

PATENT SPECIFICATION

(11) 1 481 286

1 481 286

- (21) Application No. 37824/75 (22) Filed 15 Sept. 1975
(31) Convention Application No. 521 092
(32) Filed 5 Nov. 1974 in
(33) United States of America (US)
(44) Complete Specification published 27 July 1977
(51) INT CL² B29F 1/022; B29G 3/00
(52) Index at acceptance
B5A 1R14C1X 1R14C2 2A1 3D3 3D4B 3DX



(54) RUNNER MANIFOLD FOR INJECTION MOULDING MACHINE

(71) We, ~~THE~~ CONTINENTAL GROUP, INC., formerly Continental Can Company, Inc., a corporation organized and existing under the laws of the State of New York, United States of America, of 633 Third Avenue, New York 17, N.Y. United States of America, 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 by the following statement:—

This invention relates to injection moulding, and more particularly, to a runner manifold for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of injection nozzles in an injection moulding machine.

Injection moulding machines, of the kind in which a plurality of moulds are filled simultaneously, customarily employ a runner manifold to distribute the material to be moulded to the injection nozzles. The manifold is conventionally formed of a single block, runner passages being bored in the block from its outer surfaces. The interiors of the bores are virtually inaccessible, thereby inhibiting modification, adjustment or fine machining. Further, cleaning of such runner passages is difficult and time-consuming. If, as is the usual case, any changes of direction are required, each runner passage is formed of two or more intersecting bores, thereby imposing abrupt changes in the direction of flow. Certain polymers are adversely sensitive to such abrupt changes or the consequent turbulence.

To avoid these disadvantages, slit manifolds have been proposed which comprise a pair of manifold halves clamped or fastened together during injection. Half of each runner passage is provided in each of the adjacent faces of the manifold halves in the form of a recess or channel. Accordingly, the longitudinal axes of the passages normally lie in a single plane at the interface of the manifold halves, whereby

the configuration of the passages, as well as the pattern in which the moulds may be arrayed, is largely restricted. More importantly, the internal pressures acting on the wall of the runner passages tend to force the manifold halves apart, and therefore relatively great clamping forces are required to prevent leakage. The problem becomes acute in the face of relatively large internal pressures, in the range of 10,000 to 25,000 p.s.i. and greater, which may be necessary or desirable in employing certain synthetic resins and/or certain injection moulding techniques.

It has been known for some time that large internal pressures can be contained advantageously by surrounding the source of pressure with sector-shaped elements compressively engaged by an outer ring, each element thereby supporting adjacent elements laterally and transmitting to the outer ring forces arising from the central pressure where they are distributed uniformly with relatively moderate effect on the ring. Just such an arrangement is disclosed in United States Patent Specification No. 2,554,499 which describes and illustrates a device for generating very high pressures. Here the pressure fluid is wholly confined in a central hollow tube in which opposing pistons are received at either end. There is no flow, and the generation of high pressures is, in itself, the purpose of such a device.

According to the invention there is provided a runner manifold comprising means defining a plurality of runner passages for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of nozzles in an injection moulding machine, each of the runner passages being adapted to communicate at one end thereof with the source of synthetic resinous material and at the other end thereof with one of the nozzles, wherein the passages are defined by means including a plurality of sector-shaped

50

55

60

65

70

75

80

85

90

elements arranged in a continuous radial array, each sector-shaped element having a pair of opposed radially-extending lateral faces, each lateral face being in engagement with the corresponding lateral face of an adjacent sector-shaped element and having an elongate recess formed therein cooperating with the recess in said corresponding lateral face to define one of the runner passages.

According to another aspect of the invention there is provided a runner manifold for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of injection nozzles in an injection moulding machine, the manifold comprising; a hub member having an outer support surface, means defining a concavity in the hub member adapted to communicate with the material source, and means defining a plurality of ports in the hub member in communication with the concavity; a plurality of sector-shaped elements surrounding the hub member and cooperating to define a radially inner surface complementary to the support surface and in engagement therewith, a radially outer surface, and a pair of opposed end surfaces extending between the radially inner and outer surfaces, each sector-shaped element having a pair of opposed lateral faces extending radially between the radially inner and outer surfaces and intersecting the end surfaces, each lateral face being in engagement with the corresponding lateral face of an adjacent sector-shaped element and having an elongate recess formed therein cooperating with the recess in said corresponding lateral face to define a runner passage having an inlet in communication with one of the ports in the hub member, and an outlet at one of the end surfaces; and a clamping ring surrounding the sector-shaped elements and having an inner surface complementary to and in engagement with the radially outer surface defined by the sector-shaped elements.

