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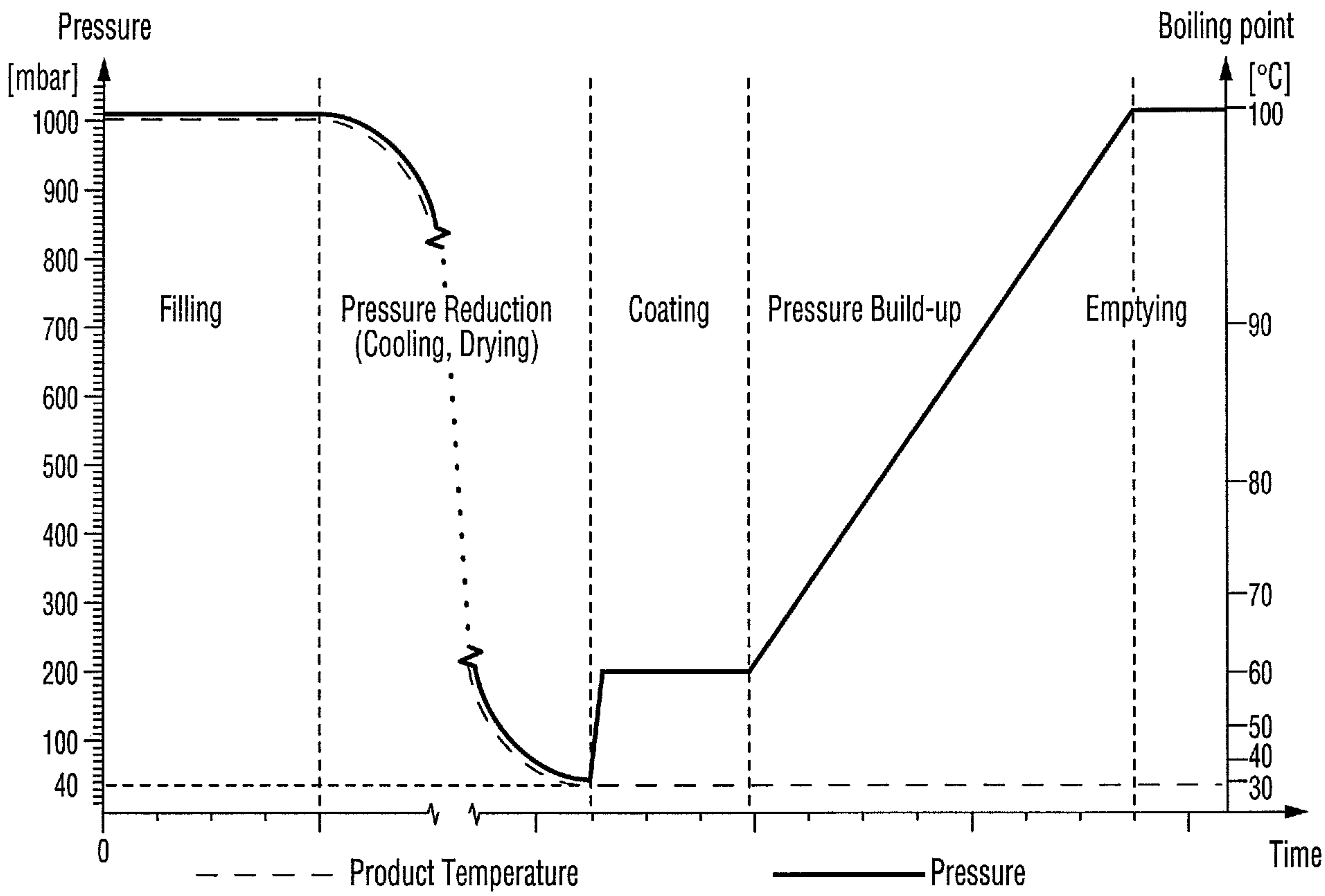
(54) Title: PROCESS FOR THE VACUUM COATING OF AN EXTRUDED MATERIAL



(57) Abrégé/Abstract:
A process for the vacuum coating of an extruded material, particularly (animal) food, in which the extruded material is coated with a flowable coating material during a vacuum phase and under reduced pressure, which is characterized in that the extruded material, during the vacuum phase, is initially dried and then coated with the coating material is provided.

