

[54] **GRAIN CLEANING MACHINE**

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[51] Int. Cl.B02c 9/00, B02b 3/08, B02c 11/64
[58] Field of Search146/225, 253, 258, 286, 292;
241/7

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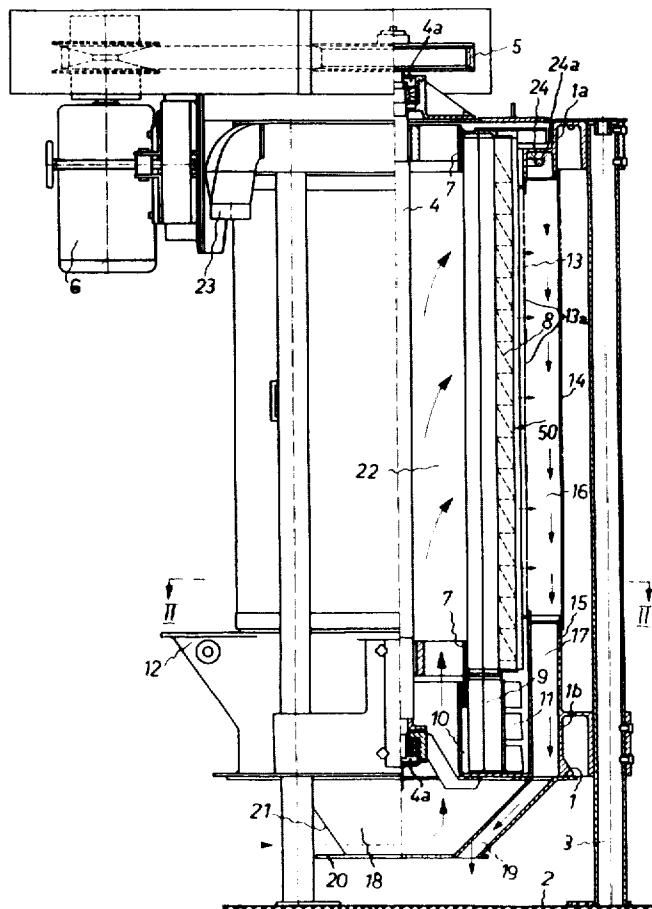
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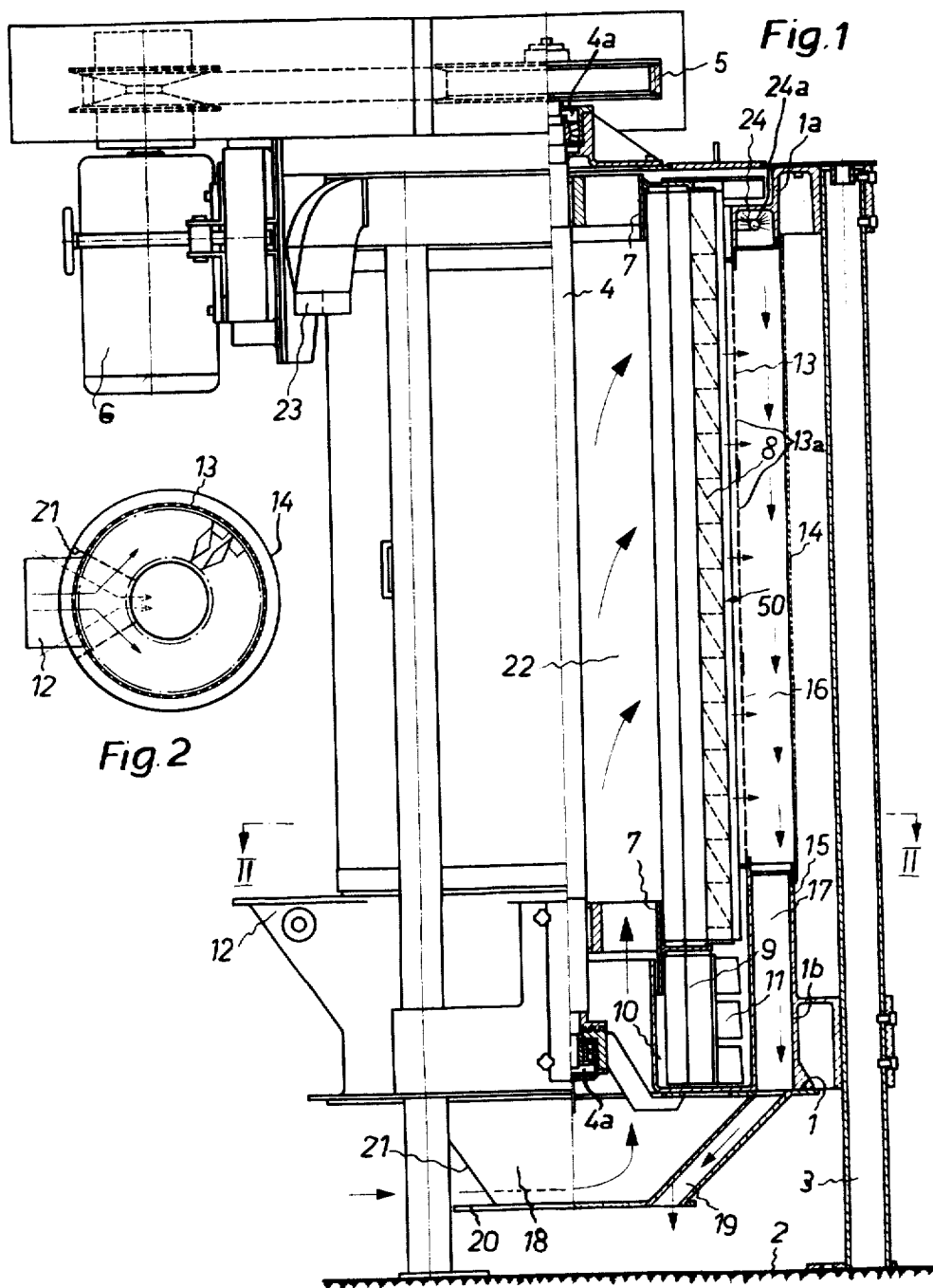
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[57] **ABSTRACT**

