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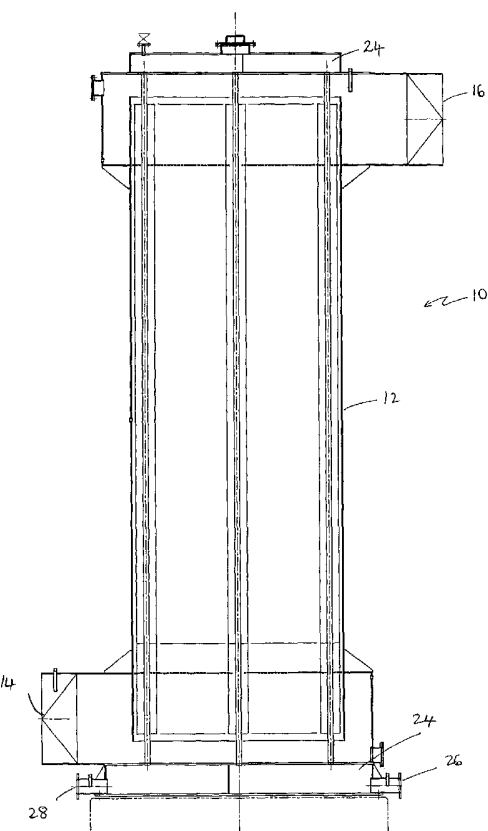
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[Continued on next page]

(54) Title: REHEATER



1. SECTIONAL ELEVATION OF REHEATER

(57) Abstract: A reheater (10) for massecuite for the sugar industry comprising a vertically orientated cylindrical housing (12), having a grid of parallel heating elements (18) comprising pipes (20) having longitudinal vanes (22) which increase the surface area for heating and permit even flow distribution and minimise reheating time. Massecuite enters the reheater at low level inlet (14) and exiting at outlet (16) at the top of the reheater.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

REHEATER**TECHNICAL FIELD OF THE INVENTION**

This invention relates to a heater and in particular a reheater finding application in the sugar industry.

5 BACKGROUND ART

The final steps in the recovery and manufacture of sugar from sugar cane or sugar beet are the evaporation of water from clarified juice until a supersaturated concentration of sugar in the juice is attained. At this point the concentrate is seeded with fine sugar crystals to initiate crystal growth. Crystals growth then occurs by absorption of sucrose
10 from the surrounding liquor which is known as molasses. Crystals are finally separated from the molasses by centrifugal separation of the molasses through a finely perforated screen.

The mixture of molasses and sugar crystals is called massecuite.

From the point of view of process economics, it is important to maximise the
15 recovery of sucrose from the molasses. This process has been established to occur optimally when the massecuite is boiled under vacuum in the range 60° to 75°C until a brix (solids concentration) of 95 to 97% is achieved. This massecuite is then slowly cooled in a stirred crystalliser for 25 to 45 hours until the massecuite is cooled to 40 to 45°C. At this state, the maximum attainable exhaustion of sucrose has been achieved
20 under process conditions, but massecuite viscosity is too high to effect centrifugal separation.

In order for centrifugal separation to be employed, the massecuite is then reheated. For every increase in temperature of the massecuite of 6 to 7°C, viscosity is halved and it has been established that centrifugal separation may be used effectively if massecuite
25 temperature is elevated into the range 55 to 60°C.

Reheating is however a finely balanced process as care must be taken to ensure that the elevation of temperature does not cause dissolution of the crystals back into the molasses. In order to avoid this re-dissolution, no part of the massecuite should be heated above the saturation temperature (approximately 55°C) of the molasses. This
5 requires that temperature of the heating medium (hot water) be restricted to 5 to 10°C above the saturation temperature, while massecuite flow through the heater must be evenly distributed without the occurrence of short circuits or dead zones. Rapid heating is also required to minimise reheating time.

Prior art reheaters comprise long horizontal structures having a plurality of heated
10 pipes. The heating ability of the pipes is enhanced by the welding of square metal plates perpendicular to the pipes at intervals along the lengths of the pipes.

