

SPECIFICATION

Nozzle for a plastics injection-moulding machine, an extruder orifice member or a hot-passage tool

5 The present invention relates to a nozzle for a plastics injection-moulding machine, an extruder orifice member or a hot-passage tool, comprising an electrically operated heating member which has a flow passage for the plastics melt, a casing and, in the region of the forward end, a discharge opening or openings, with the cross-sectional area of the member reducing towards the tip of the nozzle. 5

A heating member of this type is known (French patent specification No 1 226 094), wherein electrical heating is effected by means of a secondary circuit of a transformer. The heating member has a cylindrical or tapered body which is provided with a multiplicity of passages extending in the longitudinal direction. At a spacing from the tip of the nozzle and from the feed opening for the plastics material, this body is enclosed by two rings which, together with the body portion disposed therebetween, form part of the secondary circuit of the transformer, so that this part of the body is electrically heated. The nozzle tip of the heating member is not heated directly. 10 15

Also known is a multiple injection-moulding mould for thermoplastic synthetic materials, having at least one point injection for each moulding (AT patent specification No 286 607), which comprises a mould plate which contains the mould nests and a distributor plate which covers the mould nests and which can be connected to the injection head. Provided in the distributor plate are distributor passages and injection passages which can be heated by heating wires. The heating wires are extended to a position directly in front of the injection openings. In the injection passages of this form, the heating wire is in a U-shape configuration. As the injection passages are cylindrical, the plastics melt cannot be heated uniformly by means of the heating wire which is bent into a U-shape. Added to this is the fact that the bent bottom portion of the U-shape, which is towards the injection opening, must be at a relatively large distance from the injection opening, because of its configuration. For satisfactory operation of a multiple injection-moulding mould of this kind however, it is necessary for intensive heating of the plastics melt to be effected precisely in the region of the injection opening. 20 25

Also known is a hot-passage tool (US patent specification No 3 520 026) wherein the heating member is in the form of a mandrel and is arranged centrally in the injection passage of the tool. Provided between the heating mandrel and the wall of the passage is an annular flow passage for the plastics melt, with the plastics melt being heated in the annular flow passage. As this flow passage is defined by a cooled tool wall, this heating arrangement does not have a high level of efficiency. The highest temperature point in the known construction is displaced inwardly relative to the front tip end of the heating mandrel. This means that the highest temperature of the heating member is also not attained in the region of the injection opening. 30 35

The invention is based on the problem of constructing a nozzle of the above-defined kind in such a way that the heating member transmits the heat quickly and with a high level of efficiency to the plastics melt, even in the region of the discharge openings and the nozzle tip, and the highest temperature is developed in the region of the nozzle tip.

According to the invention, there is provided a central heating bar which is connected to the casing at the front nozzle tip, the cross-section of the heating bar decreases to the front end, a portion of large surface area is provided between the decreasing portion and the shank portion of the heating bar, the maximum cross-section of the portion of large surface area is equal to or larger than that of the shank portion and the decreasing portion of the heating bar and the portion of large surface area are disposed in the region of the discharge opening or openings. 40

In the subject of the invention, the flow passage for the plastics melt is defined by electrically heated parts, up to the tip of the heating member. Besides the reduction in cross-section of the heating bar, and the high production of heat as a consequence in the tip of the heating bar, there are also means which can deliver the heat intensively to the melt. This is effected by the part of the heating bar which is disposed between the tip and the shank portion being of considerably larger surface area. By means of this large area, a sufficient amount of heat can be transmitted to the melt. 45 50

There is a uniform temperature along the for example cylindrical shank portion of the heating bar. In the region of the enlarged portion, the conducting cross-section may be about twice as large, due to upsetting of the material, so that less heat is produced in this section, as a result of the lower electrical resistance. The production of heat rises again towards the tip, as the cross-section decreases very quickly. The enlarged section of the heating bar has a very large surface area and, with a larger cross-sectional area than the shank portion of the heating bar, has a lower degree of self-heating. This causes a drop in heat production in a direction away from the tip in which there is a very great deal of heat produced. If the components are of suitable dimensions, it is possible to have a virtually continuous variation in temperature into the tip. 55

The construction of the heating member with a central heating bar, for example, from chromium-nickel steel, which is connected to the casing at the front end, and defining the front discharge opening or openings by one or more bar portions which are capable of carrying a high load ensure that the heating member has a long service life, even under the impact loadings caused by the plastics melt which is shot into the heating member. 60

Practical experience shows that a tool provided with the heating members according to the invention is ready for operation again in a short time after a break in operation. For this purpose, only the electrical 65

heating of the heating member is required.

