(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 November 2005 (03.11.2005)

PCT

(10) International Publication Number
WO 2005/102640 A2

(51) International Patent Classification[7]: B29C 31/04, 43/34

(21) International Application Number: PCT/IB2005/001001

(22) International Filing Date: 15 April 2005 (15.04.2005)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
RE2004A000040 23 April 2004 (23.04.2004) IT

(71) Applicant *(for all designated States except US)*: **SACMI COOPERATIVA MECCANICI IMOLA SOCIETA' COOPERATIVA** [IT/IT]; 17/A, Via Selice Provinciale, I-40026 Imola (IT).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **PARRINELLO, Fiorenzo** [IT/IT]; 122/A, Via Zanardi, I-40059 Medicina (IT). **BORGATTI, Maurizio** [IT/IT]; 38, Via Giudei, I-40026 Imola (IT). **BALBONI, Alessandro** [IT/IT]; Via Budapest, 10, I-40057 Granarolo Dell'Emilia (IT).

(74) Agent: CORRADINI, Corrado; 4, Via Dante Alighieri, I-42100 Reggio Emilia (IT).

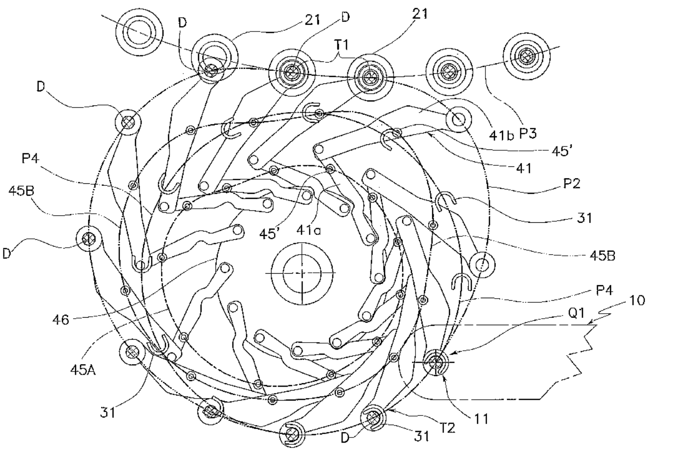
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP,*

[Continued on next page]

(54) Title: METHOD AND EQUIPMENT FOR TRANSFERRING MELTED POLYMERIC MATERIAL BODIES TO THE CAVITIES OF DIES OF A MOULDING MACHINE



(57) Abstract: The invention comprises a rotating transfer machine (40), arranged outside the path of the die cavities, having a plurality of transfer chambers (50) carried in continuous rotation, each adapted for containing a polymeric body (D) and for transferring it to a die cavity (21), and having moving means adapted for moving in a succession the transfer chambers (50) along a same path (P2) so that this path (P2) has a portion (T1) concomitant with the path (P3) of the dies, during which each transfer chamber (50) is in coaxial position and above a die cavity (21) and its motion coincides with the motion of the latter, said transfer of the polymeric body (D) to the die cavity (21) being carried out in this portion (T1). A relatively long path and thereby a correspondingly long time are provided for transferring polymeric bodies from the transfer chambers (50) to the die cavities, for carrying out and effective and correct transfer of the polymeric bodies into the die cavities, starting from a dispensing outlet of the extruder of the polymeric material, also in the case that such body has a relatively large mass.

WO 2005/102640 A2

KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

METHOD AND EQUIPMENT FOR TRANSFERRING MELTED POLYMERIC MATERIAL BODIES TO THE CAVITIES OF DIES OF A MOULDING MACHINE

TECHNICAL FIELD

The present invention relates to a method and equipment for transferring polymeric material bodies, at the melted state, dispensed by a dispensing outlet of a polymeric material, to the cavities of the dies of a moulding machine with turntable rotating with continuous motion, in the compression forming of items of polymeric material.

The item forming is obtained by relative motion with press-insertion of a punch (male die element) into a hollow bottom die (female die portion) charged with a body (or multiple bodies) of polymeric material at the melted state (where this term means a more or less viscous liquid-pasty state), in particular a thermoplastic resin, of dosed mass equal to the mass of the item to be formed.

An advantageous application of the invention is for forming pre-forms intended for the subsequent manufacture (typically, by stretch-blowing forming) of plastic bottles. However, the applications could be several and varied.

If the item is said pre-form, for manufacturing bottles and the like, this usually comprises an upper neck provided with projections and a substantially smooth, axially elongated hollow body located at the bottom of the neck.

The forming is carried out by dies moved by a moulding machine rotating with continuous motion.

Typically, the conventional moulding machines of the continuous type for manufacturing items of polymeric material by compression forming are provided with a turntable that carries a plurality of bottom dies and an overlying corresponding plurality of punches.

The turntable rotates about a vertical axis and each bottom die, along a complete turn receives a plastic (or other polymeric) body in dosed quantity (dose) heated at the necessary temperature for the plastic to be sufficiently fluid, undergoes a dose pressing step with the reciprocal approach (up to the closing of the die) of the punch and of the bottom die, followed - optionally after an item cooling step - by the opening of the die and the extraction of the pre-form from the machine.

The forming machine is associated to an extruder means that issues polymeric material at the melted state. This material is then divided according to bodies in dosed quantity (doses) that are then transferred into the machine bottom die cavities.

BACKGROUND ART

If the dosed polymeric body (dose) of polymeric material has a relatively small mass, it is known to transfer it to the bottom dies of the rotating machine through a transfer device having suitable handling members (so-called "hands") that move in a succession along a circular path and that, along such path, collect the dose from a fixed dispensing outlet, belonging to the extruder of the polymeric material, and release it in the point where the path is tangent and superimposed to the bottom die path. This release must occur in a very quick manner when the position of the handling member and of the die cavity (that is, the bottom die cavity) is perfectly superimposed and coaxial. This is virtually possible only for relatively small mass doses, for example doses adapted for forming capsule shaped stoppers for closing usual plastic bottles for mineral water or other fizzy drinks.

On the other hand, the technology described is not adapted for loading bodies of polymeric material into the bottom dies when items with a relatively large mass are to be formed, for example the PET (polyethyleneterephthalate) pre-forms currently used on the market for manufacturing (by the known stretch-blowing operation) the usual plastic bottles.
In this case, in fact, virtually it is not possible to transfer the doses from the handling members inside the die cavities, with an almost instant action, since the doses exhibit a relatively high length and a sufficiently long time is therefore needed to carry out such transfer, which is not possible with the conventional transfer devices described.
In order to solve this technical problem, a moulding machine has been proposed (patent application WO 03/047834) wherein the doses are released by a dispensing device having a plurality of dispensing outlets moving in a succession along a circular and horizontal path; at the same time, the bottom dies do not move along a circular path, rather, they have a fair possibility of moving in radial- direction relative to the turntable, and thus they can follow by a certain arc the circular path of the dose dispensing outlets, diverting relative to the conventional circular path. Thus, for a certain portion of the path (and thereby for a certain time), the dispensing outlet is placed coaxial and on the die cavity and its motion coincides with the motion of the latter.
However, one disadvantage of such solution is the complexity and the construction cost of such moulding machine, considering that such machine is very complex, both for the usually very high number of bottom dies required, and for the several operations that are carried out, and for the relatively high speed it is required to operate, and finally for the fact that bottom dies

require a very accurate positioning, whereas on the other hand, making them movable relative to the turntable complicates this requirement as a consequence.

Moreover, in the proposed solution, based on the radial movement of the bottom dies, into said common portion, it is not even possible to obtain a correct equality of the bottom die motion and of the dispensing outlets, as it would be needed; in fact, the peripheral bottom die speed necessarily varies as its radial position varies, whereas the same does not happen for the dispensing outlets whose radial position is constant; as a consequence, in said common portion the dispensing outlets cannot remain coaxial with the underlying bottom die cavities and therefore, the dose transfer cannot be correct; if the dose diameter is close to the cavity diameter, it is not even possible to make the transfer.

The technical problems related to the dose transfer to the bottom die cavities are further increased by the fact that the means for carrying out the dose transfer operations, of various shape and type, unavoidably exhibit surfaces that come into contact with such polymeric bodies at the melted state. In fact, the polymeric material tends to adhere to the surfaces of the means with which it comes into contact, due to its physical state (more or less viscous liquid at a temperature usually higher than 200°C, when it is PET).

Such adhesive effect considerably hinders the movement of the polymeric body, creating serious problems, especially if the polymeric body moves by simple gravity. For example, if the polymeric body must slide by gravity along a surface accompanying it, its tendency to adhere to such surface can affect the motion so as to make the scheduled operation impossible.

Or, if the polymeric body is left to drop within the die cavity, especially where it has a relatively narrow and deep shape, if it comes into contact with the cavity walls, it unavoidably tends to adhere thereto and does not arrange properly inside the cavity. If, for example, the polymeric body has a relatively large volume compared to the cavity volume, there exists the serious problem that the body itself could protrude on top out of the cavity by such an extent as to make the closing of the bottom die impossible in the compression step by the punch.

Moreover, said adherence problems are strongly increased by the fact that the polymeric body drop occurs while the bottom die moves continuously along a circular path, and also at a relatively high speed, since due to the centrifugal effect it is subject to, the polymeric body is pushed towards the side wall of the cavity.

It should also be said that in the contact of the polymeric body with foreign bodies, an effective heat transmission occurs, localised in the contact zone, that consequently alters the regular and substantially even distribution of the thermal values of the polymeric body; in particular, excessive even though localised drops in temperature can occur, such as to create micro-crystallisation or micro-solidification of the material, or in any case seeds of irregularities in the material that could later produce unevenness and problems in the end product.

Finally, it should be said that while in the transfer of doses with relatively small mass, this normally exhibits the shape of a more or less regular ball and can undergo rotations or rolling in the transfer of polymeric bodies with relatively high mass and relatively complex shape (for example, for forming PET pre-forms), it is normally necessary to introduce such bodies in the die cavity with the axes (or at least one axis) arranged according to a given orientation.

A technology capable of meeting the requirements described is therefore needed.

DISCLOSURE OF INVENTION

An object of the present invention is to provide a method and a relevant equipment capable of overcoming said technical disadvantages.

The invention comprises a rotating transfer machine having a plurality of transfer chambers moved in continuous rotation, each adapted for containing a polymeric body and for transferring it to a die cavity. The chambers can have a closed side surface such as to fully contain the polymeric body (as illustrated in figures 5 and 5A) or they can have a partly open side surface (as illustrated in Fig. 7) and the body can be only partly contained into the chamber itself. The containment action is needed to move the polymeric body with motion having horizontal component. The invention further comprises moving means adapted for moving in a succession said transfer chambers along a same path so that this path has a portion concomitant with the path of the dies, during which each transfer chamber is in coaxial position and above a die cavity and its motion coincides with the motion of the latter, said transfer to the die cavity being carried out in this portion.

Thanks to this solution, a relatively long path and thereby a relatively long time is provided for the transfer of the polymeric bodies from the transfer chambers to the bottom die cavities, with the result that it is possible to carry out an effective and correct transfer of the polymeric bodies into the die cavity, starting from a dispensing outlet of the extruder of the polymeric material, also in the case where such body has a relatively large mass (as is the case, for example, with a body for forming PTE pre-forms for manufacturing the usual plastic bottles for mineral water or other fizzy drinks).

In general, it is possible to obtain a more accurate positioning of the viscous polymeric body, with great advantages in the compression forming technology for all applications.

Moreover, the axial distance between punches and bottom dies that must be provided in the zone wherein the polymeric bodies are introduced into the bottom dies is relatively small, it substantially being equal to the length of a body itself, with certain advantage for the speed of the forming cycle. In particular, the transfer machine comprises a support rotating in synchronism with the moulding machine, and each transfer chamber is carried by a mechanism placed in rotation by said rotating support, which has two degrees of freedom relative to the support itself. Suitable guiding means determines the mechanism motion in relation to the angular position of the rotating support so as to univocally define the movement and the path of the transfer chamber during each rotation of the support itself. This is carried out so that there is said concomitant portion of paths.

According to a particular aspect of the invention, the shape (and of course, also the dimensions) of the polymeric body is geometrically influenced into the inner cavity of the transfer chambers, so as to be adapted for being properly inserted afterwards in the bottom die cavity. That is, while it is fully into the transfer chamber, the polymeric body takes the desired reshaped shape which it keeps while moving from the transfer chamber to the die cavity; this shape is such that it allows it to penetrate into this cavity without coming into contact with the side walls thereof during the descent, or in any case if a contact occurs, this is not such as to hinder its descent and its correct position into the cavity itself.

In particular, the inner cavity of the transfer chamber is delimited and laterally conditioned by a cylindrical side surface, whose cross size is smaller than the minimum cross size of the inlet zone of the bottom die cavity. Moreover, means for completely or partly reducing the adhesion between the dosed body and the inner contact surface of the transfer chamber is provided.

In general, thanks to the invention, the transfer of the polymeric body from the transfer chamber to the die cavity is made very quick and regular, and at the same time the contact between the means handling the body and the body itself is avoided, or is at least made irrelevant, thus overcoming the disadvantages described above.

The invention will be described in detail hereinafter with reference to the accompanying drawings, which show some exemplifying and non-limiting embodiments of the invention.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic plan view of a first embodiment of the equipment for transferring dosed bodies of polymeric material dispensed by a fixed dispensing outlet of polymeric material, to a plurality of bottom dies carried by a moulding machine with turntable rotating with continuous motion, according to the invention.

FIG. 2 is an enlarged detail of Fig. 1.

Fig. 2A schematically shows the kinematic aspects of Fig. 2

Fig. 2B is a view as Fig. 2A, showing a second embodiment of mechanisms 41 of the first transfer machine 40.

Fig. 2C is a view as Fig. 2A, showing a third embodiment of mechanisms 41 of the first transfer machine 40.

Fig. 2D is a view as Fig. 2A, showing a fourth embodiment of mechanisms 41 of the first transfer machine 40.

Fig. 3A shows an enlarged scale view of a single mechanism 41 of Fig. 2A.

Fig. 3B shows an enlarged scale view of a single mechanism 41 of Fig. 2B.

Fig. 3C shows an enlarged scale view of a single mechanism 41 of Fig. 2C.

Fig. 3D shows an enlarged scale view of a single mechanism 41 of Fig. 2D.

FIGS. 4A - 4F show a schematic vertical section view of a sequence of steps carried out by the equipment of Fig. 2 in the transfer of the polymeric bodies from the dispensing outlet 11 to the die cavities.

Fig. 5 shows a schematic, axial section, vertical elevation view of a particular embodiment of the transfer chamber of the equipment of Fig. 2.

Fig. 5A shows the section according to plane A- A of Fig. 5.

Fig. 6 shows a schematic, axial section, vertical elevation view of a modified embodiment as compared to Fig. 5.

Fig. 7 shows a schematic, axial section, vertical elevation view of a further modified embodiment as compared to Fig. 4A.

Fig. 8 shows a perspective view of a particular embodiment of the handling means 31 for transferring single polymeric bodies from the dispensing outlet to the transfer chamber, in the equipment of Fig. 2.

