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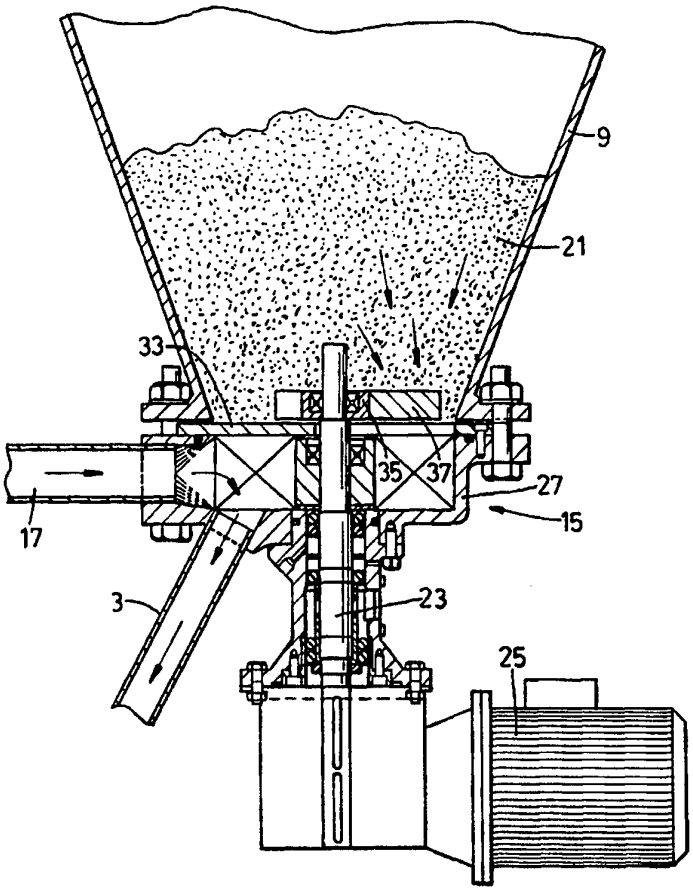
(54) Title: PNEUMATIC CONVEYING SYSTEMS

(57) Abstract

Apparatus for supplying granular or powdered material into a pneumatic conveying line (3) includes a pressurised feed vessel (9) having a material inlet (11) through which material may be supplied to said feed vessel while maintaining pressure therewithin. The pressure is balanced between the interior of the feed vessel and the outlet, and the outlet includes a material feed device (15) which has circumferentially spaced apart, radial blades (31) mounted for rotation about a substantially vertical axis in order to convey material falling between adjacent blades to an entrance to said pneumatic pipeline located below said blades.



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PNEUMATIC CONVEYING SYSTEMS

This invention relates to pneumatic material conveying systems and in particular to that part of such a system for supplying granular or powdered material into a pneumatic conveying line.

It is known to provide apparatus for supplying material into a pneumatic conveying line which incorporates screw-type devices. Apparatus incorporating such devices is limited in capacity and its ability to handle fine powdered material due to the inherent weaknesses of the screw-type design when used as a metering feeder. At large flow rates, typically above $6m^3$/hour of material, there is a tendency for many fine powdered materials to retain air and remain in a "fluid" condition within the screw device. In this condition, the frictional relationship between the screw and tube in which it turns is lost, and the material "flushes" or runs uncontrollably through the screw device.

According to the present invention there is provided apparatus for supplyin granular or powdered material into a pneumatic conveying line comprising a pressurised feed vessel having a material inlet through which material may be supplied to said feed vessel while maintaining pressure therewithin, said vessel having a material outlet through which material may be fed to the pneumatic conveying pipeline, pressure balance means interconnecting the interior of the feed vessel and said outlet to balance the pressure therebetween, said material outlet including a material feed device having circumferentially spaced apart, radial blades mounted for rotation about a substantially vertical axis in order to convey material falling between adjacent blades to an entrance to said pneumatic conveying pipeline located below said blades.

In apparatus according to the present invention, the material being supplied can be of fluid condition and the apparatus

will work perfectly normally in such a situation. Capacities in excess of 100m³/hour are possible.

