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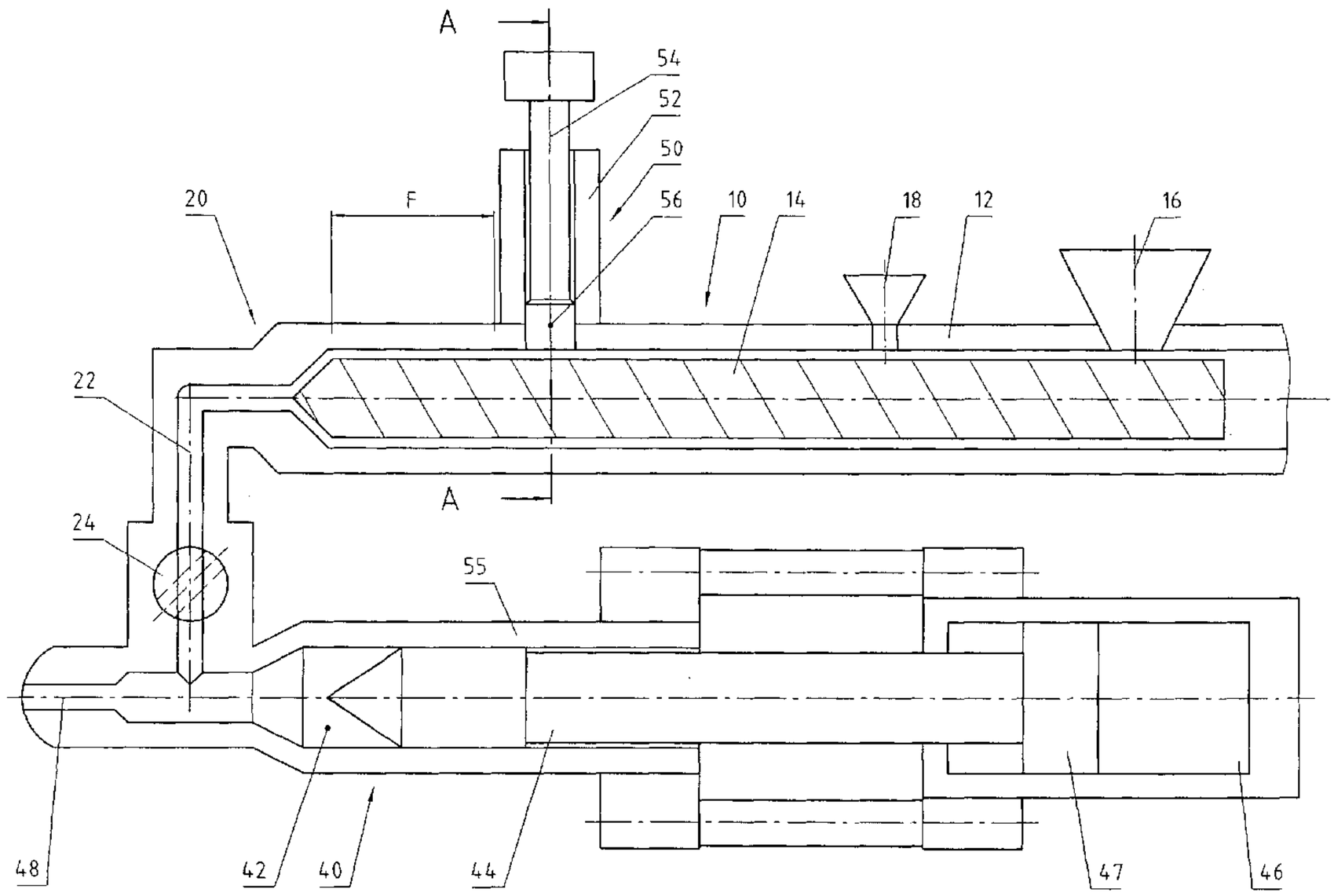
(54) Title: INJECTION MOLDING COMPOUNDER



(57) Abrégé/Abstract:
The invention relates to an injection moulding compounder, comprising an extruder (10), with an extruder housing (12) and at least one extruder screw (14), arranged as to rotate within the extruder housing (12), for the production of melt, an injection device (40), flow-connected, or which may be flow-connected to the outlet from the extruder (10) and a storage device (50) for the buffer storage of melt. According to the invention, the storage device (50) is connected to the extruder housing (12), before the end of the at least one extruder screw (14), in the supply direction of the extruder (10), such that melt produced in the extruder (10) is stored in the storage device (50).

