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(54) **DEVICE FOR MAKING ELONGATED ARTICLES OF SMALL CROSS-SECTION BY MEANS OF HOT GAS EXTRUSION.**

(57) A device for making elongated articles of small cross-section by means of hot gas extrusion comprises a hydraulic press (1), a hollow container (6) intended for a blank and located in its working space, a matrix (13) located in the container (6) and a heater (19) located coaxially to the working part (14) of the matrix (13). According to the invention a plug (9) closing the inlet opening of the container (6) is provided with an elongated external protrusion (24) in which is made a through channel (25) connected by one end to the hollow of the container (6) and having, at the other end, a sealing valve (26). The piston (5) of the hydraulic press (1) is provided with a through opening (23) through which passes the protrusion (24).

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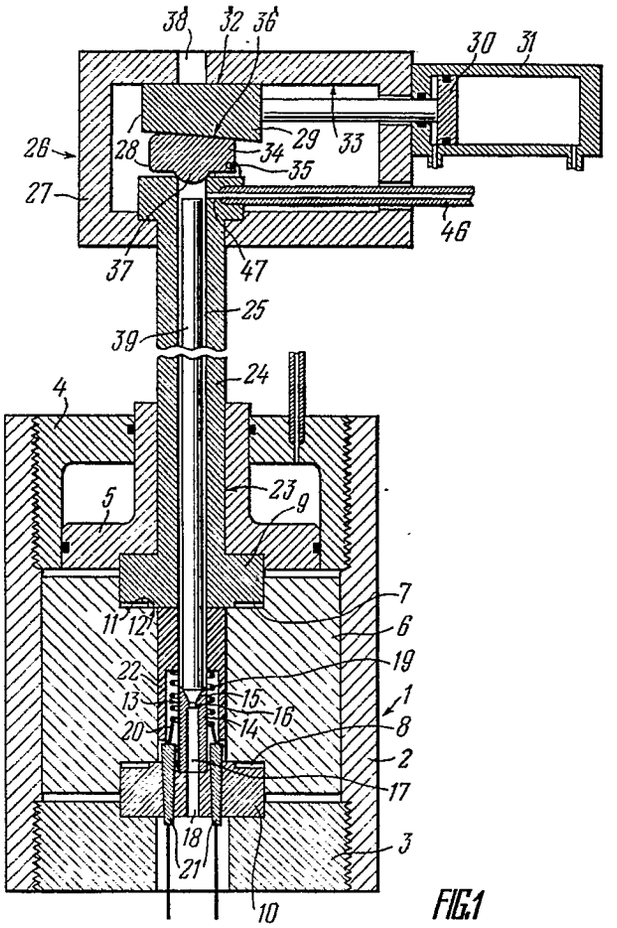
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FIG.1

APPARATUS FOR MAKING ELONGATED ARTICLES OF SMALL CROSS-SECTION BY HOT GAS EXTRUSION

Field of the Invention

This invention relates to plastic working of material, and more specifically concerns machines for making elongated articles of small cross section by hot gas extrusion.

Background of the Invention

There are widely known apparatuses for making articles of small cross section by drawing, such as single-strand and multi-strand mills, drawing blocks, and delivery presses. All these devices include a drawing die with a taperered opening of a size smaller than the cross section of the workpiece, and a means for drawing the workpiece through the die.

Obtaining wires, rods, shapes and pipes in such devices is associated with excessive number of operations including many drawing procedures woth a number of intermediate annealing operations requiring etching, washing, drying, and applying lubricants to result in reduced efficiency.

However, these prior art machines fail to attain high degree of deformation, and are incapable of deforming strong and low-plasticity materials.

There is also known an apparatus for making elongated articles of small cross section by cold extrusion in a hydraulic press comprising a container, a die holder secured in the container and holding a die, and a reel of coiled wire arranged coaxially with the die and rigidly affixed to a cup member bearing on the die holder. The apparatus further includes a rotatable disk element secured on the end of the reel facing the die holder, the disk having a slot at its outer surface in parallel with its axis. The width of this through slot corresponds to the diameter of the wire, whereas the surface of the die holder facing the disk has the form of a funnel with a central opening.

