(57) Abstract: The invention relates to a method and an apparatus for grading seeds, wherein the seeds are selected in accordance with the ratio between suspension capacity in a rising gas flow and mass. Research has shown that this selection criterion results in a considerable increase in the percentage of seeds with the ability to germinate, which results in great economic advantages, particularly in the culture of small plants. According to a first preferred embodiment the seeds are introduced into a rising gas flow and the seeds leaving the gas flow at the bottom are selected.
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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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.
APPARATUS FOR GRADING SEEDS

In the cultivation of sown crops not all seeds come up; only some of the seeds result in a plant. The percentage of seeds which does not come up is greatly dependent on the type of crop, but is generally considerable. The result of this is that the substrate or the culture material in which the seeds are sown is for a large part taken up by seeds with no ability to germinate. This results in an inefficient use of the space available for cultivating the seeds.

The sown plants must furthermore be transplanted when they become too large for their container. Since these are usually small plants, these transplanting operations are often performed automatically. This results in the problem that pieces of substrate without a plant are also transplanted, or results in a complicated test machine to verify whether a determined piece of substrate for transplanting contains a healthy plant. The automatic transplanting device must then be controlled either to transplant the relevant piece of substrate or not. The efficiency of such a complicated apparatus has been found to depend greatly on the percentage of healthy plants. In summary, it can be stated that the ability of the seed to germinate is of great importance for the cultivation of young sown plants in economic manner.

There is therefore a need for a selection apparatus for selecting seed, wherein the percentage of seeds of the selected seed with the ability to germinate can be greatly increased.

A method of grading seeds is known from GB-A-725 528, wherein the seeds are selected in accordance with the ratio between suspension capacity in a rising gas flow and mass, wherein the seeds are introduced into a rising gas flow and the seeds leaving the gas flow at the bottom are selected.
rising gas flow and the seeds leaving the gas flow at the bottom are selected.

It has been found that the ratio between surface area and mass of seed grains is an important criterion; on the basis of these results the present invention provides a method for grading seeds which is characterized in that the seeds are selected in accordance with the ratio between suspension capacity in a rising gas flow and mass.

Research has shown that this selection criterion results in a considerable increase in the percentage of seeds with the ability to germinate, which results in great economic advantages, particularly in the culture of small plants.

Since seed is usually processed in small batches, diverse types of seed with mutually varying properties are usually selected. For each type of seed the method must be applied with different parameters. In order to facilitate the setting of the parameters the invention provides the measure that the seeds subjected to the gas flow are visually observed.

With this measure it is possible to observe the selection process properly and to set the relevant parameters in order to obtain a good selection for the type of seed in question.

The present invention also provides for this purpose an apparatus for grading seeds, comprising:

- a substantially cylindrical chamber provided with a top opening and a bottom opening;
- fan means for generating in the chamber an air flow which is substantially directed vertically upward and which is dimensioned to exert an upward force on seeds present in the chamber;
- infeed means for carrying seeds for grading into the chamber;
- first discharge means for the seeds connected to the bottom opening of the chamber, the force exerted on
said seeds by the air flow being smaller than the force of gravity; and
- second discharge means for the seeds connected to the top opening of the chamber, the force exerted on said seeds by the air flow being greater than the force of gravity, which apparatus is characterized in that the chamber is provided with at least one transparent window.

The method according to the invention can be readily performed herewith.

According to a first preferred embodiment the strength of the rising gas flow is controlled on the basis of the visual observation of the seeds. The strength of the rising gas flow has been found to be the parameter with the most significant influence on the selection process.

According to a subsequent preferred embodiment the selection process is performed immediately before sowing.

During storage and transport of seed the grains of seed often shed husks or flakes which are processed as grains of seed by the sowing machine, but which do not have the ability to germinate. These problems are obviated by performing the selection process, wherein this waste is removed, immediately prior to sowing.

To enable adjustment of the selection criterion a calibration is arranged on the window or behind the window. Reference points are hereby formed during observation.

According to yet another attractive preferred embodiment, the chamber and at least a part of the feed means are manufactured from glass. Glass is transparent, so that the selection process can be readily observed, while it can also be formed easily and collects hardly any static electrical charge, which could cause a problem in the case of lighter seeds.
Other attractive preferred embodiments are stated in the remaining sub-claims.

The present invention will be elucidated hereinbelow with reference to the annexed figure, comprising a partly broken away schematic view of the apparatus according to the invention.

The apparatus according to the invention comprises a substantially cylindrical chamber 1, which debouches into the ambient on its underside. Outlet opening 2 on the underside is placed above a collecting tray 3. At the top the chamber 1 connects onto a discharge channel 4. Discharge channel 4 comprises two elbows of 90°, 5 respectively 6, which are connected by means of a horizontal piece 7 and which are followed by a vertical piece 8.

Chamber 1, together with a feed tube 11 debouching into the chamber are made from a transparent material such as glass. Components 4, 5, 6, 7 and 8 are manufactured from tube material, in the present case from metal tube.