These heaters operate reasonably effectively, but are bulky, time-consuming and expensive to manufacture and as a result of the pipes being transverse to the direction of flow of the molasses, the flow is restricted and it is difficult to keep reheating time to a
15 minimum.

It is an object of this invention to provide a reheater which has reduced space requirements, and better fulfils the ideal reheating conditions of even flow distribution, and minimum reheating time.

DISCLOSURE OF THE INVENTION

20 According to the invention, a heater for flowable material and in particular molasses or massecuite in the sugar industry, includes:

a housing having an inlet for the substance to be heated
and an outlet for the heated substance,
a plurality of heating elements extending between the inlet and outlet parallel to
25 the flow-path of the substance from the inlet to the outlet, the
heating elements including longitudinal vanes in heat-exchange relationship with the elements, at least in the zone intermediate the inlet and outlet.

The heater is preferably vertically orientated with the material to be heated entering at a low level, passing upwards past the heating elements longitudinally, and exiting at a high level. The heating elements preferably do not include vanes in the zones adjacent the inlet and outlet of the heater while a reduced number of vanes may be provided in the
5 lower regions of the heating elements.

In the preferred form the longitudinal vanes comprise angle irons of a heat conductive material, for example, steel, the angle irons being welded to the pipes along the apex of the angle. The angle of the angle iron is preferably ninety degrees and the two sections of the angle iron are preferably of equal dimensions. In this form four
10 vanes are located on each pipe giving the appearance of a cross in section.

The heating element typically comprises a bundle of closely-packed pipes supplied with heated water. In the preferred form, the pipes are arranged in a grid, all pipes being substantially equidistant from their neighbour in the grid pattern.

It will be appreciated that the distance of separation of the pipes in the grid will
15 depend on a number of factors including the selected diameter of the pipes, the dimensions of the longitudinal vanes, and also on the flow characteristics of the material to be heated. However the configuration of the heating elements will permit largely unhindered flow of material along the length thereof, with minimal separation distance between vanes and accordingly substantial reduction or even elimination of dead zones
20 and short circuits.

Furthermore, the longitudinal vanes are thermally superior to the conventional radial vanes used in the prior art reheaters in that they have a high proportion of vane area close to the heat source (pipe) and a higher pipe contact area for heat conduction into the vanes.

25 Also the vane disposition around the pipes efficiently covers the area between the pipes without any wide passages for massécuite to pass through with inadequate heating.

Overall, as the grid pattern of the invention offers a lower total cross-sectional area for the massecuite flow than in conventional designs, which results in a higher massecuite flow velocity and an even velocity distribution across this area.

Typically, the housing of the heater will be circular in cross-section and as a result
5 the selected grid pattern for disposition will not fit perfectly into this cross-sectional shape. However, the spaces left by the basic grid pattern are easily filled using vane-less pipes or pipes having one, two, three or even parts of angle irons welded thereto. It will however be appreciated that the basic grid pattern will efficiently cover most of the area.

BRIEF DESCRIPTION OF THE DRAWINGS

10 The preferred embodiment of the invention is described below with reference to the accompanying drawings in which:

Figure 1 is a sectional elevation of a heater according to the invention;

Figure 2 is a cross-sectional view of a heating element;

and

15 Figure 3 is a plan view of a heater illustrating the preferred disposition of heating elements in the main heating zone of the heater.

BEST MODE FOR CARRYING OUT THE INVENTION

In Figure 1, a heater 10 and in particular a reheater for massecuite for use in the process of production of sugar, comprises a cylindrical housing 12 with a massecuite
20 inlet 14 at a low level and an outlet 16 at the top of the reheater.

The massecuite enters the bottom of reheater radially and flows upwards in contact with heating elements 18 (Figure 2) arranged in the grid pattern shown in Figure 3. The massecuite is heated by contact with the heating elements which comprises pipes 20 having longitudinal vanes 22 to increase the surface area for heating. The heated
25 massecuite exits at 16.

Heating water is circulated through the pipes via headers 24 at each end of the reheater. The hot water enters at 26 and exits at 28. The headers may be configured for either single or multiple water passes.

For large reheating requirements, reheater units of the invention may be arranged
5 in series for lower mass flow rates or in parallel (higher flows), with the water circuits appropriately configured.

