

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 698 766 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.02.1996 Bulletin 1996/09

(51) Int Cl.⁶: **F23D 14/58**

(21) Application number: **95305876.5**

(22) Date of filing: **22.08.1995**

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

(30) Priority: **26.08.1994 GB 9417292**
16.01.1995 GB 9500777
31.03.1995 GB 9506615

(71) Applicant: **Caradon Ideal Limited**
Hull, North Humberside HU5 4JN (GB)

(72) Inventor: **Bratley, Roy**
Hessle, Hull HU13 OHP (GB)

(74) Representative: **Lerwill, John**
London, WC1V 7LE (GB)

(54) Gas burner

(57) A gas burner for a domestic boiler which substantially reduces resonant noise generation during burner ignition, has a perforated inner wall (5) with a greater flow resistance than a perforated outer wall (4), the high flow resistance of the inner wall preventing transmission of pressure pulses sufficient to cause troublesome noise generation through into the main volume of the burner.

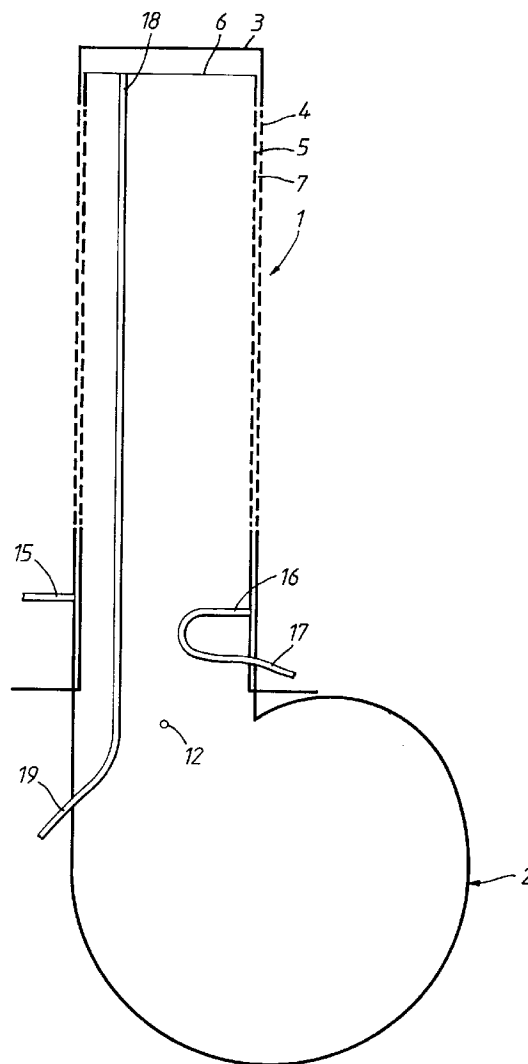


Fig.1

EP 0 698 766 A2

Description

The invention relates to gas burners, and is concerned especially, but not necessarily exclusively, with a gas burner suitable for domestic boilers.

There are known gas burners having a substantially cylindrical perforated body confining a chamber into which a gas and air mixture is fed through one end of the body. These burners generally operate satisfactorily, but they do have some drawbacks. There is a tendency for such burners to suffer from resonant noise generation during ignition, especially when the burners are mounted within relatively small volume combustion chambers in compact boilers. The pressure drop across the perforated wall of the burner body is only small, e.g. in the order of 0.1 - 0.2 mb, and for this reason it has been proposed to provide additional flow resistance between a fan which delivers the gas and air mixture to the burner, and the interior of the burner body in order to facilitate control of the gas and air mixture supply. With such an arrangement, relatively small pressure fluctuations to the combustion chamber pressure are transmitted to the interior of the burner and can produce significant changes to the mixture flow through the burner ports, which can be the cause of noise generation during periods of ignition.

The present invention addresses the disadvantage explained above and as a solution it provides a gas burner having a body into the interior of which a gas and air mixture is fed to pass out through ports in an outer perforated wall of the body for development of a flame on the exterior of the body characterised in that an inner perforated wall is positioned adjacent the outer wall and defines therewith a sub-chamber, the inner wall has ports through which the gas and air mixture flows into the sub-chamber, and the flow resistance through the inner wall is greater than that through the outer wall.

The volume of the sub-chamber should be small in relation to the volume of the interior of the body. For a burner designed for use with natural gas or methane a separation of not greater than 1.2 mm between the inner wall member and the outer perforated wall is appropriate. Due to the high flow resistance of the inner wall member, pressure pulses are not transmitted through into the main volume of the burner sufficiently to cause troublesome noise generation.

