PATENT SPECIFICATION (11) 1 581 250

1 581 250

(21) Application No. 35887/77 (22) Filed 26 Aug. 1977 (19)

(31) Convention Application No. 2639512 (32) Filed 2 Sep. 1976 in

(33) Fed. Rep. of Germany (DE)

(44) Complete Specification Published 10 Dec. 1980

(51) INT. CL.[3] B32B 31/30

(52) Index at Acceptance
B5N 3130
B5A 1R133 1R214B 1R214D 1R214G 1R314C1X 1R419 20N2 20T17 20T19 2A1 2A2 2A4A 2A4F 2A4X 2B2 2D2 2U2 2U9 A2

(72) Inventor: KLEMENS KRUMM

(54) IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF SLABS OF THERMOPLASTIC SYNTHETIC MATERIALS

(71) We, REIFENHAUSER KG, a Company organized under the laws of the Federal Republic of Germany, of Spicher Strasse, 5210 Troisdorf 15, Federal Republic of Germany, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to the manufacture of slabs of thermoplastic synthetic materials, and particularly to extrusion press equipment (particularly screw extrusion equipment) and rolling equipment. Here the term "extrusion press" includes the associated die in the form of a wide-slot nozzle. In known equipment of this type a single layer or multilayer strand, of the width of the slab to be manufactured, is extruded, and rolled to gauge in the succeeding rolls arranged in pairs behind one another and working in pairs against one another. The rolls can be either cooled, or heated to tempering temperatures. The slabs manufactured are not readily made stable in shape for lengthy periods. They usually warp and twist in course of time, which is to be attributed to uncompensated internal stresses. Time-dependent warping and twisting especially appears when very thick slabs are manufactured, having a thickness for example of 60 mm. or more.

It is the object of the invention to provide means whereby thick and very thick slabs of thermoplastic synthetic materials can be manufactured, free or adequately free from uncompensated internal stresses - so that the finished slabs no longer warp or twist.

According to the present invention, in contrast to the equipment of the known type, the rolling equipment has two groups of rolls each having at least two rolls, each group of rolls features an entry gap between two rolls adjoining an extrusion press, adjacent end rolls of the group of rolls form a bonding gap so that two individual half-slab extrusions conveyed through the groups of rolls can be introduced into the bonding gap, all the rolls of the groups of rolls are arranged with their axes in one plane and parallel to one another and the groups of rolls are arranged symmetrically with respect to the slab emerging from the bonding gap, and the rolls of the groups of rolls are equipped with heating and/or cooling installations controllable symmetrically in relation to the bonding gap. It is advantageous for both half-slab extrusions to be identical in cross-section but this however does not represent an essential feature of the invention.

The term "bonding gap" expresses the fact that in the bonding gap by application of pressure, and by the heat still present in the half-slab extrusions, or which may be additionally imparted, a solid union takes place between the two half-slab extrusions. Each group of rolls may consist of two rolls. There is also the possibility however of equipping each group with three rolls, or with more than three rolls. The half-slab extrusions entering the bonding gap may be heated in the region of their contact surfaces as they enter, whether it be by means of infra-red radiation, direct warming, ultra-sonics or the like.

The invention is based on the recognition that half-slab extrusions, which whilst warm from extrusion heating are conveyed in the manner described and are then welded together in the bonding gap, produce slabs

whose stress distribution is adjustable in such a way that when the half-slab extrusions are bonded together an adequate compensation appears, and as a result warping and twisting of the finished slabs no longer takes place. In the simplest case one tries to obtain in this a symmetrical distribution of stress in the slab cross-sections which are constituted of identically equal half-slab extrusions arranged as mirror images with respect to one another.

In order to manufacture in the first instant, by means of equipment according to the invention, half-slab extrusions which as they enter into the bonding gap have a precisely defined pre-history and accordingly precisely defined physical characteristics, it is desirable to ensure that the half-slabs after they have left the extrusion presses lie with close surface contact against the rolls in order to experience a precise heat-treatment in the form of cooling and/or heating. This can be controlled to a considerable extent by the rotational speed of the rolls. It also helps to solve this problem if some of the rolls, particularly and at least the end rolls which have no counterpart rolls, are constructed with affixing devices for the half-slab extrusions, e.g. in the form of pressure rolls and/or vacuum fixation devices. The individual half-slab extrusions may be formed of homogeneous material or of multilayer construction. For the multilayer construction the invention teaches that the extrusion presses are formed for the extrusion of multilayer laminated half-slab extrusions. However, with at least three rolls per group of rolls there is the possibility of having, in addition to the extrusion presses associated with the entry gaps, secondary extrusion presses arranged at subsequent gaps between adjacent rolls, for the production of multi-layer half-slab extrusions by means of which the layers are laid one upon the other at each roll. By appropriate devices additional components can be incorporated in the manufactured slabs the addition taking place as the half-slab extrusions enter the bonding gap. In particular, this may be inlaid reinforcements in the form of reinforcement mesh of any desired material, in the form of longitudinal reinforcement strips, or the like. Also a further extrusion of thermoplastic synthetic material may be introduced in the region of the bonding gap to provide a central layer or to act as a bonding layer. In this connection a proposal of the invention that is of special importance is characterised in that the extrusion presses or their wide-slot nozzles are adapted for the extrusion or manipulation of half-slab extrusions with recessed profiles which, when the half-slab extrusions are combined, unite to form channel-shaped chambers extending lengthwise, and equipment may be placed in front of the bonding gap to introduce filler materials into the recessed profiles or into the longitudinal chambers. These can be for example scrap synthetic material, foamed synthetic material, or the like.

