

PATENT SPECIFICATION

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(54) PROCESS AND APPARATUS FOR MOULDING RECESSED ARTICLES FROM SYNTHETIC MATERIAL

(71) We, ANTON ANGER
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 4020 Linz, Jaxstrasse 9, Austria, a limited
 liability company organised under the laws
 of Austria, 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 de-
 scribed in and by the following statement:

The present invention relates to a
 process for moulding recessed articles from
 synthetic material and to injection mould-
 ing apparatus for the performance of this
 process.

Articles, which are produced from syn-
 thetic material and which have a sleeve
 provided with an annular groove or other
 form of recess for the reception of a seal-
 ing ring, are known, for example branch
 connecting pipes, angle pipes and reducing
 pipes.

According to one known process for
 making such articles, the sleeve is
 produced by injection moulding with an
 enlarged portion which, after removal of
 the sleeve from the mould, is provided
 with the groove by a separate turning or
 milling operation.

According to another process, at first a
 sleeve with a smooth, cylindrical end por-
 tion is produced by an injection moulding
 and later, for example, in an expanding
 process, this end portion is furnished with
 an annular groove.

The expanding can be carried out either
 in a separate blowing mould or by an ap-
 propriately equipped injection moulding
 machine.

Finally, it is also known to produce by
 injection moulding an enlarged sleeve,
 which is reduced towards its end, and to
 draw in the outer end of this enlargement
 in a subsequent operation so that again an
 annular groove or chamber for the re-
 ception of a gasket is formed.

According to a first aspect of the present
 invention, there is provided a process for
 the production of an article, which is of
 synthetic material and is resilient at an
 elevated temperature and which comprises
 at least one sleeve provided in an end por-
 tion thereof with an internal annular recess
 having a depth at least equal to the thick-
 ness of the wall of the sleeve, the process
 comprising the steps of moulding such an
 article by introducing said synthetic
 material into a mould with a core element,
 the mould and the core element respec-
 tively defining the outer and inner con-
 tours of the article, causing said end por-
 tion of the sleeve of the moulded article to
 be at an elevated temperature at which it
 is resilient, removing the mould from the
 outer surface of said end portion while
 resilient, so withdrawing from said end
 portion while resilient the part of the core
 element defining the recess in said end por-
 tion that said end portion is resiliently de-
 formed from and restored to its moulded
 shape, and then removing the moulded ar-
 ticle from the core element.

Preferably, the synthetic material is
 thermoplastic plastics material.

Expediently, said end portion of the
 sleeve of the moulded article is caused to
 be at said temperature by causing heat ex-
 change exclusively with said end portion.

For preference, the process comprises
 the further steps of supporting said end
 portion axially beyond said recess at least
 at the radially inner side of said end por-
 tion by the core element after the with-
 drawal of said part of the core element
 and of causing or allowing said end portion
 to cool to its setting temperature while so
 supported, the moulded article being re-
 moved from the mould only after such set-
 ting temperature has been reached.

Preferably, said end portion of the sleeve
 of the article is maintained at a higher

temperature than the rest of the article during withdrawal of said portion of the core element.

The process may also comprise the step of introducing a film of air between the core element and the moulded article at least during withdrawal of said portion of the core element.

This process is based on the observation that most of the synthetic materials, in particular thermoplastics, used in the manufacture of articles have high elasticity immediately after manufacture in the injection moulding machine and within a definite range of temperature, so that during withdrawal of the corresponding core part out of the annular recess an elastic deformation of the corresponding part of the sleeve is possible, this part of the sleeve regaining its former shape after such withdrawal.

The process can be assisted by local cooling or heating, and by the blowing in of compressed air.

Thus, with this process the sleeve is produced in a single operation, which simplifies production and enables a more exact observance of the desired end shape than is possible with the known existing processes.

According to a second aspect of the present invention, there is provided injection moulding apparatus for performing the method according to the invention, comprising a multi-part mould and a core element locatable in the mould to define therewith a mould cavity corresponding in shape to the shape of such article, the core element defining the inner contour of such sleeve and comprising a portion, which is of reduced diameter and which carries an inner shaping member to define the inner contour of said end portion of the sleeve, the inner shaping member being provided with an annular projection determining the shape of the recess in said end portion of the sleeve and being displaceable relative to the core element in the axial direction thereof to be withdrawable from a sleeve moulded in the mould cavity.

Preferably, the mould is a two part mould.

For preference, the mould comprises a displaceable outer shaping member to define the outer contour of said end portion of the sleeve from the end of the sleeve to the part of said end portion having the greatest diameter.

Expediently, the outer shaping member is slidably mounted on the inner shaping member and/or on said reduced diameter portion of the core element and is connected with drive means to be displaceable away from an article moulded in the mould cavity, the outer shaping member

being provided with entraining means to entrain the shaping member after and only after displacement of the outer shaping member clear of the sleeve.