Another drawback of the prior art gas burners discussed above is that the pressure generated within the burner by the fan is limited by including in the flow path a restriction needed for producing a pressure differential signal indicative of the air flow rate, which signal is used to control a gas valve in order to maintain an appropriate ratio of gas to air in the mixture fed to the burner. A pressure differential signal of at least 1 mb is needed for effective control, and in order to provide this signal a restricted orifice has been provided in the fan inlet, which limits the outlet pressure the fan can produce so that a larger fan than might otherwise be used may be needed.

In accordance with a preferred embodiment of the

present invention, means are provided for sensing the pressure differential across the inner wall member of the burner. This pressure differential signal is representative of the air flow through the burner and can be used for controlling the gas valve to ensure the correct ratio of gas to air in the mixture fed to the burner. By avoiding a restriction in the fan inlet, the pressure which the fan is able to deliver to the interior of the burner is increased.

Under certain conditions it has been found that the gas flow through the double wall structure can cause a whistling sound, which is contrary to the aim of reducing noise during burner operation. A solution to this problem is to arrange the gas ports so that ports in the two walls are not aligned and hence there is not a direct rectilinear flow path through the wall structure.

A preferred solution to this problem is to so arrange the gas ports that the velocity of the gas/air mixture through the ports of the outer skin varies over the area of the outer skin, i.e. the outer skin has a variable port loading. Preferably, the ratio of the maximum outer wall port loading to the minimum outer wall port loading is in the range of 1.5:1 to 3:1, e.g. about 2:1. Advantageously, the port areas are chosen so that the pressure drop across the inner wall is at least four times greater than that across the outer wall of the burner, and preferably the pressure drop is about ten times greater.

It is suitable for the regions of maximum port loading to be spaced apart at a distance of up to 25 mm, such as around 15 mm.

A full understanding of the invention will be gained from the following detailed description which is given with reference to the accompanying drawings in which:-

Figure 1 is a schematic axial section through a gas burner embodying the invention;

Figure 2 is a schematic illustration of an alternative embodiment of the invention;

Figure 3 shows the embodiment of Figure 2 oriented to produce a downwardly directed flame;

Figure 4 illustrates a possible gas port arrangement;

Figure 5 is a cross section through part of the gas port arrangement shown in Figure 4;

Figure 6 illustrates an alternative gas port arrangement; and

Figure 7 illustrates a preferred gas port arrangement.

Illustrated in Figure 1 is a gas burner with a cylindrical body 1 mounted with its axis upright and connected to a fan 2 for delivering a premix of natural gas (mostly methane) and air into the interior of the burner through the lower end thereof. The upper end of the burner body

is closed by an end wall 3, and the body has a double side wall structure formed by an outer perforated wall or screen 4 and an inner perforated wall or screen 5 lining the outer wall and spaced therefrom at a radial distance in the range of 0.5 to 1.2 mm, and preferably about 0.8 to 1.0 mm. The density of the ports in the outer screen is greater than that of the ports in the inner screen so that as the gas and air mixture passes out through the double wall structure most of the pressure drop occurs across the inner wall 5. In the particular embodiment, and as illustrated in Figures 4 and 5, the ports 8 in the outer screen are positioned in groups, in each group there being a central port 8a surrounded by a plurality of equispaced further ports 8b, there being six such further ports as illustrated. Each of the ports 8 may be approximately 0.8 mm in diameter with the outer ports 8b having their centres 1.6 mm from the centre of the central port 8a. The groups may be arranged with their central ports 8a at the corners of a square grid pattern having a pitch of 5 mm. The outer screen may be perforated stainless steel. The ports 10 of the inner screen are fewer in number and may be positioned to register with the central ports 8a of the groups of ports in the outer screen, as clearly shown in Figures 4 and 5. With this port configuration, the flame generated by the central port 8a of each group of ports in the outer screen 4 is surrounded and stabilised by six flames generated by the outer ports 8b of the same group, which outer flames are developed closer to the surface of the screen because their ports carry a lower loading of gas and air mixture. In this way there is established a stable burner flame spaced a small distance from the exterior surface of the burner body.

According to an alternative gas port arrangement, shown in Figure 6, the inner and outer walls are relatively displaced so that the inner wall ports 10 are directed towards the centres of the solid, imperforate portions of the outer wall located between the groups of ports in this wall. As a result each port 10 is surrounded by a ring of eight ports (e.g. port 10' is surrounded by ports 8') four of which are equally spaced from the port 10 at a distance somewhat less than that at which the other four are spaced from the port 10. However, the latter ports are positioned to receive gas entering the cavity between the walls through two inner wall ports.

