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WO 2001/010182 A3

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(54) Abstract Title: **Method for making a moulded composite product**

(57) A method of moulding a composite product i.e. a gasket comprises a cladding 40 and a foam core 42 and comprises the steps of providing a foam material inside a cladding, moving the cladding and foam material through a die 12, and allowing the foam material to expand inside the die so that the product takes the shape of the die. The die may be a fixed die or formed from two or more belts (70 and 72 figure 4) which surround the product and contain it as the foam material expands. The die may be a metal aluminium die and the foam core may be a polyurethane material with a rigid plastic polypropylene insert (54 figure 30) around which the core may be moulded. Also included is an apparatus for producing such a moulded product.

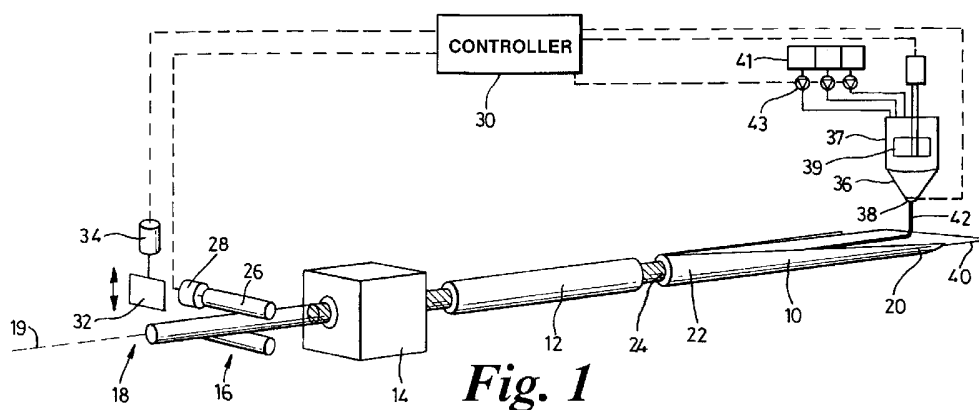


Fig. 1

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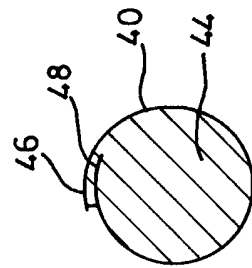
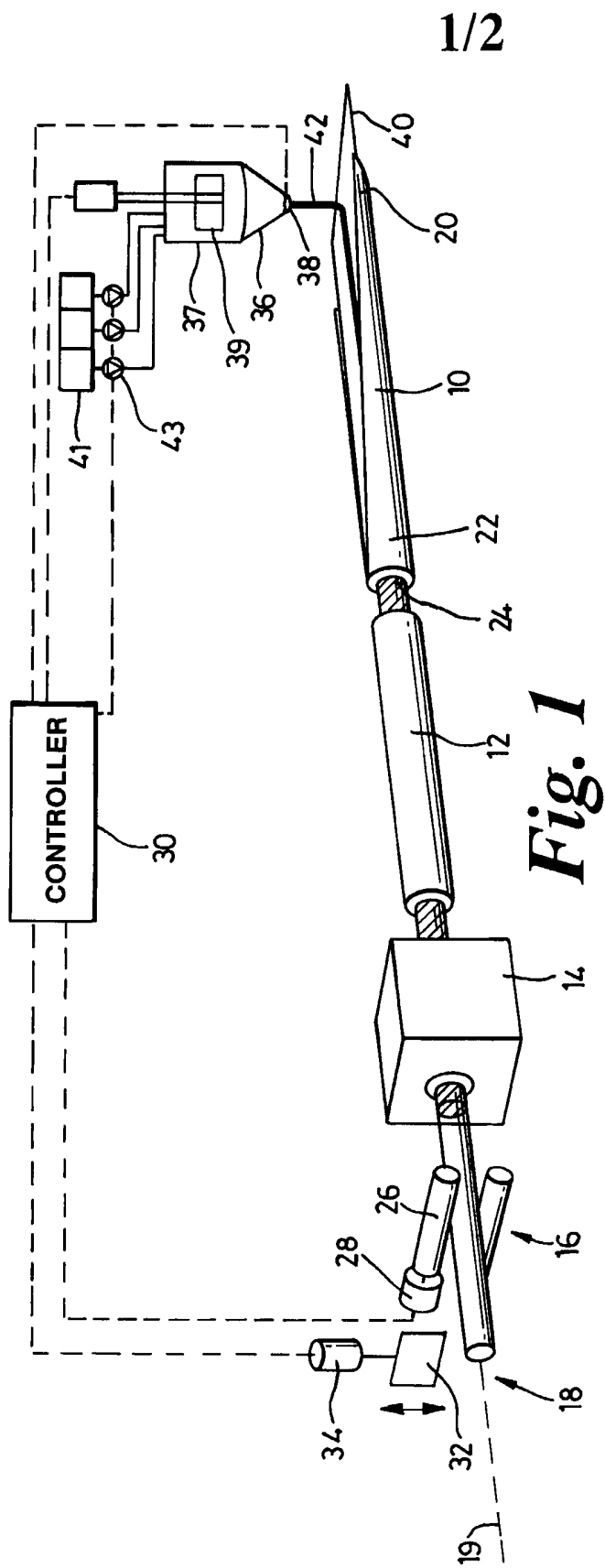


