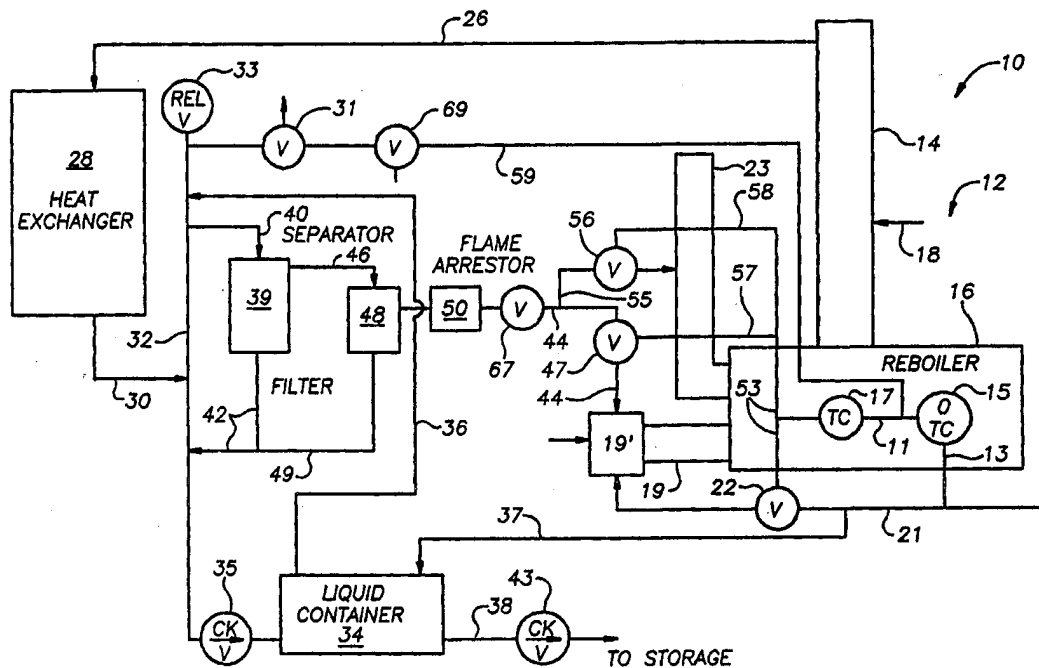




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : B01D 3/42, 53/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 98/39078 (43) International Publication Date: 11 September 1998 (11.09.98)</p>
<p>(21) International Application Number: PCT/US97/03295 (22) International Filing Date: 3 March 1997 (03.03.97) (71)(72) Applicants and Inventors: HILL, D., Jeffrey [US/US]; 244 N.W. 111th Street, Oklahoma City, OK 73114 (US). WIGGINS, E., Todd [US/US]; 244 N.W. 111th Street, Oklahoma City, OK 73114 (US). (74) Agent: RHEA, Robert, K.; Suite 305, 5350 S. Western, Oklahoma City, OK 73109 (US).</p>		<p>(81) Designated State: MX. Published <i>With international search report.</i></p>

(54) Title: METHOD AND APPARATUS UTILIZING HYDROCARBON POLLUTANTS



(57) Abstract

An environmentally safe apparatus (10) for reclaiming uncondensed hydrocarbons normally exhausted to the atmosphere from the still column (14) of a glycol dehydrator system (12), and utilizing the uncondensed hydrocarbons as fuel in the burner (20) of a reboiler fire-tube (19) by natural draft of the fire-tube exhaust stack (23).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

**METHOD AND APPARATUS UTILIZING HYDROCARBON
POLLUTANTS**

Technical Field

1 This invention relates to glycol dehydrators and more
2 particularly to a method and apparatus which eliminates noxious
3 gasses normally exhausted to the atmosphere from the still
4 column of a gas dehydrator.

5 Natural gas produced from gas wells contains entrained
6 water and oil droplets, water vapor, and condensable hydrocar-
7 bons.

8 It is necessary to remove the water and water vapor from
9 the natural gas before it passes into a pipeline to prevent
10 clogging and corrosion of the pipeline and downstream equip-
11 ment.

12 Glycol dehydrators are used to remove water and water
13 vapor from gas by contacting the wet gas with glycol absorbing
14 the water and vapor. The desiccant then flows to a reboiler
15 regenerating the glycol by driving off the water vapor,
16 allowing the reconcentrated desiccant to be returned to the
17 dehydration phase.

18 An unintentional by-product of the dehydration process is
19 the absorption of hydrocarbons with water and water vapor.

-2-

1 These hydrocarbons are normally released to the atmosphere with
2 water vapor from the regenerator. Many of these aromatic
3 hydrocarbons are hazardous to the environment, benzene, ethyl-
4 benzene, toluene, and xylene for example.

5

Background Art

6 Some prior patents, such as United States Patent No.
7 3,875,019 issued April 1, 1975 to Cocuzza et al, and United
8 States Patent No. 5,163,981 issued November 17, 1992 to Choi,
9 disclose removing noxious gasses from the vapors emitted by a
10 still column from a reboiler and passing these noxious gasses
11 to the burner of the reboiler. However, a problem occurs in
12 admitting the gasses to the reboiler burner and obtaining
13 combustion since these noxious gasses do not readily burn, as
14 does natural gas. This invention overcomes this problem.

15 The majority of the prior art patents are directed toward
16 the reclaiming and/or reconcentrating ethylene glycol.

17 United States Patent No. 4,273,620 issued June 16, 1981
18 to Knobel, United States Patent No. 4,225,394 issued September
19 30, 1980 to Cox et al, and United States Patent No. 4,322,265
20 issued March 30, 1982 to Wood, are considered good examples of
21 the further state-of-the-art in reclaiming and reconcentrating
22 used ethylene glycol.

23

Disclosure Of The Invention

24 A glycol dehydrating system includes a reboiler having an
25 upstanding still column receiving vapors having temperatures as
26 high as 177° C. In this invention the still column vent is
27 closed to prevent the normal escape of noxious gasses and water
28 vapor. These vapors are piped through a heat exchanger sized
29 to drop the temperature to less than 66° C. The condensed
30 water and condensable hydrocarbons flow by gravity to tank
31 storage through a self emptying container. The remaining
32 hydrocarbon vapors flow through a secondary separator to remove
33 remaining liquids, and through either of two thermostatically

-3-

1 controlled valves for use as dehydrator fuel. In some instal-
2 lations, the uncondensed hydrocarbons have been found to be of
3 sufficient quantity to substantially fuel the dehydrator,
4 replacing the natural gas normally used for fuel.

5 **Brief Description Of The Drawings**

6 Figure 1 is a schematic of the apparatus;

7 Figure 2 is a fragmentary side elevational view of a
8 dehydration reboiler fuel and air mixing fire-tube burner inlet
9 tube connected with a noxious gas and air mingle unit;

10 Figure 3 is a fragmentary exploded isometric view of the
11 noxious gas and air mingle unit, per se; and,

12 Figure 4 is a vertical cross sectional view taken
13 substantially along the line 4---4 of Fig. 2.

14 **Best Mode For Carrying Out The Invention**

15 Referring first to Fig. 1, the reference numeral 10
16 indicates the apparatus as a whole which includes a glycol
17 regenerating apparatus 12 comprising a reboiler 16 having an
18 over temperature controller 15, and a thermostatic temperature
19 controller 17 and having a still column 14 mounted thereon
20 receiving wet glycol from a contactor tower, not shown, via a
21 line 18. The reboiler 16 contains a fire-tube 19 having a
22 burner 20 (Fig. 2), in its burner entrance 19', supplied with
23 fuel gas by a line 21 having a fuel control valve 22 and
24 terminating in an upstanding exhaust stack 23 for heating the
25 glycol.

26 Water vapor and aromatic hydrocarbons vaporized from the
27 wet glycol are normally exhausted to the atmosphere through a
28 vent, not shown, in the wall of the still column 14. However,
29 in this invention, the still column vent is closed, and water
30 vapor and aromatic hydrocarbon gasses pass via a line 26 to an
31 air cooled heat exchanger or vapor condenser 28 where the vapor
32 volume is reduced by condensation.

33 The terms "line" and "piping" as used herein refer to

-4-

1 tubular pipes for conducting fluids.

2 Liquids flow by gravity from the vapor condenser through
3 a drain line 30 to a standpipe 32 which drains to a self
4 emptying liquid container 34 through a check valve 35. The
5 upper end portion of the standpipe is normally closed by a
6 thermostat controlled fluid pressure valve 31 and a pressure
7 relief valve 33. Air vapor or gas displaced by liquid entering
8 the liquid container 34 is vented to the upper end portion of
9 the stand pipe 32 via a line 36. The self emptying liquid
10 container 34 is fully disclosed in United States Patent No.
11 4,948,010, incorporated herein by reference. The container 34
12 is connected with the fuel gas line 21 via line 37 so that a
13 float, not shown, within the container 34 opens an internal
14 valve, similarly not shown, when the float is lifted to a
15 predetermined level by contained liquid to allow gas pressure
16 from the line 37 to discharge contained liquid to storage
17 through a check valve 43 in a drain line 38.

18 Vapor and aromatic hydrocarbon gasses in the upper end
19 portion of the stand pipe 32 pass to a separator 39 via a line
20 40. Condensed liquids in the separator drain by gravity through
21 a line 42 to the depending end portion of the stand pipe 32 and
22 to the liquid container 34. Hydrocarbons leaving the separator
23 39 are filtered by a filter 48 in a conduit 44 connected to the
24 burner 20 through a normally open thermostat- control valve 47.
25 Separated liquids in the filter 48 drain to the separator drain
26 line 42 via a line 49. A flame arrestor 50 is interposed in
27 the conduit 44 downstream from the filter 48. A branch line 55,
28 connected with the conduit 44 upstream from the valve 46
29 diverts gasses, under certain conditions as presently ex-
30 plained, to the exhaust stack 23 through a normally closed
31 thermostat controlled valve 56.

32 The over temperature controller 15 is connected with the
33 fuel gas supply 21 upstream from the valve 22 by a line 13 and

-5-

1 with the thermostatic temperature control 17 by a line 11.
2 During normal operation, the temperature control 17 supplies
3 fuel gas pressure to operate the valves 22, 46, and 56, by gas
4 piping 53, 57 and 58, respectively. Other gas piping 59
5 connects the line 11 to the vent valve 31. In the event of
6 reboiler temperature above a predetermined limit, the over
7 temperature controller 15 removes gas supply pressure to the
8 thermostat temperature control valve 17 and vent valve 31, thus
9 closing fuel and uncondensed hydrocarbons supply valves 22 and
10 46, and opening exhaust stack valve 56 and vent
11 valve 31.

12 Referring also to the remaining Figures, the burner 20 is
13 provided with an inlet opening defined by a laterally project-
14 ing boss 60 connected with the fuel line 21. The fuel burner
15 mixer end 62 is open for admitting air to be mixed with the
16 fuel from the line 21, the quantity of air being manually
17 adjusted by a baffle plate 63 on a threaded stem 64.

18 An aromatic gas and air mingle element 65 is interposed
19 between the burner end 62 and the air inlet control plate 63.
20 The mingler 65 is provided with a tubular end portion 66 which
21 receives aromatic gasses from the conduit 44. The mingle
22 element 65 has opposing side walls 68 and 70 provided with
23 axially aligned openings 72 and 74 surrounding the burner stem
24 64. The wall forming the side wall opening 72 slidably
25 surrounds the burner stem 64. The side wall 68 is provided with
26 a plurality of radial openings 73, four in the example shown,
27 admitting gas from the mixer 65 to the burner 20. The diameter
28 of the side wall opening 74 is substantially equal with the
29 diameter of the baffle plate 63.