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

Figure 1 is an end elevational view, partially in cross section, of a runner manifold constructed in accordance with the invention;

Figure 2 is a sectional view of the runner manifold taken along the line 2—2 of Figure 1 and showing adjacent features of an injection moulding machine in which the runner manifold is assembled;

Figure 3 is a partial elevational view of the runner manifold taken from an end opposite that of Figure 1; and

Figure 4 is a view similar to that of Figure 2 showing certain modifications in elements of the runner manifold.

Referring to Figures 1, 2 and 3, a runner manifold 10 comprises a plurality of sector-shaped elements 12 interposed between a clamping ring 14 and a hub member 16, Figure 2.

As illustrated, the sector-shaped elements 12 are six in number, but any plurality may be employed within practicable limits, as explained hereinafter. Each element 12 is identical with the others in form and is bounded by six faces, namely a curved inner face 18, Figure 1, a pair of generally rectangular and planar lateral faces 20 and 22 which diverge radially outwardly from the inner face, a curved outer face 24, a sector-like forward end face 26, Figure 2, and a sector-like rearward end face 28.

The inner faces 18 cooperate to define a cylindrical radially inner surface in engagement with a hub portion 30 of the hub member 16 formed with a cylindrical outer support surface 32 which is complementary to the radially inner surface. The engaged surfaces may take other forms; for example, they may be conical whereby to provide a press fit, or the hub portion 30 may be of prismatic form and the inner faces 18 planar. However, the cylindrical form permits relative ease and accuracy of machining and assists the equable distribution of forces acting on the engaged surfaces.

The outer faces 24 cooperate to define a cylindrical radially outer surface which is concentric with the radially inner surface and which is in engagement with a complementary inner cylindrical surface 34 of the clamping ring 14.

The end faces 26 cooperate to define a generally planar forward end surface. Similarly, a generally planar rearward end surface, parallel with and opposed to the forward end surface, is defined by the end faces 28.

Formed in each lateral face 20 is an elongate recess 36 of semicircular cross section, which at one of its ends intersects the inner face 18, extending therefrom in a generally continuous curve to the lateral face 20, and which at its other end intersects the end face 26, thereby dividing the face 22 into two coplanar portions on opposite sides of the recess. Each lateral face 22 is similarly provided with a recess 38 of form and dimensions identical with those of the recess 36 but reversed relative thereto, whereby the recesses 36 and 38 are mirror images of each other. Thus, when the lateral face 20 of any sector-shaped element 12 is in engagement with the corresponding lateral face 22 of an adjacent sector-shaped element, as illustrated in Figures 1 and 3, the respective recesses 36 and 38 are aligned and cooperate to define a runner passage 40 having an inlet 42 at the radially inner

surface defined by the faces 18, and an outlet 44 at the forward end surface defined by the faces 26. The runner passages 40 will of course be equal in number to the sector-shaped elements 12.

Each sector-shaped element 12 is provided with an internal heating passage 45, one of which is represented in its entirety by interrupted lines in Figure 1 and primarily by interrupted lines in Figure 2. Each heating passage is formed by a pair of intersecting bores generally parallel with the lateral faces 20 and 22, respectively, and permanently closed at their outer ends by plugs, one of which is visible at 45c in Figure 2. A second pair of bores, which extend inwardly from the end face 28 and intersect the heating passage 45 at right angles therewith, provide a heating inlet 45a and a heating outlet 45b.

The hub member 16 is provided at its rearward end with a hollow or concavity 46 of any suitable form from which a plurality of inlet ports 48, equal in number to the runner passages 40, diverge to intersect the outer support surface 32, each inlet port being aligned with one of the runner passages 40 and thereby being in direction communication with the respective runner passage inlet 42. At the forward end of the hub member 16 there is provided a cylindrical hub extension 50, of reduced cross section relative to the hub portion 30, which projects beyond the plane of the forward end surface defined by the end faces 26.

