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Giehler

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[54] **DEVICE FOR MAKING HOLLOW BODIES FROM THERMOPLASTIC MATERIAL BY ROTATION-MELTING**

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[58] **Field of Search** 425/435, 425; 432/120; 264/310

[56] **References Cited**

UNITED STATES PATENTS

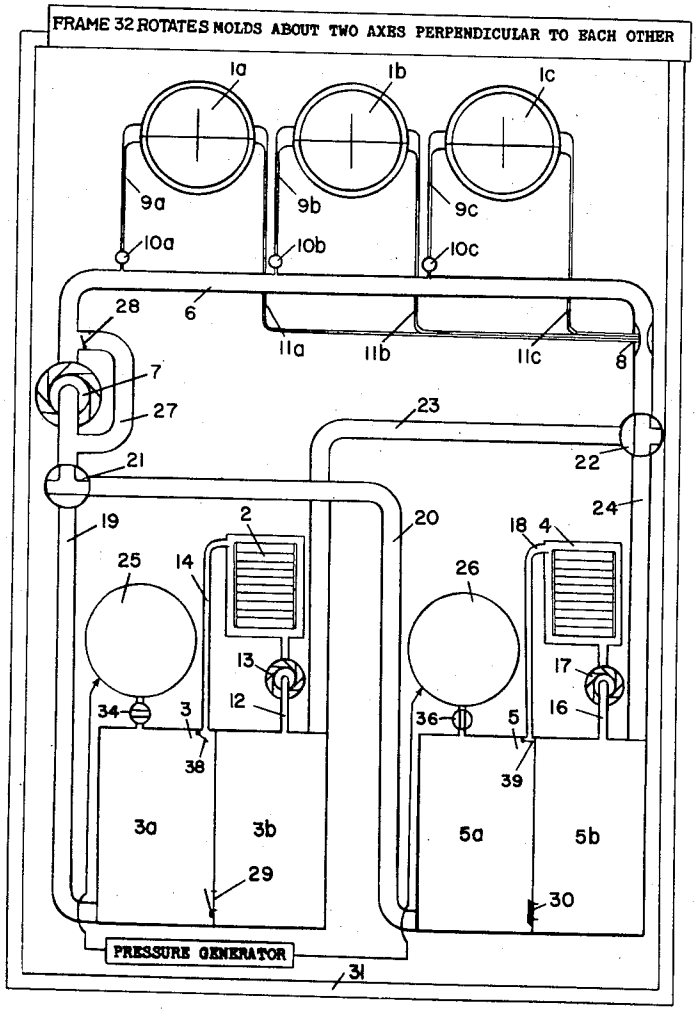
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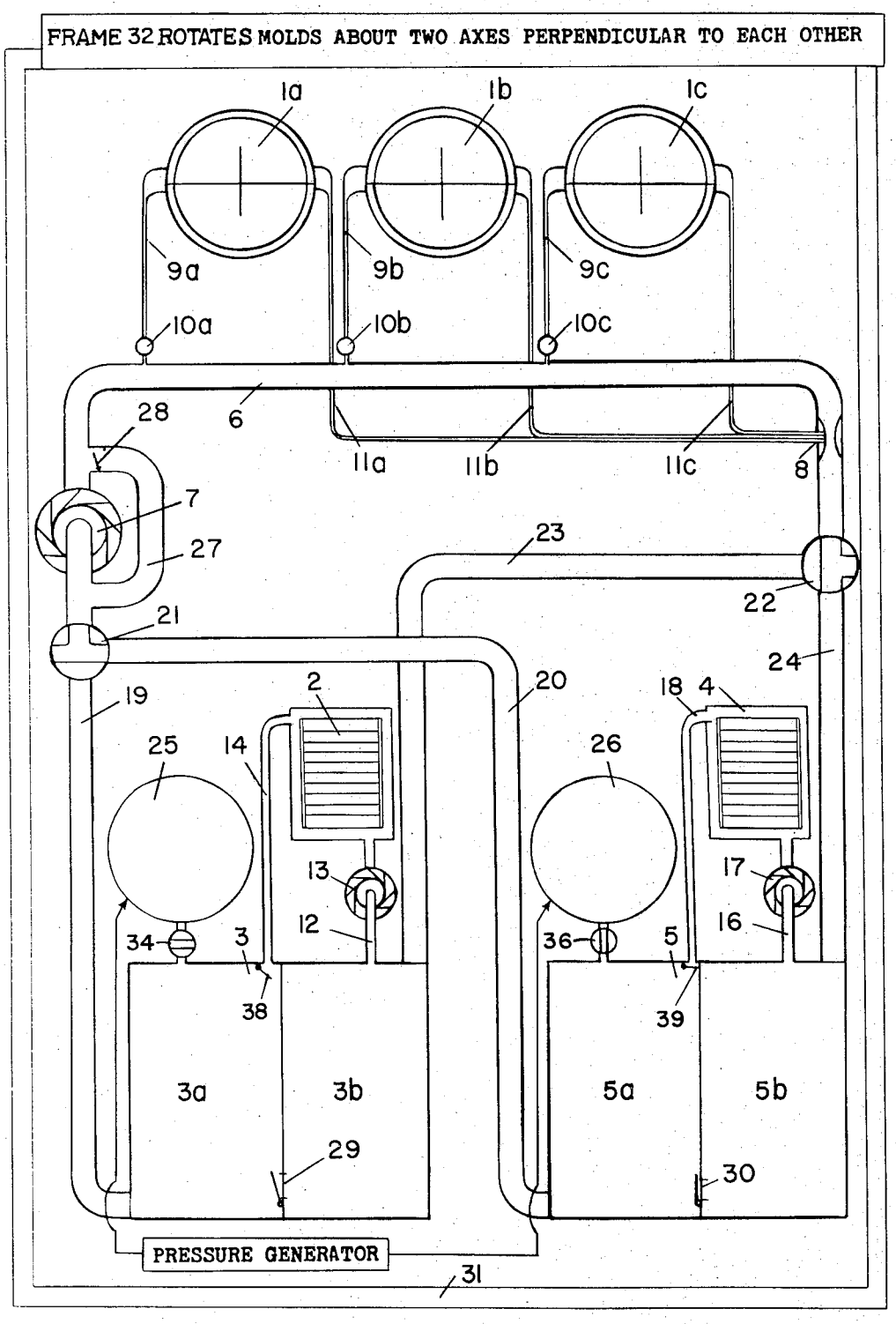
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[57] **ABSTRACT**

