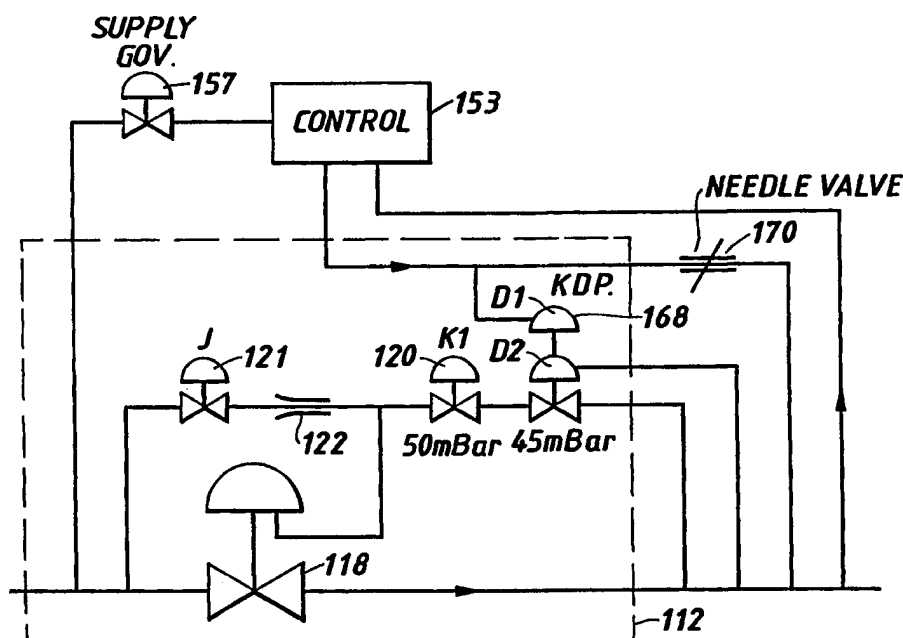


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(21) International Application Number: PCT/GB98/00653 (22) International Filing Date: 19 March 1998 (19.03.98) (30) Priority Data: 9705995.0 22 March 1997 (22.03.97) GB (71) Applicant: BG PLC [GB/GB]; 100 Thames Valley Park Drive, Reading, Berkshire RG6 1PT (GB). (72) Inventors: PERRYMAN, Clayton; 51 Millfield, Southwater, Horsham, Sussex RH13 7TH (GB). RODGERS, Leonard; 35 Nursery Road, Shamley Green, Guildford, Surrey GU5 0UL (GB). KIRKMAN, Lee; 91 Penhill Road, Lancing, Sussex BN15 8HB (GB). JENNER, Trevor; 251 North Lane, Aldershot, Hants. GU12 4TJ (GB). BLACKMAN, Richard; 9 Barrington Road, Horsham, Sussex RH13 5SN (GB). (74) Agent: MORGAN, David, J.; BG plc, Intellectual Property Dept., 100 Thames Valley Park, Reading, Berkshire RG6 1PT (GB).		(81) Designated States: BR, CZ, HU, RU, SK, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: PRESSURE REGULATING SYSTEM



(57) Abstract

A regulating system includes an underground pressure regulating module within a cartridge (112) which receives a high pressure gas stream and produces a low pressure output at a regulated pressure. The cartridge includes a main regulator valve (118) with associated pilot valves (120, 168). The pilot valve (168) has a variable set point which changes under instruction from control (153) so as to replicate demand patterns previously monitored.

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PRESSURE REGULATING SYSTEM

The invention relates to a Pressure Regulating system using an underground fluid pressure regulating control module (e.g. for fuel gas) within a pipeline.

In known underground systems a complete gas pressure regulator module 110 is provided (see Figure 1) within an underground chamber with all the major control devices being incorporated within the module housing and the module can easily be replaced for maintenance and other purposes. There is access to the module via manhole cover 111. In practice the buried system pipeline will typically include an inlet valve, an outlet valve and a flap type non return valve outside the module.

An inlet has a flange 113 (e.g. 150 mm) for coupling to an inlet pipe and a flange 115 (e.g. 200 mm) for coupling to an outlet pipe.

