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REACTOR FOR THE MANUFACTURE OF POLYETHYLENE PHTHALATES

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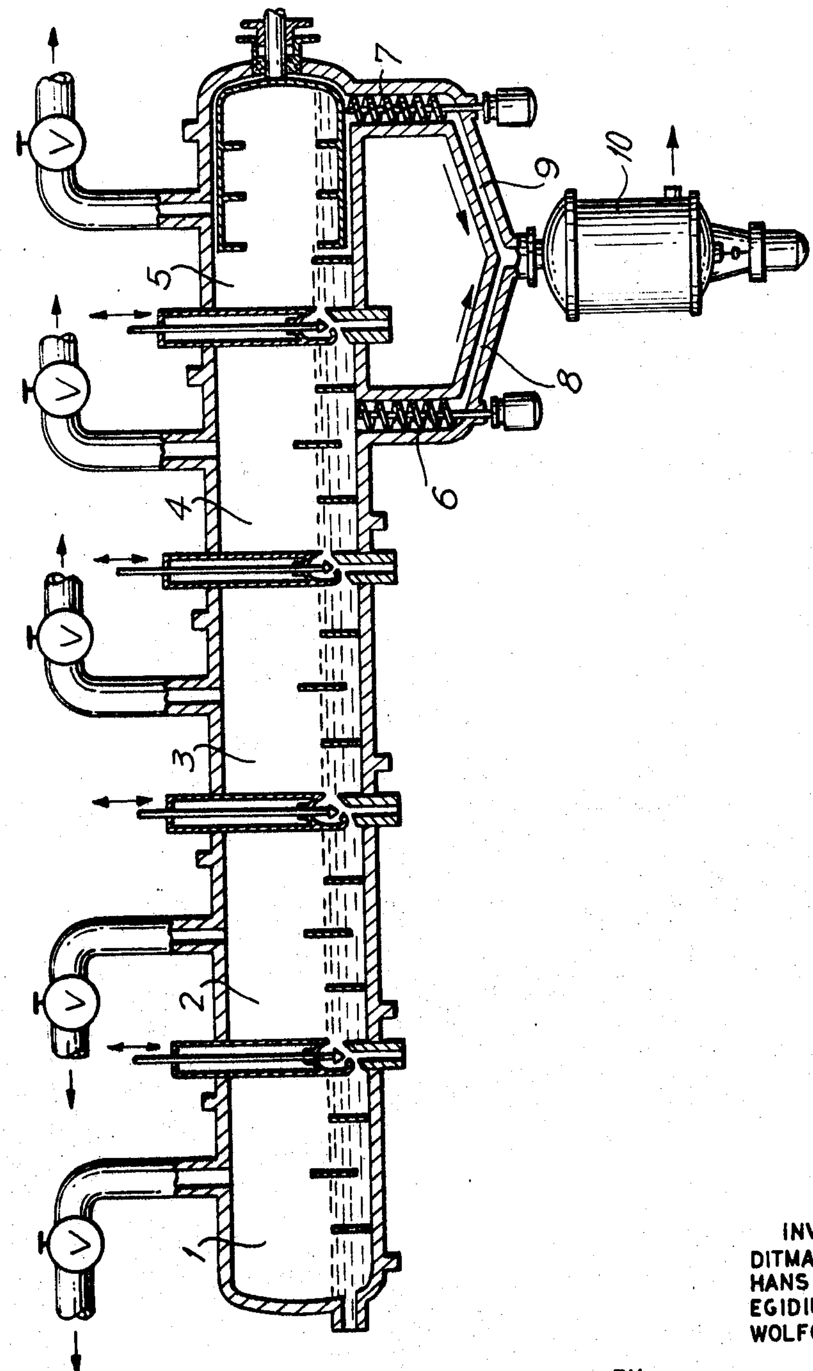

INVENTORS
DITMAR BACHMANN
HANS HOYER
EGIDIUS WELFERS
WOLFGANG FISCHER

BY

Curtis, Morris & Safford

ATTORNEYS

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REACTOR FOR THE MANUFACTURE OF POLYETHYLENE PHTHALATES

Ditmar Bachmann, Hofheim, Taunus, Hans Hoyer, Frankfurt am Main, Egidius Welfers, Niederhofheim, Taunus, and Wolfgang Fischer, Frankfurt am Main, Germany, assignors to Farbwerke Hoechst Aktiengesellschaft vormals Meister Lucius & Bruning, Frankfurt am Main, Germany, a corporation of Germany

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The present invention relates to a reactor for the continuous manufacture of pure or mixed esters of terephthalic acid and isophthalic acid, particularly polyethylene terephthalate and polyethylene isophthalate, from esters of terephthalic or isophthalic acid with lower alcohols, particularly methanol and ethylene glycol. These esters are referred to herein as "polyethylene phthalates."

In the known processes for the continuous manufacture of polyethylene phthalates several separate apparatus are used of which the first, a vessel provided with a stirrer or an apparatus similar to the known fractionating columns, serves for the re-esterification. The second and the following apparatus serve for the polycondensation proper. In the first stage of the condensation, reactors provided with a stirrer or plate-type columns are used. For the next stage of the condensation, the so-called main condensation, film reactors are advantageously used in which the reaction mixture is distributed in thin layers. It has been proposed, for example, to carry out the main condensation in reactors constructed like film or falling film evaporators. It has also been proposed to use reactors in which the stream of liquid material is dammed up in steps by weirs.

The three process steps differ not only in the apparatus that are advantageously used but also in the physical conditions under which they are carried out, such as pressure and temperature, and particularly in the flow properties of the material used.

