(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 875 368 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.11.1998 Bulletin 1998/45

(51) Int. Cl.[6]: **B30B 15/30**, B22F 3/00

(21) Application number: **98107755.5**

(22) Date of filing: **28.04.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **30.04.1997 GB 9708674**

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(54) Apparatus for feeding moulding material

(57) An apparatus (10) for feeding moulding material towards a moulding station, the feeding apparatus (10) comprising a receptacle (11) for the moulding material at a first location, conveyor means (12) for conveying moulding material from the receptacle (11) towards a second location (13), reservoir means (14) at the second location (13), the second location (13) being at or adjacent the moulding station, heating means (30) for heating the moulding material as it is conveyed by the conveyor means (12) characterised in that the heating means (30) comprises a plurality of heating units (30) spaced along the conveyor means (12), and a control means (20) individually to control the heat output of the plurality of heating units (30) thereby to provide zonal heating control along the conveyor means (12).

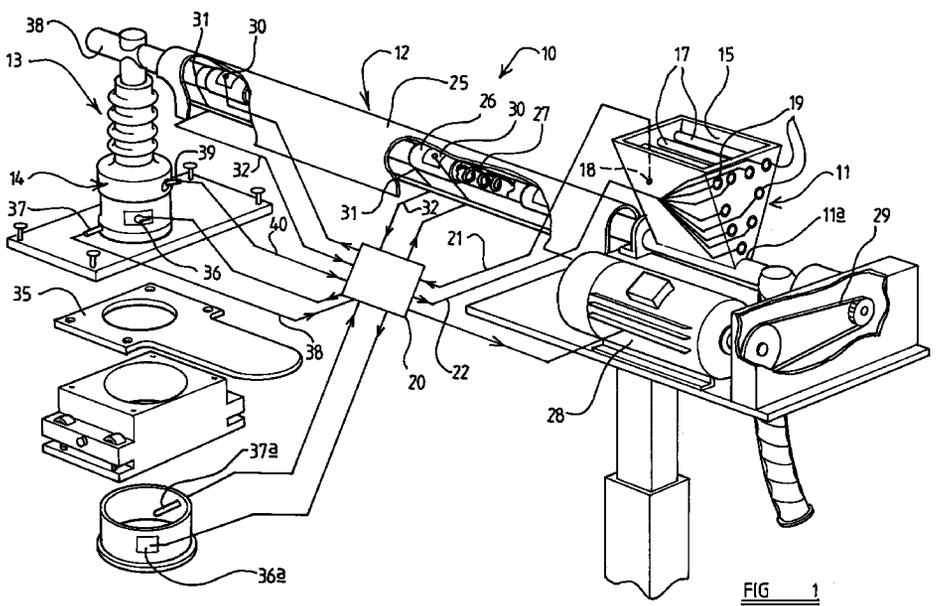

FIG 1

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Description

This invention related to an apparatus for feeding moulding material towards a moulding station where the moulding material may be used in a moulding apparatus.

The invention has particularly but not exclusively been devised for use in feeding moulding material comprising metal powder, and usually a lubricant, from a convenient position towards a metal powder moulding apparatus where the powder is formed to a shape in a mould (known as a die) as pressure is applied. However the invention may be utilised in other applications where it is desired to feed appropriate alternative moulding material towards a moulding station.

Various proposals have been made for such apparatus for feeding metal powder towards a moulding station, including a proposal for achieving conveying of the material by means of an auger being a usually helically arranged member with a central core, about which a continuous heating tape is entrained, so that the metal powder can be kept in a warm state as it is conveyed. Using an auger has an advantage in that the metal powder and lubricant constituents are continually mixed as they are conveyed, but the arrangement proposed previously has suffered from several problems.

First, the use of a continuous tape type of heater, means that it is difficult to control the temperature of the powder being conveyed, along the whole length of the auger.

Second, the auger tends to compress the powder with the result that the auger tends to become clogged with compressed material, making it less effective for conveying and eventually resulting in failure of the feeding apparatus.

The metal powder is conventionally fed into a receptacle, such as a funnel from where it is conveyed towards the moulding station, and at or adjacent the moulding station, conventionally there is a reservoir for the moulding material from which moulding material is taken into a moulding apparatus for moulding. Usually, heating tape is entrained about the funnel and the reservoir but this does not result in heat being properly applied to the metal powder etc.

Unless the temperature of the metal powder is properly controlled, during feeding and in the receptacle and the reservoir, the quality of the resultant moulding may be effected, and the moulding apparatus can become worn prematurely, particularly where the metal powder is a ferrous or other hard, based metal.