The underground module includes a filter 116 through which the gas passes into the chamber and hence to the removable cartridge 112. A slam-shut valve 117 is connected in series with the pressure regulator valve 118. A number of additional components are provided including several pilot valves. The cartridge is pre-assembled and easily replaceable to reduce downtime.

Such a regulator control module can typically cope with inlet pressures up to 4 Bar and outlet pressure set to between 20 and 75 mBar with a flow capacity of up to 8,500 m³/Hr. A vent stack 130 provides a reference atmospheric pressure point for the cartridge 112 and houses other lines (shown schematically as pipe 131). The

instrument box 133 contains a chart recorder for inlet and outlet pressures and various test points (e.g. for slam-shut testing).

In order to increase the operational efficiency of the pipeline system it is possible to include a clock operated actuator to allow a different set pressure to be available when demand is low throughout the night.

Such an arrangement is shown in Figure 2 with the slam-shut valve 117 having been omitted for the sake of clarity. The flow pressure is controlled by the main regulator valve 118 and the set point of the valve 118 is provided by pilot valve 120 (K1). The pilot control operates by receiving a pre-regulated supply of gas via the regulator 121 (J) before passing through a restrictor pipe 122 and then through the pilot regulator 120 (K1) before being bled to the outlet main (ignoring optional pilot regulator 123 (K2) for the moment). The main regulator valve 118 receives gas to its control line adjacent the outlet of the restrictor 122. Any pressure changes sensed by the pilot as it operates resulting in velocity changes in the restrictor causing a venturi effect which results in gas being sucked back from the line from the main regulator valve 118. This causes the pressure applied countering the spring regulating the diaphragm in the regulator 118 to change to bring the output pressure back in line with the preset value set by pilot 120.

Where a clock is employed, the additional pilot 123 (K2) is provided with a different set point to deal with a different set demand level such as during the night. This will require a clock device 135 with associated valve which is connected to the pilot 123 via a fluid line.

The objection of the present invention is to provide a modified arrangement with a more sophisticated control to reflect demand more closely yet be incorporated largely within the underground module.

According to the invention there is provided a fluid pressure regulating system including a removable underground regulator module for insertion into an underground chamber in use, said removable cartridge including a main pressure regulator valve and a slam shut safety valve connected in series with the regulator, and control means for providing a plurality of setting parameters during a predetermined period to replicate utilisation requirements and means within the module for responding to said parameters to effect changes in the operation of the main regulator valve within the module to provide a variable desired output pressure to meet utilisation requirements.

Further according to the invention there is provided a method of regulating pressure in a fluid regulating system including a removable underground regulation module cartridge having a regulator valve and slam shut valve therein, the method comprising: monitoring fluid utilisation over a given period in a logging device, providing a plurality of setting parameters during a preset period based on historic utilisation information and controlling the regulation valve within the cartridge by control means to vary the flow output in response to the setting parameters to effect changes to a desired output pressure to meet utilisation requirements.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an underground pressure regulating module;

Figure 2 shows a mechanism for controlling output pressure with an incorporated clock mechanism;

Figure 3 shows a graph of utilisation and output pressure requirements over time;

Figure 4 shows a modified arrangement with variable pressure regulation; and

Figure 5 shows the logger/control arrangement in more detail.

Figure 3 shows pressure graphs for the gas supply. Hence the requirement is to supply customers with a stream of gas at a steady pressure of at least 20 mBar (see Graph (a)). In practice it is possible to reduce the available pressure at the regulator output from 40 mBar to say 30 mBar during the night using the clock arrangement described earlier (see Graph (b)) and still provide customer requirements.. The present invention allows a modified underground module to have a continuously variable pressure setting dependent on previously monitored utilisation at that particular station in the gas supply network. A utilisation profile (see Graph (c)) allows the output availability of (a) to be maintained to meet demand requirements whilst allowing reduced pressure to be selected, hence lowering volume requirements and the likelihood of leakage, etc. Although the variations of Graph C are shown as being relatively static over any given short period (e.g. one hour) in practice a large number of variations can be accommodated if desired.

In order to perform the function desired the module cartridge 112 is modified as shown in Figure 4.

The pilot valve 123 of Figure 2 has been replaced by a dual diaphragm valve 168 (K_{DP}) which receives control from a logger/controller 153. The other pilot 120 ($K1$) can be

retained if required for safety reasons. A supply governor 157 provides a regulated supply of gas to the control for its use. A needle valve 170 provides a restricted path setting which, should there be a failure of the controller 153, it will act as a fail safe to give a stable controlled output pressure at the predetermined set level.

In operation, the controller 153 is programmed with information to allow it to impulse the top diaphragm D1 of the valve 168 to cause a variable setting of this valve depended on the previously stored information to allow continuous pressure variation setting to meet the profile of Figure 3(c).

In practice, to house the controller, an additional box, control box 150 (see Figure 5), is mounted on vent stack 130 below the existing instrument box 133. Lines for operational control are fed through tube 151 from the instrument box 133. The heart of the control arrangement is the controller/logger 153 which can include a microprocessor, memory, clock and display. A modem 154 allows logged information to be received remotely and control information passed to the logger/control 153 from a remote site. Dependent on operational and safety requirements a low pressure slam-open valve 156 and supply pressure regulator 157 can be included.

The controller/logger monitors pressure/usage and so receives the gas supply through a small tube at inlet 160. It also uses the gas to operate components and receives this via the supply pressure regulator 157. The outlet 161 passes to the instrument box 133. A control output 163 provides pressure control to the underground regulator via flexible pipe 164 which is the control line also received by the slam-open valve 156. In the event of a fault, when the slam-open valve senses low output it will dump control

pressure to the outlet and allow the outlet to rise to the underground regulator preset value. Line 165 provides a route to exhaust the gas during setting changes.

The logger/controller 153 monitors and records information on usage/pressure to allow a profile to be known for that station and this is typically downloaded once every 24 hours following a prompt signal via the telephone link to the modem 154. This information is utilised by a remote computer (not shown) to calculate expected usage requirement and selects a stream of different pressure settings for use throughout the next 24 hours (with a margin for handling a somewhat increased loading) and downloads this via the telephone line to the controller which uses its internal clock to increment and decrement the pressure as previously instructed throughout the day to provide variable pressure control to the cartridge 112 so as to produce the results shown in the Graph in Figure 2C for example.

The logger can also produce alarm and other signals for sending to the remote site via the modem. Although a telephone line can be used, radio or other transmission techniques could be utilised.

The cartridge is easily interchangeable with that of Figure 1 and needs no excavation work because it slides into the existing chamber and is closed using the same bulkhead.

CLAIMS

1. A fluid pressure regulating system including a removable underground regulator module cartridge for insertion into an underground chamber in use, aid removable cartridge including a main pressure regulator valve and a slam shut safety valve connected in series with the regulator, and control means for providing a plurality of setting parameters during a predetermined period to replicate utilisation requirements and means within the module for responding to said parameters to effect changes in the operation of the main regulator valve within the module to provide a variable desired output pressure to meet utilisation requirements.
2. A system as claimed in claim 1, wherein the means to effect changes in the operation of the main regulator valve include a dual diaphragm mechanism providing differential control.
3. A system as claimed in claim 2, wherein the means is located on the module but separate from the main regulator valve.
4. A system as claimed in claim 1, 2 or 3, wherein logging means are provided for monitoring fluid utilisation over a given period to assist in determining future utilisation requirements.
5. A system as claimed in claim 4, wherein remote access means are provided to receive the logged information, means for computing the setting parameters