Fig. 9 shows a section according to a vertical axial plane of the means of Fig. 8.

DETAILED DESCRIPTION OF INVENTION.

The equipment according to the invention comprises a rotating transfer machine having a plurality of transfer chambers moved in continuous rotation, each adapted for containing a polymeric body and for transferring it to a bottom die cavity 21.

Chambers 50 can have a closed side surface such as to fully contain the polymeric body (as illustrated in figures 5 and 5A) or they can have a partly open side surface (as illustrated in Fig. 7) and the body can be only partly contained into the chamber itself. The containment action is needed to move the polymeric body with motion having horizontal component. Figures from 1 to 4F show an embodiment of an equipment for transferring dosed bodies D of polymeric material, coming out of a fixed dispensing outlet 11, belonging to an extruder means 10, to a plurality of bottom dies 21 carried by a moulding machine 20 with turntable rotating with continuous motion.

The extruder means 10 is of the known type and is only schematically shown in the figures. As known, the extruder means 10 heats the polymeric material at a suitable temperature (for example, about 270° ÷ 300°C for PETs) so as to bring it to the more or less viscous melted state, so that it can take a sufficient mobility and dispense it from the fixed dispensing outlet 11 thereof.

The dispensing outlet 11 dispenses a continuous extruded cord M (typically with circular section) of fluid polymeric material which is divided in a regular manner, creating a succession of dosed bodies D of polymeric material; for example, a knife 13 (or multiple knives) are provided, operating adjacent to outlet 11, which cuts extruded element M, exactly dividing it according to a succession of bodies D of dosed mass (Fig. 4A).

The bottom dies of the moulding dies, globally indicated with reference numeral 21, are brought into rotation, along a circular path that develops in a horizontal plane, by a turntable 26 with vertical axis, belonging to a conventional moulding machine 20 operating with continuous movement, which comprises a corresponding plurality of upper punches 27, also carried by turntable 26, adapted for penetrating into the cavities of the corresponding bottom dies 21 for moulding, under compression, the desired items of polymeric material (for example the pre-forms).

The bottom die illustrated in figures 4E and 4F is intended for forming pre-forms adapted for manufacturing afterwards (typically, by blowing forming) bottles of thermoplastic resin (in particular, PET); such pre-forms comprise a neck, having the final shape provided for the bottle, and a hollow body, intended, in the bottle manufacturing step, for forming the container body of the same. In this case, the bottom die consists of a concave lower bottom die portion 21a and of an upper bottom die portion 21b with thorough cavity. The lower portion 21a exhibits a cavity whose surface is concave and smooth, substantially cylindrical, which imparts the shape to the outer surface of the hollow pre-form body, whereas the upper portion 21b exhibits a thorough cavity whose surface is concave which imparts the shape to the outer surface of the neck. Since this is provided with radial projections, said upper portion 21b is divided into at least two half-portions (in the illustrated case they are two) adapted for being transversally moved away from one another for releasing the pre-form.

The concavity of the lower portion 21a of bottom die, optionally along with the cavity of the upper portion 21b, forms the so-called die cavity.

Of course, the invention can be used for the introduction of the polymeric body D into bottom dies 21 wherein the cavity is shaped differently, or consists of the lower portion 21a only, without the upper portion 21b.

Moreover, bottom die 21 can be suitable for forming products other than pre-forms.

Each bottom die 21 is brought into rotation by turntable 26 along with the other bottom dies 21.

At the extraction zone of the items formed by the moulding machine 20, a machine 60 is located for drawing out and moving away such items from machine 20.

According to the invention, the transfer machine 40 comprises moving means adapted for moving in a succession the transfer chamber 50 which, according to the embodiment shown in the figures, comprises a rotating circular support 46, arranged on a horizontal plane, rotating in synchronism with the moulding machine, about a fixed axis vertical shaft 47.

Said moving means further comprises a plurality of mechanisms 41, each carried in rotation by said rotating support 46, and in turn, carries a respective transfer chamber 50 at the free end thereof. Each of these mechanisms 41 is provided with at least one degree of freedom and preferably two degrees of freedom relative to support 46 and further comprises guiding means adapted for determining the movement in relation to the angular position of the rotating support 46, so as to univocally define the movement and the path of the transfer chamber during each rotation of the support itself.

Preferably, each of said mechanisms 41 comprises an arm consisting of two members 41a, 41b constrained to one another, of which a first member 41a is constrained to the rotating support 46, and the other member 41b carries a said transfer chamber 50, mechanism 41 being provided with two degrees of freedom relative to support 46 itself.

According to the particular embodiment illustrated in figures 2 and 2A, each mechanism 41 consists of an articulated arm having two members pivoted to one another, of which a first member 41a is pivoted with its inner end to the rotating support 46, and with the other end to the second member 41b; the latter has a free end the carries said transfer chamber 50.

Said guiding means adapted for determining the movement of each of said mechanisms (41) comprises, for the series of members 41a of mechanisms 41, a relative fixed track 45A acting on driven means (idle rollers 45') carried by members 41a themselves; and respectively, a fixed track 45B, for the series of members 41b, acting on driven means (idle rollers 45') carried by members 41b themselves. This is to univocally define the movement of the transfer chamber 50 during each rotation of support 46.

These tracks 45A and 45B constrain suitable points of the two members 41a and 41b of mechanism 41 to follow respective paths; for each angular position of support 46 (and therefore of each mechanism 41 relative to the fixed portion of the equipment), the position of its members 41a and 41b relative to support 46 remains univocally determined and therefore, the motion of mechanisms 41 and consequently, path P2 of the transfer chambers 50 and their motion along path P2 itself remains univocally determined, in combination with the motion of support 46 itself.

The second embodiment of mechanisms 41 of the first transfer machine 40 (illustrated in Fig. 2B) differs from the previous one in that each mechanism 41 comprises a first member 41a, pivoted at its inner end to the rotating support 46 (by a pin 48), and a second member 41b, which carries a transfer chamber 50 at its free end. This member 41b, rather than being pivoted to the first member 41a, is coupled prismatic-wise thereto; that is, it is constrained with possibility of sliding axially (without other movement) relative to the first member 41a which is shaped as a sleeve or guide. Also here, as in the previous embodiment (Fig. 2), a fixed track 45A is provided, acting on driven means (idle rollers 45′) carried by levers 49 fixed to members 41a; and respectively, a fixed track 45B, acting on driven means (idle rollers 45′) carried at the inner end of members 41b. This is to univocally define the movement of the transfer chamber 50 during each rotation of support 46.

In the third embodiment of mechanisms 41 (illustrated in Fig. 2C), each mechanism 41 comprises, here as well (as in the first embodiment), an articulated arm having two members 41a, 41b pivoted to one another, of which the first member 41a is pivoted with an end to the rotating support 46, and the other member carries a transfer chamber 50. However, a further constraining means is provided, which along with the other two members (41a, 41b) reduces to only one the degree of freedom of the mechanism; in fact, for each articulated arm 41, the transfer machine 40 comprises a third member 42, pivoted on the rotating support 46 and constrained to the articulated arm 41. In particular, the third member 42 is entire and is pivoted to the rotating support 46 with its inner end and to the second member 41b with the other end, and forms an articulated quadrilateral with arm 41 itself.

The movement of the mechanism (an articulated quadrilateral) defined by said three members 41a, 41b and 42 relative to support 46 is constrainable by a single fixed track 45C. For example, each arm 41 exhibits a driven means 45′ (an idle roller) pivoted on the articulation axis between the two arms 41a and 41b constrained on two sides to follow track 45C. This track constrains a suitable point of said articulated quadrilateral, to follow a fixed path and univocally determines, in combination with the motion of support 46, path P2 of the transfer chambers 50 and their movement along path P2.

In the fourth embodiment of mechanisms 41 (illustrated in Fig. 2D), each mechanism 41 comprises a member 41d carried by the rotating support 46 and constrained thereto with a constraint having one degree of freedom only. In particular, each member 41d carries at its outer end a respective transfer chamber 50 and is prismatic-wise coupled to a sleeve 461 fixed to the rotating support 46, relative to which it can axially slide. As an alternative, member 41d can be hinged to the rotating support 46, always with a constraint having a single degree of freedom.

Also in this case (as in the third embodiment), a single fixed track 45D is provided, acting on driven means 45' (idle rollers) located on member 41d so as to univocally define path P2 of the transfer chambers 50 during each rotation of support 46 and their movement along such path.

It is possible to suitably design the path of the pair of tracks 45A and 45B or of track 45C or 45D only, so as to obtain a consequent path P2, along which the transfer chambers 50 move in a succession (figures 2A, 2B, 2C and 2D), having a portion T1 that is concomitant with the circular path P3 of the bottom dies, along which portion T1 each transfer chamber 50 is in coaxial position and above the cavity of a bottom die 21 and its motion coincides with the motion of the latter. The transfer of the polymeric bodies D from chambers 50 to the cavities of bottom dies 21 is then carried out along this portion T1.

By providing a suitable length for portion T1 concomitant with paths P2 and P3, thanks to the coincidence of the movements in such portion T1, a relatively high time is provided (depending on the rotation speed of the moulding machine 20 and on the length of the concomitance portion T1) during which it is possible to carry out the transfer of each body D to the cavity of a bottom die, while the transfer chamber 50 remains superimposed and exactly coaxial therewith.

For the use of the invention, also other mechanisms 41 could be used, differing from those illustrated above but equivalent to them as regards the operation and the kinematic effects obtainable in the spirit of the invention itself.

In the embodiments illustrated in the figures, path P3 of bottom dies 21 is circular and as a consequence, the concomitant portion T1 is circular as well. However, path P3 can be made with a different shape; for example, it can exhibit a rectilinear portion, along which also portion T1 is determined. In this case, the centrifugal thrust on the polymeric body advantageously is null or almost null.

In the embodiments of mechanisms 41 illustrated with reference to figures 2C and 2D, in the concomitant portions T1 and T2, the movement (trajectory and speed) of the transfer chambers 50, unlike the two previous embodiments, does not exactly match the movement of bottom dies 21 or respectively, the movement of the handling means 31 (described hereinafter) but however, it is similar, in a sufficiently approximate manner, such movements.

According to the invention, there is provided means adapted for transferring the polymeric bodies D from the dispensing outlet 11 to the transfer chambers 50.

This means can consist of a second rotating transfer machine 30, adapted for moving the polymeric bodies away from the fixed point from where they come out (the dispensing outlet 11) and transferring them, with a motion having horizontal component, to the transfer chambers 50 (as in the embodiments illustrated in figures described hereinafter).

According to the embodiment illustrated in figures from 1 to 4F, said second transfer machine 30 comprises a plurality of handling means 31, carried in continuous rotation. Each means 31 exhibits a concave inner surface 32b, with cross section shaped as a "U" open on a side, intended to come into contact with the polymeric bodies D pushing and guiding them in descent. Surface 32b has an axial development according to a substantially vertical axis and such shape as to define a channel open on a side (the side facing the direction of forward movement) capable of accompanying the polymeric bodies D making them slide in contact therewith.

The second transfer machine 30 exhibits moving means adapted for actuating in a succession the handling means 31 so that it transfers, with a relative movement in cross direction, dosed bodies D of polymeric material at the viscous liquid state coming out of the dispensing outlet 11 and arranges them one at a time into the transfer chambers 50.

Said moving means comprises a circular support 36, arranged on a horizontal plane, rotating in synchronism with the moulding machine, about a vertical shaft coaxial with shaft 47 of support 46 (or about a shaft 361 away from shaft 47, as in the case shown in Fig. 2C) having fixed axis, at the periphery of which there is fixed the handling means 31, arranged with the open side of surface 32b facing tangentially forward relative to the direction of rotation.

The path P4 covered by the contact surfaces 32b develops on a horizontal plane and is arranged below and at a short distance from the dispensing outlet 11 (but sufficient to avoid the collision against the lower end of the extruded cord M that comes down from the outlet itself), so that the upper end of the contact surface 32b moves below outlet 11, knife 13 being interposed; moreover, said path P4 is arranged above and at a short distance from the underlying path P2 of chambers 50, so that the lower end of the contact surface 32b moves slightly touching the upper end of chambers 50.

The path P4 covered by means 31 is circular an a portion thereof (indicated with T2 in figures 2A, 2B, 2C and 2D) is made concomitant with path P2 of transfer chambers 50. During this portion T2, each handling means 31 is in coaxial position and above a transfer chamber 50 and its motion coincides with the motion of the latter. Since the path P4 covered by means 31 is rigidly circular, it being rigidly fixed to support 36, path P2 of the transfer chambers 50 is the one that, by suitably shaping the path of the fixed tracks 45A-45D, is made to deviate relative to a circular path and made to coincide with said portion T2 of path P4 of the handling means 31.

The dispensing outlet 11 is located in the proximity of the upstream end of said portion T2.

In use, means 31 is made to pass below the dispensing outlet 11, where body D, just cut by knife 13, enters into the concavity formed by the contact surface 32b and is pushed by contact in horizontal motion by the latter. In the meantime, body D also moves by gravity downwards, sliding in a guided manner along the contact surface 32b itself, until it leaves it and falls within an underlying transfer chamber 50. This transfer is carried out along portion T2, along which, as said before, the contact surface 32b is arranged above and coaxial with a transfer chamber 50 and moves with it with the same motion.

Thanks to the concomitant portion T2 of paths P2 and P4 that will have suitable length and thanks to the coincidence of the movements in such portion T2, a relatively high time is provided (depending on the rotation speed of the moulding machine 20 and on the length of portion T2) during which it is possible to carry out the proper transfer of each body D from the dispensing outlet 11 to the transfer chamber 50.

The lower portion 33 of surface 32b is closed and converging (like a funnel) in order to improve the descent of item D into the release seat.

Figures from 4A to 4D show the crucial steps of the transfer of the polymeric body D from the dispensing outlet 11 to the transfer chambers 50 by the handling means 31, all of which occur into said concomitant portion T2.

Fig. 4A shows body D just entered into the concavity of surface 32b and just separated from extruded element M by the action of knife 13. This step corresponds to position Q1 of Fig. 2A.

In figures from 4B to 4D, the polymeric body D goes down accompanied by surface 32b until it fully enters into the underlying transfer chamber 50 (Fig. 4D).

Figures 4E, 4F show the crucial steps of the transfer of the polymeric body D from the transfer chamber 50 to the underlying cavity of a bottom die 21, all of which occur into said concomitant portion T1.

As an alternative to what illustrated above, means can be provided, adapted for transferring the polymeric bodies D from the dispensing outlet 11 to the transfer chambers 50, adapted for carrying out said transfer only by vertical descent of the polymeric body from the fixed dispensing outlet directly to the transfer chamber 50; in this case, such transfer means is defined by members associated to the outlet itself (a piston that pushes and cuts the extruded material, one or more knives that cut the extruded material, etc.), which make the polymeric body detach from the dispensing outlet, and thereby fall by gravity (or for other factors, for example a compressed air push, etc.) into the transfer chamber, this being arranged below the outlet itself.

