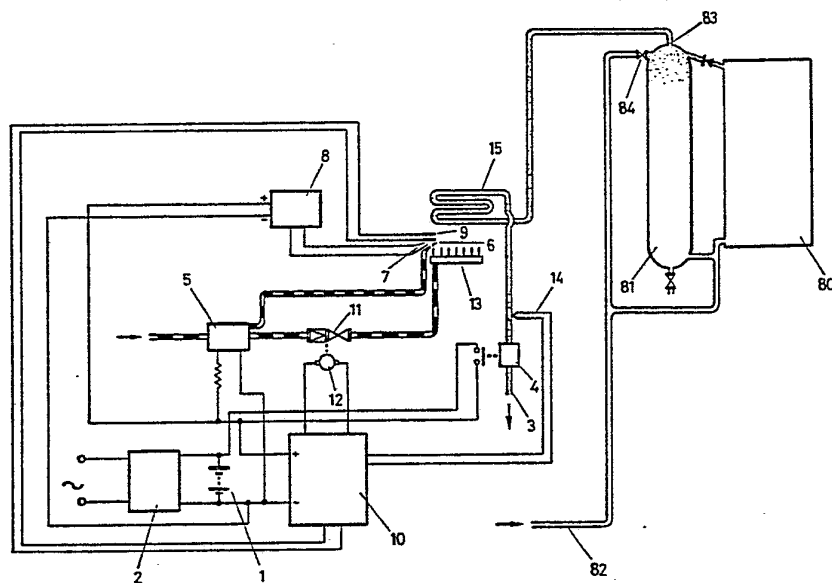




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ³ : F24H 9/20	A1	(11) International Publication Number: WO 81/02774 (43) International Publication Date: 1 October 1981 (01.10.81)
(21) International Application Number: PCT/AU81/00037 (22) International Filing Date: 26 March 1981 (26.03.81) (31) Priority Application Number: PE 2925 (32) Priority Date: 26 March 1980 (26.03.80) (33) Priority Country: AU (71) Applicant (for all designated States except US): SOUTH AUSTRALIAN GAS COMPANY [AU/AU]; 35 Waymouth Street, Adelaide, S.A. 5007 (AU). (72) Inventors; and (75) Inventors/Applicants (for US only): IWANICKI, Walter [AU/AU]; 451 Belair Road, Belair, S.A. 5052 (AU). DUANE, Brian [AU/AU]; 6 Cambridge Terrace, Brighton, S.A. 5048 (AU).		(74) Agent: COLLISON & CO.; Savings Bank Building, 97 King William Street, Adelaide, S.A. 5000 (AU). (81) Designated States: AU, DE, GB, JP, US. Published With international search report

(54) Title: SOLAR/GAS HEATER



(57) Abstract

An instantaneous gas domestic hot water system incorporating a solar heating panel (80) connected to a hot water storage cylinder (81), the outlet from the hot water storage cylinder passing through a heating tube assembly (15) adapted to be heated by a gas burner (13). The outlet from the heating tube assembly is connected to a flow switch (4) and a temperature sensing device (14), the flow switch being connected through an electrical control system (10) to operate a control gas valve (11) and a main gas control (5) to control the flow of gas to a pilot burner (6) which is ignited on sensing of the flow of hot water (3) with the temperature sensing unit (14) controlling the control valve (11) to regulate the flow of gas to the main burner (13) to maintain the water at the outlet (83) at a desired temperature.

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	KP	Democratic People's Republic of Korea
AU	Australia	LI	Liechtenstein
BR	Brazil	LU	Luxembourg
CF	Central African Republic	MC	Monaco
CG	Congo	MG	Madagascar
CH	Switzerland	MW	Malawi
CM	Cameroon	NL	Netherlands
DE	Germany, Federal Republic of	NO	Norway
DK	Denmark	RO	Romania
FI	Finland	SE	Sweden
FR	France	SN	Senegal
GA	Gabon	SU	Soviet Union
GB	United Kingdom	TD	Chad
HU	Hungary	TG	Togo
JP	Japan	US	United States of America

1.

"SOLAR/GAS HEATER"

This invention relates to a solar/gas heater particularly adapted for heating the water to provide hot water in a domestic situation.

5 BACKGROUND OF THE INVENTION

At the present time there has been developing a great interest in the utilization of solar heat for the supply of domestic hot water, and many of these systems are incorporated with an electrical heating system to
10 maintain a satisfactory supply of hot water during periods when there is insufficient solar energy absorbed by the solar heating panel to maintain a satisfactory hot water supply. Also solar/gas storage systems are presently available.

15 However while these are satisfactory, many homes are supplied with a gas supply, either being reticulated or being supplied by storage cylinders and it is an object of this invention to provide a suitable instantaneous type gas domestic water heater.

20 STATEMENT OF THE INVENTION

In a broad form of the invention there is provided a gas domestic hot water system connected to a water supply, the water passing through a heating tube assembly adapted to be heated by a gas burner.



2.