Fig. 2

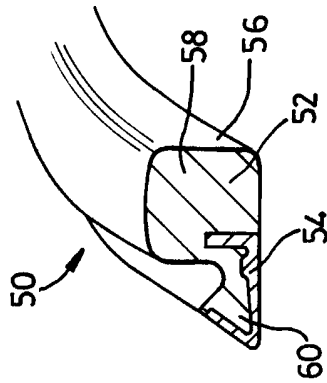


Fig. 3

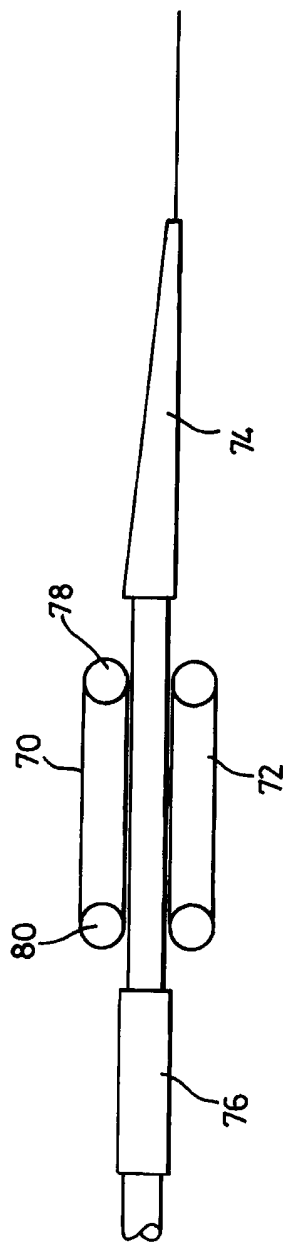


Fig. 4

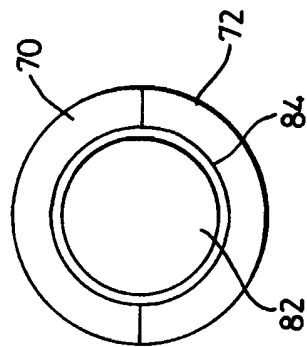


Fig. 5

MOULDING COMPOSITE PRODUCTS

The present invention relates to the moulding of composite products.

5 Moulded composite products of the type comprising a liner or cladding and a foam core are conventionally manufactured by a batch production process in which a die is provided to correspond to a desired final shape of the composite product. The liner is placed inside the mould and filled with nascent foam, which expands to fill the liner. On a production line,
10 these distinct steps may be carried out at a single location so that the flow of nascent foam is interrupted for each product formed.

According to the present invention there is provided a method of moulding a composite product comprising a cladding and a foam core, the
15 method comprising the steps of:
 providing a foam material inside a cladding;
 moving the cladding and foam material through a die; and
 allowing the foam material to expand inside the die so that the product takes the shape of the die.

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According to a further aspect of the invention there is provided apparatus for producing a moulded product, the apparatus comprising:

 means for providing a foam material inside a cladding;
 a die; and
25 means for moving the cladding and foam material through the die so that the foam material can expand within the die.

The die may be a fixed die. Alternatively, the die may be formed from two or more belts which surround the product and contain it as the foam
30 material expands.