According to a first aspect of the invention we provide an apparatus for feeding moulding material towards a moulding station, the feeding apparatus comprising a receptacle for the moulding material at a first location, conveyor means for conveying moulding material from the receptacle towards a second location, reservoir means at the second location, the second location being at or adjacent the moulding station, heating means for heating the moulding material as it is conveyed by the conveying means characterised in that the heating means comprises a plurality of heating units spaced along the conveyor means, and a control means individually to control the heat output of the plurality of heating units thereby to provide zonal heating control along the conveyor means.

Thus, more accurate control of the temperature of the moulding material as it is conveyed may be achieved than with hithertofore known apparatus.

The conveyor means may comprises a rotatable screw member received in a casing, the rotatable screw member having a generally central hollow. For example the hollow rotatable screw member may comprise a helical wire but any other suitable hollow screw member may instead be provided.

In each case the hollow screw member may in use rotated by a motive means through a transmission including a continuous loop element such as a toothed belt

Thus in such an apparatus the advantages of using an auger type feed are preserved, but the problem of compaction of the moulding material has been overcome or at least lessened.

The receptacle may comprise an open top through which moulding material is introduced into the receptacle and may include a heating means for heating the moulding material therein, the heating means comprising at least one heating element which extends through the receptacle and is in use at least partly embedded in the moulding material.

It has been found that by providing such a heating means for the receptacle, particularly in a metal powder moulding process, the temperature of the moulding material can be maintained more even than with known heating tape and the like arrangements.

The receptacle may have at least one tube extending therethrough in which the heating element is located in use.

The apparatus of the invention may also comprise a heating means for heating the moulding material in the reservoir means, the heating means comprising at least one heating unit which extends only partly about an exterior wall of the reservoir means.

Thus using a heating means of this kind, such as a band heater, for the reservoir of moulding material, again more accurate control of the temperature of the moulding material in the reservoir means may be achieved.

Each of the heating means of the receptacle, the conveyor means and the reservoir means may be controlled by a control means in response to inputs from various sensor means which sense the temperature of the moulding material (directly or indirectly).

The invention is particularly but not exclusively applicable where the moulding material comprises metal powder and a lubricant, but may be used in other applications.

The invention will now described with reference to the accompanying drawings which is an illustrative perspective view of an apparatus in accordance with the invention.

Referring to the drawing there is shown an apparatus 10 for feeding moulding material towards a moulding station at a second location 13. The apparatus 10 comprises a generally funnel shaped receptacle 11 for the moulding material at a first location, a conveyor means 12 for conveying moulding material from the receptacle 11 towards the second location 13, a reservoir means 14 at the second location 13. The apparatus 10 is particularly for feeding moulding material comprising metal powder which preferably contains a lubricant, which is moulded at the moulding station by a powder moulding technique under pressure, or compaction in a mould or die, to form the metal powder into a desired configuration.

The receptacle 11 has an open top 15 into which moulding material may be introduced at a convenient location distant from the moulding station. Within the receptacle 11, there is provided a heating means for heating the moulding material in the receptacle 11, the heating means comprising at least one heating element 19 which extends through the receptacle 11, in this example there being several heating elements each located in a respective tube 17, at least some of the tubes 17 being embedded in the moulding material in the receptacle 11 in use.

The temperature of the moulding material in the receptacle 11 is carefully controlled by a control means 20 which receives an input from an appropriate sensor 18 which is also in use embedded in the moulding material in the receptacle 11. The sensor 18 sends a signal along a line 21 to the control means 20. Depending on the temperature sensed, the control means 20 sends appropriate control signals along a control line 22 to the heating elements 19 within the tubes 17. If desired, all of the heating elements 19 may be controlled in parallel, or at least some of the heating elements 19 may be controlled individually, so that heat of varying intensity may be imparted into the moulding material within the receptacle 11 as it waits to be conveyed along the conveyor means 12.

The conveyor means 12 comprises an outer casing 25 and an inner casing 26. Within the inner casing 26 there is provided a rotatable screw member 27 having a generally central hollow, and which in this example comprises a helical wire, the diameter of the screw member 27 being slightly less than the inside diameter of the inner casing 26 of the conveyor means 12.

In use, the hollow screw member 27 is rotated by means of a motive means 28 comprising in this example an electric motor, which drives the hollow rotatable screw member 27 via a transmission, which includes in this example, a toothed belt 29 although any other flexible loop may be utilised, or indeed any other appropriate direct or indirect transmission may be used as desired.

The hollow screw member 27 in the form of a helical wire, acts in the manner of an auger to convey the moulding material from the receptacle 11, or at least a base 11a of the receptacle 11 along the casing 26 from the first receptacle 11 towards the second location 13. By virtue of the screw member 27 being hollow, it has been found that the metal powder tends not to be compacted within the casing 26 but is more easily carried along the conveyor means 12 without problems occurring.