As illustrated in Figures 2 and 3, a plurality of injection nozzles 52 are secured to the manifold 10 by any suitable means such as socket-head machine screws 54. Each nozzle is in communication with the outlet 44 of a respective one of the runner passages 40 and overlies equal portions of adjacent sector-shaped elements 12. During injection, the nozzles 52 are held in engagement with any desired moulds suitable for injection moulding (one of which is represented fragmentarily at 56 in Figure 2) by any one of a number of well-known clamping means (not shown).

The hub member 16 is provided with an annular flange 58 which extends radially outwardly of the hub support surface 32 and engages the greater portion of the rearward end surface defined by the end faces 28 of the sector-shaped elements. At the forward end of the hub member 16 a retaining ring 60 is carried by the hub extension 50 and is secured against movement relative to the hub member by any suitable fastening means such as machine bolts 62. The retaining ring 60 engages the end faces 26 to preclude movement of the sector-shaped elements 12 in a forward direction relative to the hub member 16. The flange 58 precludes such movement in a rearward

direction, and because of its relatively large diameter, it also acts to preclude any cocking or skewing of the sector-shaped elements relative to each other and to the hub member 16.

Referring to Figure 2, the hub member 16, and thus the manifold 10 when assembled, is secured in an injection moulding machine by any suitable means such as socket-head machine screws 64. More particularly, the flange 58 is shaped to receive a plasticizer barrel 66 of the injection moulding machine, screws 64 being inserted through holes formed in the flange 58 to be threadedly received in the barrel 66. Additional support for the manifold 10 may be provided as necessary. A cylinder 68 defined by the barrel 66 is aligned with the concavity 46, a reciprocating plasticizer screw 70 being received in the cylinder. The screw and cylinder cooperate in well-known manner to comprise a source of synthetic resinous material in a flowable state, as briefly explained hereinbelow.

While the screw-and-cylinder arrangement shown is frequently employed in the injection moulding of thermoplastics, the invention may be used with any suitable source of material. Further, the invention is not limited to use with thermoplastics but also finds application in the injection moulding of thermosets.

Concentric with the barrel 66 and secured to the flange 58 by any suitable means, such as machine bolts 74, is an annular mounting member 72 on which an annular heating intake conduit 76 is mounted as by brazing or welding (not shown). An annular heating discharge conduit 78 is, in turn, mounted on the intake conduit by similar means. The intake conduit 76 communicates with each of the heating inlets 45a by means of a flexible hose 80, one of which is visible in Figure 2, and which is secured in position in the respective sector-shaped element 12 by a threaded fitting 82. Similar hose and fitting arrangements none of which is visible in the drawings, provide communication between the heating outlets 45b and the discharge conduit 78.

The heating conduits 76 and 78 are in communication with a source 84 of heating medium, shown diagrammatically in Figure 2, which is connected to a temperature control device 86. The heating medium source 84 includes a source of heat and suitable pump means, neither of which is shown.

Assembly of the manifold 10 is accomplished with relative ease and will be largely apparent from the foregoing description. Briefly, the mounting member 72, together with the heating conduits 76 and 78, is fastened to the flange 58, and thus to the hub member 16 by means of the bolts

70

75

80

85

90

95

100

105

110

115

120

125

130

74, and the hub member 16 is secured to the barrel 66 by means of the screws 42. A sub-assembly is formed by positioning the sector-shaped elements 12 within the clamping ring 14, thereby providing a central opening defined by the inner faces 18 of the sector-shaped elements. The sub-assembly is then mounted on the hub member 16, the hub portion 30 being received in the central opening. At this point the runner passages 40 are aligned with the inlet ports 48, which may be done by means of registry marks (not shown), for example, provided on the hub member and on the forward end faces 26. The retaining ring 60 is placed over the hub extension 50 and secured to the hub member by means of the bolts 62 which, when tightened, urge the ring 60 into firm engagement with the forward end faces 26. This in turn urges the sector-shaped elements 12, and more particularly the rearward end faces 28, into firm engagement with the flange 58, thereby axially positioning the sector-shaped elements precisely relative to the hub member 16. The injection nozzles 52 are now mounted on the forward end faces 26 by means of the screws 54, the flexible hoses 80 are secured in position by means of the threaded fittings 82, and the heating conduits 76 and 78 are connected to the heating medium source 84 to complete the assembly of the runner manifold with the injection moulding machine. It will be apparent, however, that the precise order of the assembly steps just described may be varied as desired within the limitations imposed by the particular physical characteristics of the various elements. Disassembly is accomplished as readily as assembly, essentially by reversing the foregoing procedure.