Conveniently, the inner shaping member is provided with support means contiguous with the annular projection to support the free end of the sleeve after withdrawal of the annular projection from the sleeve.

The apparatus may further comprise regulable heating means to heat at least either of the annular projection of the inner shaping member or the portion of the outer shaping member determining the outer contour of said end portion of the sleeve in the region of the recess. In addition, at least the inner shaping member may be provided with air outlets in its surface defining the inner contour of said end portion of the sleeve.

Instead of a single core element, two or more part cylindrical members may be provided, which together form the core element and which are individually displaceable one after another.

In special cases, the final outer contour of the end of the sleeve can be determined directly by the outer mould.

One further advantage of the moulding process is that the portion of the sleeve which is deformed during withdrawal of the core element part can be maintained at a higher temperature than the remaining portion of the sleeve, so that the first said portion is more easily deformable and after withdrawal of the core element part regains its original shape because of its thermal restoring capability.

Embodiments of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:—

Figs. 1 to 3 are sectional views of injection moulding apparatus according to a first embodiment of the invention, respectively showing three different operating settings in carrying out the process of the invention;

Fig. 4 is a view similar to Fig. 1 of part of injection moulding apparatus according to a second embodiment of the invention;

Fig. 5 is a side view of an injection moulding machine incorporating the apparatus of Figs. 1 to 3 or of Fig. 4; and

Fig. 6 is a section on the line A-A in Fig. 5.

Referring now to the drawings, in Figs. 1 to 3 there is shown an injection moulding apparatus in three different working positions, only the upper half of the apparatus being represented and all ancillaries being omitted.

The apparatus comprises two outer mould halves 1, which are divided in accordance with a plane perpendicular to

the drawing plane and coinciding with, for example, the axis 2 of a core element 3.

The greater part of an article to be moulded is produced in a region (not shown) to the left of the parts of the apparatus shown in Figs. 1 to 3, in which region are provided inlets connected to an injection moulding machine 23 (Figs. 5 and 6). Thus, only that region of the apparatus is shown which serves for the moulding of an end sleeve 4 of the article with an annular groove 5, the groove 5 normally receiving a sealing ring. In addition, at the end of the sleeve a short extension 6 is formed.

In Fig. 1, the apparatus is shown in the setting for injection moulding. The mould halves 1 are closed, and the core element 3, an inner shaping member 7 and an outer shaping member 8 are located in the positions shown in Fig. 1 by co-operating stop surfaces 9 and 10 and a half ring shaped wedge 12, which is connected with the upper mould half and which engages into an annular groove 11 at the upper side of the shaping member 8.

Instead of the wedge 12, by appropriate construction of a hydraulic holding device 24 (Figs. 5 and 6), the member 8 may be kept in its operative position only by the holding force.

An annular rib 13 on the member 7 determines the inner contour of the annular groove 5. The outer contour of the extension 6 and of the groove 5 up to the region thereof having the greatest outside diameter is determined by an annular insert 14 in the member 8.

In the embodiment according to Figs. 1 to 3, a heating device 22, preferably an electrical resistance heating device is provided for the insert 14, whereas no such device is provided in the apparatus of the embodiment according to Fig. 4.

In the vicinity of the insert 14, thermocouples or the like may be provided, which by appropriate regulators cause the annular insert 14 to be at a predetermined temperature. It is also possible to provide a heating device in the rib 13.

The moulding operation is carried out in the setting of the apparatus shown in Fig. 1. Subsequently, the member 8 is displaced to the right by means of an attached flange 15 and driving means (not shown) until a stop 16 of the insert 14 and a co-operating stop 17 of the member 7 meet, so that the position according to Fig. 2 is attained, in which the outer contour of the end of the sleeve is released. The above-mentioned displacement is only possible after separation of the mould halves 1 and withdrawal of the wedge 12 out of the groove 11. If the heating device 22 is provided, the injected material initially cools down, but

after such cooling the sleeve in the region of the rib 13 is heated to a higher temperature by the heating device 22. Alternatively, the sleeve in the region of the rib 13 is prevented from a greater cooling immediately after the injection operation. In the case of polyvinylchloride, the temperature of the insert 14, even during the injection operation, is adjusted to about 80 to 120°C, so that in this region a slight cooling down and an orientation of the macromolecules of the synthetic material in accordance with the shape of the mould cavity takes place, but without hardening or setting.

If the member 8 is moved to the right from the position shown in Fig. 2 to the position shown in Fig. 3, the rib 13, as a result of elastic deformation of the end of the sleeve, can be pulled out of the annular groove 5, the stop 16 engaging the stop 17 so as to entrain the member 7.

