PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification [4] :		(11) International Publication Number:
B04C 5/04, 5/12, 5/28 **B04C 7/00**	**A1**	**WO 86/ 06301**
		(43) International Publication Date: 6 November 1986 (06.11.86)

(21) International Application Number: PCT/AU86/00111

(22) International Filing Date: 23 April 1986 (23.04.86)

(31) Priority Application Number: PH 0274/85

(32) Priority Date: 23 April 1985 (23.04.85)

(33) Priority Country: AU

(71) Applicant *(for all designated States except US):* CARROLL, Noel [AU/AU]; Sherbrooke Road, Sherbrooke, VIC 3789 (AU).

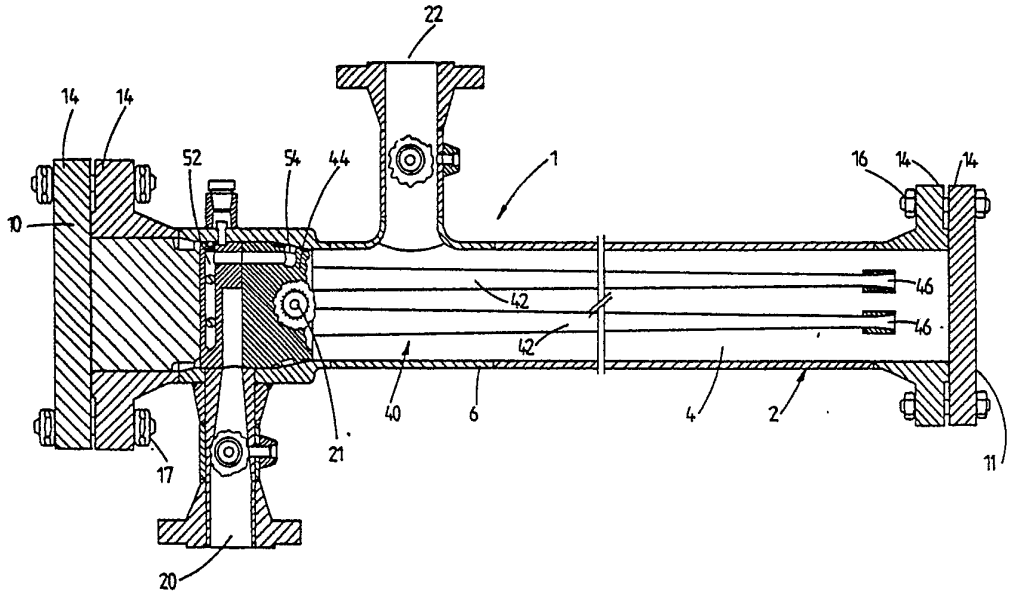
(72) Inventor; and
(75) Inventor/Applicant *(for US only) :* WEBB, David, Andrew [AU/AU]; 4 Simla Court, Heathmont, VIC 3135 (AU).

(74) Agents: SMEETON, Anthony, R. et al.; Davies & Collison, 1 Little Collins Street, Melbourne, VIC 3000 (AU).

(81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE, DE (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL, NL (European patent), NO, SE (European patent), US.

Published
With international search report.

(54) Title: SYSTEM AND APPARATUS FOR THE SEPARATION OF MULTI-PHASE MIXTURES



(57) Abstract

A combined feed head and overflow collection device (44) for a parallel flow multiple cyclone arrangement in a single closed tubular casing (2), the casing having a single inlet port (20) and outlet ports (22, 21) for the underflow and overflow. The head includes a major inlet passage (48) in communication with the inlet port (20) and leading to a plurality of tangentially directed feed inlets (50) each feeding to a separate cyclone unit (42). The head further includes an annular outlet passage (54) for the overflow fluid from the individual cyclones (42) and a tapered sealing portion to provide a seal with a similarly tapered portion of the casing (1). The outlet passage (54) may be located in this portion.

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.

AT	Austria	**GA**	Gabon	**MR**	Mauritania
AU	Australia	**GB**	United Kingdom	**MW**	Malawi
BB	Barbados	**HU**	Hungary	**NL**	Netherlands
BE	Belgium	**IT**	Italy	**NO**	Norway
BG	Bulgaria	**JP**	Japan	**RO**	Romania
BR	Brazil	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SN**	Senegal
CH	Switzerland	**LI**	Liechtenstein	**SU**	Soviet Union
CM	Cameroon	**LK**	Sri Lanka	**TD**	Chad
DE	Germany, Federal Republic of	**LU**	Luxembourg	**TG**	Togo
DK	Denmark	**MC**	Monaco	**US**	United States of America
FI	Finland	**MG**	Madagascar		
FR	France	**ML**	Mali		

"SYSTEM AND APPARATUS FOR THE SEPARATION OF MULTI-PHASE MIXTURES"

This invention relates generally to the separation of multi phase mixtures and more particularly though not exclusively, to the separation of oil/water mixtures.