Compressive prestresses may be imparted to the sector-shaped elements and the hub member by means of either of two preferred procedures, as follows.

The sector-shaped elements 12 on the one hand, and the clamping ring 14 on the other, may be formed of materials having different predetermined coefficients of expansion, two such alloys of steel for example, the material selected for the sector-shaped elements having the greater coefficient of expansion. Thus, when the manifold 10 is heated by means of the heating passages 45, the sector-shaped elements will expand at a greater rate than the clamping ring, thereby giving rise to compressive prestresses acting on the sector-shaped elements and distributed over the faces 18, 20, 22 and 24. The hub member will also be subjected to compressive prestresses distributed over the support surface 32, while the clamping ring 14 will be subjected to tensile pre-stresses.

Alternatively, the sector-shaped elements and the clamping ring may be formed of the

same material, the clamping ring being pre-heated and shrink-fitted over the outer faces 24 of the sector-shaped elements by being allowed to cool.

The compressive prestresses act to hold adjacent lateral faces 20 and 22 in firm engagement to seal the respective runner passage 40 longitudinally, and also act to hold the inner faces 18 in firm engagement with the support surface 32 to effect a seal at the juncture of each inlet port 48 and the respective runner passage inlet 42.

Turning briefly to operation of the manifold 10, the heating medium source 84 is energized, and the temperature control 86 is adjusted to maintain a heating medium temperature which will in turn maintain the synthetic resinous material in a flowable state within the manifold. The heating medium, which is suitably a temperature-stable oil, is circulated from the source 84 to the heating intake conduit 76, thence to the heating passages 45 by way of the flexible hoses 80 and the heating inlet 45a. The heating medium is withdrawn from the heating passages by way of the heating outlets 45b and the associated flexible hoses (not shown) to the heating discharge conduit 78, whence it is returned to the source 84 and heated to repeat the cycle.

When the manifold has reached its operating temperature, a thermoplastic material in pellet or granulated form is introduced to cylinder 68 at a location removed from the concavity 46, and the plasticizer screw 70 is rotated to knead the plastics in cooperation with the wall of the cylinder. The plastics is thereby heated and reduced to a flowable state. (The plasticizer barrel 66 may include heating elements to provide a supplementary source of heat). As the screw rotates, the concavity 46 is filled with flowable plastics, and further accumulation of plastics acts to move the screw to the right as viewed in Figure 2. When a sufficient amount of flowable plastics has been accumulated, the screw is moved to the left as viewed in Figure 2 to fill the inlet ports 48, the runner passages 40 and the nozzles 52 with plastics and thereby place the injection moulding machine in condition for continuous operation.

The moulds 56 are then clamped in engagement with the nozzles 52. When a sufficient amount of plastics has again been accumulated, the screw 70 is moved to the left once more to fill the moulds. The moulds are removed from the nozzles and the injection procedure repeated continuously or intermittently as desired.

During injection, relatively high internal pressures are exerted on the wall of each pair of recesses 36 and 38 forming one of the runner passages 40.

The resultant forces are largely exerted in

directions normal to the corresponding lateral faces 20, 22, thereby tending to urge adjacent sector-shaped elements away from each other. However, large components of these forces are balanced because of the circular array of the sector-shaped elements. A second but smaller component acts radially outwardly on the clamping ring 14 and is substantially uniformly distributed about its inner surface 34, whereby the clamping ring 14 is subjected to tensile stresses.

Since the forces acting on the sector-shaped elements are primarily compressive, extremely high pressures within the runner passages 40 may readily be tolerated.

As previously mentioned, any number of sector-shaped elements 12 may be employed within practicable limits. The largest practicable number is determined by the minimum permissible or feasible transverse dimensions of the inner faces 18, the nozzles 52 and the runner passages 40.

Referring now to Figure 4, modified forms of hub member 16 and lateral face 20 are shown.

The hub member is provided with an annular relieved portion 16a to divide the support surface into two annular unrelieved support portions 16b and 16c in engagement with the inner face of the sector shaped element. Thus, the compressive forces acting on the hub member and the inner face are concentrated at the consequently reduced zones of engagement. Since one of these zones includes the inter-section of the recess 36 (and the recess 38, not shown in Figure 4) with the inner face, the sealing effect of such forces will be enhanced.

