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Hodler

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[54] **CASTING MOULD HAVING A VENTILATION DUCT**

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[52] **U.S. Cl.** **425/135;** 425/812; 249/141; 164/305

[51] **Int. Cl.** **B29c 1/00;** B22d 17/14

[58] **Field of Search** 425/DIG. 812, 242, 135, 425/146; 164/305, 410, 154, 155; 249/141; 251/61.3

[56] **References Cited**

UNITED STATES PATENTS

2,288,642	7/1942	Powell	251/61.3
2,293,068	8/1942	McLaughlin	251/61.3
3,191,233	6/1965	Linderoth	425/146
3,349,833	10/1967	Hodler	164/305

FOREIGN PATENTS OR APPLICATIONS

306,274	6/1955	Switzerland

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[57] **ABSTRACT**

A casting mold having a ventilation duct, a ventilation valve in the duct, a recess in communication with the mold cavity, a pressuresensitive membrane forming part of the wall of the recess, and actuating means responsive to flexion of the membrane, under the influence of the pressure of casting material entering the recess, to initiate closure of the valve.

10 Claims, 4 Drawing Figures

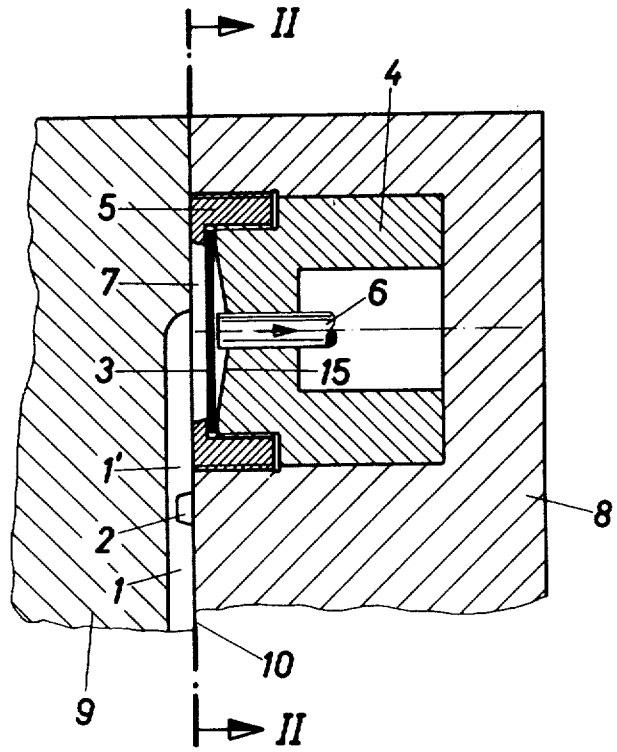


Fig.1

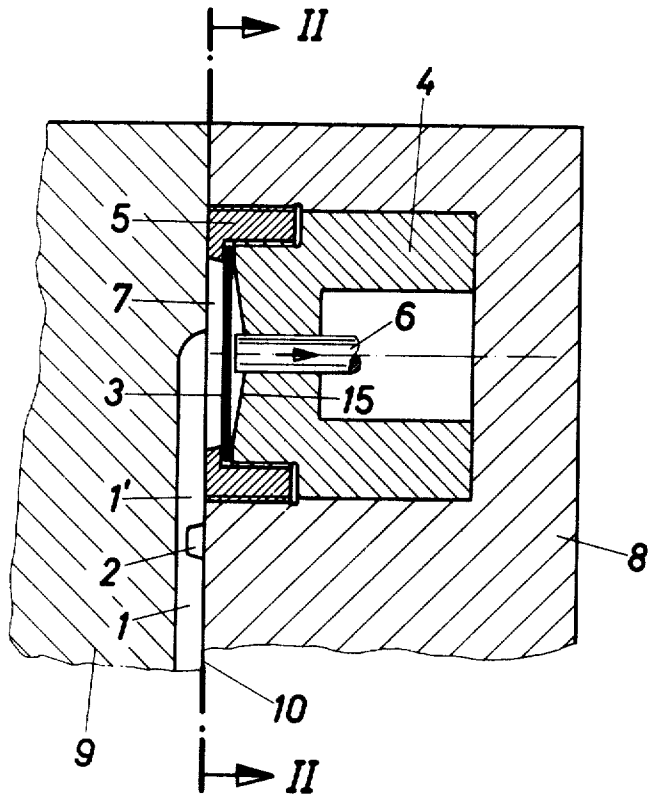


Fig.2

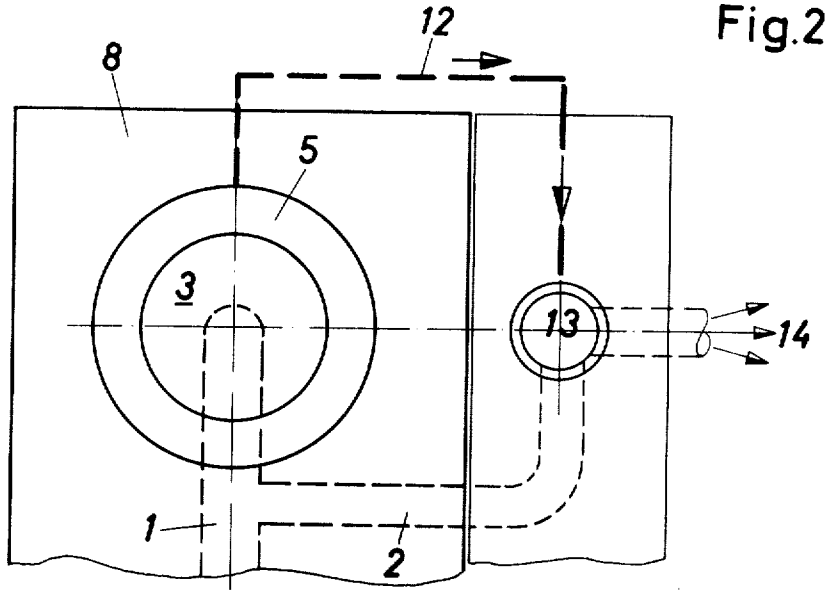


Fig. 3

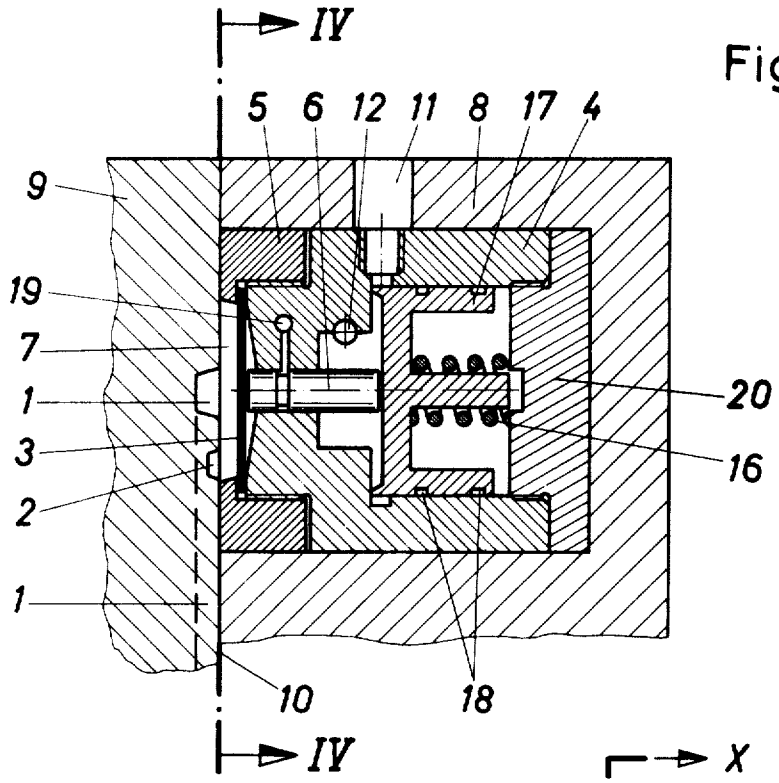
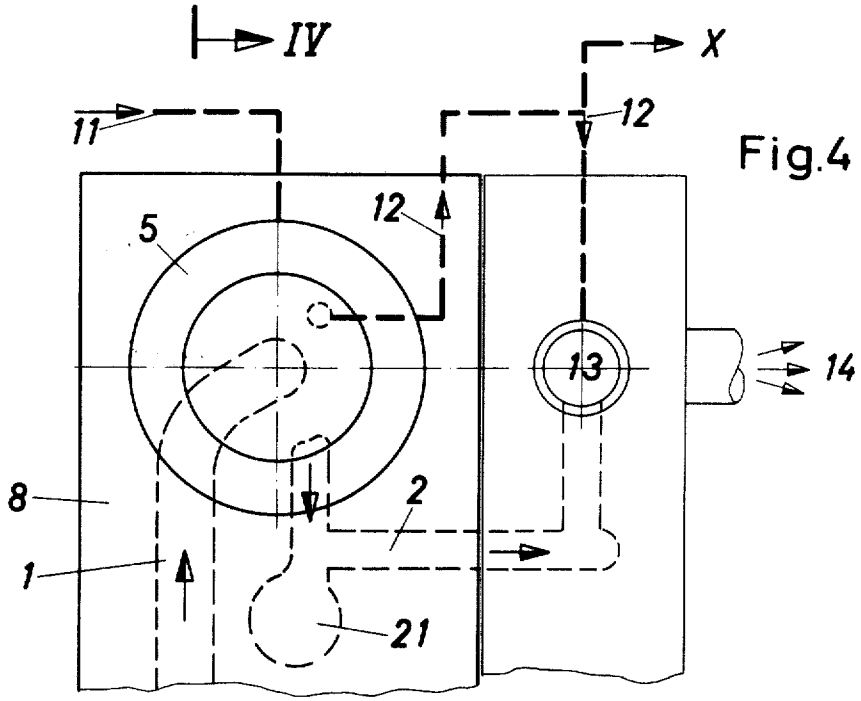


Fig.4



CASTING MOULD HAVING A VENTILATION DUCT

The present invention relates to a control device for a ventilation valve in a casting mold, e.g. for casting metal or plastics. With these valves the ventilation duct between the mold cavity and an evacuation device (or the atmosphere) is closed in dependence on the filling of the cavity. The closing of the ventilation duct is intended to prevent liquid casting material reaching the evacuation device which may comprise a special vacuum apparatus, or escaping into the free atmosphere, with which the mold cavity is connected via the ventilation duct, in order to allow the escape of the air which expels by the casting material in the mold cavity during the filling of the mold. This involves the ventilation of the mold cavity of the casting mold for as long as possible, and the closure of the ventilation duct as nearly instantaneously as possible when the cavity is full.

A method for this end has already become known in which the increase in pressure in the hydraulic working circuit of the injection piston, which increases results from the blockage of material at the gate of the ventilation duct at the end of the mold filling process, is used for a control actuator for the ventilation valve (German Pat. No. 1,249,464). This actuator, which transmits a control pulse to the ventilation valve and is designed as a valve, must be exactly regulated for the actuation of the ventilation valve in order to maintain the ventilation of the mold cavity for as long as possible without, however, risking the penetration of casting material through the ventilation duct to the evacuation device. This exact regulation of the control valve is not easy and above all in such casting molds as those in which casting material flows into the ventilation duct, difficulties are involved not after the filling of the mold has been concluded, but rather during the filling of the mold.