According to an embodiment of the handling means 31 illustrated in figures 8 and 9, this comprises means for totally or partly reducing the adhesion between the polymeric body D and the inner surface 32B with which it comes into contact.

Means 31 comprises a curved wall 32, open on a side whose inner surface defines said contact surface 32b; the lower end portion 33 of wall 32 is circular and closed and has an axial section slightly converging downwards.

Means 31 comprises means adapted for forming a fluid interspace (especially a gas) along the inner surface 32b such as to totally or partly reduce the adhesion effect between the dosed body D and the inner surface itself.

In particular, the curved wall 32 (comprised its lower portion 33) is porous so as to allow the gas passage through it, and moreover it comprises a second tubular wall 320 external and coaxial to the curved wall 32, and connected thereto with its upper and lower ends. A chamber 34 is defined between the two walls 32 and 320 which surrounds the porous curved wall 32, and extends by the entire or almost the entire length thereof, which is connected to means 38 (only partly shown in Fig. 9) adapted for delivering gas under pressure inside chamber 34 itself, which gas comes out at the contact surface 32b.

Chamber 34 is divided into an upper portion 34′ and a lower portion 34 respectively fed by a duct 35′ and by a duct 35″, which ducts are separate so as to allow the delivery in the two portions of chamber 34 of fluids having different (pressure) characteristics, so as to better control the descent of item D.

Excellent results have been obtained with a wall 32 formed with a porous material having the features illustrated above with reference to the transfer chamber 50. Moreover, similarly to what said above, means (not shown in the figures) can be provided, adapted for thermally influencing the gas so as to decrease its temperature, with the features and the results described above.

As an alternative, the gas may be delivered on the contact surface 32b with a flow directed in tangent manner to the surface itself, so as to develop an interspace that touches the surface itself.

The provision of a fluid interspace between the contact surface 32b of the handling means 31 and the polymeric body D produces the favourable effects described in detail hereinafter with reference to the transfer chamber 50.

According to a preferred embodiment of the invention, transfer chambers 50 comprise means adapted for geometrically influencing the shape (and of course, the relevant size) of the polymeric body D.

In the first place, this conditioning is to make the polymeric body D suitable for going down in the cavity of bottom die 21, without coming into contact with its wall during the descent, or in any case with such contact as not to hinder the descent, and therefore to properly introduce it into the bottom die cavity.

This aspect of the invention is advantageous especially (not only) if the bottom die cavity is relatively deep and narrow relative to the mass of the polymeric body D and/or the operating speeds are relatively high. A typical case is in the forming of PET pre-forms, used for manufacturing the usual plastic bottles for mineral water or other fizzy drinks, in this case the bottom die cavity being relatively deep and narrow as compared to the dose mass.

Thanks to this aspect, as already mentioned above, the passage of the polymeric body from the transfer chamber to the bottom die cavity can be carried out in such quick manner that said concomitant portion T1 of paths P2 and P3, during which each transfer chamber 50 is in coaxial position and above the cavity of a bottom die 21, can be unnecessary.

According to a preferred embodiment, it is the same shape of the inner cavity 50a of the transfer chamber 50 the one that geometrically influences the shape of the polymeric body D. That is, body D is introduced in the transfer chamber 50 with a shape that can be different from that of the inner cavity 50a of the chamber itself, and it is physically influenced thereby meaning that it comes into contact with it and takes the same shape as it, especially the shape of the side surface, thanks to its intrinsic fluidity and plasticity.

In this meaning, according to the embodiment illustrated in figures 4A - 4F, 5, the inner cavity 50a of the transfer chamber 50 is laterally delimited by the inner surface 51b of a side wall 51, which surface is cylindrical, with section of a shape corresponding to the shape of the section of the bottom die cavity, with vertical generatrices, and its cross size is smaller than the minimum cross size on the inlet zone of the bottom die cavity. In the frequent case where the generic cross section of the bottom die is circular, also the inner surface 51b exhibits circular section.

In the case illustrated, for example, in figures 4E and 4F, the cavity of the upper portion 21b of the bottom die has a smaller diameter than the side cylindrical surface of the lower portion 21a. In this case, the diameter of the inner cavity 50a is a little smaller than the diameter of the cavity of the upper portion 21b.

The contrary applies if the side cylindrical surface of the cavity of the lower portion 21a of the bottom die has a smaller diameter than the cavity of the upper portion 21b.

When body D is released from chamber 50 into the cavity of the underlying bottom die 21, it has such shape that enables it to penetrate into the cavity without or hardly coming into contact, during the descent, with its side walls, or in any case if a contact occurs, this does not considerably hinder the descent and its proper positioning inside bottom die 21.

The transfer chamber 50 comprises connectable and disconnectable means adapted for preventing the descent of the polymeric body and alternately adapted for releasing the body itself.

In particular, as shown in figures 5 and 6, the inner cavity 50a of the transfer chamber 50, besides being laterally delimited by the cylindrical and closed side wall 51, is delimited at the bottom by a lower base wall 52 adapted for taking (by means not shown) a closing position and alternately an opening position of the lower outlet.

In the step in which the transfer chamber 50 receives the polymeric body D from the dispensing outlet 11, the lower wall 52 is in closed position; on the other hand, in the step in which the transfer chamber 50 releases the polymeric body D to the bottom die cavity, the same lower wall 52 is in open position.

According to the embodiment shown in the figures, the lower base wall 52 is flat and, to move to the open position, it moves remaining in the same horizontal plane as it is when in closed position, with sliding adhering to the lower end edge of the side wall 51; in particular, it moves under rotation, relative to the side wall 51, about the vertical axis pin 521 constrained to wall 51.

Also other portions of chamber 50, besides the side wall 51, can serve to influence by contact the shape of the polymeric body D. In particular, the inner surface 52b of the lower wall 52, which comes into contact with the lower end of body D, can be shaped so as to model such end of suitable shape. For example, it can be a more or less pointed and rounded shape that allows the polymeric body a better introduction along the bottom die cavity, especially when the latter is relatively long and narrow. Or it can be a shape similar to that of the lower end of the bottom die cavity. Also in this case, the lower base wall can be porous to enable the passage of the anti-adhesion fluid through its thickness and moreover it consists of at least two portions that can be opened with a more or less centrifugal movement.

Since the polymeric body D comes into contact with the inner surface of cavity 50a of the transfer chamber 50, especially with the side inner surface 51b and with the inner surface 52b of the lower base 52, chamber 50 comprises means for partly or totally reducing the adhesion caused by such contact.

According to an embodiment of the transfer chamber 50, illustrated in Fig. 5, this means is adapted for providing a fluid, in particular a gas (preferably air) in the cavity of chamber 50 itself. In particular, this means emits gas for forming a gas interspace between the inner surface of the transfer chamber 50 and the polymeric body D such as to decrease the adhesion effect between the polymeric body D itself and the inner contact surface.

Preferably, the side wall 51 and the lower base wall 52 of the transfer chamber are porous so as to allow the gas passage through their thickness. In this case, an embodiment provides for a second outer side wall 51′ coaxial to the side wall 51, which surrounds it and is connected thereto at the upper and lower edge. A side chamber 51a is defined between the two walls 51 and 51′

which surrounds the side porous wall 51 by 360 degrees and extends by the entire or nearly the entire height thereof, which is connected to means (not shown in the figures) adapted for delivering gas under pressure, through a channelling 59 and inlets 56, inside chamber 51a itself and hence through the porous wall 51 inside the transfer chamber 50.

Moreover, if a lower base wall 52 is provided, a second outer base wall 52′ is provided, located at the bottom of wall 52 and connected thereto through the outer edge. A thin lower chamber 52a is defined between the two walls 52 and 52′ extends by the entire extension of the base wall 52, which is also connected to said means adapted for delivering gas under pressure inside chamber 52a itself and hence through the porous wall 51, inside the transfer chamber 50.

The gas under pressure is delivered to chambers 52a and 51a, and hence it passes through the porous walls 52 and 51 forming a gas interspace arranged between the inner surfaces 52b and 51b of walls 52 and 51 and the outer surface of the polymeric body D. This gas interspace has the effect of avoiding the contact between the polymeric body D and walls 52 and 51 or at least reduce the time and the extension of the contact zones, thus reducing the macroscopic adhesion effect between the polymeric body D and walls 52, 51, favouring an effective downward sliding of the body itself.

It has been found that, by interposing a fluid interspace with sufficient pressure and flow rate values (that vary according to the application, and are in any case relatively easily assessable) between the contact surface and the polymeric body D, it is possible to totally or at least partly reduce the effect of adhesion of the polymeric body D so that, in the practice, this does not stick and does not adhere to the surface.

In fact, forming a fluid interspace with appropriate pressure and flow rate values, which are generally relatively low (one or few bar are sufficient), the contact between the polymeric body D and the contact surface is avoided. If the contact occurs anyway, this is localised and limited over time. To this end, it has been experimentally proved that limiting the contact time between the polymeric body D and the surface to relatively low values, a correspondingly macroscopic limited adhesion effect occurs; if the adhesion time is of few micro-seconds, the macroscopic adhesion effect is virtually null.

The phenomenon can be explained with the fact that, to obtain an adhesion effect, the contact time needed is not less than such a value (reaction time) that the chemical-physical adhesion strengths can have effect. This reaction time is function of the material, of the temperature and of the local pressure. The fluid interspace causes the continuous interruption of this process, so that the maximum adhesion does not occur; or it even avoids any contact.

Excellent results are obtained by making the above porous walls with a material whose pores have a diameter comprised between 5×10^{-3} mm and 20×10^{-3} mm and delivering gas in the chamber at a pressure of 0.5 - 1 bar.

In a first embodiment alternative to the use of porous walls, walls of non-porous material can be provided, on which however several small holes are made, such as to allow the fluid passage through them, distributed on the zone where contact with the polymeric body D occurs (Fig. 6). For example, such holes can have a helical distribution to obtain the maximum coverage on the contact zone.

According to a further alternative embodiment, said porous wall is replaced by a wall obtained with a plurality of elements sided to one another so as to form a plurality of lines of reciprocal separation relatively thin, shaped and distributed in an appropriate manner on the contact zone, through which the fluid passage is carried out.

In a further alternative embodiment, the fluid can be delivered inside the transfer chamber 50 with means that emits a direct flow tangent to the contact surface 52b, 51b so as to develop an interspace that touches the surface itself, avoiding the adhesion of body D to the contact surface.

The described advantageous effect produced by the fluid interspace is further increased by thermally influencing the same fluid delivered between the contact surface and the polymeric body D, so as to decrease the temperature of the surface of the polymeric body D and/or of the contact surface.

To this end, means (not shown in the figures) can be provided, adapted for thermally influencing the gas so as to drop its temperature. In this case, the gas interspace formed between the inner surface of the transfer chamber 50 and the outer surface of the polymeric body D also produces an effective heat exchange with the mass of walls 52 and 51 and with the outer surface of the polymeric body D, that can advantageously be used to promote the sliding of the polymeric body D itself. The cooled fluid, passing through the wall, or simply touching both the contact surfaces 51b and 52b and the surface of the polymeric body D, decreases at least in surface their temperature, thus increasing the viscosity of the polymeric body D, thus decreasing the adhesion of the plastic material. In fact, it has been found that if the contact time is increased (from microseconds to milliseconds), it is necessary to decrease the wall temperature to prevent adhesion.

In the case described above where the contact surface is located on a wall made of a porous material, or in the case where the fluid passes through relatively narrow openings, the fluid itself in se has a favourable "cooling effect" due to its expansion in output, in the passage through the wall.

Of course, the fluid temperature is calibrated so as to prevent excessive dropping, even though localised, of the polymeric body D such as to produce micro-crystallisation of the material or in any case, seeds of irregularities in the material. Anyway, the cooling effect on the polymeric body produced by the fluid is totally different from that obtained by relatively long direct physical contact of the body itself with the contact surface of the dose handling means. In fact in the first case, a sort of micro-cooling occurs that only concerns the most superficial layer of the body of polymeric material D and is distributed on the entire surface thereof in a regular and homogeneous manner; moreover, such cooling is of lower intensity and thanks to the heat conduction arising from the remaining body mass, it is quickly balanced, the body exits from the fluid influence. On the other hand, in the case of contact between the polymeric body D and the handling means, a strong and relatively deep cooling occurs, limited to a relatively small body portion, with harmful consequences for the formed item, as mentioned above.

The cooling effect on the polymeric body in order to totally or partly reduce the adhesion between the polymeric body and the inner surface of the transfer chamber 50 can be obtained by cooling of the walls of the chamber itself, carried out with means other than air, for example with fluid circulation inside the wall to be cooled.

According to another important aspect of the invention, a forced fluid, in particular air (or other gas) is introduced into the transfer chamber 50 above the polymeric body for generating a thrust directed downwards for making the output of the polymeric body D through the lower outlet quicker.

To this end, closing means is provided, adapted for closing the upper base of the transfer chambers 50, wherein one or more openings are obtained through which, by suitable means for dispensing fluid under pressure, forced fluid is dispensed into the chamber 50 in order to push, under pressure, the polymeric body D out through the lower outlet.

According to the embodiment illustrated in figures 4E, 4F, said closing means is defined by closing bodies 54 that are in closing position of the upper outlet of the transfer chamber 50 every time the latter is in position suitably superimposed to the die cavity. When said superimposition occurs, fluid under pressure is delivered through openings 54a obtained in body 54 and directed downwards, inside the transfer chamber 50, so as to strongly push downwards the underlying polymeric body D.

Advantageously, said bodies 54 are fixed below the outer edge of a rotating support disk 36′ of the second transfer machine 30 (integral and concentric with support 36 carrying the handling means 31), that extends with such diameter that its outer edge superimposes to the path of bottom dies 21. The kinematic features of machine 30 and of the moulding machine 20 are in such relation that for each transfer chamber 50 superimposed to a cavity of bottom die 21, a closing body 54 is in closing position of the upper outlet of the transfer chamber 50; and in this step, fluid under pressure is introduced through body 54 so that the polymeric body D is "shot" downwards in the underlying bottom die cavity.

According to an alternative embodiment illustrated in figures 5 and 6, the upper outlet of the inner cavity 50a is closed by an upper base wall 53 that can be opened and closed (by means not shown), integrally constrained to the transfer chamber 50. In detail, a second outer base wall 53′ is provided, located at the top of wall 53 and connected thereto along the outer edge. A thin upper chamber 53a is defined between the two walls 53 and 53′ extends by the entire extension of the base wall 52, which is connected to means adapted for delivering gas under pressure inside chamber 53a itself and hence through holes 57, inside the transfer chamber 50.

In particular, the upper base wall 53 is flat and, to move to the open position, it moves remaining in the same horizontal plane as it is when in closed position, moving under rotation about the vertical axis pin 531 constrained to wall 51.

In the step in which the transfer chamber 50 receives the polymeric body D from the dispensing outlet 11, the upper wall 53 is in open position whereas the lower wall 52 is in closed position; on the other hand, in the step in which the transfer chamber 50 releases the polymeric body D to the bottom die cavity, the upper wall 53 is in closed position whereas the lower wall 52 is in open position. In this step, forced fluid is introduced into the transfer chamber 50 above the polymeric body for generating a thrust directed downwards for making the output of the polymeric body (D) through the lower outlet quicker.

An effect equivalent to that described above can be obtained thanks to the presence of the same fluid under pressure introduced into chamber 50 for reducing the adhesion between the polymeric body D and the inner chamber surfaces. In fact, closing chamber 50 by the upper base wall 53, after body D has been introduced in the same chamber, when fluid is introduced into the chamber itself, when the transfer chamber 50 is in portion T1 for carrying out the descent of the polymeric body into the cavity of a bottom die 21, a certain pressure is created into chamber 50; when the lower base wall 52 is opened, the gas under pressure into chamber 50 produces a "shooting" effect that quickly and effectively pushes body D into the underlying bottom die cavity.

This effect can replace or can be added to the effect described above, obtained by forced fluid delivered through the closing means 54, 53. This occurs in the embodiments illustrated in figures 5 and 6 where, in fact, the upper base wall 53 is adapted for emitting forced fluid through holes 57, whereas other fluid enters into the chamber through the side wall 51 and the lower base wall 52.

Of course, the upper outlet of the transfer chamber 50 can remain open; in this case, since the polymeric body D dimensions, in particular the diameter, are smaller than those of the cavity of bottom die 21, the polymeric body D itself can fall by gravity into said cavity.

According to a different embodiment, for influencing the geometrical shape of the polymeric body D in relation to the shape of the die cavity, as an alternative or in addition to its contact with the inner surface of the transfer chamber 50 (illustrated above), means is provided, adapted for introducing fluid under pressure into the chamber itself, acting on the side surface of the polymeric body D and/or on the lower end surface. The fluid is directed against the surface of the polymeric body D with such methods as to influence its shape. For example, the diameter of the cross section of body D is decreased, so as to make it geometrically suitable for going down into the cavity of bottom die 21 without (considerable) contact with the walls thereof. An example of embodiment is illustrated in Fig. 6, where the transfer chamber 50 is substantially equal to that of Fig. 5; however, rather than being porous, wall 51 is provided with a plurality of holes 57 of larger diameter than the pores, through which fluid under pressure (in particular air) is introduced in the inner cavity 50a. Holes 57′ equal to said holes 57 can also be provided in the lower base 52.

Thanks to this solution it is possible to influence the shape of body D in an adjustable manner, changing only the features of the flow introduced into chamber 50, without changing the geometrical characteristics thereof. Besides optimising the introduction of the polymeric body D in the bottom die cavity, as already mentioned above, the conditioning of its shape can advantageously be used so as to optimise its pressing, to obtain a formed item having the physical-chemical characteristics. For example, it has been found that such a shape of the polymeric body as to make it as much as possible conforming to the die cavity wherein it is introduced, so that the body adheres as much as possible to the surface of the cavity itself, gives the best results in terms of quality of the item obtained. If on the other hand, a polymeric body has a quite different shape relative to that of the cavity, for example it has such a narrow shape that its axis considerably bends, in the compression forming it undergoes localised deformations with alteration of the desired physical-chemical characteristics. With the invention it is possible to influence both the side surface and the lower end surface of the transfer chamber 50, so as to make their shape equal or almost equal to that of the corresponding surfaces of the bottom die cavity. In this case, the polymeric body D fully or almost fully adheres to the cavity and the result is that the compression forming it is subject to occurs in the optimum conditions as regards the stresses the material is subject to.

According to another embodiment of the transfer chamber 50, not illustrated in the figures, different means is provided for totally or partly reducing the adhesion between the polymeric body D and the inner surface of the transfer chamber. In particular, chamber 50 and in particular its inner surfaces 51b, 52b are placed in vibration at such frequency values to prevent or at least partly reduce the macroscopic adhesion effect between the polymeric body D and the inner surfaces themselves. In fact, it has been found that with suitable vibration values, even though the polymeric material is sticky and at a microscopic level it produces adhesion points, these have a very small extension and above all, stay for very short times, so that the macroscopic adhesion strength between the material and the contact surface is relatively very small, and the adhesion phenomenon between such contact surface 51b and the polymeric body D is drastically reduced. Excellent results have been noted with a vibration excitation acting in the plane perpendicular to the vertical axis of the transfer chamber 50, with frequency of 300 pulses a second, in the case of PET dose.

A further embodiment of the transfer chamber 50 (not illustrated in the figures), in order to totally or partly reduce the adhesion between the polymeric body D and the inner surface of the transfer chamber 50, provides for a thin coating layer covering the inner surface of cavity 50a of chamber 50, of a material having anti-adhesion properties towards the polymeric body D, for example a PTFE (Teflon ®), whose outer surface defines said contact surface with the polymeric body D.

According to a further embodiment, illustrated in Fig. 7, the side cylindrical surface that delimits the inner cavity of the transfer chamber 50 has an opening 58 on a side zone (for example for introducing body D laterally) and comprises means adapted for emitting fluid under pressure directed towards body D through said side opening 58 for influencing the shape of the body itself at this opening. In particular, the side wall of chamber 50 has a U shaped section and at the two free ends, two vertical 58a ducts are arranged, communicating through channels 58b with a source of fluid under pressure; in turn, the vertical ducts 58a are provided with several openings 58d adapted for emitting jets of fluid towards opening 58. Thus, the polymeric body D remains influenced partly by the contact (with an interposed air layer) with the side wall 51 and partly by the action of the fluid emitted through openings 58d.

Even though the equipment according to the invention is described and illustrated in the figures herein for transferring polymeric bodies to the bottom die cavities, it is understood that the invention can also refer to the case where such polymeric bodies are to be arranged on the upper end of a die punch, which in this case will be arranged at the bottom of the relevant bottom die, facing upwards and will, directly or not, result in a more or less protruding cavity capable of seating the dosed body.

Of course, the means for reducing the adhesion effect between the polymeric body and the contact surface described above can be used in combination with one another.

Of course, several practical-application changes can be made to this invention, without departing from the scope of the inventive idea as claimed hereinafter.

CLAIMS

1. Equipment for transferring polymeric material bodies at the melted state, dispensed by a dispensing outlet (11) to the cavities of dies (21) carried by a moulding machine (20) rotating with continuous movement, in the compression forming of items of polymeric material,

characterised in that it comprises a rotating transfer machine (40), arranged outside the path of the die cavities, having a plurality of transfer chambers (50) carried in continuous rotation, each adapted for containing a polymeric body (D) and for transferring it to a die cavity (21), and having moving means adapted for moving in a succession the transfer chambers (50) along a same path (P2) so that this path (P2) has a portion (T1) concomitant with the path (P3) of the dies, during which each transfer chamber (50) is in coaxial position and above a die cavity (21) and its motion coincides with the motion of the latter, said transfer of the polymeric body (D) to the die cavity (21) being carried out in this portion (T1).

2. Equipment according to claim 1, characterised in that said moving means of the transfer machine (40) comprises:

a support (46) rotating in synchronism with the moulding machine (20),

a plurality of mechanisms (41), brought in rotation by said rotating support (46), each of which carries a respective transfer chamber (50), said mechanism being provided with at least one degree of freedom relative to the support (46) itself,

guiding means adapted for determining the motion of each mechanism (41) in relation to the angular position of the rotating support (46) so as to univocally define the movement and the path of the transfer chamber during each rotation of the support itself.

3. Equipment according to claim 2 characterised in that each of said mechanisms (41) comprises an arm consisting of two members (41a, 41b) constrained to one another, of which a first member (41a) is constrained to the rotating support (46), and the other member (41b) carries a said transfer chamber (50), mechanism (41) being provided with two degrees of freedom relative to support (46) itself.

4. Equipment according to claim 3, characterised in that in said mechanism (41), the first member (41a) is pivoted with one end to the second member (41b) and with the other end, to the rotating support (46).

5. Equipment according to claim 3, characterised in that in said mechanism (41), the first member (41a) is constrained to the rotating support (46) and the second member (41b) is prismatic-wise coupled to the first member (41a).

6. Equipment according to claim 3, characterised in that said guiding means adapted for determining the movement of each of said mechanisms (41) comprises a respective fixed track (45A, 45B) acting on a respective series of members (41a, 41b) so as to univocally define the movement of the transfer chamber (50) during each rotation of the support (46).

7. Equipment according to claim 3, characterised in that each mechanism (41) comprises a further constraining means (42) which, along with the other two members (41a, 41b), reduces to only one the degree of freedom of the mechanism relative to the support (46), and moreover comprises a fixed track (45C) acting on driven means (45′) carried by mechanism (41) so as to univocally

define the movement of the transfer chamber (50) during each rotation of the support (46).

8. Equipment according to claim 7, characterised in that in said further constraining means (42) is defined by a third member (42) entire and pivoted to the rotating support (46) and to the second member (41b) and forming an articulated quadrilateral with arm (41).

9. Equipment according to claim 2, characterised in that each mechanism (41) comprises a member (41d) constrained to the rotating support (46) with a constraint at a single degree of freedom,

and further comprises a fixed track (45D) acting on driven means (45') carried by member (41d) so as to univocally define the movement of the transfer chamber (50) during each rotation of support (46).

10. Equipment according to claim 1, characterised in that it comprises means adapted for transferring the polymeric bodies (D) from said dispensing outlet (11) to said transfer chambers (50).

11. Equipment according to claim 10, characterised in that for transferring single polymeric bodies from the dispensing outlet (11) to said transfer chamber, comprises a second rotating transfer machine (30) having a plurality of handling means (31), each having a concave inner contact surface (32b), open on a side, adapted for pushing the polymeric body (D) and for guiding it in descent, said handling means (31) being moved along a circular path to pass below said dispensing outlet (11).

12. Equipment according to claim 10, characterised in that the moving means of the first transfer machine (40) is adapted for moving in a succession the transfer

chambers (50) along a path (P2) that has a portion (T2) concomitant with a path (P4) of the handling means (31), during which each transfer chamber (50) is in coaxial position and below a handling means (31) and its motion coincides with the motion of the latter, said transfer of the polymeric body (D) to the transfer chamber (50) being carried out in this portion.

13. Equipment according to claim 11, characterised in that said handling means (31) comprises a concave inner surface (32b), with "U" shaped cross section intended to come into contact with the polymeric bodies D for pushing and guiding them in descent and are carried by a support (36) rotating in synchronism with the first transfer machine (40).

14. Equipment according to claim 11, characterised in that said handling means 31 comprises means adapted for forming a fluid interspace along its inner surface (32b) such as to totally or partly reduce the adhesion effect between the dosed body (D) and the inner surface itself.

15. Equipment according to claim 14, characterised in that said handling means 31 comprises a curved wall (32), open on a side whose inner surface defines said contact surface (32b), said curved wall being porous so as to allow the fluid passage through it, and further comprises means adapted for delivering fluid under pressure through the curved wall (32) so that it comes out at the contact surface (32b).

16. Equipment according to claim 1, characterised in that it comprises means adapted for completely or partly reducing the adhesion between the polymeric body (D) and the inner contact surface of the transfer chamber (50).

17. Equipment according to claim 16, characterised in

that for completely or partly reducing the adhesion between the polymeric body (D) and the contact surface of the transfer chamber (50), it comprises means adapted for providing fluid inside the chamber itself for forming a fluid interspace between the contact surface of the chamber itself and the polymeric body (D).

18. Equipment according to claim 17, characterised in that it comprises means adapted for thermally influencing said fluid delivered between the inner surface of the chamber (50) and the polymeric body (D).

19. Equipment according to claim 1, characterised in that it comprises means adapted for entering forced fluid into the transfer chamber 50, above the polymeric body, adapted for generating a thrust directed downwards, for making the output of the polymeric body (D) through the lower outlet quick.

20. Method for transferring dosed bodies of polymeric material at the more or less viscous liquid state, dispensed by at least one dispensing outlet (11) of polymeric material, to the cavities of dies (21) carried by a moulding machine (20) rotating with continuous movement, in the compression forming of items of polymeric material,

characterised in that it comprises the transfer of the polymeric bodies (D) from the dispensing outlet (D) into a plurality of transfer chambers (50), each adapted for containing single bodies (D), and the subsequent transfer of the bodies (D) themselves from the transfer chambers (50) to the cavities of dies (21), said transfer chambers (50) being actuated in a succession along a same path (P2) so that this path (P2) has a portion (T1) concomitant with the path (P3) of the dies (21), during which each transfer chamber (50) is in coaxial position and above the cavity of die (21) and its motion coincides with the motion of the latter, said transfer of the polymeric body (D) to the cavity of die (21) being carried out in this portion (T1).

21. Method according to claim 20, characterised in that it comprises the transfer of the polymeric bodies (D) to the transfer chambers (50) by transport with handling means (31) having a concave contact surface (32b), open on a side, which passing below the dispensing outlet (11) of the polymeric material, draw the dosed bodies (D) coming out of the outlet itself and, pushing and guiding them in the descent, arrange them one at a time in the transfer chambers (50).

Method according to claim 21, characterised in that the transfer of the polymeric bodies (D) to the transfer chambers (50) is carried out along a portion (T2) of path (P2) of the transfer chambers (50) concomitant with the path (P4) of the handling means (31), during which each transfer chamber (50) is in coaxial position and below a handling means (31) and its motion coincides with the motion of the latter.

23. Method according to claim 20, characterised in that the shape of the polymeric body (D) is geometrically influenced into the inner cavity (50a) of said transfer chamber (50), in relation to the shape of the die cavity.

24. Method according to claim 23, characterised in that the shape of the polymeric body (D) is geometrically influenced so as to make it geometrically suitable for going down into the die cavity without or almost without contact with the side zones of the cavity itself.

25. Method according to claim 20, characterised in that

the shape of the polymeric body (D) is geometrically influenced by the contact with a side surface (51b) that laterally delimits the inner cavity (50a) of said transfer chamber (50), whose cross size is smaller than the minimum cross size of the inlet zone of the die cavity.

26. Method according to claim 23, characterised in that for completely or partly reducing the adhesion between the dosed body (D) and the inner contact surface of the transfer chamber (50), fluid is introduced in the chamber (50) itself so as to form a fluid interspace between the contact surface and the polymeric body (D).

27. Method according to claim 26, characterised in that said fluid delivered between the inner surface of the chamber (50) and the polymeric body (D) is thermally conditioned.

28. Method according to claim 20, characterised in that it comprises the forced introduction of fluid into the transfer chamber (50), above the polymeric body, adapted for generating a thrust directed downwards, for making the output of the polymeric body (D) through the lower outlet quicker.