This apparatus is likewise incapable of attaining high degree of derormation due to limitations associated with pressures employed. Conversely, an increase in pressure results in a less reliable operation of the apparatus. In addition, this apparatus fails to deform workpieces from high-strength low-plasticity materials due to the need of employing superhigh pressures affecting the operability and reliability of the spparatus.

There is finally known an apparatus for making elongated articles of small cross section by hot gas extrusion comprising a hydraulic press, a hollow container for the workpiece accommodated in the working space of the press, communicating with a source of high pressure, having inlet and outlet holes with sealing plugs each engageable by their outer surfaces with one of the power elements of the hydraulic press, particularly with a power frame or with a hydraulic cylinder, a die inside the container having a working portion made up of a guide cone and a calibrating band, an outlet passage, and a heater positioned concentrically with the working part of the die (cf. "Kuznechno-shtampovochnoe proizvodstvo", No.10, 1980; V.D.Berbentsev, et al "Vysokotempaturnaya gazovaya exstruzis s lokalnym nagrevom" pages 10 to 12).

This prior art apparatus operates in the following manner. The die holder, heater, die and workpiece compacted therein are placed in the container mounted on a movable platform. Then the platform is rolled into the working space of the press followed by sealing of the inlet and outlet holes of the container with plugs. A gas compressor then acts to provide a working pressure of gas in the container, after which the heater is energized to heat the center of deformation and part of the wcrkpiece present therein. Upon attaining a preset temperature the workpiece is extruded into a wire. Extrusion is terminated by deenergizing the heater, the gas pressure in the container is reduced to the atmospheric, and then the container is depressurized and rolled on the platform out of the working space of the press. The container is then allowed to cool to room temperature and the die holder, heater, die and the remainder of the workpiece are removed from the container. The use of a heater in this apparatus allows heating of the deformation center which affords an increase in the degree of deformation by using relatively low pressures. For example, the degree of deformation of workpieces from hard-to-deform high-speed steels at a pressure of 5 to 7 kilobar is over 95%.

However, this apparatus is characterized by low efficiency due to the time-consuming operations associated with recharging the container residing in the following: reduction of the gas pressure in the container to the atmospheric and of the oil pressure in the hydraulic cylinder of the press prior to depressurization of the container, provision for rolling the platform carrying the container out of the working space of the press, cooling of the container and equipment to the room temperature, bringing the die holder, die and remainder of the material out of the container, compacting a successive workpiece in the die, and carrying out the aforedescribed operations in the reverse sequence.

The time for preparing the apparatus for the extrusion operation is therefore longer than the duration of extrusion by a factor of ten.

In addition, the operation efficiency is lowered by that the length of the workpiece is limited by the length of the container in turn confined by the length of the working space of the hydraulic press.

Summary of the Invention

The aim of this invention is to provide an apparatus for making elongated articles of small cross sections having a container so constructed as to allow its recharging without removing a hydraulic press from the working space to thereby machine workpieces of a length greater than the length of the working space of the hydraulic press, whereby it would be possible to increase the efficiency of the process of hot gas extrusion for obtaining elongated articles of small cross section.

The aim of the invention is attained by that in an apparatus for making elongated articles of small cross section by hot gas extrusion comprising a hydraulic press, a hollow container to accommodate a workpiece in its working space communicating with a source of high pressure, having inlet and outlet holes with sealing plugs each engageable by their outer surfaces with one of power elements of the hydraulic press, particularly with a power frame or with the hydraulic cylinder, a die disposed inside the container and having a working portion made up of a guide cone and a calibrating band, and an outlet passage, and a heater positioned concentrically with the working portion of the die, according to the invention, the sealing plug in the inlet hole of the container has an elongated outer projection with a through passage therein coaxial with the interior of the container and with the die and having a diameter greater than the diameter of the workpiece, communicating by one end with the interior of the container and provided at the other end with a sealing gate, whereas the power element of the hydraulic press engageable with the plug has a through hole for the projection to extend therethrough.

Preferably, the sealing gate gas the form of a power casing rigidity connected to the projection of a wedge pair disposed inside the casing, one element of the pair being capable of reciprocations in a direction perpendicular to the axis of the passage to engage by its surface opposite to the inclined surface with the wall of the casting, the second element being pivotably connected to the projection and having at a surface opposite to the inclined surface a spherical lug of a diameter greater than the diameter of the passage, this lug ensuring sealing of the hole in the passage in response to the translational movement of the first element.

