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

(11) EP 0 935 098 B2

(12) **NEW EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the opposition decision:
05.10.2005 Bulletin 2005/40

(45) Mention of the grant of the patent:
11.12.2002 Bulletin 2002/50

(21) Application number: **98300830.1**

(22) Date of filing: **04.02.1998**

(51) Int Cl.[7]: **F23N 5/16**, F23G 7/08

(54) **Flame detection apparatus and method**

Flammendetektionseinrichtung und Verfahren

Dispositif et procédé de détection de flamme

(84) Designated Contracting States:
BE DE ES FR GB IT NL

(43) Date of publication of application:
11.08.1999 Bulletin 1999/32

(73) Proprietor: **JOHN ZINK COMPANY,L.L.C.**
Tulsa, OK 74116 (US)

(72) Inventors:
- **Schwartz, Robert E.**
  Tulsa, Oklahoma 74135 (US)
- **Berg, Lawrence E.**
  Tulsa, Oklahoma 74145 (US)
- **Bussmann, Wesley R., Dr.**
  Tulsa, Oklahoma 74127 (US)

(74) Representative: **Senior, Alan Murray et al**
J.A. KEMP & CO.,
14 South Square,
Gray's Inn
London WC1R 5JJ (GB)

(56) References cited:
EP-A- 0 428 373
DE-A- 3 447 754
GB-A- 1 056 410
GB-A- 2 161 916
JP-A- 59 191 812
US-A- 2 767 783
US-A- 2 966 209
US-A- 3 635 018
US-A- 3 811 816
US-A- 3 932 111
US-A- 4 147 493
US-A- 4 559 006
US-A- 4 573 906
US-A- 4 959 638
US-A- 5 120 214

- **PATENT ABSTRACTS OF JAPAN vol. 009, no. 057 (M-363), 13 March 1985 & JP 59 191812 A (NIPPON KOKAN KK), 31 October 1984,**

EP 0 935 098 B2

Description

[0001] The present invention relates to a flame detection apparatus and method for detecting the presence or non-presence of a flame from a location remote from the flame.

[0002] Burners for combusting fuel and air mixtures generally include one or more pilot burners for igniting the fuel and air mixture when the burner is operated. Usually the main burners are operated intermittently and the pilot burners are operated continuously. In order to prevent explosions or the like, when the pilot burner malfunctions and an ignition flame is not provided, pilot flame detection apparatus are provided and are commonly set up to shut off the fuel to the burner if a pilot flame is not present.

[0003] Flares or flare stacks are used for combusting and disposing of combustible wastes and other materials such as disclosed in US 4,559,006. Flare stacks are commonly located at production, refining and processing plants for disposing of combustible wastes or other combustible streams which are diverted during venting, shut downs, upsets and/or emergencies.

[0004] Flares generally also include continuously operated pilot burners and flame detection apparatus which are often located at the elevated open discharge ends of the flares at the tops of stacks. Because of the heights of such flare stacks and the high temperatures experienced during flaring, failures of flame detection apparatus have often occurred and have been relatively difficult to repair and replace.

[0005] One prior art flame detection system for flares includes a thermocouple for generating a thermoelectric current when heated by a pilot flame. When the pilot flame is not present, less thermoelectric current is generated which is electronically sensed and an alarm is indicated.

[0006] Optical systems have heretofore also been developed for use with flare stacks which are mounted on the ground and detect the presence or non-presence of flame at the top of the flare stacks. However, such systems are susceptible to false readings as a result of varying weather conditions and the like. In addition, they may not distinguish between the pilot flame and the main flame.

[0007] Other infrared, ultraviolet, optical and acoustical flame detection devices have been developed and used with burners and flares, but they also must be mounted relatively close to the flame being detected to be effective, i.e., within a metre or less and are subject to rapid deterioration due to intense heat and are difficult to repair or replace.

[0008] JP-A59/191812 and DE-A3447754 disclose a flame detection apparatus using a sound sensor linked to a combustion chamber by a duct providing an acoustic connection. In dependence on the noise detected, voltage signals are produced which are analysed by a signal processor for indicating the status of the flame.

[0009] US-A-4959638 discloses an acoustic combustion efficiency analyser having various forms of flame sensor..

[0010] According to one aspect of the present invention, there is provided a flare stack according to claim 1.

[0011] The flame detection apparatus of this invention can be located a relatively long distance from the flame being monitored whereby it is not subjected to intense heat, is resistant to changing weather conditions and can easily be serviced or replaced.