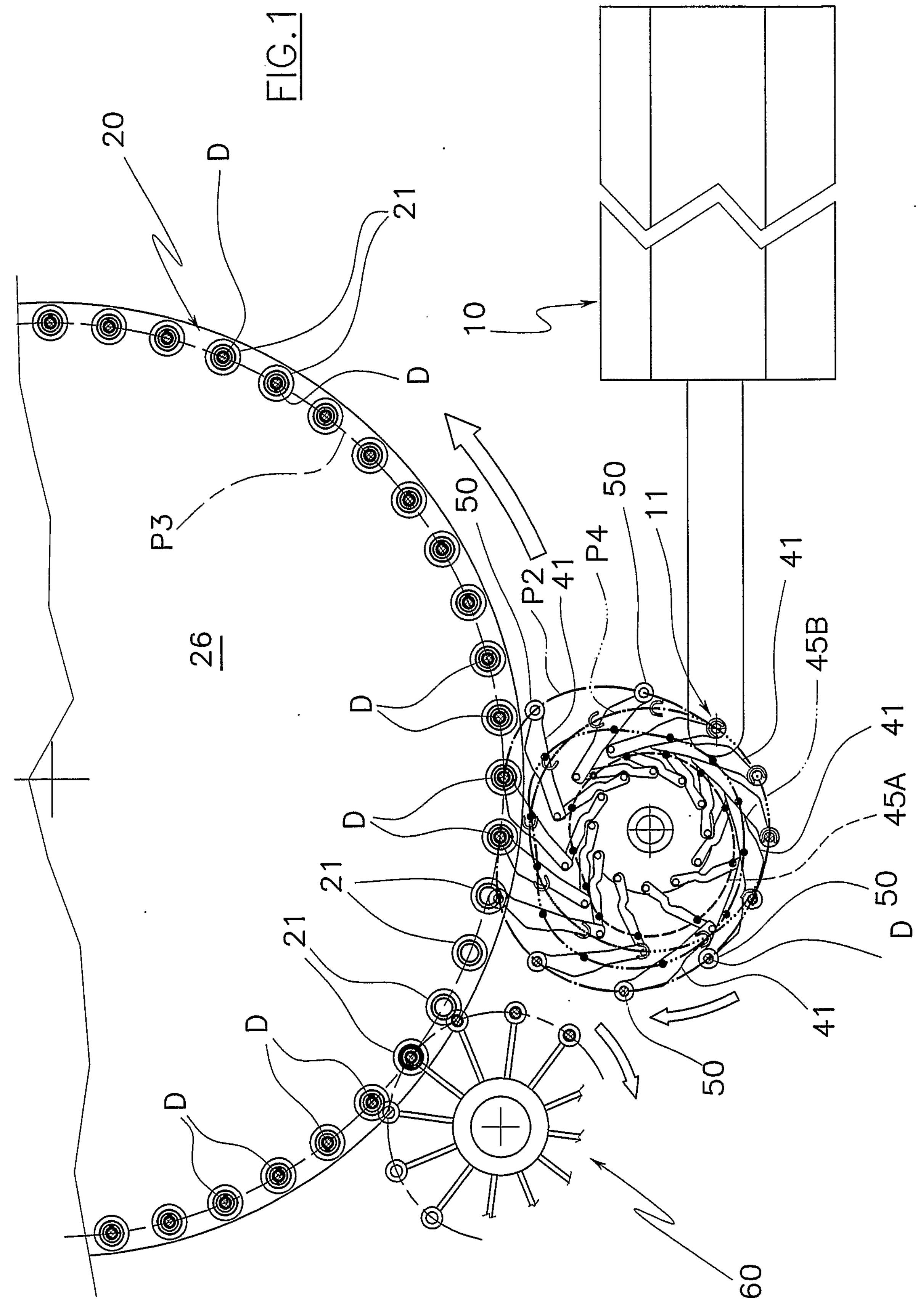


FIG. 1

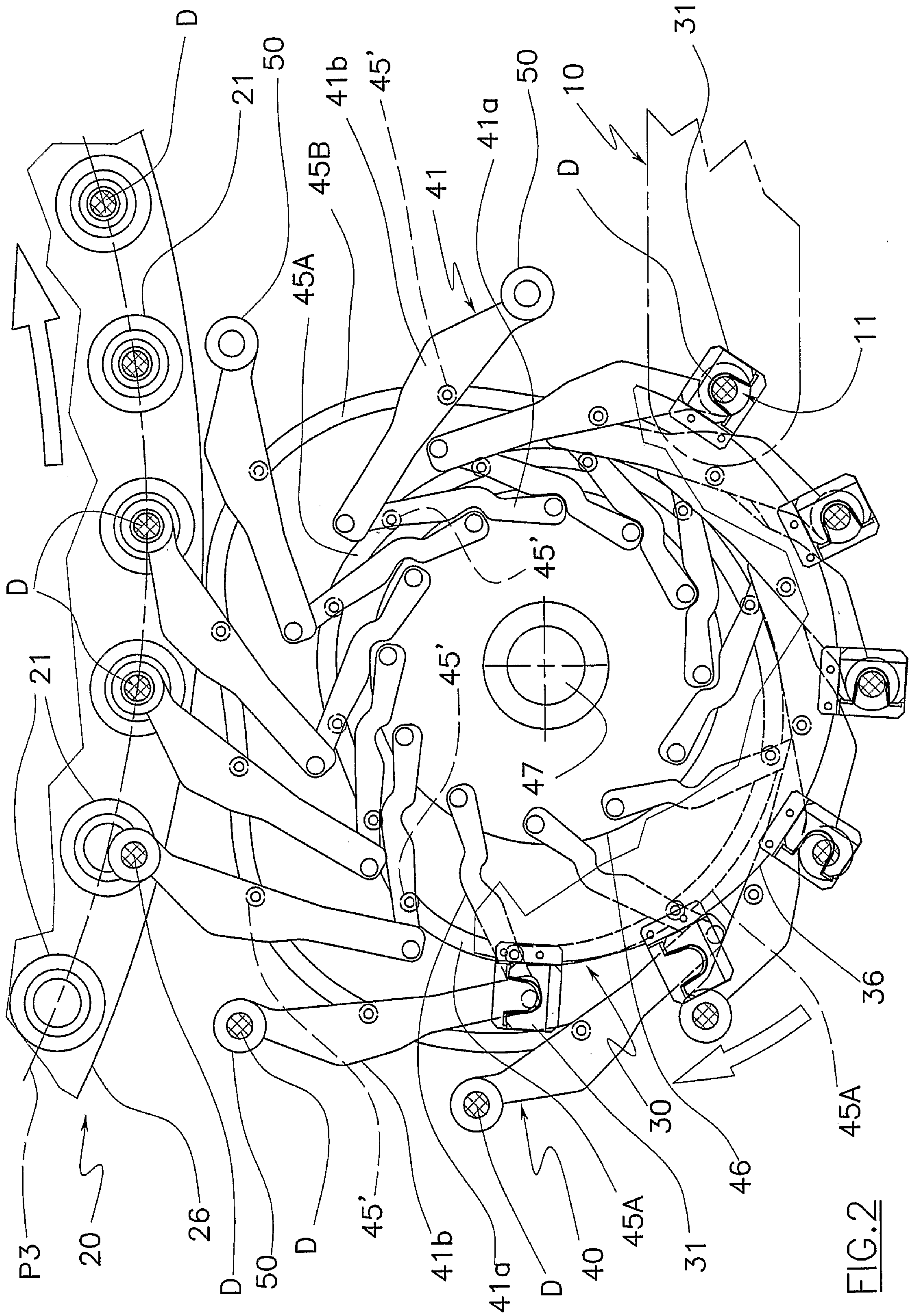

D
50
21
41b
45'
41a
50
10
31
D
41
45B
45A
11
D
45'
45'
47
36
45A
46
30
31
45A
40
D
41a
41b
45'
D
50
D
26
20
P3
21
21