Preferably, the elongated projection is made up of at least two sections arranged in succession in terms of the height of the projection and rigidly interconnected therebetween, a spherical lug coaxial with the through passage and having a diameter of the sphere greater then the diameter of the passage being provided at the points of abutment between the sections at one of adjacent surfaces.

The apparatus for making elongated articles of small cross section by hot gas extrusion according to the invention is characterized by high operating efficiency since it is possible to recharge the container without removing it from the working space of the hydraulic press through the sealing gate provided at the end of a passage in the elongated projection. Such an arrangement reduces the time necessary for recharging the container. In addition, the passage in the elongated projection is in fact the extrusion of the interior of the container, which affords treatment of longer workpieces, that is reduction in the number of recharges of the container per unit length of the workpiece whereby it is possible to increase the efficiency of the apparatus.

Brief Description of the Drawings

The invention will now be described in greater detail with reference to a specific embodiment thereof taken in conjunction with the accompanying drawings, in which:

Fig.1 is a longitudinal sectional view of an apparatus for making elongated articles of small cross section according to the invention;

Fig.2 shows a portion A in Fig.1 with the gate open; and

Fig.3 is a longitudinal sectional view of a projection.

Best Mode of Carrying out the Invention

An apparatus for making elongated articles of small cross section by hot gas extrusion shown in Fig.1 comprises a hydraulic press 1 which includes a cylindrical casing 2, a bearing plate 3 threadingly connected thereto, and a hydraulic cylinder 4 with a piston 5. The casing 2 and bearing plate 3 connected thereto form a power frame. Accommodated in a working space of the press 1 inside the casing 2 between the bearing plate 3 and piston 5 is a hollow container 6 having an interior thereof communicating with a source (not shown) of high gas pressure and also having inlet and outlet holes 7 and 8, respectively. The holes 7, 8 of the container 6 are closed by plugs 9 and 10, each of these plugs engaging by its outer surface with

one of the power elements of the hydraulic press 1. viz., the plug 9 engages with the piston 5 (hydraulic cylinder), whereas the plug 10 engages with the bearing plate 3 (power frame). Annular shoulders 11 of the plugs 9, 10 engage with flat ends 12 of the container 6 to seal the container 6 as pressure is applied to the hydraulic cylinder 4. Arranged coaxially inside the container 6 is a die 13 having a working portion 14 made up of a guide cone 15 and a calibrating band 16, and an elongated outlet passage 17. The die 13 is secured in a socket of the plug 10, this plug 10 having a central hole 18 which is an extension of the outlet passage 17 of the die 13. Arranged concentrically with the working portion 14 of the die 13 outside the die 13 is a spiral heater 19 terminals 20 of which are electrically connected (in contact) with tapered current leads 21 sealingly embedded into the plug 10 and electrically insulated therefrom. Provided between the heater 19 and walls of the container 6 is a heat insulating spacer 22.

A through hole 23 is made in the piston 5 of the hydraulic cylinder 4 engageable with the plug 9, whereas the plug 9 has an elongated outer projection 24 extending through the hole 23 in the piston 5 and having a central through passage 25 coaxial with the interior of the container 6 and die 13 and communicating by one end with the container 6. The other end of the passage 25 accommodates a gate 26 which seals the through passage 25 of the proection 24. The gate 26 has a casing 27 rigidly connected to the projection 24. The casing 27 accommodates a wedge pair 28 one element 29 of which is capable of reciprocations in a direction perpendicular to the axis of the passage 25 for which purpose the element 29 is rigidly connected to a piston 30 of a hydraulic cylinder 31 in turn rigidly connected to the casing 27. As it moves, the wedge element 29 engages by its surface 32 with a wall 33 of the casing 27. A second element 34 of the pair 28 is connected through a pivot 35 to the projection 24, and has at a surface opposite to the inclined plane 36 a spherica projection 37 of a diameter greater than the diameter of the through passage 25. The casing 27 has a hole 38 coaxial with the passage 25 to introduce a workpiece 39 to the passage 25. The diameter of the hole 38, as well as the diameter of the passage 25 exceeds the diameter of the workpiece 39.

