PATENT SPECIFICATION (11) 1 590 772

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(21) Application No. 10635/78 (22) Filed 17 March 1978

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F4W 2C2B 2C3A 2C3C 3A 42A 42B 7

(72) Inventor DUNCAN COLBORN SYME

(54) IMPROVEMENTS IN HEATING APPARATUS

(71) We, VERMONT CASINGS, INC., a corporation organised and existing under the laws of the State of Vermont, United States of America, of Randolph, Vermont, United States of America, do hereby declare the invention for which

ERRATUM

SPECIFICATION No. 1,590,772

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THE PATENT OFFICE
24 JUNE, 1983

off as the wood burns, are generally left unburned. The unburned volatiles remain for two reasons, first because the gases, by the time they have left the wood, are generally too cool for secondary combustion and second, because oxygen that it admitted to the stove or fireplace is usually consumed by the coals at the base of the fire mass, causing the gases to rise through an oxygen-deficient atmosphere. The loss of the hot, unburned volatile gases is a serious problem, because they represent approximately half of the total heat value of the wood. It is as though one were to run an open line of natural gas up a chimney without bothering to ignite it first. In addition, the volatile gases given off from the wood without being ignited may condense on the cool sides of long metal flue pipes and drip out as creosote which may sometimes be inadvertently and dangerously burned, in their solid creosote form, as a chimney fire.

The present invention provides heating apparatus comprising a heat conducting housing enclosing a primary combustion chamber, a secondary combustion chamber in gaseous communication with said primary combustion chamber, and an internal flame path defined by baffles in gaseous communication with said secondary combustion chamber, a vertically oriented, downwardly directed baffle separating said housing and in gaseous communication with said internal flame path for providing an exit port for combustion products.

Preferably, the apparatus includes a thermostatically controlled inlet port in said housing for supplying air to said first supply path.

Preferably also, the apparatus includes a pivoting side door in said housing and baffle means for providing a smokeless loading aperture in said side when said door is pivoted to an open condition.

A specific embodiment of the present inventin will now be described, by way of example, with referenece to the accompanying drawings in which:—

Figure 1 is a front perspective view of a heating apparatus according to the invention;

Figure 2 is a back perspective view of the heating apparatus of Figure 1;

Figure 3 is a cut-away front perspective view of the heating apparatus according to the invention;

Figure 4 is a cross-sectional view taken along lines 4-4 of Figure 3; and

Figure 5 is an enlarged view of the circled area of Figure 4.

Referring to the accompanying drawings,

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(54) IMPROVEMENTS IN HEATING APPARATUS

(71) We, VERMONT CASINGS, INC., a corporation organised and existing under the laws of the State of Vermont, United States of America, of Randolph, Vermont, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates generally to heating apparatus and in particular to a wood-burning heating apparatus or stove.

Wood-burning stoves have been available for centuries. Perhaps the most well-known wood-burning stove is the Franklin stove which, while being practical for its time, burned wood inefficiently. That stove, like most cast iron stoves available today, provides for updraft combustion, such as is found in a fireplace and in which the volatile gases (volatiles), which are driven off as the wood burns, are generally left unburned. The unburned volatiles remain for two reasons, first because the gases, by the time they have left the wood, are generally too cool for secondary combustion and second, because oxygen that it admitted to the stove or fireplace is usually consumed by the coals at the base of the fire mass, causing the gases to rise through an oxygen-deficient atmosphere. The loss of the hot, unburned volatile gases is a serious problem, because they represent approximately half of the total heat value of the wood. It is as though one were to run an open line of natural gas up a chimney without bothering to ignite it first. In addition, the volatile gases given off from the wood without being ignited may condense on the cool sides of long metal flue pipes and drip out as creosote which may sometimes be inadvertently and dangerously burned, in their solid creosote form, as a chimney fire.

The present invention provides heating apparatus comprising a heat conducting housing enclosing a primary combustion chamber, a secondary combustion chamber in gaseous communication with said primary combustion chamber, and an internal flame path defined by baffles in gaseous communication with said secondary combustion chamber, a vertically oriented, downwardly directed baffle separating said primary and secondary combustion chambers, said baffle, in combination with the housing providing a first opening connecting said primary and secondary combustion chambers for said gaseous communication therebetween and a second opening connecting said secondary combustion chamber with said flame path for providing said gaseous communication therebetween, a first air supply path for providing preheated air for promoting combustion in said primary combustion chamber, a second air supply path for providing preheated air to said secondary combustion chamber, and a combustion chamber, and a combustion products exit aperture at a top portion of said housing and in gaseous communication with said internal flame path for providing an exit port for combustion products.

Preferably, the apparatus includes a thermostatically controlled inlet port in said housing for supplying air to said first supply path.

Preferably also, the apparatus includes a pivoting side door in said housing and baffle means for providing a smokeless loading aperture in said side when said door is pivoted to an open condition.

A specific embodiment of the present inventin will now be described, by way of example, with referenece to the accompanying drawings in which:—

Figure 1 is a front perspective view of a heating apparatus according to the invention;

Figure 2 is a back perspective view of the heating apparatus of Figure 1;

Figure 3 is a cut-away front perspective view of the heating apparatus according to the invention;

Figure 4 is a cross-sectional view taken along lines 4-4 of Figure 3; and

Figure 5 is an enlarged view of the circled area of Figure 4.

Referring to the accompanying drawings,

a wood-burning heating apparatus 8 comprises a housing 10 preferably comprised of a heavy-duty cast iron. The sides 12*a*, 12*b*, front 12*c* with doors 12*e*, 12*f*, back 12*g*, top 12*h*, and bottom 12*i* of the housing are joined in a channeled construction to form an integral, air-tight unit. The front pivoting doors 12*e*, 12*f*, allow the heating apparatus to be opened from the front for both loading of wood and for viewing the fire when the heating apparatus is used as a fireplace. A pivoting side door 14 of the apparatus, has hinges 15*a*, 15*b* which allow it to pivot about a vertical rotation axis, whereby wood may be loaded into a primary combustion chamber 16 (Figure 3) from the side of the apparatus. In its closed position, door 14 seals against a gasketing material such as a one-quarter inch diameter asbestos rope sealing member. Door 14 interlocks with a damper 18 (Figures 3 and 4) whose position is controlled by a handle 20 so that the door can be fully opened only when the apparatus is in an updraft combustion configuration as described in more detail below. Illustrated top member 12*h* supports a cast iron cooking surface 21.

Referring to Figures 2 and 3, air is supplied to the primary combustion chamber 16, through a primary inlet port 22, by a primary air supply flow path having branches 24*a*, 24*b* (Figures 3 and 4). Inlet port 22 is thermostatically controlled by a thermostat 26 which operates a pivoting damper 28, removably covering an aperture 30 in the back frame member 12*g*. Thermostat 26 is for example an 8″ coil of bimetallic material connected to damper 28 by a flexible chain. Heating apparatus 8 also has a damper control lever 34 for regulating thermostat 26. A manually controlled night/secondary air inlet port 35 in side member 12*a* provides the air inlet for air supplied to a secondary combustion chamber 36 (Figure 3) through a secondary air flow path 37.

Referring to Figure 3, primary air entering through aperture 30 travels through primary air supply paths 24*a*, 24*b* and is heated by contact with the hot walls which define the supply paths 24*a*, 24*b*. Thus, the primary air is preheated and therefore helps to keep a hotter fire going with less air and wood being consumed. The primary combustion chamber is bounded by the substantially vertically oriented downwardly extending fireback baffle 38, side door 14 and side wall 12*a*, the front doors 12*e*, 12*f* and front wall 12*c*, the top 12*h* and bottom 12*i* panels, and a vertically oriented interior panel 40 which separates the primaray combustion chamber from the secondary combution chamber 36.

The secondary combustion chamber is connected to and is in gaseous communication with the primary combustion chamber through an opening 44 in panel 40. Illustrated opening 44 is defined by the panel 40 in combination with the bottom and front panels. The secondary combustion chamber is bounded by the vertically oriented panel 40 in combination with panels 12*b*, 12*c*, 12*g*, 12*h*, and 12*i*. As noted above, the secondary combustion chamber receives preheated air from the air inlet port 35 through the secondary air supply flow path 37. The flow path 37 comprises an imperforate section 48 which extends between the inlet port 35 and panel 40, and a perforate section 49 extending from panel 40 into the secondary combustion chamber.