ABSTRACT

A process for the vacuum coating of an extruded material, particularly (animal) food, in which the extruded material is coated with a flowable coating material during a vacuum phase and under reduced pressure, which is characterized in that the extruded material, during the vacuum phase, is initially dried and then coated with the coating material is provided.

PROCESS FOR THE VACUUM COATING OF AN EXTRUDED MATERIAL

Field of the Invention

The invention relates to a process for the vacuum coating of an extruded material, particularly an (animal) food, in which the extruded material is coated with a flowable coating material during a vacuum phase and under reduced pressure.

Background of the Invention

In the case of numerous extruded products, particularly in the human and animal food sector, for manufacturing and product-related reasons, the need exists not to have certain constituents of the finished end product, e.g. fatty substances, in the mixture to be extruded, but to add the same only following the extrusion process, so that an extruded product serves as a carrier for the substances to be subsequently applied.

A known procedure consists of providing a product, which can be porous after extrusion, with desired constituents, in that the extrusion product is initially dried and then exposed to a vacuum, being coated under reduced pressure with a coating material, which has a flowable consistency. At the end of the vacuum phase the increasing pressure forces the coating material into any existing pores of the extruded material, so that the latter has an increased content of e.g. fat, without the latter being preponderantly located on the surface and leading to an excessive stickiness of the product. The porous, extruded product consequently in part mainly serves as a carrier for the flowable material to be added. In this way, at a vacuum of e.g. 200 mbar, fat contents of up to 30 wt.% are obtained in the end product.

It is a disadvantage of this proven coating process that the total costs for drying and coating are high and also the absorptivity of the extruded product for a coating material is not always adequate, even when using a vacuum.

Summary of the Invention

It is an object of the present invention to improve the known coating process by addressing the above-noted deficiencies, i.e. in particular to lower the drying costs and also bring about increased absorptivity for the coating material.

According to an aspect of the present invention, there is provided a process for the vacuum coating of an extruded material in which the extruded material is coated with a flowable coating material during a vacuum phase under reduced pressure wherein the extruded material is initially dried and then coated with the coating material and wherein the pressure at the start of the vacuum phase is lowered to 40 millibar and during the vacuum phase the pressure is raised to 200 millibar.

According to another aspect of the present invention, there is provided a process for the vacuum coating of an extruded material in which the extruded material is coated with a flowable coating material during a vacuum phase under reduced pressure wherein the extruded material is initially dried and then coated with the coating material and wherein during the vacuum phase the pressure is lowered to 200 millibar and then lowered to 40 millibar and wherein the pressure of 40 millibar is maintained until the extruded material has reached a temperature of 30°C or lower.

The drying of the extruded material during, instead of before the vacuum phase surprisingly leads to several advantages. Firstly, the optionally already porous, extruded material expands further as a result of the evaporation of water during the vacuum phase so that pores are produced or the pore volume is increased and a correspondingly increased absorptivity for flowable coating material is obtained. In addition, in the case of a vacuum, the drying process can be much better controlled than e.g. drying in hot air, because under reduced pressure there is evaporation of the further inwardly located material areas, which would otherwise not be accessible to contact with drying air. As a result, smaller local fluctuations of the moisture content of the product occur, so that the mean moisture content can be raised by approximately 1%, which is obviously associated with a considerable cost saving. As a result of the extraction of heat in the drying process the extruded product is simultaneously cooled, so that there is no need for a separate cooling of the material leaving the extruder at a temperature of approximately 100°C.

The coating material can contain fat and/or water.

Preferably, the extruded material is porous and expands during the vacuum phase.

Preferably, at the start of the vacuum phase the extruded material has a temperature higher than 90°C.

According to a preferred embodiment, at the start of the vacuum phase, the extruded material has a moisture content, related to its dry weight, of no more than 25 wt.%.

According to an embodiment of the invention, during the vacuum phase, the moisture content of the extruded material is lowered by 6 wt.%, based on the dry weight.

Prior to the start of the vacuum phase, the extruded material can be pre-dried at normal pressure.

Preferably, after drying and coating, the extruded material has a final moisture content of 9 wt.%, based on its dry weight. After drying and coating, the extruded material preferably has a temperature of 25°C.

During the vacuum phase the pressure can be lowered to 200 mbar.