The present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of an apparatus according to a
5 first embodiment of the invention;

Figure 2 is a sectional view through a moulded composite product formed by the apparatus of Figure 1;

Figure 3 is a sectional view through a composite product according to a further embodiment of the invention;

10 **Figure 4** is a schematic view of part of an apparatus according to a second embodiment of the invention; and

Figure 5 is a section through the apparatus of Figure 4.

Referring to Figure 1, a moulding apparatus for continuously moulding a
15 composite product such as a gasket comprises a former 10, a die 12, a curing station 14, pulling rollers 16 and a cutting station 18, all arranged in line along a processing axis 19, with the former 10 at the upstream end and the cutting station 16 at the downstream end.

20 The former 10 defines a channel having an upstream end 20 that is substantially flat and a downstream end 22 that defines an orifice 24. The curvature of the former 10 increases gradually and continuously from the upstream end to the downstream end as the cross section of the former therefore varies continuously along its length. The former 10 is arranged
25 to wrap a cladding around a foam core as will be described in more detail below.

The die 12, which is downstream of the former 10, is of constant cross section along its length, that cross section corresponding to the cross
30 section that the finished moulded product is to take. The die is formed of metal so as to have good thermal conductivity and has a smooth internal

surface to allow the moulded product to move smoothly through it. In this case the die is formed as an aluminium extrusion.

5 The curing station 14, which is downstream of the die 12, is a flash curing station arranged to heat the moulded product to cure it. Although one curing station is shown, several flash curing stations can be provided along the axis of the apparatus to cure the product in a number of steps.

10 The pulling station 16 is downstream of the curing station 14 and comprises driven rollers 26. One pair of rollers 26 is shown that are arranged to grip the moulded product between them and be rotated so that they can pull the product in a straight line through the former 10, die 12 and curing station 14. In practice further pairs of rollers could be included spaced along the same axis. The rollers are driven by motors 28
15 under the control of a system controller 30. The controller can therefore start and stop the rollers 26 and control the speed at which they rotate.

In a modification to the simple rollers 26, haul-off belts can be provided on opposite sides of the moulded product, each belt being supported on a
20 pair of spaced apart rollers so that it is in contact with the product over the length of the space between the rollers. This provides a much larger contact area with the moulded product and therefore improves the grip on the product and therefore the force with which it can be pulled through the apparatus.

25

The cutting station 18 comprises a cutting blade 32 driven by an actuator 34 which is also controlled by the controller 30. The controller can therefore control the timing of the cutting of the moulded product and hence the length to which it is cut.

30

A foam material dispensing nozzle 36 is arranged above the upstream end of the former 10 so that it can dispense foam material from a mixing chamber 37 onto the cladding as it passes onto the former. The nozzle includes a valve 38 that is controlled by the controller 30 which can
5 therefore control the rate at which the foam core material is applied to the cladding. Typically this valve is only used to start and stop the supply of nascent foam. The three constituents of the nascent foam mixture are supplied from respective reservoirs 41 by means of respective flow metering pumps 43. The pumps are controlled by the controller 30. A
10 mixer 39 is provided in the mixing chamber 37 to mix the constituents of the foam material. The required flow rate of the nascent foam from the nozzle 36, and the relative proportions of the constituents, are determined for the rate of feeding of the cladding 40, and the controller controls the pumps 43 to maintain these parameters. As the mixing chamber is closed,
15 the rate at which the constituents are pumped into it determines the rate at which the nascent foam is dispensed onto the cladding.

In operation, the cladding material 40 is fed continuously onto the open end 20 of the former 10 as a flat sheet from a roll (not shown). The
20 mixed constituents of the foam material 42 are applied to the cladding 40 as it passes over the open end 20 of the former. As the cladding is pulled through the former 10 the sides of the cladding are turned upward by the former. The circumference of the orifice 24 at the downstream end of the former 10 is less than the width of the strip of cladding material, so that
25 the edges of the cladding are caused to overlap and completely enclose the foam material as the cladding passes out of the former 10. As the foam material is carried over the former 10 by the cladding 40 it begins to foam and expand.