A machine for cleaning grain or the like which is of the type incorporating a vertically oriented centrifuge possessing a rotor simultaneously constructed as an air blower and a substantially cylindrical jacket having openings or recesses which surrounds the rotor. The grain which is to be cleaned is upwardly conveyed from below along the centrifuge to an outlet, and the impurities together either with water and air or air alone fall in an annular compartment bounded at the inside by the cylindrical jacket, downwardly into a funnel-shaped housing portion located below the centrifuge. This housing portion possesses a throughflow or throughpassage communicating with the aforesaid annular compartment and additionally possesses an inlet for air communicating with the internal space of the centrifuge. Beneath the housing portion there is arranged a collecting basin leading to a first withdrawal means, there also being provided a second withdrawal means which, when the machinery operates so as to carry out a dry treatment, is coupled by means of a suitable connection member in flow communicating fashion with the throughflow or throughpassage means.

7 Claims, 9 Drawing Figures





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Fig. 3

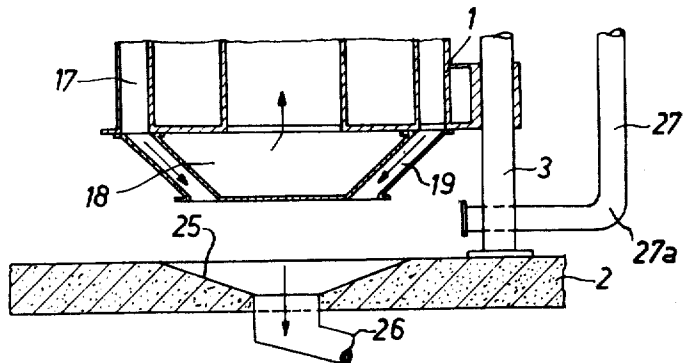


Fig. 4

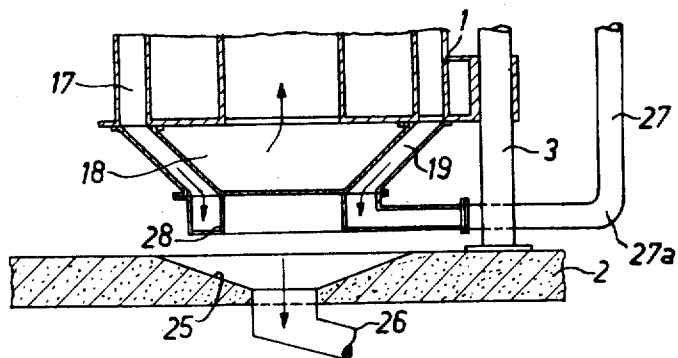


Fig. 5

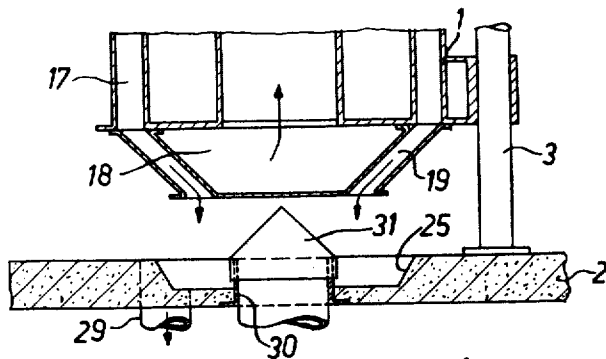
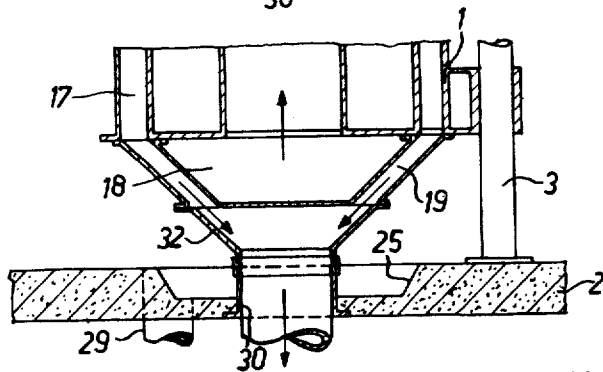
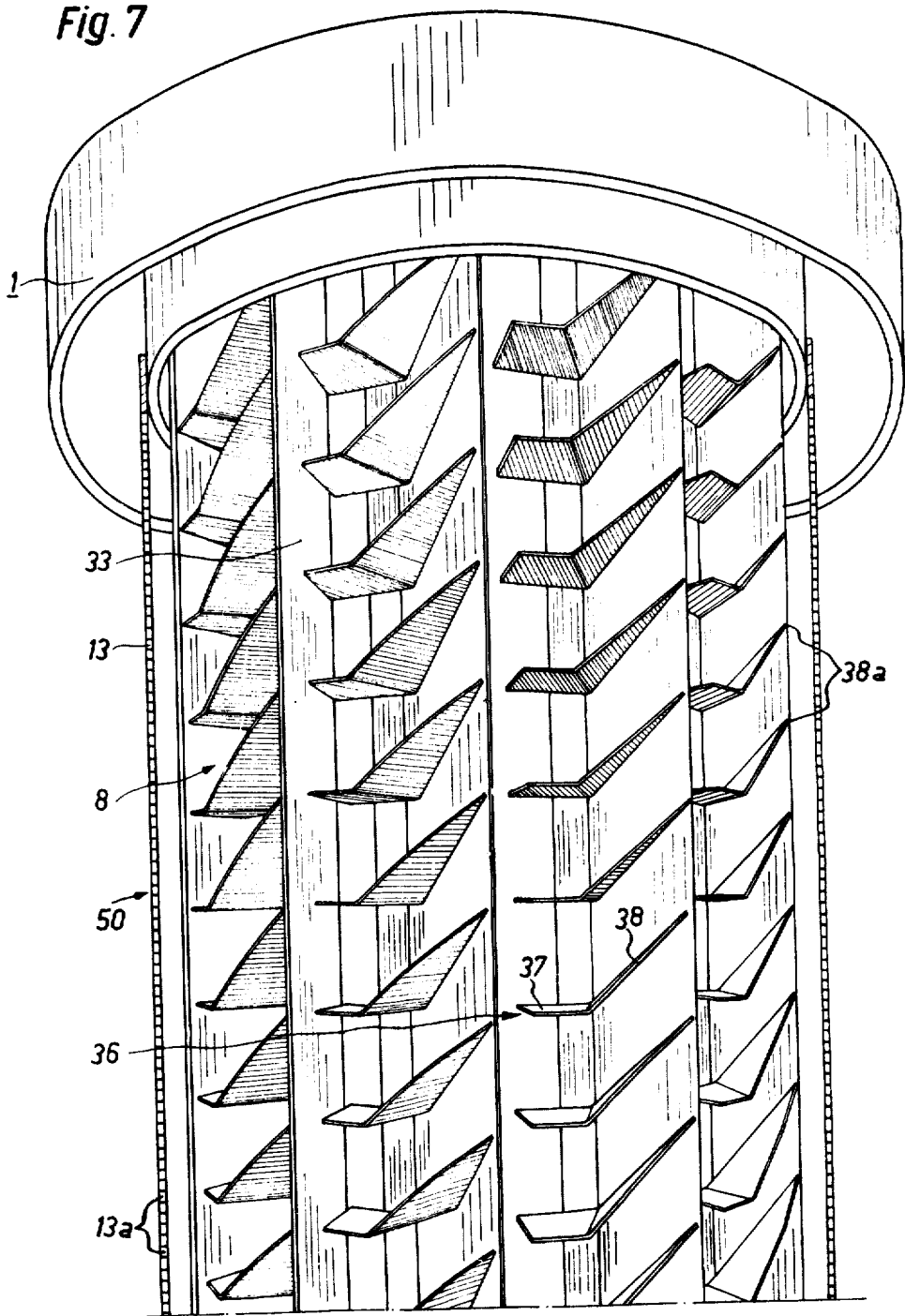