In the case of another known control device of the type already referred to, a thermocouple is provided as a pulse transmitter for controlling the ventilation valve (German Pat. Specification No. 1,174,945). This control device also fails to work with sufficient rapidity as a result of the fact that the thermo-electric current is not produced instantaneously. In the case of another known control device an electric contact is provided in the ventilation duct instead of the thermocouple, and this sends a control pulse to the ventilation valve. As the parts of the mold generally need to be lubricated after each cast piece has been ejected, a cloud of vapor is formed at the electrical contact and this prevents the instantaneous giving off of pulses with the result that this then takes place either erratically or too late.

In the case of a further known control device of the type already referred to, the device for giving off pulses for the control of the ventilation valve is a control piston located in the ventilation duct upstream of the ventilation valve, this being actuated by the pressure of the liquid casting material and thus actuating the ventilation valve via power transmission means (Swiss Pat. No. 306,274). With this type of construction, however, there is the disadvantage that the control piston of the control valve sliding in a cylinder can be jammed in the cylinder by means of molten metal forced between the wall of the cylinder and the piston and by the accumulation of "metal fins" formed by this metal, and as a result it may only be removed from the cylinder by dint

of blows with a hammer and subsequent cleaning. As a result of the high temperature generally occurring in casting work and also the high pressure peaks in the casting system which result from sudden braking of the flow of liquid casting material at the end of the filling of the mold, and also as a result of the aggressive nature of the casting material vis-a-vis the walls of the piston and cylinder, such penetration of metal between cylinder and piston occurs even if there is a play of les than 0.01 mm there between.

The object forming the basis of the present invention is therefore, in the case of a control device of the type referred to initially, to remove the disadvantages which have been described, i.e. to guarantee instantaneous actuation of the ventilation valve without the need for an exact and complicated adjustment of an existing pulse transmitting device and avoiding the danger of inability to function as a result of liquid casting material penetrating between moving parts in the form of "fins."

The present invention provides a casting mold having a ventilation duct, a ventilation valve in the duct, a recess in communication with the mold cavity, a pressure-sensitive membrane forming part of the wall of the recess, and actuation means responsive to flexion of the membrane, under the influence of the pressure of casting material entering the recess, to initiate closure of the valve.

The actuating means may operate mechanically, pneumatically, hydraulically, and/or electrically. In this way, a sufficiently great control force can be provided for the actuation of the ventilation valve in the shortest time, e.g. for closing the ventilation valve with a temporal accuracy of less than 0.001 seconds. It is possible by this means to keep the ventilation duct open until the last possible moment in order to ensure a substantially complete evacuation in the mold cavity.

The recess communicating with the mold cavity and having a membrane as a lateral wall may be completely independent of the ventilation duct, and may comprise, for example, a chamber adjacent to the mold cavity or a special duct attached to this cavity. If the membrane is arranged adjacent to the ventilation duct, this duct is expediently widened in the region of the membrane to form a pressure area. In this case the ventilation duct should additionally have in the part between the membrane and the valve outlet, at least locally, a smaller flow cross-section at any point in the part between the membrane and the mold cavity.

As a result of the high pressure forces reaching the membrane and acting thereon through the casting material it is advantageous to provide a rigid support surface for the depressed membrane on that side of the membrane remote from the recess.

It is preferable for the membrane to be arranged in the casting mold in such a way that the plane of separation of the parts of the mold lies adjacent to the recess, the membrane extending substantially parallel to the plane of separation. This makes it possible to free the membrane and the recess of solidified casting material after each casting process.

The invention will be further described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 shows a cross-section through part of a casting mold with a control device for a ventilation valve;

FIG. 2 shows a section along line II-II of FIG. 1;

FIG. 3 shows a cross-section through one part of a casting mold with another embodiment of the control device; and

FIG. 4 shows a section along line IV-IV of FIG. 3.