FIG.2

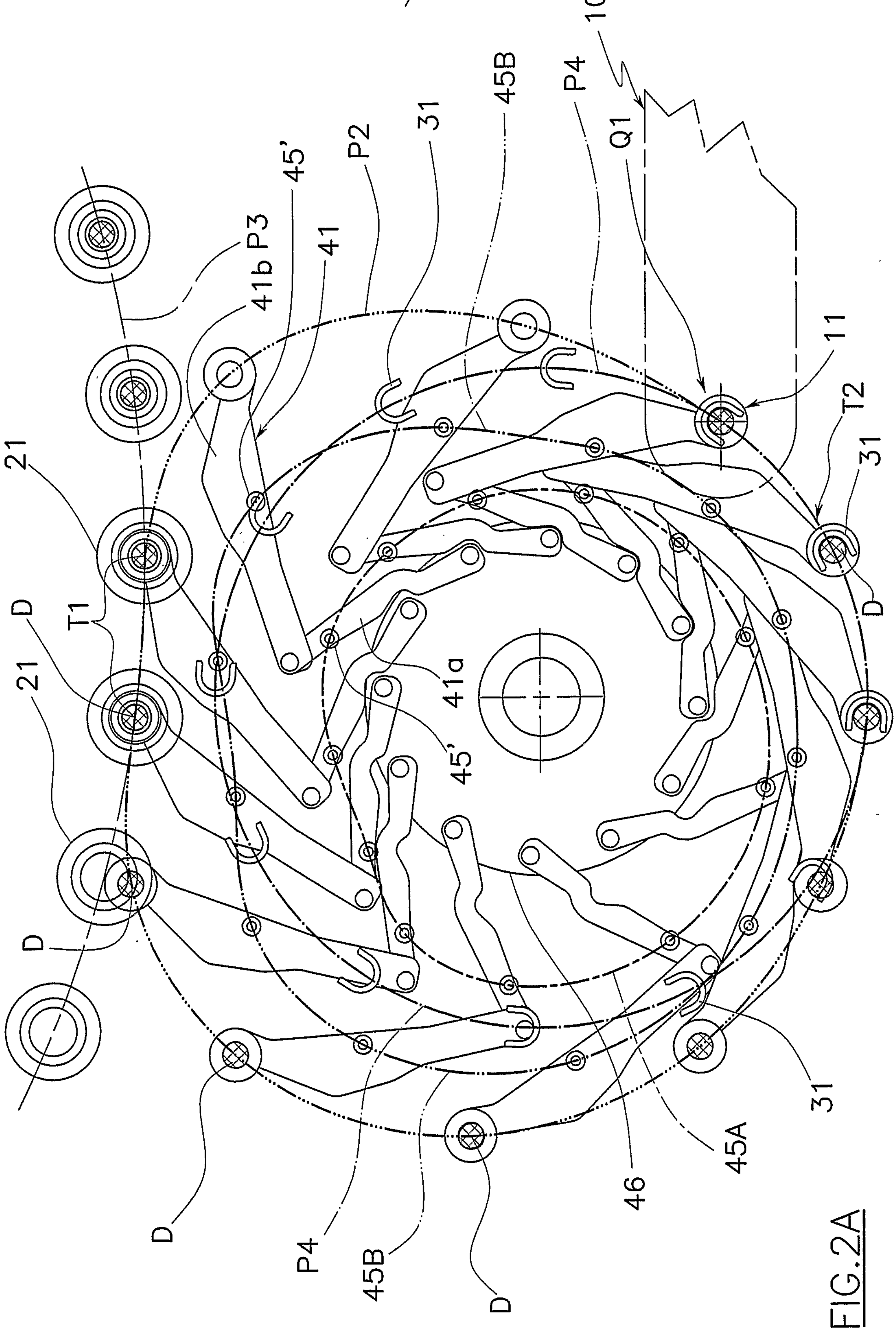

10
Q1
P4
45B
31
P2
45'
41
41b P3
21
T1
D
21
D
11
T2
31
D
41a
45'
D
P4
45B
D
46
45A
31
D

FIG.2A

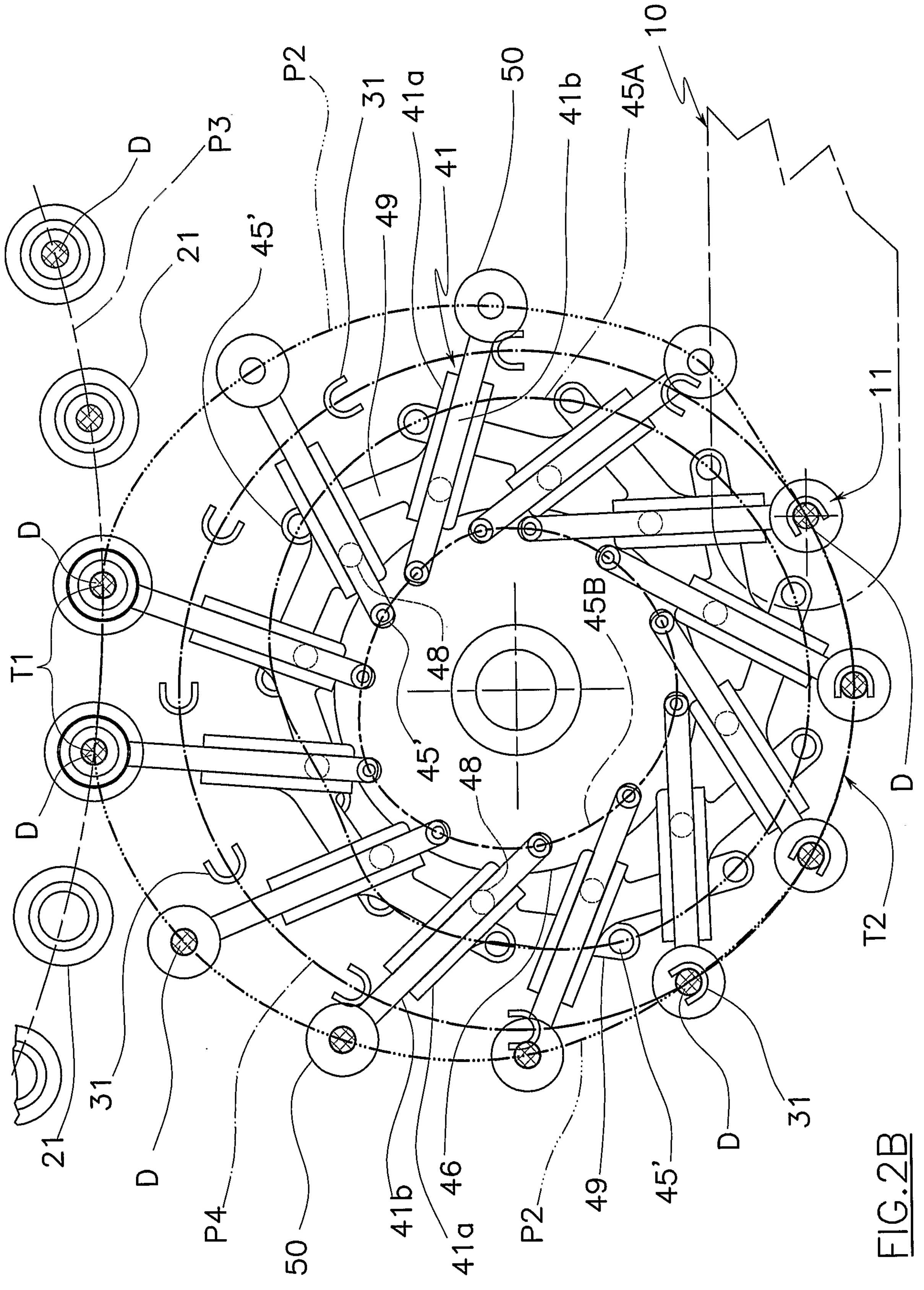


FIG.2B

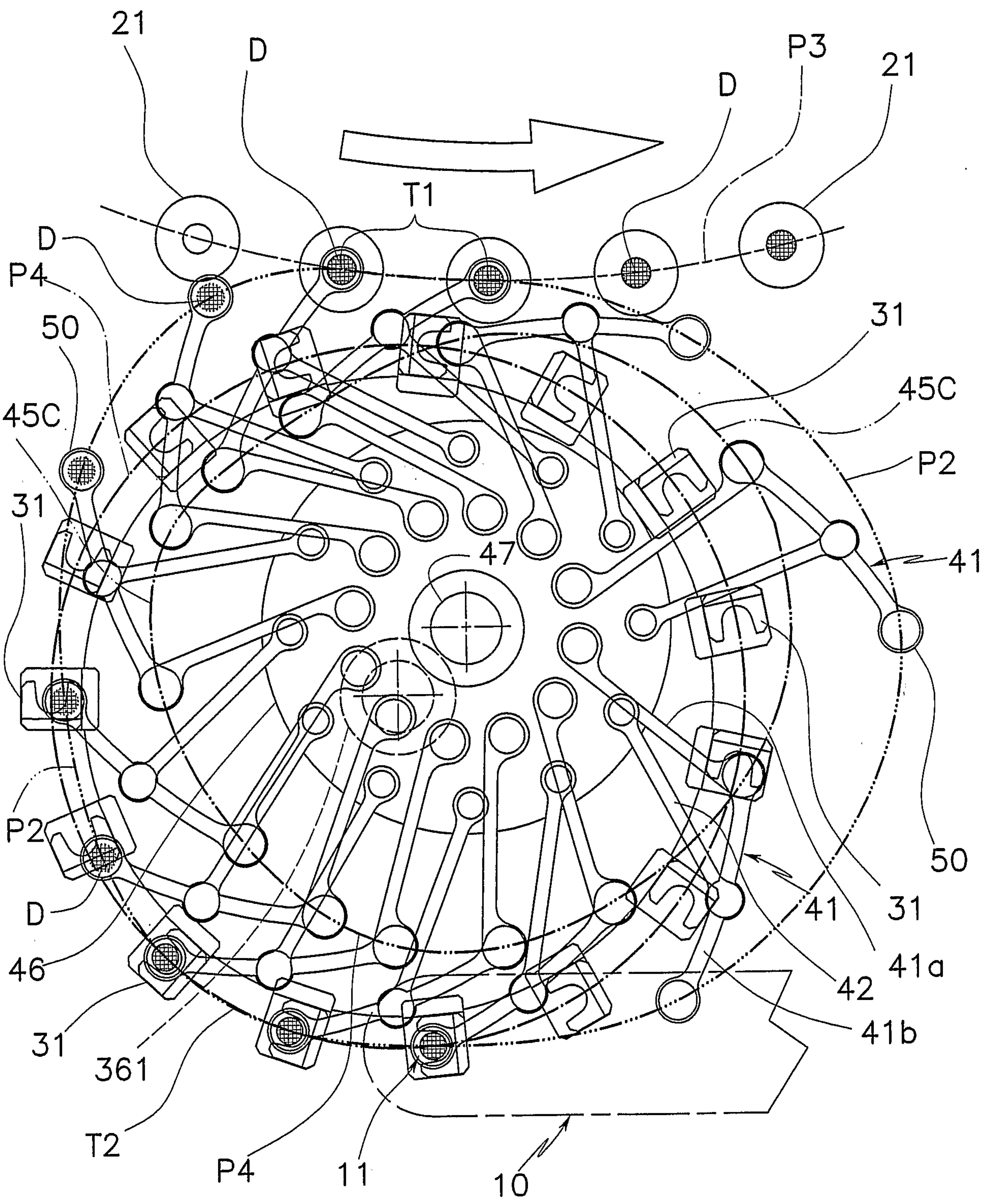

21
D
P3
D
21
T1
D
P4
50
45C
31
31
45C
P2
41
47
31
50
P2
D
46
31
361
T2
P4
11
10
41
31
42
41a
41b

FIG.2C

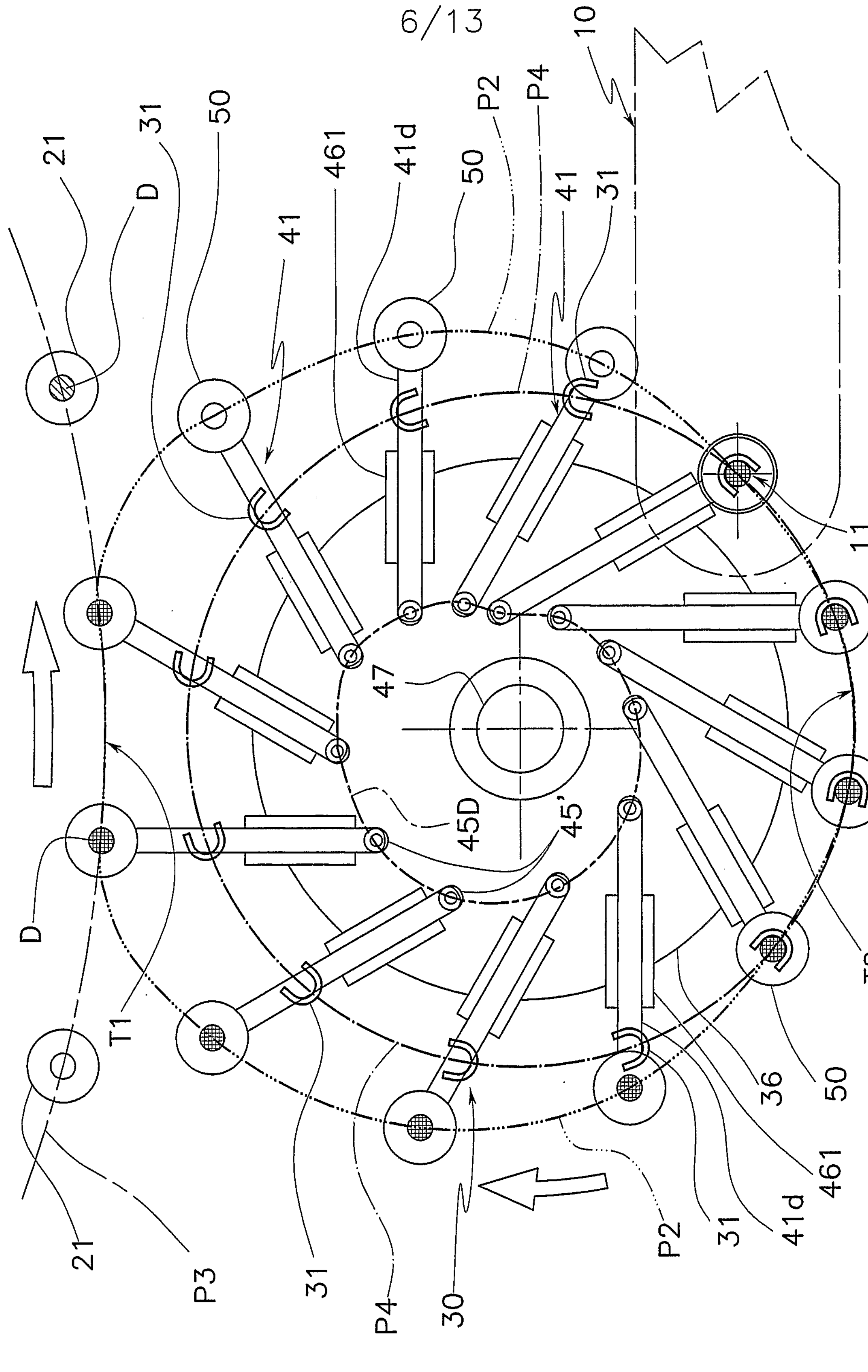

10
P2
P4
31
50
461
41d
50
41
31
21
D
41
11
47
45D
45'
D
T1
T2
36
50
21
P3