According to an embodiment, at the start of the vacuum phase the pressure is lowered to 40 mbar. The pressure can be kept at 40 mbar until the extruded material reaches a temperature of 30°C or lower.

The vacuum phase can last up to 5 minutes.

During the vacuum phase, it is possible to supply additional energy, particularly in the form of infrared or microwave radiation.

Brief Description of the Drawings

Further advantages and features of the invention can be gathered from the following description of preferred embodiments with reference to the attached drawings, wherein show:

Fig. 1 In exemplified manner, the time behaviour of product temperature and pressure in an embodiment of the process according to the invention.

Fig. 2 In exemplified manner, an arrangement for performing the process according to the invention.

Fig. 3 In a similar representation to Fig. 1, the time behaviour of product temperature and pressure in a known process.

Detailed Description of the Invention

Reference is firstly made to Figs. 2 and 3 in order to illustrate the known procedure. A mixture to be extruded passes into the extruder 1 (arrow 2) and leaves it at its discharge opening 3 at a temperature of approximately 100°C. Based on the dry weight of the extruded product, the moisture content at this point is approximately 25%. The extruded product is then dried in a drier 4 until, after coating in a mixer 5, it has a moisture content, based on the dry substance, of 9 wt.% and a temperature of 25°C. The moisture content to be obtained at the drier outlet is dependent on the particular coating material used for coating the extruded material in the mixer 5, i.e. on its water content. For example, when coating with an aqueous coating material a moisture content of 6 wt.% may be necessary at the drier outlet, in order to arrive at a final moisture content of 9 wt.%. Conversely when coating with a coating material containing little or no water, e.g. a fatty substance, it may be admissible to have a higher moisture content than 9% at the outlet of the drier 4 or on entering the mixer 5, because the moisture percentage, based on the dry weight, decreases when an anhydrous substance is applied.

Fig. 3 illustrates the time sequence of the processes during vacuum coating within the mixer 5 in accordance with the prior art. Extruded, dried, porous material cooled to approximately 30°C (below 50°C) is filled under ambient pressure into the mixer 5, whose charging opening is directed upwards (left-hand mixer representation in Fig. 2). The filling opening is closed and the internal pressure is lowered within a relatively short time of approximately 1.5 minutes to approximately 200 millibar. Previously, subsequently or simultaneously coating material is fed into the mixer and the extruded material is mixed therewith. The pressure in the mixer is then increased again to ambient pressure, the coating material being forced deeply into the porous cavities of the extruded material. As shown in Fig. 3, throughout the process the product temperature remains almost unchanged at approximately 30°C, which corresponds to the filling or charging temperature.

Compared with this prior art, the process according to the invention differs in that the extruded product, which leaves the extruder 1 at its discharge opening with a temperature of approximately 100°C, is initially not cooled and is passed into the mixer 5 at approximately 95°C (as a result of the unavoidable transporting path the extruded product temperature decreases by approximately 5°C). This is further illustrated in Fig. 1, which in a similar manner to Fig. 3 shows the time behaviour of the product temperature and pressure during the coating and mixing process. It is also pointed out that on the right-hand side of Figs. 1 and 3 is plotted the boiling point of water, which corresponds to the pressure on the left. Thus, 200 mbar correspond to a boiling point of approximately 60°C and 40 mbar to approximately 30°C, etc.

The extruded, porous material passes more or less directly out of the extruder into the mixer, the temperature being almost 100°C. After closing the mixer, the pressure is lowered to approximately 200 mbar, or as shown in Fig. 1, even to 40 mbar, so that as a result of the boiling point reduction and the evaporation of the water contained in the extruded material associated therewith, there is a considerable cooling. After the pressure, whose time behaviour is not precisely shown in Fig. 1, has reached its lowest point of approximately 40 mbar or has stayed for a certain time at this value, e.g. if in the extruded material at approximately 100°C there was a moisture content of 25 wt.%, following cooling to 30°C (boiling point at 40 mbar) a moisture content of 19 wt.% still existed, i.e. as a result of the "vacuum drying" there was a moisture content decrease of 6 wt.% accompanied by a simultaneous cooling to 30°C.

Following such, a cooling and drying coating takes place with a desired material, together with a pressure rise to approximately 200 mbar, the product temperature still being 30°C. This and the emptying of the mixing vessel (right-hand mixer representation in Fig. 2) substantially correspond to the prior art procedure.