Behind the fireback baffle 38 are a plurality of connecting smoke passages 50, 52 which provide a circuitous path from the secondary combustion chamber to the flue exit opening at flue collar 58. These passages direct the spent flue gases from the secondary combustion chamber to the left end of the illustrated apparatus through passage 50, then upward into the upper channel or passage 52 back toward the right-hand portion of the stove, where they exit through the flue collar 58.

The secondary combustion chamber, taken together with the smoke passages, make up the flame path. Since the heat of the flue gases is considerable, and is transferred to the surfaces of the stove as the flue gases traverse the passages, a significant amount of heat is given off to the room, especially through the side and back panels, rather than being lost up the chimney. In addition, since the passages are adjacent to the primary combustion chamber, higher temperatures are maintained within the fire mass itself, which aids in burning the volatile gaseous products escaping from the burning wood.

The illustrated flue collar 58 is attached to the top panel 12*h* and provides a vertical or top exit for the spent flue gases.

The flue collar can be attached, for example, to an upper portion of back panel member 12g to provide a rear exit for the flue gases if desired.

As noted above, the thermostatically controlled inlet port 22 supplies air for the primary air flow path. Ambient air enters the apparatus through aperture 30 in frame back wall 12*g* and almost immediately divides between the side branch 24*a* and the back branch 24*b*. That portion of the incoming air which passes into the back branch 24*b* is directed along the back of fireback baffle 38 and is constrained to follow a path adjacent to the fireback baffle by an enclosing member 64. Fireback baffle 38 has a plurality of holes 66 extending therethrough for providing preheated pri-

mary air to the back of the primary combustion chamber. Illustrated enclosing member 64 is a cast iron plate and branch 24*b* has a substantially constant cross-sectional area along its length.

That portion of the ambient air passing through aperture 30 which follows side branch 24*a* passes through the baffle 38 at a lower section of the baffle (Figure 3) and is directed into the primary combustion chamber along a periodically slotted conduit 68 which extends from baffle 38, along side wall 12*a* (below side door 14) and for approximately one-fifth the distance along a bottom section of front wall 12*c*. The slotted conduit has a cross-sectional area which is substantially constant and is partially open at its end 70. Primary air is thus provided to promote a uniform flow of combustion supporting oxygen across the entire primary combustion chamber.

The air provided by primary flow branches 24*a* and 24*b* thus enters the primary combustion chamber along the bottom back and bottom left-hand boundary surfaces of the chamber (looking from the front), and provides combustion along the entire bottom of the wood supply. Upon reaching the right-hand portion of the primary combustion chamber, the air flow now containing volatiles) continues through opening 44 into the secondary combustion chamber and exits through the circuitous flow path provided by the back baffle system arrangement extending between baffle 38 and rear wall 12*g*.

Referring to Figures 3 and 4, the back baffle system for directing the flue gases along the circuitous path through the space between baffle 38 and back wall 12*g* consists of a lower baffle 90, an upper baffle 92, and a vertical plate member 94. Illustrated lower baffle 90 consists of a cast plate member which extends in a transverse direction between the fireback 38 and the back wall of the frame. Illustrated baffle 90 extends lengthwise from the substantially triangular shaped, vertical plate member 94 to the vertical panel 40. Plate member 94 extends transversely between the fireback 38 and back wall 12*g* and vertically from a level near the bottom of door 14 (preferably from lower baffle 90) to a position above the top of door 14 (and preferably to the level of the upper baffle 92). Triangular plate 94 provides a barrier to prevent flue gases in the space behind the fireback from escaping through an opened side door 14.

The upper baffle 92 extends above baffle 90 and consists of a cast plate member extending from vertical baffle 40 to a position near side wall 12*a*. Baffle 92 thereby creates an aperture 96 so that the flue gases pass from the lower horizontally directed passage 50 through aperture 96 to the upper horizontally directed passage 52 from which they exit through flue collar 58.