30 On leaving the former 10 through the orifice 24 the partly formed product then passes into the die 12. As the product, comprising the cladding 40

and the foam material, passes through the die, the foam material continues to expand and set so that the product takes the same cross sectional shape as the die 12. Referring to Figure 3, when the product leaves the die 12 the foam material 42 has expanded and at least partially hardened to form a solid, but resilient, foam core 44 with the cladding 40 surrounding it to form an outer layer covering the whole of the outer surface of the product. Some of the foam material 42 seeps between the two overlapped edges 46, 48 of the cladding, and adhesion between the foam material and the cladding holds the cladding in place around the core and secures the two edges of the cladding together. The cladding 40 is surface treated to improve adhesion between the foam 44 and the cladding.

When the moulded product has passed out of the die 12 it then passes into the curing station 14 where it is cured to harden the core 44. On passing out of the curing station 14 the product passes between the pulling rollers 26. These frictionally engage opposite sides of the product, specifically the cladding, and pull the product continuously through the former 10, die 12 and curing station 14. As the cladding is substantially non-elastic, it will be appreciated that pulling on the downstream end of the product pulls the cladding through the other components of the apparatus, and the cladding carries the foam material with it.

When the moulded and cured product passes through the cutting station 18 it is cut into the required lengths by the cutter 32 as controlled by the controller 30.

In one mode of operation, the rollers 26 are driven at a constant speed, and the product is therefore drawn through the former 10 and die 12 at constant speed. The flow of the foam material onto the cladding 40 is also controlled to be constant. The process therefore runs continuously, with

- the forming and shaping and curing steps being performed on the product (or its components) as it moves continuously through the respective parts of the apparatus, i.e. the former 10, die, 12 and curing station 14. Because the former 10, die 12, curing station 14, pulling rollers 14 and cutting station 18 are all spaced along a common straight axis 19, the product is kept in a straight condition throughout the whole process and each of its stages. The product is therefore not bent during any of the stages, or indeed over the whole process.
- 10 In a modification to this process, the speed of movement of the product along the production line may vary instead of being constant. This can allow for further control of the process to ensure that the final product has the required characteristics.
- 15 In another mode of operation, the cladding 40 and foam material 42 are advanced in stages through the apparatus. The product is thereby shaped in lengths, while those lengths are still joined together. When the product is stationary, one part or length of the product is located in the die 12, one length is located in the curing station, and one length is resting on the former 10. The product is therefore stationary during at least part of the shaping step within the former, and during curing. Between each stationary phase, the product is advanced through the apparatus. While it is moving, the nozzle 36 is opened to apply the foam material for one length or part of the product, while another length is moving into the die, and another length is moving into the curing station 14.
- 20
25

Clearly whether each part of the product only stops once in the die and once in the curing station 14 will depend on the relative lengths of those parts of the system, and the distance through which the product is moved at each step. The product could be advanced in a series of short steps so

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that each part of it stops several times in each section of the apparatus, and during each stage of the process,

Referring to Figure 3, a specific example of a product formed by the process described above is a composite weather seal or gasket 50 used on PVCu, timber or aluminium windows and doors in the construction industry. The gasket 50 includes a PU (polyurethane) foam core 52, a rigid plastic extruded insert 54, in this case made of polypropylene and a cladding 56. In cross section the gasket 50 has a main sealing portion 58 and a narrower retaining rib 60 extending along one side. The outer shape of the retaining rib 60 is formed by the insert 54 and the core 52 is moulded around the insert 54. The cladding 56 encloses the core 52 and the insert 54.

The core is formed from a high resilience foam formed from polyether polyhydroxyls (referred to as polyol), diisocyanates and water. The cladding 56 is made from a blend of LDPE and LLDPE. The cladding film has a nominal thickness of 100 to 150 microns and is surface treated to improve foam adhesion.

During moulding of this gasket, the insert 54 is extruded continuously and laid onto the cladding in a continuous feeding process. As an alternative it could be simply laid onto the cladding in lengths. As a further alternative, it can be extruded and stored on a coil, and then fed into the moulding apparatus from the coil at the same rate as the cladding 40.

For other applications different materials will be used. For example in EMI shielding applications, the cladding can be based on a nylon weave and the foam material include a high level of solid filler as a combustion modifier.