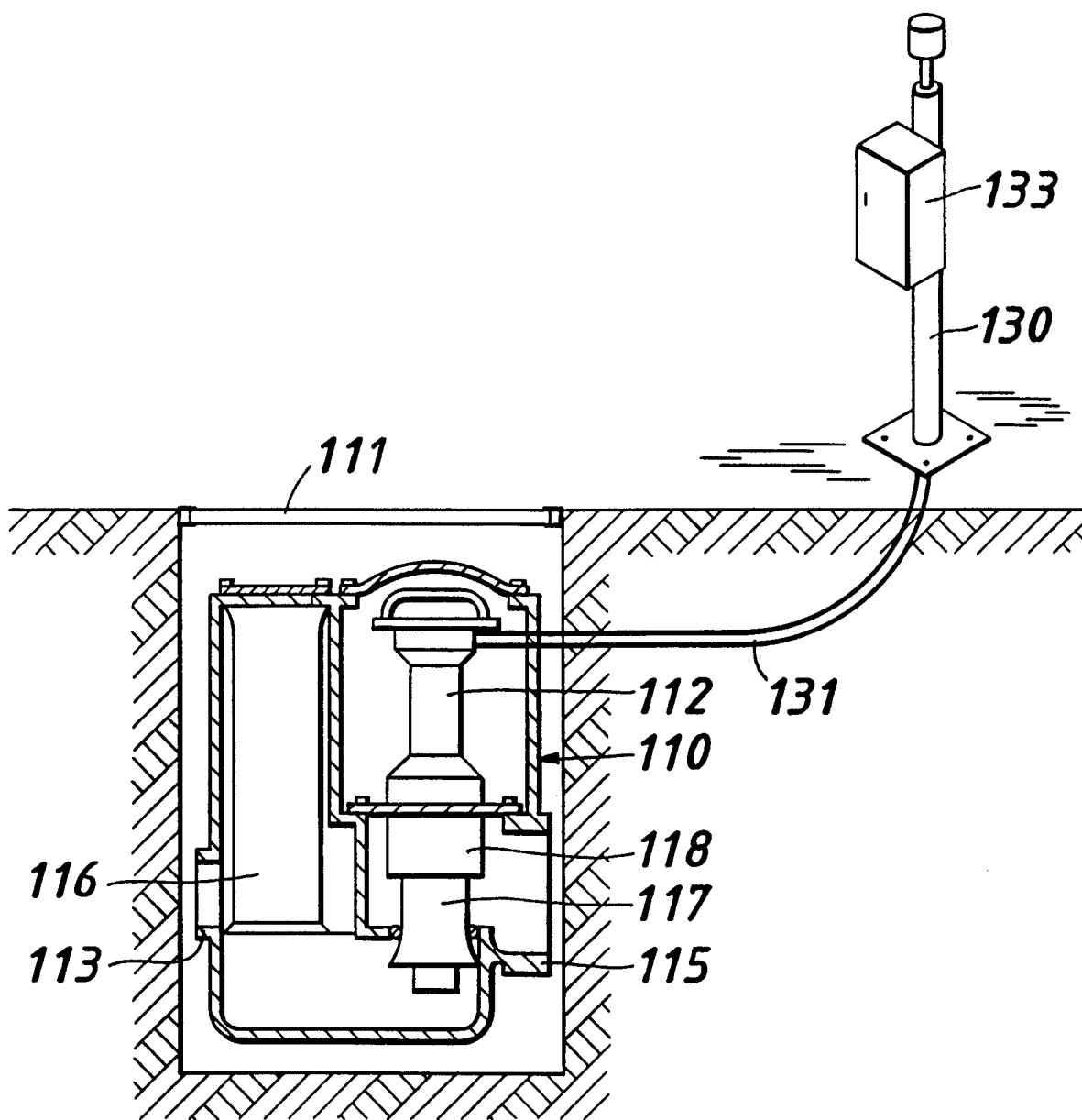
therefrom and means for transmitting the parameter information to allow control of the remote regulating system.

6. A system as claimed in claim 4 or 5, wherein the logging means is provided on a vent stack above ground level.
7. A system as claimed in any preceding claim, wherein a regulated pressure source is provided for the control means and a slam-open valve is provided to open in the event of a fault condition developing.
8. A system as claimed in any preceding claim, including needle valve means to provide a stable reference setting in the event of failure of the control means.
9. A method of regulating pressure in a fluid regulating system including a removable underground regulation module cartridge having a regulator valve and slam shut valve therein, the method comprising: monitoring fluid utilisation over a given period in a logging device, providing a plurality of setting parameters during a preset period based on historic utilisation information and controlling the regulation valve within the cartridge by control means to vary the flow output in response to the setting parameters to effect changes to a desired output pressure to meet utilisation requirements.
10. A method as claimed in claim 9 including remotely accessing the logged information, computing the setting parameters therefrom and transmitting the parameter settings back to the regulator system to allow control thereof.