The heating elements 18 comprise pipes 20 having in the preferred form, four longitudinal vanes 22 in the form of right-angled angle irons. The vanes are arranged equidistantly spaced apart around the circumference of each pipe giving the appearance
10 of a cross (see Figure 2). The vanes are welded along the apex 32 to the pipes. The sections 34 and 36 of the vanes are the same size.

Turning to Figure 3, the heating elements 18 are disposed such that the pipes form a grid pattern. The distance 38 between each pipe and each of its neighbours 40 is equal, forming an even distribution of pipes throughout the majority of the circular
15 cross-section of the heater. The separation distance 38 is variable according to pipe diameter, viscosity of material to be heated and dimensions of the vanes.

At the lower end of the heater, adjacent the mass flow inlet 14 (Figure 1), the pipes are devoid of the longitudinal vanes. This permits free distribution of mass flow across the full cross-sectional area of the heater. Adjacent the entry zone, the pipes are
20 provided with vanes, but these may be fewer than is illustrated in Figure 3 which shows a high vane density in what is the main heating zone of the heater. This eases the flow of the still cold and viscous mass flow.

In the zone area the mass flow outlet 16. The pipes are again devoid of vanes to permit free radial flow.

In the main heating zone illustrated in Figure 3, it is clear that use of the preferred grid pattern of heating elements will result in some gaps around the perimeter of the cylindrical heater. These gaps are easily filled using vane-less pipes 42 or pipes having one vane, two vanes 44, three vanes 46 or partial vanes 48.

- 5 This results in minimal reduction in efficiency of the heater at the periphery and generally, by use of the grid pattern and cross-sectional configuration of the vanes heating elements, maintains the massecuite within a very small distance of the heating surface at all times.

CLAIMS

1. A heater for flowable material and in particular molasses or massecuite in the sugar industry characterised in that it includes a housing having an inlet for the substance to be heated
- 5 and an outlet for the heated substance,
a plurality of heating elements extending between the inlet and outlet parallel to the flow-path of the substance from the inlet to the outlet, the heating elements including longitudinal vanes in heat-exchange relationship with the elements, at least in the zone intermediate the inlet and outlet.
- 10 2. A heater according to claim 1 characterised in that it is vertically orientated with the material to be heated entering at a low level, passing upwards past the heating elements longitudinally, and exiting at a high level.
3. A heater according to claim 1 or claim 2 characterised in that the heating elements do not include vanes in the zones adjacent the inlet and outlet of the heater.
- 15 4. A heater according to any of the above claims characterised in that a reduced number of vanes is provided in the lower regions of the heating elements.
5. A heater according to claim 1 characterised in that with the material to be heated entering at a low level, passing upwards past the heating elements longitudinally, and exiting at a high level.

6. A heater according to claim 5 characterised in that the angle of the angle iron is ninety degrees and the two sections of the angle iron are preferably of equal dimensions.

7. A heater according to claim 6 characterised in that four vanes are located on each pipe giving the appearance of a cross in a section.

5 8. A heater according to claim 1 in which the heating elements typically comprise a bundle of closely-packed pipes supplied with heated water characterised in that the pipes are arranged in a grid, all pipes being substantially equidistant from their neighbour in the grid pattern.

9. A heater according to any of the above claims in which the heater is circular in
10 cross-section, any spaces inadequately filled by the grid pattern of heating elements being filled by one or more vane-less pipes and/or pipes having one, two, three or parts of angle irons welded thereto.