A damper 18 of the heating apparatus enables the apparatus to be used both as a parlor stove and as a fireplace. When the damper is in the substantially vertical position shown in Figure 4, the heating apparatus operates as a stove and the flue gases exit substantially as shown by the arrow 98 (Figure 3). When the damper is placed in a substantially horizontal position indicated by dotted lines 100 (Figure 4), the apparatus can be used as a fireplace with the flue gases exiting from the primary combustion chamber along a path generally indicated by arrow 102. This provides updraft combustion.

When fuel is loaded into the apparatus through side door 14, the flue must be in the closed position (the damper in a horizontal position) or otherwise smoke will pour out of door opening. An interlocking arrangement between the door 14 and the damper 18 ensures that the flue is closed before the side door 14 can be fully opened. The illustrated arrangement consists of a handle 20 on the damper which, when the flue is open is in the vertically downward position and engages the door 14 to prevent it being opened. Other arrangements can also be used.

In the present embodiment of the invention, the opening 44 has a height of between 3 and 5 inches and is preferably 4 1/2 inches high. It has been found for the particular apparatus depicted in Figure 3, that the height of opening 44 is important and a height substantially greater than 4 1/2 inches increases the heat output of the apparatus and also its conversion efficiency.

To further control combustion within the heating apparatus, the illustrated frame members are interconnected along their edges in a channeled construction (Figure 5). The channeled construction consists of a cast groove 130, at the edge 131 of one of the joining members, which receives a layer 132 of plastics sealing material, for example an asbestos gasketing material, and the other joining member 133. This construction provides an airtight, physically secure and rigid structure.

The apparatus as described with reference to the accompanying drawings is effective for reducing the volatiles found in typical updraft combustion by providing for horizontal combustion wherein the flames move horizontally in the primary combustion zone. This is radically different from typical updraft combustion and provides more efficient operation of the stove. The apparatus thus aids the burning of

the volatile gases in several ways. First, by using horizontal combustion, the gases are forced to pass close to the hot coals which maintain sufficiently high temperatures to ignite them. In addlition, the manually controlled inlet port 35, which is segregated from the primary air source, provides air which is ducted down a path integral with the heated back wall and which is heated by the flue gases. This channel preheats the air to maintain the air at the elevated temperatures required for secondary combustion. Thus, oxygen from the secondary night inlet port 35 is directed into the secondary combustion chamber through numerous air ports to mix with the combustible gases and to provide secondary combustion. During night operation when the thermostat is turned down and damper 18 is closed, the secondary/night inlet port provides sufficient air to maintain a self-regulating cyclic operation.)

In addition, behind the fireback which is provided at the back of the primary combustion chamber, the circuitous path consisting of passages 50, 52 conducts the smoke back and forth along the back of the apparatus and upwardly toward the exit at the flue collar 58. Since the heat of the flue gases is considerable, significant heat transfer occurs from the flue gases to the surfaces of the stove, which in turn is given off into the room rather than being lost up the chimney. In addition, the circuitous path aids in maintaining a higher temperature in the combustion chamber which aids in burning the volatile gases driven off from the wood. Thus, a large heat output is available. In addition, the fire is controlled by not only the structure of the apparatus but by the thermostatically controlled input port 22 which supplies the primary air.

There is thus provided a wood-burning heating apparatus having an exceedingly high efficiency due both to its secondary combustion chamber and the secondary air supply supporting it, as well as to its long flue gas flow path and horizontal combustion.

Attention is directed to the claims of our copending application 4831/78, (Serial No 1 590 771).

WHAT WE CLAIM IS:—

1. Heating apparatus comprising a heat conducting housing enclosing

a primary combustion chamber,

a secondary combustion chamber in gaseous communication with said primary combustion chamber, and

an internal flame path defined by baffles in gaseous communication with said secondary combustion chamber,

a vertically oriented, downwardly directed baffle separating said primary and secondary combustion chambers, said baffle, in combination with the housing, providing a first opening connecting said primary and secondary combustion chambers for said gaseous communication therebetween and a second opening connecting said secondary combustion chamber with said flame path for providing said gaseous communication therebetween,

a first air supply path for providing preheated air for promoting combustion in said primary combustion chamber,

a second air supply path for providing preheated air to said secondary combustion chamber, and

a combustion products exit aperture at a top portion of said housing and in gaseous communication with said internal flame path for providing an exit port for combustion products.