In applications where there is no requirement for an insert, a strengthening element, such as a glass fibre chord, can be embedded in the foam along the length of the product. This serves to increase the tensile strength of the finished product, but also helps to reduce stretching of the product as it is pulled through the moulding apparatus. The cord is then fed into the product from a coil in place of the insert.

Referring to Figure 4, in a modification to the embodiment of Figure 1, a pair of drive belts 70, 72, referred to as haul off belts, are provided to transfer the product between the former 74 and the die 76. The belts 70, 72 are provided on opposite sides of the product and are each supported on a pair of driven rollers 78, 80. As can be seen from Figure 5, the two belts 7, 72 are each profiled to fit against the surface of the product, and to fully enclose it, with the edges of the two belts coming into contact on either side of the product. As the internal shape of the belts is arranged to correspond to the desired shape of the finished product, the belts form a moving mould which moves at the same rate as the product, and serves to shape the product as the foam 82 expands within the cladding 84, as well as to transport the product from the former 74 to the fixed die 76.

CLAIMS

1. Method of moulding a composite product comprising a cladding
5 and a foam core, the method comprising the steps of:
 providing a foam material inside a cladding; and
 moving the cladding and foam material through a die; and
 allowing the foam material to expand inside the die so that the
product takes the shape of the die.
10
2. A method according to Claim 1, wherein the product is moved
substantially continuously through the die.
3. A method according to Claim 1 or Claim 2, wherein the product is
15 pulled through the die.
4. A method according to any foregoing claim wherein the foam
material is placed onto the cladding and the cladding is wrapped around
the foam material.
20
5. A method according to claim 4 wherein the cladding is wrapped
around the foam material by means of a former.
6. A method according to claim 5 wherein the cladding is wrapped
25 around the foam material by moving the cladding and foam through the
former.
7. A method according to any of claims 4 to 6 wherein the cladding is
wrapped around the core so as to completely enclose the core.
30

8. A method according to claim 7 wherein the cladding is wrapped so that its two edges overlap to enclose the core.
9. A method according to any of claims 5 to 8 wherein the cladding and foam are moved substantially continuously through the former.
10. Method according to any preceding claim wherein the liner is moved relative to the die at a constant speed.
11. Method according to any preceding claim including the step of curing the product after it has passed through the die.
12. Method according to any foregoing claim including the step of cutting the moulded product into a plurality of lengths.
13. Apparatus for producing a moulded product, the apparatus comprising:
means for providing a foam material inside a cladding; and
a die
means for moving the cladding and foam material through the die so that the foam material can expand within the die.
14. Apparatus according to claim 13 wherein the die is fixed.
15. Apparatus according to claim 13 or claim 14, wherein the die comprises a metal die.
16. Apparatus according to any of claims 13 to 15 further comprising a former arranged to wrap the cladding around the foam as the cladding is moved through the former.

17. Apparatus according to any of claims 13 to 15 further comprising a foam application means upstream of the former arranged to apply the foam material to the cladding.
- 5 18. Apparatus according to claim 17 wherein the foam application means is arranged to apply the foam material to the cladding substantially continuously.
19. Apparatus according to an of claims 14 to 18 further comprising
10 pulling means arranged to pull the cladding and foam through the die.
20. Apparatus according to claim 19 wherein the pulling means is arranged to pull the cladding and foam substantially continuously.
- 15 21. Apparatus according to claim 20 wherein the pulling means is arranged to pull the cladding and foam material at a substantially constant speed.
22. Apparatus according to any of claims 14 to 21 further comprising
20 cutting means arranged to cut the moulded product into lengths.
24. Apparatus according to any of claims 14 to 22 further comprising curing means arranged to cure the moulded product.
- 25 25. A method of moulding a composite product substantially as hereinbefore described with reference to the accompanying drawings.
26. Apparatus for moulding a composite product substantially as
hereinbefore described with reference to the accompanying drawings



INVESTOR IN PEOPLE

Application No: GB0508580.8

Examiner: Mr Haydn Gupwell

Claims searched: 1-24

Date of search: 30 June 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-22 and 24	WO 01/10182 A3 (AMESBURY GROUP INC) see whole document especially figures 1a-c showing foam 170, folding die 175, die heater 180, die belts 190, 195, drive wheels 225 and 230 and lines 10-24 page 5.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

B5A

Worldwide search of patent documents classified in the following areas of the IPC⁰⁷

B29C

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI