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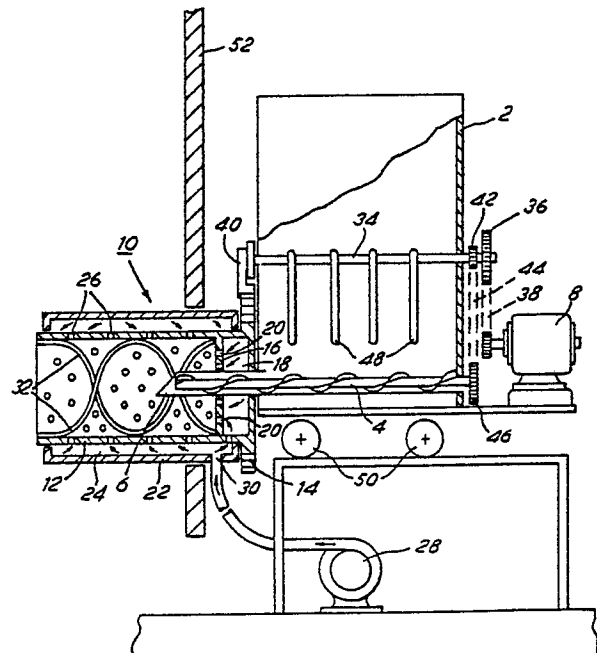
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Solid fuel burner.

A burner for low-grade solid fuels such as unprocessed peat and pelleted municipal waste comprises a substantially tubular housing (12) or combustion chamber rotatable by drive means (8) about a substantially horizontal axis, and a source of fuel (2,4) supplying fuel at a controlled rate to a region substantially centrally of, at or adjacent one end of, the tubular housing (12). A source of air under pressure (28) supplies air to the interior of the housing (12) while feed means (32) within the housing (12) ensure that, on rotation of the housing (12), the fuel and products of combustion within the housing (12) are fed from the one end towards the other end thereof.



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SOLID FUEL BURNER

This invention relates to solid fuel burners and has particular, though not exclusive application to burners utilising low grade fuels such as unprocessed peat and pelleted municipal waste.

There are a number of burners currently available that are capable of burning certain low grade fuels, such burners commonly being of the flat bed type and incorporating moving grates to attempt to avoid the build-up of clinker which inevitably forms an combustion of such fuels. Thus it will be appreciated that such burners are of relatively complex and therefore expensive construction.

These conventional burners, including chain grate stokers and fluidised bed combustors are, however, still unable to burn satisfactorily sub-quality fuels such as unprocessed peat, coal wash slurry, pelleted municipal waste material and the like because of the problems of clinker.

In view of the ready availability of such sub-quality fuels, it would be desirable to be able to provide a burner capable of burning these fuels efficiently and without any significant build-up of clinker or the like.

According to the present invention there is provided a solid fuel burner comprising a substantially tubular housing mounted for rotation about a substantially horizontal axis, a source of fuel adapted to supply fuel at a controlled rate to a region substantially centrally of, at or adjacent one end of, the tubular housing, a source of air under pressure adapted to be fed to the interior of the tubular housing, and means within the housing which, on rotation of the housing, feed the fuel and products of combustion thereof from the one end of the housing towards the other end thereof.

With such an arrangement, the fuel supplied to the burner housing is first of all ignited and combustion air is then fed to the housing to maintain the flame. The rotation of the housing together with the action of the feed means within the housing ensure continuous movement and agitation of the fuel and combustion products thereof within the burner in such a manner as to prevent any clogging of the bed whilst at the same time providing an efficient output therefrom.

Such a burner is particularly suited to the burning of unprocessed peat which has a high moisture content of up to 60%, sawdust, coal slurry from colliery washing plants and pelleted municipal waste material even with high plastic content, none of which can be burned satisfactorily in convention burners.

The housing may comprise a continuous tubular member the defining walls of which are provided with a plurality of apertures therethrough, the

burner further comprising an outer sleeve surrounding said tubular member to define an annular chamber between the sleeve and the tubular member, air under pressure being supplied to said chamber and entering the interior of the housing, substantially radially thereof, through the apertures in the tubular member.

Conveniently air under pressure is also supplied through the one end of the housing in a direction substantially axially thereof.

In an alternative embodiment of the invention, the housing comprises a plurality of axially aligned, tubular portions of increasing diameters, adjacent ends of which are located one within the other to provide a substantially continuous housing with annular gaps between said adjacent ends through which air under pressure can be supplied to the interior of the housing.