Fig.2 shows the sealing gate 26 is a position when the passage 25 is insealed end the workpiece 39 is introduced thereto.

Fig.3 illustrates an alternative embodiment of the elongated projection 24 in which the latter is made up of at least two (in this embodiment three) sections 40 rigidly interconnected therebetween. The sections 40 are interconnected by means of flanges 41 positioned at the ends of the sections 40 and threaded joints 42. The flanges 41 are joined together in pairs by pins 43 and nuts 44. Provided at the points of connection between the sections 40 at one of adjacent surfaces in each joint is a spherical projection 45 coaxial with the through massage 25 and having a diameter of the sphere greater than the diameter of the passage 25.

The proposed apparatus operates in the following manner. In order to prepare the apparatus for operation, the container 6 with the die 13 disposed therein is sealed by the plugs 9 and 10 by applying a force produced by the hydraulic cylinder 4 of the hydraulic press 1.

Prior to starting operation the wedge element 29 of the gate 26 is brought to the extreme right-hand position (Fig.2), the wedge element 34 is through upwards, and the through passage 25 and space in the gate 26 between the hole 38 and inlet to the passage 25 is made free,

The workpiece 39 having a lead portion thereof machined to match the hole in the die (guide cone 15 and calibrating hand 16) is introduced in the hole 38 to the through passage 25 of the projection 24 of the plug 9 to the interior of the container 6 (Fig.1) until it bears on the working portion 14 of the die 13 and seals in its calibrating band 16. By applying pressure to the hydraulic cylinder 31 the piston 30 is caused to move whereby the wedge element 29 moves to the left. Therewith, the wedge element 34 turns about the pivot 35 to the forced by its spherical projection 37 to the end face of the projection 24 blocking the passage 25. At a certain force produced by the hydraulic cylinder 31 the passage 25 is sealed. Then a high pressure from a high pressure source (not shown) is fed via a pipe 46 and hole 47 at the top of the projection 24 to provide inside the container 6 and in the passage 25 a high pressure of gas surrounding the workpiece 39, die 13, and all the parts accommodated in the container 6. Then electric current is applied from a source (not shown) through the current leads 21 to the heater 19 for the latter to heat the working portion 14 of the die 13 and part of the workpiece 39 adjacent to the die 13.

Upon attaining the preset temperature of the material of the workpiece 39 present in the working portion 14 of the die 13 the action of high gas pressure causes squeezing out (extrusion) of the workpiece 39 through the guide cone 15 and calibrating band 16 of the die 13 to the outlet passage 17 to form an elongated article of small cross-sectional size.

After extrusion of the workpiece 39 into an article but before the entire workpiece 39 leaves the die 13 leaving a small part thereof (appropximately equalling the working portion 14 of

the die 13) in the container 6 the extrusion process is terminated by stopping the application of heat (the metal of the workpiece 39 and die 13 tending to be cooled at a fast rate thanks to vigorous gas heat transfer), the pressure of gas inside the container 6 and in the passage 25 is reduced to the atmospheric, and the wedge element 29 is moved to the right by the hydraulic cylinder 31. The wedge element 34 is thrown upwards under the action of a spring (not shown) to open the inlet to the through passage 25 and to the space accommodating a successive workpiece 39. The next workpiece is introduced through the hole 38 and free space in the casing 27 to the passage 25 and interior of the container 6 until it bears by its bottom end on the top end of the preceding workpiece 39, the wedge element 29 is again moved to the left, the wedge element 34 is turned about the pivot 35 to force the spherical projection 37 to the end face of the projection 24 and seal the passage 25.

The new cycle of extrusion is effected by applying the action of high gas pressure end electric current. The abutment between the preceding workpiece 39 and sesseeding workpiece passes through the guide cone 15 and calibrating band 16 of the die 13, after which extrusion of the next workpiece starts.