As there is no need for electrical control of the heating member during operation, it is possible to use only an economical control unit.

Embodiments of the invention are illustrated in the drawings and are described hereinafter.

5 In the drawings:

Figure 1 shows a view in cross-section of part of a hot-passage tool,

Figure 2 shows a view in vertical section of one of the heating members shown in *Figure 1*,

Figure 3 shows a view in the direction of arrow III in *Figure 2*,

Figure 4 shows a perspective view in cross-section of the heating member shown in *Figure 2*,

10 *Figures 5, 6 and 7* show views in cross-section of the rear casing portion of the heating member, in different operating positions,

Figures 8, 9 and 10 show views in horizontal section through the front end of different heating members,

Figure 11 shows a modified form of the front end of the heating member,

Figure 12 shows a view in the direction of arrow XII in *Figure 11*,

15 *Figure 13* shows a view in the direction of arrow XIII in *Figure 11*,

Figures 14, 15 and 16 show views in horizontal section through the front end of different heating members with bar portions which define the discharge openings being turned through 90°,

Figure 17 shows a perspective view of a unit comprising three heating members,

Figure 18 shows a view in cross-section of a further embodiment of a heating member,

20 *Figure 19* shows structural details of the heating member of *Figure 18*,

Figure 20 shows a perspective view of a further embodiment of a heating member,

Figure 21 shows a structural detail of the heating member of *Figure 20*,

Figures 22, 23 and 24 show further embodiments of heating members in which the casing comprises two portions which are electrically insulated from each other,

25 *Figure 25* shows a view in cross-section of a heating member in which the casing is made in one piece, and

Figures 26, 27, 28 and 29 show further embodiments of the configuration of the front end of the heating member.

The hot-passage injection-moulding tool shown in *Figure 1* has a receiving sleeve 1 for a machine nozzle.

A distributor passage 2 is filled by way of the machine nozzle, an elongated heating wire 3 for heating the plastics melt being provided in the passage 2. From the distributor passage 2, the plastics melt passes into heating members 4 which project with their rearward ends into the distributor passage 2. The plastics melt flows through the heating members 4 and passes by way of the discharge openings 5 at the front end of the heating members, into the nests of moulds at 6. The tool is opened in the plane indicated at 7, for removing the mouldings from the mould, once the mouldings have set. The mouldings are removed from the nest of moulds by the ejectors 8.

In the embodiment shown in *Figures 2 to 4*, the heating member comprises a central heating bar 9 and a front casing portion and a rear casing portion, indicated at 10 and 11 respectively. The two casing portions are electrically insulated from each other by insulating plates or discs 12 and 13. The casing portions are connected together by way of the heating bar 9.

40 In the embodiment shown in *Figures 2 to 4*, the feed of current is by way of a plug contact 14 and a contact ring 15 which is conductively connected to the rear casing portion 11. The flow of current is indicated in *Figure 2*. The flow of current is by way of the contact ring 15, the rear casing portion, the heating bar and the front casing portion which is connected to earth. The heating bar may be made from chromium-nickel steel while the casing portions 10 and 11 are manufactured from a structural steel. The heating bar 9 is provided with a lance-like tip 16 which is square or rectangular in cross-section and which merges into the round part of the heating bar. Temperatures of up to 400°C may be produced in the heating member. In the embodiment shown in *Figures 1 to 4*, two bar portions 17 and 18 are connected to the front end of the heating bar. The bar portions 17 and 18 are integral with the front casing portion 10 and are bent towards the heating bar from the outer edge of the casing portion. Together with the front end of the heating bar, the bar portions 17 and 18 define the discharge openings 5 of the heating member. The discharge openings 5 in the front casing portion 10 begin upstream of the reduction in cross-section of the heating bar. The lateral projecting portions of the lance-like end 16 of the heating bar extend outwardly through the discharge openings 5. This provides for intensive surface contact between the front end of the heating bar and the plastics melt, which results in optimum heat exchange between the heating bar and the plastics melt. Depending on the cross-sections selected, the bar portions 17 also heat the plastics melt, although there is a temperature drop between the front end of the heating bar and the bar portions 17 and 18.

The above-described configuration of the front end of the heating member and the current circuit provided thereby produce intensive heating in the direct region of the injection opening leading to the nest of moulds in the moulding tool.

