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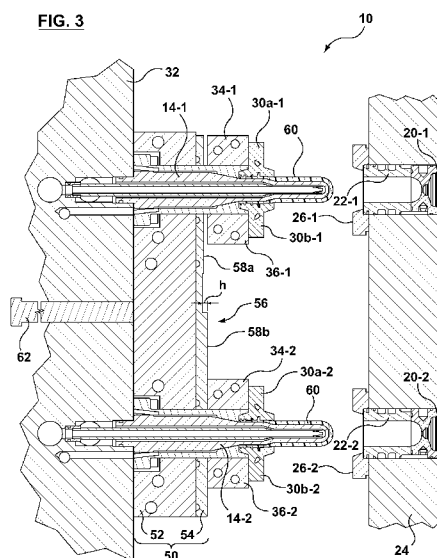
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(54) Title: OFFSET SURFACE STRIPPER ASSEMBLY



(57) Abstract: Disclosed herein, amongst other things, is an injection mold includes a plurality of mold stacks configured to mold molded articles and a stripper assembly for applying an ejection force to the molded articles. The stripper assembly is configured to sequentially eject the molded articles from the plurality of mold stacks.

OFFSET SURFACE STRIPPER ASSEMBLY**TECHNICAL FIELD**

Non-Limiting embodiments disclosed herein generally relate to injection molding, and more particularly to an injection mold stripper assembly having offset surfaces.

Injection molding has found a wide variety of applications in modern commerce. An example is the creation of polyethylene terephthalate (PET) preforms or parisons. Molding machines used in such application are, for example, disclosed in US Patent No. 6,569,370 and US Patent No. 5,736,173, the contents of which are hereby incorporated by reference.

As disclosed in these and other similar patents, modern molding machines typically include a mold defining several mold cavities to allow the concurrent formation of multiple preforms. Cavities of a multi-cavity mold are concurrently fed with molten material which is then allowed to cool. After cooling, the mold is opened and the multiple molded preforms are ejected.

Unfortunately, the force required in ejecting the molds to initially dislodge a molded preform from its mold core may be substantial. In the case where multiple preforms are dislodged at the same time, the required force will increase in direct proportion to the number of preforms that are dislodged.

Generation of such forces and their transmission through the mold equipment may be substantial.

Accordingly, new molds and related components are desirable.

SUMMARY

In accordance with an aspect disclosed herein, there is provided an injection mold comprising a plurality of mold stacks configured to mold molded articles and a stripper assembly for applying an ejection force to the molded articles, wherein the stripper assembly is configured to sequentially eject the molded articles from the plurality of mold stacks.

Conveniently, the stripper assembly may sequential apply ejection force to first dislodge a first subset of the molded articles from their mold stacks, and then to a second subset.

In accordance with another aspect disclosed herein, there is provided a method of ejecting a plurality of molded articles in an injection mold comprise sequentially: applying an ejection force to dislodge a first subset of the molded articles; and applying an ejection force to dislodge a second subset of the molded articles.

In accordance with yet another aspect disclosed herein, there is provided a stripper assembly for an injection mold comprising a stepped surface that defines a plurality of contact regions of varying heights, wherein each of the plurality of contact regions configured to slidably support one of a plurality of slide bars of the mold, and to urge a slide bar supported thereon forward as the stripper assembly is moved forward.

These and other aspects and features of non-limiting embodiments will now become apparent to those skilled in the art upon review of the following description of specific non-limiting embodiments in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

The non-limiting embodiments will be more fully appreciated by reference to the accompanying drawings, in which:

FIG. 1 is a cross-sectional view of a portion of an injection mold in a closed position, exemplary of an embodiment of the present invention;

FIG. 2 is a perspective view of a portion of the injection mold of FIG. 1, exemplary of an embodiment of the present invention;

FIGS. 3 to 6 are partial cross-sectional views of the injection mold of FIG. 1 depicting an exemplary ejection sequence; and

FIG. 7 is a partial cross-sectional view of an alternate stripper assembly of the mold of FIGS. 1 to 6.

The drawings are not necessarily to scale and may be illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details that are not necessary for an understanding of the embodiments or that render other details difficult to perceive may have been omitted.

DETAILED DESCRIPTION OF THE NON-LIMITING EMBODIMENT(S)

Reference will now be made in detail to various non-limiting embodiment(s) of an injection mold stripper assembly having offset surfaces. It should be understood that other non-limiting embodiment(s), modifications and equivalents will be evident to one of ordinary skill in the art in view of the non-limiting embodiment(s) disclosed herein and that these variants should be considered to be within scope of the appended claims.

Furthermore, it will be recognized by one of ordinary skill in the art that certain structural and operational details of the non-limiting embodiment(s) discussed hereafter may be modified or omitted (i.e. non-essential) altogether. In other instances, well known methods, procedures, and components have not been described in detail.

FIG. 1 is a cross-sectional view of a portion of an injection mold 10, exemplary of an embodiment of the present invention. Mold 10 is shown to include two mold stacks 12-1 and 12-2 (individually and collectively, mold stack(s) 12).

As illustrated, mold stack 12-1 includes mold core 14-1 fitted to core plate 32, and retained by lock rings 16-1. Mold core 14-1 further includes a cooling tube 18-1, for circulating a coolant, in use. Mold stack 12-1 further includes cavity insert 20-1 and gate insert 22-1, that are retained in a cavity plate 24 of mold 10 by flange 26-1. A pair of neck rings 30a-1 and 30b-1 are mounted on slide bars 34-1, 36-1, around mold core 14-1.

A mold cavity 40-1 is at least partially defined by the components of the mold stack 12-1 within which a molded article (not shown) is moldable. Specifically, mold core 14, defines the inner walls of the molded article. Cavity insert 20-1, gate insert 22-1 and neck rings 30a-1, 30b-1 further define the outer wall of the molded article. In the depicted embodiment, the molded article is a bottle preform (also referred to as a parison) of the type that may be further blow moldable into a container (not shown). Of course, other molded articles could similarly be formed.