11. A method as claimed in claim 9 or 10 including controlling a dual diaphragm control valve to modulate the setting of the regulator valve.
12. A method as claim in claim 9,10 or 11 including opening a slam open valve in the event of a fault to allow pressure to rise to a preset value.
13. A method as claimed in any one of claims 9 to 12, including providing a needle valve to facilitate a stable reference in the even of control means failure.
14. A fluid pressure regulating system substantially as described herein with reference to Figures 3 to 5 of the accompanying drawings.
15. A method of regulating pressure in a fluid regulating system substantially as described in the embodiment herein.

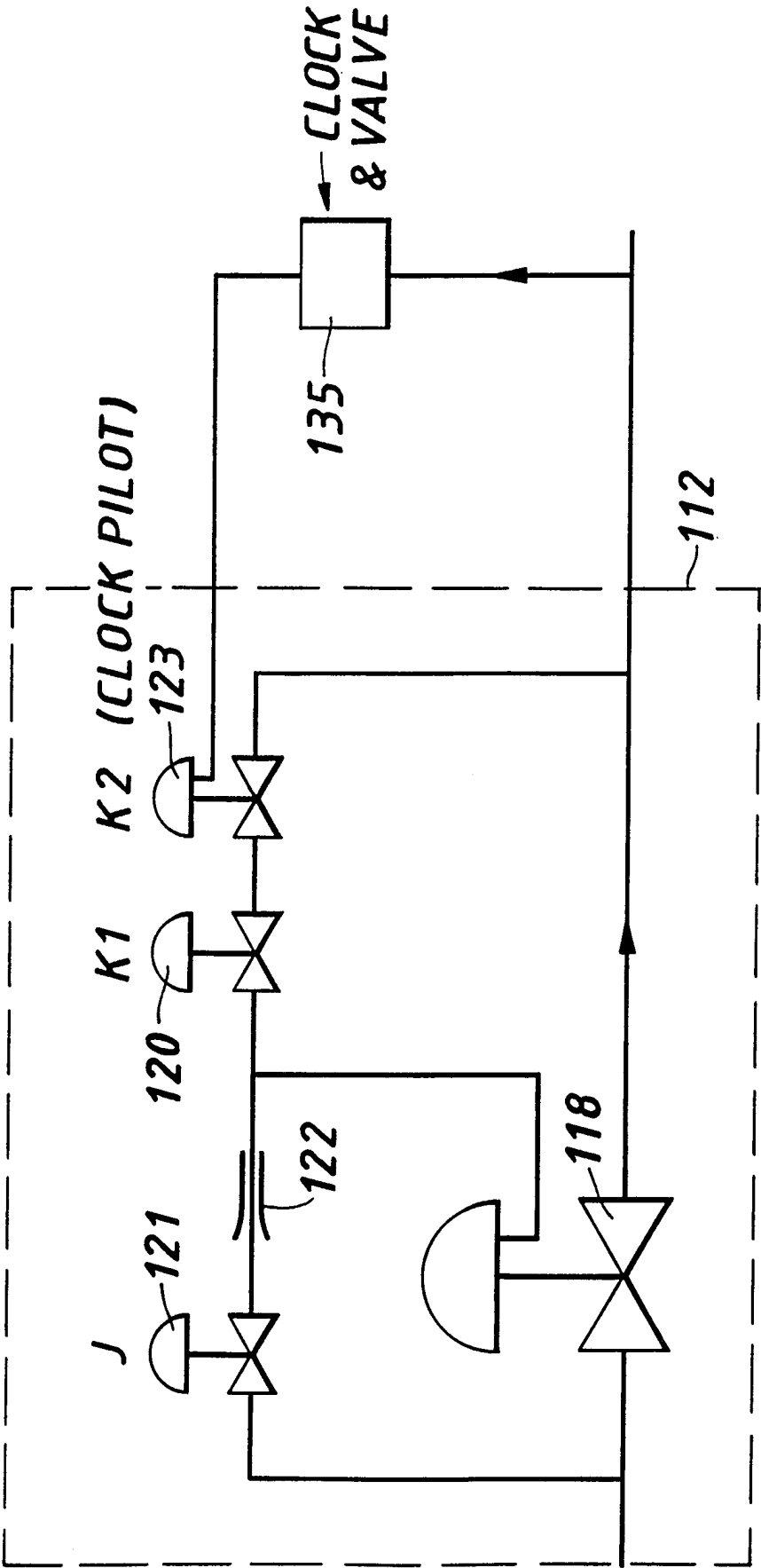
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FIG. 1.