60 However, the front end of the heating member is also of such a configuration that it can carry high compression loadings. In this connection, account should be taken of the fact that the plastics melt is shot into the tool from the injection-moulding machine nozzle, under a pressure of about 1200 kp/cm². When this occurs, high injection speeds occur, which involve uncontrollable dynamic flow loadings.

As the heat exchange between the active heaters of the heating member and the plastics melt occurs directly, without any interposed materials, the heating member operates virtually without any inertia.

The rearward part 19 of the front casing portion 10 is of larger diameter than the remainder of the casing portion and, in the embodiment shown in Figures 2 and 4, is in the form of a cylindrical chamber 20 which partly receives the rear casing portion 11, the contact ring 15 and the two insulating discs 12 and 13. The chamber 20 can be closed by way of a ring nut 21.

5 The heat loadings on the heating member can be absorbed by one of the casing portions being in the form of an expansion compensating means. 5

For this purpose, in the embodiment shown in Figures 2 to 4, the rear casing portion 11 is alternately provided with openings 22 in the shape of a circular segment. In the cold condition of the heating member, the openings 22 may be compressed in the region of their edges which are at the periphery of the casing portion, as shown in Figure 7. While Figure 7 shows the starting condition of the rear casing portion, Figures 10 5 and 6 show operating conditions which occur when the heating member is subjected to a thermal loading. Figure 5 can also be the starting condition.

The flow of electrical current can also be influenced by the openings 22 and by a particular selection in respect of their arrangement. This makes it possible to influence the temperature pattern in the heating 15 member. 15

The plastics melt flows into the interior of the rear casing portion 11 from the distributor passage 2 by way of openings 23.

The flow passage for the plastics melt, which is defined by the central heating bar 9 and 16 and the casing portions 10 and 11 is indicated by reference numeral 24.

20 It will be seen from Figures 9 and 10 that, at the front end, the heating bar 9 may also be of a cross-like or star-like configuration. In Figure 9, four bar portions 25 are associated with the front end of the heating bar, while the construction shown in Figure 10 has three bar portions 26. Like the bar portions 17 and 18 in the front tip of the heating member, the bar portions 25 and 26 are also connected to the heating bar. 20

Figures 11 to 13 show the front end of a heating member wherein the bar portions 27 and 28 which are 25 connected to the casing portion 10 are turned through 90° before they are joined to the heating bar 9. This measure reduces the flow resistance of the plastics melt in the region of the front discharge openings 5. Mixing and homogenisation of the plastics melt is achieved at the same time. 25

Figure 14 shows a view in section taken along line XIV-XIV in Figure 12.

Figures 15 and 16 show that the front end of the heating bar may also be of a configuration which differs 30 from the lance-like shape, in this construction with the bar portions which are turned through 90°. Figure 15 shows a heating bar which is of a cross-like configuration, while Figure 16 shows a heating bar of a star-like configuration. The bar portions 29 and 30 which are associated with the heating bars are also turned through 90° relative to the casing portion and are then joined to the front tip of the heating bar by welding or soldering. 30

35 Figure 17 shows that the rearward part 19 of the front casing portion 10 may also be of a square or rectangular configuration or block-like. A common block may also be associated with a plurality of heating members. 35

In the embodiment shown in Figures 18 and 19, the rear casing portion 31 is in the form of a cylindrical coil spring. At its rearward end, the coil spring is connected to the heating bar 9 by way of a holding bar member 40 32. Otherwise, the structure of the heating member shown in Figure 18 is the same as that shown in Figure 2. 40

In the embodiment shown in Figures 20 and 21 the rear casing portion 33 is of a sieve-like construction and is provided with longitudinal slots 34. When the heating member is subjected to a thermal loading in operation, the bars which define the longitudinal slots may be deformed and may assume for example the shape indicated in dash-dotted lines in Figure 21.

45 Figure 22 shows a heating member in which the front casing portion 35 is provided with slots or openings 36 which permit compensation for expansion of the casing, under the influence of the thermal loading in operation of the heating member. The rear casing portion 37 is of a disc or plate-like configuration and has through-flow passages 38 for introducing the plastics melt into the flow passage 39. The front casing portion is electrically insulated from the rear casing portion 37 by an insulating disc or plate 40. An insulating disc or 50 plate 42 is also provided between the rear casing portion 37 and the end plate portion of the cap nut 41 which secures the two casing portions together. 50

In the embodiment shown in Figure 23, the rear casing portion 43 is provided with a metal diaphragm 44 which is provided with through-flow bores 45 for the plastics melt. The inside edges of the metal diaphragm are fixedly connected to the heating bar 9 so that heat compensation as between the functional components 55 of the heating member can be effected by means of the diaphragm. 55