The outlet from the heating tube assembly is connected to flow switch and temperature sensing device, the flow switch being connected through an electrical control system to operate a main gas control to control the flow of gas which is ignited on sensing of the flow of hot water with the temperature sensing controlling the control valve to regulate the flow of gas to the main burner.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic drawing of the invention, FIG. 2(a) and 2(b) are a circuit diagram of the control unit, FIG. 3 is a preferred main gas valve, and FIG. 4 is a preferred magnetic flow switch.

In a preferred form of the invention the electrical circuit is provided by rechargeable batteries 1 continuously rechargeable by charger 2 supplied by electrical mains power supply so that even in the event of an electrical mains power failure the unit is still operable.

In operation as soon as there is a flow of hot water through hot water outlet 3a flow switch 4 is activated by the flow of hot water which then in turn activates a main control valve 5 to allow a flow of gas to the pilot jet 6 and to initiate an igniter 7 through igniter control 8 to ignite_____

3.

the pilot flame. Upon ignition an iron rod sensing device 9 senses the flame and in turn activates a main control 10 which then opens the control and shut-off valve 11 by a motor drive 12 to supply the gas to the main burner 13. The main electrical control 10 is under the influence of a temperature sensing unit 14 which senses the temperature of the water passing outwardly from the heating tube assembly 15 to thus activate the motorized control 12 to regulate the flow of gas to the main burner 15 to maintain the outlet water temperature at a satisfactory level.

The motorized control and shut-off valve is under the control of a motor control unit which is adapted to drive the motor controlling the valve with a pulsing movement. Thus a dead zone is selected within which the value of the controlled variable results in the controller remaining inactive. The temperature sensing device which is connected to the motor control unit determines whether the value lies in the dead zone in which case no pulsing occurs, the value lies below the dead zone in which case pulsing occurs to open the control valve or the value lies above the dead zone in which case pulsing occurs to close the control valve. The controller can be adjusted so that the angle turned per pulse is essentially fixed but the pulse frequency can be adjusted manually or automatically. Alternatively the pulse frequency can be fixed but the angle turned is adjustable either manually or automatically and in a third alternative the cycle time is essentially fixed but the angle turned/time off relationship is adjusted manually or automatically.

4.

Thus the temperature control circuit is intended to simulate the time constants involved in the gas part of the system thereby giving water at an outlet temperature controlled within acceptable limits as the water at the inlet varies in temperature depending on the solar collector's efficiency in preheating the water during the day.

One form of sensing unit as shown in FIG. 2(a) could be a conventional thermister which is a miniature encapsulated temperature sensor which is designed to respond quickly to changes in ambient temperature. This thermister is connected to an operational amplifier circuit 20 connected in a bridge circuit including a resistance 21 which is for adjustment of the temperature and is pre-set to the desired temperature.

Amplifier gain is determined by a further resistance 22 and the greater the amplifier gain the smaller the temperature band over which the outlet goes from fully high to fully low.

The control unit also includes a timing generator 23, which can be a timing multi-vibrator to set up the time interval over which the temperature is assessed via voltage VI and within which the time proportional pulse drives the motor clockwise or anticlockwise depending upon the value of a voltage proportional to the temperature assessed at the start of each time interval at output A and B. Also included is a forward proportional timer 24 which depending upon the sensed temperature via the applied voltage, the circuit for the forward proportional timer must provide the pulsing drive to the motor in the forward direction.

5.

Similarly there is a reverse proportional timer 25 in which the drive is generated to run the motor in an anticlockwise direction. These are connected in turn to the motor drive circuit 26, and this circuit is so arranged that should forward and reverse drive be applied to the signal input simultaneously the safer of the two, that is, the reverse drive signal overrides the forward and the motor is reversed thus closing the valve.

The switchoff - gasoff circuit gives the safety control. When the switch 28 is closed transistor 29 is held on and the capacitor 30 is discharged. When the switch 28 is opened and transistor 29 turned off capacitor 30 charges slowly to drive the motor in reverse until the capacitor 30 is charged.

The portion of this circuit "reverse drive while sparking" interconnects the ignition and control circuit (FIG. 2(b)) and the reverse motor drive line. The output signal at C on FIG. 2(b) is low while the inverter generating the high voltage spark is operating. During the flame and monitoring mode point C is not held low for most of the time, and the reverse drive while sparking circuit integrates this drive signal. While C is oscillating for the major part of the time the reverse drive signal is generated but is removed when the oscillator drops back to the flame monitoring mode.

The magnetic flow switch 4 for sensing the flow of hot water can comprise a body 49 in which a spring loaded plug valve 50 is adapted to close on the valve seat 51 when there is no flow of water. However immediately there being a flow of water_____



6.

5 this flow will cause the plug valve 50 to move opening the valve, the plug valve 50 being such that it opens fully from the valve seat 51 and through the surrounding valve flow passage so that if there is any flow the valve must open completely.