31
P4
30
P2
31
41d
461

FIG.2D

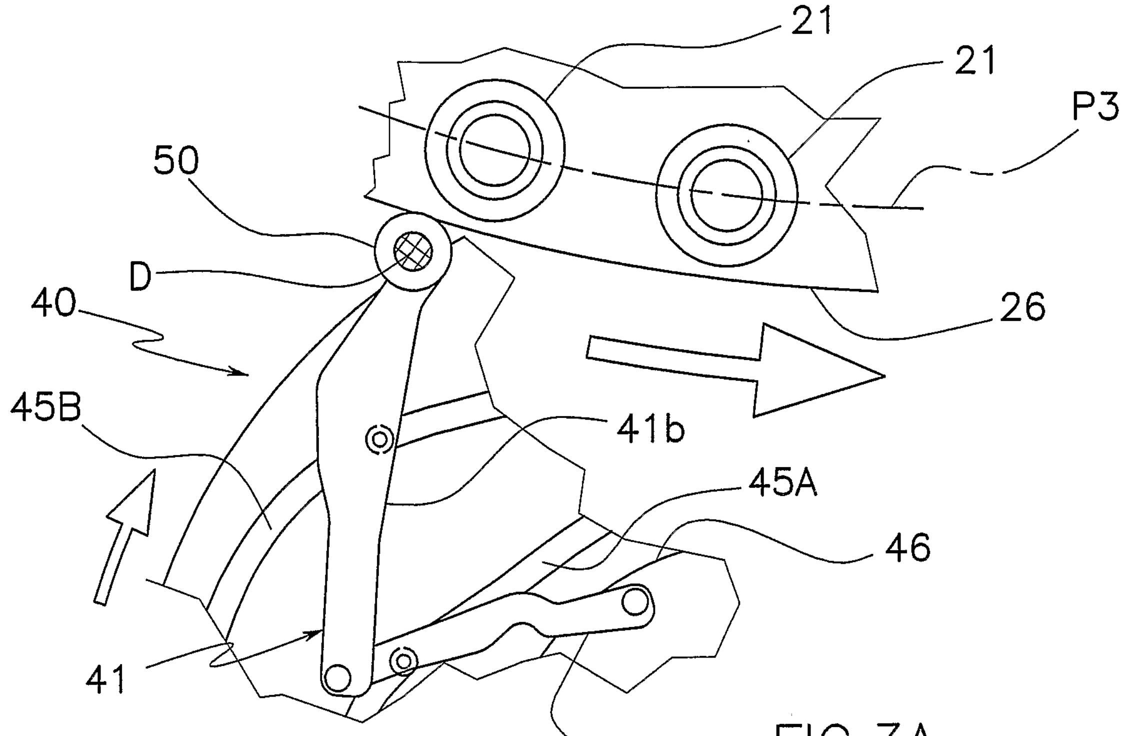

21
21
P3
50
D
40
45B
41b
45A
46
41
41a
26

FIG.3A

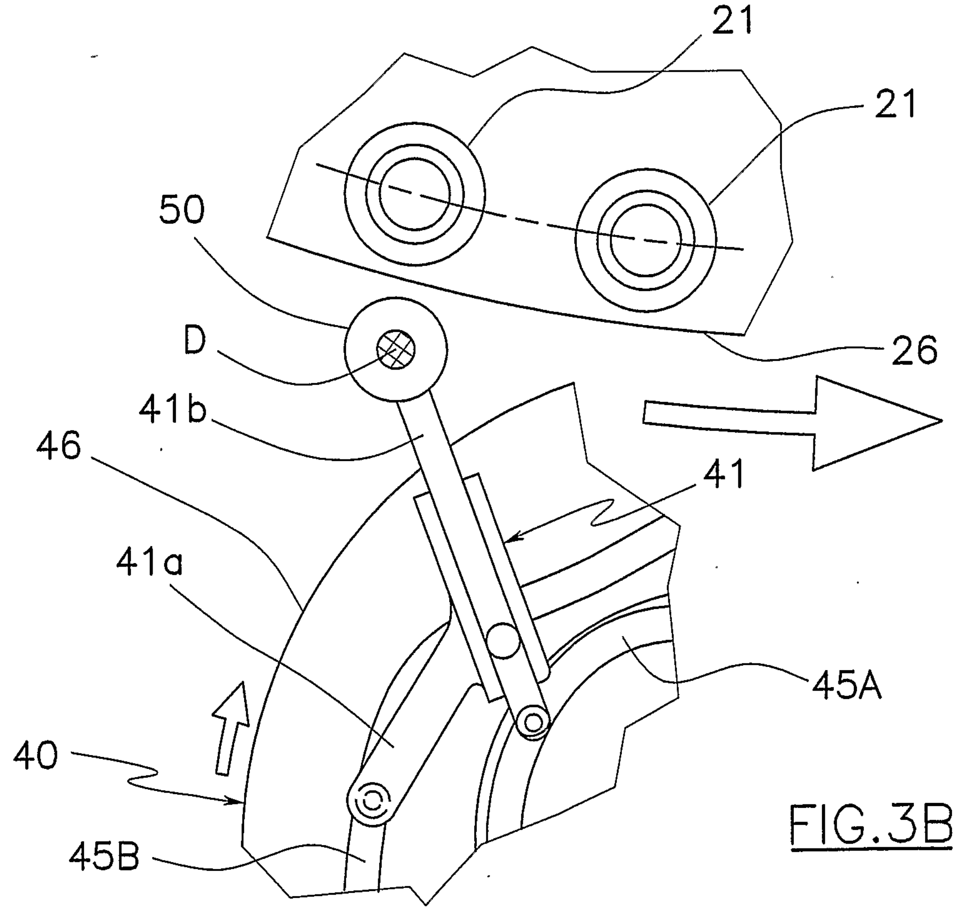

21
21
50
D
26
41b
46
41
41a
45A
40
45B

FIG.3B

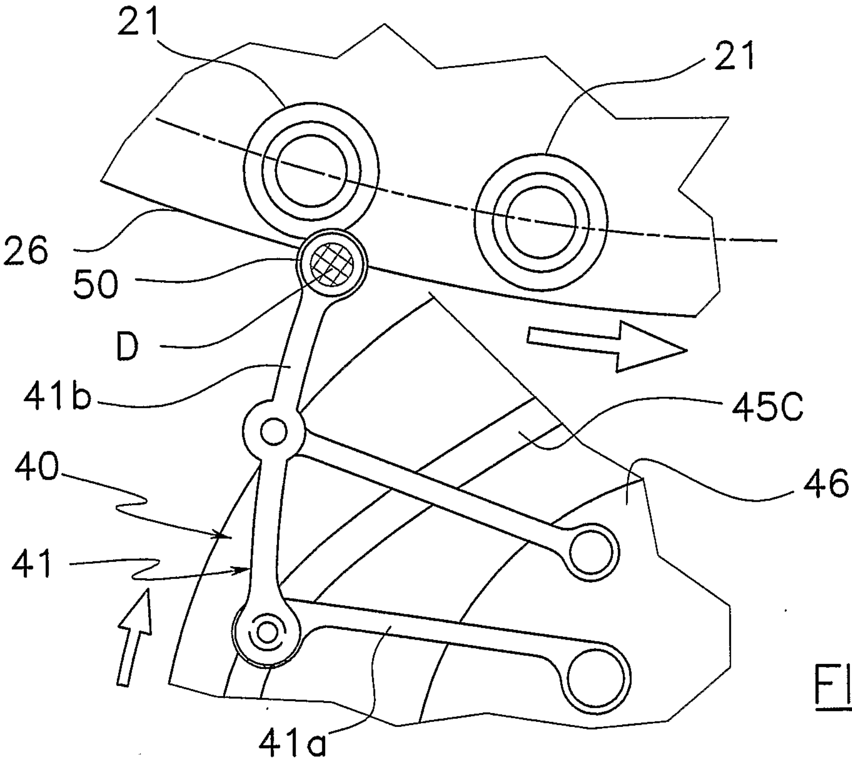


FIG.3C

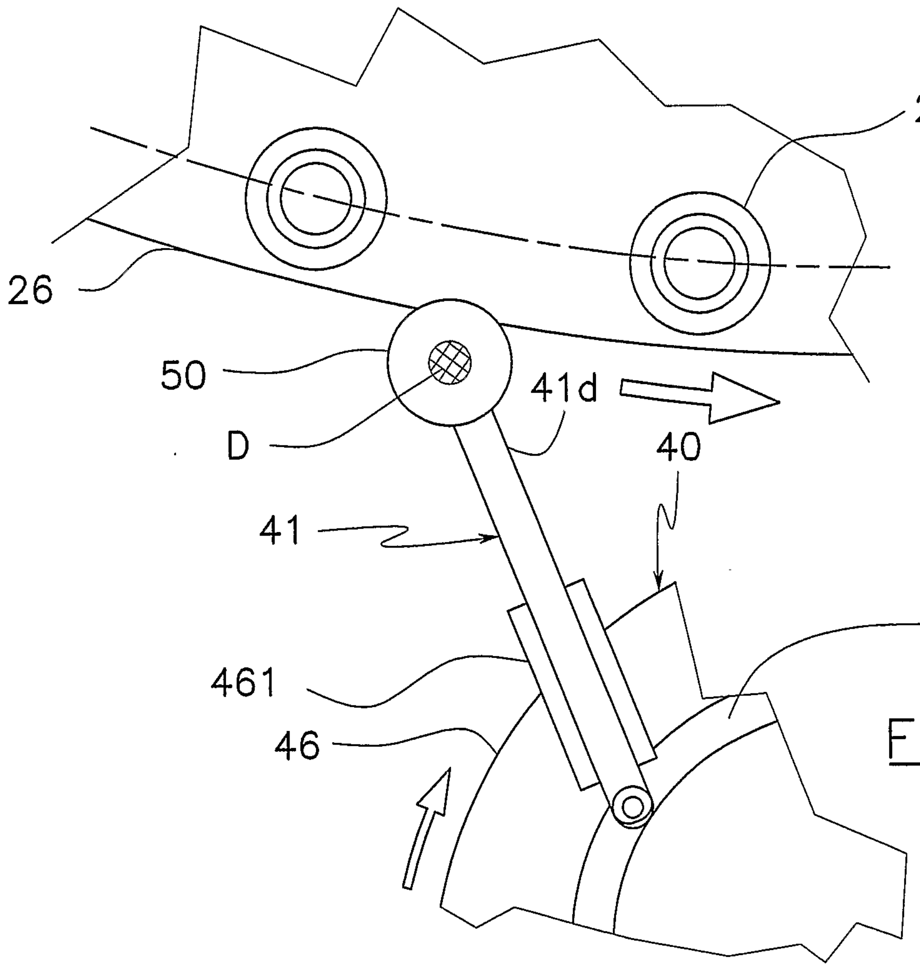


FIG.3D

FIG.4C

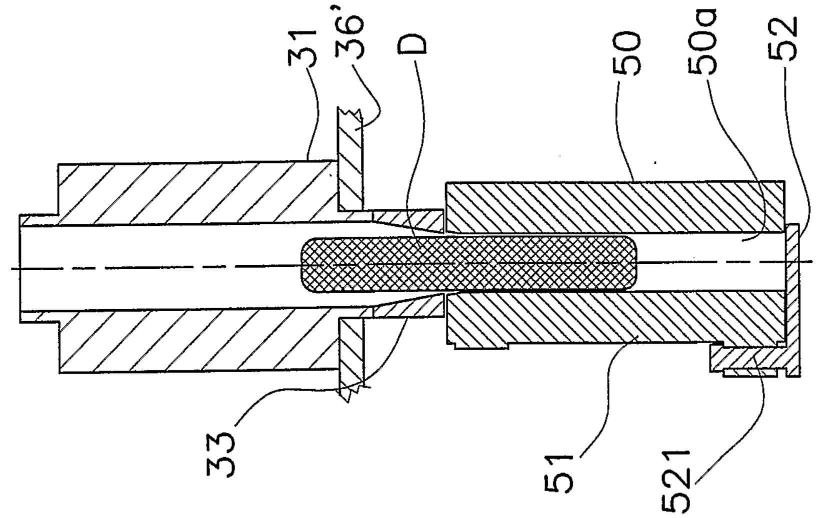


FIG.4B

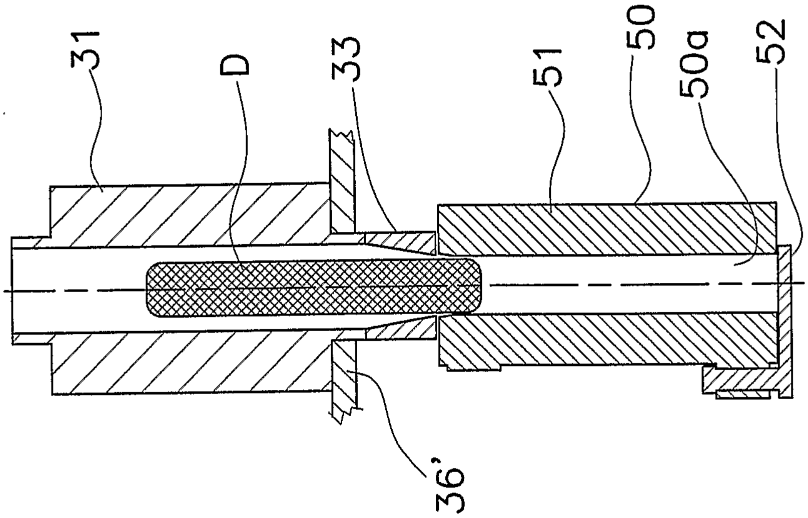
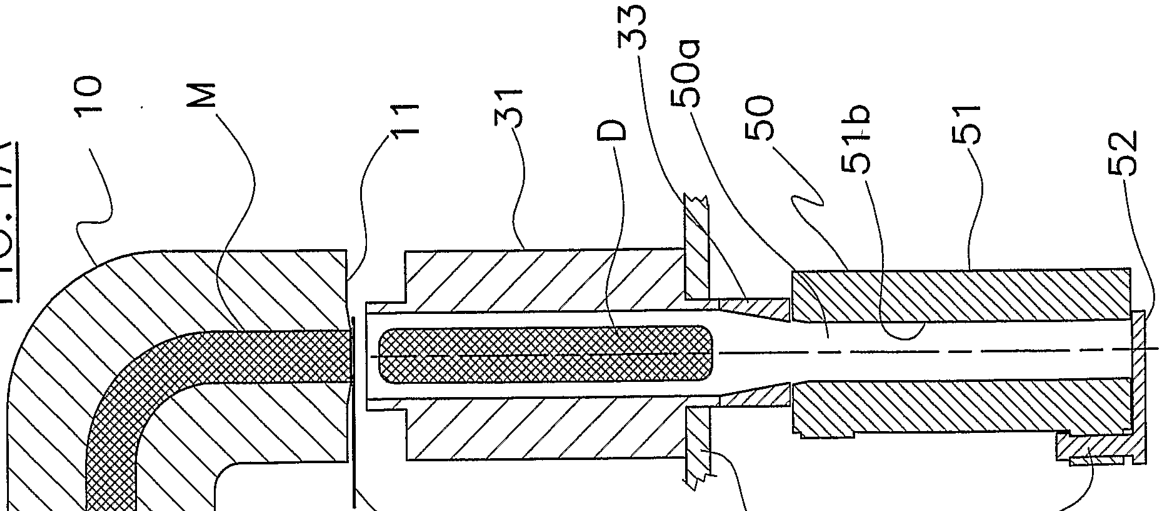