The modified lateral face 20, which may or may not be employed in association with the modified hub member, is similarly provided with a pair of relieved portions 20c on opposite sides of and spaced from the recess 36 to provide a pair of unrelieved coplanar portions 20a lying on either side of and immediately adjacent to the recess. The lateral face 22 (not shown in Figure 4) is similarly modified to provide a mirror image of face 20. Here again, compressive forces will be concentrated at the unrelieved portions to enhance sealing along the length of the runner passages.

A second pair of unrelieved portions 20b, coplanar with portions 20a, may be provided at locations remote from the recess 36 to negate any tendency of the sector-shaped elements to skew relative to the hub member and the clamping ring.

It will be noted that a manifold constructed in accordance with the invention provides complete access to the interiors of the runner passages, permitting them to be precisely machined in any desired configuration and in any desired direction.

Abrupt changes of direction may be entirely avoided. The runner passages may be formed with varying transverse dimensions along their lengths, or with internal projections, baffles or fluting intended to provide turbulent flow or assist laminar flow. They may be fitted with inserts of any suitable material or internal configuration, including unbroken tubular sleeves to provide a complete seal longitudinally. They may be cleaned conveniently and thoroughly.

Since the runner passages are arranged in a radial array, they may be of equal lengths to provide the same pressure at each nozzle; that is, the pressure drop from inlet to outlet will be the same for each runner passage. This is an important consideration, since it assists the filling of each mould evenly and uniformly.

WHAT WE CLAIM IS:—

1. A runner manifold comprising means defining a plurality of runner passages for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of nozzles in an injection moulding machine, each of the runner passages being adapted to communicate at one end thereof with the source of synthetic resinous material and at the other end thereof with one of the nozzles, wherein the passages are defined by means including a plurality of sector-shaped elements arranged in a continuous radial array, each sector-shaped element having a pair of opposed radially-extending lateral faces, each lateral face being in engagement with the corresponding lateral face of an adjacent sector-shaped element and having an elongate recess formed therein cooperating with the recess in said corresponding lateral face to define one of the runner passages.

2. A runner manifold for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of injection nozzles in an injection moulding machine, the manifold comprising: a hub member having an outer support surface, means defining a convavity in the hub member adapted to communicate with the material source, and means defining a plurality of ports in the hub member in communication with the concavity; a plurality of sector-shaped elements surrounding the hub member and cooperating to define a radially inner surface complementary to the support surface and in engagement therewith, a radially outer surface, and a pair of opposed end surfaces extending between the radially inner and outer surfaces, each sector-shaped element having a pair of opposed lateral faces extending radially between the radially inner and outer surfaces and intersecting the



directions normal to the corresponding lateral faces 20, 22, thereby tending to urge adjacent sector-shaped elements away from each other. However, large components of these forces are balanced because of the circular array of the sector-shaped elements. A second but smaller component acts radially outwardly on the clamping ring 14 and is substantially uniformly distributed about its inner surface 34, whereby the clamping ring 14 is subjected to tensile stresses.

Since the forces acting on the sector-shaped elements are primarily compressive, extremely high pressures within the runner passages 40 may readily be tolerated.

As previously mentioned, any number of sector-shaped elements 12 may be employed within practicable limits. The largest practicable number is determined by the minimum permissible or feasible transverse dimensions of the inner faces 18, the nozzles 52 and the runner passages 40.

Referring now to Figure 4, modified forms of hub member 16 and lateral face 20 are shown.

The hub member is provided with an annular relieved portion 16a to divide the support surface into two annular unrelieved support portions 16b and 16c in engagement with the inner face of the sector shaped element. Thus, the compressive forces acting on the hub member and the inner face are concentrated at the consequently reduced zones of engagement. Since one of these zones includes the inter-section of the recess 36 (and the recess 38, not shown in Figure 4) with the inner face, the sealing effect of such forces will be enhanced.

The modified lateral face 20, which may or may not be employed in association with the modified hub member, is similarly provided with a pair of relieved portions 20c on opposite sides of and spaced from the recess 36 to provide a pair of unrelieved coplanar portions 20a lying on either side of and immediately adjacent to the recess. The lateral face 22 (not shown in Figure 4) is similarly modified to provide a mirror image of face 20. Here again, compressive forces will be concentrated at the unrelieved portions to enhance sealing along the length of the runner passages.