Components of mold stack 12-2 (and any other mold stacks 12) are identical to those of mold stack 12-1. Mold core 14-2 is identical to mold core 14-1 (collectively and individually mold core(s) 14); lock ring 16-2 is identical to lock ring 16-1 (collectively and individually lock ring(s) 16); gate insert 22-2 is identical to gate insert 22-1 (collectively and individually cavity insert(s) 20); flange 26-2 is identical to flange 26-1 (collectively and individually flange(s) 26).

Likewise slide bars 34-2, 36-2, are identical to slide bars 34-1, 36-1 (collectively and individually slide bar(s) 34, 36) and neck rings 30a-2 and 30b-2 are identical to neck rings 30a-1 and 30a-2 (collectively and individually neck rings(s) 30a, 30b). The resulting mold cavity 40-2 is also identical to mold cavity 40-1 (collectively and individually mold cavity 40).

Now, for simplicity of illustration and explanation FIG. 1 only depicts two mold stacks 12-1 and 12-2. However, a typical mold includes many more mold stacks 12 – for example seventy-two (72), arranged in rows and columns – as for example illustrated in FIG. 2, with a pair of slide bars 34, 36 associated with each row in mold 10. Thus stack 12-1 is in one of such rows, while stack 12-2 is in another. FIG. 1 is a partial cross-sectional view of FIG. 2 along cut line I-I.

In FIG. 1, mold 10 is closed for molding articles (i.e. in the depicted embodiment, preforms). The compressive load required to keep the mold closed while molding is transferred largely through mold stacks 12. Hot molten material – such as plastic - may be injected through the top of cavity insert 20 to form a preform or other article to be molded within mold cavity 40. The molten material is conveyed to mold cavity 40 by way of a hot runner nozzle, hot runner manifold and hot runner stacks (all not specifically illustrated).

Once molten material has been injected, it is cooled: cooling channels (such as cooling tube 18, and other cooling channels not specifically illustrated) may circulate cooling fluid from a source (also not shown) through mold core 14, cavity insert 20, neck rings 30a, 30b and gate insert 22 to remove heat from the injected material.

A stripper assembly 50, includes, among other components, a stripper plate 52 and a wear plate 54. Stripper assembly 50 is used in the ejection of molded articles, as further described below. Stripper assembly 50 provides a contact surface 56 that ultimately comes into contact with slide bars 34, 36 to urge these and any neck rings 30a, 30b thereon forward. As illustrated, contact surface 56 is offset in a forward direction, providing two generally flat offset contact regions 58a and 58b, offset from each other by a height “h”. As such, when mold 10 is closed, as depicted in FIG. 1 there is a slight gap, for example 0.5mm, between contact region 58b and slide bars 34-1 and 36-1. However, as no substantial load is borne through slide bars 34, 36 this is quite tolerable.

An ejector 62 or similar assembly may urge stripper assembly 50 forward. A linking mechanism may move slide bars 34, 36, in a direction parallel to the longitudinal axes of mold

cores 14. Multiple slide bars 34, 36 of mold 10 may be linked by the same mechanism to provide concurrent lateral movement of the slide bars 34, 36, as stripper assembly 50 is moved forward by ejector 62. The linking mechanism may take the form of a cam arrangement, a rack and pinion, or other suitable mechanical linkage. Example linking mechanism are, for example, disclosed in US Patent No. 7,766,644; alternative linking mechanism for opening slide bars 34 and 36 are disclosed in US Patent No. 6,799,962 and U.S. Patent Publication 2007/0059395, the contents of each of which is hereby incorporated by reference.

Once molded articles are formed on mold cavity(ies) 40 and at least partially cooled, mold 10 may be opened as depicted in FIGS. 3 to 6.

As mold 10 is initially opened, as depicted in FIG. 3, a moveable half of mold 10 that includes mold core 14 and stripper plate 52 and wear plate 54 is moved away from a stationary half of mold 10.

After opening, molded preforms 60 are initially retained on mold core(s) 14, as depicted in FIGS. 3 and 4.

Next, as illustrated in FIGS. 4 to 6, neck rings 30a, 30b are urged forward to apply an ejection force on articles formed on core(s) 14. (For ease of understanding, cavity plate 24 of FIGS. 1 and 3 has been omitted from FIGS. 4 to 6). In order to so eject formed preforms 60, stripper assembly 50 is moved in a direction parallel to the lengthwise extend of mold cores 14 to initially dislodge preforms from mold cores 14, as illustrated in FIGS. 4.

To that end, stripper assembly 50 provides offset contact surface 56 that urges neck rings 30a and 30b forward by applying a forward force on neck rings 30a and 30b through slide bars 34, 36, to first dislodge molded preform(s) 60 from mold core 14, and then eject them. As noted, forward force on stripper assembly 50 may be applied through one or more rams, such as ejector 62.

Contact surface 56 may further provide support surfaces on which slide bars 34, 36 may slide laterally for release of the preforms 60. Contact surface 56 may be formed on stripper plate 52, or on an optional wear plate 54. Optional wear plate 54 of stripper assembly 50 is typically sacrificial material and reduces the wear between the slide bars 34, 36 and stripper plate 52 when the neck rings 30a and 30b are moved apart by slide bars 34, 36 to release a molded preform 60 from mold cavity 40.

Of note, contact surface 56 of stripper assembly 50 is a stepped contact surface that provides at least two contact regions 58a and 58b, formed by two portions of stripper assembly 50 that are offset relative to each other in the forward direction. In the depicted embodiment, the contact regions 58a and 58b are offset by a height “h”. This height “h” may for example, be between .1 mm and 5 mm.

In the depicted embodiment, contact region 58a and 58b each define one half the front surface of stripper assembly 50. The offset surfaces may be formed by providing a stepped stripper plate 52 and/or a stepped wear plate 54 that offsets the contact regions 58a and 58b, relative to each other, by for example height “h”, to define stepped contact surface 56. Alternatively, two separate wear plates having thickness differing by “h” placed on a flat stripper plate may be used in the formation of the offset contact surface.