Fig. 6

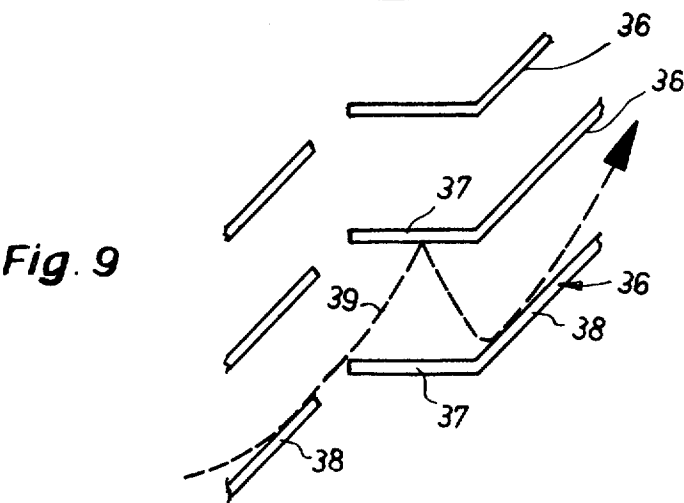
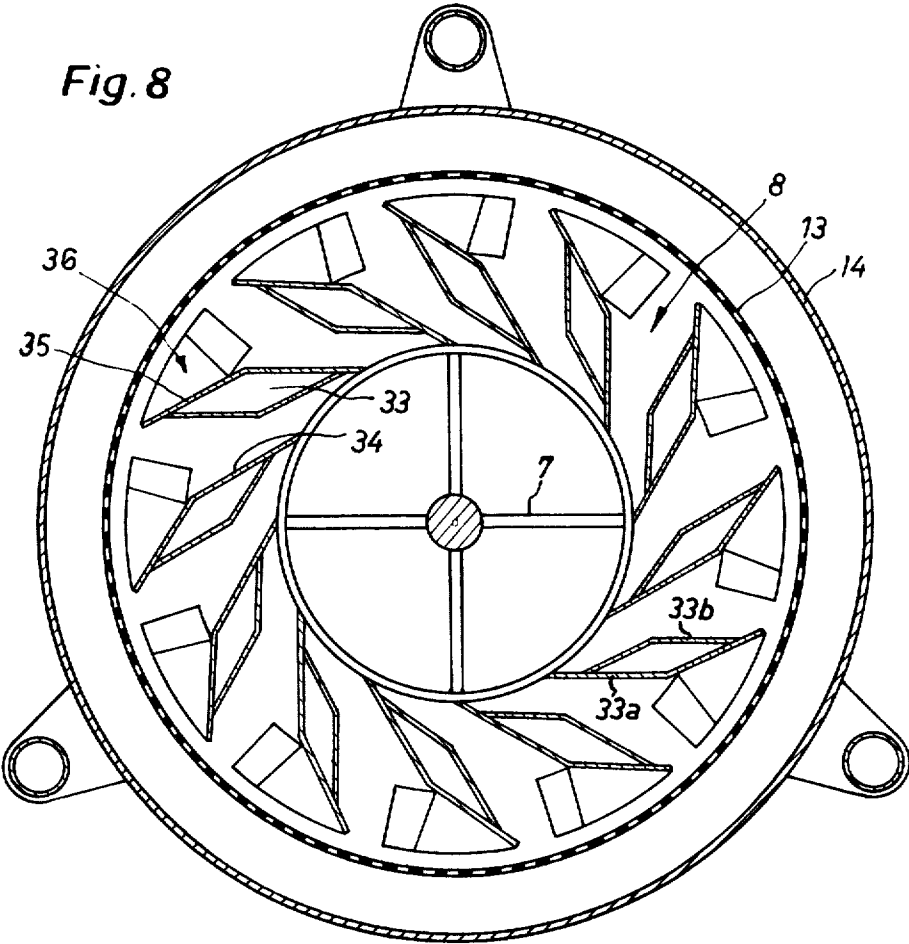


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Fig. 7



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GRAIN CLEANING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved machine for cleaning grain or the like by means of a centrifuge having an upstanding or vertically disposed axis and a rotor simultaneously constructed as an air blower and further incorporates a cylindrical jacket or shell equipped with openings surrounding the rotor.

There are already known to the art machines for cleaning grain which employ a centrifuge having a vertically extending axis, the grain being cleaned in a vat or basin filled with water and thereafter being conveyed to the centrifuge. The water adhering to the grain is spun off or centrifuged at the centrifuge and the grain granules or corns are scrubbed or cleaned at a cylindrical jacket. With this type equipment operating in accordance with a wet process the grain is infed at the lower end of the machinery and again removed at the upper end thereof after it has passed through the machine along the centrifuge. Generally the rotors of the centrifuges of these machines are constructed and designed so as to withdraw or suck air out of the interior of the rotor and to force or press such against the cylindrical jacket equipped with openings or recesses. The air escapes from a discharge located at the region of the upper end of the equipment.

Machinery for cleaning grain through the use of a centrifuge having a vertical axis and wherein the cleaning operation occurs without water, only through the introduction of air, is also known to the prior art. With this type machinery, the grain is introduced into an inlet arranged at the upper end of the centrifuge. The grain corns or granules then drop under the action of their own weight downward and during their throughpassage these grain granules are centrifuged by the rotor of the centrifuge against the cylindrical jacket, at which location they are scrubbed or cleaned. Both the grain granules and the impurities then depart from the equipment at separate outlets or discharges arranged at the lower end.

SUMMARY OF THE INVENTION

However, notwithstanding the existing state-of-the-art equipment certain limitations are inherently present in the ability of such equipment to perform grain cleaning operations according to different techniques. Therefore, a primary objective of the present invention relates to an improved machine for the cleaning of grains or the like which is not associated with these operational limitations of the prior art and affords greater versatility for the grain cleaning operation.

In keeping with this objective a still further and more specific objective of the present invention relates to the provision of improved machinery for cleaning grain, whereby the grain can be selectively cleaned with a wet- or dry cleaning process with the introduction of water and air or air alone, as desired.

Yet a further significant object of the present invention relates to grain cleaning equipment which is designed and constructed in such a manner that the cleaning operation performed thereby can be readily adapted to the desired cleaning process to which the grain material is to be subjected, conversion of the equipment from one type operation to another being possible through the performance of a few simple manipulations, easy to carry out by even unskilled or relatively skilled workers.

A further significant object of the present invention relates to an improved machine for the cleaning of grains which is relatively simple in construction, economical to manufacture, extremely efficient and reliable in operation, easy to clean, and requires a minimum of servicing and maintenance.