Abstract

The invention relates to an injection molding compounder, comprising an extruder (10), with an extruder housing (12) and at least one extruder screw (14), arranged as to rotate within the extruder housing (12), for the production of melt, an injection device (40) which is fluidly connected or connectable to the outlet of the extruder (10) and an accumulator (50) for temporarily storing melt. According to the invention, the accumulator (50) is connected to the extruder housing (12) in conveying direction of the extruder (10) ahead of the end of the at least one extruder screw (14) so that melt produced in the extruder (10) is stored in the accumulator (50).

Title

INJECTION MOLDING COMPOUNDER

Description

The invention relates to an injection molding compounder according to the preamble of claim 1.

It is known from the prior art to process in an extruder various starting materials, of which at least one starting material is a thermoplastic material, to a homogenous melt, in order to then introduce this melt by an injection device into a mold. The melt is hereby pushed into the cavity at high pressure. Examples for different materials being mixed include thermoplastic polymers or so-called thermosetting polymers with organic or inorganic particles or fiber-shaped fill elements and ceramics with wax or polymer binders.

An apparatus of this type, comprised of an extruder as well as an injection device connected downstream in flow direction, is designated in the following as injection molding compounder. WO 86/06321 discloses, for example, an injection molding compounder. This document described in particular in Fig. 2 a compounder with a twin-screw extruder for producing melt which is then transferred into a plunger-type injection unit. As the plunger is pushed forwards, melt contained in the chamber of the injection device is introduced into the cavity of the molding tool. During return travel of the plunger, a non-return valve clears the path for the melt forwards so that a sufficient shot amount can again be provided in front of the plunger.

A drawback of such an injection molding compounder resides in the fact that the extruder can only be operated discontinuously and has to be shut down during each injection process.

In order to assure a quasi-continuous operation with a continuously running extruder and intermittently running injection device, apparatuses are known having an intermediate accumulator (also called buffer) in which melt material continuously produced by the extruder is temporarily stored during an injection process. When the injection device is cleared again for filling with melt, melt material is introduced into the injection device from the extruder as well as from the intermediate accumulator. Representatives of such apparatuses include US 6,071,461, DE 11 42 229 as well as JP utility model 36-19372.

These injection molding compounders are, however, constructed with complicated accumulator and require feed lines and discharge lines to and from the accumulator.

It is an object of the present invention to provide an injection molding compounder of the afore-stated type, which is simple in construction and cost-efficient to make.

This object is attained by the features set forth in claim 1.

In accordance therewith, the accumulator known per se of a conventional injection molding compounder is placed in fluid communication with the interior space of the extruder housing in transport direction of the extruder ahead of its outlet and, as viewed in axial direction, in an area of the extruder screw.

As a consequence of this construction, melt produced in the extruder flows in one mode of operation into the intermediate accumulator before reaching the outlet thereof, and exits the intermediate accumulator again in another mode of operation for introduction into the extruder. The hereby provided opening of the extruder housing, through which opening the outflow or inflow of melt from or into the accumulator takes place, is thus located, as viewed in axial direction of the

extruder, in the area of the at least one extruder screw. This is accompanied by further advantages. Melt can be supplied directly to the injection device, after exiting the extruder, without requiring a separate bypass via an accumulator. Moreover, melt temporarily stored in the accumulator is mixed again during outflow from the accumulator with melt located in the extruder. For this purpose, mixing elements are preferably provided in the extruder, in particular at the extruder screws. These mixing elements may be provided in the area of the outflow or inflow opening, as well as downstream. Overall, the present invention provides thus a continuously operated extruder whose melt production can be withdrawn in batches.

A further advantage in connection with highly viscous melt material resides in the fact that the last end of the extruder assists with its conveying action the transport of the melt and the introduction into the injection device.