10 The plug valve 50 is connected by a valve stem 52 to a magnet 53, the magnet 53 and stem 52 all being mounted in a sheath 54. The sheath 54 at its outer end also is provided with a mounting block 55 on which is mounted a reed switch 56, the arrangement being such that when the plug valve 50 is opened that the magnet 53 is moved to close the contacts of the reed switch 56.

15 The valve stem 52 is provided at its upper end with a return spring 57 mounted within the sheath 54 such that when there is a cessation of flow that the spring 57 immediately closes the valve.

20 The motorized control and shut-off valve 11 is preferably such that the shut-off valve controlling the gas flow is completely isolated electrically from the driving motor, and to this extent the coupling drive between the motor and the valve is preferably by a magnetic drive.

25 As the motorized control and shut-off valve 11 is to control and regulate the flow of gas depending upon the temperature requirements of the water, the valve has a valve body 60 includes an axial outlet valve seat 61 which is closed by a shaped plug valve 62. This plug valve is supported by a plug support pin 63 in a rotating shaft 64, which rotating shaft 64 is connected to a series of magnets_____

30



7.

65. The rotating shaft 64 is mounted in a shaft assembly fitting 66 which is sealed by O ring 67 to a cap 68 extending over the end of the rotating shaft 64 and its mounting screw 69, which supports the magnets 65. The motor driving shaft 70 is provided with a yoke 71 carrying magnets 72 so that the yoke magnets 72 are in a relative position to the magnets 65 connected to the rotating shaft 64, so that the rotating shaft 64 will move in unison with the yoke 71.

10 The inlet 73 to the valve is radial into the valve seat 61, and the plug valve 62 includes a rubber washer 74 sealing against the valve seat when the valve is in its closed position.

15 The main gas control unit 5 which can close off the gas supply and also regulates the flow to the pilot burner 6 can be of conventional type which is again controlled by the flow switch 4.

20 The gas ignition controller can be conventional gas ignition system, and the sensing unit can be an ionization electrode to sense the presence of the pilot flame to thus activate the main control unit to open the motorized control and shut-off valve to regulate the flow to the main burner.



8.

5 The instantaneous gas heater can be utilized in many differing situations. For example as shown the heater is combined with a solar heater panel connected to a water storage cylinder 81 provided with a cold water inlet 82. The outlet 83 of the storage cylinder 81 is connected to a heating tube assembly. The cold water supply is also connected to the upper portion of the storage cylinder 81 by a cold water mixing thermostat 84 so that if the temperature of the water in 10 the cylinder is above a certain limit, on hot water being drawn the valve 84 automatically opens controlled by the thermostat to lower the temperature of the water flowing into the outlet to the required degree.

15 The instantaneous heater can be connected directly to a cold water supply, or any other source of heated water, such as a source of waste heat.

20 Thus there is provided according to the invention a gas heater/booster for a solar hot water system in which the pilot flame does not burn continuously, but is only supplied with gas and ignited upon the flow of hot water from the water storage cylinder of the system.

25 Thus the heater and burner and all controls could be incorporated into the solar panel itself so that at one end there could be the storage container, and at the other end of the panel there_____

9.

can be a housing for the burner and controls and the only leads to the unit would be the gas supply line, water supply and also the electrical power to operate the battery charger.

5 Although one form of the invention has been described in some detail it is so to be realised that the invention is not to be limited thereto but can include various modifications falling within the spirit and scope of the invention.

10.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A gas domestic instantaneous hot water system supplied by water from a water supply, said system comprising a heating tube assembly, a gas burner for supplying heat to said heating tube assembly, and outlet
5 from said heating tube assembly, and flow switch sensing water flow in said outlet, and temperature sensing device sensing the temperature of water flowing in said outlet, the flow switch being connected through an electrical control system controlling gas control valve
10 means to control flow of gas to said burner which is ignited on the sensor sensing flow of water, the temperature sensing device controlling the flow of gas to the burner dependant on the temperature of the water sensed.

2. A gas domestic instantaneous hot water system as defined in claim 1 characterised in that the gas control means includes a gas control valve and a main gas valve, said flow sensing device controlling said main gas valve
5 to supply gas to said burner, and said gas control valve is under the influence of said temperature sensing device.

3. A gas domestic instantaneous hot water system as defined in Claim 2 characterised in that said burner includes a pilot burner supplied with gas, a sensing device to sense the presence of said pilot burner to
5 control said main gas valve.



11.