In the position shown in Fig. 3, a shoulder 18 of the member 7 supports the extension 6 of the sleeve until sufficient solidifying of the moulded article has taken place. The shoulder 18 prevents shrinkage of the extension 6 below the nominal diameter.

After hardening of the groove 5 and extension 6, the core element 3 is pulled further out of the mould halves 1 by a stop 21 of the member 8 which co-operates with a shoulder 19, which serves as guide for the members 7 and 8, at the end of a reduced diameter part 20 of the core element 3.

Finally, the sleeve 4 is removed from the core element 3.

In returning the apparatus to the setting shown in Fig. 1, the stops 9 and 10 push the members 7 and 8 and the core element back into their respective positions in relation to the mould halves 1, thus enabling a further injection moulding operation to be carried out.

For quicker cooling of the groove 5 and extension 6, a current of compressed air may be supplied to the mould cavity through the mould halves 1.

In Figs. 5 and 6 there is shown an injection moulding machine 23 essentially consisting of a closing unit 25, an injection unit 26, and the hydraulic holding device 24 for the mould halves 1.

The apparatus and process hereinbefore described may be able to be employed with advantage in all cases where annular recesses, in particular deep recesses have to be provided in cylindrical or other hollow bodies, for example ventilating ducts and containers.

WHAT WE CLAIM IS:—

1. A process for the production of an

the drawing plane and coinciding with, for example, the axis 2 of a core element 3.

The greater part of an article to be moulded is produced in a region (not shown) to the left of the parts of the apparatus shown in Figs. 1 to 3, in which region are provided inlets connected to an injection moulding machine 23 (Figs. 5 and 6). Thus, only that region of the apparatus is shown which serves for the moulding of an end sleeve 4 of the article with an annular groove 5, the groove 5 normally receiving a sealing ring. In addition, at the end of the sleeve a short extension 6 is formed.

In Fig. 1, the apparatus is shown in the setting for injection moulding. The mould halves 1 are closed, and the core element 3, an inner shaping member 7 and an outer shaping member 8 are located in the positions shown in Fig. 1 by co-operating stop surfaces 9 and 10 and a half ring shaped wedge 12, which is connected with the upper mould half and which engages into an annular groove 11 at the upper side of the shaping member 8.

Instead of the wedge 12, by appropriate construction of a hydraulic holding device 24 (Figs. 5 and 6), the member 8 may be kept in its operative position only by the holding force.

An annular rib 13 on the member 7 determines the inner contour of the annular groove 5. The outer contour of the extension 6 and of the groove 5 up to the region thereof having the greatest outside diameter is determined by an annular insert 14 in the member 8.

In the embodiment according to Figs. 1 to 3, a heating device 22, preferably an electrical resistance heating device is provided for the insert 14, whereas no such device is provided in the apparatus of the embodiment according to Fig. 4.

In the vicinity of the insert 14, thermocouples or the like may be provided, which by appropriate regulators cause the annular insert 14 to be at a predetermined temperature. It is also possible to provide a heating device in the rib 13.

The moulding operation is carried out in the setting of the apparatus shown in Fig. 1. Subsequently, the member 8 is displaced to the right by means of an attached flange 15 and driving means (not shown) until a stop 16 of the insert 14 and a co-operating stop 17 of the member 7 meet, so that the position according to Fig. 2 is attained, in which the outer contour of the end of the sleeve is released. The above-mentioned displacement is only possible after separation of the mould halves 1 and withdrawal of the wedge 12 out of the groove 11. If the heating device 22 is provided, the injected material initially cools down, but

after such cooling the sleeve in the region of the rib 13 is heated to a higher temperature by the heating device 22. Alternatively, the sleeve in the region of the rib 13 is prevented from a greater cooling immediately after the injection operation. In the case of polyvinylchloride, the temperature of the insert 14, even during the injection operation, is adjusted to about 80 to 120°C, so that in this region a slight cooling down and an orientation of the macromolecules of the synthetic material in accordance with the shape of the mould cavity takes place, but without hardening or setting.

If the member 8 is moved to the right from the position shown in Fig. 2 to the position shown in Fig. 3, the rib 13, as a result of elastic deformation of the end of the sleeve, can be pulled out of the annular groove 5, the stop 16 engaging the stop 17 so as to entrain the member 7.

In the position shown in Fig. 3, a shoulder 18 of the member 7 supports the extension 6 of the sleeve until sufficient solidifying of the moulded article has taken place. The shoulder 18 prevents shrinkage of the extension 6 below the nominal diameter.

After hardening of the groove 5 and extension 6, the core element 3 is pulled further out of the mould halves 1 by a stop 21 of the member 8 which co-operates with a shoulder 19, which serves as guide for the members 7 and 8, at the end of a reduced diameter part 20 of the core element 3.