The time pressure distribution, only intimated in Fig. 1, on reducing the pressure from ambient pressure to 40 mbar, or at least 200 mbar, is, inter alia, dependent on the moisture content with which the extruded material is introduced into the mixer and to what extent drying is to take place, i.e. what type of coating (aqueous or anhydrous) is used for coating purposes. The expanding behaviour of the extruded material can also be influenced by the speed of the pressure drop.

Under the basic assumption that in a specific process sequence in the vacuum phase in the mixer there is always a moisture content reduction by 6 wt.%, without the temperature dropping below 25 to 30°C, e.g. the following process alternatives are conceivable:

1. Extruded material entering the mixer at 16 wt.% moisture and 95°C, following a pressure drop to 40 mbar, after a certain time, reaches a moisture content of 10 wt.% and a temperature of 25°C. After coating with a fat-containing coating material containing little or no water the desired moisture content of 9 wt.% is reached (the delivery temperature is in unchanged form 25°C).

2. If the moisture contents of the extruded material are higher, it is either necessary to operate with an external energy supply during the vacuum phase or with predrying before the vacuum phase.

If the moisture content of the extruded material is e.g. 25% and coating is to take place with an aqueous material, the extruded material can initially be predried (at 95°C) to 12 wt.%, before being inventively dried during the pressure reduction to 40 mbar to 6 wt.% moisture and 25°C. By coating with aqueous material 9 wt.% moisture at 25°C is obtained.

Alternatively a drying to a higher moisture content, e.g. 16 wt.%, would be adequate, if coating takes place with a material containing little or no water. Then, in the mixer, on reducing the pressure, there is e.g. a 10 wt.% moisture content and a temperature of 25°C and after fat coating 9 wt.% moisture at 25°C.

When operating with an initial moisture content of 25 wt.%, without predrying, energy must be supplied during the vacuum phase, particularly in the form of microwave heating. As a result, the desired values of e.g. 6 wt.% moisture at 25°C can be obtained prior to coating.

As in the case of vacuum drying there are scarcely any local fluctuations of the moisture content or peak values, a very precise moisture setting occurs, so that the mean value of the moisture content can be raised by approximately 1 wt.% compared with the known procedure using a hot air drier. This is not altered by the fact that in certain cases, according to the invention, it can be appropriate to use a (hot air) predrier, because this merely lowers the overall moisture content prior to the actual drying stage, whereas the actual "fine setting" takes place during the vacuum phase. Considerable energy savings result from this.

As a result of the time control of the pressure reduction or distribution, it is possible to influence whether or not the extruded product is to be (further) expanded. It can be appropriate in some cases to solidify the extruded product in a predrier to such an extent that it does not excessively stick.

The features of the invention disclosed in the description, drawings and claims can be essential to the implementation of the different embodiments of the invention, either singly or in the form of random combinations.

THE EMBODIMENTS OF THE PRESENT INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A process for the vacuum coating of an extruded material in which the extruded material is coated with a flowable coating material during a vacuum phase under reduced pressure wherein the extruded material is initially dried and then coated with the coating material and wherein the pressure at the start of the vacuum phase is lowered to 40 millibar and during the vacuum phase the pressure is raised to 200 millibar.

2. A process for the vacuum coating of an extruded material in which the extruded material is coated with a flowable coating material during a vacuum phase under reduced pressure wherein the extruded material is initially dried and then coated with the coating material and wherein during the vacuum phase the pressure is lowered to 200 millibar and then lowered to 40 millibar and wherein the pressure of 40 millibar is maintained until the extruded material has reached a temperature of 30 °C or lower.

3. A process according to claim 1 or 2 wherein the coating material contains fat and/or water.

4. A process according to any one of claims 1 to 3 wherein the extruded material is porous and expands during the vacuum phase.

5. A process according to any one of claims 1 to 4 wherein at the start of the vacuum phase the extruded material has a temperature of more than 90 °C.

6. A process according to any one of claims 1 to 5 wherein at the start of the vacuum phase the extruded material has a moisture content of no more than 25 wt.% based on its dry weight.

7. A process according to any one of claims 1 to 6 wherein the moisture content of the extruded material is lowered by 6 wt.% based on its dry weight during the vacuum phase.