30 A cylindrical flame arresting element 75 is axially
31 interposed between the burner end 62 and the mingler side wall
32 68. A nut 76 on the stem 64 holds the side wall 68 in contact
33 with the adjacent surface of the element 75. In addition to its

-6-

1 flame arresting characteristics, the element 75 acts to
2 thoroughly mix or commingle the aromatic gasses with air to
3 form a combustible mixture as they enter the burner 20. A
4 manually operated control valve 67 is interposed in the conduit
5 44 downstream from the flame arrestor 50, and a manual bleed
6 valve 69 is interposed in the gas piping 59 upstream from the
7 vent valve 31.

8 As an example, the above described system was installed
9 on a glycol dehydrator and operated for 90 days. The dehydra-
10 tor has a 375,000 BTU heater, a 76.2 cm contactor, and dries 20
11 mmcf natural gas per day. Gas temperature is 43° C. Contactor
12 pressure is 1,000 psi. Total liquid hydrocarbons recovered,
13 3.33 bbls/day x 90 = 299.7 bbls. Total natural gas fuel saved
14 by using the aromatic hydrocarbons as fuel is: 18 mcf/day x 90
15 = 1.620 mmcf.

16 Under normal conditions the apparatus continuously
17 operates under a predetermined temperature controlled by the
18 temperature controller 17. In the event of a malfunction, such
19 as the temperature rising or falling to a temperature range
20 beyond the setting of the temperature control, the over temp-
21 erature controller 15 closes the burner valve 22 and uncon-
22 densed hydrocarbon gas valve 47 and opens the uncondensed
23 hydrocarbon gas valve 56 to the exhaust stack 23 and opens the
24 vent valve 31 to atmosphere. Uncondensed hydrocarbon gasses
25 diverted to the exhaust stack are mingled with a thermal draft
26 in the presence of an igniter, not shown.

27 Obviously the invention is susceptible to changes or
28 alterations without defeating its practicability. Therefore,
29 we do not wish to be confined to the preferred embodiment shown
30 in the drawings and described herein.

-7-

Claims

1 1. A method for recovering water and aromatic hydrocar-
2 bons evaporated from glycol in a still column (14) mounted on
3 a reboiler (16), having a fire-tube (19) provided with a fuel
4 and air intake end (19'), in a glycol regenerating apparatus
5 (12), the method including the steps of: (a) passing water and
6 hydrocarbons vapor from said still column (14) to a vapor
7 condenser (28); (b) passing uncondensed vapors from said vapor
8 condenser (28) to a condensate separator (39); (c) passing
9 effluent from said vapor condenser (28) and said separator (39)
10 to a self emptying container (34); and, (d) passing non-
11 condensable hydrocarbon vapors from said condensate separator
12 (39) through a hydrocarbon vapor and air mingler (65) at the
13 fuel and air intake end of the fire-tube in said reboiler,
14 whereby the only gaseous discharge from the reboiler regenerat-
15 ing apparatus (16) is combustion products from the reboiler
16 fire-tube.

1 2. The method of claim 1 wherein said vapor condenser
2 (28) is an air cooled condenser.