Now, as illustrated in FIGS. 3 and 4, as stripper assembly 50 initially moves forward, contact region 58b contacts slide bars 34-2 and 36-2 before contact region 58a contacts slide bars 34-1 and 36-1. In fact, stripper assembly 50 may move a distance “h” forward without contacting slide bars 34-1 and 36-1, as depicted in FIG. 4. As such, the entire force F applied through ejector 62 to stripper assembly 50 for this forward distance will only bear on slide bars 34-2 and 36-2 during this interval of movement of stripper assembly 50. In turn, the entire forward force F will be transmitted only to those neck rings 30a and 30b in contact with slide bars 34-2 and 36-2. Conveniently, then, the entire force F will act to eject only a subset of the preforms 60 formed by mold 10 for this distance h. Thus, as the entire force F will be exerted on fewer preforms than if stripper assembly 50 provided a uniform contact surface, a greater force per preform will be exerted to initially dislodge and eject these preforms.

As will be appreciated, the force required to initially dislodge preforms 60 will typically be the greatest, as this initial force is required to overcome static friction and any residual bonding force between a mold core 14 and a preform 60 formed thereon. As will be further appreciated, the height h may be chosen as desired in order to exert the greater force on the subset of preforms beneath slide bars 34-2, and 36-2 for a longer interval.

As well, as will be appreciated, although stripper assembly 50 has been illustrated to include two offset contact regions 58a and 58b, stripper assembly 50 could be easily modified to include more than two offset regions – for example one contact region for each pair of slide bars 34, 36; or one contact region for each two pairs of slide bars 34, 36; or the like.

Once surface 56 has been displaced a distance equivalent to the distance equal to the offset between contact regions 58a and 58b, the forward force is applied through contact surface 56 to those neck rings atop region 58a. At this point, the subset of preforms atop contact region 58b have already been dislodged – at least in part. The force required to move this first subset forward is significantly less than the force required to initially dislodge them. As such, the entire force F applied through ejector 62, now moves the first subset of preforms 60 atop slide bars 34-2 and 36-2 forward, while also dislodging the subsequent subset atop slide bars 34-1 and 36-1.

Once preforms are dislodged from mold cores 14, slide bars 34 and 36 are moved laterally relative to each other to slide neck rings 30a and 30b laterally, apart from each other, to release molded preforms 60, as illustrated FIG. 6.

Both contact regions 58a and 58b may exert force on slide bars 34-2, 36-2 and 34-1 and 36-1, ejecting all of the preforms 60, as illustrated in FIGS. 5 and 6.

In an alternative embodiment depicted in FIG. 7, a mold 10' includes a stripper assembly 50' having a stripper plate 52' that may include two portions of different thicknesses, providing two surfaces of different heights, offset relative to each other by a distance "h". Wear plates 54a' and 54b' may then be formed as two separate plates of the same thickness to define offset surface 56'.

In yet a further embodiment, wear plates 54 (FIGS. 1-6) or wear plates 54a' and 54b' (FIG. 7) may be replaced with wear plates formed of a different material less susceptible to wear – such as aluminium, steel, or the like. The harder material may allow for frequent lateral motion of slide bars 34, 36 without substantial wear. Offset surfaces 58 could be achieved by applied coating, or by machining the wear plates of a different thickness.

It is noted that the foregoing has outlined some of the more pertinent non-limiting embodiments. It will be clear to those skilled in the art that modifications to the disclosed non-embodiment(s) can be effected without departing from the spirit and scope thereof. As such, the described non-limiting embodiment(s) ought to be considered to be merely illustrative of some of the more prominent features and applications. Other beneficial results can be realized by applying the non-limiting embodiments in a different manner or modifying them in ways known to those familiar with the art. This includes the mixing and matching of features, elements and/or functions between various non-limiting embodiment(s) is expressly

contemplated herein so that one of ordinary skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment may be incorporated into another embodiment as skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment may be incorporated into another embodiment as appropriate, unless described otherwise, above. Although the description is made for particular arrangements and methods, the intent and concept thereof may be suitable and applicable to other arrangements and applications.

WHAT IS CLAIMED IS:

1. An injection mold (10) comprising:
 - a plurality of mold stacks (12) configured to mold molded articles;
 - a stripper assembly (50) for applying an ejection force to the molded articles;
 - wherein said stripper assembly (50) is configured to sequentially eject the molded articles from the plurality of mold stacks (12).
2. The injection mold of claim 1, wherein said stripper assembly (50) comprises an offset surface (56) comprising at least two forwardly offset contact regions (58a, 58b), with a subset of said mold stacks (12) beneath each of said at least two offset contact regions (58a, 58b), so that said ejection force dislodges molded articles from their mold stacks (12) and is sequentially applied through each of said two offset contact regions (58a, 58b) to dislodge a subset of said molded articles.
3. The injection mold of claim 1, wherein said stripper assembly (50) comprises a stripper plate (52), and wherein said stripper plate (52) is of varying height.
4. The injection mold of claim 1, wherein said stripper assembly (50) comprises at least one wear plate (54), and wherein said at least one wear plate (54) defines two offset contact regions (58a, 58b).
5. The injection mold of claim 4, wherein said stripper assembly (50) comprises multiple wear plates (54) each of said multiple wear plates (54) having a different thickness to define one of said at least two offset contact regions (58a, 58b).
6. The injection mold of claim 2, wherein said ejection force is applied to each molded article through a moveable mold portion, defining at least a portion of one of said molded articles.
7. The injection mold of claim 6, wherein said moveable mold portion comprises a neck ring assembly (16).
8. The injection mold of claim 7, further comprising a plurality of slide bars (34, 36) to laterally move neck ring assemblies (16), wherein each of said offset contact regions (58a, 58b) engages at least one of said plurality of slide bars (34, 36).