As the metal powder and lubricant is conveyed, hotter and colder volumes are mixed so that a more even temperature throughout the powder volume is achieved. Further, to preserve the temperature of the moulding material as it is conveyed, according to the invention, the temperature is controlled zonally along the conveying means 12. This is achieved by the provision of a plurality of heating units 30, only two of which are illustrated in the example, each heating unit 30 being for example, a band heater and having an associated heat sensor 31. The sensors 31 provide signals along appropriate lines 32 to the control means 20, which in response, controls operation of the heating units 30 to switch them on or off or otherwise to control the heat dissipated by the heating units 30 in their zonal positions.

In this way the temperature of the moulding material as it is conveyed along conveyor 12 can be maintained within quite strict limits.

At the second location 13 there is provided a receptacle 14 for receiving the mixed conveyed moulding material and for holding the mixed moulding material until it is carried into a moulding apparatus, for example by means of a shuttle 35, where it is moulded, i.e. compacted in a mould or die under pressure.

To control the temperature of the moulding material in the reservoir 14 there is provided a heating means comprising a band heater 36 which extends only partly around the reservoir 14 but in intimate contact with the outside surface of the reservoir 14. The effect of this heating means 36 is monitored by means of a sensor 37 which provides an input to the control means 20 along line 38, and in response, the control means 20 controls the heating means 36 so that the temperature of the moulding material within the reservoir 14 is maintained substantially constant. More than one band heater 36 may be provided if desired.

In the arrangement shown, the reservoir 14 is deep and hence a second heating means is provided comprising a second heating element and sensor 36a,37a which are also connected to the control means 20.

The reservoir 14 also is provided with a level sensor 39 which senses the level of metal powder in the reservoir 14. When the level rises to sensor 39, sensor 39 provides an input (or stops providing an input) to control means 20 along line 40. In response, control means 20 may slow the speed of the screw member 27, or may stop the screw member 24 rotating altogether, until the

level of metal powder in the reservoir 14 again falls below the level of the sensor 39 (or a second, lower, sensor; not shown).

Then the screw member 27 may again be rotated, or rotated at full speed, to deliver more metal powder to the reservoir 14. Mainly by virtue of the zonal temperature control along the conveyor 12, this does not present any problem of the powder and lubricant being too hot or cold in the conveyor 12.

Various modifications may be made without departing from the scope of the invention.

For example, the particular nature of the receptacle 11 may be varied. The receptacle 11 shown is generally funnel shaped, but could be of an alternative configuration although preferably has an open top 15 to receive the moulding material.

The length of the conveyor means 12 between the receptacle 11 and the second location 13 may be varied substantially from what is shown although the gauge of the wire for the hollow screw member 27 may need to be increased over particularly long runs of conveyor means 12 or even some mechanism by which drive is imparted to an opposite end 38 of the hollow screw member 27 to that at which the motive means 28 is provided, may need to be provided.

It is preferred for a space between the outer 25 and inner 26 casings of the conveyor means 12 to be insulated to preserve heat within the inner casing 26 although the outer casing 25 may in some applications be omitted altogether.

The nature of the reservoir 14 is dependant largely upon the moulding apparatus adjacent thereto. In the example described, the reservoir 14 forms part of the moulding apparatus although may be a more simple reservoir from which moulding material is removed and delivered directly into the moulding apparatus.

Although the invention has been described with reference to a moulding apparatus for moulding metal powder, the principles of the invention may be applied to other kinds of moulding apparatus.

The features disclosed in the foregoing description the following claims or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method of process for attaining the disclosed result, or a class or group of substances or compositions, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. An apparatus (10) for feeding moulding material towards a moulding station, the feeding apparatus comprising a receptacle (11) for the moulding material at a first location, conveyor means (12) for conveying moulding material from the receptacle (11) towards a second location (13), reservoir means (14) at the second location (13), the second location (13) being at or adjacent the moulding station, heating means (30) for heating the moulding material as it is conveyed by the conveying means (12) characterised in that the heating means (30) comprises a plurality of heating units (30) spaced along the conveyor means (12), and a control means (20) individually to control the heat output of the plurality of heating units (30) thereby to provide zonal heating control along the conveyor means (12).

2. An apparatus according to claim 1 characterised in that the conveyor means comprises (12) comprises a rotatable screw member (27) received in a casing (26), the rotatable screw member (27) having a generally central hollow.

3. An apparatus according to claim 2 characterised in that the hollow rotatable screw member (27) comprises a helical wire.

4. An apparatus according to claim 2 or claim 3 characterised in that the screw member (27) is in use rotated by a motive means (28) through a transmission including a continuous loop element (29).

5. An apparatus according to anyone of the preceding claims characterised in that the receptacle (11) comprises an open top (15) through which moulding material is introduced into the receptacle (11).