Figure 24 shows a heating member in which the front casing portion 46 and the rear casing portion 47 are electrically insulated from the injection tool. The insulation used is provided by insulating discs or plates 48, 49 and 50 and the sleeve 51. The current is passed by way of the connections 52 and 53. The contact ring 54 and the rearward part 55 of the front casing portion 46 are arranged in a cylindrical annular chamber 56 60 which is closed by a ring nut 57. 60

It will be seen from Figures 26 and 27 that the front end of the heating bar may be in the form of a separate shaped member 58. The shaped member 58 may be in the form of a sheet metal stamping or a punching. The discharge openings in this construction are defined by bar portions which are in the form of a U-shaped member 59. As can be seen in particular from Figure 27, the shaped members are form-lockingly fitted 65 together and are then joined together and to the heating bar 60 by welding or soldering. 65

It is also possible for the front end of the heating member to be constructed as shown in Figures 28 and 29. In this construction, the bar portions which define the discharge openings are formed by angular shaped members 61 which are fitted into and secured in recesses 62 in the front tip of the heating bar, and connected at the other end to the front casing portion 63.

- 5 In the above-described embodiments, the heating bars shown are of circular cross-section. It will be appreciated that it is also possible to use heating bars which are of a non-circular cross-section. 5

It has been found desirable for the ratio between the surface area of the heating bar in the region of the flow passage, and the inside surface area of the casing, to be from 1:1.5 to 1:3.5 and preferably from 1:1 to 1:3. An optimum ratio is 1:2.5.

- 10 If the heating member is designed in this way, the plastics melt forms an insulating layer on the inside of the casing portions, and this layer has been found to be advantageous for operating the heating member, in a certain thickness. After a break in operation, and after the heating member has been heated up again, the desired internal insulating layer is re-formed from the material of the plastics melt. 10

- Figure 25 shows a heating member in which a one-piece metal casing 65 is associated with the heating bar 64. The heating bar is connected at the front end to the bar portions 66 of the casing. Electrical insulation in the region of the rear end of the casing, between the heating bar 64 and the casing, is provided by means of a sealing means 67. The sealing means 67 also defines the flow passage 68 in the heating member at the rearward end, to which the plastics melt is supplied by way of a lateral inlet opening 69. The sealing means bears against an internal flange 70 in the casing. The flange 70 defines an opening for the heating bar 64 to pass therethrough. The sealing means is secured in the casing by way of a ring nut 71. 15 20

The tip of the heating member may be provided with a valve ball which is adapted to the valve seat in the pre-chamber sleeve or in the mould nest.

- In operation, the above-described insulating discs or plates are subjected to a loading by high temperatures. When the heating member is used in a machine nozzle, high pressure loadings of 5 to 10 kg/cm² also occur. So that the assembly can carry these loadings, the insulating plates or discs are of a large surface area and are made from aluminium oxide-ceramic. The axial pressures which occur in operation and which must be carried by the machine nozzle produce additional impact loadings on the insulating plates or discs. 25

30 CLAIMS 30

1. A nozzle for a plastics injection-moulding machine, an extruder orifice member or a hot-passage tool, comprising an electrically operated heating member which has a flow passage for the plastics melt, a casing and, in the region of the forward end, a discharge opening or openings, with the cross-sectional area of the member reducing towards the tip of the nozzle, wherein there is provided a central heating bar which is connected to the casing at the front nozzle tip, the cross-section of the heating bar decreases to the front end, a portion of large surface area is provided between the decreasing portion and the shank portion of the heating bar, the maximum cross-section of the portion of large surface area is equal to or larger than that of the shank portion and the decreasing portion of the heating bar and the portion of large surface area are disposed in the region of the discharge opening or openings. 35 40

2. A nozzle according to claim 1 wherein the casing comprises two portions which are in one or more pieces, and the two casing portions are electrically insulated from each other.

3. A nozzle according to claim 1 wherein the casing is made in one piece and is electrically insulated from the heating bar in the region of the rear end, by way of a sealing means.

- 45 4. A nozzle according to claim 3 wherein the sealing means delimits the flow passage of the heating member at the rear end and the plastics melt can be passed into the flow passage by way of a lateral inlet opening. 45

5. A nozzle according to claim 3 or claim 4 wherein the sealing means is supported on an internal flange of the casing which flange delimits an opening for the heating bar passing therethrough, while at the other side the sealing means is secured by means of a ring nut. 50

6. A nozzle according to claim 1 wherein the discharge opening or openings in the front casing portion begins or begin in front of the portion of the heating bar.