In view of the aforedescribed, charging of the container 6 with each successive workpiece 39 does not require removal of the container 6 from the working space of the hydraulic press 1 and breaking the seals at the holes 7, 8 to result in a substantial reduction in the time necessary for recharging the container 6 and ensures a higher operation efficiency of the proposed apparatus. The use of an elongated projection 24 allows to extend the interior of the high pressure container 6 and accommodate there a longer workpiece 39, whereby it is possible to reduce the number of recharges in the container 6 per unit length of the workpiece 39 (and the article) and consequently increase the operation efficiency. The provision of a simple and fast acting sealing gate 26 also results in a higher operation efficiency of the apparatus through reducing the time necessary for recharging the workpieces 39.

Sectional conctruction of the projection 24 with spherical lugs 45 can be fabricated in a simple and efficient manner, as it is possible to dispense with drilling deep holes of small diameter, these spherical lugs 45 ensuring reliable sealing of the through high-pressure passage 25 at the abutments between the sections 40.

Industrial Applicability

The proposed apparatus for making elongated articles of small cross section by hot gas extrusion can be used in mechanical engineering and instrument making for producing high-quality wires, rods and shapes from a range of materials, including hard-to-deform materials. The apparatus can also find application in the tool manufacturing processes for manufacturing small-diameter cutting tools, such as drills and screw taps, as well as in the electrical engineering, such as for making wire.

Claims

1. An apparatus for making elongated articles of small cross section by hot gas extrusion comprising a hydraulic press (1), a hollow container (6) to accommodate a workpiece disposed in its working space, communicating with a source of high pressure having inlet and outlet holes (7 and 8) with sealing plugs (9,10) engageable by their outer sirfaces with one of power elements of the hydraulic press (1), particularly with a power frame or with the hydraulic cylinder (4), a die (13) disposed inside the container and having a working portion (14) made up of a guide cone (15) and a calibrating bend (16), and an outlet passage (17), and a heater (19) positioned concentrically with the working portion (14) of the die (13), **characterized** in that the sealing plug (9) in the inlet hole (7) of the container (6) has an elongated outer projection (24) with a through passage (25) therein coaxial with the interior of the container (6) and with the die (13) and having a diameter greater than the diameter of the workpiece, communicating by one end with the interior of the container (6), and provided at the other end with a sealing gate (26), whereas the power element of the hydraulic press (1) engageable with the plug (9) has a through hole (23) for the projection (24) to extend therethrough.

2. An apparatus as claimed in Claim 2, **characterized** in that the sealing gate (26) has the form of a power casing (27) rigidly connected to the projection (24) of a wedge pair (28) disposed inside the casing (27), one element (29) of the pair being capable of reciprocations in a direction perpendicular to the axis of the passage (25) to engage by its surface (32) opposite to the inclined surface with the wall (33) of the casing (27), the second element (34) of the wedge pair (28) being pivotably connected to the projection (24) and having at a surface opposite to the inclined surface a spherical lug (37) of a diameter greater than

the diameter of the passage (28), this lug ensuring sealing of the hole in the passage (25) in response to the translational movement of the first element (29) of the wedge pair (28).

3. An apparatus as claimed in Claims 1 or 2, **characterized** in that the elongated projection (24) is made up of at least two sections (40) arranged in succession in terms of height of the projection (24) and rigidly interconnected therebetween, a spherical lug (45) coaxial with the through passage (25) and having the diameter of the sphere greater than the diameter of the passage (25) being provided at the points of abutment between the sections at one of adjacent surfaces.