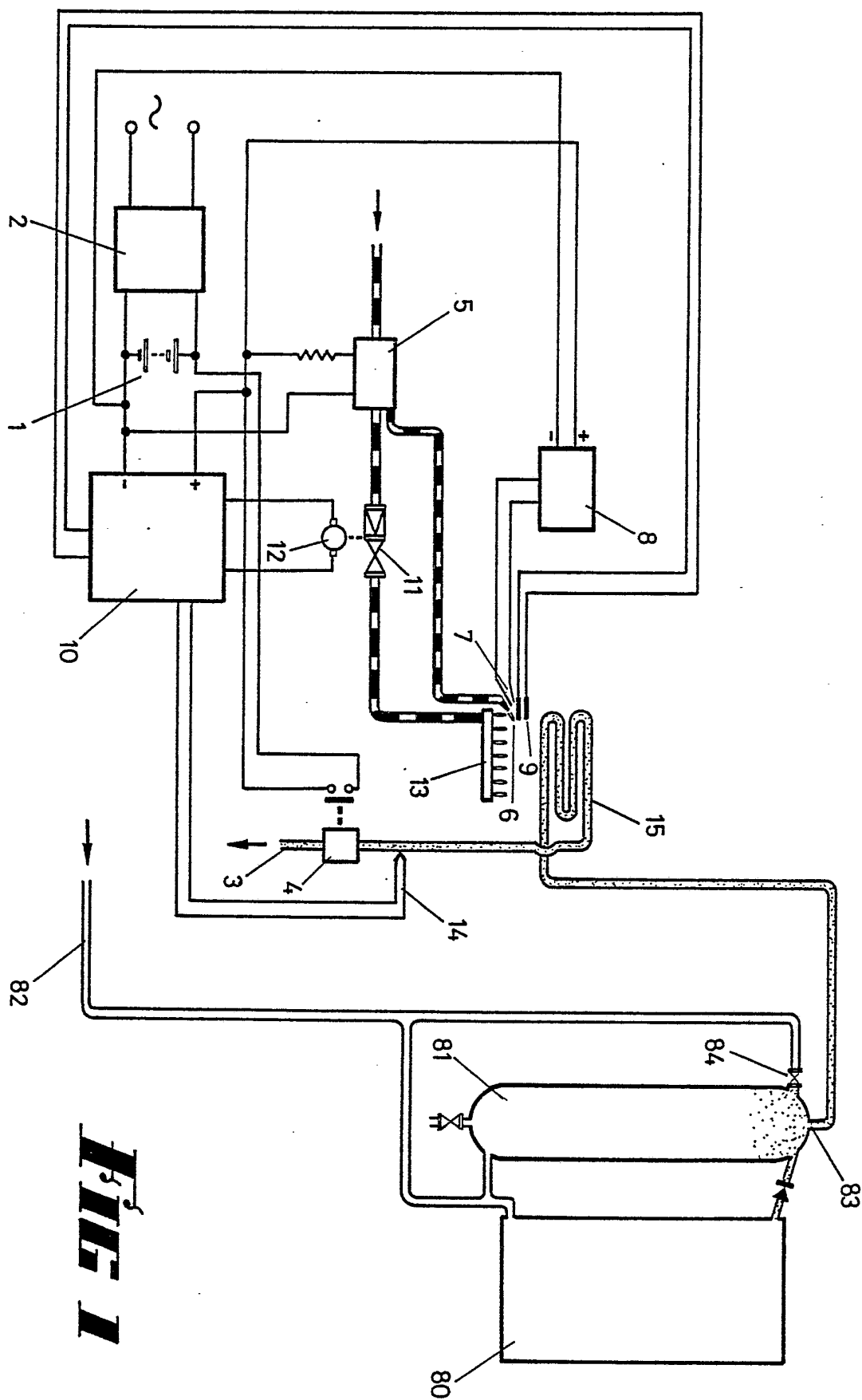
4. A gas domestic instantaneous hot water system as defined in Claims 1 to 3 wherein said water supply is from a water storage chamber, said water being preheated by a solar collector.

5. A gas domestic instantaneous hot water system as defined in Claim 2 wherein said gas control valve is operated by a reversible motor, said reversible motor driving said valve through a magnetic coupling.

6. A gas domestic instantaneous hot water system as defined in Claim 1 wherein said flow sensing valve comprises a plug valve removable by the flow of water, said plug valve being connected to a magnet to operate a reed switch on movement of said magnet.