According to a particularly preferred embodiment, the accumulator is constructed integral with the extruder. The accumulator may especially be flange-mounted directly to the extruder housing. This results in an especially compact embodiment of the injection molding compounder. As a consequence, in particular additional lines and therefore costs can be saved.

According to a simple embodiment of the invention, the accumulator includes an accumulator housing, for example in cylindrical shape, having an interior space in which a plunger is movable guided for formation of the reservoir with variable volume. The plunger in the accumulator can be externally acted upon in the direction of the extruder screw and/or away from the extruder screw. In this case, a controlled outflow or inflow of melt in the accumulator is possible. Of course, respective spring devices, hydraulic devices, pneumatic devices, electromotive or mechanical devices must hereby be provided for operation of the plunger, as well as respective control and regulating devices.

A particularly preferred embodiment of the invention is characterized by configuring the plunger surface of the accumulator on the extruder screw side complementary to the screw geometry in such a manner that the contour of the extruder housing, in particular the extruder barrel, is replicated, when the plunger is fully shifted inwardly. As a consequence, the intermediate accumulator can be completely emptied and no residue is left behind in the accumulator.

Of course, the extruder may be equipped with one, two or more screws. Especially suitable are twin-screw extruders with screws that run in a same direction or in opposite direction.

An exemplified embodiment of the present invention will now be described in more detail with reference to the present drawings, in which:

Fig. 1 is a schematic illustration of an injection molding compounder according to the invention with injection device and extruder including integrated accumulator, and

Fig. 2 is a sectional view taken along the line A-A in FIG. 1.

The present concrete exemplified embodiment of the injection molding compounder according to the invention includes an extruder 10 having an extruder housing 12 in the form of an extruder barrel. Rotatably disposed in the extruder housing 12 are two extruder screws 14 rotating in a same direction. A drive for the extruder screws is not illustrated here as it does not form an immediate part of the invention.

The extruder housing 12 includes two fill openings, namely a first feed hopper 16 and a second feed hopper 18. Various materials can be introduced via the feed hoppers into the extruder 10. It is, for example, possible to introduce

polypropylene pellets via the first feed hopper 16 into the extruder 10 and to add glass fiber material via the second feed hopper 18.

During operation of the extruder screws 14, melt with added glass fiber is produced in the extruder 10. The outlet of the extruder 10 is connected in a manner known per se via a connecting line 22 with the forward part of an injection device 40. The connecting line 22 terminates hereby into the forward part of an injection chamber 42 of the injection device 40. In order to be able to de-couple the injection device 40 from the extruder 10, a valve 24 is provided in the connecting line 22 for cutting the flow communication.

The injection device 40, also called shot-pot, is of conventional design and includes essentially an injection plunger 44 which can move back and forth in an injection cylinder 55. The injection plunger 44 is acted upon by a hydraulic device, not shown in more detail, which operates a hydraulic plunger 47 in a hydraulic chamber 46 for back and forth movement of the injection plunger 44.

The mode of operation of the injection device 40 is known per se. When the valve 24 is open, melt is filled into the injection chamber 42 while the plunger 44 retracts or is pushed back. Once the injection chamber 42 is filled in the desired manner, valve 24 is closed, and melt is introduced via an injection nozzle into a cavity of a molding tool (not shown) as the plunger 44 moves forward.

An essential component of the present embodiment is an accumulator 50 for the melt, which has a cylindrical housing 52 directly flange-mounted to the extruder housing 12. Supported for reciprocation in the cylindrical housing 52 is a plunger 54 which extends perpendicular to the conveying direction of the extruder 10. The back-and-forth movement of the plunger creates a reservoir with variable volume. The interior space of the extruder 10 is in fluid communication with this reservoir, here via a bore with constant diameter.

The plunger 54 has on the extruder screw side an end 56 which, as shown in more detail in Fig. 2, is configured in accordance with the inner contour of the extruder barrel 12. In this way, the reservoir can be brought to zero, when the plunger is shifted completely inwards, so that no melt residues can remain in this situation in the accumulator.