A second pair of unrelieved portions 20b, coplanar with portions 20a, may be provided at locations remote from the recess 36 to negate any tendency of the sector-shaped elements to skew relative to the hub member and the clamping ring.

It will be noted that a manifold constructed in accordance with the invention provides complete access to the interiors of the runner passages, permitting them to be precisely machined in any desired configuration and in any desired direction.

Abrupt changes of direction may be entirely avoided. The runner passages may be formed with varying transverse dimensions along their lengths, or with internal projections, baffles or fluting intended to provide turbulent flow or assist laminar flow. They may be fitted with inserts of any suitable material or internal configuration, including unbroken tubular sleeves to provide a complete seal longitudinally. They may be cleaned conveniently and thoroughly.

Since the runner passages are arranged in a radial array, they may be of equal lengths to provide the same pressure at each nozzle; that is, the pressure drop from inlet to outlet will be the same for each runner passage. This is an important consideration, since it assists the filling of each mould evenly and uniformly.

WHAT WE CLAIM IS:—

1. A runner manifold comprising means defining a plurality of runner passages for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of nozzles in an injection moulding machine, each of the runner passages being adapted to communicate at one end thereof with the source of synthetic resinous material and at the other end thereof with one of the nozzles, wherein the passages are defined by means including a plurality of sector-shaped elements arranged in a continuous radial array, each sector-shaped element having a pair of opposed radially-extending lateral faces, each lateral face being in engagement with the corresponding lateral face of an adjacent sector-shaped element and having an elongate recess formed therein cooperating with the recess in said corresponding lateral face to define one of the runner passages.

2. A runner manifold for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of injection nozzles in an injection moulding machine, the manifold comprising: a hub member having an outer support surface, means defining a convavity in the hub member adapted to communicate with the material source, and means defining a plurality of ports in the hub member in communication with the concavity; a plurality of sector-shaped elements surrounding the hub member and cooperating to define a radially inner surface complementary to the support surface and in engagement therewith, a radially outer surface, and a pair of opposed end surfaces extending between the radially inner and outer surfaces, each sector-shaped element having a pair of opposed lateral faces extending radially between the radially inner and outer surfaces and intersecting the



end surfaces, each lateral face being in engagement with the corresponding lateral face of an adjacent sector-shaped element and having an elongate recess formed therein cooperating with the recess in said corresponding lateral face to define a runner passage having an inlet in communication with one of the ports in the hub member, and an outlet at one of the end surfaces; and a clamping ring surrounding the sector-shaped elements and having an inner surface complementary to and in engagement with the radially outer surface defined by the sector-shaped elements.

3. A runner manifold according to Claim 2, including means preventing relative movement between the hub member and the sector-shaped elements in at least one axial direction.

4. A runner manifold according to Claim 2 or Claim 3, wherein the hub member includes a flange extending radially outwardly of the support surface in engagement with one of the end surfaces defined by the sector-shaped elements.

5. A runner manifold according to any one of Claims 2 to 4, including a retaining member secured to the hub member and engaging one of the end surfaces defined by the sector-shaped elements.

6. A runner manifold according to any one of Claims 2 to 5, wherein the hub member includes a hub extension of reduced transverse dimension relative to the support surface and projecting beyond the plane of one of the end surfaces defined by the sector-shaped elements, the manifold including a retaining ring carried on the hub extension in engagement with said one end surface, and means securing the retaining ring against movement relative to the hub member.

7. A runner manifold according to any one of Claims 2 to 6, wherein each lateral face is generally planar and is traversed by the elongate recess therein to divide the face into two coplanar face portions lying on opposite sides of the recess, each of the face portions being in substantially continuous engagement with the corresponding face portion of an adjacent sector-shaped element.

8. A runner manifold according to any one of Claims 2 to 6, wherein each lateral face is traversed by the elongate recess therein and includes relieved portions thereof on each side of the recess in spaced relation thereto to provide a pair of unrelieved coplanar face portions lying on opposite sides of the recess and immediately adjacent thereto, each of the unrelieved face portions being in substantially continuous engagement with the corresponding unrelieved face portion of an adjacent sector-shaped element.

