

Description

TECHNICAL FIELD

This invention relates to an injection nozzle for an injection molding machine, and in particular, to an injection nozzle protruding from the front end of a heating cylinder and utilized for injecting molten material into a metallic mold.

BACKGROUND ART

The injection nozzle front end section of an injection molding machine is in contact with a metallic mold, which is cooled to a low temperature. The injection nozzle is consequently apt to be cooled, too. In order to prevent this, the injection nozzle itself is conventionally heated separately, independently of the heating cylinder. Since, however, this separate heating is performed with a single heating device such as a coil heater, the following problems are involved:

Since the injection nozzle end is in contact with a metallic mold, which is set at a temperature much lower than the melting point of molten material such as plastics, its temperature is lower than the set value of the injection nozzle temperature normally by several tens of degrees C. In the rear section of the injection nozzle, on the other hand, there is heat transfer from the heating cylinder. This situation, along with the low heat radiation from the injection nozzle, makes the nozzle rather overheated, resulting in an uneven heat distribution over the nozzle itself. This is readily appreciated from Fig. 3, which shows the result of an investigation into the heat distribution of an injection nozzle. In Fig. 3, the two-dot chain line A represents the heat distribution when the temperature control is effected by detecting the temperature in the rear section of the injection nozzle. The dashed line B represents the heat distribution when the temperature is controlled with a temperature detecting apparatus provided in the vicinity of the injection nozzle front end.

The temperature control is thus performed with only one system for detecting and controlling nozzle temperature, in spite of the temperature difference of several tens of degrees C between the front end and the rear section of an injection nozzle. Setting the nozzle front end to an appropriate temperature consequently results in a raised temperature in the nozzle rear section, which causes the resin to be overheated until it is "burned". In addition, the resin pushed out through the nozzle drips from the nozzle opening, presenting a phenomenon called "stringing" or "drooling". When, on the other hand, the temperature setting is conducted to the nozzle rear section, the tip resistance

is increased, augmenting the pressure loss, a situation which leads to increased variation in molding.

Furthermore, with an injection molding machine it is an important requirement that the injection nozzle does not have too large an outer diameter. The reason for this is that with a narrow nozzle the holes in the mold can be smaller and therefore the rigidity of the metallic mold is improved and burr generation is reduced.

When providing a composite complexly heated nozzle there is the need to provide wiring to the various different parts of the composite nozzle. The use of the composite nozzle enables greater temperature control to be provided.

The problem however is that it is necessary to provide wiring into the various differently located coils and this is difficult if the nozzle is to maintain a narrow diameter.

The present invention overcomes this problem by utilizing a coil heater on the front of the nozzle body and a band heater on the middle to rear section of the nozzle, and providing a slit within the band heater to receive the lead wire wiring for the coil heater. This then enables the narrow configuration of the nozzle to be maintained.

Prior specification DE-U-8620956 discloses a device where two coil heaters are used one with a fine pitch and the other with a rough pitch respectively. Because the rough pitch coil would slip axially if fitted directly on to the nozzle, an arrangement is adopted where the two coils are mounted between an inner casing 4 and an outer casing 5. This then gives rise to inconsistencies in heating.

On the other hand with the present invention, the coils are directly wound on the nozzle and use of a band heater for the region where a reduced level of heating is required gives much more consistent results.

Accordingly the present invention is characterised in that the heating member surrounding the front end section of said nozzle body consists of a coil heater and the heating member surrounding the middle-rear section of said nozzle body consists of a band heater, said band heater having opposed edges longitudinally extending to form a slit therebetween for receiving the lead wire of said coil heater.

Because of the above construction, the temperature control of the injection nozzle in accordance with this invention is in individually so effected that the nozzle front end section in the vicinity of a metallic mold is set to a relatively high temperature, whereas the nozzle middle-rear section is set to a normal temperature. The problems due to the overheating of the nozzle middle-rear section and the temperature fall at the nozzle front end can consequently be overcome.