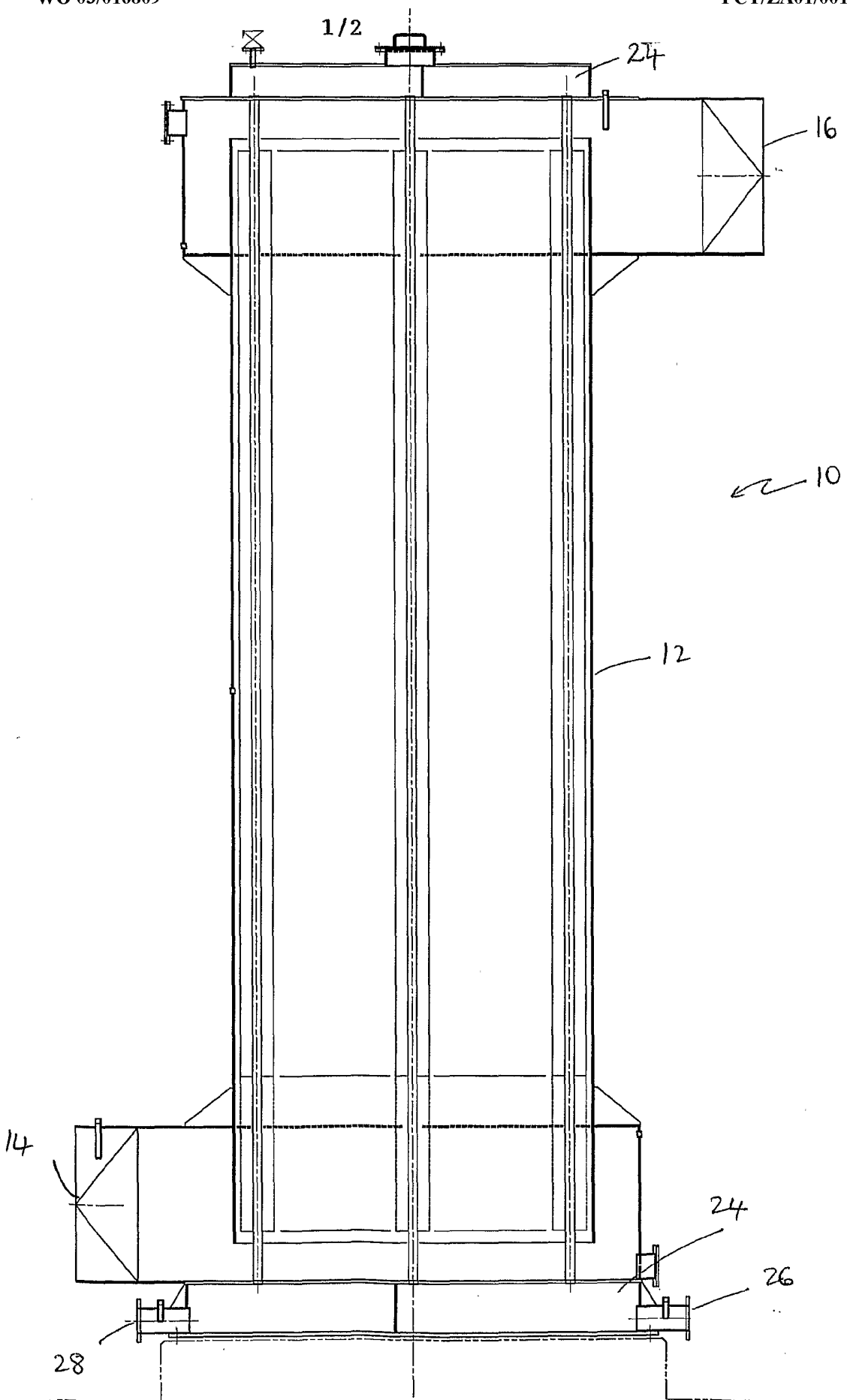


FIGURE 1
1. SECTIONAL ELEVATION OF REHEATER

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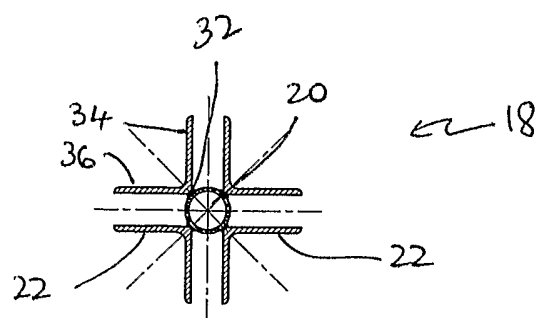


FIGURE 2.