9. A runner manifold according to Claim 8, wherein each lateral face includes a second pair of unrelieved face portions coplanar with the first pair of unrelieved face portions and lying on opposite sides of and remote from the elongate recess, each of the second pair of unrelieved face portions being separated from the first pair of unrelieved face portions by one of the relieved portions, each of the second pair of unrelieved face portions being in engagement with the corresponding unrelieved face portion of an adjacent sector-shaped element.

10. A runner manifold according to any one of Claims 2 to 9, wherein the runner passages intersect the radially inner surface defined by the sector-shaped elements at the inlets of the runner passages, the hub member including a relieved portion dividing the support surface of the hub member into a pair of unrelieved support portions thereof, the ports in the hub member intersecting one of the unrelieved support portions, said one unrelieved support portion being in engagement with the radially inner surface at a zone thereof which includes the runner passage inlets.

11. A runner manifold according to any one of Claims 2 to 10, wherein the clamping ring is shrink-fitted over the radially outer surface defined by the sector-shaped elements.

12. A runner manifold according to any one of Claims 2 to 10, including means for heating the sector-shaped elements, the clamping ring being formed of a first material having a predetermined coefficient of expansion, the sector-shaped elements being formed of a second material having a pre-determined coefficient of expansion greater than that of the first material, whereby when the heating means is energized, the sector-shaped elements are subjected to compressive stresses.

13. A runner manifold according to Claim 2, wherein the outer support surface of the hub member is cylindrical, wherein the sector-shaped elements co-operate to define a cylindrical radially inner surface complementary to the support surface and in engagement therewith, a generally planar forward end surface, and a generally planar rearward end surface opposed to the forward end surface, wherein each runner passage inlet is at the radially inner surface aligned with one of the ports in the support surface and each runner passage outlet is at said forward end surface, and wherein the clamping ring has a cylindrical inner surface complementary to and in engagement with the radially outer surface defined by the sector elements.

14. A runner manifold according to Claim 13, wherein the hub member includes an



1,481,286

7
annular flange concentric with and extending radially outwardly of the support surface at the end of the hub member having the concavity, the flange being in engagement with the rearward end surface defined by the sector-shaped elements, the hub member including at the other end thereof a hub extension of reduced transverse dimension relative to the support surface and projecting beyond the plane of the forward end surface defined by the sector-shaped elements, the manifold including a retaining ring carried on the hub extension in engagement with the forward end surface, and means securing the retaining ring against movement relative to the hub member.

15. A runner manifold according to Claim 13 or Claim 14, wherein the generally planar rearward surface is generally parallel with the generally planar forward end surface, wherein each lateral face extends from the radially inner surface to the forward end face and on each side of the recess formed therein has relieved portions disposed in spaced relation to the recess to provide a pair of unrelieved co-planar portions lying on opposite sides of the recess and immediately adjacent thereto, wherein each recess co-operates with the recess in the corresponding lateral face of an adjacent sector-shaped element to define a runner passage, and wherein each of the unrelieved face portions are in substantially continuous engagement with the corresponding unrelieved face portion of an adjacent sector-shaped element.

16. A runner manifold according to Claim 15, wherein each lateral face includes a second pair of unrelieved face portions

coplanar with the first pair of unrelieved face portions and lying on opposite sides of and remove from the elongate recess, each of the second pair of unrelieved face portions being separated from the first pair of unrelieved face portions by one of the relieved portions, each of the second pair of unrelieved face portions being in engagement with the corresponding unrelieved face portion of an adjacent sector-shaped element.

17. A runner manifold according to Claim 15 or Claim 16, wherein the hub member includes a relieved portion dividing the support surface of the hub member into a pair of unrelieved support portions thereof, the ports in the hub member intersecting one of the unrelieved support portions, said one unrelieved support portion being in engagement with the radially inner surface at a zone thereof which includes the runner passage inlets.

18. A runner manifold according to any one of Claims 1 to 17 in combination with an injection moulding machine having a source of synthetic resinous material in a flowable state and a plurality of injection nozzles.

19. A runner manifold for conducting a synthetic resinous material in a flowable state from a source thereof to a plurality of injection nozzles in an injection moulding machine, substantially as herein described with reference to and as illustrated in the accompanying drawings.

PAGE, WHITE & FARRER,
Chartered Patent Agents,
27, Chancery Lane,
London WC2A 1NT.
Agents for the Applicants.