In accordance with a preferred embodiment of this invention, the plurality of heating members are composed of coil heaters and the lead wire of the coil heater surrounding the front end section of the nozzle body is arranged such that it forms a multiple coil together with the adjacent coil heater on the rear end section, so that the entire injection nozzle need not have a large outer diameter to secure the space for arranging the lead wires.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a longitudinal sectional view of the first embodiment of this invention;

Fig. 2 is a cross-sectional view taken along the line II-II of Fig. 1; and

Fig. 3 is a chart showing the relation between the positions on the injection nozzle and the temperature.

BEST MODE OF CARRYING OUT THE INVENTION

An embodiment of the injection nozzle for an injection molding machine in accordance with this invention will now be described with reference to the attached drawings. Figs. 1 and 2 show an embodiment of this invention. A nozzle body 3 protrudes from the front end of a heating cylinder 1 containing a screw 2. The nozzle body 3 is detachably connected to the heating cylinder 1 with screwing means or the like. This nozzle body 3 includes a passage 4, an axial through-hole 5, and an axial groove 6 which is in the middle-rear section 3a of the nozzle body.

A coil heater 7 with a square cross-section which serves as the first heating member is wound around the outer peripheral surface of the front end section 3b of the nozzle body 3, and a lead wire 8 is connected to the rear end of the coil heater. This coil heater 7 occupies the nozzle area which extends 40 mm or less from the front end.

A temperature detecting thermo-couple 9 for detecting the temperature of the coil heater 7 is provided in the above through-hole 5 in the nozzle body 3. The front end of the thermo-couple 9 is embedded in the nozzle body 3 in the direction of the front end section 3b, and is connected to a temperature controller (not shown) through convenience outlets 13.

A band heater 10 which is made of a shape memory alloy or a bimetal or the like and which is inwardly tightened as the temperature rises is wound around the outer peripheral surface of the middle-rear section 3a of the nozzle body 3 and serves as the second heating member. A temperature detecting thermo-couple 11 is arranged in the above groove 6 such that it is held between the

band heater 10 and the nozzle body 3, and is connected to a temperature controller (not shown) through a convenience outlet 13.

A heater cover 12 for protecting the first and second heating members wound around the above nozzle body 3 is provided in such a manner that the front end section 3b of the nozzle body 3 is fitted into the opening at the front end thereof.

It is naturally understood that various heating means such as electromagnetic induction heating may be adopted as the heating means, apart from usual heating means. The reference character a in Fig. 3 indicates the nozzle length range extending 40 mm or less from the nozzle front end, and the curve C represents the result of controlling the injection nozzle temperature with two control systems in accordance with this invention.

As described above, the injection nozzle in accordance with this invention includes two thermocouples, one (reference numeral 9 in Fig. 1) provided in a section affected by the temperature of an metallic mold, and the other (reference numeral 11 in Fig. 1) in a section particularly related to such phenomena as stringing or drooling. These thermocouples are connected in a usual manner to respective temperature controllers, the thermo-couple 9 controlling the electricity supply to the coil heater 7 and the thermo-couple 11 the electricity supply to the band heater 10. The coil heater 7 and the band heater 10 can accordingly be separately temperature-controlled. The nozzle temperature represented by the curve C of Fig. 3 can be obtained as a result, by setting the nozzle front end section 3b, which exhibits the highest resistance and which is most subject to temperature fall, to a high temperature, and setting the nozzle middle-rear section 3a to the normal temperature. The temperature fall at the nozzle front end section can thus be substantially mitigated.

Since the injection nozzle for an injection molding machine in accordance with this invention is, as described above, capable of separately effecting the temperature control of the nozzle front end section and that of the nozzle middle-rear section, the following effects can be obtained with it:

(1) Since the temperature of the nozzle front end section and that of the nozzle middle-rear section can be separately set and controlled, the temperature fall and the stringing or drooling of resin at the nozzle front end can be prevented.