5



**Fig. 1**

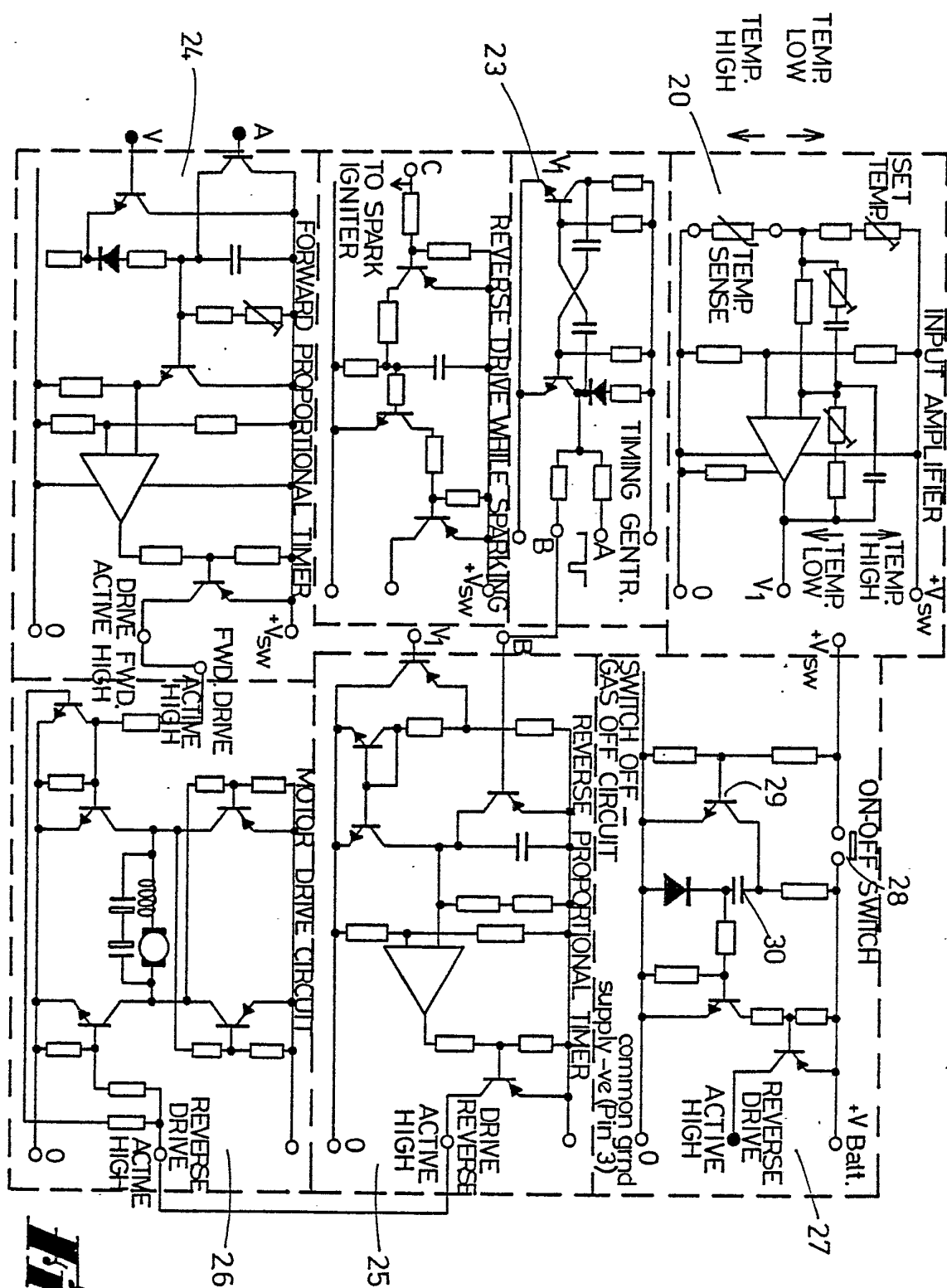