[0012] A sound detector is connected to the conduit positioned at a location remote from the flame, i.e., at about 1 metre to 200 metres or more from the flame. The sound detector detects sound produced by the flame and conducted by the conduit and generates an electric signal representative of the sound. Electronic means are provided for receiving the electric signal and for indicating the presence or non-presence of the flame in response thereto.

[0013] A second aspect of this invention provides a method of detecting the presence or non-presence of a flame issued from a pilot burner located at the open discharge end of a flare stack according to claim 10.

[0014] In order that the present invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings in which:-

Figure 1 is a side elevational view of a flare stack including one embodiment of detection apparatus of the present invention;
Figure 2 is a top plan view of the flare stack of Figure 1;
Figure 3 is an enlarged schematic view of the pilot burner ignition flame generator shown in Figure 1;
Figure 4 is an enlarged schematic view of the flame detector illustrated in Figure 1;
Figure 5 is an enlarged view of the pilot burner and sound conducting conduit illustrated in Figure 1;
Figure 6 is a cross-sectional view taken along lines 6-6 of Figure 5;
Figure 7 is a cross-sectional view taken along lines 7-7 of Figure 5;
Figure 8 is a side elevational view of the flare stack of Figure 1 showing a second embodiment of the flame detection apparatus of the present invention;

[0015] Figures 1 and 2 show a flare stack 10 including the improved flame detection apparatus of the present invention, the flare stack 10 including a flare 12 and stack 14 which are bolted together by a plurality of bolts 15 at a flanged connection 16. While the heights of flare stacks vary depending upon various factors, most flare stacks utilized in production, refining and processing plants range in height from about 6 metres to as high as about 200 metres. The bottom end of the stack 14 is closed by a ground level base plate 18 and one or more waste gas inlet pipes 20 located at or near ground level

are connected to the stack 14.

[0016] The flare 12 (also sometimes referred to as a flare tip) may include a cylindrical perforated wind deflector 22 attached thereto adjacent to the upper open discharge end 24 of the flare 12 and at least one pilot burner 26 positioned adjacent the open discharge end 24. The pilot burner 26 is usually operated continuously to provide a continuous flame for igniting streams of combustible gases which are intermittently flowed to the flare stack 10.

[0017] Pilot burner 26 is connected to a pipe 28 which is attached to the flare 12 by a plurality of brackets 30. A conventional fuel-air mixer 32 is disposed in the pipe 28 near the flanged connection 16 between the flare 12 and stack 14, and the pipe 28 is connected to a source of combustible fuel gas, such as methane. Fuel gas is mixed with inspirated air as it flows through the mixer 32, the mixture flows through the pipe 28 above the mixer 32 to the pilot burner 26 and is burned within and adjacent to the pilot burner 26.

[0018] A second pipe 34 extends from the pilot burner 26 to a location at or near ground level and is attached to the pipe 28 by a plurality of brackets 35. The pipe 34 is connected at its upper end to the pilot burner 26 and to an ignition flame generator 36 at its lower end. In addition, a flame detector assembly 38 is connected to the pipe 34 near ground level between the ignition flame generator 36 and the pilot burner 26.

[0019] An ignition flame generator 36 is operated to produce a flame which is propagated through the pipe 34 to the pilot burner 26. When the ignition flame exits the pipe 34, it ignites the fuel-air mixture flowing from the pilot burner 26. After the pilot burner 26 is ignited, the ignition flame generator 36 is shut off.

[0020] The sound produced by the flame (not shown) of the pilot burner 26 is conducted by the pipe 34 to the flame detector assembly 38, which continuously indirectly detects the sound or lack of sound, which indicates the presence or non-presence of the flame at the pilot burner 26. If the flame of the pilot burner 26 is extinguished for any reason, the flame detector assembly 38 provides a warning such as a light and/or audible alarm so that the pilot burner 26 can immediately be reignited. Preferably the ignition flame generator 36 can be set up to be electronically operated each time the flame detector assembly 38 detects the non-presence of a flame at the pilot burner 26.

[0021] Referring now to Figures 5-7, the pilot burner 26 and the upper end portions of the pipes 28 and 34 are illustrated in detail. The pilot burner 26 comprises a cylindrical perforated wind shield 40 which is attached to a conventional pilot burner nozzle (or tip) 42 which is in turn attached to the pipe 28. The nozzle 42 includes one or more fuel-air mixture discharge orifices 44 therein for discharging the fuel-air mixture in a pattern which produces a stable pilot flame.