It is an object of the present invention to provide an improved system and apparatus for use in the system which is more efficient and more compact than the prior art devices.

According to one aspect of the present invention there is provided apparatus for separating multi-phase mixtures or at least partially separating a more dense component of the mixture from a less dense component thereof, the apparatus comprising an outer casing having a cavity therein, an intake port through which, in use, the mixture is fed to the apparatus, a first outlet port from which a more dense component can be discharged from the apparatus and a second outlet port from which a less dense component can be discharged from the apparatus, the apparatus further including a cyclone separating means which is locatable within said cavity and comprises a plurality of separating chambers each chamber having a primary portion which has a greater cross-sectional dimension at one end than at its other end and comprises an

inlet at least two outlets one of said outlets of each separating chamber being in communication with said first outlet port and the other of said outlet being in communication with said second outlet port, and said inlets being in communication with said intake port. Preferably the cyclone separating means is removable from the cavity.

Preferably, one of the outlets comprises an overflow outlet at the end of the separating chamber of greater cross sectional dimension and the other outlets comprises an under flow outlet 22 at the other end of the separating chamber. It is to be understood, however, that other arrangements are envisaged. For example, both outlets could be disposed at the downstream end with suitable arrangements for removing the separated phases.

In one arrangement, the separating means includes a head portion operatively connected to or formed integral with the aforementioned one end of each of the separating chambers. The head portion includes a major inlet passage in fluid communication with the intake port of the apparatus and the plurality of tangentially directed feed inlets communicating with the major inlet passage and directing fluid to respective ones of the separating chambers. The underflow outlets are preferably in communication with the cavity, so that the more dense component can pass into the cavity and then be discharged through the second outlet port.

Preferably, the outer casing comprises an elongated tubular member having its ends closed by plugs or caps. Furthermore, the intake port and a second outlet port are preferably disposed adjacent the head portion and the first outlet port is spaced from the head portion. Preferably, the head portion comprises a major inlet passage

in fluid communication with the intake port when the device is disposed within the cavity. The head portion may also comprise a block like element having the major inlet passage formed therein and a series of tangentially directed feed inlets associated therewith which feed the mixture to respective primary portions of the separating chamber.

Preferably, four separating chambers are provided, each having one of the feed inlets which is of involute form.

Preferably, the head portion includes an outlet passage for discharge of the less dense component through the first outlet port, the outlet passage comprising a groove in the outer surface of the block like element from which the less dense component is discharged, the annular outlet passage being disposed near the end of the block, adjacent the separating chambers.

Collecting passages may be provided for receiving the separated component from the overflow end of each chamber and transferring it to the outlet passage. The head portion may further comprise a tapered forward end which is adapted to seat in a complementary tapered portion on the outer casing, the outlet passage being provided on this tapered portion sealing means.

According to another aspect of the present invention there is provided a system for separating multi-phase mixtures comprising an input line through which the multi-phase mixture is delivered, an output line through which at least one of the separated phases of the mixture is discharged and a plurality of apparatus according to any preceding claim arranged in parallel between the input and output lines, valve means being provided so that each apparatus

can be selectively operable or inoperable.

Preferred embodiments of the invention will hereinafter be described with reference to the accompanying drawings and in those drawings:

Figure 1 is a sectional side elevation of the apparatus according to the present invention;

Figure 2 is a sectional side elevation of the outer casing of the apparatus according to the present invention;

Figure 3 is a sectional side elevation of the cyclone separating device;

Figures 4 to 7 are more detailed views of the head portion of the apparatus; and

Figure 8 is a schematic view of a system according to the invention.

Referring to the drawings, the apparatus generally indicated at an outer casing 2 having a cavity 4 therein. An intake portion 20 is provided through which, in use, the mixture is fed to the apparatus, and a first outlet port 21 from which a more dense component can be discharged from the apparatus and a second outlet port 22 from which a less dense component can be discharged from the apparatus. The apparatus further includes a cyclone separating device 40 which comprises a plurality of separating chambers 42 each chamber having a primary portion which has a greater cross sectional diameter at one end than at its other end and further having an overflow outlet 45 at one end thereof, and an underflow outlet 46 at the other end thereof.

The separating device further includes a head portion 44 operatively connected to or formed integral with the overflow outlet end of each of the separating chambers 42. The head portion 44 includes a major inlet passage 48 in fluid communication with the

intake portion of the apparatus and the plurality of tangentially directed feed inlets, communicating with the major inlet passage and directing fluid to respective ones of the separating chambers, the underflow outlets being in communication with the cavity, so that the more dense component can pass into the cavity and then be discharged through the second outlet port.