In the embodiment shown in FIGS. 1 and 2, one half 9 of the casting mold contains a ventilation duct which consists of two branches 1, 2 and leads to an evacuation device or into the free atmosphere, while the other half 8 of the mold contains the control device for a ventilation valve 13 arranged in the ventilation duct. In this case the arrangement of the ventilation duct in the half 9 of the mold is such that one side of the duct coincides with the plane of separation 10 of the two halves 8, 9 of the mold. The branch 1, which comes from the mold cavity, discharges into a recess 7 in the other half 8 of the mold, whereas the branch 2 branching off therefrom previously leads via the ventilation valve 13 to the evacuation device or the free atmosphere 14. The recess 7 has a circular shape in a section extending parallel to the plane of separation 10 and is limited at the side lying opposite the discharge of the branch 1 of the ventilation duct by a pressure-sensitive membrane 3 which is held at its periphery in the plane of the surface of the membrane between a bearing member 4 and a securing ring 5 screwed onto it. The holding force should be such that the membrane can move if there is a thermally-produced change in its radial measurement, without allowing liquid casting material (molten metal) to pass between the membrane and securing ring, and that when impingement of pressure of the liquid casting material reaching into recess 7 has been completed, the membrane may revert to the flat initial position shown in FIG. 1 without permanent deformation.

The branch 2 of the ventilation duct has at least locally a smaller cross-section than the branch 1 of this duct leading to the recess 7, so that liquid casting material may pass, in dependence on the filling of the mold cavity, into the recess 7 where it may exert a cumulative pressure on the membrane 3. The membrane 3 bulges to the right (in the drawing) as a result of this pressure until it comes to rest against the support surface 15 of the bearing member 4. In doing this the membrane 3 displaces a push-rod 6 arranged coaxially in the bearing member 4, this serving to open a hydraulic or pneumatic valve, to close an electrical contact, or to actuate a lever system, as the result of which the closure of the ventilation valve is initiated.

In FIG. 2 the broken line diagrammatically represents the power transmission system which, as a result of the displacement of the rod 6 by the membrane 3 when the pressure of the casting material impinges on it, initiates the closure of ventilation valve 13 in order to close ventilation ducts 1, 2 and prevent liquid casting material spurting out via the air outlet and reaching the evacuation device of the atmosphere.

The embodiment of the control device according to the invention shown in FIGS. 3 and 4 differs from that in FIGS. 1 and 2 in only a few characteristics. The same reference numerals are used for features which are precisely the same in both embodiments.

One essential difference resides simply in the fact that the recess 7 which contains the membrane 3 as a lateral wall forms a connection between the branch 1 emerging from the mold cavity and the branch 2 of the ventilation duct leading to the ventilation valve 13, with the result that casting material which penetrates into duct branch 2 must in every event travel past the pressure-sensitive membrane 3. The membrane which is housed in the same way as in the embodiment according to FIGS. 1 and 2 is also subjected to a change of shape and to bulging if it experiences, by means of the casting material in the recess 7, a unilateral impingement of pressure, so that it moves the displacement rod 6 to the right in the same way. In this case this rod 6 displaces - against the action of a compression spring 16 - a valve body 17 (this being in the form of the piston of a pneumatic or hydraulic control valve for the ventilation valve 13), as a result of which the connection between a conduit 11 coming from a source of pressure medium and a conduit 12 for conducting the pressure medium to the ventilation valve 13 is opened, this serving to control the ventilation valve. The initial stress on the compression spring 16 may be adjusted by means of a bolt 20. In order to guarantee adequate sealing between the valve piston 17 and the cylinder wall of the bearing member 4, grooves 18 for receiving seals are provided on the periphery of the piston. Pressure medium passing between the displacement rod 6 and the wall of the bore in the bearing body 4 may escape into the atmosphere via leakage air conduit 19, with the result that bulging of the membrane 3 is not obstructed.

In FIG. 4 the branch X from the pressure medium duct 12 indicates that a plurality of ventilation valves 13 may be actuated at one and the same time by the control device.