[0022] As best shown in Figure 7, the cylindrical wind shield 40 includes a side opening formed therein within which the top end portion 48 of the pipe 34 is welded. An elongated end segment of the pipe 34 within the wind shield 40 is removed and the top end of the pipe 34 outside the wind shield 40 is closed whereby the pipe 34 opens into the wind shield 40 by way of an opening 50 extending below, beside and above the nozzle 42.

[0023] A variety of pilot burner 26 and flame sound-conducting pipe 34 designs and arrangements can be chosen, it only being necessary that the sound produced by the presence of a flame be conducted to the remote location where the flame detector assembly 38 of this invention is mounted.

[0024] Referring now to Figure 3, the ignition flame generator 36 includes a plate 52 upon which a transformer 54 is located connected to an electric power source (not shown) by wires 56. Wires contained within an electric wire conduit 60, connect transformer 54 to an enclosed spark plug 58, which is connected to a fuel-air ignition chamber 61 having a sight glass 62 therein. The chamber 61 is connected to an air inlet conduit 64 having a shut-off valve 66 and a pressure gauge 68 disposed therein and to an ignitor fuel gas conduit 70 having a shut-off valve 72 and pressure gauge 74 disposed therein by way of a T-connection 76.

[0025] In operation of the ignitor flame generator 36, a combustible fuel gas-air mixture is flowed to the pilot burner 26 by way of the conduit 28. The valves 66 and 72 of the ignitor flame generator 36 are then opened to produce a combustible fuel gas-air mixture which flows into the chamber 61 and through the conduit 34 to the pilot burner 26. The transformer 54 is operated by pushing the button 55 thereon to spark the spark plug 58 and ignite the fuel gas-air mixture flowing through the chamber 61. The sight glass 62 provides a visual indication of the ignition. The flame flows through the opening 50 of the conduit 34 within the wind shield 40 of the pilot burner 26 whereby the fuel gas-air mixture being discharged by the nozzle 42 is ignited. After the ignition of the pilot burner 26 has been accomplished, the valves 66 and 72 of the ignition flame generator 36 are closed.

[0026] Referring now to Figure 4, the flame detector assembly 38 is shown enclosed in a housing 78 and includes a sound detector 80 which is sealingly connected to the conduit 34. The sound detector 80 is an electronic acoustic vibration receiver such as a microphone, a piezoelectric crystal, a geophone or the like, which converts the sound conducted to it into an electric signal which is conducted to an electronic network 84 by wires 82. The electronic network 84 filters the electric signal to a signal representative of one or more preselected frequency bands, the signal then being conducted by wires 86 to an electronic energy detecting circuit 88 which determines the energy content of the electric signal at the preselected frequency band or bands thereby to indicate the presence or non-presence of the pilot burner flame. That is, if the energy content of the signal is equal to or higher than a predetermined energy content for the preselected frequency band or bands, the

presence of flame is indicated. If lower, the non-presence of the flame is indicated.

[0027] Various other techniques can be used to electronically analyze the signal produced by the acoustic vibration receiver in order to detect the presence or non-presence of the flame. For example, the signal can be analyzed to determine the presence or non-presence of an energy peak at a preselected frequency band or bands; or the shape of a plot of the signal frequency versus energy can be compared to a standard plot indicating the presence of flame; or the rate of change of the frequency versus energy in a preselected frequency band or bands can be compared to the rate of change when a flame is present.

[0028] Electric power is provided to the electronic components 84 and 88 by a transformer 92 connected to an electric power supply (not shown) by wires 94 and to the electronic component 88 by wires 90. The presence or non-presence of the pilot burner flame is indicated by the electronic component 88 by an electric signal which is conducted by wires 96 to an alarm and/or other electronic system, e.g., a system for automatically operating the ignition flame generator 36.

[0029] In carrying out the step of indicating the presence or non-presence of the flame electronically or otherwise from an electric or other signal, e.g., microwave, light wave, etc., generated by the sound detector, various techniques can be utilized.

[0030] The apparatus and method of this invention can be utilized with flare sacks or other burners which do not include ignition flame generators and separate conduits for conducting ignition flames to the burners or pilot burners thereof. In those applications where an existing conduit for conducting sound to the detection apparatus is not available, an additional conduit for conducting the sound can be installed. Also, as illustrated in Figure 8, if for some reason it is undesirable to utilize the ignition flame generator conduit 34 for conducting flame sound, a separate conduit 100 can be installed and the flame detector assembly 38 can be connected to it as shown.