As shown, the outer casing 3 comprises an elongated tubular member 6, having its ends closed by suitably fitting plugs or caps 10 and 11. The intake port may be in a form of an intake pipe at one end of the elongated member and the second outlet port may be in the form of a pipe also at the aforementioned one end or spaced therefrom. The intake port, in use, is adapted to deliver to the apparatus the mixture required to be separated and the second outlet port is adapted to discharge the more dense component from the apparatus. Preferably the first outlet port which is adapted to discharge the less dense component from the apparatus is also disposed at the aforementioned one end.

As mentioned, the cyclone separating device comprises a plurality of separating chambers which conveniently may be of the type described in applicant's many co-pending patent applications relating to cyclone separators. The primary portions are preferably operatively connected to or formed integral with the head portion which has a major inlet passage in fluid communication with the intake port when the device is disposed within the cavity.

The head portion comprises a block like element having the major inlet passage formed therein and a series of tangentially directed feed inlets associated therewith which feeds the mixture to respective primary portions of the separating chambers. Preferably where four separating chambers are provided, four

feed inlets are provided and desirably these feed inlets are of involute form.

The head portion further includes an outlet passage for discharge of the less dense component (e.g. the oil) through the first outlet port. Preferably the outlet passage is defined by a groove in the outer surface of the block like element from which the oil is discharged. Preferably, the annular outlet passage is disposed near the end of the block, adjacent the separating chambers for reasons which will hereinafter become apparent. Collecting passages may also be provided for receiving the separated component from the overflow end of each chamber and transferring it to the outlet passage.

Preferably the head portion comprises a tapered forward end which is adapted to seat in a complementary tapered portion on the outer casing. Preferably the outlet passage is provided on this tapered portion and suitable sealing means such as O-rings are disposed on either side of the groove. As this groove is disposed at the forward end of the head portion, the pressure of the incoming fluid mixture into the head portion, tends to force the tapering sides together to assist in sealing of the two parts.

As shown in Figure 8, a system for separating multi-phase mixtures comprising an input line through which the multi-phase mixture is delivered, an output line through which at least one of the separated phases of the mixture is discharged and a plurality of apparatus as described above arranged in parallel between the input and output lines. Preferably, valve means is provided so that each apparatus can be made selectively operable or inoperable.

CLAIMS:-

1. Apparatus for separating multi phase mixtures or at least partially separating a more dense component of the mixture from a less dense component thereof, the apparatus comprising an outer casing (2) having a cavity therein, an intake port (20) through which, in use, the mixture is fed to the apparatus, a first outlet port (22) from which a more dense component can be discharged from the apparatus and a second outlet port (21) from which a less dense component can be discharged from the apparatus, the apparatus further including a cyclone separating means (40) locatable within said cavity and which comprises a plurality of separating chambers (42), each chamber having a primary portion which has a greater cross-sectional dimension at one end than at its other end and comprises an inlet (50), at least two outlets (44) (46), one of said outlets (46) of each separating chamber being in communication with said first outlet port (22) and the other of said outlet (44) being in communication with said second outlet port (21), and said inlets (50) being in communication with said intake port (20).

2. Apparatus according to claim 1 wherein one of said outlets comprises an overflow outlet (21) at the end of the separating chamber of greater cross sectional dimension and the other said outlets comprises an under flow outlet (22) at said other end of said separating chamber.

3. Apparatus according to claim 1 or claim 2 wherein said separating means includes a head portion (44) operatively connected to or formed integral with said one end of each of the separating chambers, the head portion including a major inlet passage (48) in fluid communication with the intake port (20) of the apparatus and the plurality of tangentially directed feed inlets (50), communicating with the major inlet passage (48) and directing fluid to respective ones of the separating chambers, the underflow outlets (46) being in communication with the cavity, so that the more dense component can pass into the cavity and then be discharged through the second outlet port (21).

4. Apparatus according to c laim 3 wherein the outer casing comprises an elongated tubular member (6), having its ends closed by plugs or caps (10, 11).

5. Apparatus according to claim 3 or claim 4 wherein said intake port (20) and said second outlet port (21) are disposed adjacent said head portion (44) and said first outlet port (22) is spaced from said head portion (44).

6. Apparatus according to claim 3,4 or 5 wherein said head portion (44) comprises a major inlet passage (48) in fluid communication with the intake port (20)when the device is disposed within the cavity.

7. Apparatus according to claim 3,4,5 or 6 wherein said head portion (44) comprises a block like element having said major inlet passage (48) formed therein and a series of tangentially directed feed inlets associated therewith which feed the mixture to respective primary portions of the separating chambers.

8. Apparatus according to claim 7 wherein four separating chambers are provided, each having one said feed inlets which is of involute form.

9. Apparatus according to claim 8 wherein the head portion (44) includes an outlet passage (52) for discharge of the less dense component through the first outlet port, the outlet passage comprising a groove in the outer surface of the block like element from which the less dense component is discharged, the annular outlet passage being disposed near the end of the block, adjacent the separating chambers.