Another noteworthy object of the present invention relates to an improved design of grain cleaning equipment wherein the components constituting the equipment itself are designed and arranged in such a fashion that the interior of the equipment can be easily and effectively cleaned when desired and wherein certain components of the equipment which must be

periodically cleaned and/or replaced are readily accessible for these purposes.

Now, in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the inventive machine for the cleaning of grains and which is of the aforementioned type embodying a centrifuge having a vertical axis and a rotor simultaneously designed as an air blower as well as a substantially cylindrical jacket equipped with openings and surrounding the rotor, is manifested by the features that the grain material which is to be cleaned is upwardly conveyed from below along the centrifuge in a direction towards and to a discharge or outlet. The impurities together with the water and air or the air alone fall, within an annular compartment bounded at the inside by the cylindrical jacket, downwardly to a funnel-shaped housing portion located beneath the centrifuge. This housing portion is equipped with a throughpassage communicating with the annular compartment and with an inlet for the air communicating with the interior of the centrifuge. Furthermore, a collecting basin leading to a first withdrawal conduit or line is arranged beneath this housing portion, and additionally, a second withdrawal line or conduit is provided which, when the equipment operates to perform a dry treatment, that is when only using air as the fluid medium, can be operatively connected in flow communicating manner with the throughpassage by means of an associated connection piece.

In the event that the moisture content of the grain is so great that it no longer can be washed, then, the possibility exists, by virtue of the design of the inventive grain cleaning equipment, to dry scrub or clean the grain with the same piece of equipment. By the same token, if the supply of water at certain times is limited or not available at all, then during these time periods it is readily possible to convert the equipment in easy fashion for the performance of a dry cleaning type operation.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a schematic view of a first embodiment of inventive grain cleaning machinery, partially shown in front view and partially in longitudinal sectional view;

FIG. 2 is a cross-sectional view, on a reduced scale, of the grain cleaning machine shown in FIG. 1, taken substantially along the line II—II thereof;

FIGS. 3 to 6 inclusive depict respective schematic views of the lower portion of the inventive equipment for different operating conditions;

FIG. 7 is a perspective view of the upper portion of the centrifuge of the grain cleaning machinery of FIGS. 1 to 6 inclusive;

FIG. 8 is a cross-sectional view of the grain cleaning equipment of the invention at the region of the rotor of the centrifuge; and

FIG. 9 is a schematic diagram illustrating the displacement path of the grain between the blades of the rotor of the centrifuge.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, the exemplary embodiment of inventive machinery for the cleaning of grains as illustrated in FIGS. 1 and 2 will be seen to be composed of a housing 1 supported on the ground 2 by means of three column members 3 anchored to the ground and arranged externally of such housing 1. As will be readily understood by referring to FIG. 1, the housing 1 is formed as a bipartite structure consisting of both housing portions 1a and 1b which are arranged in superimposed fashion and detachably fixed to the column members 3. A vertically disposed or upright shaft 4 is situated centrally of

the equipment, shaft 4 being rotatably mounted at both its lower and upper ends within the housing 1, for instance by means of the bearing arrangements 4a. Shaft 4 piercingly extends through the upper end of the housing 1 and by means of its upper shaft end which protrudes outside of such housing is drivingly connected with a suitable drive motor 6 through the agency of an appropriate belt member 5.

Furthermore, this shaft member 5 supports at its upper and lower end a respective attachment collar 7 at which there is secured the rotor 8 of the centrifuge, generally designated by reference character 50. At the lower collar 7 there is additionally attached a further rotor 9 arranged directly beneath the rotor 8. This rotor 9 operates within an annular-shaped vessel or basin 10 which is open at its top region. Rotor 9 additionally is equipped with blades 11 or equivalent structure which, during rotation of rotor 9, brings about an upwardly effective conveying action. Located at the lower region of the equipment is an infeed funnel 12 for the grain which communicates with the aforementioned basin or vat 10. Above this vat 10 and flush with the outer wall thereof there is located a substantially cylindrical peeling jacket 13 equipped with openings or recesses 13a. Jacket 13 is stationarily arranged and encircles in spaced relationship the rotor 8 of the centrifuge 50. Further, the peeling jacket 13, in turn, is surrounded in spaced relationship by a cylindrical sheet-metal jacket 14, jacket 14 being mounted at its upper and lower ends at the cylindrical outer wall 15 of the equipment housing 1. The lower cylindrical outer wall 15 of the housing 1 likewise encircles at a spacing the outer wall of the basin or vat 10, with the exception of the region where there is located the infeed funnel 12, so that externally of the peeling jacket 13 there is formed an annulus or ring-shaped compartment 16 which is aligned with a further compartment 17 located directly below ring-shaped compartment 16 and which circumferentially extends through an angle of about 270°. Compartment 17 is open at its lower end, as shown.