[0031] The term "flame" is used herein to mean any flame or combustion reaction which produces detectible sound. The flame detection apparatus of this invention can be utilized with burners that combust liquid fuel as well as gaseous fuel and that any oxidizer such as air, oxygen or other oxidizing substance can be used to support the combustion.

Claims

1. A Flare stack comprising : a ground level base plate (18) closing the bottom end of the stack (14);

flame detection apparatus for detecting the presence or non-presence of a flame issued from a pilot burner (26) at the top open end (24) of the flare stack (10) said apparatus comprising:

a conduit (34) having an end positioned at said open discharge end (24) of said flare stack relative to said flame whereby sound produced by said flame is conducted by said conduit to a sound detector (38) connected to said conduit at a location remote from said flame for detecting sound conducted by said conduit and for generating a signal representative of said sound; and

means (38, 82-90) for receiving said signal, said means comprising electronic circuitry for signalling the presence or non-presence of said flame in response to the received signal;

wherein said sound detector is at a location remote from said flame near the bottom of said flare stack.

2. Apparatus according to claim 1, wherein said signal generated by said sound detector (38) is an electric signal.

3. Apparatus according to claim 1 or 2, wherein said electronic circuitry for receiving said signal and signalling the presence or non-presence of said flame is responsive to the energy content of said signal at one or more preselected frequency bands for thereby indicating the presence or non-presence of said flame.

4. Apparatus according to claim 1 or 2, wherein said electronic circuitry for receiving said signal and signalling the presence or non-presence of said flame is responsive to the presence or non-presence of an energy peak in said signal at one or more preselected frequency bands for thereby indicating respectively the presence or non-presence of said flame.

5. Apparatus according to claim 1 or 2, wherein said electronic circuitry for receiving said signal and signalling the presence or non-presence of said flame is responsive to the shape of a plot of the frequency of said signal versus energy and compares said shape with a standard plot for thereby indicating the presence or non-presence of said flame.

6. Apparatus according to claim 1 or 2, wherein said electronic circuitry for receiving said signal and signalling the presence or non-presence of said flame is responsive to the rate of change of the frequency of said signal versus energy at one or more preselected frequency bands for thereby indicating the presence or non-presence of said flame.

7. Apparatus according to any preceding claim, wherein said sound detector comprises an electronic acoustic vibration receiver.

8. Apparatus according to any one of claims 1 to 6, wherein said sound detector comprises a microphone or a piezoelectric crystal.

9. Apparatus according to any one of the preceding claims, and further comprising an ignition flame generator (36) connected to said conduit (34), said ignition flame generator producing an ignition flame for igniting said pilot burner (26) that propagates through said conduit to said pilot burner.

10. A method of detecting the presence or non-presence of a flame issued from a pilot burner (26) located at the open discharge end (24) of a flare stack (10), said method comprising the steps of:

conducting the sound produced by said flame through a conduit (34) from the location of said flame to a location remote from the location of the flame;
detecting the conducted sound and producing a signal representative of said sound; and
indicating the presence or non-presence of said flame from said signal representative of said sound,

wherein the bottom end of the stack (14) is closed by a ground level base plate (18), said conduit extends from the location of the flame to a remote location near the bottom of said stack; and wherein said step of detecting the conducted sound is carried out at said location remote from the flame.

11. A method according to claim 10, wherein said signal is an electric signal and the presence or non-presence of said flame is electronically determined from said electric signal.

12. A method according to claim 10 or 11, wherein said flame when present is issued from a pilot burner for igniting a combustible gas stream.

13. A method according to claim 10 or 11, which further comprises the step of igniting said pilot burner when required by generating an ignition flame and propagating it through said conduit to said pilot burner.