10. Apparatus according to claim 9 including collecting passages (54) for receiving the separated component from the overflow end of each chamber and transferring it to the outlet passage.

11. Apparatus according to claim 10 wherein head portion (44) comprises a tapered forward end which is adapted to seat in a complementary tapered portion on the outer casing, the outlet passage being provided on this tapered portion sealing means.

12. A system for separating multi phase mixtures comprising an input line through which the multi phase mixture is delivered, an output line through which at least one of the separated phases of the mixture is discharged and a plurality of apparatus according to any preceding claim arranged in parallel between the input and output lines, valve means being provided so that each apparatus can be selectively operable or inoperable.

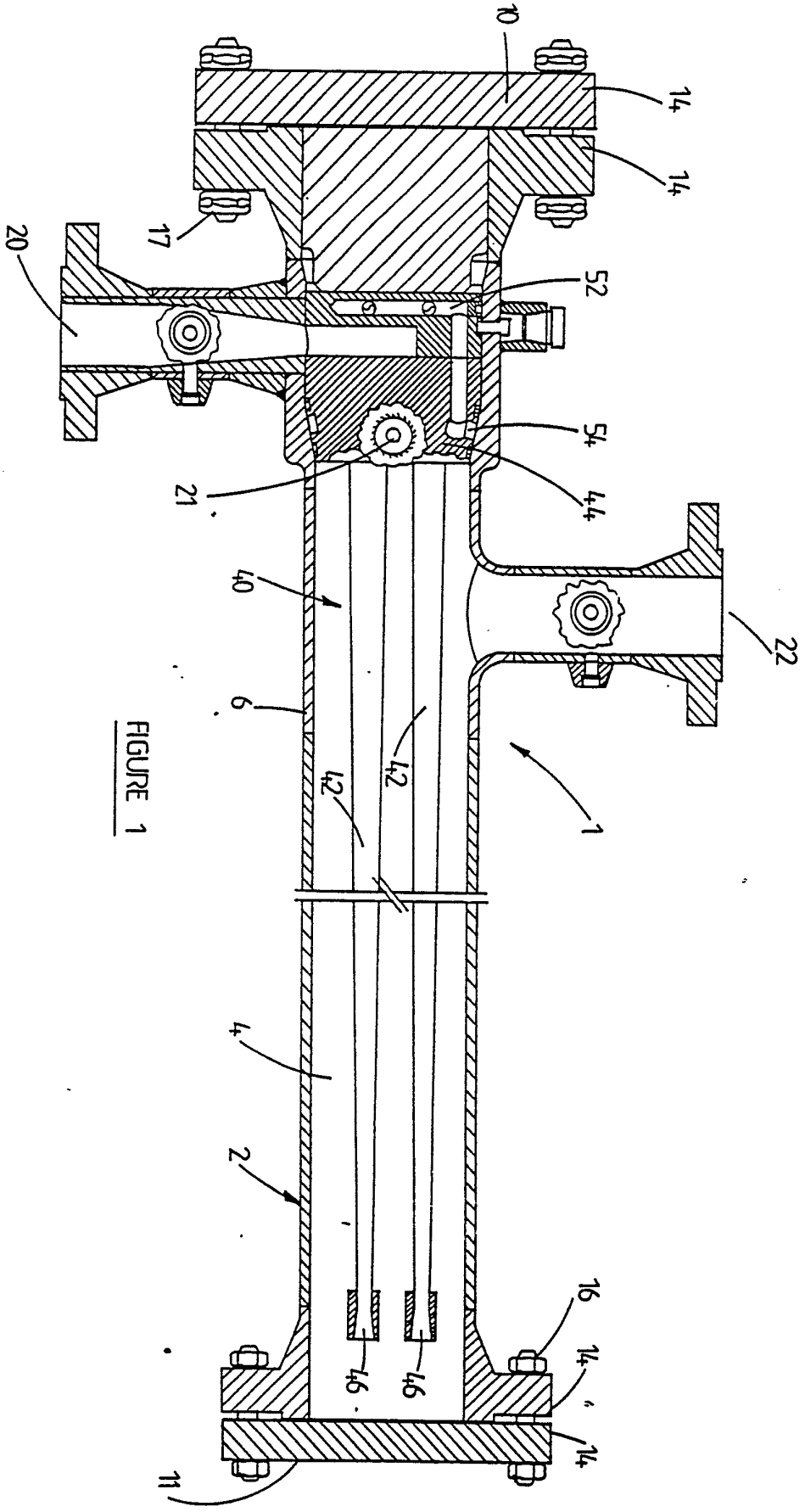


FIGURE 1

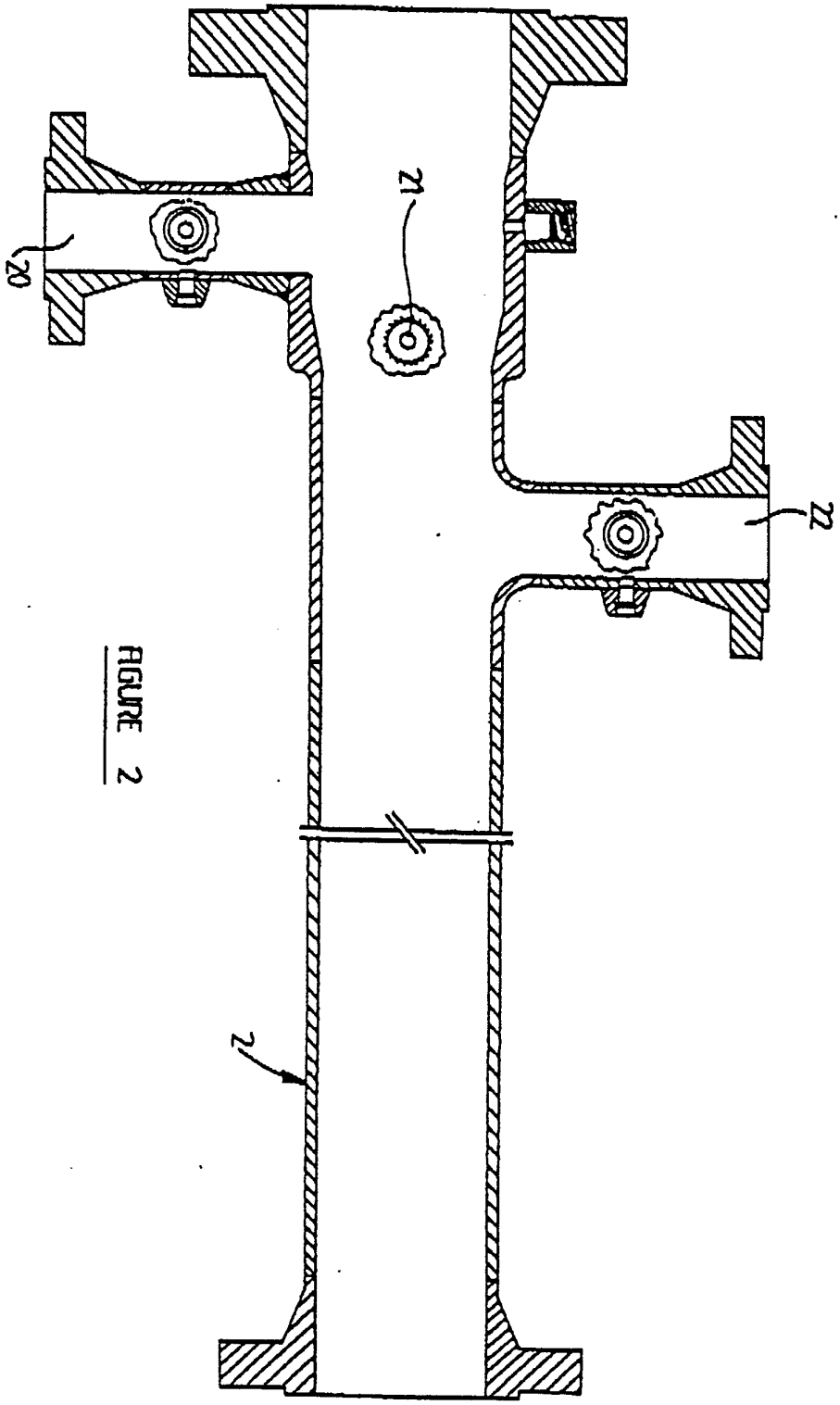


FIGURE 2

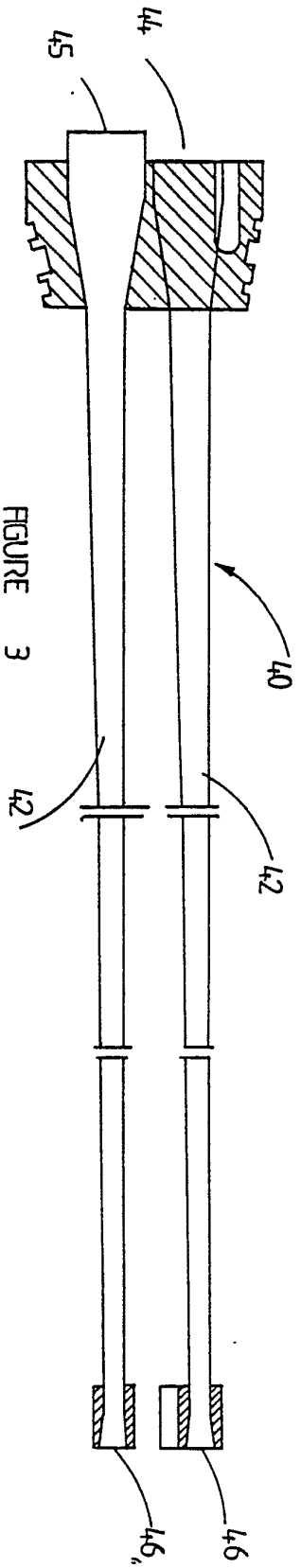


FIGURE 3

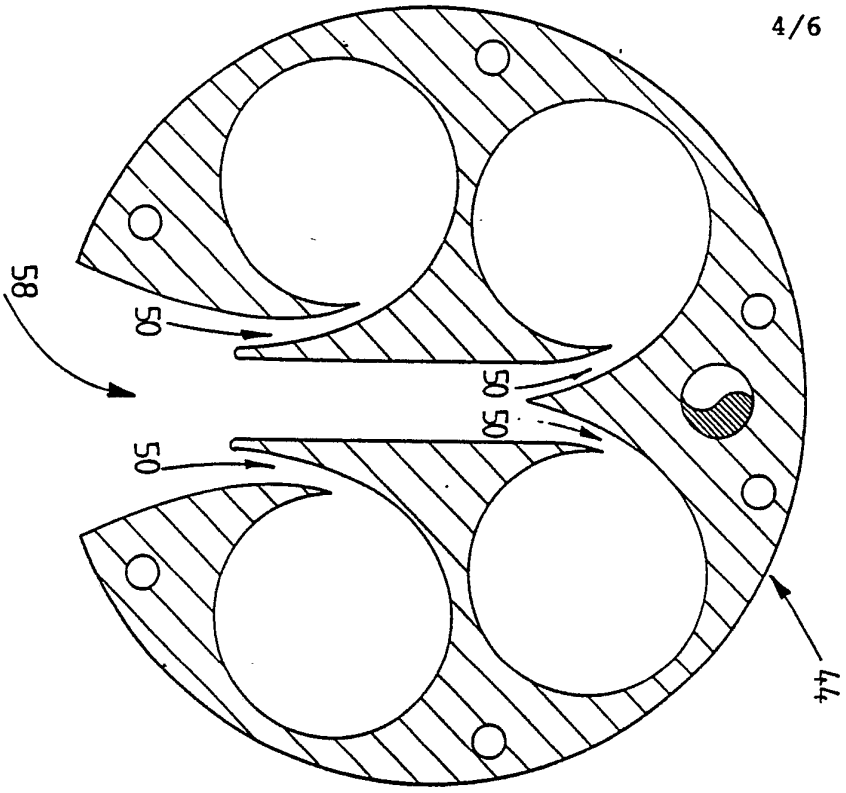


FIGURE 4

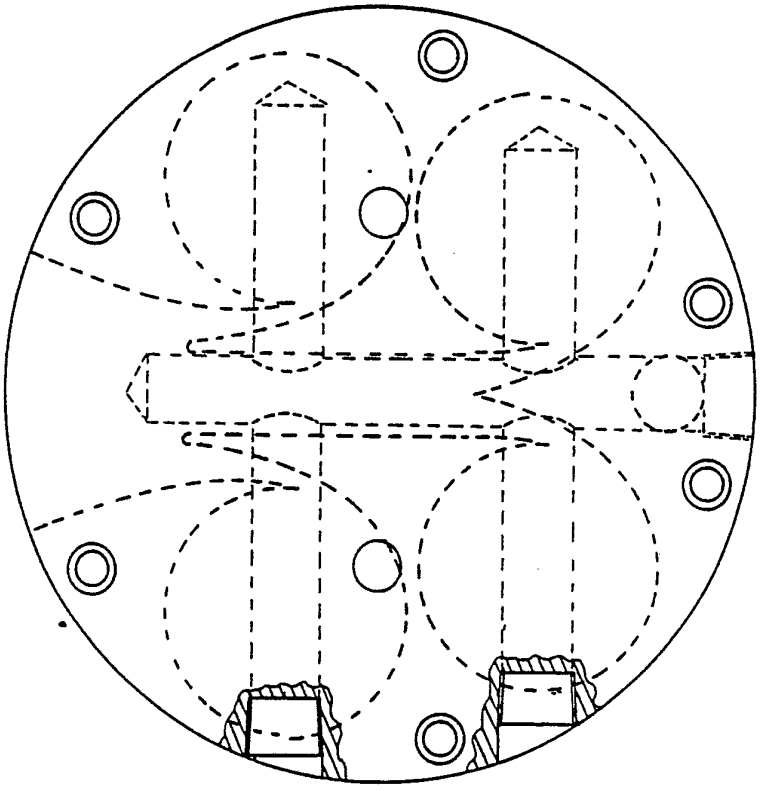
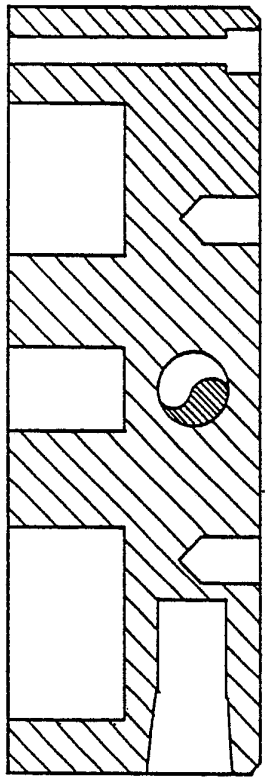