Continuing, it will be understood that at the region of the infeed funnel 12, the annular compartment 16 is closed at its lower end by means of non-illustrated sheet metal members which extend at an inclination and are directed into the compartment 17. A downwardly tapering discharge funnel 18 is mounted at the lower end of the machine housing 1, the axis of funnel 18 aligning with the lengthwise axis of the machine. This discharge funnel 18 possesses a throughflow passageway 19 which extends along the outer periphery of the discharge funnel 18, throughflow passageway 19 being open at its upper and lower ends and communicating with the compartment 17. Furthermore, throughflow passageway 19 extends over the same circumferential region as the compartment 17. With the exception of the throughflow passageway 19 this discharge funnel 18 is closed at its lower end by means of a plate member 20 and at that region in which the throughflow passageway 19 does not extend such discharge funnel 18 is laterally open and thus forms an inlet 21 for air which communicates with the internal compartment 22 of the equipment.

Having now had the benefit of the foregoing description the operation of this grain cleaning equipment when working with a wet cleaning technique or process will now be first considered:

The grain and the water are infeed into the infeed or delivery funnel 12, flowing from this location into the vat or basin 10. At the basin 10 the grain together with the water is acted upon by the rotating rotor 9 and is upwardly conveyed. Due to this action, the grain and the water are uniformly admixed and at the same time thoroughly washed. The grain which is conveyed in upward direction by the rotor 9 then arrives at the operable zone of the rotor 8 of the centrifuge 50. This rotor 8 of such centrifuge is equipped with beater elements 33, which are not specifically shown in FIG. 1, although will be discussed shortly in conjunction with the description of FIG. 8, such beater elements 33 having blades 36 (FIG. 8) and serving to convey the grain along a helical-shaped path upwardly in the direction of and to the discharge 23 provided for the cleaned

grain. Furthermore, this rotor 8 is constructed as an open rotor structure and sucks air out of the inlet 21, pressing such radially towards the outside through the peeling jacket or shell 13. The grain, during its throughpassage along the centrifuge 50, is flung or centrifuged against the peeling jacket 13 owing to the presence of the centrifugal forces. As a result, the water adhering to the grain is likewise flung or centrifuged towards the outside, and simultaneously the grain is scrubbed or cleaned at the peeling jacket 13 and freed of impurities or other undesirable foreign particles.

The centrifuged water and the impurities move through the openings or recesses 13a of the jacket 13 into the annular compartment or space 16, then fall downwards and leave the equipment via the throughpassage or throughflow means 19. The air sucked in by the rotor 8 of the centrifuge 50 through the inlet 21 enhances the cleaning and drying of the grain. This air likewise leaves the machine via the annular compartment 16 and the throughpassage 19. At the upper end of the annular compartment 16 there is provided a ring-shaped conduit arrangement 24 equipped with nozzles 24a, by means of which water can be downwardly sprayed for the purpose of cleaning or maintaining clean the equipment walls, especially the jacket 13 of the annular compartment 16. At the region of the basin or vat 10 there is arranged any suitable non-illustrated door by means of which it is possible to influence or control the water level within the basin 10 and for the additional purpose of also cleaning this basin.

The same piece of equipment can also be effectively utilized for operating according to a dry technique, and specifically, the mode of operation of the machinery when working in accordance with a dry cleaning technique corresponds to the above-described function, with the exception of the following deviations which will now be explained. When utilizing the dry technique only grain is introduced into the infeed funnel 12. Hence no water is contained within the basin 10. Moreover, no water is introduced or sprayed into the annular compartment 16 via the ring-shaped conduit arrangement 24. Consequently, by means of the throughpassage 19 now only dry impurities, typically the so-called peeling dust and air depart from the equipment.

Depending on whether the machinery operates in the wet or dry process it is accordingly necessary to resort to certain measures in order to deliver the impurities to the appropriate withdrawal means or conduits, which in the case of the dry process appears in the form of dust or dust particles. In this context reference will now be made to the lower portion of the equipment depicted in FIGS. 3 to 6, in connection with which there will now be undertaken a more definitive discussion of these aspects of the invention.

At the outset it should here be mentioned that FIGS. 3 to 6 illustrate different structural embodiments of the connection components which can be coupled in operable relationship with the discharge funnel 18 at the lower end of the equipment. Hence, FIGS. 3 and 4 show one form of structural embodiment of this portion of the equipment and FIGS. 5 and 6 another form. In the first arrangement depicted in FIGS. 3 and 4 the withdrawal means or conduits, to be considered more fully shortly, are positioned so as to extend laterally away from the equipment and in the second embodiment of FIGS. 5 and 6 the withdrawal means or conduits are constructed as drop tubes or conduits. Both the equipment structure of the embodiment of FIG. 3 as well as that of the embodiment of FIG. 5 illustrate the lower portion of the machinery during such time as it operates according to a wet process, and the illustrations of the lower portion of the equipment for the respective embodiments of FIGS. 4 and 6 show such equipment structure when working according to a dry process.

Having now made the foregoing general statements, particular attention is now directed to the embodiment of FIGS. 3 and 4 wherein it will be noted that a collecting basin or trough 25 is formed at the bottom or floor 2 which is located in spaced relationship beneath and from the discharge funnel 18. At the lower end of this collecting basin 25 there is connected

in flow relationship a withdrawal means, here shown as a withdrawal or removal line 26 which is laterally directed away from such collecting basin beneath the floor 2. Additionally, a riser conduit 27, likewise providing withdrawal means, is mounted adjacent the machinery, conduit 27 being provided with a horizontal conduit portion 27a at its lower end, horizontally extending stud or conduit portion 27a terminating at a lateral spacing from the outer wall of the discharge funnel 18.