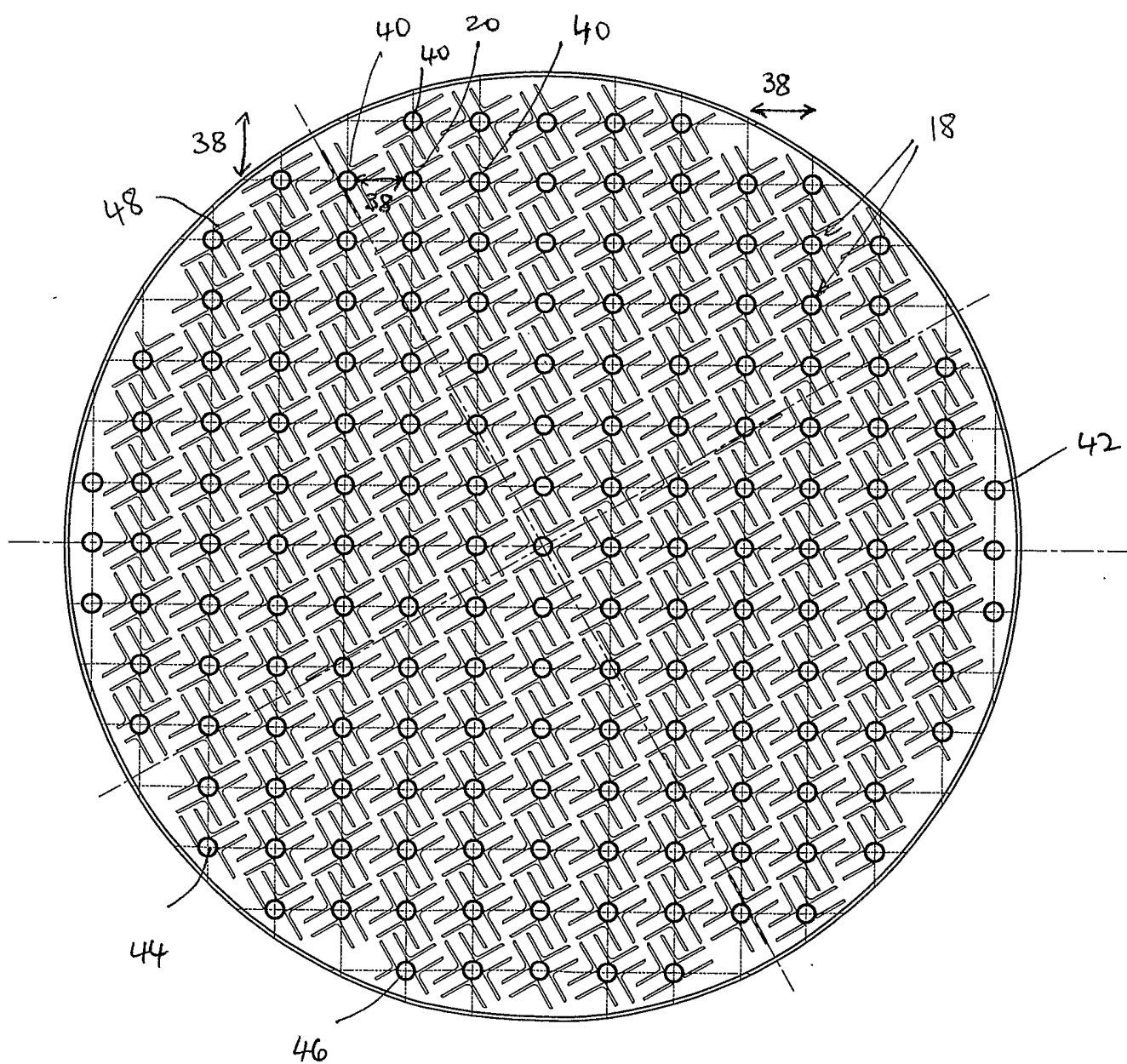


FIGURE 3.

INTERNATIONAL SEARCH REPORT

International Application No

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A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F28D7/16 F28F1/14 C13G1/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F28D F28F C13G

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents:

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X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

Date of the actual completion of the international search

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International Application No

PCT/ZA 01/00116

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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