In a still further embodiment, the housing may comprise a spirally wound strip of material with the edge regions of adjacent windings overlapping one another but being slightly spaced from one another in a substantially radial direction, air under pressure being supplied to the interior of the housing through said radial spacings between adjacent windings.

The feed means within the tubular housing may comprise one or more helical bars secured to the inner wall of the housing.

Alternatively said feed means may comprise a plurality of fins secured to the inner wall of the housing and spaced substantially helically therearound.

Preferably the source of fuel comprises a hopper supplying fuel to a rotary screw feeder, the output end of said feeder being positioned at said region substantially centrally of, at or adjacent the one end of, the tubular housing.

Conveniently the rotary screw feeder and the tubular housing are movable relative to one another in a direction substantially axially of the housing whereby the position of the output end of the feeder can be varied axially within the housing.

The solid fuel burner comprises drive means for rotating the tubular housing, which drive means conveniently comprises a D.C. motor which may rotate the housing continuously or periodically through predetermined angular steps.

Preferably said drive means for the tubular housing also drives the rotary screw feeder, control means being provided whereby the drive to the housing and the drive to the feeder can be varied independently of one another.

By way of example only, an embodiment of the invention will now be described in greater detail

with reference to the accompanying drawing which is a side view, partly in vertical section, of a burner according to the invention.

Referring to the drawing, the illustrated burner comprises a fuel hopper 2 provided in its lower regions with a rotary screw feeder 4 having an output end 6 projecting from the hopper 2. The feeder 4 is driven by a D.C. motor 8 as will be described in more detail below whereby fuel in the hopper 2 can be fed along the feeder 4 to the output end 6 thereof in a controlled manner.

The burner further comprises a burner assembly indicated generally at 10 and including a tubular housing 12 or combustion chamber mounted for rotation about a horizontal axis. More particularly, the one end of the housing 12 comprises a gearwheel 14 inwardly of which is provided a plate 16 whereby a chamber 18 is defined between said plate 16 and the gearwheel 14. A plurality of axial apertures 20 are formed through the plate 16 to interconnect the chamber 18 with the interior of the housing 12.

A tubular sleeve 22 surrounds the housing 12 to define an annular chamber 24 between said sleeve 22 and the housing 12, the housing 12 being rotatable in substantially sealing relationship within the fixed sleeve 22. A plurality of radial apertures 26 are formed in the wall of the housing 12 to interconnect the chamber 24 with the interior of the housing 12 and with the chamber 18.

A fan 28 is connected to an inlet 30 in the sleeve 22 feeding into the chamber 24 whereby air under pressure can be supplied by said fan 28 through said inlet 30 into the chamber 24. Said air under pressure then flows through the radial apertures 26 into the interior of the housing 12 as well as into the chamber 18 and through the axial apertures 20 into the interior of the housing 12 as will be described in more detail below.

A pair of helical bars 32 are welded to the interior wall of the housing 12 in the form of an Archimedean screw again for reasons which will become apparent.

A horizontal drive shaft 34 extends through the hopper as shown, one end of said shaft carrying a gearwheel 36. A chain 38 interconnects said gearwheel 36 with the output from the variable speed D.C. motor 8 whereby said shaft 34 is driven by said motor 8.

An adjustable, eccentric indexing pawl 40 is mounted on the other end of, to be rotatable with, the shaft 34, said pawl 40 co-operating with the teeth of the gearwheel 14 integral with the housing 12. Thus, on each rotation of the shaft 34, the pawl 40 engages with the gearwheel 14 to effect a predetermined degree of rotation of the housing 12 dependent upon the precise setting of the pawl 40.

A further gearwheel 42 is mounted on the one

end of the shaft 34 adjacent said gearwheel 36, a chain 44 interconnecting said gearwheel 42 with a gearwheel 46 mounted on the end of, to be rotatable with, the feeder 4 whereby said feeder 4 is driven by the motor 8.

A plurality of removable flails or agitators 48 are axially spaced along the shaft 34 to be rotatable with the shaft 34 to agitate the fuel in the hopper 2 as and when necessary.

The described burner is conveniently mounted on wheels such as 50 so that the overall apparatus can be mounted on rails and be readily presented to an aperture in the door 52 of a furnace or boiler to which the burner is to be applied.

The burner assembly 10 and associated equipment is movable axially relative to the hopper 2 and feeder 4 so that the axial position of the output end 6 of the feeder within the housing 12 can be varied.