FIGURE 5



Section C-C

FIGURE 6

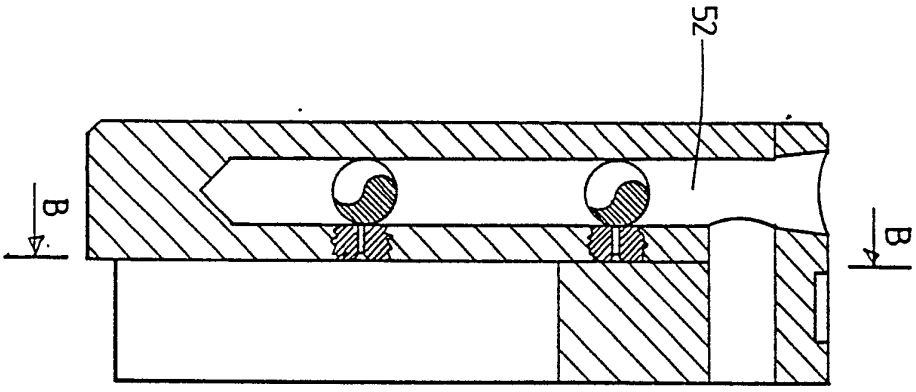


FIGURE 7

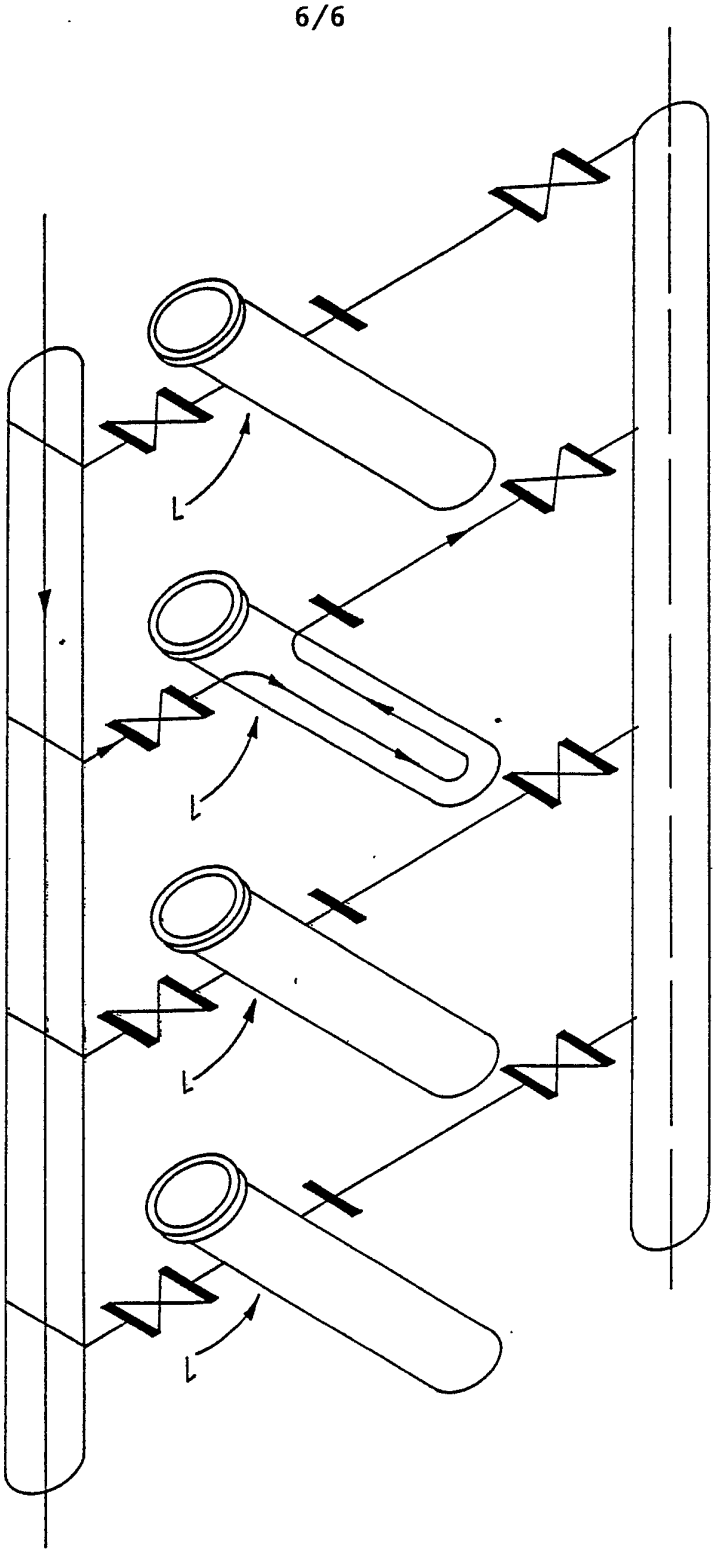


FIGURE 8

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 86/00111

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

Int. Cl.[4] B04C 5/04, 5/12, 5/28, 7/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B04C 5/04, 5/12, 5/28, 7/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	AU,B, 2849/51 (157393) (STAMICARBON) 2 August 1951 (02.08.51)	(1-8,12)
X	AU,B, 1090/51 (151513) (STAMICARBON) 3 May 1951 (03.05.51)	(1-6,12)
X	AU,B, 60943/73 (471421) (WIKDAHL) 10 April 1975 (10.04.75)	(1-6,12)
X	US,A, 3543931 (RASTATTER) 1 December 1970 (01.12.70)	(1-6,12)
X	US,A, 2668620 (FONTEIN) 9 February 1954 (09.02.54)	(1-8)
X	AU,B, 5648/61 (260487) (RESEARCH & DEVELOPMENT) 2 May 1963 (02.05.63)	(1-8)
X	AU,B, 24179/29 (INTERNATIONAL PRECIPITATION) 29 July 1930 (29.07.30)	(1-6)
X	AU,B, 12640/47 (137073) (WESTINGHOUSE) 3 July 1947 (03.07.47)	(1-6)
X	AU,B, 14186/47 (137231) (HOWDEN) 9 October 1947 (09.10.47)	(1-6)
X	AU,B, 20398/70 (459393) (WIKDAHL) 30 March 1972 (30.03.72)	(1-6)

(continued)

* 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

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
23 July 1986 (23.07.86)	6 August 1986 (06.08.86)
International Searching Authority	**Signature of Authorized Officer**
Australian Patent Office	A.W. WINCH

Form PCT/ISA/210 (second sheet) (January 1985)

BAD ORIGINAL

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document with indication where appropriate of the relevant passages	Relevant to Claim No