1 3. An apparatus for recovering water and aromatic
2 hydrocarbons evaporated from glycol comprising a glycol
4 regenerating apparatus (12) including a still column (14), said
5 regenerator apparatus also including an over temperature
6 controller (15) and a thermostat temperature control (17) on a
7 reboiler section (16) having a fire-tube (19) therein including
8 a burner (20) having a fuel and air intake end portion (19')
9 and an opposite exhaust stack end portion (23) extending
10 therefrom, characterized by: a water and hydrocarbon gas vapor
11 condenser means (28) down-stream from said still column (14)
12 including separate outlets for water and condensed hydrocarbons
13 and uncondensed hydrocarbons; an uncondensed hydrocarbons
14 separator (39) downstream from said vapor condenser (28) and
15 having separate outlets for water and condensed hydrocarbons

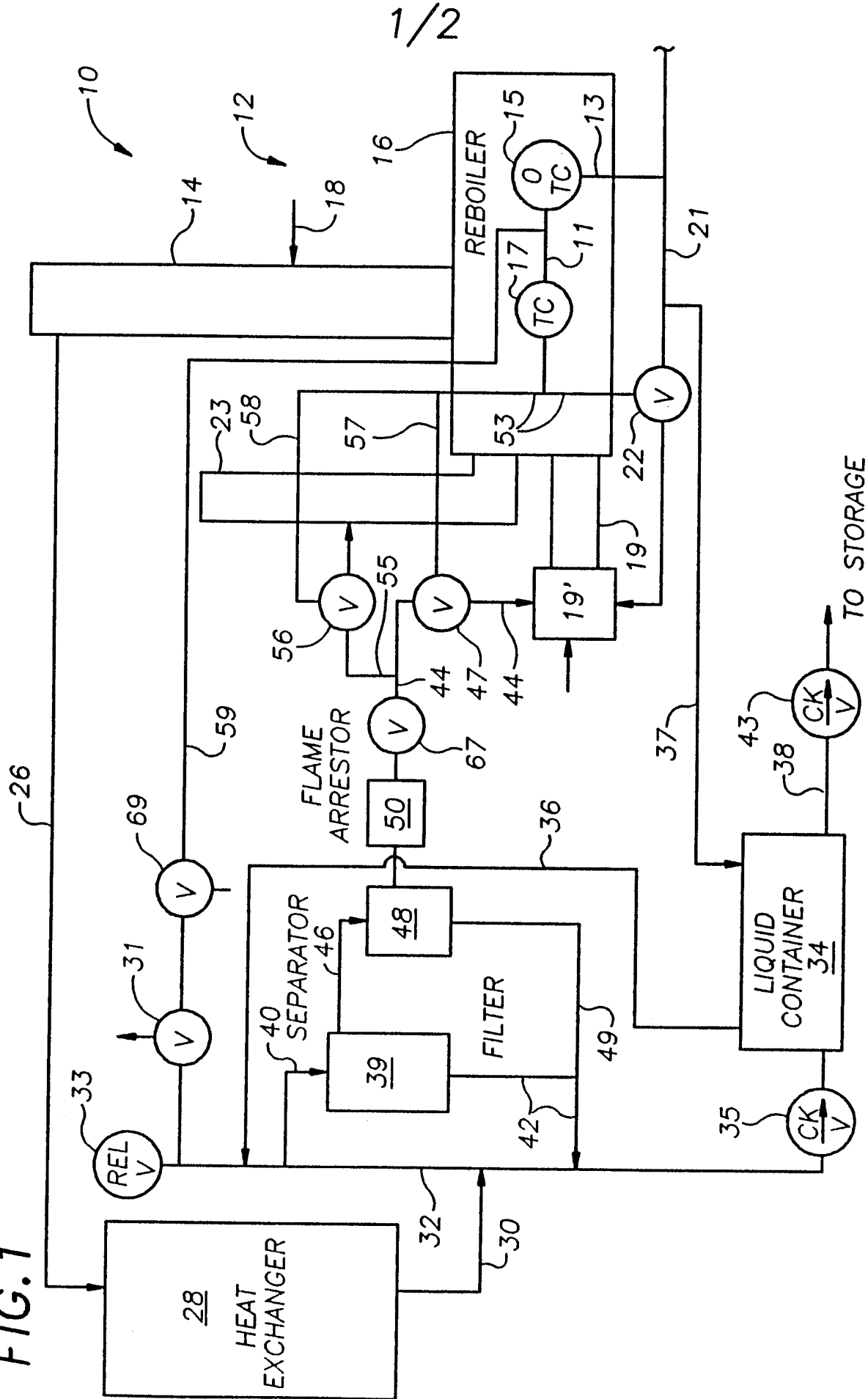
-8-

16 and uncondensed hydrocarbons; a self emptying to storage
17 liquid receiving container (34) down stream from the water and
18 condensed hydrocarbons outlet of said vapor condenser and said
19 separator; a conduit (44) extending from said separator (39)
20 for convey-ing uncondensed hydrocarbons to said burner (20);
21 and, an air and uncondensed hydrocarbons mingle means (65)
22 inter-posed between said conduit (44) and said burner (20) for
23 forming a combustible mixture entering said burner.

1 4. The apparatus according to claim 3 and further
2 including: pipe means (37) connecting burner fuel gas with
3 said container (34) for displacing condensate therein; and,
4 a vent tube (36) connecting said container (34) with the vapor
5 condenser uncondensed hydrocarbons outlet (32).

1 5. The apparatus according to claim 4 and further
2 including: a first normally closed valve (31) on said vapor
3 condenser outlet (32) upstream from the uncondensed hydrocar-
4 bons outlet (40); a second normally open valve (47) interposed
5 in said conduit (44); a third normally closed valve (56) and
6 tubing (55) interposed between said conduit (44) and said
7 reboiler exhaust stack (23) upstream from said second valve
8 (47); and, reboiler fuel gas piping means (57, 58, and 59),
9 connecting said temperature controller (17) with said first
10 (31), second (47) and third (56) valves for opening said first
11 and third valves and closing said second valve, respectively,
12 in response to a temperature malfunction.