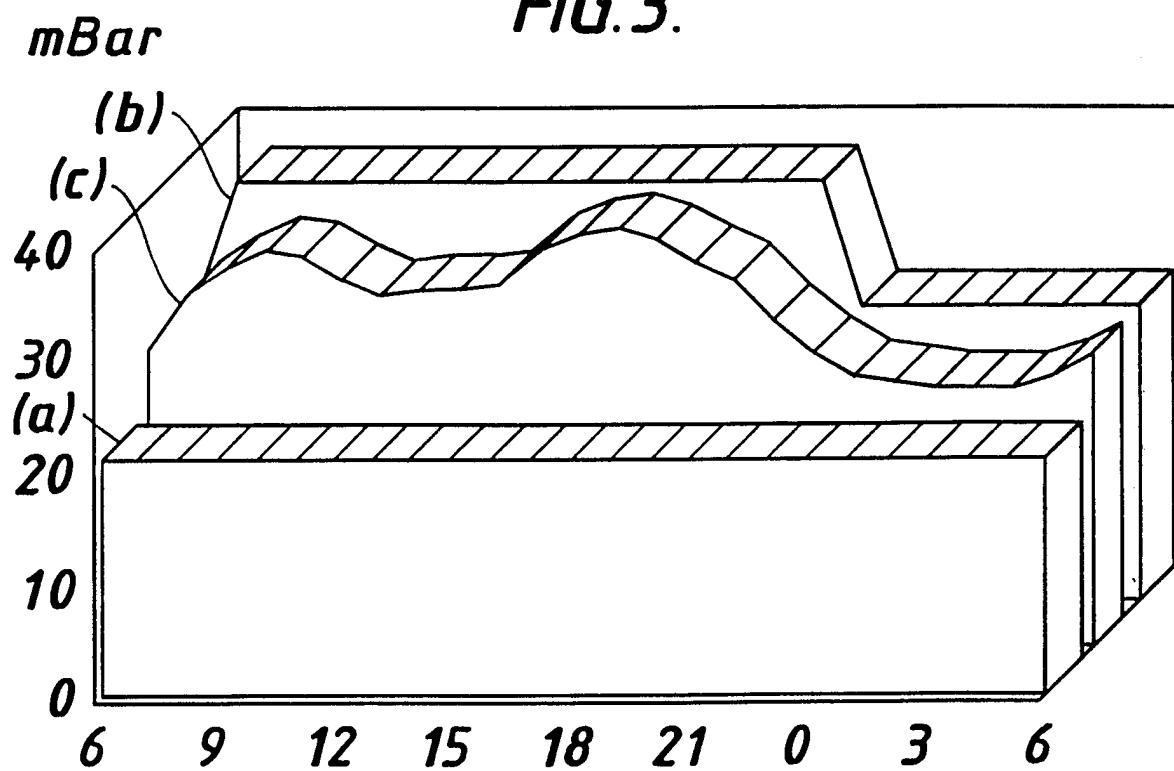
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