8. A process according to any one of claims 1 to 7 wherein prior to the start of the vacuum phase the extruded material is predried at normal pressure.

9. A process according to any one of claims 1 to 8 wherein after drying and coating the extruded material has a final moisture content of 9 wt.% based on its dry weight.

10. A process according to any one of claims 1 to 9 wherein after drying and coating the extruded material has a temperature of 25 °C.

11. A process according to any one of claims 1 to 10 wherein during the vacuum phase additional energy is supplied in the form of microwave energy.

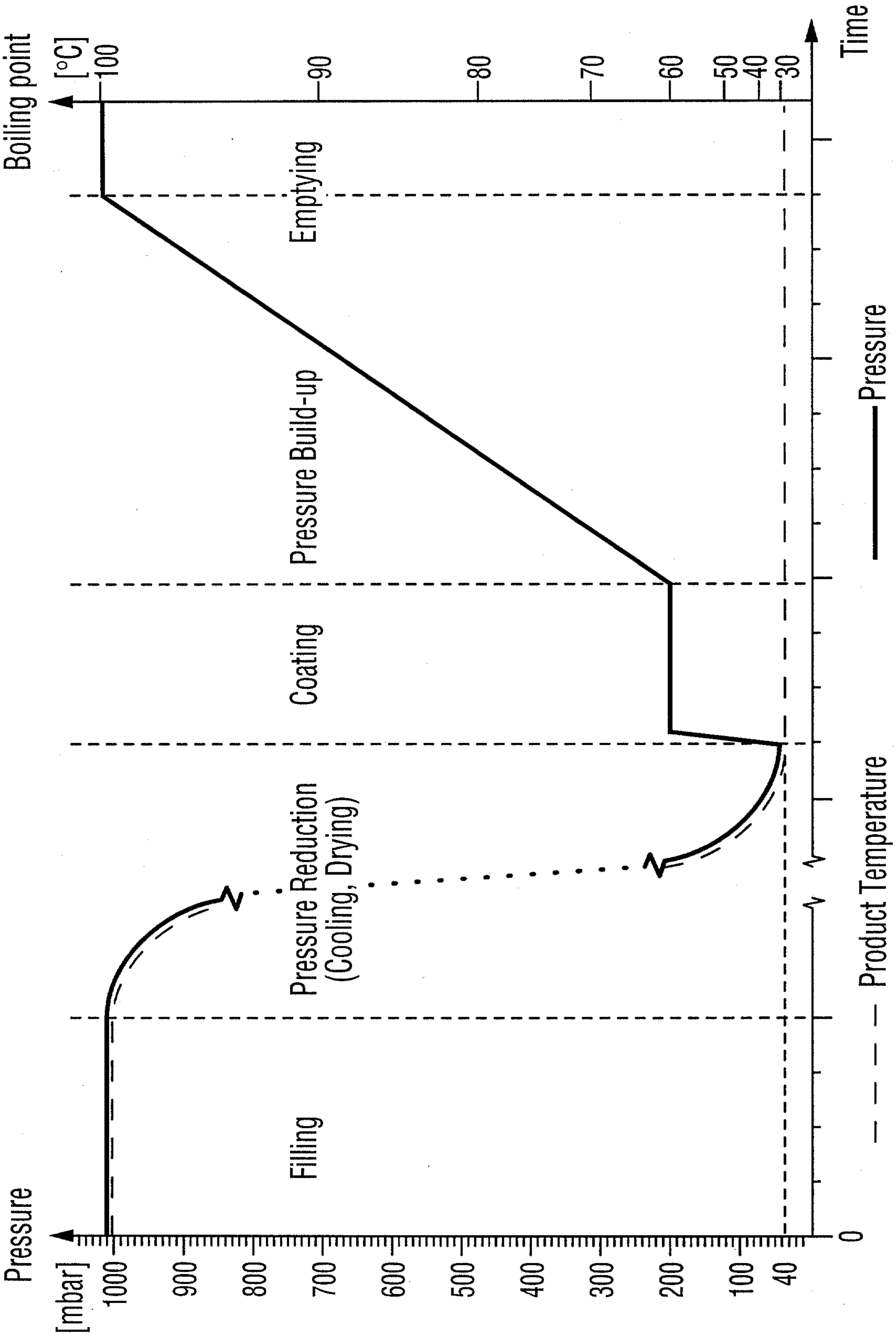

Boiling point
[°C]
100
90
80
70
60
50
40
30
Time
Pressure
[mbar]
1000
900
800
700
600
500
400
300
200
100
40
0
Filling
Pressure Reduction
(Cooling, Drying)
Coating
Pressure Build-up
Emptying
Pressure
Product Temperature