A device for making hollow bodies from thermoplastic material by rotation-melting, wherein either one or several hollow molds which are to be filled partially with fluid or easily pourable plastic and which are composed of two mold halves, are rotatably positioned within a frame or base about two axes preferably position at right angle with respect to each other and are selectively heated or cooled controllably during the rotation, by means of a fluid heat transfer medium.

2 Claims, 1 Drawing Figure




FRAME 32 ROTATES MOLDS ABOUT TWO AXES PERPENDICULAR TO EACH OTHER
1a
1b
1c
9a
9b
9c
10a
10b
10c
6
28
11a
11b
11c
8
7
27
23
22
21
24
20
19
2
18
4
25
14
26
13
17
12
16
34
3
36
5
38
39
3a
3b
5a
5b
29
30
PRESSURE GENERATOR
31

DEVICE FOR MAKING HOLLOW BODIES FROM THERMOPLASTIC MATERIAL BY ROTATION-MELTING

DESCRIPTION OF THE PRIOR ART

Known in the art is a device of the type described hereinabove in which the hollow molds are provided double-walled and the hollow spaces or cavities in the mold walls are traversed by an oil being adjusted to a specific temperature for either heating or cooling the molds. The oil circulates in two cycles, namely a heating cycle and a cooling cycle, which are selectively passed over the molds, depending upon whether the molds are intended to be heated so as to melt the plastic which is to be treated or processed therein, or cooled in order to harden the finished molded plastic objects. It is important in this connection that, within the area of the molds, there must be neither an excess or positive pressure, nor a negative or underpressure in the oil steams respectively passed over the molds. In order to avoid such differential pressures two conduit-feed pumps have heretofore been installed in each of the two oil cycles, namely one for the forward movement flow or stroke, i.e. into the line from the oil reservoir to the molds, and another one for the return movement or stroke, i.e. into the line from the molds to the oil reservoir. Both of the pumps must be adjusted precisely with respect to each other in the feed performance, and specifically in such a manner that the excess pressure in the forward movement and the underpressure in the return movement will cancel each other out within the area of the molds.

This particular arrangement has several significant disadvantages. Apart from the fact that two pumps are more expensive, than one larger pump would be, a greater precision is required in order to achieve a sufficiently uniform delivery from both pumps. As a result, the device becomes more expensive. In addition thereto, however, the susceptibility to disturbances is increased. When only one pump breaks down, the device already becomes inoperative. When the disturbance or fault in the pump is located in the return movement or stroke, the damage possibly is not limited only to the production or delivery stoppage of the device.

Damages to or even the destruction of the molds also may occur because in such an instance an excess pressure will prevail in the area of the molds. In order to prevent such occurrence as well, the prior art provides an additional device which, in case of the breakdown or failure of one pump, simultaneously cuts off also the second pump of the same circular conduit.

THE OBJECTS OF THE INVENTION ARE

to improve the device of the prior art for making hollow bodies from thermoplastic material by rotation-melting;

to reduce to a minimum the susceptibility to disturbances in the feed device for the heat transfer agent, for example an either hot or cold oil, which flows through the molds alternately for purposes of heating or for cooling;

to speed up the alternations of the heat transfer agent between the heating phase and the cooling phase so that they take place as rapidly as possible;

to shorten thereby as much as possible the various shaping or molding operations;

to make, after each completed alternation or change respectively, the flow velocity of the heat transfer agent through the mold walls only as high as is necessary for keeping the respectively set temperature in the walls of the mold constant;

and to provide the apparatus described and particularly the feed system for the heat transfer agent thereof preferably with a single pump only in a design which is cheaper to make and simpler in its operation and maintenance than the comparable devices of the prior art.

BRIEF DESCRIPTION OF THE DRAWINGS

The sole FIGURE of drawings is a view, partly in crossection, of a preferred embodiment of the apparatus of the invention.

DESCRIPTION OF THE BASIC PRINCIPLES OF THE APPARATUS

The present invention provides a device for making hollow bodies from thermoplastic material by means of rotation-melting.

Either one or several hollow molds are to be filled partially with fluid or easily pourable plastic. The molds are composed of two mold halves and are rotatably positioned within a frame or base about two axes perpendicular to each other. This structural arrangement is conventional in the art as exemplified by the disclosure of U.S. Pat. No. 3,454,988. The walls of the molds have continuous hollow chambers or cavities provided with pipe connections. During the rotation the molds are adapted to be selectively either heated or cooled by means of heat transfer medium, such as oil, which flows through the cavities in the mold walls.

The apparatus comprises one line with a reservoir containing a heated oil cycle and another line with a reservoir containing a cooled oil cycle. These two lines are adapted to be connected selectively to the cavities in the mold walls.

Along the molds there extends a mold feed pipe line for the purpose of charging the molds with tempered oil. The mold-feed pipe line is connected at the forward stroke side with at least one forward stroke branch pipe for each of the molds. At least one Venturi tube is provided in the return stroke side part of the mold-feed pipe line. In the underpressure zone of each Venturi tube terminates one return movement or stroke connection from either one or several molds.

The mold-feed pipe line is connected at the forward stroke side end thereof by means of a forward three-way valve with a flow line from the reservoir with the heated oil and with a flow line from the reservoir with the cooled oil and, with the return stroke side end thereof via another, a return three-way valve, with two return pipes, one of which extends into the reservoir with the heated oil and the other one of which extends into the reservoir with the cooled oil.