9. The injection mold of claim 8, wherein each of said offset contact regions (58a, 58b) provides a sliding surface for one of said plurality of slide bars (34, 36).
10. The injection mold of claim 8, further comprising at least one linkage to connect said stripper assembly to said slide bars (34, 36) to move said slide bars (34, 36) laterally as said stripper assembly is moved forward.
11. A method of ejecting a plurality of molded articles (60) in an injection mold (10), said method comprising, sequentially:
 - applying an ejection force to dislodge a first subset of said molded articles;
 - applying an ejection force to dislodge a second subset of said molded articles.
12. The method of claim 11, wherein said ejection force to dislodge said first and second subset of said molded articles is applied through a stripper assembly (50).
13. The method of claim 12, wherein said stripper assembly (50) includes at least two offset contact regions (58a, 58b), forwardly offset by a distance h relative to each other.
14. The method of claim 12, wherein said applying an initial ejection force to said first subset of said molded articles (60), comprises moving said stripper assembly (50) forward a distance h .
15. The method of claim 14, wherein said applying an initial ejection force to said second subset of said molded articles, comprises moving said stripper assembly (50) further forward after moving said stripper assembly forward a distance h .
16. The method of claim 15, further comprising moving said stripper assembly (50) forward to eject articles in both said first and second subset of molded articles.
17. The method of claim 15, further comprising releasing said molded articles as said stripper assembly (50) is moved forward, by laterally moving at least a portion of said mold defining said articles in said first and second subset of said molded articles.
18. The method of claim 11, wherein said molded articles comprise bottle preforms.

19. A stripper assembly for an injection mold (10) comprising:
 - a stepped surface (56) that defines a plurality of contact regions (58a, 58b) of varying heights;
 - each of said plurality of contact regions (58a, 58b) configured to slidably support one of a plurality of slide bars (34, 36) of the mold (10), and to urge a slide bar (34, 36) supported thereon forward as the stripper assembly is moved forward.
20. The stripper assembly (50) of claim 19, wherein said stripper assembly (50) comprises a stripper plate (52), and wherein said stripper plate (52) is of varying height.
21. The stripper assembly (50) of claim 19, wherein said stripper assembly (50) comprises at least one wear plate (54), and wherein said at least one wear plate (54) defines two offset contact regions (58a, 58b).
22. The stripper assembly (50) of claim 21, wherein said stripper assembly (50) comprises multiple wear plates (54) each of said multiple wear plates (54) having a different thickness to define one of said at least two offset contact regions (58a, 58b).
23. The stripper assembly (50) of claim 19, further comprising a plurality of slide bars (34, 36) to laterally move neck ring assemblies (16), wherein each of said offset contact regions (58a, 58b) engages at least one of said plurality of slide bars (34, 36).
24. The stripper assembly (50) of claim 23, wherein each of said offset contact regions (58a, 58b) provides a sliding surface for one of said plurality of slide bars (34, 36).
25. The stripper assembly (50) of claim 23, further comprising at least one linkage to connect said stripper assembly to said slide bars (34, 36) to move said slide bars (34, 36) laterally as said stripper assembly is moved forward.