The advantages achieved are to be seen in that when manufacturing slabs of thermoplastic synthetic materials by means of equipment according to the invention internal stresses arising in the half-slab extrusions are adjusted in such a way that they practically compensate one another after bonding the half-slab extrusions together into finished slabs, so that the finished slabs remain free from warping and twisting.

The invention will now be explained in more detail in terms of a pair of embodiments, by way of example only and with reference to the accompanying drawings, in which:-

Figure 1 is a side view of equipment according to the invention with groups of rolls each featuring two rolls;

Figure 2 is a corresponding view of equipment according to the invention with groups of rolls each featuring three rolls;

Figure 3 is a cross-section through a portion of slab manufactured in accordance with the invention from thermoplastic synthetic material and showing the stress distribution;

Figure 4 is a sectional view from the line A-A of Figure 2; and

Figure 5 corresponds to part of Figure 4 but to a larger scale and showing further detail.

The equipment shown in the Figures serves for the manufacture of slabs 1 of thermoplastic synthetic material. Basically it consists of extrusion press equipment 2a, 2b and rolling equipment 3a, 3b. In the example of construction and according to the preferred form of construction the extrusion press equipment 2a, 2b is equipped with screw extrusion presses 2a and 2b. In particular the lay-out is so arranged that the rolling equipment 3a, 3b consists of two groups of rolls each of which features at least two rolls 4. In the form of construction according to Figure 1 there are just two rolls 4 in each group of rolls 3a and 3b. In the form of construction according to Figure 2 each group of rolls 3a and 3b is equipped with three rolls 4. All the rolls 4 are arranged with axes in one plane and parallel to one another. Each group of rolls 3a and 3b possesses an entry gap 5 adjoining the associated extrusion presses 2a and 2b. Furthermore the groups of rolls 3a and 3b, by means of their end rolls which face one another, form a bonding gap 6, so that two individual half-slab extrusions 1a and 1b, fed through the groups of rolls 3a and 3b can be led into the bonding gap 6. In the example of construction and according to the preferred form of construction of the invention all the rolls 4 of the groups of rolls 3a, 3b are constructed with the same diameter. They

are arranged symmetrically with respect to the bonding gap 6. Although not shown in the drawings the rolls 4 are equipped with heating and/or cooling devices for use according to the requirements of the material to be handled, and the rolls 4 of groups of rolls 3a, 3b are controllable in respect of their heating and/or cooling in symmetrical relationship to the bonding gap 6. By this means two half-slab extrusions 1a, 1b, identically the same as regards material and in complete accordance of geometrical form, can be fed into the bonding gap 6; they have identically the same pre-history from the extrusion presses 2a and 2b up to the bonding gap 6, and consequently if any internal stresses should be present they possess a stress distribution which is annulled in the slab 1 made from the two united half-slab extrusions 1a, 1b. It is within the scope of the invention to arrange matters so that some rolls 4 are provided with fixation devices 7 for the half-slab extrusions 1a, 1b, as indicated in Figure 4. However one could also undertake fixation by vacuum, as this is in itself known from the so-called vacuum thickness control.

In the example of construction the extrusion presses 2a and 2b are constructed for the manufacture of homogeneous half-slab extrusions 1a, 1b. The half-slab extrusions 1a, 1b, can however themselves be of multilayer-bonded half-slab extrusions. In the form of construction with three rolls one can also take other measures, in fact such as have been indicated by dotted lines on the right-hand side of Figure 2, where in addition to the extrusion presses 2a and 2b associated with the entry gaps 5 secondary extrusion presses 8a, 8b are arranged at subsequent gaps between adjacent rolls for the production of multilayer half-slab extrusions. Finally Figure 5 shows how other material 9 can be incorporated between the half-slab extrusions 1a, 1b; the extrusion presses 2a, 2b or their wide-slot nozzles form half-slab extrusions 1a, 1b with recessed profiles, which in the bonding gap 6 unite to form complete chambers 10 (see also Figure 4) into which filler materials 9 can be introduced. In Figure 2 has been indicated a heating device 11 in front of the bonding gap 6, which heating device serves to heat the bonding surfaces of the half-slab extrusions 1a, 1b.