The underside of piece 8 is connected by means of a conical part 9 to a connecting piece 10 to which a suction side of a fan 11 is connected. It is thus possible to create a rising air flow in chamber 1 when the vacuum cleaner is switched on.

For infed of the seeds for selection the upper part of chamber 1 is provided with a branch 11. This branch is formed integrally with chamber 1. For this purpose the upper part of the chamber is formed by a T-piece 12. A vibrating funnel 14 connects to branch 11. It is hereby possible to carry out the seed feed automatically and uniformly.

Through being fed from funnel 14 the seeds are carried into chamber 1, where they are subjected to the action of the rising air flow. The heavier seeds with the ability to germinate will herein offer sufficient resistance to the rising air flow that they fall
downward through chamber 1 and drop into collecting tray 3.

The lighter seeds and possible waste, such as husks and flakes of the seeds, will be carried along by the air flow and discharged upward.

The ratio between the upward force exerted on the seeds by the rising air flow and the force of gravity is of course important here for the selection criterion. The ratio between surface area and weight is hereby of particular importance, wherein the shape of the seeds and the structure of the surface of the seeds also play a part.

In order to achieve the correct settings during successive selection of different types of seed quickly and without losing too much time, a calibration is arranged on the chamber. It is then easy for an observer to verify whether the separation process is taking place in the correct manner and, if this is not the case, how it should be adjusted.

A filter 16 is arranged in the vertical tube part 8. This filter is formed by a T-piece 17, in the branching part of which is placed a filter 18 with radial passage. This filter 18 as such is intended for the purpose of collecting the rejected seed. To this end the filter unit 16 comprises a funnel 19 which leads to a thin tube 20, which leads to the interior of the actual filter 18. The outside of the actual filter 18 is in turn directly connected to the main passage of tube 8. To enable cleaning of the filter a cover 21 is arranged on the stub of T-piece 16.

A control device is arranged above filter unit 16. This control device is formed by a control valve 22 operable from outside. The air flow can be throttled by adjusting the valve.

So as not to overload the fan 11 an outlet 23 is arranged under valve 22, which outlet can also be closed by a valve 24. As valve 22 is further closed, valve 24
must be opened in order to prevent overloading of fan 11.

It is otherwise usually also possible to control the capacity of the fan per se, whereby the control device becomes unnecessary. Experience shows that it is possible by adjusting the air flow to make the residence time of the seeds in chamber 1 quite long, up to a residence time of several tens of seconds. This option results in the precise determination of the selection criterion; seeds with a long residence time fall exactly in the critical range.

It will further be apparent that other constructions can be used to perform a method according to the present invention, for instance constructions which make use of a cyclone-like configuration.
CLAIMS

1. Method of grading seeds, wherein the seeds are selected in accordance with the ratio between suspension capacity in a rising gas flow and mass, wherein the seeds are introduced into a rising gas flow and the seeds leaving the gas flow at the bottom are selected, characterized in that the seeds subjected to the gas flow are visually observed.

2. Method as claimed in claim 1, characterized in that the strength of the rising gas flow is controlled on the basis of the visual observation of the seeds.

3. Method as claimed in claim 1 or 2, characterized in that the selection process is performed immediately prior to sowing.

4. Apparatus for grading seeds, comprising:
   - a substantially cylindrical chamber provided with a top opening and a bottom opening;
   - fan means for generating in the chamber an air flow which is substantially directed vertically upward and which is dimensioned to exert an upward force on seeds present in the chamber;
   - infeed means for carrying seeds for grading into the chamber;
   - first discharge means for the seeds connected to the bottom opening of the chamber, the force exerted on said seeds by the air flow being smaller than the force of gravity; and
   - second discharge means for the seeds connected to the top opening of the chamber, the force exerted on said seeds by the air flow being greater than the force of gravity, characterized in that the chamber is provided with at least one transparent window.

5. Apparatus as claimed in claim 4, characterized in that a calibration is arranged on the window or behind the window.
6. Apparatus as claimed in claim 4 or 5, characterized in that the chamber and at least a part of the feed means are manufactured from transparent material.

7. Apparatus as claimed in claim 6, characterized in that the chamber and at least a part of the feed means are manufactured from glass.

8. Apparatus as claimed in any of the claims 4-7, characterized in that

- the fan means comprise a fan connected to the top opening of the chamber,
- the first discharge means comprise a collecting tray placed under the bottom opening of the chamber, and
- the second discharge means comprise a filter placed between the top opening of the chamber and the fan.

9. Apparatus as claimed in any of the claims 4-8, characterized in that a tube piece bent into a U-shape is placed between the top opening of the chamber and the fan, that the filter is placed in a substantially vertical tube piece and that the filter is formed by a removable filter.

10. Apparatus as claimed in any of the foregoing claims, characterized in that the capacity of the fan is controllable.

11. Apparatus as claimed in any of the foregoing claims, characterized in that a throttle valve is arranged in the channel between the top opening of the chamber and the fan.

12. Apparatus as claimed in claim 11, characterized in that a short-circuit valve to the ambient is placed between the throttle valve and the fan.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 B07B7/01 B07B4/02

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 B07B AO1C

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, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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| X | Patent family members are listed in annex. |

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