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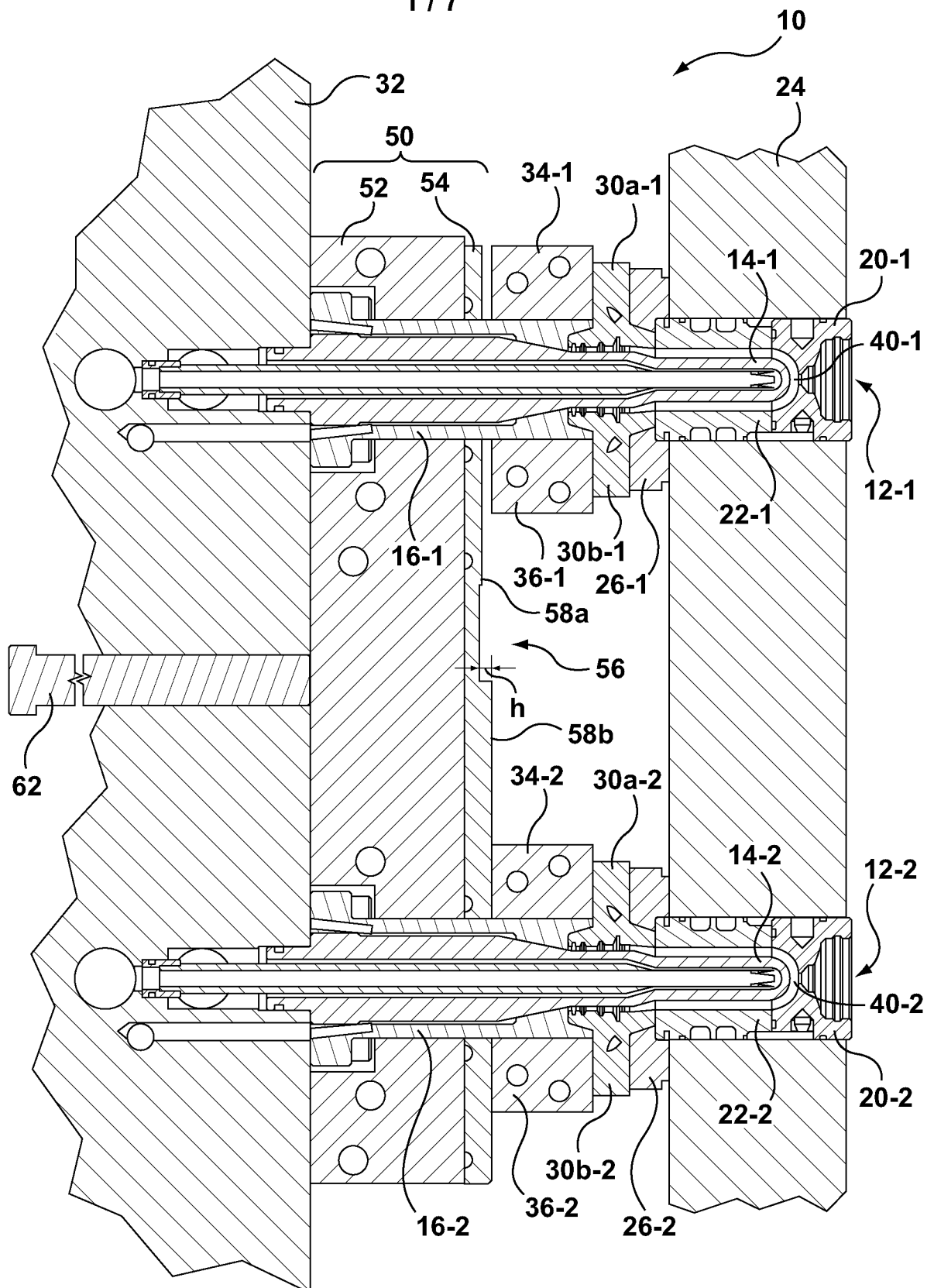