Finally, the sleeve 4 is removed from the core element 3.

In returning the apparatus to the setting shown in Fig. 1, the stops 9 and 10 push the members 7 and 8 and the core element back into their respective positions in relation to the mould halves 1, thus enabling a further injection moulding operation to be carried out.

For quicker cooling of the groove 5 and extension 6, a current of compressed air may be supplied to the mould cavity through the mould halves 1.

In Figs. 5 and 6 there is shown an injection moulding machine 23 essentially consisting of a closing unit 25, an injection unit 26, and the hydraulic holding device 24 for the mould halves 1.

The apparatus and process hereinbefore described may be able to be employed with advantage in all cases where annular recesses, in particular deep recesses have to be provided in cylindrical or other hollow bodies, for example, ventilating ducts and containers.

WHAT WE CLAIM IS:—

1. A process for the production of an



article, which is of synthetic material and is resilient at an elevated temperature and which comprises at least one sleeve provided in an end portion thereof with an internal annular recess having a depth at least equal to the thickness of the wall of the sleeve, the process comprising the steps of moulding such an article by introducing said synthetic material into a mould with a core element, the mould and the core element respectively defining the outer and inner contours of the article, causing said end portion of the sleeve of the moulded article to be at an elevated temperature at which it is resilient, removing the mould from the outer surface of said end portion while resilient, so withdrawing from said end portion while resilient the part of the core element defining the recess in said end portion that said end portion is resiliently deformed from and restored to its moulded shape, and then removing the moulded article from the core element.

2. A process as claimed in claim 1, wherein the synthetic material is thermoplastics material.

3. A process as claimed in either claim 1 or claim 2, wherein said end portion of the sleeve of the moulded article is caused to be at said temperature by causing heat exchange exclusively with said end portion.

4. A process as claimed in any one of the preceding claims, comprising the further steps of supporting said end portion axially beyond said recess at least at the radially inner side of said end portion by the core element after the withdrawal of said part of the core element and of causing or allowing said end portion to cool to its setting temperature while so supported, the moulded article being removed from the mould only after such setting temperature has been reached.

5. A process as claimed in any one of the preceding claims, wherein said end portion of the sleeve of the article is maintained at a higher temperature than the rest of the article during withdrawal of said portion of the core element.

6. A process as claimed in any one of the preceding claims, comprising the further step of introducing a film of air between the core element and the moulded article at least during withdrawal of said part of the core element.

7. A process for the production of an article substantially as hereinbefore described with reference to Figs. 1 to 3 of the accompanying drawings.

8. Injection moulding apparatus for performing the method according to claim 1, comprising a multi-part mould and a core element locatable in the mould to define therewith a mould cavity corresponding in shape to the shape of such article,

the core element defining the inner contour of such sleeve and comprising a portion, which is of reduced diameter and which carries an inner shaping member to define the inner contour of said end portion of the sleeve, the inner shaping member being provided with an annular projection determining the shape of the recess in said end portion of the sleeve and being displaceable relative to the core element in the axial direction thereof to be withdrawable from a sleeve moulded in the mould cavity.

9. Apparatus as claimed in claim 8, wherein the mould is a two part mould.

10. Apparatus as claimed in either claim 8 or claim 9, wherein the mould comprises an individually displaceable outer shaping member to define the outer contour of said end portion of the sleeve from the end of the sleeve to the part of said end portion having the greatest diameter.

11. Apparatus as claimed in claim 10, wherein the outer shaping member is slidably mounted on the inner shaping member and/or on said reduced diameter portion of the core element and is connected with drive means to be displaceable away from a sleeve moulded in the mould cavity, the outer shaping member being provided with entraining means to entrain the inner shaping member after and only after displacement of the outer shaping means clear of the sleeve.

12. Apparatus as claimed in any one of claims 8 to 11, wherein the inner shaping member is provided with support means contiguous with the annular projection to support the free end of the sleeve after withdrawal of the annular projection from the sleeve.

13. Apparatus as claimed in any one of claims 8 to 12, comprising regulable heating means to heat the annular projection of the inner shaping member and/or the portion of the outer shaping member determining the outer contour of said end portion of the sleeve in the region of the recess.

14. Apparatus as claimed in any of claims 8 to 13, wherein at least the inner shaping member is provided with air outlets in its surface defining the inner contour of said end portion of the sleeve.

15. Injection moulding apparatus substantially as hereinbefore described with reference to Figs. 1 to 3 of the accompanying drawings.

16. Injection moulding apparatus substantially as hereinbefore described with reference to Fig. 4 of the accompanying drawings.

17. An injection moulding machine comprising injection moulding apparatus as



(21)

claimed in any one of claims 8-16 and being substantially as hereinbefore described with reference to Figs. 5 and 6 of the accompanying drawings.

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