When using the machinery so as to operate in a wet treatment, then, as best shown by referring to the embodiment of FIG. 3, the region below the discharge funnel 18 is maintained free, so that the water together with the impurities flowing through the throughpassage means 19 can discharge via the collecting basin 25 at the floor 2 into the withdrawal conduit 26 for further conveyance to a suitable recovery installation.

On the other hand, if the equipment is to be used for dry treatment, then, as best shown by referring to FIG. 4, there is mounted between the lower end of the discharge funnel 18 and the ascending or riser conduit 27 a connection piece 28. Now the air together with the impurities departing from the throughflow means 19 is conveyed via the connection piece 28 and by means of a suitable non-illustrated blower provided at the withdrawal conduit 27 to such withdrawal conduit.

With the embodiment of equipment structure depicted in FIGS. 5 and 6 there is also once again formed at the ground or base 2, beneath the discharge funnel 18, a collecting basin or trough 25. A first drop conduit 29 is arranged near the neighborhood of the outer periphery of this collecting basin 25 and at the center of such collecting basin there is arranged a second drop or fall conduit 30 which is in alignment with the lengthwise axis of the machine.

Now if this equipment is operated to carry out a wet treatment, as shown in FIG. 5, then the upper end of the central drop conduit 30 is covered by means of a suitable hood member 31. Consequently, the water together with the impurities emanating from the throughpassage means 19 falls freely into the collecting basin 25 and from that location flows into the conduit 29 to the desired location.

On the other hand, if this embodiment of equipment is operated according to a wet treatment, then, as best shown by referring to FIG. 6, there is mounted between the discharge funnel 18 and the central withdrawal pipe or conduit 30 a connecting funnel 32. Now the air together with the impurities emanating from the throughflow or throughpassage 19 falls into the withdrawal conduit 30 and by means of a suitable blower is conveyed to a desired location.

By virtue of the foregoing description and the herein disclosed construction of the various forms of inventive grain cleaning machinery, it will be readily apparent that by carrying out a few simple manipulations it is possible to convert the described equipment for the cleaning of grain from a wet treatment operation to a dry treatment operation and vice versa.

With particular reference now to FIGS. 7 to 9 there will be more fully explained the construction of the rotor 8 of the centrifuge 50 used in the equipment arrangement of FIG. 1.

More explicitly, then, this rotor 8 possesses so-called beater elements 33 which embody two opposed, substantially roof-shaped flexed wall elements 33a, 33b assembled together to define or form hollow ledges, as best seen by referring to FIG. 8. These beater elements 33 extend between the two attachment collars 7 and are uniformly distributed about the periphery of the rotor 8 and are connected with such two collars 7. In the showing of FIG. 8 the rotor 8 will be understood to revolve in the clockwise direction. The wall portion 33a of each beater element 33 which is situated forwardly in the clockwise direction and disposed laterally with respect to the rearward disposed wall portion 33b, forms the working wall portion and will be seen to be equipped with a radially inwardly situated wall section 34 and a radially outwardly situated wall section 35. Both sections 34 and 35, viewed from their radially innermost edge, extend rearwardly with respect

to the direction of rotation of the rotor 8. The radially inwardly situated wall section 34 forms an angle of about 30° with the tangential plane at the periphery of the collar and taken through the radial innermost edge of such wall section 34. The radial outer wall section 35 is flexed towards the inner wall section 34 rearwardly with respect to the direction of rotation of the rotor 8.

Now at each radial outer wall section 35 there are arranged the spaced superimposed blade members 36, as best observed by referring to FIG. 7. Again as will be best recognized by reference to this figure, the blades 36, in each instance, will be seen to comprise, when viewed in the direction of rotation of the rotor 8, a forwardly or leading situated horizontally extending blade section 37 with which merges a rearwardly upwardly directed or ascending blade section 38. Blade section 38 is of triangular configuration and terminates at a point or tip 38a. Furthermore, the horizontal blade sections 37 which are disposed adjacent to one another in the peripheral direction of the rotor 8, in each instance, will be seen to be disposed at a common respective plane.

During operation of the machine air is now sucked from the interior of the machine by the rotating rotor and is pressed outwardly through the beater elements 33. Furthermore, the grain is elevationally conveyed between the blades along a substantially helical or spiral-shaped path, thereby repeatedly centrifuged or flung against the peeling jacket 13. It has been found that it is advantageous to construct and design the beater elements 33 so as to possess two different inclined working sections, so that the inclination of the inner section 34 can be selected with regard to obtaining good air conveying characteristics and the inclination of the outer section 35 can be selected with regard to obtaining optimum scrubbing or cleaning effect.