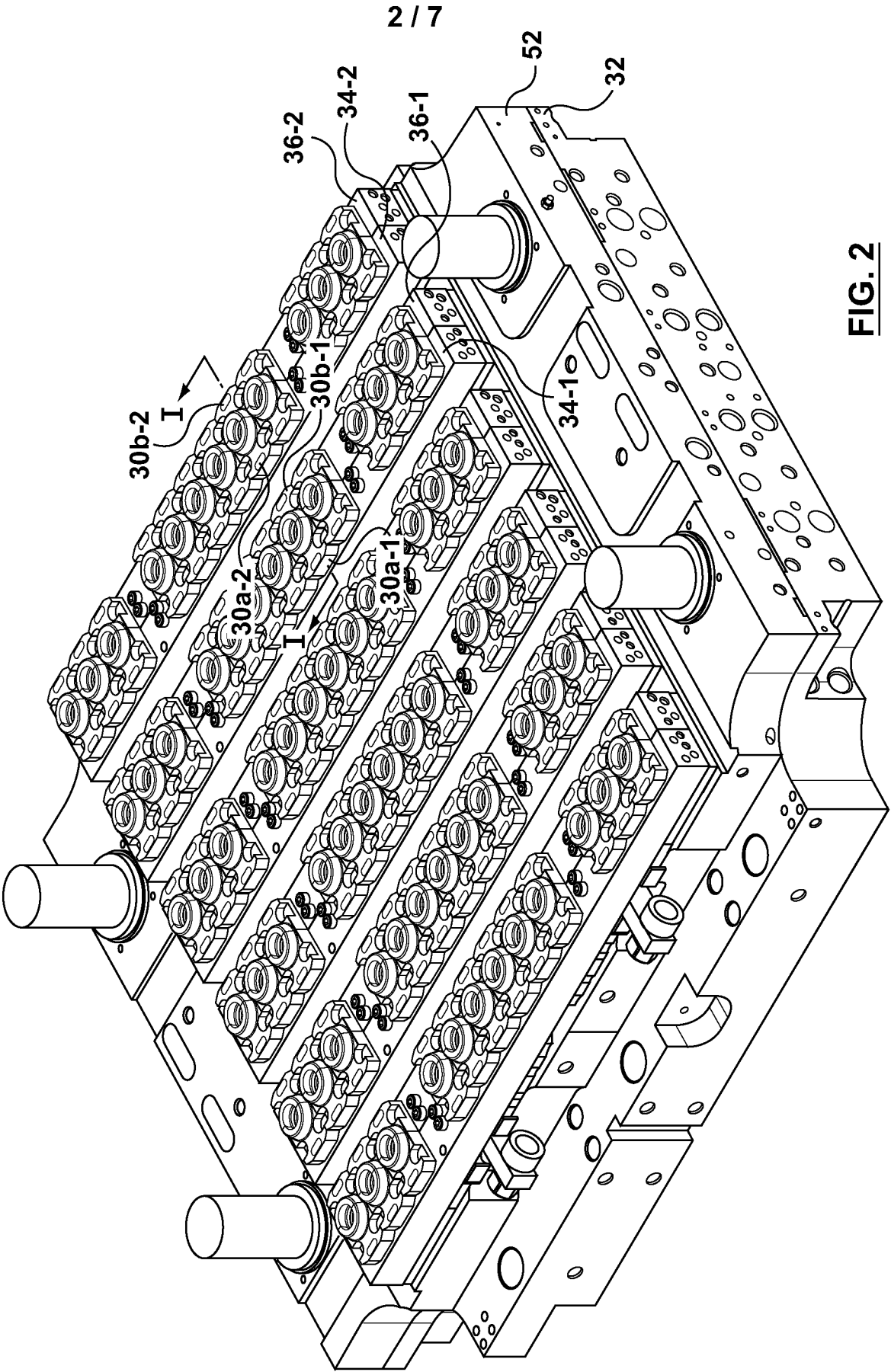
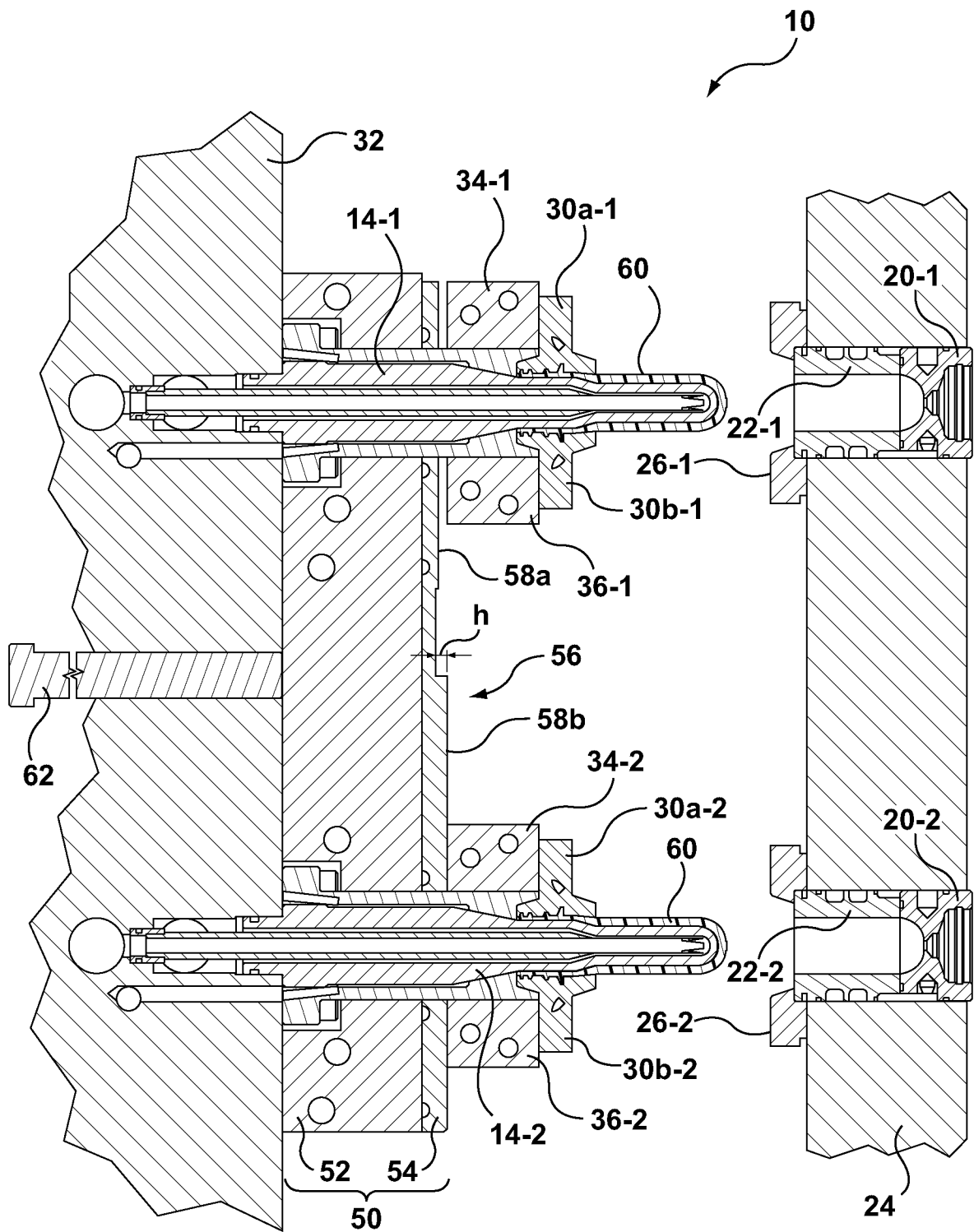