Not shown here are assemblies by which the plunger 52 can be moved in a direction to or away from the extruder screws 14. Spring elements, pneumatic, hydraulic or electromagnetic devices may be used for example. A suitably controlled or regulated operation of the plunger 54 allows a precise inflow or outflow of melt from or into the accumulator 50. In any event, the plunger 54 should be biased by force toward the extruder screw, when melt is desired to flow out from the accumulator 50 back into the extruder 10.

The mode of operation of the present injection molding compounder according to the invention is as follows: When the valve 24 is open and melt should be introduced into the injection device 40, melt is directly conducted from the extruder 10 via the connecting line 22 into the injection chamber 42 of the injection device 40.

When the injection chamber 42 is sufficiently filled and the valve 24 is closed for an injection process, melt is pushed into the accumulator 50 during continuous operation of the extruder screws 14 and resultant continuous production of melt, so that the plunger 52 is shifted upwards in the attached Figures. Further melt advancement does no longer take place in the area (F) of the extruder 10. Rather, melt located in this area remains in this area.

Melt is fed into the accumulator 50 as long as the valve 24 is closed. Of course, the volume of the accumulator 50 should be dimensioned in such a way that

accumulating melt during closed valve 24 can be received completely in the accumulator 50 which acts as a buffer.

When the valve 24 opens after an injection process to allow re-charging of the injection device 40, the plunger 52, acted upon to move inwardly, forces the melt in the accumulator 50 back again into the interior space of the extruder 10. The extruder screws 14 are hereby preferably so configured that the melt derived from the accumulator 50 is mixed with the melt derived from the upstream part of the extruder.

During charging of the injection device 40, the reservoir of the accumulator50 is completely emptied. As a consequence of the configuration of the inner piston surface, as shown in particular in Fig. 2, it is assured that the melt is returned completely again into the extruder 10. Thus, melt residues in the accumulator 50 are prevented.

The screw section F may further be configured to promote a better conveying action so that highly viscous melt in particular can easily be supplied via the connecting line 22 to the injection device 40.

The present invention provides a cost-efficient, compact and simple injection molding compounder which permits a discharge in batches, even when the screw operates continuously.

List of Reference Characters

10 extruder

12 extruder barrel

14 extruder screw

16 first fill opening

18 second fill opening

20 extruder outlet

22 connecting line

24 valve

40 injection device

42 injection chamber

44 injection plunger

46 hydraulic chamber

47 hydraulic plunger

48 injection nozzle

50 accumulator

52 housing

54 accumulator plunger

56 screw-proximal plunger end

Claims

1. Injection molding compounder, comprising
an extruder (10) with an extruder housing (12) and at least one extruder screw (14) rotatably disposed in the extruder housing for producing melt,
an injection device (4) which is fluidly connected or connectable to the outlet of the extruder (10), as well as
an accumulator (50), fluidly connected or connectable to the extruder, for receiving and discharging melt,
characterized in
that the accumulator (50) is placed in fluid communication with the interior space of the extruder housing (12) in transport direction of the extruder (10) ahead of its outlet and, as viewed in axial direction, in an area of the extruder screw (14).

2. Injection molding compounder according to claim 1, characterized in that the accumulator (50) is constructed integral with the extruder (10).

3. Injection molding compounder according to claim 1 or claim 2, characterized in that the accumulator (50) is flange-mounted directly to the extruder housing (12).

4. Injection molding compounder according to one of the preceding claims, characterized in that the accumulator (50) includes an accumulator housing (52) in which a plunger is movable guided for formation of a reservoir with variable volume.

5. Injection molding compounder according to claim 4, characterized in that the plunger (54) can be acted upon in the direction of the at least one extruder screw (14) for back and/or forth movement relative thereto.

6. Injection molding compounder according to claim 5, characterized in that the plunger (54) is acted upon by a spring device, hydraulic device, pneumatic device, or electromotive or mechanical device.

7. Injection molding compounder according to one of the preceding claims 4 to 6, characterized in that the extruder screw proximal part of the plunger (54) is so shaped that the reservoir approaches essentially zero, when the plunger (52) is fully pushed toward the extruder screw (14).