(2) Since a whole-resin type open nozzle can be adopted instead of such nozzles as a needle valve nozzle, whose operation is a mechanical one, the mechanical reliability of the nozzle can be enhanced, the nozzle being enabled to become narrower than ever.

(3) Since the temperature of the nozzle front end section can be raised and the resistance is

decreased and stabilized, variation in size of molded articles can be reduced.

(4) Since a narrow nozzle can be inserted and the sprue is shortened, a substantial decrease in material cost can be expected.

(5) Since a narrow nozzle can be used, nozzle holes provided in metallic molds can also be narrow, so that the rigidity of metallic molds can be augmented, with the burr generation decreased.

Claims

1. An injection nozzle for an injection molding machine having a nozzle body (3) protruding from the front end of a heating cylinder (1), comprising a plurality of electric heating members (7, 10) surrounding said nozzle body (3) and longitudinally arranged side by side, a plurality of temperature detecting members (9, 11) for detecting the temperatures of the different nozzle body sections (3a, 3b) surrounded by said heating members (7, 10) and a control mechanism for individually controlling said plurality of heating members in accordance with the detected temperatures of said temperature detecting members, characterised in that the heating member surrounding the front end section (3b) of said nozzle body (3) consists of a coil heater (7) and the heating member surrounding the middle-rear section (3a) of said nozzle body (3) consists of a band heater (10), said band heater (10) having opposed edges longitudinally extending to form a slit therebetween for receiving the lead wire (8) of said coil heater (7).

Patentansprüche

1. Spritzdüse für eine Spritzgießmaschine mit einem vom Vorderende eines Heizzylinders (1) abstehenden Düsenkörper (3), umfassend eine Anzahl elektrischer Heizelemente (7, 10), welche den Düsenkörper (3) umgeben und in Längsrichtung nebeneinander angeordnet sind, eine Anzahl von Temperaturmeßelementen (9, 11) zum Messen der Temperaturen der verschiedenen, von den Heizelementen (7, 10) umgebenen Düsenkörperabschnitte (3a, 3b) sowie eine Steuereinrichtung zum einzelnen Ansteuern der mehreren Heizelemente in Abhängigkeit von den durch die Temperaturmeßelemente gemessenen Temperaturen, dadurch gekennzeichnet, daß das den vorderen Endabschnitt (3b) des Düsenkörpers (3) umgebende Heizelement aus einer Heizschlange (7) besteht und das den mittleren/hinteren Abschnitt (3a) des Düsenkörpers (3) umgebende Heizelement

aus einem Bandheizelement (10) besteht, wobei das Bandheizelement (10) gegenüberliegende, sich in Längsrichtung erstreckende Ränder aufweist, die zwischen sich einen Schlitz zur Aufnahme des Zuleitungsdrahts (8) der Heizschlange (7) bilden.

Revendications

1. Buse d'injection destinée à une machine de moulage par injection, ayant un corps (3) de buse qui dépasse de l'extrémité avant d'un cylindre (1) de chauffage, comprenant plusieurs organes de chauffage électrique (7, 10) qui entourent le corps (3) de la buse et qui sont placés longitudinalement côte à côte, plusieurs organes (9, 11) de détection des températures des différents tronçons (3a, 3b) du corps de la buse qui sont entourés par les organes de chauffage (7, 10), et un mécanisme de réglage destiné à régler individuellement les organes de chauffage d'après les températures détectées par les dispositifs de détection de température, caractérisée en ce que l'organe de chauffage entourant le tronçon d'extrémité avant (3b) du corps (3) de la buse est formé d'un organe de chauffage à enroulement (7) et l'organe de chauffage entourant le tronçon médian-arrière (3a) du corps (3) de la buse est formé d'un organe de chauffage à bande (10), l'organe de chauffage à bande (10) ayant des bords opposés disposés longitudinalement afin qu'ils délimitent une fente entre eux pour le passage du fil (8) d'alimentation de l'organe (7) de chauffage à enroulement.



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