Figure 7 illustrates a preferred port arrangement in which, like in the previous embodiments, the ports 10 of the inner wall or skin are arranged in rows, and the outer skin ports 8 are located in groups which are arranged in rows and uniformly distributed. In all the embodiments the inner and outer skins are spaced at a radial distance in the range 0.5 to 1.2 mm, and preferably about 0.8 to 1 mm. Each row of inner skin ports (A,B...) is aligned with a row of outer skin ports (A2,B2...) and each port 10 registers with the central port 8a of a respective group of outer skin ports, although this is not crucial to the working of the invention. It is preferred nonetheless for the centre of each port 10 to lie within a circle joining the centres of the ports 8b of the group of outer skin ports. Between

adjacent rows of the outer skin port groups which confront the inner skin ports 10 are two other rows of skin port groups (A1,A3,B1,B3...). As a result of this disposition of the ports, the velocity of gas/air mixture through the outer skin ports, i.e. the port loading, varies across the area of the outer skin with the ratio of the maximum to the minimum port loading being approximately 2:1. It will be appreciated that due to the variation in port loading, the flame height will differ over the area of the burner and as a consequence the tendency to generate noise in the combustion chamber will not be concentrated at any one frequency.

In the preferred embodiment, each of the inner skin ports 10 is approximately 2.2 mm in diameter, and the rows of inner skin ports A,B are spaced approximately 15 mm apart. The outer skin ports 8a,8b are approximately 0.8 mm in diameter with ports 8b in each group having their centres on a circle of diameter of around 3.2 mm and concentric with the central port 8a of that group. The groups of outer skin ports have their centres located at the corners of a square grid pattern with a length of side of about 5.0 mm. The pressure drop produced across the inner skin is approximately 10 times that across the outer skin.

All these arrangements of ports are applicable to cylindrical burners and flat wall burners as described in this application, and are not limited to any particular burner configuration.

With the burner body equipped with the inner wall member as described, any pressure fluctuations in the combustion chamber will not be transmitted to the interior of the burner and will instead be confined to the relatively small volume of the sub-chamber 7 defined between the inner and outer perforated walls. As a consequence tendency for resonant noise generation upon burner ignition is substantially diminished.

To control the ratio of gas to air in the mixture delivered to the burner by the fan, a gas valve adjusted in accordance with air flow is employed. To sense the air flow, the pressure drop across the inner perforated wall 5 is detected. A high pressure sensing orifice 12 is located at the outlet of the fan 2, and three alternative arrangements for sensing the low pressure in the sub-chamber 7 between the inner and outer walls 4,5 are shown in Figure 1. In the first alternative, the low pressure is sensed by an orifice 15 opening through the outer wall 4 at a location below the perforated area of this wall. In the second alternative the low pressure is sensed by an orifice 16 opening through the inner wall member below the perforated sections of the two wall members, a tube 17 connected to this orifice being led in a sealed manner out through the double wall structure. According to the third alternative the pressure is sensed through an orifice 18 in an upper end wall 6 of the inner screen, this orifice being connected to a tube 19 extending along the interior of the burner and then out through a hole in the wall of the fan outlet.

With the burner construction of the invention, in the

absence of any flow restrictions on either the inlet or outlet sides of the fan, it can be readily ensured there will be produced within the burner a pressure level adequate to ensure flame stability.

The invention is applicable to cylindrical burners mounted horizontally as well as cylindrical burners having their axes substantially vertical. Furthermore, the invention is not restricted to cylindrical burners and can be applied to burners of other forms. In Figure 2 for example there is shown a gas burner embodying the invention and having a substantially flat or planar face at which the flames are produced. More particularly, the burner 20 has a body of rectangular configuration with a perforated top wall 24 with gas ports which could be arranged in a pattern similar to that described above in connection with Figs. 4 to 7 or in any other suitable array. Mounted in the body and spaced about 1 mm below the wall 24 is an inner wall member 25 also provided with gas ports but providing a smaller aggregate through flow area than the gas ports to the top wall 24, and hence a greater flow resistance. A fan 22 delivers a gas and air mixture into the interior of the burner through an inlet in the bottom wall. To sense the air flow rate for automatic adjustment of a gas valve, sensing orifices 12 and 13 connected to respective tubes are positioned to sense the high pressure in the body interior and the low pressure in the small volume sub-chamber confined between the walls 24 and 25. The operation and advantages of the burner shown in Figure 2 will be apparent from the above description relating to Figs 1 and 4-7.