The described apparatus operates as follows. With fuel in the hopper 2 and with the motor 8 actuated, the feeder 4 delivers fuel from its output end 6 into the interior of the housing 12. This fuel is ignited by applying a flame thereto, and, once established, the fan 28 is actuated to deliver air to the housing 12 to maintain the combustion in the housing. The flame so formed extends from the open end of the housing 12, the air under pressure entering said housing 12 axially thereof through the apertures 20 serving to direct the flame in blow-torch manner from said open end of the housing 12.

The rotation of the housing effected by the drive pawl 40, typically one to three revolutions per hour, together with the provision of the feed bars 32, serve to agitate the fuel and products of combustion thereof within the housing 12 thus exposing any unburnt fuel to the incoming combustion air which totally envelopes the fuel and ensures complete combustion thereof. Furthermore, the configuration of the bars 32 is such that the fuel and products of combustion thereof are continuously moved forwards within the housing 12 towards the open end thereof, an ash disposal unit (not shown) being provided below said open end of the housing to collect and dispose of the ash so formed.

Clearly the type of fuel being used determines the settings of the variable features of the apparatus. If the fuel is very moist, such as unprocessed peat which may have up to 60% moisture content, the output end of the feeder 4 is positioned as shown in the drawing - i.e. as far into the combustion chamber as possible - so that the fuel can be preheated and dried prior to ignition.

The speed of rotation of the housing 12 is chosen dependent upon the combustion time of the fuel being supplied thereto. Peat, for example, needs time to burn and the housing is therefore

rotated relatively slowly, typically one revolution per hour, while coal, being more volatile, needs more agitation and the housing is therefore rotated faster, typically three revolutions per hour.

Conversely, the rotational speed of the feeder 4 supplying the fuel to the housing 12, for a given output from the burner, is substantially inversely proportional to the rate of combustion, being slower for volatile fuels such as coal and faster for less-combustible fuels such as peat.

The agitators 48 are particularly useful when dust-type fuels such as sawdust and the like are used, the agitators serving to prevent caking of the fuel and bridging of the feeder 4 by the fuel.

A burner according to the invention, the diameter of the housing 12 of which may typically be up to 30 cms, may provide a thermal output equivalent to between 50 and 300 kilowatts.

As mentioned above, burners according to the invention are particularly suited to low grade fuels that, in conventional flat-bed burners, would produce substantial clinker and clog the grates. Such fuels include unprocessed peat, rice husks, pelleted municipal waste, lignite, coal washery slurry, straw, wood chips and sawdust.

The burner may include an automatic control system to provide optimum operating conditions for the various fuels at the required heat loads, said control system governing the rate of feed of fuel to the burner assembly, the rate of rotation of the housing 12 and the flow of combustion air from the fan 28.

It will be appreciated that the precise construction of the burner can vary from that detailed above without departing from the scope of the basic invention.

For example, the housing 12 may be other than a continuous tubular member and may comprise a plurality of axially aligned, tubular portions of increasing diameters the adjacent ends of which are located one within the other to provide a substantially continuous housing with annular gaps between the adjacent ends of the tubular portions permitting air under pressure to be supplied therethrough to the interior of the housing.

Alternatively, the housing may comprise a spirally wound strip of material with the edge regions of adjacent windings overlapping one another but being slightly spaced from one another to enable air under pressure to be supplied to the interior of the housing through the radial spacings between adjacent windings.

The feed means within the housing 12 may be other than helical bars and may comprise, for example, a plurality of fins secured to the inner wall of the housing and spaced substantially helically therearound. Alternatively, the helical bars or fins may be replaced by a pair of continuous hollow

helical tubes within the housing 12 or by a plurality of hollow tubes spaced substantially helically around the inner wall of the housing, these tubes being provided with a plurality of holes therein.

Thus, on supplying air under pressure to these tubes, said air is emitted through the holes in the tubes, substantially radially of the housing 12 to improve combustion within said housing, such an arrangement being particularly useful in larger burners with deeper beds therein.

The sleeve 22 may be arranged to rotate with the housing 12, while, instead of being index driven in step-like manner by the eccentric pawl 40, the housing 12 may be continuously rotated by a variable speed motor such as 8.

- Other modifications and variations from the described arrangement will be apparent to those skilled in the art.

Claims

1. A solid fuel burner characterised by a substantially tubular housing (12) mounted for rotation about a substantially horizontal axis, a source of fuel (2,4,6) adapted to supply fuel at a controlled rate to a region substantially centrally of, at or adjacent one end of, the tubular housing (12), a source of air under pressure (28) adapted to be fed to the interior of the tubular housing (12), and means (32) within the housing (12) which, on rotation of the housing (12), feed the fuel and products of combustion thereof from the one end of the housing towards the other end thereof.