8. Injection molding compounder according to one of the preceding claims 6 or 7, characterized in that the inside surface of the plunger (52) continues the inner wall of the extruder housing, when the plunger (52) has been fully moved to the extruder screw (14).

9. Injection molding compounder according to one of the preceding claims, characterized in that the at least one extruder screw (14) has mixing elements in the area of the accumulator (50).

10. Injection molding compounder according to one of the preceding claims, characterized in that the extruder (10) has two extruder screws (14) which can be operated in a same direction or in opposite direction.

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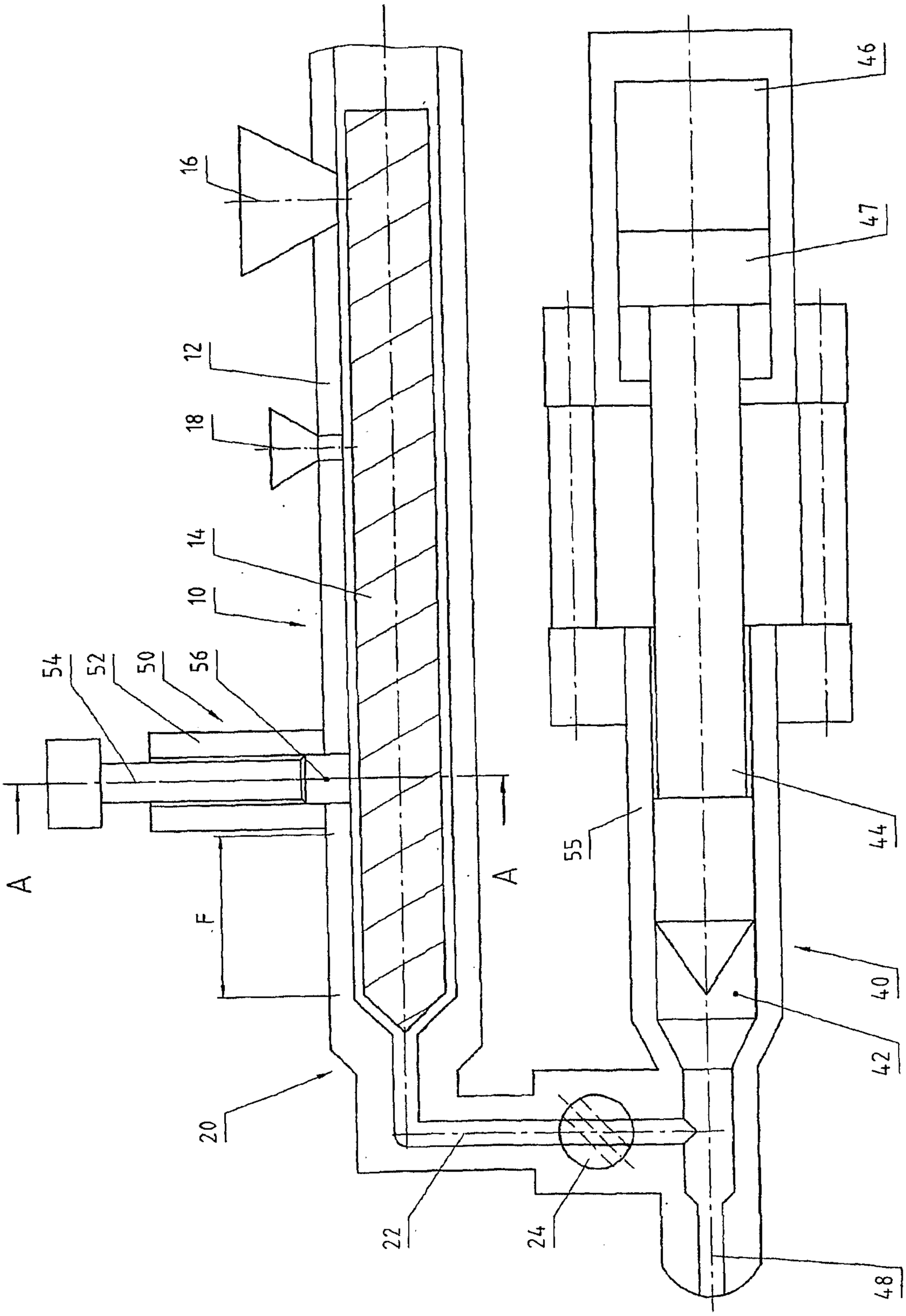