The burner in Fig 3 is of essentially the same construction as that of Fig. 2 except that is inverted so that the burner is down firing instead of upfiring.

Claims

1. A gas burner having a body (1) into the interior of which a gas and air mixture is fed to pass out through ports (8) in an outer perforated wall (4) of the body for development of a flame on the exterior of the body characterised in that an inner perforated wall (5) is positioned adjacent the outer wall (4) and defines therewith a sub-chamber (7), the inner wall has ports (10) through which the gas and air mixture flows into the sub-chamber, and the flow resistance through the inner wall is greater than that through the outer wall.
2. A gas burner according to claim 1, characterised in that means (12,15;12,16,17;12,18,19) are provided for sensing the pressure differential across the inner perforated wall (5).
3. A gas burner according to claims 1 or 2, characterised in that ports (10) through the inner wall register with ports (8) in the outer wall to allow flow of the gas and air mixture directly through the sub-chamber.

4. A gas burner according to claim 1 or 2, characterised in that ports (10) through the inner wall (5) are confronted by solid portions of the outer wall (4).
5. A gas burner according to any one of claims 1 to 4, wherein ports (8) in the outer wall (4) are arranged in groups (A_2, B_2) associated with respective ports (10) in the inner wall (5).
6. A gas burner according to claim 5, wherein the outer wall includes additional groups (B_1, B_3, A_1, A_3) of ports (8) not directly associated with a port (10) in the inner wall.
7. A gas burner according to any one of the preceding claims, characterised in that the outer wall (4) has a variable port loading.
8. A gas burner according to claim 7, characterised in that the ratio of maximum outer wall port loading to the minimum outer port loading is in the range 1.5:1 to 3:1.
9. A gas burner according to claim 8, characterised in that the said ratio is about 2:1.
10. A gas burner according to claims 2 to 9, characterised in that the gas in the gas and air mixture is natural gas or methane, and the separation between the inner wall (5) and the outer wall (4) is less than 1.2 mm.
11. A gas burner according to any one of claims 1 to 7 characterised in that the pressure drop across the inner wall is at least four times, and preferably around 10 times, greater than that across the outer wall.