FIG. 1

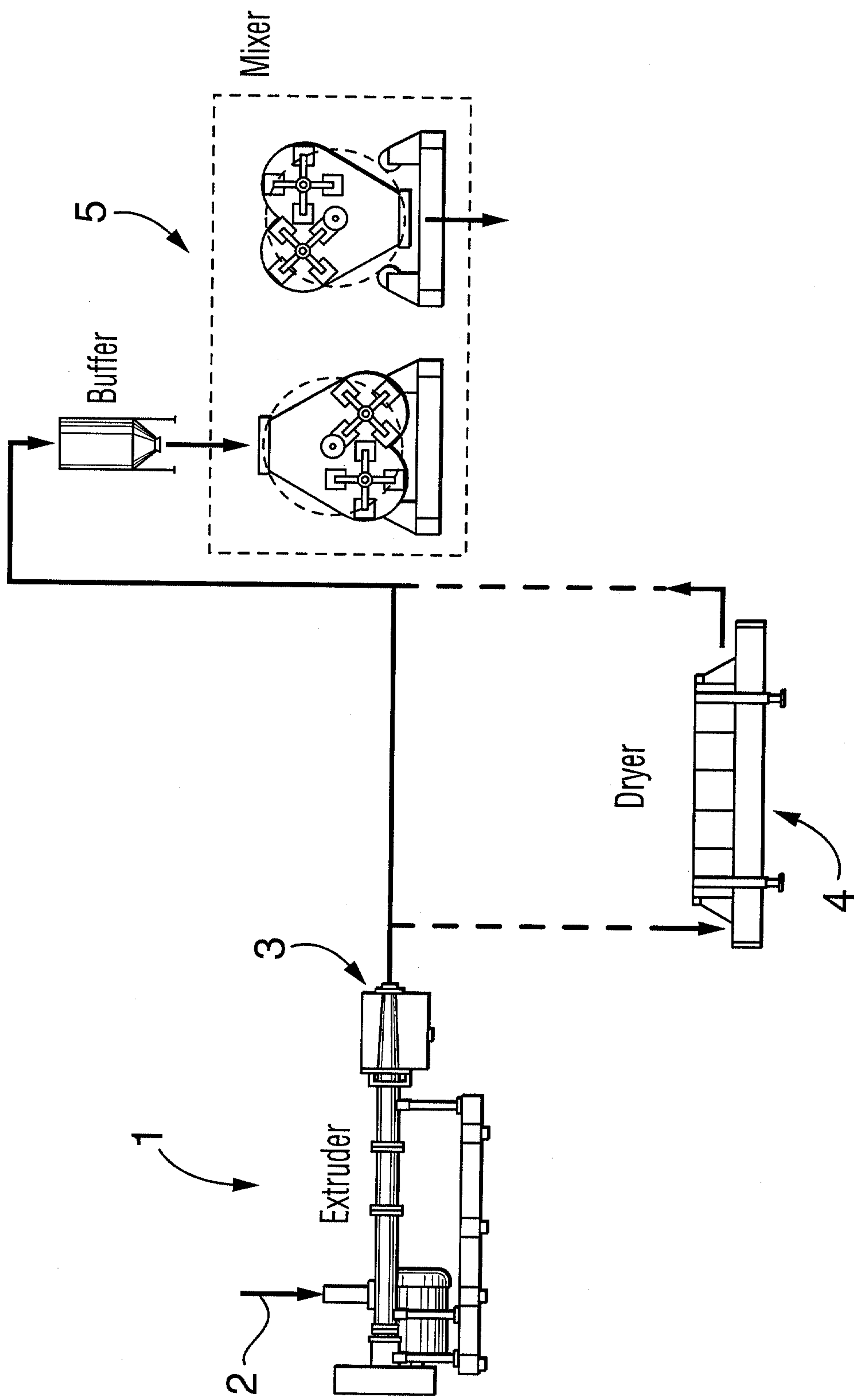


FIG. 2

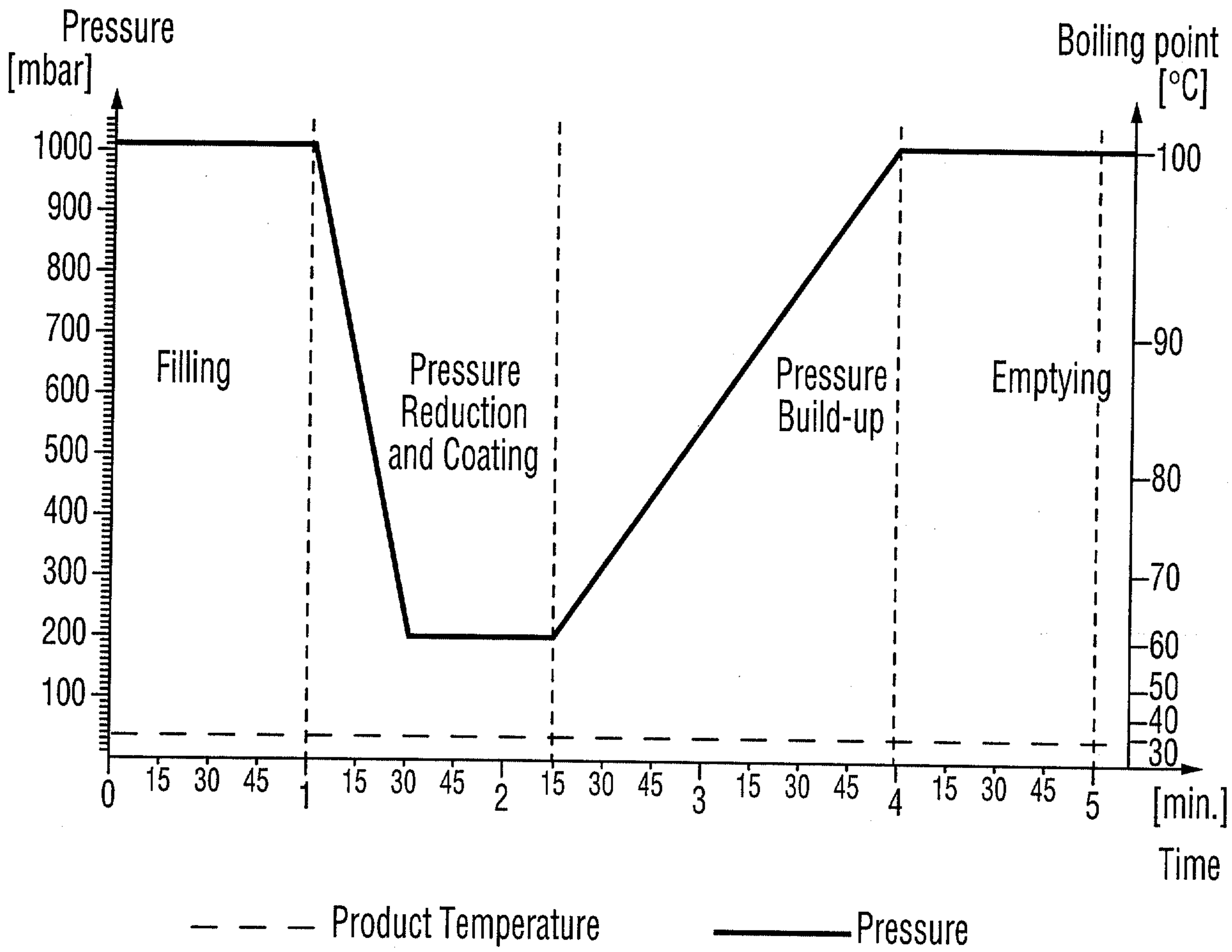


FIG. 3
PRIOR ART


Pressure
[mbar]
1000
900
800
700
600
500
400
300
200
100
40
0
Boiling point
[°C]
100
90
80
70
60
50
40
30
Filling
Pressure Reduction
(Cooling, Drying)
Coating
Pressure Build-up
Emptying
Time
Product Temperature
Pressure