X	GB, A, 466983 (BUELL) 9 June 1937 (09.06.37)	(1-6)
X	EP, A, 109764 (ELAST-O-COR) 30 May 1984 (30.05.84)	(1-6)
Y	US, A, 3940331 (RASTATTER) 24 February 1976 (24.02.76)	(1-6)
Y	AU, B, 7296/52 (153946) (STAMICARBON) 13 March 1952 (13.03.52)	(1-6, 12)
X	AU, B, 53982/59 (236969) (TERMOKIMIK) 28 April 1960 (28.04.60)	(1-6)
X	AU, B, 29945/77 (513238) (CPC INTERNATIONAL) 24 May 1979 (24.05.79)	(1-6)
X	US, A, 2956679 (HOFFMANN) 18 October 1960 (18.10.60)	(1-6)
X	US, A, 3371794 (JOHNSON) 5 March 1969 (05.03.69)	(1-6)
X	US, A, 2439850 (HELLER) 20 April 1948 (20.04.48)	(1-6)
X	US, A, 2862571 (COWARD) 2 December 1958 (02.12.58)	(1-6)
X	GB, A, 2136327 (OHISHI) 19 September 1984 (19.09.84)	(1-6)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 86/00111

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
AU 60943/73	CA 975715	DE 2349702	ES 419348
	FR 2201929	GB 1446176	IT 993998
	JP 49095260	SU 908241	US 3959123
	SE 7404538		
AU 20398/70	BE 756804	CA 965713	CH 528925
	DE 2046892	ES 384070	FR 2062764
	GB 1258389	NL 7014149	US 3747306
	ZA 7006648	US 4070171	US 4092130
	BE 769778	CA 982065	CH 527638
	DE 2133098	ES 392651	FR 2112898
	GB 1348685	GB 1506877	NL 7108712
	ZA 7104270	BR 7505175	DE 2524469
	DK 2638/75	FI 752021	FR 2290244
	IT 1080751	JP 51053682	NL 7507380
	NO 753693	SE 7508294	
AU 29945/77	BE 859954	CA 1075204	DE 2747443
	ES 463416	ES 463416	FR 2393067
	GB 1541182	IT 1088803	JP 53086048
	NL 7711574	PH 13476	US 4144087
	US 4244748		
GB 2136327	JP 59169554	SE 8401473	CA 1206441
EP 109764	JP 59098751	CA 1081622	CA 1105848
	DE 2547228	FR 2289245	GB 1529948
	JP 51066558	SE 7512044	
US 3940331	US 3984308		

END OF ANNEX