Patentansprüche

1. Facketrohr umfassend: eine Grundplatte (18) in Bodennähe, die das untere Ende des Rohrs (14) verschließt,
eine Flammenerfassungsvorrichtung zum Erfassen des Vorhandenseins oder Fehlens einer Flamme, die aus einem Zündbrenner (26) am oberen offenen Ende (24) des Fackelrohrs (10) austritt, wobei die Vorrichtung umfasst:

eine Leitung (34), deren eines Ende an dem offenen Auslassende (24) des Fackelrohrs bezüglich der Flamme angeordnet ist, wodurch Schall, der durch die Flamme erzeugt wird, von dem Rohr zu einem Schalldetektor (38) geleitet wird, der mit der Leitung an einer Stelle verbunden ist, die von der Flamme entfernt ist, um Schall, der durch die Leitung geleitet wird, zu erfassen und ein Signal zu erzeugen, das den Schall darstellt; und

Mittel (38, 82-90) zum Empfangen des Signals, wobei die Mittel einen elektronischen Schaltungsaufbau zum Anzeigen des Vorhandenseins oder Fehlens der Flamme in Antwort auf das empfangene Signal umfassen;

wobei der Schalldetektor sich an einer Stelle befindet, die von der sich nahe dem Boden des Fackelrohrs befindenden Flamme entfernt ist.

2. Vorrichtung nach Anspruch 1, wobei das durch den Schalldetektor (38) erzeugte Signal ein elektrisches Signal ist.

3. Vorrichtung nach Anspruch 1 oder 2, wobei der elektronische Schaltungsaufbau zum Empfangen des Signals und Anzeigen des Vorhandenseins oder Fehlens der Flamme auf den Energieinhalt des Signals bei einem oder mehr vorgewählten Frequenzbändern reagiert, um **dadurch** das Vorhandensein oder Fehlen der Flamme anzuzeigen.

4. Vorrichtung nach Anspruch 1 oder 2, wobei der elektronische Schaltungsaufbau zum Empfangen des Signals und Anzeigen des Vorhandenseins oder Fehlens der Flamme auf das Vorhandensein oder Fehlen einer Energiespitze in dem Signal bei einem oder mehr ausgewählten Frequenzbändern reagiert, um **dadurch** jeweils das Vorhandensein oder Fehlen der Flamme anzuzeigen.

5. Vorrichtung nach Anspruch 1 oder 2, wobei der elektronische Schaltungsaufbau zum Empfangen des Signals und Anzeigen des Vorhandenseins oder Fehlens der Flamme auf die Form einer Darstellung der Frequenz des Signals gegenüber der Energie reagiert und die Form mit einer gängigen Standarddarstellung vergleicht, um **dadurch** das Vorhandensein oder Fehlen der Flamme anzuzeigen.

6. Vorrichtung nach Anspruch 1 oder 2, wobei der elektronische Schaltungsaufbau zum Empfangen des Signals und Anzeigen des Vorhandenseins oder Fehlens der Flamme auf die Änderungsrate der Frequenz des Signals gegenüber der Energie bei einem oder mehr ausgewählten Frequenzbän-

dern reagiert, um **dadurch** das Vorhandensein oder Fehlen der Flamme anzuzeigen.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Schalldetektor einen elektronischen akustischen Schwingungsempfänger umfasst.

8. Vorrichtung nach einem der Ansprüche 1 bis 6, wobei der Schalldetektor ein Mikrophon oder einen piezoelektrischen Kristall umfasst.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, weiter umfassend einen Zündflammenerzeuger (36), der mit der Leitung (34) verbunden ist, wobei der Zündflammenerzeuger eine Zündflamme zum Zünden des Zündbrenners (26) erzeugt, die sich durch die Leitung zum Zündbrenner ausbreitet.

10. Verfahren zum Feststellen des Vorhandenseins oder Fehlens einer Flamme, die aus einem Zündbrenner (26) austritt, der an dem offenen Auslassende (24) eines Fackelrohrs (10) angeordnet ist; umfassend die Schritte:

Leiten des durch die Flamme erzeugten Schalls durch eine Leitung (34) von der Stelle der Flamme zu einer Stelle, die von der Stelle der Flamme entfernt ist;

Feststellen des geleiteten Schalls und Erzeugen eines Signals, das den Schall darstellt; und

Anzeigen des Vorhandenseins oder Fehlens der Flamme von dem den Schall darstellenden Signal,

wobei das untere Ende des Rohrs (14) durch eine Grundplatte (18) in Bodennähe verschlossen wird, sich die Leitung von der Stelle der Flamme zu einer entfernten Stelle nahe dem Boden des Rohrs erstreckt; und wobei der Schritt des Feststellens des geleiteten Schalls an dieser von der Flamme entfernten Stelle durchgeführt wird.

11. Verfahren nach Anspruch 10, wobei das Signal ein elektrisches Signal ist und das Vorhandensein oder Fehlen der Flamme elektronisch von dem elektrischen Signal bestimmt wird.