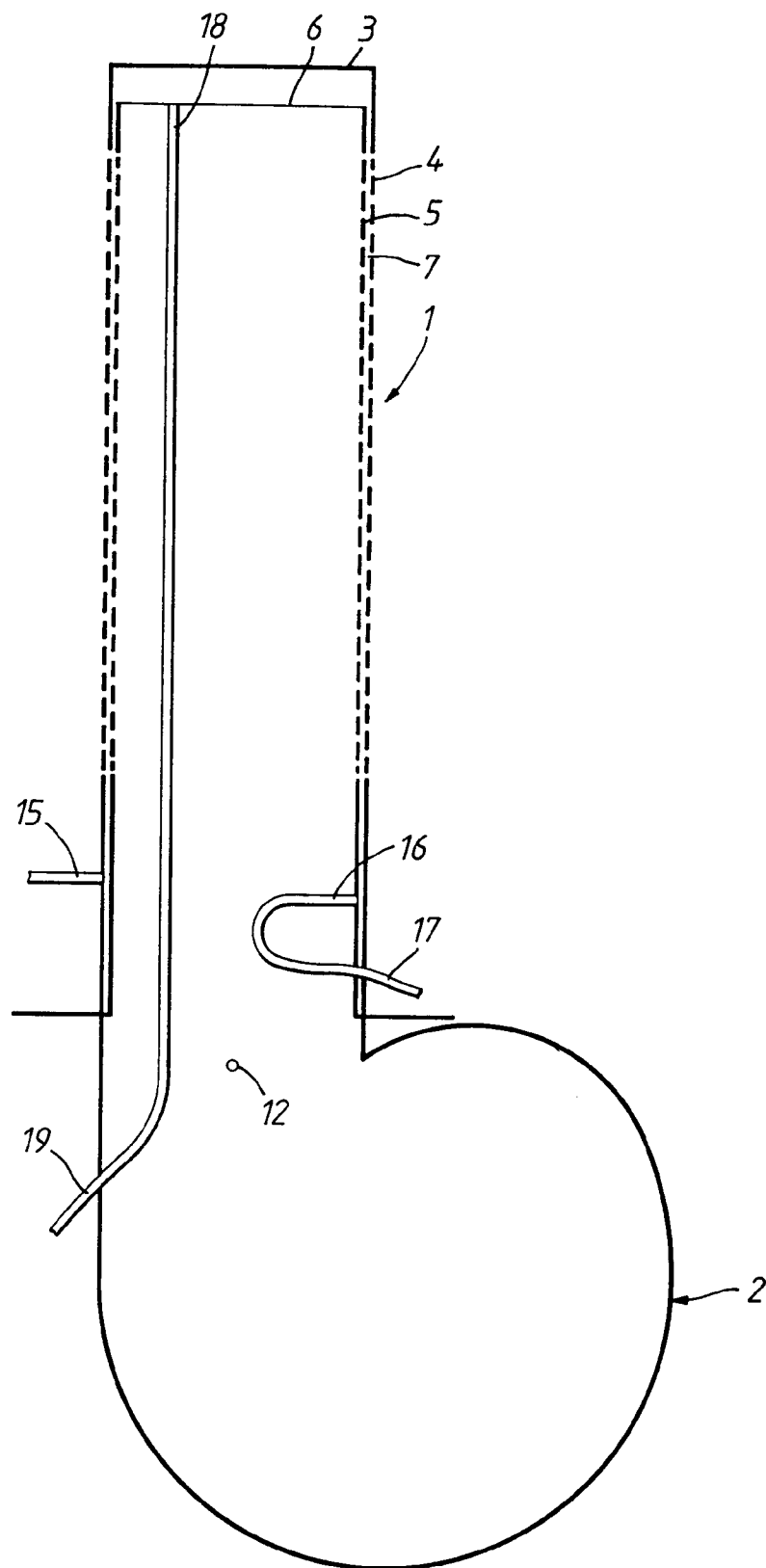


Fig.1

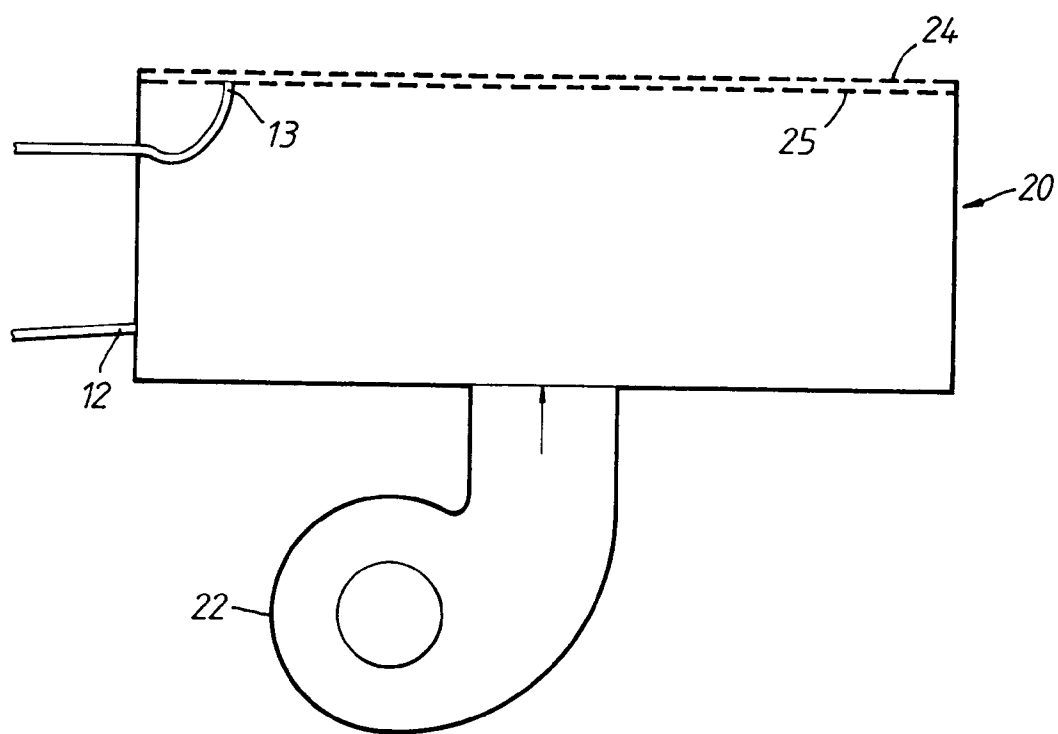