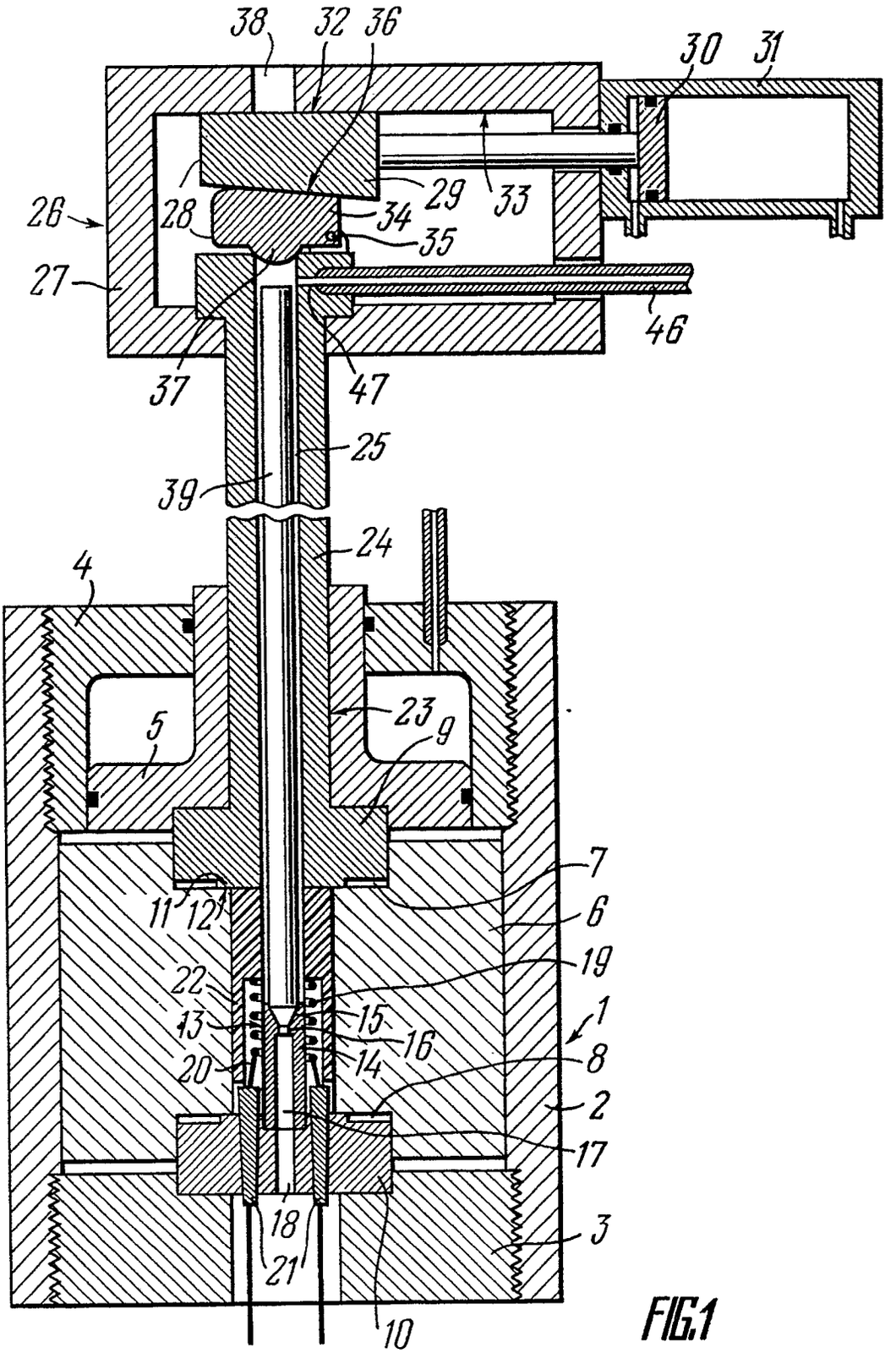
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FIG.1