12. Verfahren nach Anspruch 10 oder 11, wobei die Flamme, wenn sie vorhanden ist, von einem Zündbrenner zum Entzünden eines brennbaren Gasstroms austritt.

13. Verfahren nach Anspruch 10 oder 11, das weiter erforderlichenfalls den Schritt des Zündens des Zündbrenners durch Erzeugen einer Zündflamme und deren Ausbreiten durch die Leitung zum Zündbrenner umfasst.

Revendications

1. Torchère comportant: une plaque de base au niveau du sol (18) fermant l'extrémité inférieure de la cheminée (14),

un dispositif de détection de flamme pour détecter la présence ou la non-présence d'une flamme émise par un brûleur pilote (26) à l'extrémité ouverte supérieure (24) de la torchère (10), ledit dispositif comportant:

un conduit (34) ayant une extrémité positionnée à ladite extrémité d'évacuation ouverte (24) de ladite torchère par rapport à ladite flamme de telle sorte qu'un son produit par ladite flamme est conduit par ledit conduit vers un détecteur de son (38) relié audit conduit à un emplacement éloigné de ladite flamme pour détecter un son conduit par ledit conduit et pour produire un signal représentatif dudit son; et

des moyens (38, 82 à 90) pour recevoir ledit signal, lesdits moyens comportant un circuit électronique pour signaler la présence ou la non-présence de ladite flamme en réponse au signal reçu;

dans laquelle ledit détecteur de son est à un emplacement éloigné de ladite flamme proche de la partie inférieure de ladite torchère.

2. Dispositif selon la revendication 1, dans lequel ledit signal produit par ledit détecteur de son (38) est un signal électrique.

3. Dispositif selon la revendication 1 ou 2, dans lequel ledit circuit électronique pour recevoir ledit signal et signaler la présence ou la non-présence de ladite flamme est sensible au contenu énergétique dudit signal dans une ou plusieurs bandes de fréquence présélectionnées pour indiquer ainsi la présence ou la non-présence de ladite flamme.

4. Dispositif selon la revendication 1 ou 2, dans lequel ledit circuit électronique pour recevoir ledit signal et signaler la présence ou la non-présence de ladite flamme est sensible à la présence ou la non-présence d'un pic d'énergie dans le signal dans une ou plusieurs bandes de fréquence présélectionnées pour indiquer ainsi respectivement la présence ou la non-présence de ladite flamme.

5. Dispositif selon la revendication 1 ou 2, dans lequel ledit circuit électronique pour recevoir ledit signal et signaler la présence ou la non-présence de ladite

flamme est sensible à la forme d'un tracé de la fréquence dudit signal en fonction de l'énergie et compare ladite forme avec un tracé étalon pour indiquer ainsi la présence ou la non-présence de ladite flamme.

6. Dispositif selon la revendication 1 ou 2, dans lequel ledit circuit électronique pour recevoir ledit signal et signaler la présence ou la non-présence de ladite flamme est sensible à la vitesse de changement de la fréquence dudit signal en fonction de l'énergie dans une ou plusieurs bandes de fréquence présélectionnées pour indiquer ainsi la présence ou la non-présence de ladite flamme.

7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel ledit détecteur de son comporte un récepteur de vibration acoustique électronique.

8. Dispositif selon l'une quelconque des revendications 1 à 6, dans lequel ledit détecteur de son comporte un microphone ou un cristal piézoélectrique.

9. Dispositif selon l'une quelconque des revendications précédentes et comportant de plus un générateur de flamme d'allumage (36) relié audit conduit (34), ledit générateur de flamme d'allumage produisant une flamme d'allumage pour allumer ledit brûleur pilote (26), qui se propage à travers ledit conduit vers ledit brûleur pilote.

10. Procédé de détection de la présence ou de la non-présence d'une flamme émise par un brûleur pilote (26) situé à l'extrémité d'évacuation ouverte (24) d'une torchère (10), ledit procédé comportant les étapes consistant à:

conduire le son produit par ladite flamme à travers un conduit de l'emplacement de ladite flamme à un emplacement éloigné de l'emplacement de la flamme;
détecter le son conduit et produire un signal représentatif dudit son; et
indiquer la présence ou la non-présence de ladite flamme à partir dudit signal représentatif dudit son,

dans lequel l'extrémité inférieure de la cheminée (14) est fermée par une plaque de base au niveau du sol (18), ledit conduit s'étend de l'emplacement de la flamme à un emplacement éloigné proche de la partie inférieure de ladite cheminée; et dans lequel ladite étape de détection du son conduit est effectuée audit emplacement éloigné de la flamme.