6. An apparatus according to claim 5 characterised in that the receptacle (11) includes a heating means (19) for heating the moulding material therein, the heating means (19) comprising at least one heating element (19) which extends through the receptacle (11) and is in use at least partly embedded in the moulding material

7. An apparatus according to claim 6 characterised in that the receptacle (11) has at least one tube (17) extending therethrough in which the heating element (30) is located in use.

8. An apparatus according to any one of the preceding claims wherein heating means (36) are provided for heating the moulding material in the reservoir means (14), the heating means (36) comprising at least one heating unit (36) which extends only partly about an exterior wall of the reservoir means (14).

9. An apparatus according to any one of the preceding claims characterised in that the moulding material comprises metal powder and a lubricant.

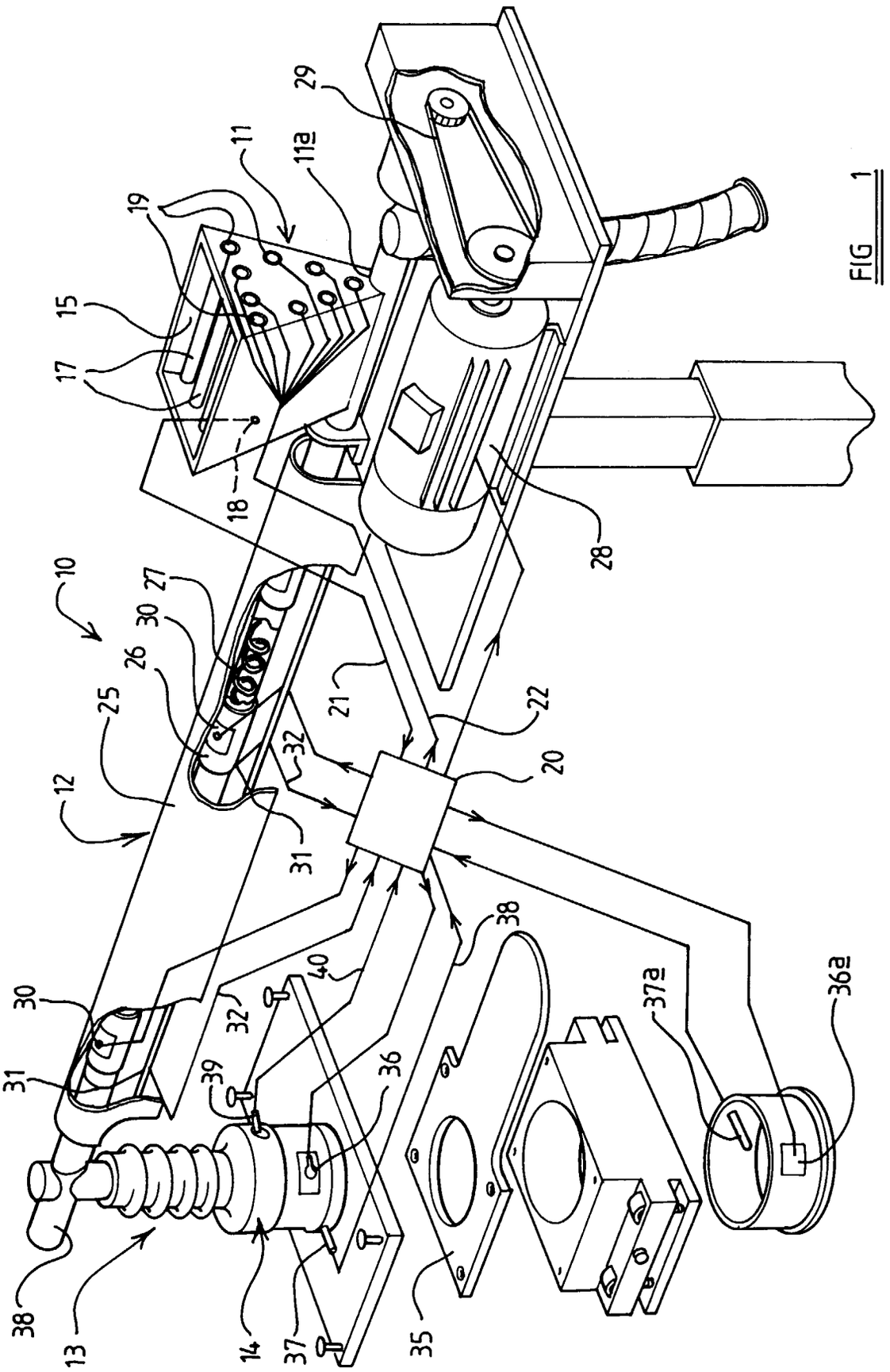
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FIG 1