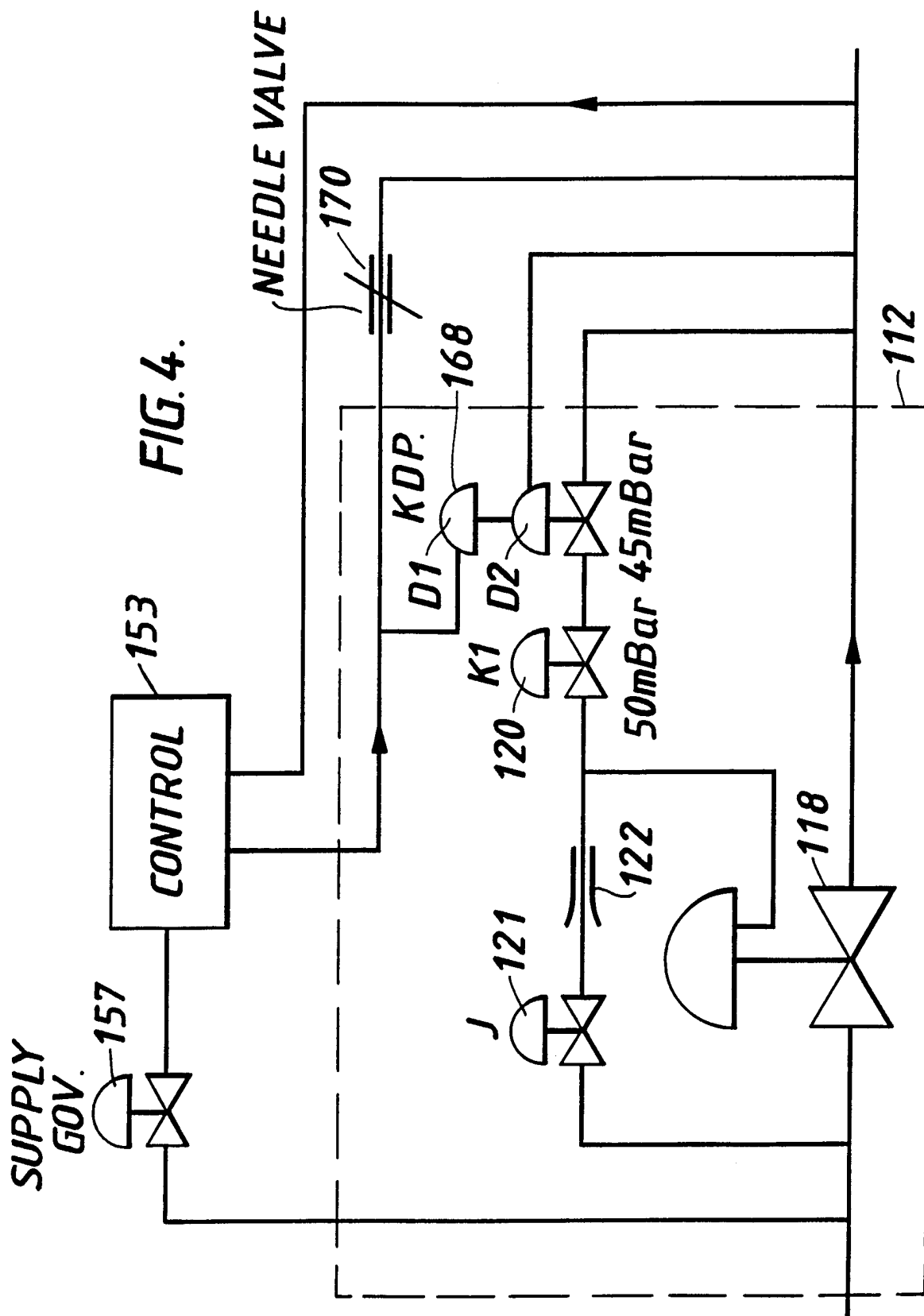
FIG. 2.