2. A burner as claimed in claim 1 in which the housing comprises a continuous tubular member (12) the defining walls of which are provided with a plurality of apertures (26) therethrough, the burner further comprising an outer sleeve (22) surrounding said tubular member (12) to define an annular chamber (24) between the sleeve (22) and the tubular member (12), air under pressure being supplied to said chamber (24) and entering the interior of the housing (12), substantially radially thereof, through the apertures (26) in the tubular member (12).

3. A burner as claimed in claim 2 in which air under pressure is also supplied through the one end of the housing (12) in a direction substantially axially thereof.

4. A burner as claimed in claim 1 in which the housing comprises a plurality of axially aligned, tubular portions of increasing diameters, adjacent ends of which are located one within the other to provide a substantially continuous housing with annular gaps between said adjacent ends through which air under pressure can be supplied to the interior of the housing.

5. A burner as claimed in claim 1 in which the housing comprises a spirally wound strip of material with the edge regions of adjacent windings overlapping one another but being slightly spaced from one another in a substantially radial direction, air under pressure being supplied to the interior of the housing through said radial spacings between adjacent windings.

6. A burner as claimed in any one of claims 1 to 5 in which the feed means within the tubular housing comprise one or more helical members (32) secured to the inner wall of the housing.

7. A burner as claimed in claim 6 in which the or each helical member comprises a hollow tube, said tube or tubes being provided with a plurality of holes therein whereby, on supply of air under pressure to the interior of said tube or tubes, air is emitted through said holes into the interior of the housing (12).

8. A burner as claimed in any one of claims 1 to 5 in which the feed means within the tubular housing comprise a plurality of fins secured to the inner wall of the housing (12) and spaced substantially helically therearound.

9. A burner as claimed in claim 8 in which each fin is hollow and is provided with a plurality of holes therein whereby, on supply of air under pressure to the interior of said fins, air is emitted through said holes into the interior of the housing (12).

10. A burner as claimed in any one of claims 1 to 9 in which the source of fuel comprises a hopper (2) supplying fuel to a rotary screw feeder (4), the output end (6) of said feeder (4) being positioned at said region substantially centrally of, at or adjacent the one end of, the tubular housing (12).

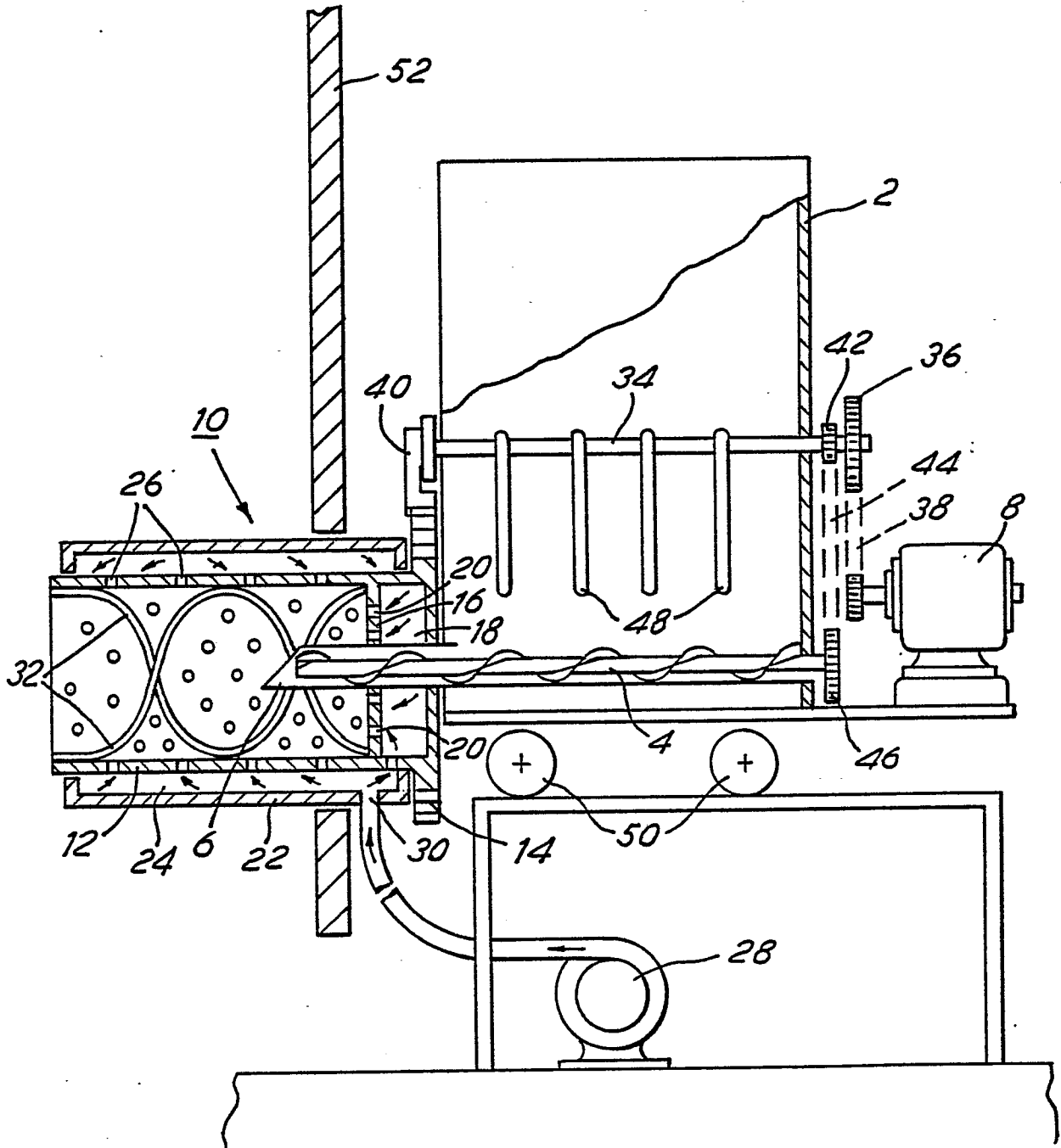
11. A burner as claimed in claim 10 in which the rotary screw feeder (4) and the tubular housing (12) are movable relative to one another in a direction substantially axially of the housing (12) whereby the position of the output end (16) of the feeder (4) can be varied axially within the housing (12).