FIG. 1



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**FIG. 3**

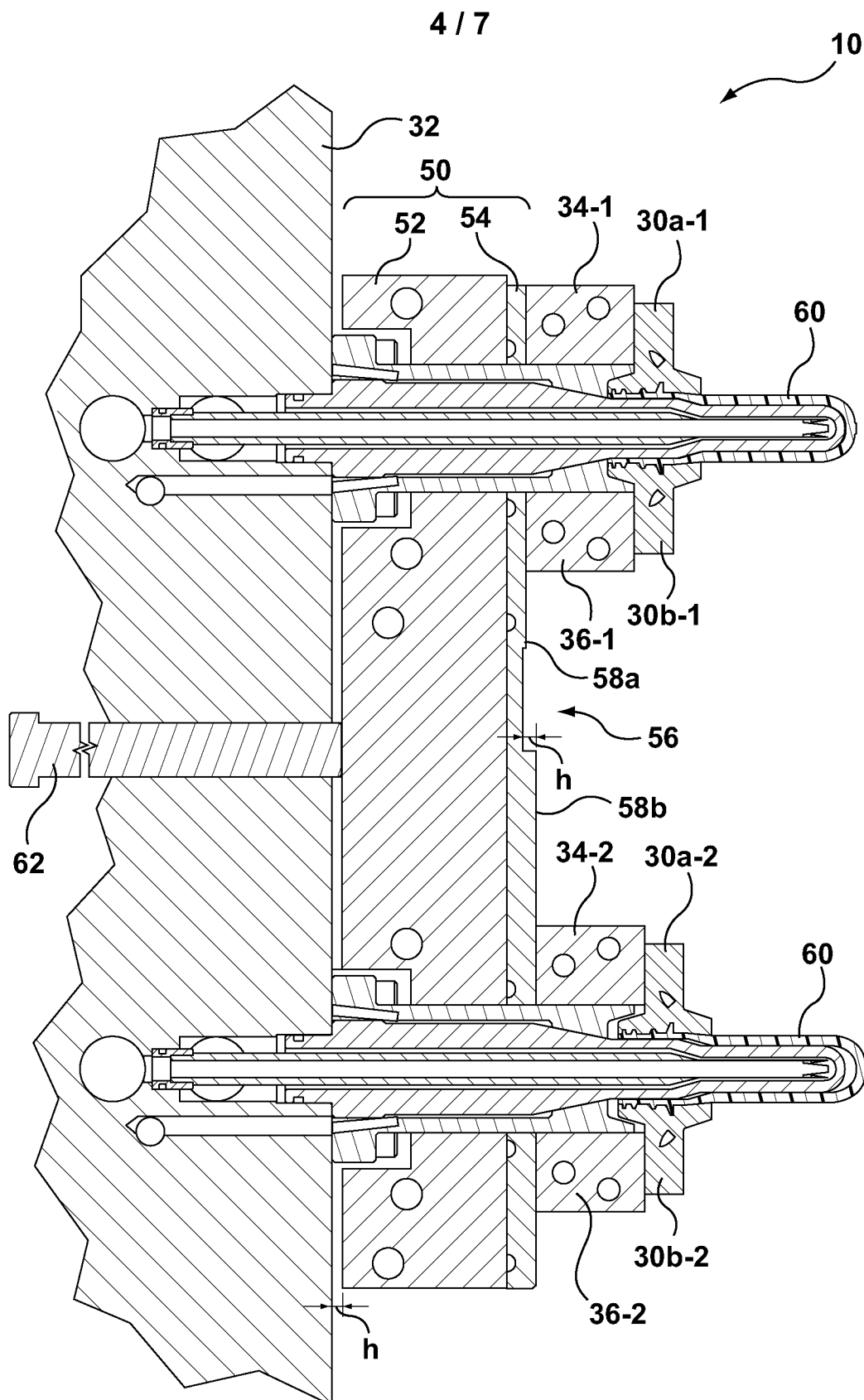
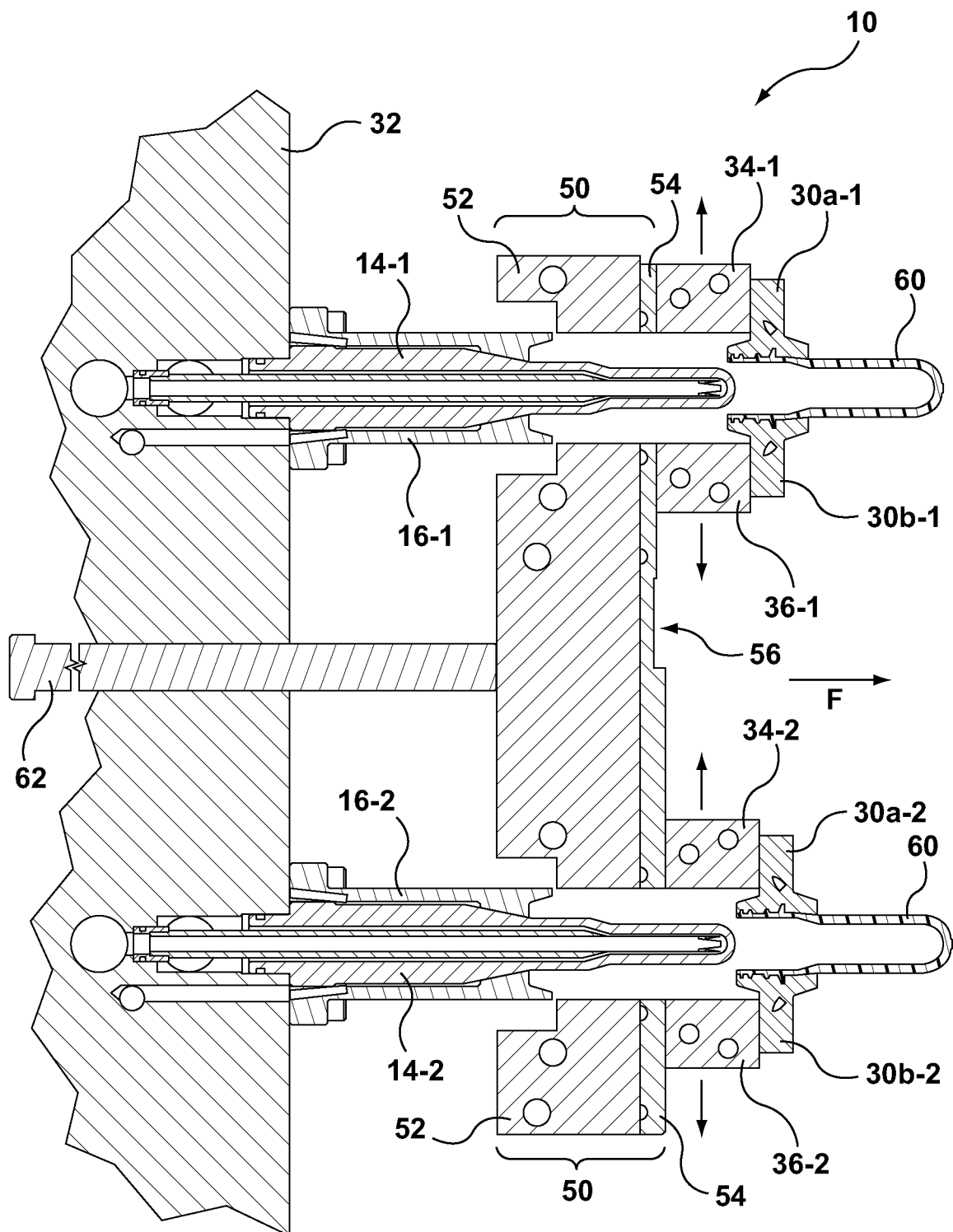
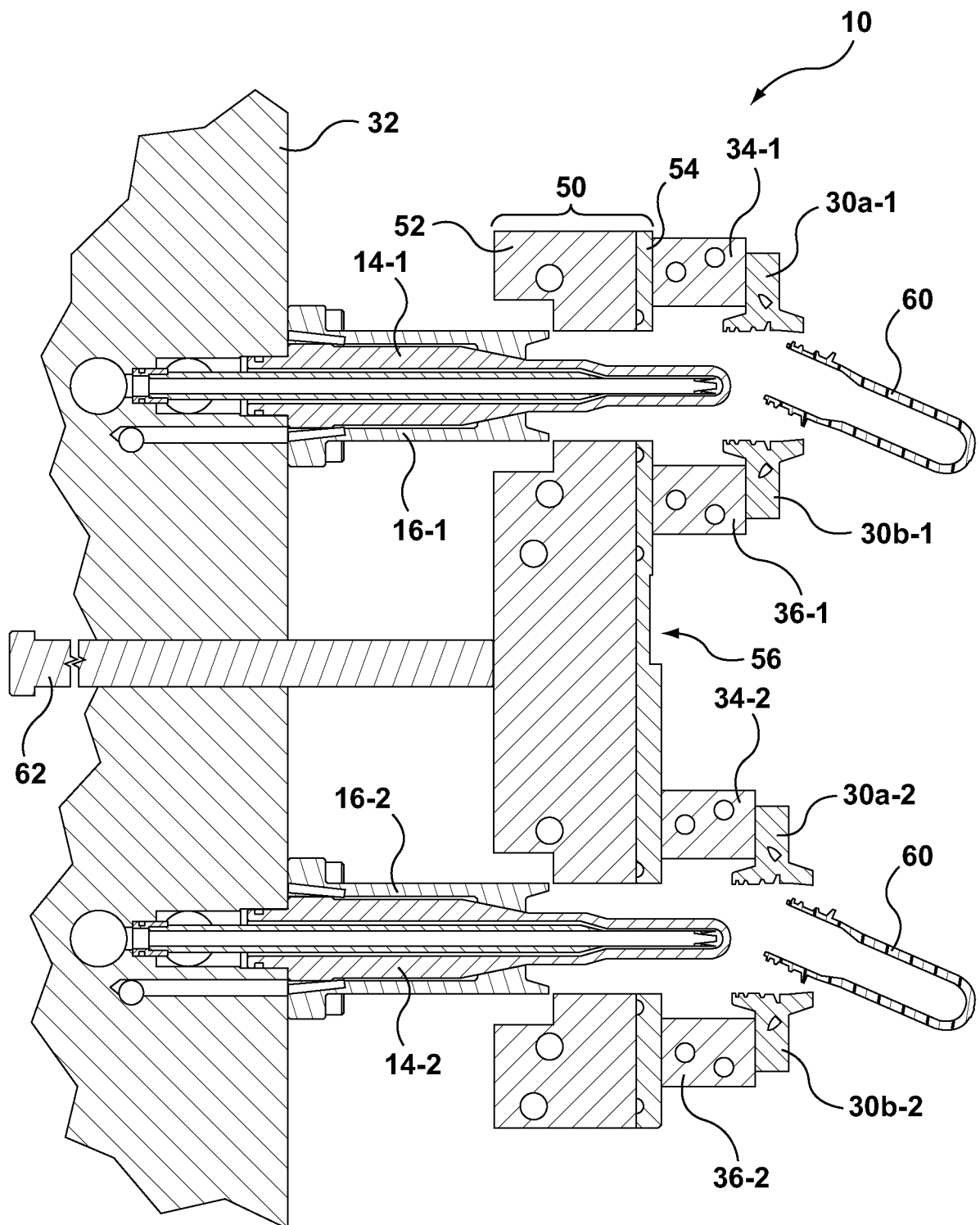