WHAT WE CLAIM IS:-

1. Equipment for the manufacture of slabs of thermoplastic synthetic material comprising extrusion press equipment and rolling equipment, the rolling equipment having two groups of rolls each having at least two rolls, each group of rolls features an entry gap between two rolls adjoining an extrusion press, adjacent end rolls of the groups of rolls form a bonding gap so that two individual half-slab extrusions conveyed through the groups of rolls can be introduced into the bonding gap, all the rolls of the groups of rolls are arranged with their axes in one plane and parallel to one another and the groups of rolls are arranged symmetrically with respect to the slab emerging from the bonding gap, and the rolls of the groups of rolls are equipped with heating and/or cooling installations controllable symmetrically in relation to the bonding gap.

2. Equipment as in Claim 1, wherein each group of rolls features three or more rolls and an extrusion press is associated with the or an additional roll gap.

3. Equipment as in Claim 1 or Claim 2, wherein the extrusion presses or their nozzles are adapted to extrude and/or form half-slab extrusions with recessed profiles which unite in the completed slab to form longitudinal chambers, and equipment is placed in front of the bonding gap to introduce additional materials or objects into the chambers and/or between the half-slab extrusions.

4. Equipment for the manufacture of slabs of thermoplastic synthetic materials substantially as hereinbefore described with reference to Figure 1 or Figure 2 of the accompanying drawings.

HULSE AND CO.
Chartered Patent Agents
Cavendish Buildings
West Street
Sheffield S1 1ZZ

Printed for Her Majesty's Stationery Office,
by Croydon Printing Company Limited, Croydon, Surrey, 1980.
Published by The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

1581250 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

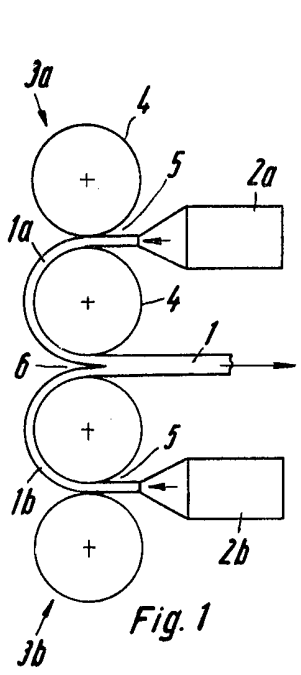

Fig. 1

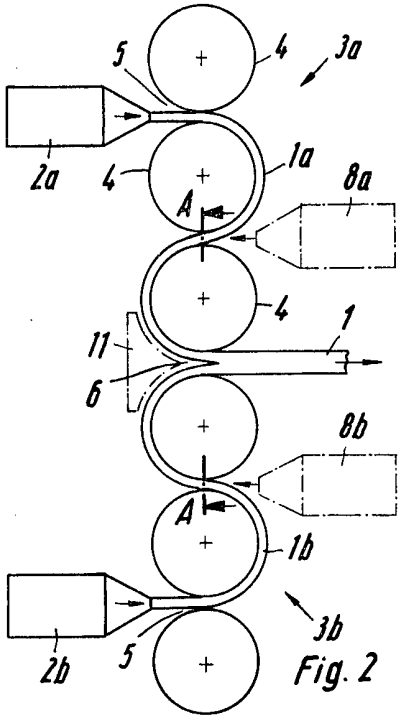

Fig. 2

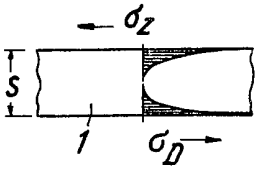

Fig. 3

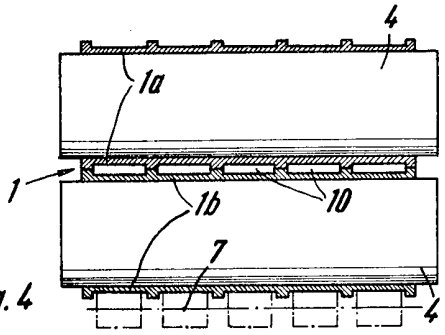

Fig. 4

1581250 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

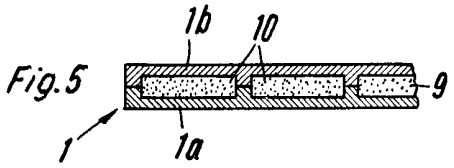

Fig. 5