FIG.4A



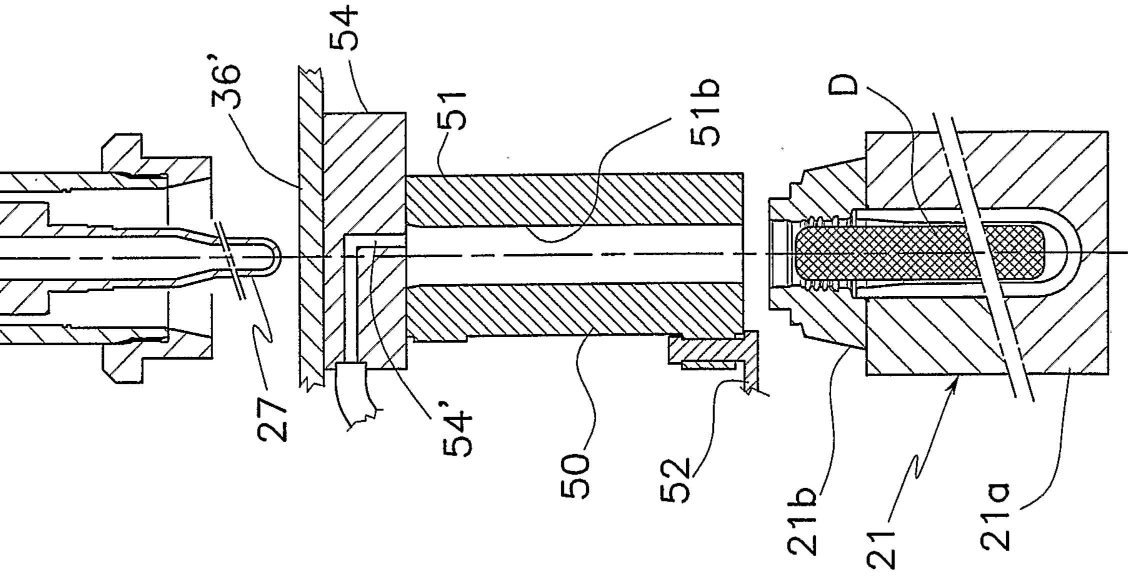


FIG.4F

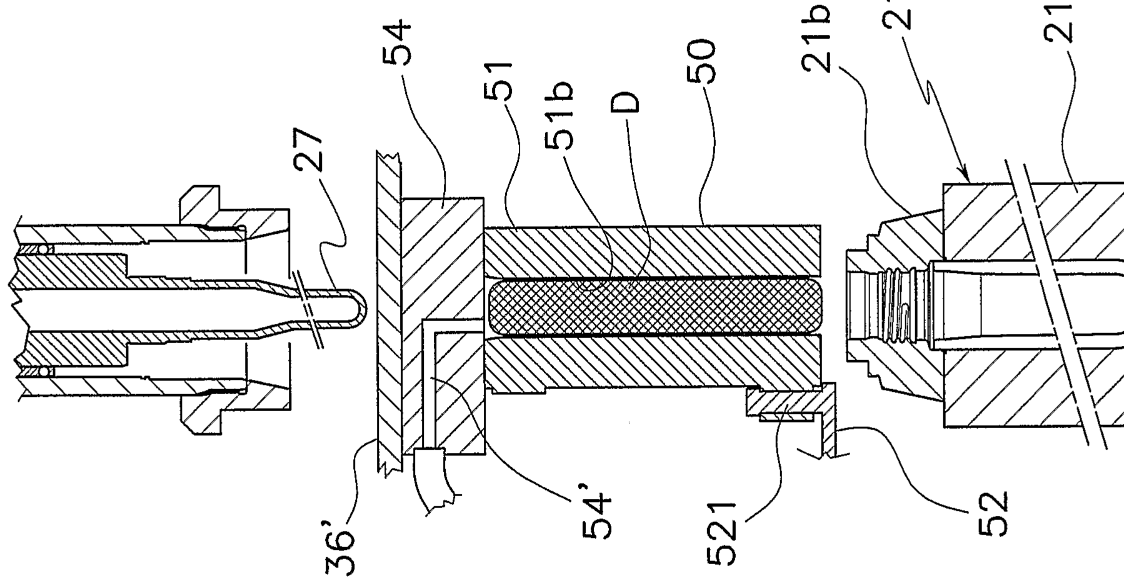


FIG.4E

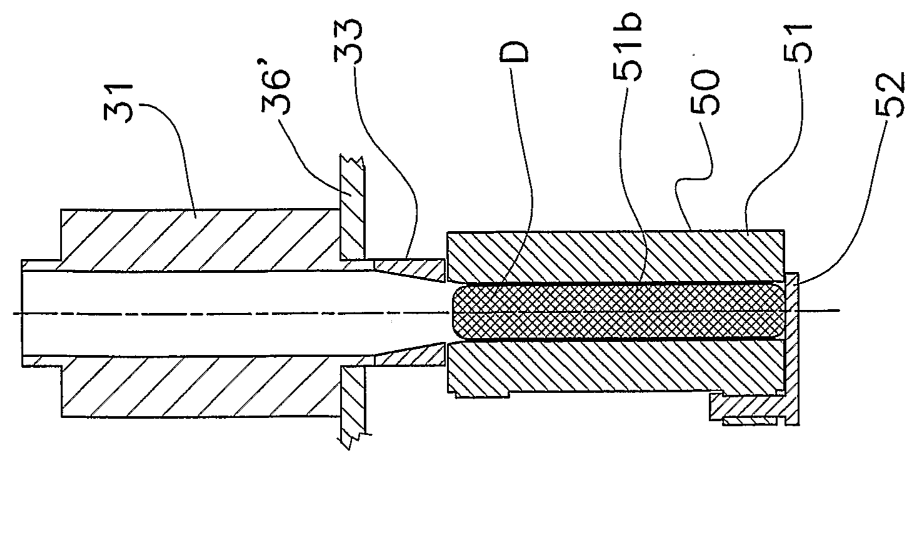


FIG.4D

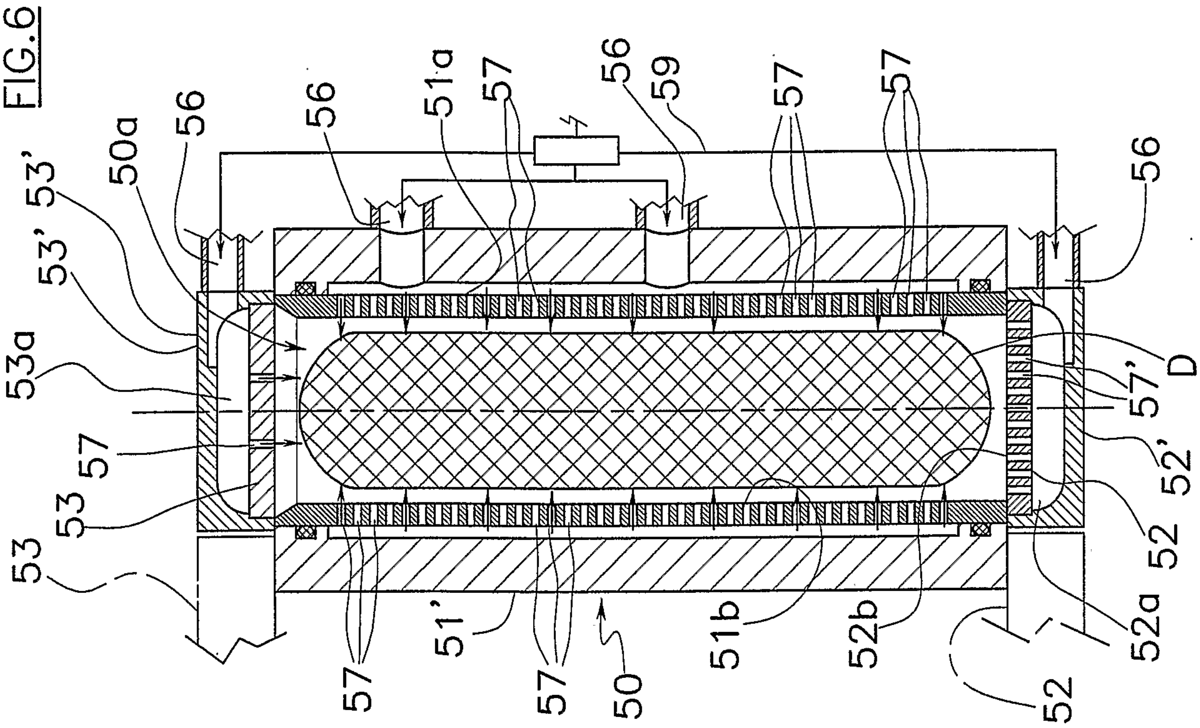

56
51a
57
56
59
57
57
56
50a
53'
53'
53a
57
53
53
D
57'
52'
52
52a
51'
50
51b
52b
52

FIG.6

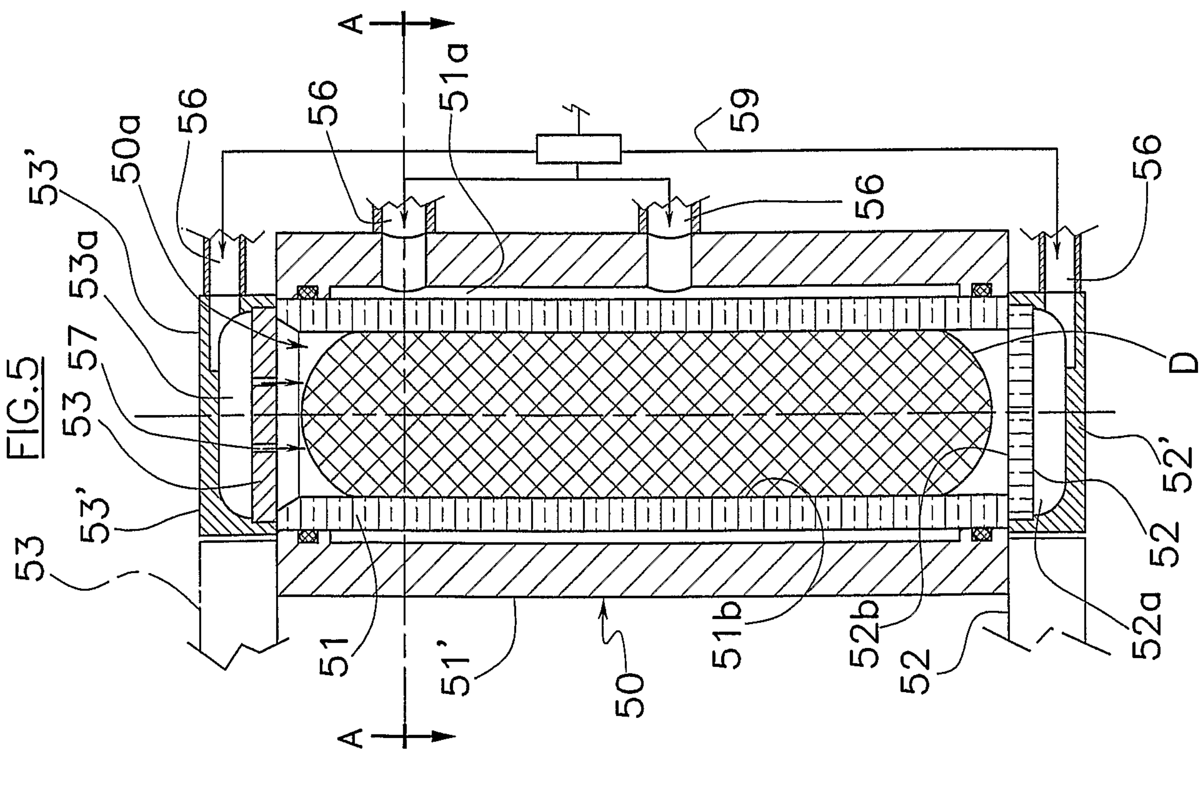

A
56
51a
59
56
56
50a
53'
53a
57
53
53'
53
D
52'
52
52a
51
51'
50
51b
52b
52
A

FIG.5

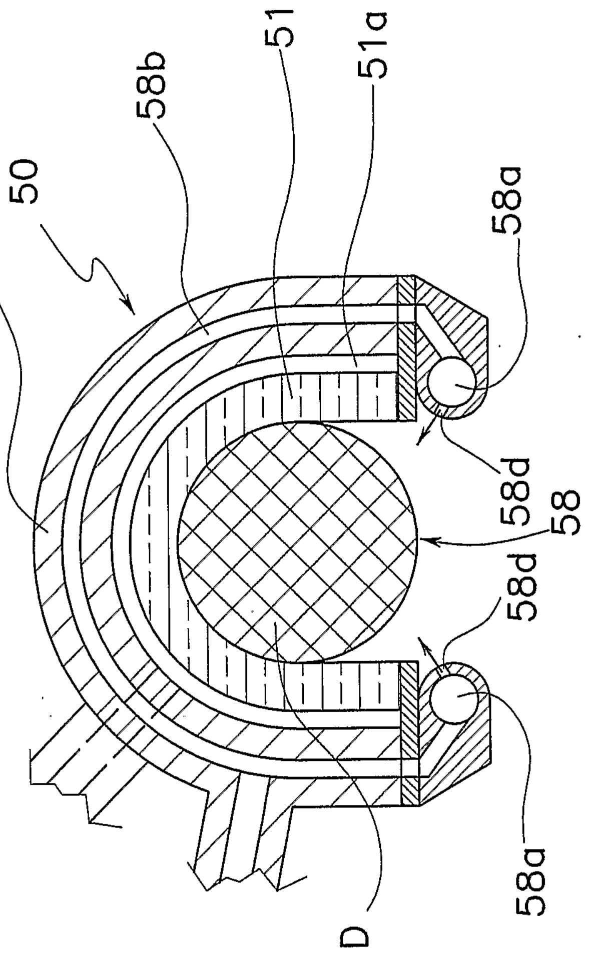


FIG.7

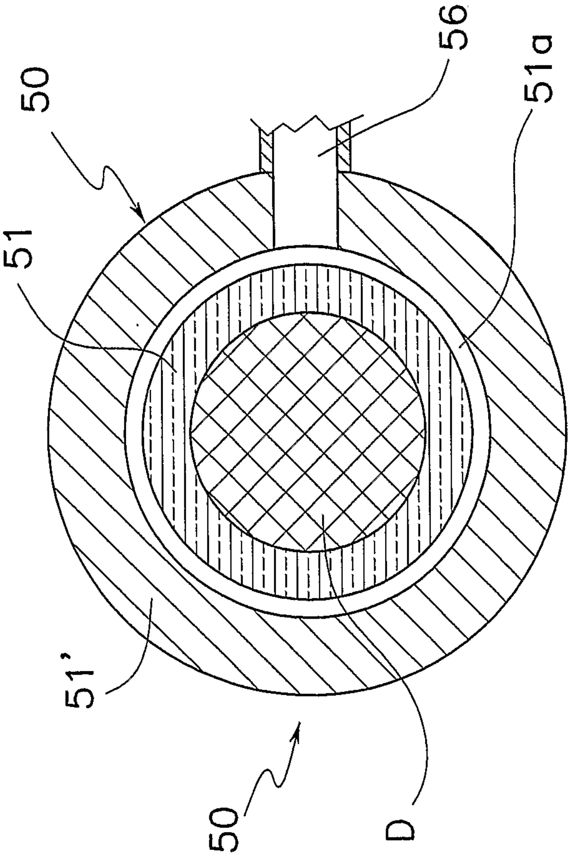


FIG.5A

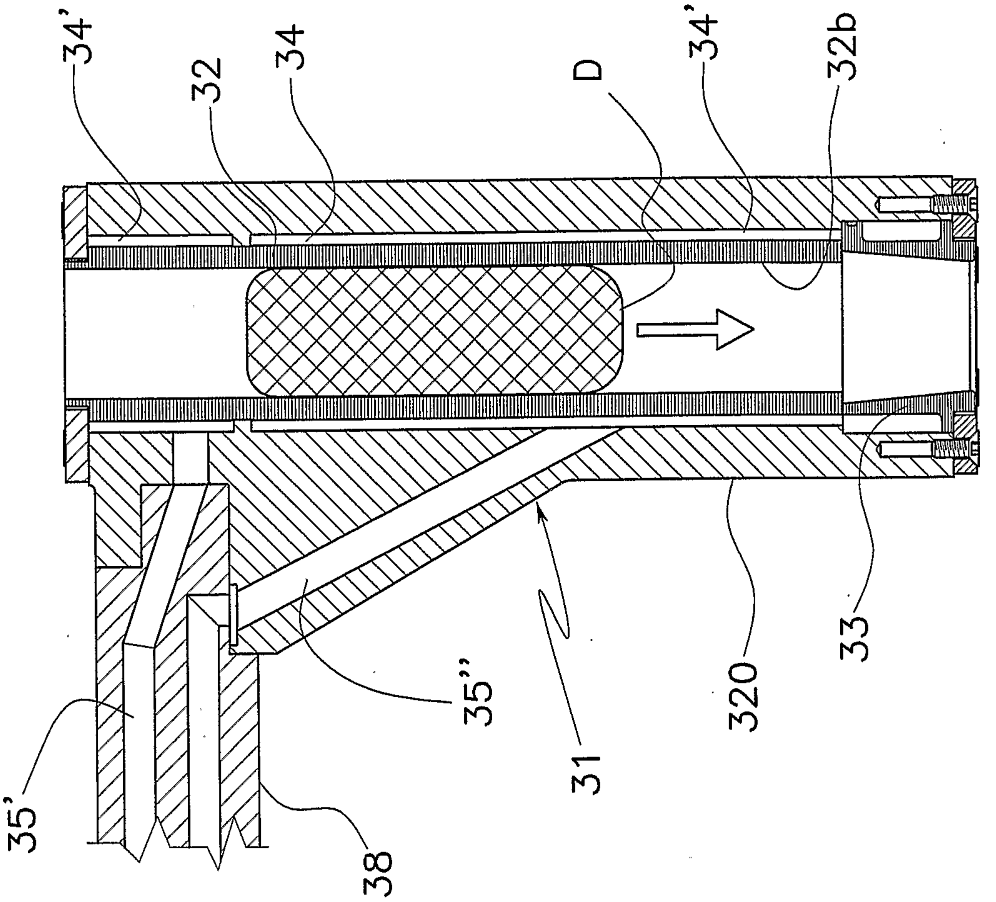


FIG.9

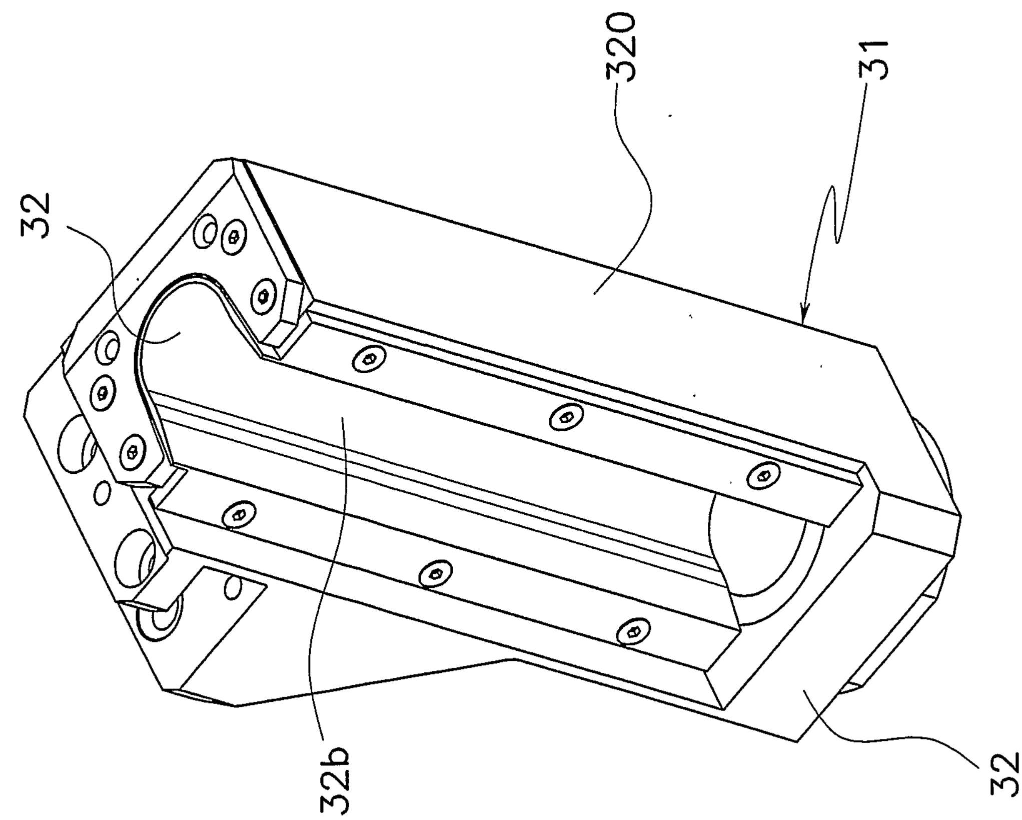


FIG.8