Fig. 2

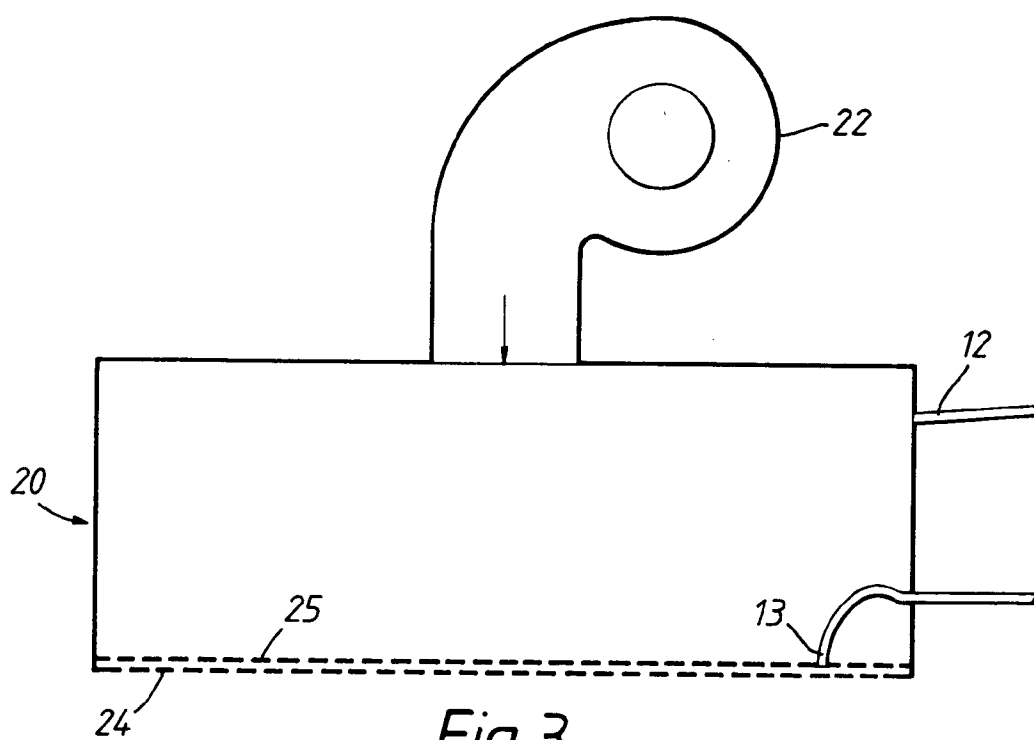


Fig. 3

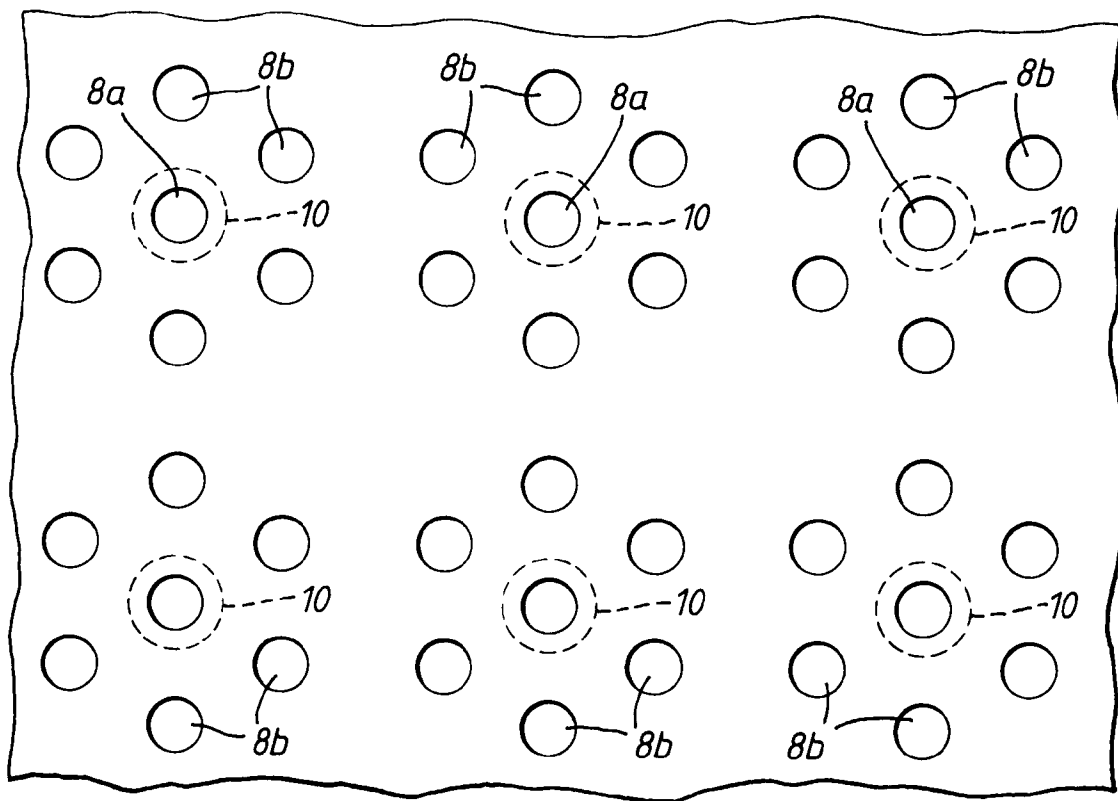