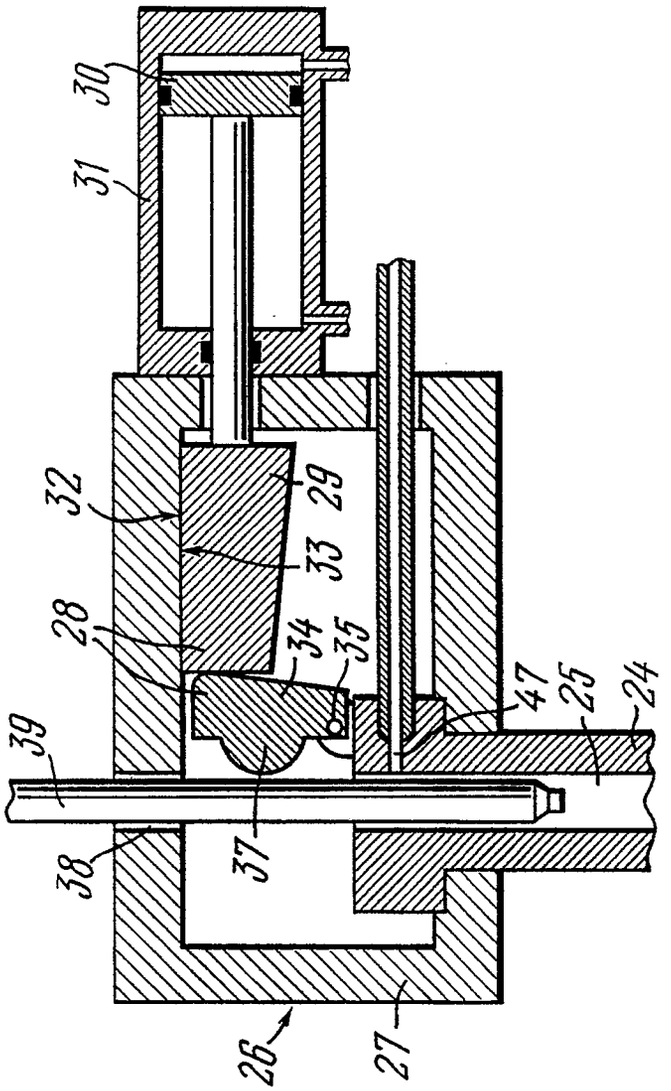
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FIG.2

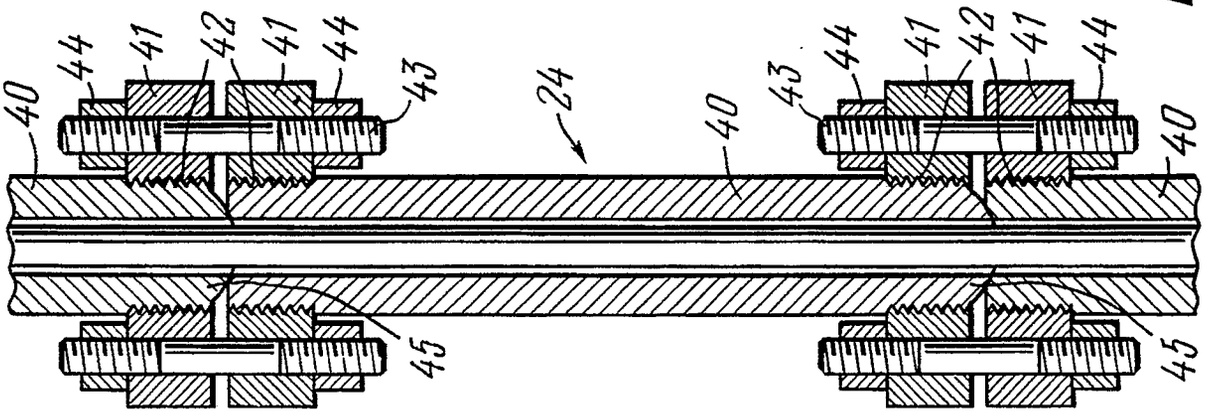
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FIG.3

INTERNATIONAL SEARCH REPORT

International Application No PCT/SU 89/00080

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl.[5] - B21J 5/04

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
Int.Cl.[4]	B21J 5/00-5/04, B21C 23/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	SU, A1, 649498 (V.G. PENKOV), 12 April 1979, (12.04.79), see the claims, figure 1	1-3
A	Kuznechno-shtampovochnoe proizvodstvo, No.10, 1980, (MASHINOSTROENIE, MOSCOW), Ju.S. Konyaev et al. "Vysokotemperaturnaya gazovaya extruzia s lokalnym nagrevom" see pages 13-15, figure 1	1-3
A	FR, A5, 2093774 (ALLMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET), 28 January 1972 (28.01.72), see claim 1, figs. 1,2	1,2
A	GB, B, 1299872 (THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION) 13 December 1972 (14.12.72), see page 2, lines 5-19	1
A	SU, A1, 142502 (L.A. JUTKIN et al.) 12 March 1962, (12.03.62), see figure 2	2

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" 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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" 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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" 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

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
24 October 1989 (24,10.89)	6 December 1989 (06.12.89)
International Searching Authority	**Signature of Authorized Officer**
ISA/SU	