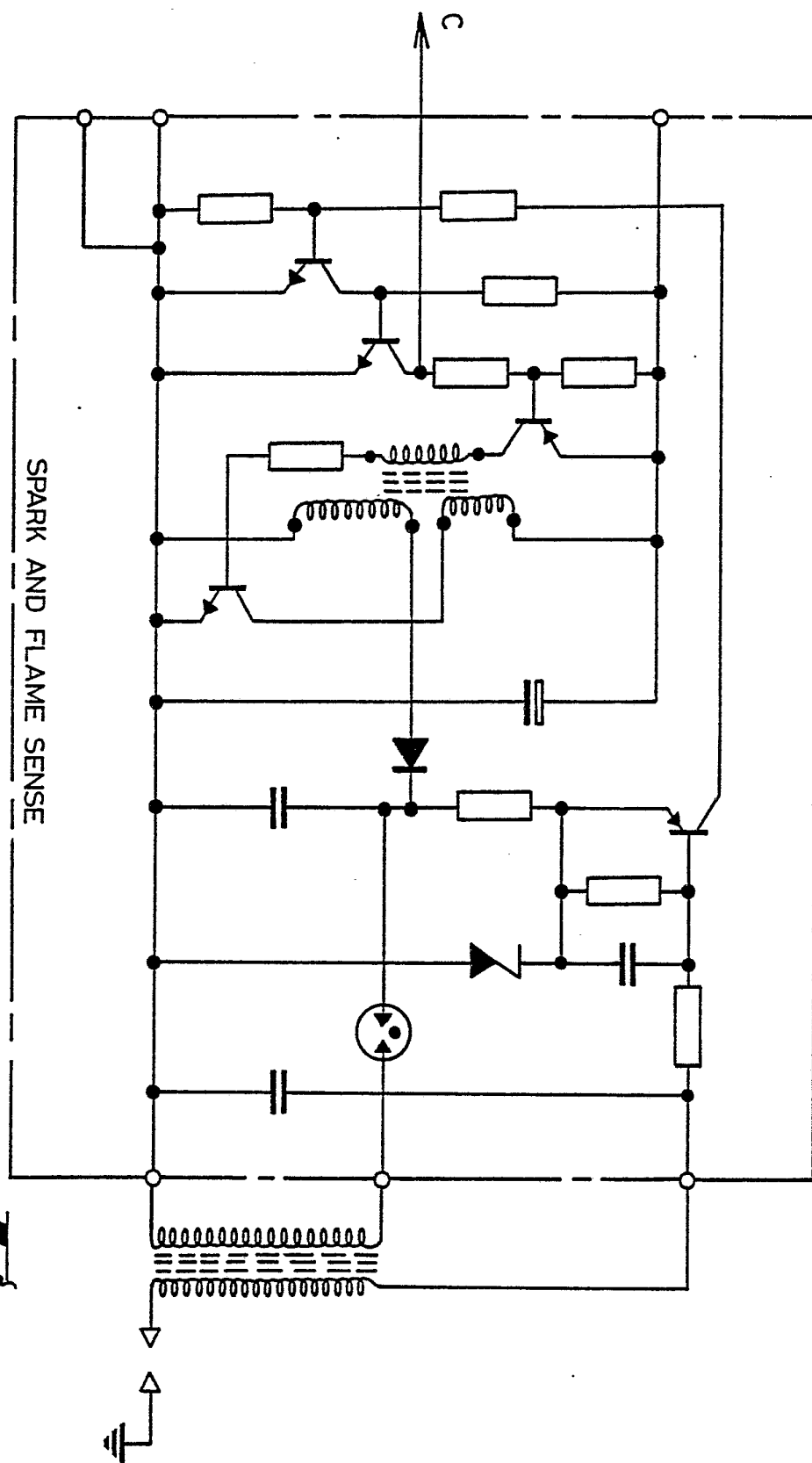