FIG. 1



1/2

2/2

FIG. 2

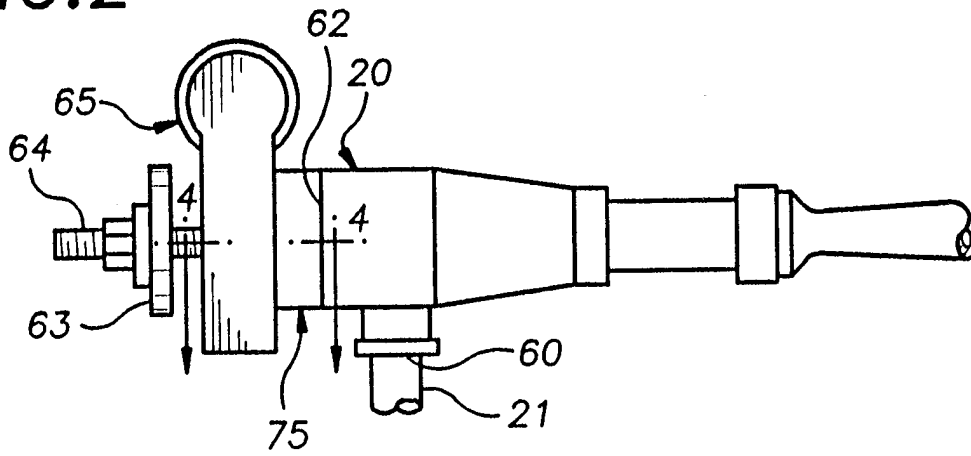


FIG. 3

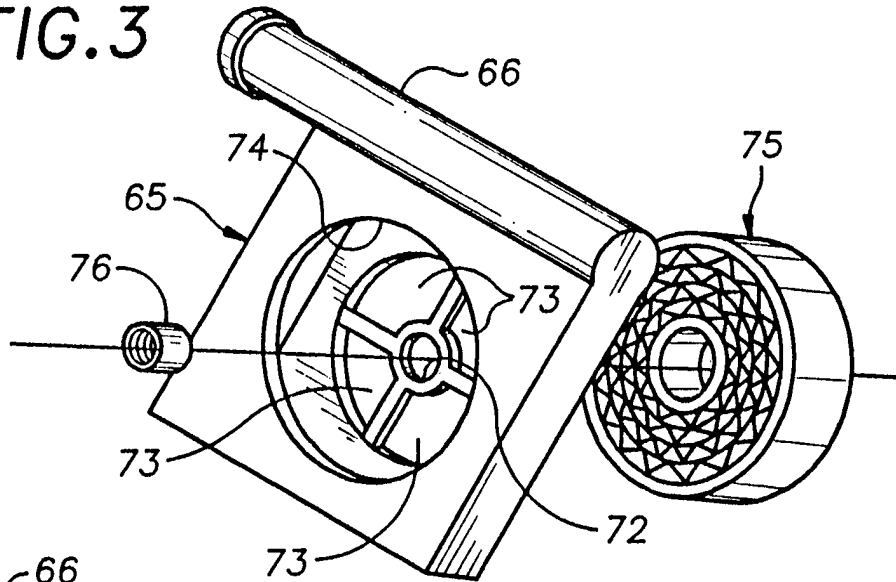
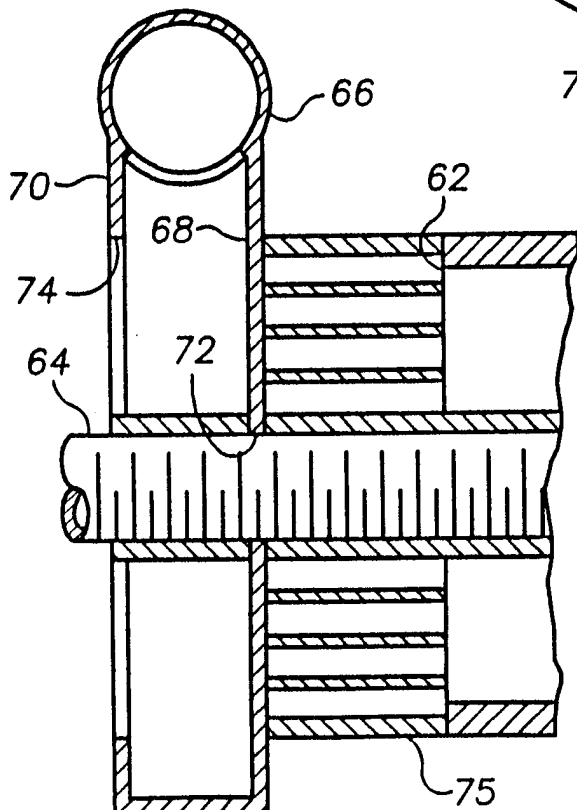


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/03295

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :BOID 3/42, 53/00
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 55/228, 257.7, 267, 270; 95/14, 18, 193, 251, 254; 96/173; 202/160, 182, 185.3, 202; 203/2, Dig. 18; 261/152; 431/.5

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,234,552 (MCGREW ET AL) 10 August 1993, See column 6, lines 5-37	1-3
Y	US, A, 5,084,074 (BEER ET AL) 28 January 1992, See column 3, lines 11-64.	1-4
A	US, A, 3,347,019 (BARNHART) 17 October 1967, See entire document.	1-5
A	US, A, 3,914,115 (PARKER, SR.) 21 October 1975, See entire document.	1-5
A	US, A, 3,443,623 (SINEX) 13 May 1969, See entire document.	1-5
A	US, A, 5,141,536 (SCHIEVELBEIN ET AL) 25 August 1992, See entire document.	1-5

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search 16 MAY 1997	Date of mailing of the international search report 24 JUN 1997
--	---

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer: <i>Debbie Tran</i> VIRGINIA MANOHARAN Telephone No. (703) 308-3844
--	--

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/03295

A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

55/228, 257.7; 95/193, 254; 96/173; 202/160, 182, 185.3, 202; 203/2, Dig. 18; 431/.5