By using a rotary blade feeding device in a vessel in which the pressure therewithin is balanced with that of the pipeline to which the material is being supplied, it is possible to eliminate any pressure differentials between the vessel and the pipeline and as a result the apparatus can be used at very high pressures. Indeed the only limitation on the vessel is due to the strength of the components and the seals of the shaft turning the blades. As a result it can cope with pressures of 20 barg or higher.

Because of the balancing of the pressures as mentioned above, there is no need to provide very small clearances between the rotor blades and the housing. Such small clearances would be required if there was any significant pressure differential between the interior of the supply vessel and the pneumatic conveying line.

An embodiment of apparatus in accordance with the present invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:-

- Figure 1 is a diagramatic elevational view of apparatus of the invention;

- Figure 2 shows in detail, and mainly in vertical section, the material feed device of the apparatus of Figure 1; and

- Figure 3 is a further detailed view, largely in plan, of the feed device of the apparatus of Figure 1.

Referring to Figure 1 of the accompanying drawings, apparatus 1 for supplying granular or powdered material into a pneumatic conveying line 3 is located below a storage bin 5 for the material and includes a double pressure vessel system having pressure vessels 7 and 9. In this way material may be fed

from storage bin 5 via valve 11 into pressure vessel 7. Valve 11 may be closed, vessel 7 pressurised and material then fed into pressure vessel 9 via valve 13. In this way the pressure within vessel 9 may be maintained throughout the operation of the entire system.

At the base of pressure vessel 9 there is located material feed device 15 which includes a rotary blade arrangement to be described in more detail below. Device 15 feeds material from pressure vessel 9 into conveying pipeline 3, conveying air being fed to device 15 via pipe 17. Interconnecting pipe 17 and the interior of pressure vessel 9 is a balance pipe 19 as a result of which the pressure in the feed device 15 is balanced with that in pressure vessel 9.

Material is fed from storage bin 5 into pressure vessel 9, via vessel 7, to an extent sufficient to maintain the material level within pressure vessel 9 above the level probe 21.

Referring to Figures 2 and 3 of the accompanying drawings material 21 within pressure vessel 9 is fed to conveying pipeline 3 by means of the rotary feed device 15, conveying air being supplied to said device by pipe 17. Rotary feed device 15 includes a drive shaft 23 mounted for rotation about a vertical axis and driven by means of motor and gear box arrangement 25. Mounted on drive shaft 15 within a housing 27 bolted to the bottom of pressure vessel 9, is a rotor 29 which includes a plurality of circumferentially spaced apart, radial blades 31.

Located directly above rotor 29 and extending over nearly half of the area swept up by the rotor is a plate 33. Plate 33 is located directly over the entrance to conveying pipeline 3 although separated therefrom by the rotor blades 31. Drive shaft 23 extends upwardly above rotor 29 and plate 33 terminating within pressure vessel 9 a short distance above this plate 33. Mounted on this upper portion of drive shaft 23 is a paddle wheel 35 having three circumferentially equally spaced apart, radially extending paddles 37.

As indicated by arrows in Figure 2 material flows from pressure vessel 9 and is swept by the paddles of paddle wheel 35 into the pockets between rotor blades 31 on that side of the rotor opposite the entrance to conveying pipeline 3, the other side being blocked by plate 33. As the rotor 29 turns, material is conveyed to the entrance to conveying pipeline 3. This material is propelled by air supplied along pipe 17 into conveying pipeline 3 to its point of use destination. Due to the balance of pressure between the pressure in the feed device 15 and the pressure vessel 9 above it, there is no need for the very small clearances between the rotor 29 and its housing 27 that would be required if there was a pressure differential and the pressure attainable in the conveying pipeline 3 is only limited by the strength of the vessel and the shaft seals in the feed device 15.

Adjustment of material flow rate is achieved by changing the speed of the motor 25 with an electrical frequency variator. In order to obtain very accurate feed rate control, the lower vessel can be mounted on a suitable weighing system.