The liquid mixture which is being reacted is conveyed from one apparatus to the next one through pipes by means of mechanically driven devices, such as gear pumps or diaphragm pumps.

The use of separate apparatus for each process step enables each apparatus to be well adapted to the respective process steps, but involves also great disadvantages. The large number of spots of packing in apparatus, pipes and conveying devices, particularly at the openings for the drives for the stirrers, scrapers and pump shafts, allow air to enter which alters the degree of whiteness of the product. Mere traces of air or oxygen lead to products of inferior quality or rejected products. This disadvantage of the known apparatus cannot even be overcome satisfactorily by thorough control of the process by the operator or by automatic devices. At best, the process can be interrupted prematurely.

Another disadvantage of such apparatus is that the control of the stream of material and the adjustment of the pressure and temperature to the course of the process is difficult to achieve in apparatus of such different type.

To avoid the above disadvantages in the continuous manufacture of polyethylene phthalates from dimethyl phthalates and ethylene glycol, it has been proposed to use a reactor which comprises several chambers arranged side by side which can be heated separately and which are provided with weirs. Each chamber communicates with the adjacent chamber through an adjustable opening disposed below the level of the overflow edge of the weirs. The gas chambers, i.e. the spaces above the liquid level in the individual chambers, are each connected with a separate steam ejector device or an adjustable stage of a common multistage steam ejector device so that the reactor can be operated with regulatable pressures graduated from the entrance to the outlet of the reactor.

Besides offering advantages as to arrangement, this reactor enables the known polycondensation process to be effectively adjusted so that any desired degree of polycondensation can be obtained. However, when changing over to another product, for example a product of lower degree of polymerization or lower viscosity, it takes some time until a steady state of operation is obtained.

Now we have found that the above disadvantage can be avoided by improving the said reactor by providing at least two of the chambers, advantageously the last ones, each with an adjustable discharge device with shutoff means through which the liquid space of the chamber communicates with a device disposed after the reactor, such as a conveying means, mixer, extruder, roll mill, spinning device or another device appropriate for forming the product.

This construction enables partial streams of polycondensate to be united with the product that issues from the last chamber, while omitting one or more chambers. The degree of viscosity of the mixture depends only on the viscosity and quantity of the individual partial streams. Any desired degree of viscosity can rapidly be adjusted within the limits given by the partial streams, without time-consuming readjustment of the reactor. This mode of working is particularly advantageous if the type of further treatment varies from case to case.

As discharge device it is advantageous to use a screw pump with a variable drive. It is also possible to use worm pumps or other known discharge devices. Such discharge devices enable the weight velocity of flow of the streams of polycondensate to be adjusted as desired. When the pumps stand still, they act as shut-off device. They can advantageously be used to overcome pressure differences between the place of drawing-off and the place where the partial streams are united, without differences in output occurring. With the help of such discharge devices known in themselves the streams of material can therefore be fed to a common conveying means, for example a collecting pipe or screw conveyor, or they may be directly introduced, without being collected, into a mixer or another apparatus, without the adjusted quantities being varied.

For example, the partial streams of polycondensate may be fed to a spinning device in a manner such that they are united in the spinning head. Such arrangement enables the manufacture of three-dimensionally crimped fibers and filaments of particularly good crimp retentivity.

An example of an improved reactor constructed in accordance with the invention will now be described in greater detail with reference to the accompanying drawing.

In the drawing which is a longitudinal section through the improved reactor constructed in accordance with the invention, the chambers are denoted by reference numerals 1 to 5 in the direction in which polycondensation proceeds. To simplify the drawing only the last chamber **5** and penultimate chamber **4** are each provided with a discharge device. Discharge devices **6** and **7** are screw pumps. Instead of screw pumps, worm pumps or other known discharge devices may be used. Through pipes **8** and **9** the polycondensate is conducted to a mixer **10**. The said pipes **8** and **9** run separately and join only immediately before the inlet to the mixer.

Discharge devices **6** and **7** are of one and the same type and have identical dimensions. The viscosity is only insignificantly influenced by the mixing operation and is in the first place a function of the rate of the numbers of revolutions to which the pumps have been adjusted. In the reactor shown in the drawing, the limits within which the viscosity can be adjusted are given by the viscosities of the two partial streams.

The lower limit of the range within which the viscosity may be adjusted can still be lowered if, contrary to the reactor shown in the drawing, further chambers are provided with discharge devices and connected accordingly.

We claim:

1. In a reactor for the continuous manufacture of polyethylene phthalates from dimethyl phthalates and ethylene glycol, which reactor is provided with several chambers where chambers are arranged side by side, each of which is provided with weirs, separate heating means, and each of which chambers communicates with the adjacent chambers through an adjustable opening placed below the level of the overflow edge of the weirs, and in which chamber the gas space above the liquid level is connected with a separate steam ejector device or for each chamber an individually adjustable and common steam ejector device, the improvement comprising of: at least two chambers, each with an adjustable discharge device having shut-off means, said devices communicating exteriorly of the reactor through the liquid space of each chamber from which liquids are discharged and through a device in which the withdrawn liquids from each chamber are joined and discharged from the reactor; and means for regulating each of the adjustable discharge devices responsive to a preselected combination of liquids wtihdrawn from each of the chambers.

2. The reactor according to claim 1 wherein the discharge device is provided with a screw pump with a variable drive through which the liquid space of a chamber is connected with the device from which the liquids from each chamber are joined and discharged and means for regulating the operation of each of the discharge devices to withdraw a liquid of a preselected degree of condensation.

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JAMES H. TAYMAN, Jr., *Primary Examiner.*

M. O. WOLK, *Examiner.*