2. Apparatus as claimed in claim 1 further including a thermostatically controlled inlet port in said housing for supplying air to said first supply path.

3. Apparatus as claimed in claim 1 or 2 further including a pivoting side door in said housing and baffle means for providing a loading aperture in said side when said door is pivoted to an open condition.

4. Apparatus as claimed in claim 3 further including an asbestos sealing member between the side door and the housing for sealing said loading aperture when the side door is in a closed position.

5. Apparatus as claimed in claim 3 or 4 in which said baffle means for providing a loading aperture comprises a vertical panel extending parallel to a side of said housing between said primary chamber and a back wall of said housing, and positioned adjacent said side having said door.

6. Apparatus as claimed in claim 5, further including a pivotable damper for providing in one position an updraft combustion apparatus and in a second position a horizontal combustion apparatus, and means connected with said damper for preventing said door from fully opening when the damper is in said second position.

7. Apparatus as claimed in any preceding claim wherein a branch of said first air path in said primary combustion chamber is a conduit having a plurality of slotted apertures.

8. Apparatus as claimed in any preceding claim wherein said second air supply path comprises an air supply conduit connected at one end to a supply port and having its other end positioned in said secondary combustion chamber for supplying preheated air to promote secondary combustion in said secondary chamber.

9. Apparatus as claimed in claim 8

wherein a section of said supply conduit has, for one side thereof, a portion of said downwardly directed baffle.

10. Apparatus as claimed in any preceding claim wherein said opening has a vertical height of between 3 and 5 inches.

11. Apparatus as claimed in claim 10 wherein said opening has a height of approximately 4½ inches.

12. Apparatus as claimed in any preceding claim further comprising a manually controlled inlet port for providing air to said second supply path.

13. Apparatus as claimed in any preceding claim in which said housing comprises exterior panels interconnected along their edges with channeled construction.

14. Apparatus as claimed in any preceding claim further including a cast iron cooking element, gravity positioned in a top section of said housing, and having a smooth upper cooking surface.

15. Heating apparatus substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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1590772 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