FIG 2(a)

**FIG 2(b)**

4/5

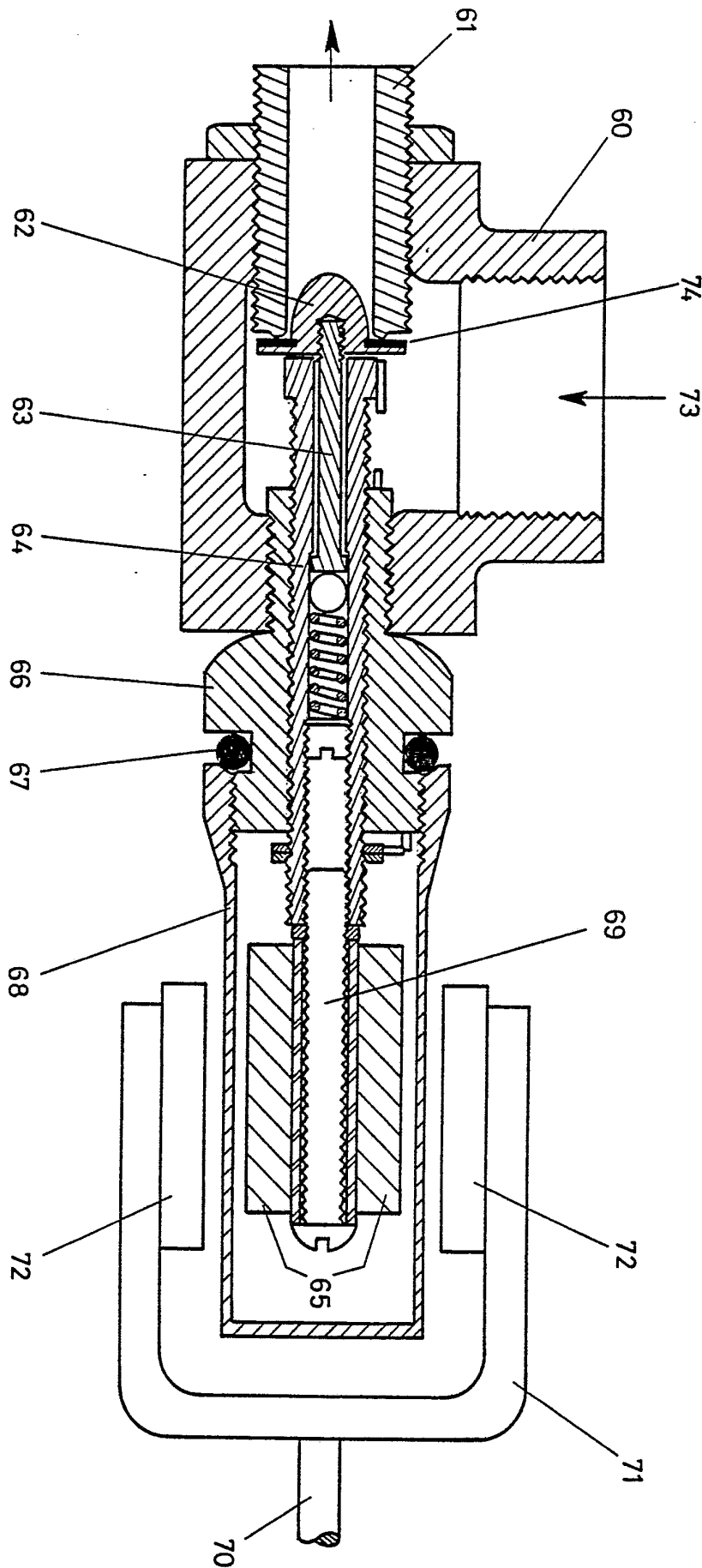
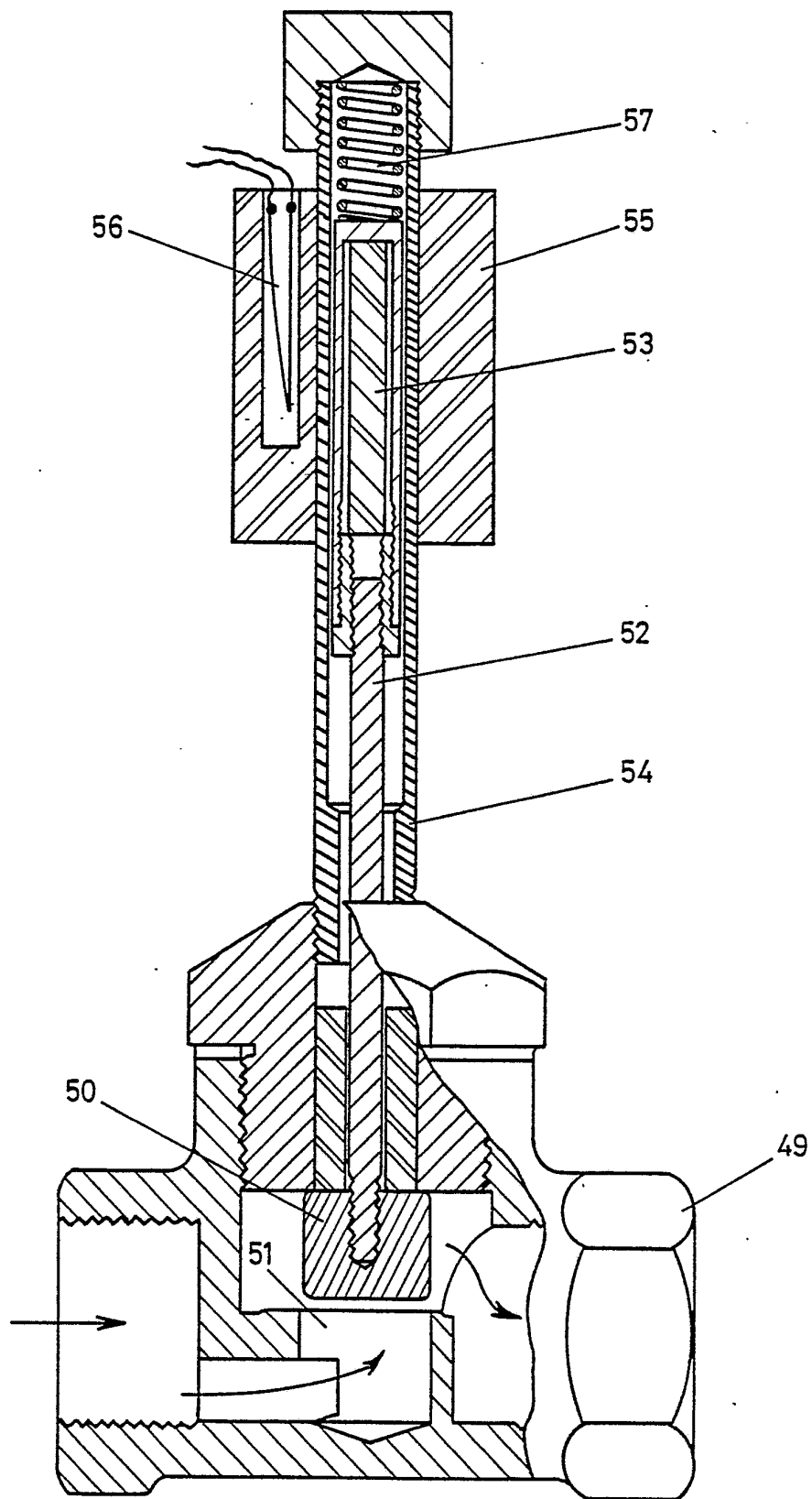