7. A nozzle according to claim 1 wherein bar portions which delimit the discharge openings are integral with the front casing portion and are bent away from the casing portion and converge forwardly to a tip. 55

8. A nozzle according to claim 7 wherein the bar portions which are integral with the casing are connected to the front end of the heating bar, after turning through 90°.

9. A nozzle according to claim 1 wherein bar portions which delimit the discharge openings are shaped members which are connected to the front end of the heating bar and to the front casing portion.

- 60 10. A nozzle according to claim 1 wherein the front end of the heating bar is in the form of a separate shaped member preferably in the form of a sheet metal punching or stamping. 60

11. A nozzle according to claim 9 wherein the bar portions which delimit the discharge openings are in the form of a U-shaped shaped member preferably a sheet metal stamping.

12. A nozzle according to claim 1 or claim 2 wherein the front end of the heating bar is of a lance-like configuration of square or rectangular cross-section. 65



It is also possible for the front end of the heating member to be constructed as shown in Figures 28 and 29. In this construction, the bar portions which define the discharge openings are formed by angular shaped members 61 which are fitted into and secured in recesses 62 in the front tip of the heating bar, and connected at the other end to the front casing portion 63.

5 In the above-described embodiments, the heating bars shown are of circular cross-section. It will be appreciated that it is also possible to use heating bars which are of a non-circular cross-section. 5

It has been found desirable for the ratio between the surface area of the heating bar in the region of the flow passage, and the inside surface area of the casing, to be from 1:1.5 to 1:3.5 and preferably from 1:1 to 1:3. An optimum ratio is 1:2.5.

10 If the heating member is designed in this way, the plastics melt forms an insulating layer on the inside of the casing portions, and this layer has been found to be advantageous for operating the heating member, in a certain thickness. After a break in operation, and after the heating member has been heated up again, the desired internal insulating layer is re-formed from the material of the plastics melt. 10

Figure 25 shows a heating member in which a one-piece metal casing 65 is associated with the heating bar 64. The heating bar is connected at the front end to the bar portions 66 of the casing. Electrical insulation in the region of the rear end of the casing, between the heating bar 64 and the casing, is provided by means of a sealing means 67. The sealing means 67 also defines the flow passage 68 in the heating member at the rearward end, to which the plastics melt is supplied by way of a lateral inlet opening 69. The sealing means bears against an internal flange 70 in the casing. The flange 70 defines an opening for the heating bar 64 to pass therethrough. The sealing means is secured in the casing by way of a ring nut 71. 15

20 The tip of the heating member may be provided with a valve ball which is adapted to the valve seat in the pre-chamber sleeve or in the mould nest. 20

In operation, the above-described insulating discs or plates are subjected to a loading by high temperatures. When the heating member is used in a machine nozzle, high pressure loadings of 5 to 10 kg/cm² also occur. So that the assembly can carry these loadings, the insulating plates or discs are of a large surface area and are made from aluminium oxide-ceramic. The axial pressures which occur in operation and which must be carried by the machine nozzle produce additional impact loadings on the insulating plates or discs. 25

30 CLAIMS 30

1. A nozzle for a plastics injection-moulding machine, an extruder orifice member or a hot-passage tool, comprising an electrically operated heating member which has a flow passage for the plastics melt, a casing and, in the region of the forward end, a discharge opening or openings, with the cross-sectional area of the member reducing towards the tip of the nozzle, wherein there is provided a central heating bar which is 35 connected to the casing at the front nozzle tip, the cross-section of the heating bar decreases to the front end, a portion of large surface area is provided between the decreasing portion and the shank portion of the heating bar, the maximum cross-section of the portion of large surface area is equal to or larger than that of the shank portion and the decreasing portion of the heating bar and the portion of large surface area are 40 disposed in the region of the discharge opening or openings. 40

2. A nozzle according to claim 1 wherein the casing comprises two portions which are in one or more pieces, and the two casing portions are electrically insulated from each other.

3. A nozzle according to claim 1 wherein the casing is made in one piece and is electrically insulated from the heating bar in the region of the rear end, by way of a sealing means.

45 4. A nozzle according to claim 3 wherein the sealing means delimits the flow passage of the heating member at the rear end and the plastics melt can be passed into the flow passage by way of a lateral inlet opening. 45

5. A nozzle according to claim 3 or claim 4 wherein the sealing means is supported on an internal flange of the casing which flange delimits an opening for the heating bar passing therethrough, while at the other 50 side the sealing means is secured by means of a ring nut. 50

6. A nozzle according to claim 1 wherein the discharge opening or openings in the front casing portion begins or begin in front of the portion of the heating bar.