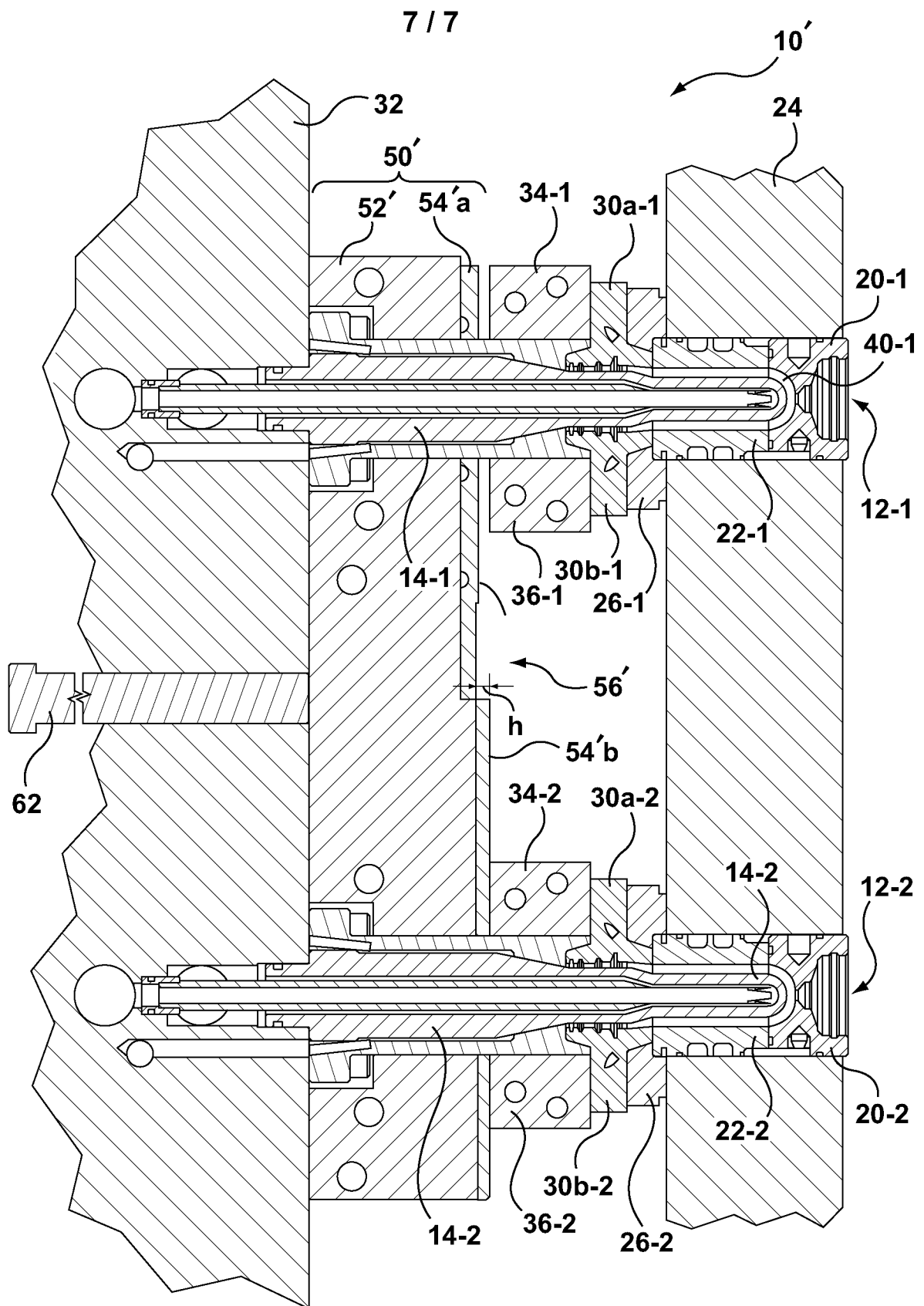
FIG. 4

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**FIG. 5**

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**FIG. 6**

**FIG. 7**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2014/050419

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **B29C 45/40** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: **B29C 45/40** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Total Patent, Canadian Patents Database, EPOQUE (keywords: injection mo(u)lding, offset, sequential, ejection, ejector, force, stripper)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,892,472 A (HARRISON, J.) 09 January 1990 (09-01-1990)	1-25

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* "A" "E" "L" "O" "P"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance earlier application or patent but published on or after the international filing date document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed	"T" "X" "Y" "&"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art document member of the same patent family
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09 June 2014 (09-06-2014)

Date of mailing of the international search report
16 July 2014 (16-07-2014)

Name and mailing address of the ISA/CA
Canadian Intellectual Property Office
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CA2014/050419

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US4892472A	09 January 1990 (09-01-1990)	US4892472A EP0245495A1 US4741874A WO8702930A1 US4710124A	09 January 1990 (09-01-1990) 19 November 1987 (19-11-1987) 03 May 1988 (03-05-1988) 21 May 1987 (21-05-1987) 01 December 1987 (01-12-1987)