Fig. 4

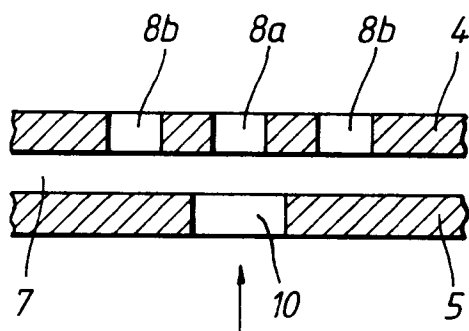


Fig. 5

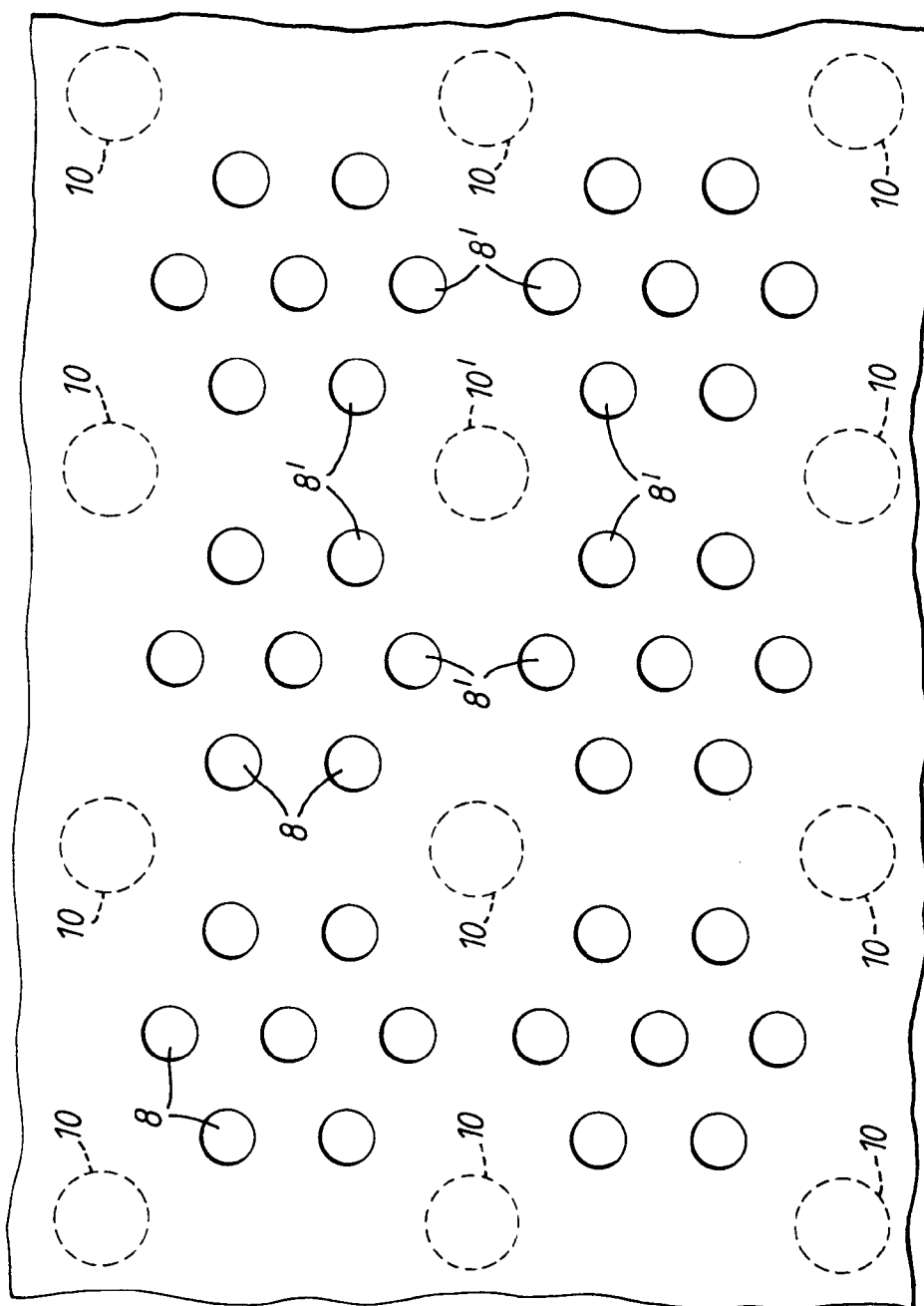


Fig. 6

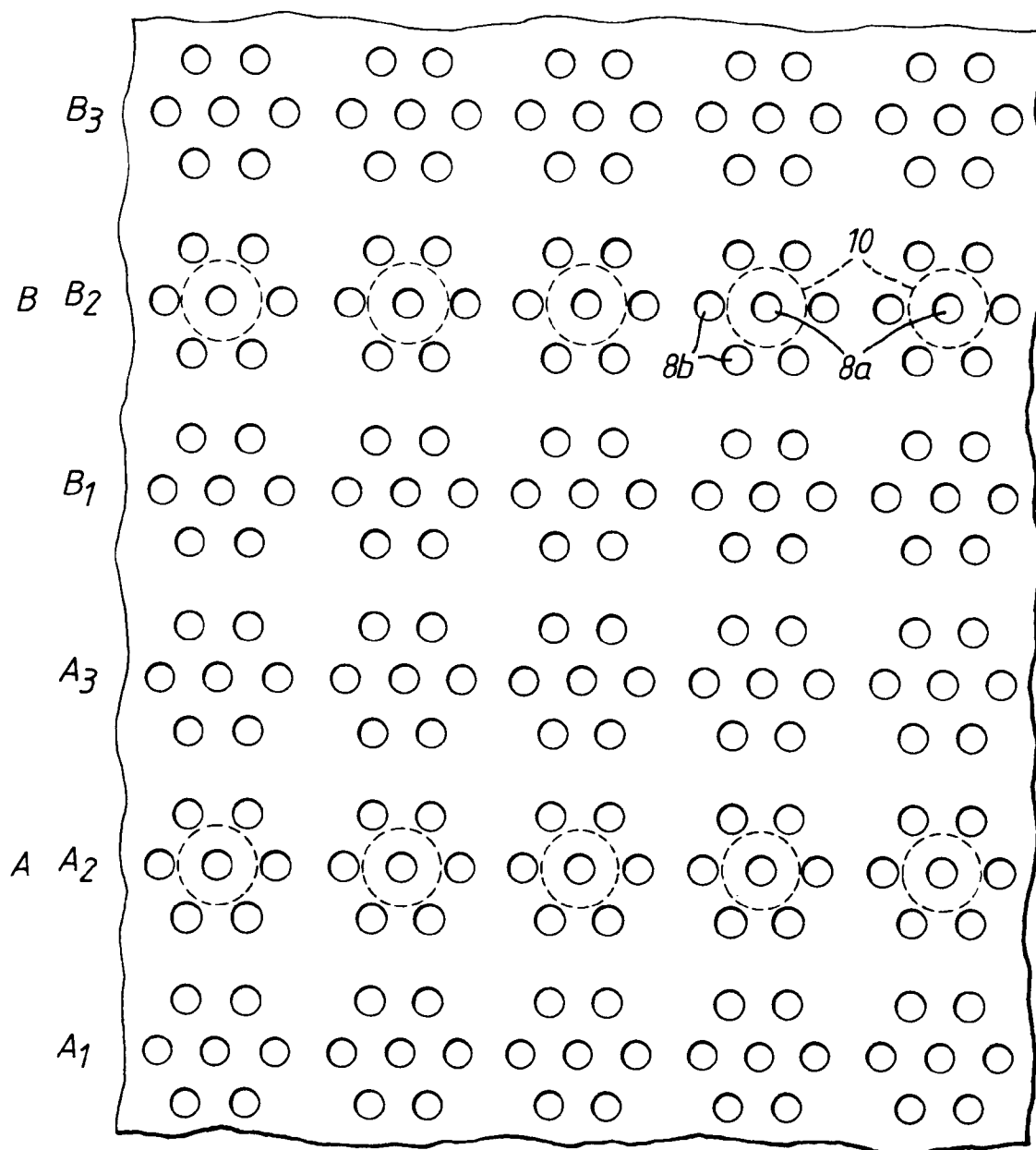


Fig.7