11. Procédé selon la revendication 10, dans lequel ledit signal est un signal électrique et la présence ou la non-présence de ladite flamme est déterminée électroniquement à partir dudit signal électrique.

12. Procédé selon la revendication 10 ou 11, dans lequel ladite flamme lorsqu'elle est présente est émise par un brûleur pilote pour allumer un flux de gaz combustible.

13. Procédé selon la revendication 10 ou 11, qui comporte de plus l'étape consistant à allumer ledit brûleur pilote lorsque c'est nécessaire en produisant une flamme d'allumage et en la propageant à travers ledit conduit jusqu'audit brûleur pilote.

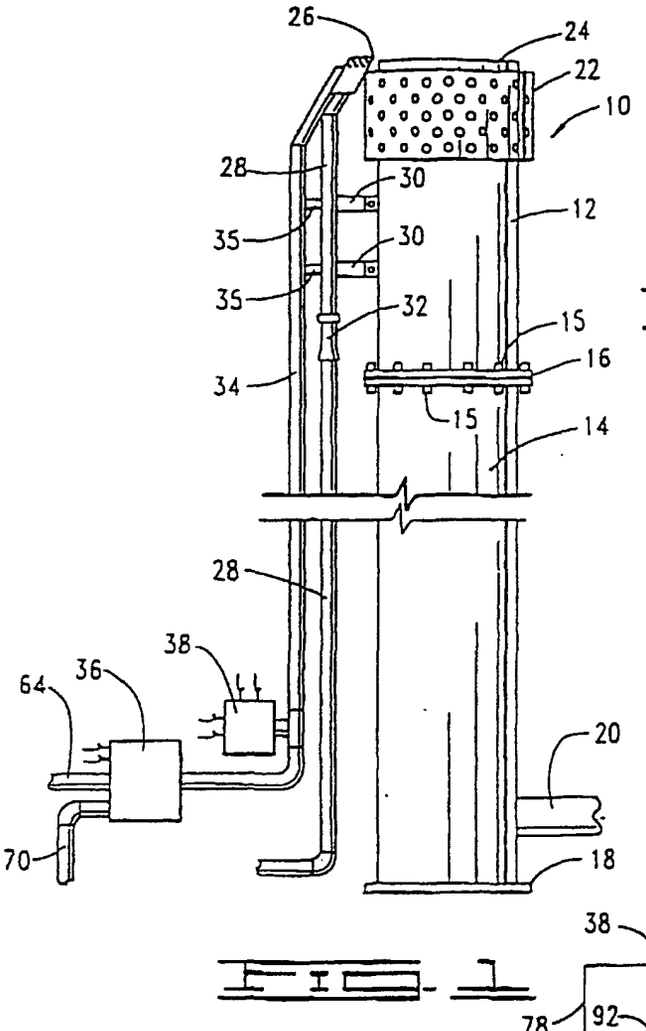

FIG. 1

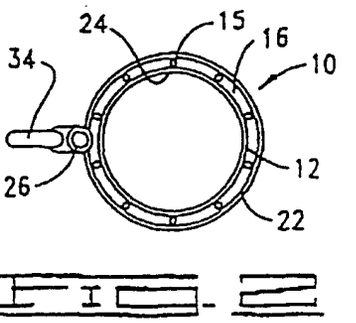

FIG. 2

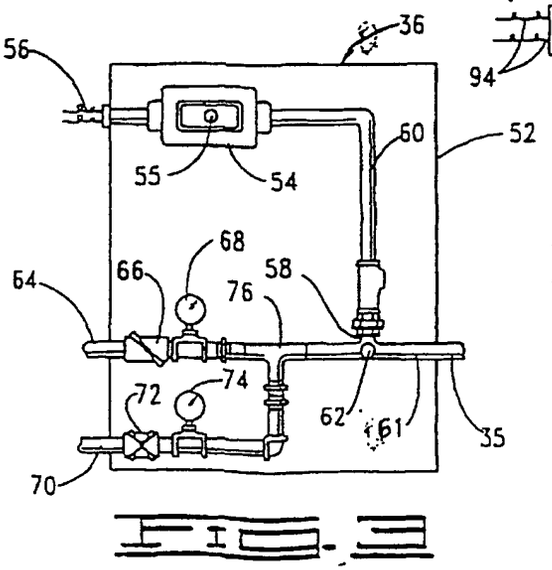

FIG. 3

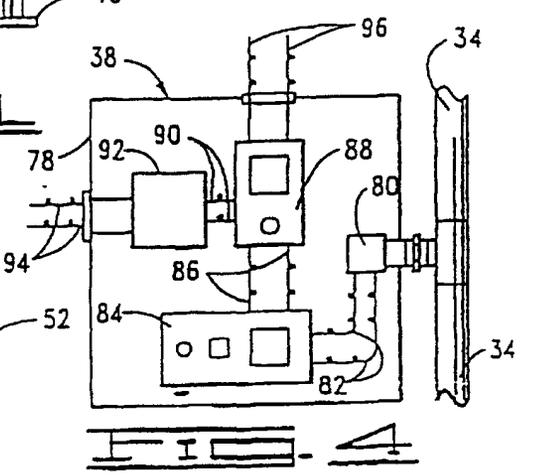

FIG. 4

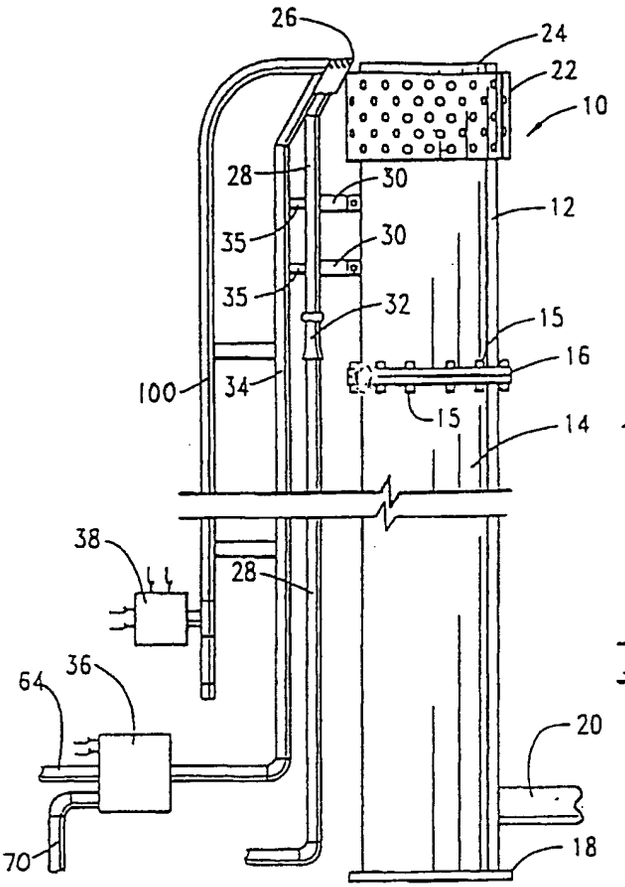

FIG. 5

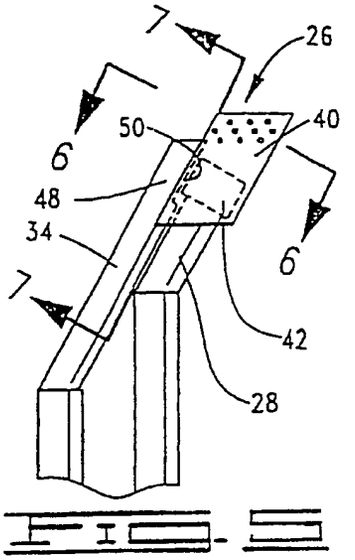

FIG. 6

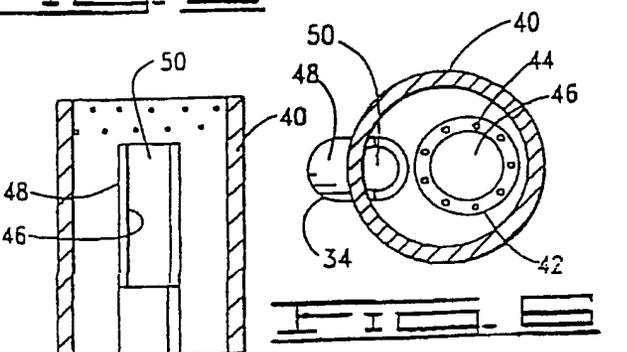

FIG. 7