It is possible to attach to the branch 2 of the ventilation duct leading from recess 7 to the ventilation valve 13, a chamber 21 which serves to hold up the flow of liquid casting material to the ventilation valve 13. Such a chamber 20 may also be provided in the case of the embodiment of FIGS. 1 and 2 in the duct branch 2.

It may be expedient under certain circumstances and as a variation of the two embodiments shown, to arrange or subject to initial stress the membrane 3 in its initial position where it is not impinged upon by casting material in such a way that it bulges out into the recess 7. In this case it may be sufficient if the membrane is pressed flat or approximately flat by the impingement of pressure caused by the casting material in the recess 7, the bearing surface 15 of the bearing body 4 similarly requiring modification in the light of this.

In view of the temperatures acting upon it by means of the liquid casting material the membrane preferably comprises heat-resistant steel. Its thickness preferably increases towards the center point of the membrane. Because of the large diameter of the valve body 17 it is sufficient if the membrane is subjected in its central zone to a movement of only 0.2 mm in the direction of the axis of the membrane in order to release a sufficient quantity of compressed air (pressure medium) for the rapid closure of the ventilation valve. In this case the membrane is subjected to only a very low degree of bending with large bending radii, as a result of which the stress on the membrane remains extra-ordinarily slight.

The control devices described above ensure that the closure of the ventilation duct by the ventilation valve can take place at the optimum time, for example, only when the liquid metal has already completely filled the mold cavity, without thereby necessitating a large expense in terms of devices or a cumbersome exact adjustment, which is difficult to carry out, of the control member by means of specialists. In addition the config-

uration is such that collection or penetration of metal fins between parts of the control device which are in relative motion is excluded to a large extent or totally.

I claim:

1. A casting mold having a ventilation duct, a ventilation valve in the duct, a recess in communication with the mold cavity, a pressure-sensitive membrane forming part of the wall of the recess, and actuating means responsive to flexion of the membrane, under the influence of the pressure of casting material entering the recess, to initiate closure of the valve.

2. A mold as claimed in claim **1,** in which the membrane being arranged in an extension of the ventilation duct.

3. A mold as claimed in claim **1,** in which the membrane is held in a liquid-tight but movable manner at its periphery.

4. A mold as claimed in claim **1,** including, adjacent to and spaced from the side of the membrane which is remote from the recess, a rigid support surface for supporting the depressed membrane.

5. A mold as claimed in claim **1,** in which the actuating means includes a displacement member adapted to be displaced by the membrane during deformation, the said member being adjacent to the side of the membrane which is remote from the recess.

6. A mold as claimed in claim **5,** in which the actuating means further comprises a pneumatic control valve having a displaceable valve body arranged to be displaced by the displacement member.

7. A mold as claimed in claim **6,** in which the valve body has the same direction of movement as the displacement member and is urged into the closed position against the action of the displacement member.

8. A mold as claimed in claim **1,** in which the membrane, when not subjected to the pressure of the casting material, bulges into the recess.

9. A casting mold having a ventilation duct, a ventilation valve in the duct, a recess in communication with the mold cavity, a pressure-sensitive membrane forming part of the wall of the recess, and actuating means responsive to flexion of the membrane, under the influence of the pressure of casting material entering the recess, to initiate closure of the valve, the recess being in communication with the mold cavity via the ventilation duct, the ventilation duct has in the part between the recess and the valve outlet at least locally a smaller flow cross-section than at any point between the recess and the mold cavity.

10. A casting mold having a ventilation duct, a ventilation valve in the duct, a recess in communication with the mold cavity, a pressure-sensitive membrane forming part of the wall of the recess, and actuating means responsive to the flexion of the membrane, under the influence of the pressure of casting material entering the recess to initiate closure of the valve, wherein the mold is in two parts having a plane of separation, the recess being directly adjacent to this plane, and the membrane extending substantially parallel to this plane.

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