CLAIMS

1. Apparatus for supplying granular or powdered material into a pneumatic conveying line comprising a pressurised feed vessel having a material inlet through which material may be supplied to said feed vessel while maintaining pressure therewithin, said vessel having a material outlet through which material may be fed to the pneumatic conveying line, pressure balance means interconnecting the interior of the feed vessel and said outlet to balance the pressure therebetween, said material outlet including a material feed device having circumferentially spaced apart, radial blades mounted for rotation about a substantially vertical axis in order to convey material falling between adjacent blades to an entrance to said pneumatic line located below said blades.

2. Apparatus according to Claim 1 in which the radial blades are mounted for rotation on a common drive shaft extending from a central position at the base of the feed vessel downwardly towards a drive mechanism arranged below said feed vessel.

3. Apparatus according to Claim 1 or Claim 2 in which the feed vessel is provided with a plate extending horizontally over at least a part of the space swept out by the radial blades.

4. Apparatus according to Claim 3 in which the plate extends over nearly half the area swept out by the radial blades.

5. Apparatus according to any of the preceding claims in which the radial blades are mounted on a common drive shaft and, mounted also on the drive shaft, above said radial blades, is means for sweeping material located above the blades to ensure good feed of said material in a direction towards said blades.

6. Apparatus according to Claim 5 in which the sweeping means is in the form of a paddle wheel having circumferentially spaced apart, radially extending paddles.

7. Apparatus according to any of the preceding claims in which the material outlet extends from the base of the feed vessel in a direction downwardly and radially outwardly from a position below the radial blades located radially outwardly of the centre of the feed vessel.