Between the forward stroke side end of the mold-feed pipe line and the forward stroke branch pipe which is positioned closest to the first mold, is a mold-feed pump in the mold-feed pipe line. The feed performance or delivery of the mold-feed pump is greater than is necessary merely for feeding and flushing the mold walls. A throttle is mounted in each of the for-

ward stroke branch pipes extending from the feed pipe line toward the molds.

In order to carry out the oil changes with the utmost speed the reservoirs for the heated oil and the reservoir for the cooled oil are subdivided each into two chambers, one of which feeds the forward stroke and the other one of which absorbs the return stroke or flow. Both chambers of one reservoir are interconnected by an opening adapted to be closed and/or by means of an overflow. From the chamber absorbing the return stroke or flow, a pipe line extends toward the oil heating means and, respectively, the oil cooling means, whereas the pipe line from the oil heating means, and, respectively, the oil cooling means terminates into the chamber feeding the forward stroke.

A pressure reservoir, containing, for example, a highly compressed gas, is connected with each of the chambers of the two oil reservoirs feeding or supplying the forward stroke. In the mold-feed pipe line a by-pass line with a check valve is mounted extending past the mold-feed pump.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be explained hereinafter in further detail on the basis of the sole FIGURE of drawings.

The inventive device comprises a housing **31** with a conventional frame **32** in which at least one mold is mounted rotatably in two axes. For practical purposes, however, three molds **1***a*, **1***b*, and **1***c* are shown. These are provided with a hot oil cycle system with an oil heating means **2** and a hot oil reservoir **3**, and a cool oil cycle system with an oil cooling means **4**, and a cool oil reservoir **5**. Through a mold-feed pipe line **6** a mold-feed pump **7** supplies oil to the molds. Each mold has a forward flow or stroke side.

The mold-feed pipe line extends along the molds **1***a*, **1***b*, **1***c* in tandem. In the forward stroke side part thereof with respect to each mold, a forward stroke branch pipe **9***a*, **9***b*, **9***c* branches off toward the respectively adjacent mold. Provided in each of these branch pipes is a throttling means **10***a*, **10***b*, **10***c* for purposes of reducing the pressure in the branch line. Disposed close to the return stroke side thereof in the mold-feed pipe line is a Venturi tube **8**.

From each mold one return stroke connection **11***a*, **11***b*, **11***c* extends toward the feed pipe line **6** where it terminates in the underpressure zone of the Venturi tube.

Each of the oil reservoirs **3** and **5** respectively, is subdivided into two chambers **3***a*, **3***b*, **5***a*, **5***b*, which are interconnected by means of closable openings **29** and **30** respectively. The forward stroke is in each case supplied from one forward stroke hot or cold chamber **3***a* and **5***a*, respectively, whereas the return stroke hot or cold chamber **3***b* and **5***b*, respectively absorbs the oil returned from the mold-feed pipe line **6**. From the hot return chamber **3***b* which absorbs the return stroke or flow of the hot oil cycle, a heater pump pipe line **12** with a heater feed pump **13** connects with an oil heater **2** which in turn, connects through a heater pipe line **14** via check valve **38** with the hot forward chamber **3***a* feeding or supplying the forward stroke of the hot oil cycle. From the cold return chamber **5***b* absorbing the return stroke of the cool oil cycle a cold pump pipe line **16** with a cold feed-pump **17** extends toward an oil cooler **4** which in turn is connected by means of a cold pipe line **18** via check valve **39** with the chamber **5a** feeding or supplying the forward stroke of the cool oil cycle.

The hot forward stroke chamber **3***a* of the hot oil reservoir **3** and the cold forward stroke chamber **5***a* of the cool oil reservoir **5** are jointly connected by means of one joint pipe line each, hot or cold **19** and/or **20**, via a first three-way valve **21** with the forward stroke side end of the feed pipe line **6**, whereas the return stroke side end of the feed pipe line **6** is connected via the second three-way valve **22** in to the return stroke chambers **3b** and **5b**, respectively, of the oil reservoirs by means of hot return stroke pipe line **23** and/or cold return stroke pipe **24**.