By virtue of the construction and arrangement of the rows of blades 36 there is attained an optimum displacement or movement path for the grain. This will be more fully explained in conjunction with FIG. 9. By referring to that figure, it will be seen that such depicts in front view a number of partially illustrated blades 36, which in this figure, during operation are moved from the right towards the left. The phantom line designated by reference character 39 illustrates the movement or motion path of a grain granule or corn. This grain granule impacts against the surface of the ascending blade section 38 of a first blade member, leaves such and then is propelled approximately with the inclination of the section 38 against the underface of the horizontally extending section 37 of the next higher situated blade 36 of the neighboring blade row. At this location, the grain granule is then deflected downwardly against the upper surface of the ascending blade section 38 of the next lower blade of the same blade row, and from this location the described operation again repeats between the next successive blades. In this manner the grain is upwardly conveyed relatively quickly and along a path of travel which is as long as possible—this being advantageous for the cleaning operation itself. Moreover, since the ascending blade section 38 of each of the blades 36 terminates in a tip portion 38a, as previously explained, it is possible to effectively prevent that the grain granules will be centrifuged or thrown against a blade edge and damaged.

Furthermore, it is here mentioned that the construction of the inventive equipment incorporating a bipartite or two-piece housing, wherein each part is detachably connected by suitable attachment means at column members 3 extending externally of the working compartment of the equipment, favors maintaining the machinery clean and enables simple mounting or assembly thereof. Additionally, accessibility is excellent for cleaning purposes and for the exchange of the peeling or cleaning jacket.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. A machine for cleaning grain and the like of impurities, comprising:
 - a. a housing with a substantially funnel-shaped housing portion;
 - b. centrifuge means with an upper and lower end and having a substantially vertically disposed axis and a rotor means simultaneously defining an air blower provided for said housing;
 - c. said substantially funnel-shaped housing portion being located beneath said centrifuge means;
 - d. a substantially cylindrical jacket member equipped with openings surrounding said rotor means;
 - e. discharge means for the grain;
 - f. means for conveying the grain from the lower end of said centrifuge means along the latter to said discharge means;
 - g. means forming an annular compartment bounded at the inside by said cylindrical jacket member, wherein the impurities together with a fluid medium, either water and air or air alone, respectively, fall downwards through said annular compartment into said substantially funnel-shaped housing portion;
 - h. said funnel-shaped housing portion incorporating means defining a throughflow passageway communicating with said annular compartment;
 - i. said funnel-shaped housing portion further including air inlet means communicating with the interior of said centrifuge means;
 - j. a collecting basin situated below said funnel-shaped housing portion;
 - k. a first withdrawal means and a second withdrawal means positioned to cooperate with said collecting basin; and
 - l. a connecting element for operably connecting in flow relationship said second withdrawal means with said throughflow passageway when the grain cleaning machine performs a dry treatment of the grain.
2. The machine as defined in claim 1, wherein both said funnel-shaped housing portion and said centrifuge means possess a respective lengthwise axis which are in alignment with one another, said throughflow passageway extending along the outer periphery of said funnel-shaped housing portion over the major portion of its peripheral surface, said throughflow passageway having an inlet portion located essentially directly beneath said annular compartment.
3. The machine as defined in claim 2, wherein said throughflow passageway further includes an outlet portion, said funnel-shaped housing portion being closed at its lower end with the exception of the outlet region of said outlet portion, said air inlet means being located laterally between both peripheral ends of said throughflow passageway.
4. The machine as defined in claim 2, wherein said throughflow passageway further possesses an outlet portion, said second withdrawal means including a connecting piece and is situated laterally of said funnel-shaped housing portion, said connecting element essentially comprising an upwardly

open trough fitting upon said outlet portion of said throughflow passageway and opening into said connecting piece of said second withdrawal means.

5. The machine as defined in claim 2, wherein the upper end of said second withdrawal means is coaxially arranged with respect to said funnel-shaped housing portion and piercingly extends through said collecting basin, a hood member provided for said second withdrawal means, said connecting element possessing a substantially funnel-shaped configuration, and wherein when the grain cleaning machine performs a wet treatment said hood member is mounted upon an upper end of said second withdrawal means and when the grain cleaning machine performs a dry treatment said connecting element is mounted between a lower end of said funnel-shaped housing portion and the upper end of said second withdrawal means.

6. The machine as defined in claim 1, wherein said housing is constructed as a bipartite member both portions of which are disposed above one another in superimposed fashion, and column means located externally of said housing to which said housing portions are detachably connected.

7. A machine for cleaning grain and the like of impurities, comprising:

- a. a housing with a lower housing portion;
- b. substantially upright centrifuge means embodying an upper and lower end and a rotor means forming an air blower arranged within said housing;
- c. said lower housing portion being located beneath said centrifuge means;
- d. a substantially cylindrical jacket member equipped with openings surrounding said rotor means;
- e. discharge means for the grain;
- f. means for conveying the grain from said lower end of said centrifuge means to said discharge means;
- g. means forming an annular compartment, wherein the impurities together with a fluid medium, either water and air or air alone, respectively, fall downwards through said annular compartment into said lower housing portion;
- h. said lower housing portion incorporating means defining a throughflow passageway communicating with said annular compartment;
- i. said lower housing portion further including air inlet means communicating with the interior of said centrifuge means;
- j. a collecting basin situated below said lower housing portion;
- k. a first withdrawal means for both the impurities and the air and water and a second withdrawal means for the impurities and air positioned to cooperate with said collecting basin; and
- l. connecting means interposed in flow relationship between said second withdrawal means and said throughflow passageway when the grain cleaning machine undertakes dry treatment of the grain.

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