FIG 3

5/5

**FIG 4**

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 81/00037

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³ According to International Patent Classification (IPC) or to both National Classification and IPC Int. Cl. ³ F24H 9/20																																
II. FIELDS SEARCHED Minimum Documentation Searched ⁴ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; text-align: left; font-size: 0.8em;">Classification System</th> <th style="text-align: left; font-size: 0.8em;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px;">IPC</td> <td style="padding: 5px;">F24H 9/20</td> </tr> <tr> <td style="padding: 5px;">US Cl.</td> <td style="padding: 5px;">236/20R, 21B, 21R, 25A, 25R</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵ AU: IPC as above			Classification System	Classification Symbols	IPC	F24H 9/20	US Cl.	236/20R, 21B, 21R, 25A, 25R																								
Classification System	Classification Symbols																															
IPC	F24H 9/20																															
US Cl.	236/20R, 21B, 21R, 25A, 25R																															
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; text-align: left; font-size: 0.8em;">Category [*]</th> <th style="text-align: left; font-size: 0.8em;">Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷</th> <th style="text-align: left; font-size: 0.8em;">Relevant to Claim No. ¹⁸</th> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>US, A, 2007714, published 1935, July 9, Gauger</td> <td>(1,3)</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>US, A, 4147159, published 1979, April 3, Thorwaldson</td> <td>(1-2)</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>JP, A, 54-108953, published 1979, August 27, Noritsu K.K. (Japatic English language abstract).</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>JP, A, 52-109641, published 1977, Sept 14, Hitachi Netsukigu K.K. (Japatic English language abstract).</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>JP, A, 52-88843, published 1977, July 25, Sharp K.K. (Japatic English language abstract)</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>DE, A, 2552226, Published 1976, July 22, Trotter Schifko</td> <td>(1,3,6)</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>DE, A, 2540406, Published 1977, March 24, Robert Bosch GmbH</td> <td>(1-2)</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>DE, A, 2213565, published 1973, October 4, Junkers & Co GmbH.</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>DE, 2322722, published 1974, February 28, Trotter Schifko</td> <td></td> </tr> </table> [*] Special categories of cited documents: ¹⁵ "A" document defining the general state of the art "E" earlier document but published on or after the international filing date "L" document cited for special reason other than those referred to in the other categories "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but on or after the priority date claimed "T" later document published on or 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			Category [*]	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸	X	US, A, 2007714, published 1935, July 9, Gauger	(1,3)	X	US, A, 4147159, published 1979, April 3, Thorwaldson	(1-2)	X	JP, A, 54-108953, published 1979, August 27, Noritsu K.K. (Japatic English language abstract).		X	JP, A, 52-109641, published 1977, Sept 14, Hitachi Netsukigu K.K. (Japatic English language abstract).		X	JP, A, 52-88843, published 1977, July 25, Sharp K.K. (Japatic English language abstract)		X	DE, A, 2552226, Published 1976, July 22, Trotter Schifko	(1,3,6)	X	DE, A, 2540406, Published 1977, March 24, Robert Bosch GmbH	(1-2)	X	DE, A, 2213565, published 1973, October 4, Junkers & Co GmbH.		X	DE, 2322722, published 1974, February 28, Trotter Schifko	
Category [*]	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸																														
X	US, A, 2007714, published 1935, July 9, Gauger	(1,3)																														
X	US, A, 4147159, published 1979, April 3, Thorwaldson	(1-2)																														
X	JP, A, 54-108953, published 1979, August 27, Noritsu K.K. (Japatic English language abstract).																															
X	JP, A, 52-109641, published 1977, Sept 14, Hitachi Netsukigu K.K. (Japatic English language abstract).																															
X	JP, A, 52-88843, published 1977, July 25, Sharp K.K. (Japatic English language abstract)																															
X	DE, A, 2552226, Published 1976, July 22, Trotter Schifko	(1,3,6)																														
X	DE, A, 2540406, Published 1977, March 24, Robert Bosch GmbH	(1-2)																														
X	DE, A, 2213565, published 1973, October 4, Junkers & Co GmbH.																															
X	DE, 2322722, published 1974, February 28, Trotter Schifko																															
IV. CERTIFICATION <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> Date of the Actual Completion of the International Search ³ 02 June 1981 (02.06.81) </td> <td style="width: 50%; padding: 5px;"> Date of Mailing of this International Search Report ³ 09 June 1981 (09.06.81) </td> </tr> <tr> <td style="padding: 5px;"> International Searching Authority ¹ Australian Patent Office </td> <td style="padding: 5px;"> Signature of Authorized Officer ²⁰ A.S. Moore </td> </tr> </table>			Date of the Actual Completion of the International Search ³ 02 June 1981 (02.06.81)	Date of Mailing of this International Search Report ³ 09 June 1981 (09.06.81)	International Searching Authority ¹ Australian Patent Office	Signature of Authorized Officer ²⁰ A.S. Moore																										
Date of the Actual Completion of the International Search ³ 02 June 1981 (02.06.81)	Date of Mailing of this International Search Report ³ 09 June 1981 (09.06.81)																															
International Searching Authority ¹ Australian Patent Office	Signature of Authorized Officer ²⁰ A.S. Moore																															

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

- | | |
|---|---|
| X | DE, 1604022, published 1970, August 27,
Saunier Duval. |
| X | DE, 2846916, published 1979, May 3,
Saunier Duval S.A. |
| X | DE, A, 2708445, published 1978, August 31,
Honeywell B.V. |
| X | FR, A, 2242642, published 1975, March 28,
Potterton International Limited. |

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.