Coordinated to the forward stroke chambers **3a** and **5a** of the oil reservoirs **3** and **5** is a heater pressure reservoir **25** and a cooler pressure reservoir **26**, each containing a highly compressed gas. Also disposed at the same time in the mold-feed pipe line **6** is a by-pass pipe line **27** with a by-pass check valve **28** extending past the mold-feed pump **7**.

THE OPERATION OF THE APPARATUS OF THE PRESENT INVENTION

Once the molds **1***a*, **1***b*, **1***c* have been filled with plastic and closed, the two three-way valves **21** and **22** are so set that the mold-feed pipe line **6** is connected with the hot reservoir **3**. At the beginning of the rotation of the mods **1**, **1***b*, **1***c* the mold-feed pump **7** in the mold-feed pipe line **6** is switched to full or maximum delivery. The throttles **10***a*, **10***b*, **10***c* in the forward stroke branch line **9***a*, **9***b*, **9***c* towards the molds are so adjusted that the excess pressure existing in the forward stroke and the underpressure being produced by the Venturi tube **8** in the return stroke connections **11***a*, **11***b*, **11***c* between the molds and the mold-feed pipe line **6**, will cancel each other out, or balance each other in the area of the molds. It is therefore immaterial at which delivery or feed performance the feed pump **7** operates, for with each change of the excess pressure in the forward stroke, the underpressure in the return stroke also will be changed accordingly by virture of the Venturi tube depending in the efficacy thereof upon the flow in the feed pipe line.

At the beginning of a heating and, respectively, cooling phase, the respective pressure reservoir **25** and/or **26**, each equipped with a valve **34** and **36**, respectively, is opened toward the corresponding storage reservoir **3***a* and/or **5***a*, at which time the connection between the two chambers of the corresponding reservoir will be closed. The pressure of the pressure reservoir **25** and/or **26** now acting upon the oil of the forward stroke chamber **3***a* and/or **5***a* supports the mold-feed pump **7** in the mold-feed pipe line **6**, whereby oil will additionally be guided past the feed pump **7** through the mold-feed by-pass pipe line **27**. The oil change in the molds is thereby accelerated. As soon as the pressure supply of the pressure reservoir is exhausted, the check valve **28** in the by-pass line **27** will be closed. The mold-feed pump **7** in the feed pipe line **6** now alone assumes and handles the further continuation of the oil circulation.

As soon as, after oil change, the molds are completely traversed with hot and/or cold oil, the output or performance of the feed pump **7** may be reduced to

such an extent that it will just about suffice for maintaining the present temperature.

When the heating phase has been completed, the cooling phase will be initiated by changing over the two three-way valves **21** and **22,** but not simultaneously. The forward stroke valve **21** will be changed first, and only afterwards the return stroke valve **22.** As a result thereof, the hot oil still contained in the molds will to a large extent flow back into the hot oil storage reservoir **3** instead of becoming mixed with the cool oil. An analogous procedure will take place also with the next initiation of the heating phase.

The application of the present invention is not limited to the embodiment described herein. It is not absolutely mandatory that the oil storage containers be subdivided into two chambers each. On the other hand, slight temperature varaiations in the rhythm of the alternating phases cannot be avoided in that case. It is also not absolutely necessary that pressure reservoirs be coordinated to the forward stroke chambers of the oil supply reservoirs. In that case, however, the oil changes cannot be carried out as rapidly.

Finally, variations are possible with respect to the arrangement of the forward stroke branch lines at the feed pipe line, as well as with respect to the number and the arrangement of the Venturi tubes in the feed pipe line. Thus it is possible, for example, to combine the forward stroke branch lines for all the molds in one starting point, in which case only one throttle regulates the flow in all of the forward stroke branch lines whereas, on the other hand, one Venturi tube is disposed opposite each mold in the feed pipe line, and in the underpressure zone thereof there terminates in each case a return stroke connection coming from the adjacent mold.