12. A burner as claimed in any one of claims 1 to 11 and including drive means for rotating the tubular housing (12) said drive means comprising a D.C. motor (8).

13. A burner as claimed in claim 12 in which the D.C. motor (8) is of variable speed and drives the tubular housing (12) continuously.

14. A burner as claimed in claim 12 in which the D.C. motor (8) is of variable speed, the drive means further comprising an indexing mechanism (34,40,14) driven continuously by said motor (8) and co-operating with the tubular housing (12) to rotate the housing (12) through predetermined angles in step-like manner.

15. A burner as claimed in any one of claims 12 to 14 together with claim 10 or claim 11 in which the drive means (8) for the tubular housing (12) also drives the rotary screw feeder (4), control means being provided whereby the drive to the housing (12) and the drive to the feeder (4) can be varied independently of one another.





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
E	GB-A-2 198 519 (HALL) * Claims 1-14; figure * ---	1-6,8, 10-15	F 23 B 1/32 F 23 G 5/20 F 23 K 3/00 // F 23 B 3/00
X	US-A-4 338 868 (LIENTZ) * Column 7, lines 14-47; column 7, line 67 - column 8, line 2; column 8, lines 41-44; column 9, lines 43-47; figure 3 * ---	1	
Y	---	2-4,6-8 ,10-13 -	
Y	US-A-3 380 407 (NILSSON) * Column 3, lines 16-45; figures 1,2 * ---	2	
Y	DE-B-1 227 599 (HANIEL & LUEG) * Column 3, lines 8-20; figures 1,2 * ---	2,3	
Y	US-A-1 728 958 (DUNCAN) * Page 2, lines 10-26; page 2, line 47 - page 3, line 29; figures I,II * ---	4,10	
A	---	15	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Y	CH-A- 503 951 (DENAeyer) * Column 1, line 37 - column 2, line 14; figure 1 * ---	6,7	F 23 B F 23 G
Y	DE-A-2 433 676 (TOHKAI DENKI TOSOH) * Page 3, line 30 - page 4, line 27; figures 1-3 * ---	8	
Y	US-A-2 963 996 (UHL) * Column 2, lines 10-29; figures 1,2,3a,3b * --- -/-	12,13	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 08-02-1989	Examiner PHOA Y. E.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-4 108 088 (BURDEN) * Column 2, line 62 - column 3, line 4; figure 2 * ---	6	
A	US-A-3 749 033 (SUGANO) * Column 4, lines 14-19; figures 1,3 * -----	8	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Place of search THE HAGUE		Date of completion of the search 08-02-1989	Examiner PHOA Y. E.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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