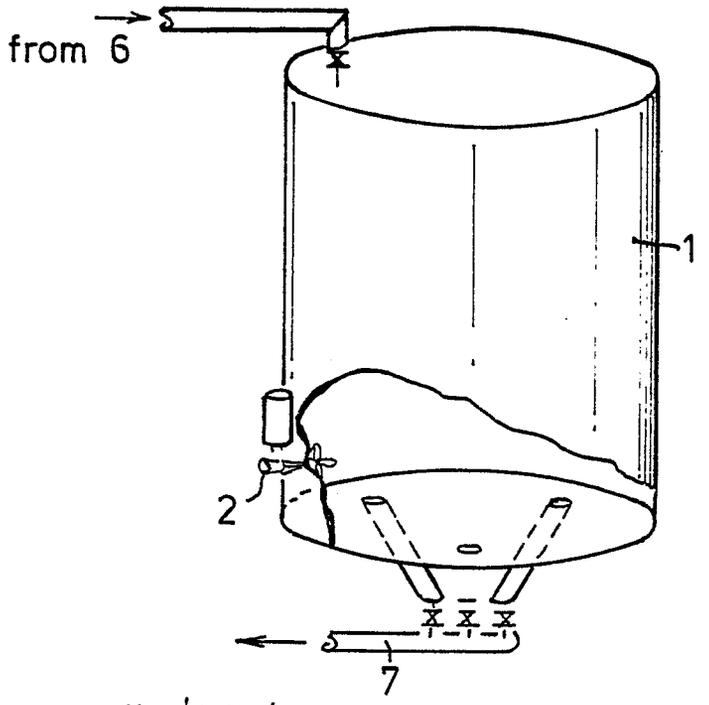

FIG. 2

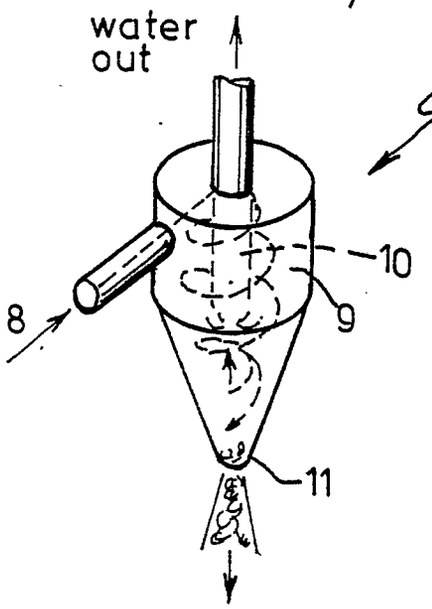

FIG. 3

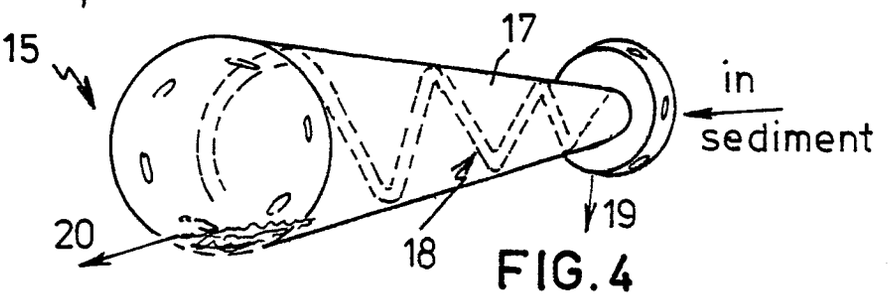

FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 20 0001

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-4 530 131 (ZELL) * Whole document *	1,3,6	B 08 B 3/08
A	GB-A-2 166 043 (URBANI) * Abstract; figure 2 *	1,3,5	
A	EP-A-0 160 805 (MATTER) * Page 8; figures 1-1a *	1,2	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 08 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-07-1987	VOLLERING J.P.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03.82