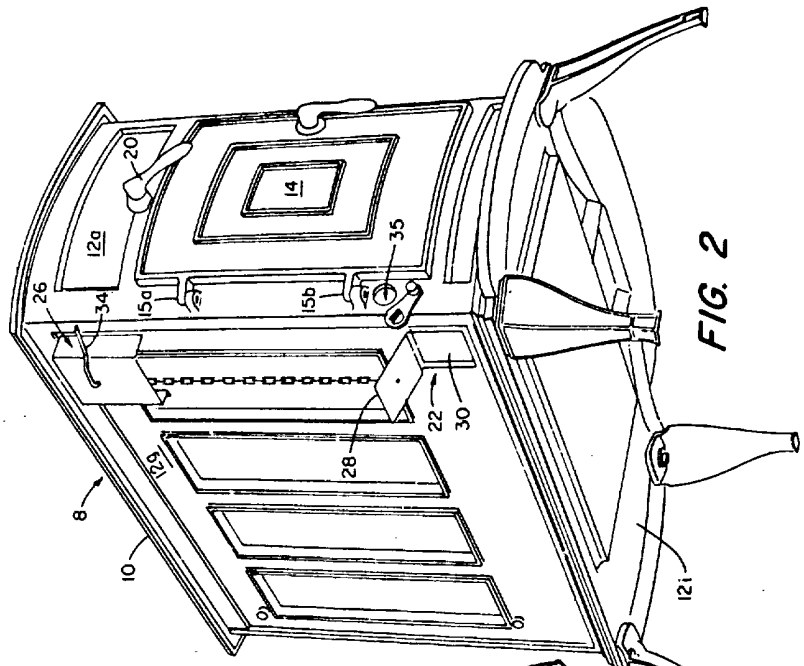


FIG. 2

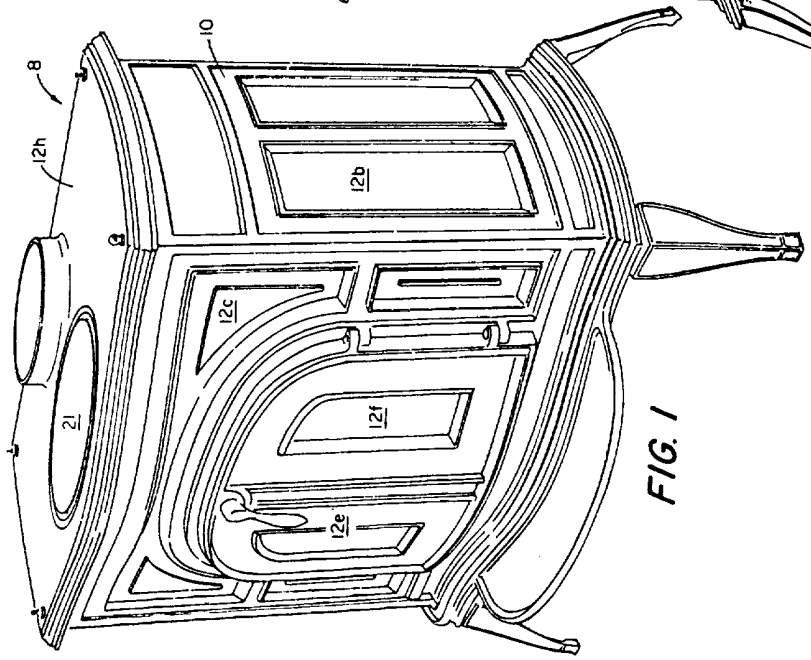
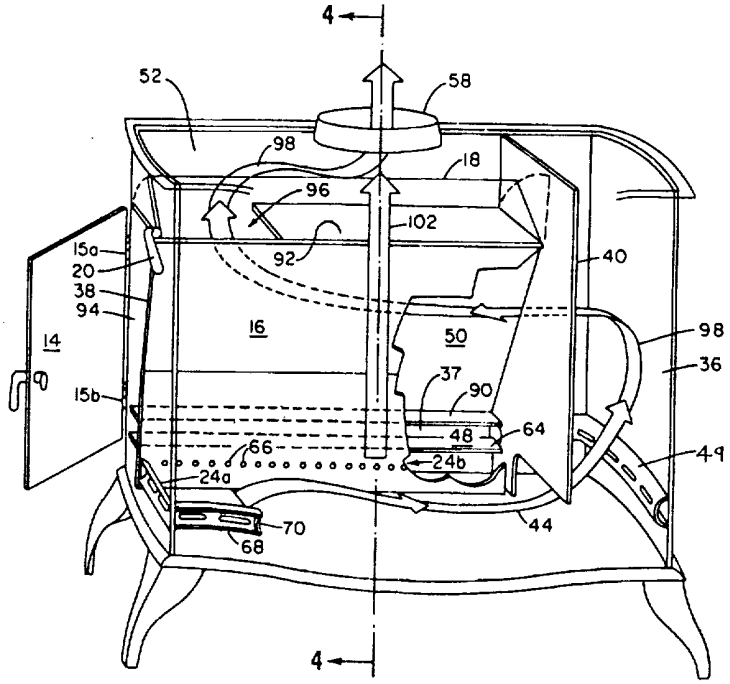


FIG. 1

1590772 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

FIG. 3



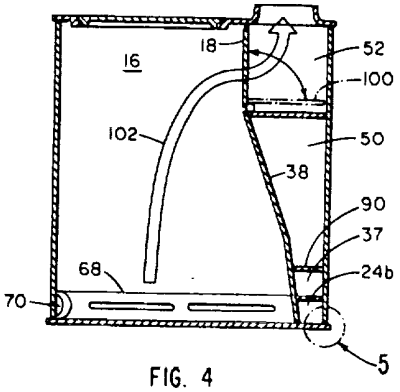


FIG. 4

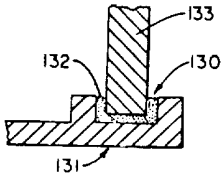


FIG. 5