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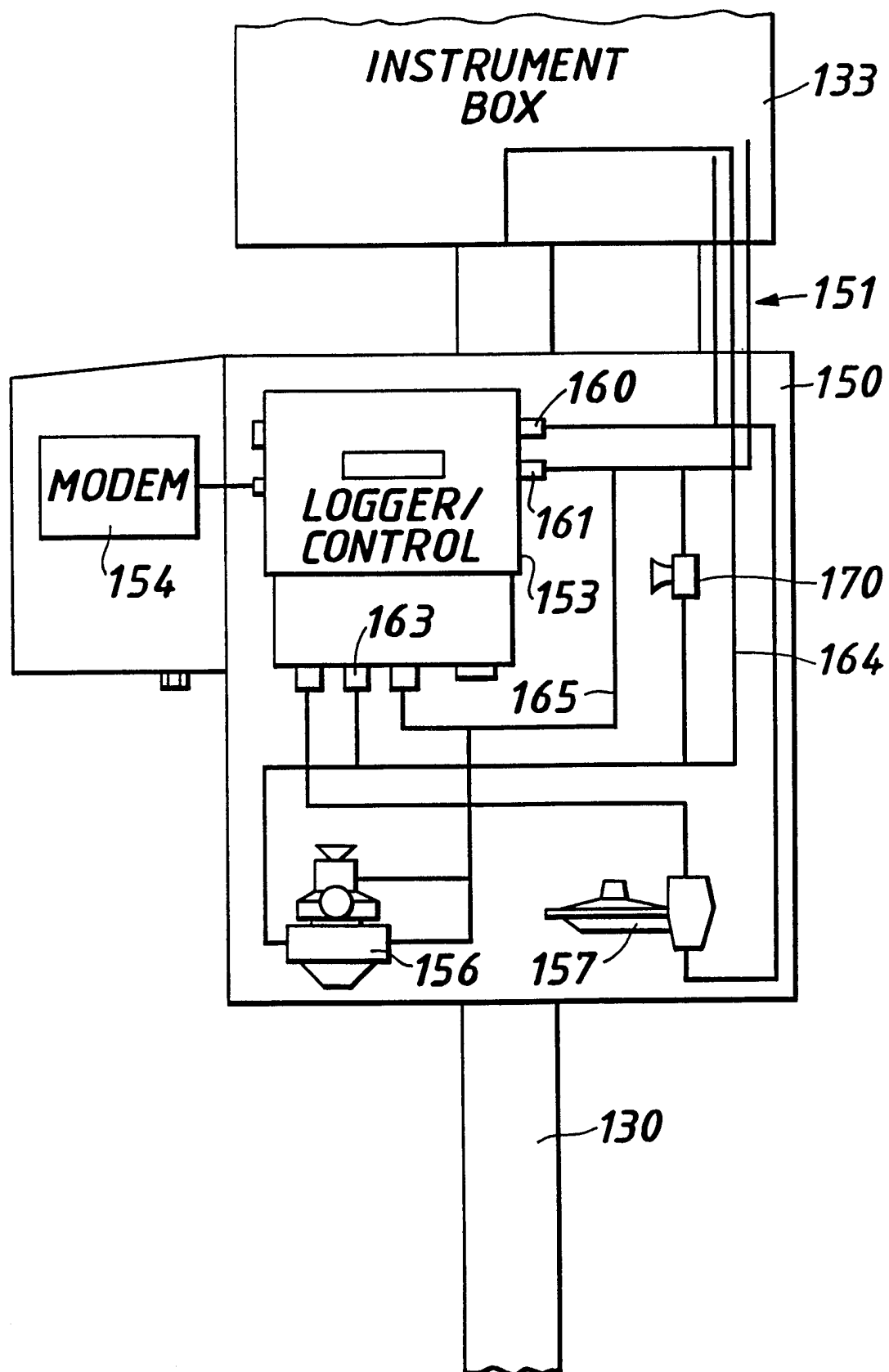
FIG. 3.





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FIG. 5.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 98/00653

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G05D16/20 F17D3/01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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IPC 6 G05D F17D F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 024 650 A (BRITISH GAS CORP.) 16 January 1980 see page 1, line 54 - line 117; figure 1 ----	1,7,9,12
A	WO 93 08519 A (J.T.A. STRAVER) 29 April 1993 see page 2, line 7 - line 38; figure 1 ----	1,7,9,12
A	EP 0 277 526 A (DRÄGERWERKE AG) 10 August 1988 see column 3, line 19 - column 4, line 50; figure 1 -----	1,3,9

☐ Further documents are listed in the continuation of box C.

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