Fig.1

A – A

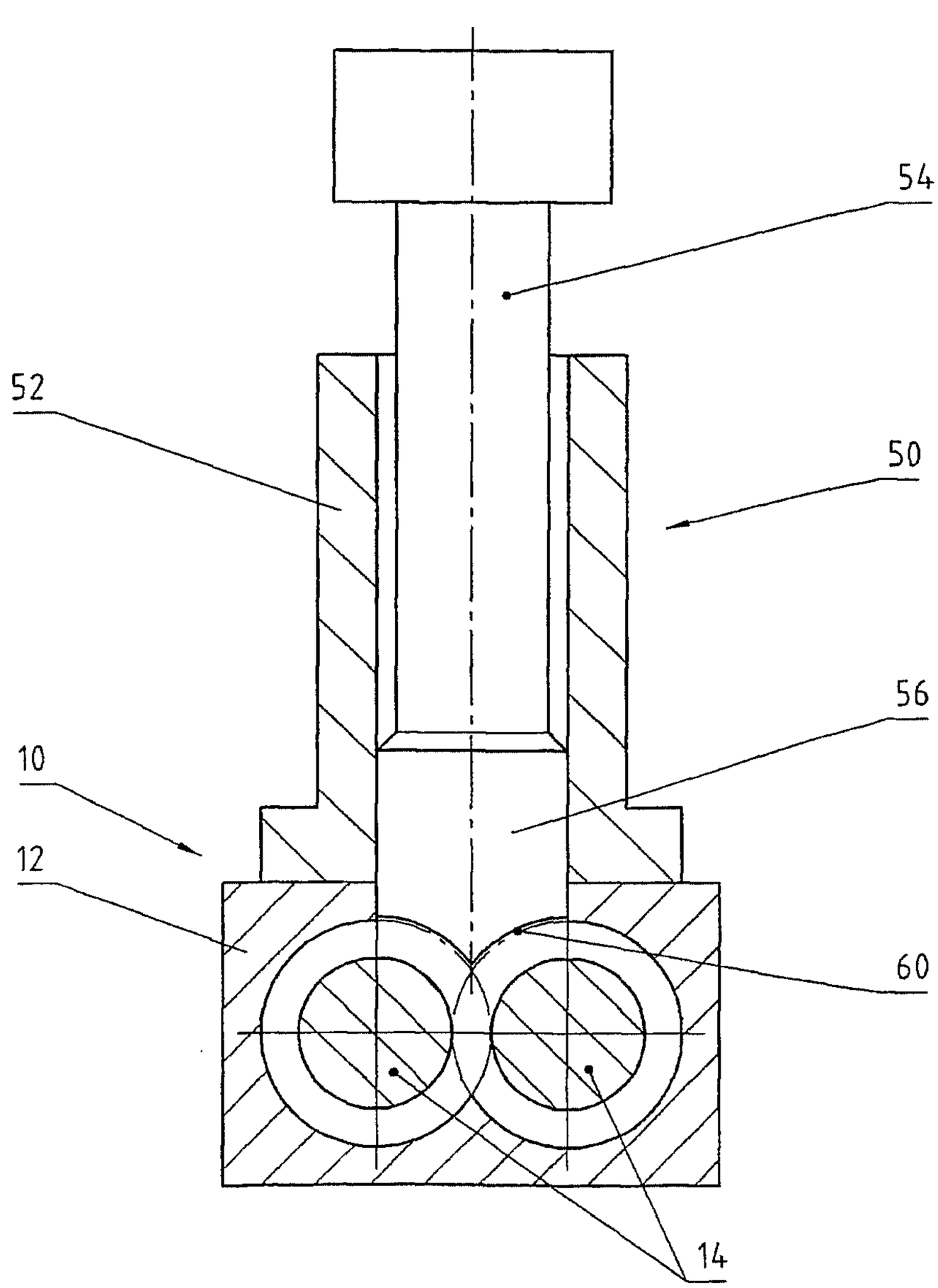
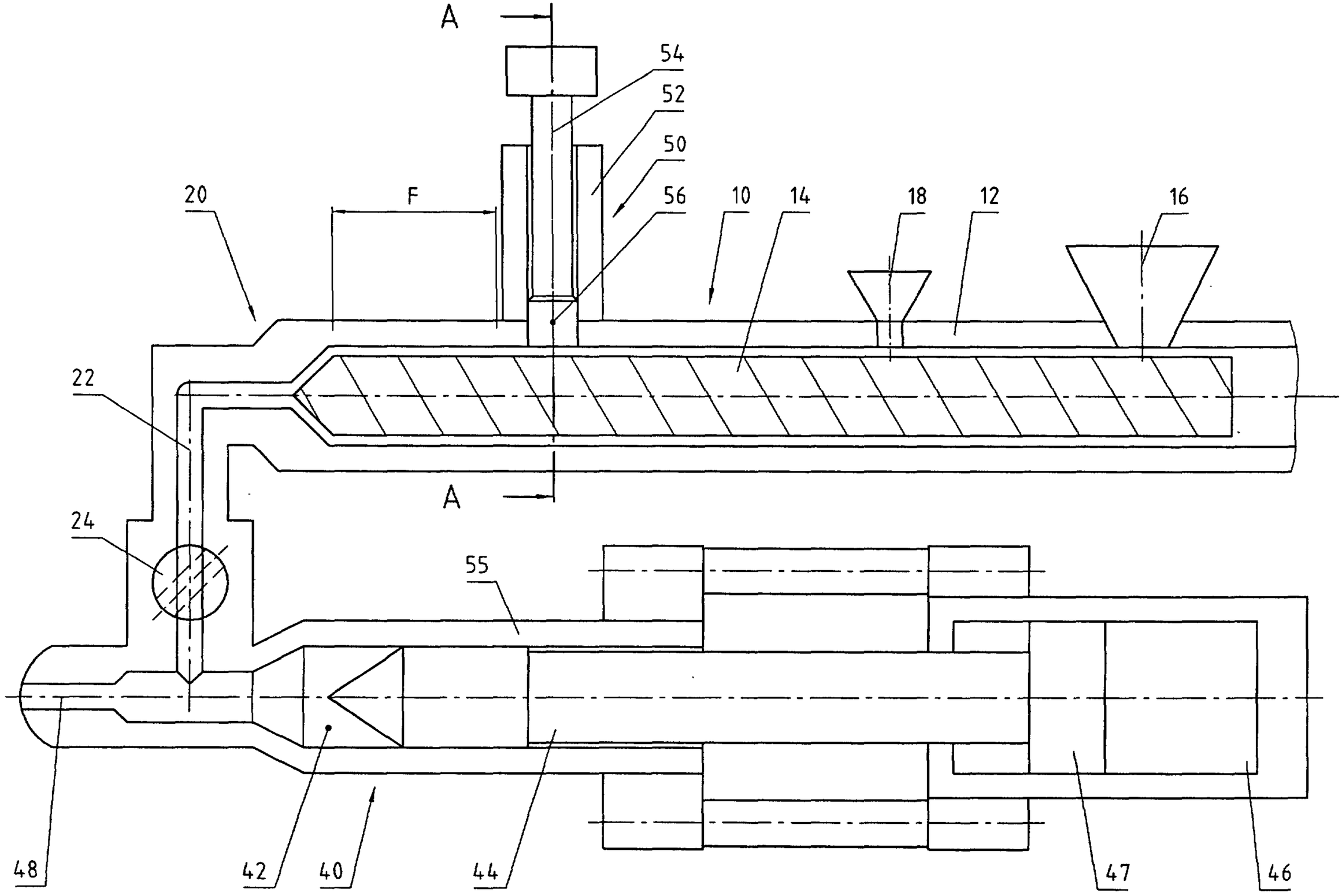


Fig.2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