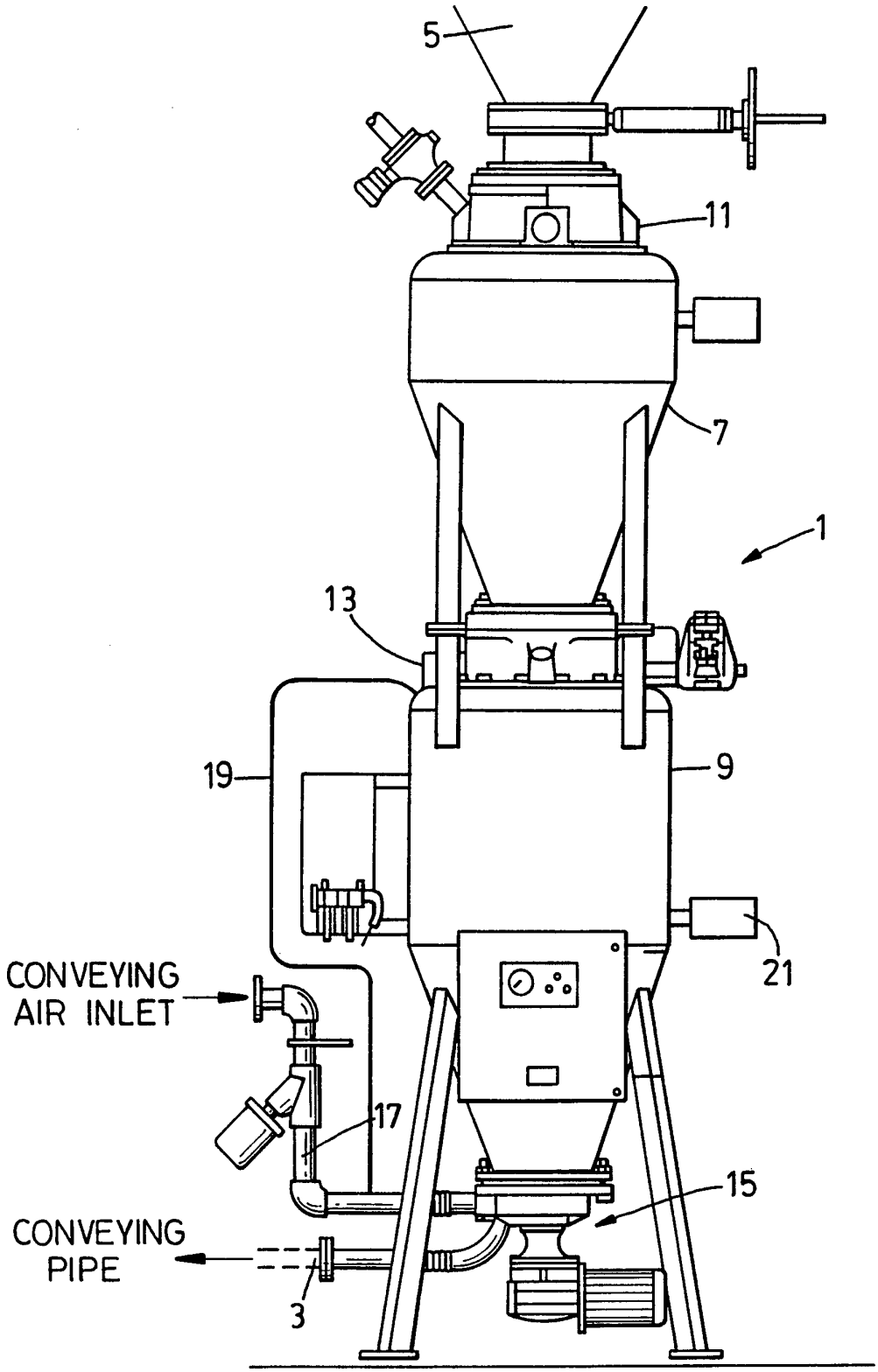

Fig. 1

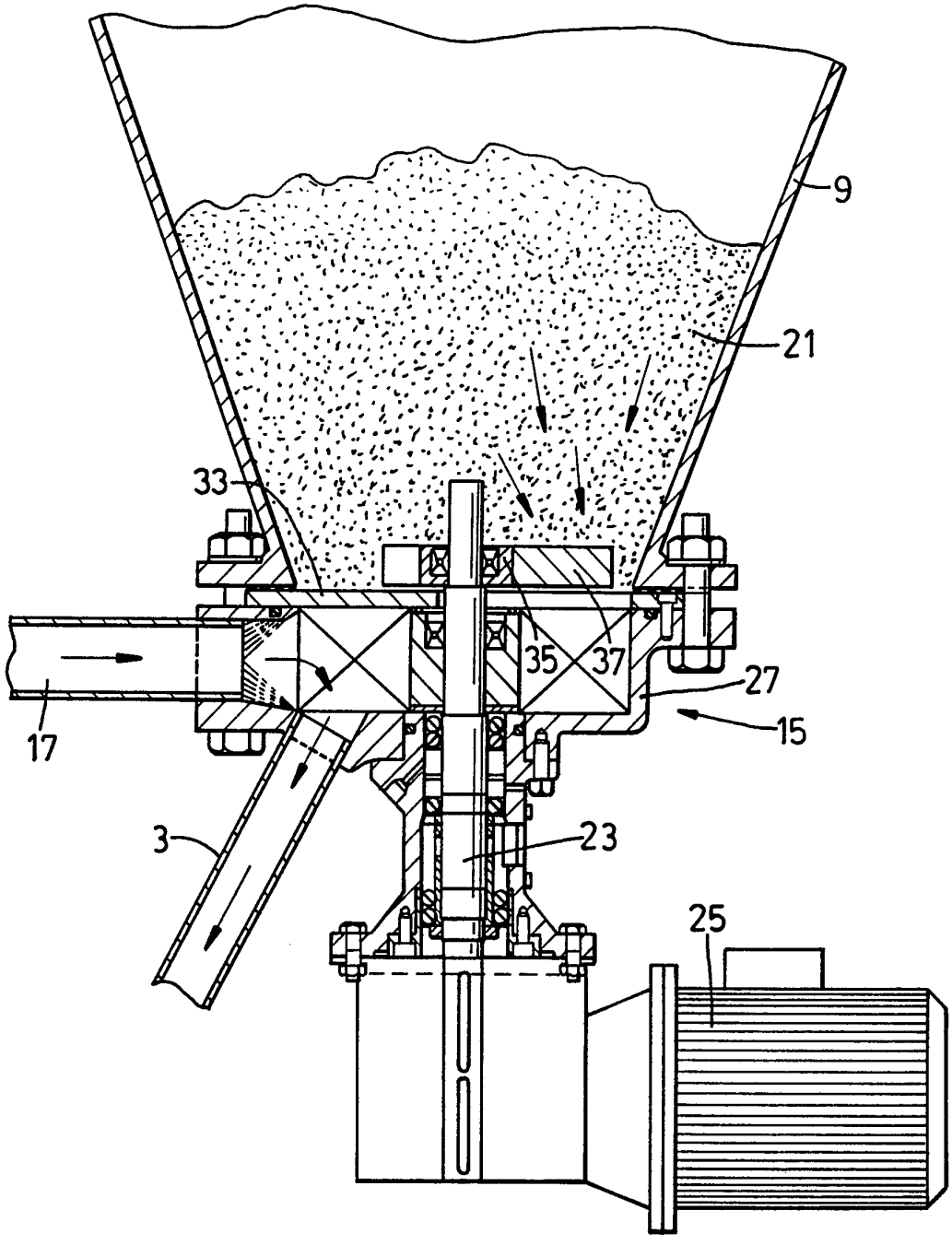

Fig. 2

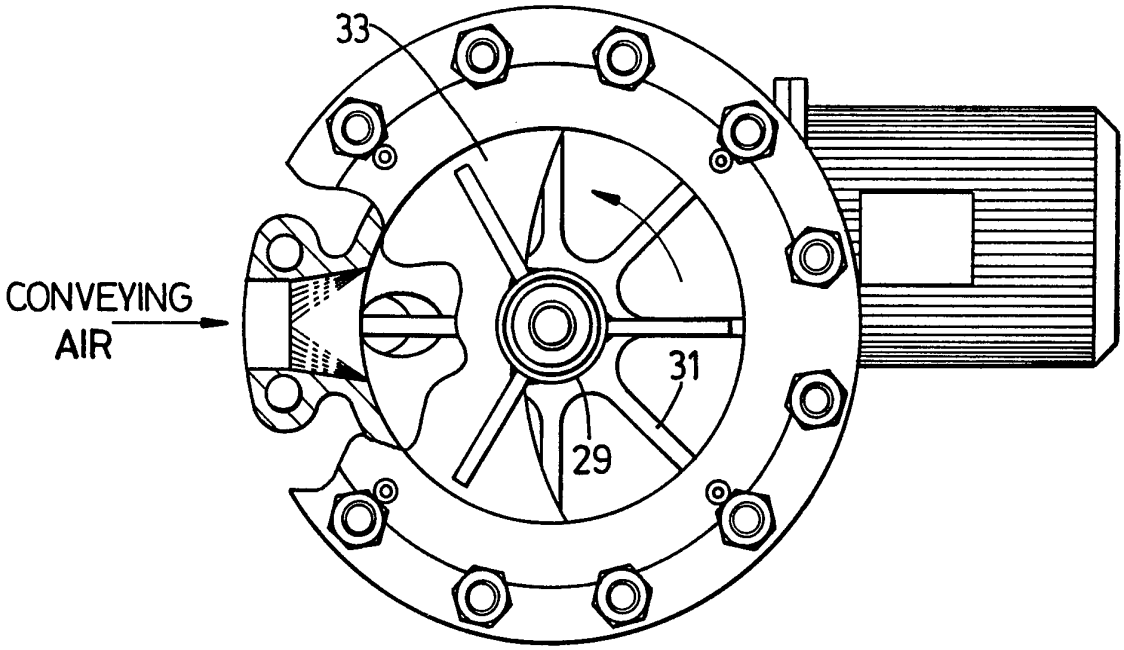

Fig. 3

INTERNATIONAL SEARCH REPORT

Inter ɔnal Application No
PCT/GB 94/01376

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 B65G53/46

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 5 B65G

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 212 256 (AVT ANLAGEN- UND VERFAHRENSTECHNIK GMBH) 4 March 1987 see the whole document	1-7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 October 1994	14. 10. 94
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Interr nal Application No
PCT/GB 94/01376

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0212256	04-03-87	DE-A- 3544014	19-02-87
		JP-A- 62043524	25-02-87
		US-A- 4747524	31-05-88