The pressure reservoirs **25** and **26** are to be connected to a pressure generator **34** by means of which pressure gas losses can be compensated for.

While oil has been mentioned throughout the specification as the heat exchange medium, the invention encompasses the use of other equivalent materials.

I claim:

1. A device for making hollow bodies from plastic material comprising:

a frame;

at least one hollow rotatably mounted mold unit being partially filled with a charge of fluid plastic and including two mold halves, each of said mold halves having continuous wall means, each of said continuous wall means surrounded by a continuous cavity;

means including a forward flow stroke branch pipe operatively connected to said continuous cavities and a throttling means operatively mounted in said forward flow stroke branch pipe;

means including a return flow stroke pipe operatively connected to said continuous cavities;

a feed pipe line operatively connected with said forward and return flow pipes;

a Venturi tube being provided in said return flow pipe on the return stroke side of said feed pipe line;

a reservoir of heated oil;

said feed pipe line being operatively connected at the forward stroke side end by a forward three-way valve with a flow pipe line to said heated oil reservoir;

a reservoir of cooled oil;

said feed pipe line being operatively connected with a flow pipe line from said cooled oil reservoir and with the return stroke side end thereof via another three-way valve with two return pipes;

one of said two return pipes extending into said heated oil reservoir and the other one extending into said cooled oil reservoir;

an excess capacity feed pump located in said feed pipe line between the forward stroke side end of said feed pipe line and the forward stroke branch pipe;

each of said heated and cooled oil reservoirs being subdivided into two chambers, one of which feeds the forward stroke and the other one of which absorbs the return stroke, both chambers of each reservoir being interconnected by a valve means;

each of said chambers absorbing the return stroke having operatively connected therewith a pipe line means extending to an oil heating means, and respectively, an oil cooling means;

whereas the pipe line means extending from oil heating means, and respectively, from said oil cooling means terminating into the said chamber feeding the forward stroke; and

a compressed gas pressure reservoir means being connected with each of said chambers of said heated and cooled oil reservoirs feeding the forward stroke;

said mold unit being adapted to be selectively heated and cooled by the respective heating and cooling oil which flows from said heated and cooled oil reservoirs to said continuous cavities.

2. A device for making hollow bodies from plastic materials by rotation-melting, requiring a heating and/or a cooling cycle, comprising:

a housing;

at least one hollow mold means for containing a plastic charge within, supported in said housing and composed of two mold halves, each of said mold halves having a continuous wall, said mold means adapted to be rotatably mounted with said housing for rotation about two axes, perpendicular to each other;

said hollow mold means including a continuous cavity surrounding the continuous wall of the mold means and having inlet forward flow and outlet return flow orifices and at least one respective forward and return flow branch for the flow of a heat exchange medium through said cavity;

at least one reservoir, having multi-chambers for receiving a hot medium, said hot medium reservoir having a hot feed pipe line and at least one return stroke hot connection, said hot feed pipe line connected with the respective forward flow branch;

at least one reservoir, having multi-chambers for receiving a cold medium, said cold medium reservoir having a cold pipe line and a return stroke cold pipe;

each of said respective multi-chambered hot and cold medium reservoirs including two interconnected chambers, one of which operatively feeds the forward stroke and the other one of which operatively absorbs the return stroke;

a Venturi tube mounted in the return stroke cold pipe;

said return flow branch connected in the underpressure side of said Venturi tube to said hot feed pipe line;

a pump connected to said hot feed pipe line in advance position to a forward flow branch;

a hot pipe connected to said hot medium reservoir;

a forward three-way valve connected between said hot pipe, said circulating pump and said cold pipe line leading to said cold medium reservoir;

a return three-way valve connected between said Venturi tube, said cold medium reservoir and said hot medium reservoir;

said pump having a delivery capacity in excess of that required for heating and cooling said mold cavity; and

a throttle mounted in said forward flow branch;

the flows of said heated and cooled medium through said continuous cavity in said mold means being selectively provided at a controlled temperature and at a constant pressure.

* * * * *