7. A nozzle according to claim 1 wherein bar portions which delimit the discharge openings are integral with the front casing portion and are bent away from the casing portion and converge forwardly to a 55 tip. 55

8. A nozzle according to claim 7 wherein the bar portions which are integral with the casing are connected to the front end of the heating bar, after turning through 90°.

9. A nozzle according to claim 1 wherein bar portions which delimit the discharge openings are shaped members which are connected to the front end of the heating bar and to the front casing portion.

60 10. A nozzle according to claim 1 wherein the front end of the heating bar is in the form of a separate shaped member preferably in the form of a sheet metal punching or stamping. 60

11. A nozzle according to claim 9 wherein the bar portions which delimit the discharge openings are in the form of a U-shaped shaped member preferably a sheet metal stamping.

65 12. A nozzle according to claim 1 or claim 2 wherein the front end of the heating bar is of a lance-like configuration of square or rectangular cross-section. 65



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13. A nozzle according to claim 12 wherein the lateral projecting portions of the lance-like member extend outwardly through the discharge openings.
14. A nozzle according to claim 1 wherein the front end of the heating bar is of a star-like or cross-like configuration.
- 5 15. A nozzle according to claim 1 or claim 2 wherein the casing or the casing portions is or are cylindrical. 5
16. A nozzle according to claim 15 wherein the front casing portion is reduced in diameter and the rearward portion of the front casing portion is of the large diameter.
17. A nozzle according to claim 16 wherein the rearward portion is in the form of a cylindrical chamber which partly accommodates the rear casing portion, a contact ring connected to the rear casing portion, and
- 10 at least two insulating discs, and which can be closed by way of a ring nut. 10
18. A nozzle according to claim 17 wherein the rearward portion is of 4-cornered outside contour.
19. A nozzle according to claim 2 wherein one of the casing portions is in the form of an expansion compensation means.
20. A nozzle according to claim 19 wherein the rear casing portion is alternately provided with openings
- 15 in the form of circular segments. 15
21. A nozzle according to claim 20 wherein the rear casing portion is in the form of a cylindrical coil spring which is provided at the rear end with a holding bar portion secured to the heating bar.
22. A nozzle according to claim 19 wherein the rear casing portion is of a sieve-like form and has longitudinal slots.
- 20 23. A nozzle according to claim 2 wherein the rear casing portion is of a plate or disc-like configuration and has at least one through-flow passage for the plastics melt. 20
24. A nozzle according to claim 23 wherein the rear casing portion is provided with a metal diaphragm which is secured to the heating bar and which is provided with through-flow bores for the plastics melt.
25. A nozzle according to claim 20 wherein openings which are offset relative to each other are provided
- 25 in the front casing portion and the rear casing portion is in the form of a plate or disc. 25
26. A nozzle according to claim 21 or claim 25 wherein in the cold condition of the heating member, the openings are compressed in the region of the edges of the openings which are at the periphery of the casing portion.
27. A nozzle according to claim 2 wherein the front and rear casing portions are electrically insulated with
- 30 respect to the injection tool. 30
28. A nozzle according to one of the preceding claims wherein the cross-section of the heating bar differs from a circular form.
29. A nozzle according to one of the preceding claims wherein the ratio of the surface area of the heating bar in the region of the flow passage to the internal surface of the casing is 1:1.5 to 1:3.5, preferably from 1:1
- 35 to 1:3. 35
30. A nozzle according to claim 29 wherein the ratio of the surface area of the heating bar in the region of the flow passage to the internal surface area of the casing is 1:2.5.
31. A nozzle according to one of the preceding claims wherein the tip of the heating member is provided with a valve ball for cooperation with a valve seat in a pre-chamber sleeve or in a mould nest.
- 40 32. A nozzle according to claim 18 wherein the insulating discs are made from aluminium oxide-ceramic. 40
33. A nozzle for a plastics injection-moulding machine, an extruder orifice member or a hot-passage tool, substantially as hereinbefore described with reference to Figures 1 to 7 as modified or not by Figures 8 to 10, Figures 11 to 13, Figures 14 to 16, Figure 17, Figures 18 and 19, Figures 20 and 21, or Figures 22, 23, 24, 25, 26,
- 45 27, 28 or 29 of the accompanying drawings. 45