

AUSTRALIA
The Patents Act 1952

650205

CONVENTION APPLICATION FOR A PATENT

We, PAUL WURTH S.A., a Luxembourg corporation, of 32 rue d'Alsace, L-1122 Luxembourg, Grand Duchy of Luxembourg, hereby apply for the grant of a Patent for an invention entitled:

"DEVICE FOR INJECTING PREHEATED AIR INTO A SHAFT FURNACE"

which is described in the accompanying complete specification.

This application is a Convention application and is based on the Application No. 87 730 for a patent or similar protection made in Luxembourg on 27th April, 1990.

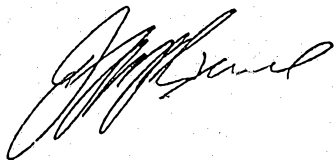
Our address for service is care of CALLINAN LAWRIE, Patent & Trade Mark Attorneys, of 278 High Street, Kew, Victoria 3101, Australia.

D A T E D this 5th day of March 1991.

PAUL WURTH S.A.

By their Patent Attorneys

CALLINAN LAWRIE



To: The Commissioner of Patents.

650205

- (a) Delete for Non-Convention Application.
(b) Delete for Convention Application.

Declaration in Support of
(a) A Convention Application
~~(b) An Application~~
for a Patent ~~or Patent of Addition~~

(c) Insert Full Name of

In support of the ~~Application~~/Convention Application made by

(c) PAUL WURTH S.A. hereinafter termed
"the said Company"

for a patent/~~patent of addition~~ for an invention entitled:

(d) Insert Title of Invention.

(d) Device for injecting preheated air into a
shaft furnace

(e) Insert Full Names of
Declarant(s).

~~+~~ We (e) RENE STREFF & CORNEILLE MELAN

(f) Insert Address(es) of
Declarant(s).

of (f) 32 rue d'Alsace, L-1122 Luxembourg, Grand Duchy of
Luxembourg
do solemnly and sincerely declare as follows:—

(g) Delete when Applicant is a
Company.

1. (g) ~~I am/we are the applicant(s) for the patent/patent of addition~~
~~or~~

(h) Delete when Applicant is an
Individual. Fill in Name of
Applicant if a Company.

(h) ~~I am~~ we are authorised by the said Company

the applicant for the patent/~~patent of addition~~ to make this declaration on its behalf.

(i) For Non-Convention Appli-
cation, delete. For Con-
vention application, fill in
details of basic application.

2. (i) The basic application(s) as defined by Section 141 of the Act was/~~were~~ made
in Luxembourg on the 27th day of April 1990
by ~~PIERRE MAILLIET, of 1 allée Drosbach, L-1423 Howald,~~
~~Luxembourg; and~~
~~JEAN BENCK, of 134 rue du Parc, L-3543 Dudelange,~~
~~Luxembourg~~

"the said Company"

(j) Delete for Non-Convention
Application by Assignee of
Inventor and for Con-
vention Application.

3. (j) ~~I am/we are the actual inventor(s) of the invention~~
~~or~~

(k) Delete for Non-Convention
Application by Inventor and
for Convention Application
by assignee.

(k) ~~I am/we are the actual inventor(s) of the invention referred to in the basic application~~
~~or~~

PIERRE MAILLIET, of 1 allée Drosbach, L-1423 Howald,
Luxembourg; and
JEAN BENCK, of 134 rue du Parc, L-3543 Dudelange,
Luxembourg

(l) Delete for Application by
Inventor. For Application by
Assignee, insert name,
address and occupation of
inventor.

(l)

~~I am~~ we are the actual inventor(s) of the invention and the facts upon which

~~I am/we are~~ the said Company is entitled to make the application are as follows:

the said Company would, if a patent was to be granted up an
(m) application made by the said actual inventors, be entitled
to have the patent assigned to it

(n) Insert details of Assign-
ment, etc. Date of Assign-
ment only is insufficient.

(4) Delete for Non-Convention
Application.

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

(n) Insert place and date of
signature.

(n) Declared at Luxembourg

this 25th day of February 1991

SIGN

X

PAUL WURTH S.A.

HERE

f : The Commissioner of Patents.

STREFF René

MELAN Corneille



AU9172649

(12) PATENT ABRIDGMENT **(11) Document No. AU-B-72649/91**
(19) AUSTRALIAN PATENT OFFICE **(10) Acceptance No. 636205**

- (54) Title
DEVICE FOR INJECTING PREHEATED AIR INTO A SHAFT FURNACE
- International Patent Classification(s)
(51)⁵ **C21B 007/16 F27B 001/16**
- (21) Application No. : **72649/91** (22) Application Date : **06.03.91**
- (30) Priority Data
- (31) Number (32) Date (33) Country
87730 27.04.90 LU LUXEMBOURG
- (43) Publication Date : **07.11.91**
- (44) Publication Date of Accepted Application : **22.04.93**
- (71) Applicant(s)
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- (56) Prior Art Documents
US 4987838
US 4940005
US 3766868
- (57) Claim

1. A device for injecting preheated air into a shaft furnace, consisting of a plurality of separate elements, each consisting of an external armouring and an internal refractory lining, and including ^{in serial connection} an oblique portion connected by a gooseneck, a nozzle, a tuyere and a ball-and-socket joint to the wall of said furnace, in which said oblique portion includes a tapered tube flange-mounted by its upper part onto an upper connection piece forming part of a bustle pipe and the lower part of which dips axially into a lower connection piece integral with said gooseneck, a bellows expansion joint ensuring sealing between said tapered tube and said lower connection piece, and tension rods ensuring mechanical connection between said tapered tube and said lower connection piece, wherein said lower connection piece and said tapered tube are adapted to move mutually in the axial direction and have means for limiting their radial mobility.

636205

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Form 10

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Short Title:

Int. Cl:

Application Number:
Lodged:

Complete Specification - Lodged:
Accepted:
Lapsed:
Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant: PAUL WURTH S.A.

Address of Applicant: 32 rue d'Alsace, L-1122 Luxembourg, Grand Duchy of Luxembourg

Actual Inventors: Pierre Mailliet and Jean Benck

Address for Service: CALLINAN LAWRIE, Patent & Trade Mark Attorney, 278 High Street,
Kew, Victoria 3101, Australia.

Complete Specification for the invention entitled:

"DEVICE FOR INJECTING PREHEATED AIR INTO A SHAFT FURNACE"

The following statement is a full description of this invention, including the best method of performing it known to me:-

P-PWU-227

DEVICE FOR INJECTING PREHEATED AIR INTO

A SHAFT FURNACE

5 The present invention relates to a device for
injecting preheated air into a shaft furnace, consisting
of a plurality of separate elements, each consisting of
an external armouring and an internal refractory lining,
and comprising an oblique portion connected by a goose-
neck, a nozzle, a tuyere and a ball-and-socket joint to
10 the wall of the furnace, in which the oblique portion
comprises a tapered tube flange-mounted by its upper part
onto an upper connection piece forming part of a bustle
pipe and the lower part of which dips axially into a
lower connection piece integral with the gooseneck, a
15 bellows expansion joint ensuring the sealing between the
tapered tube and the lower part, and tension rods ensur-
ing the mechanical connection between the tapered tube
and the lower connection piece.

20 These devices, more generally known under the
name of "blast connection", are subject to problems of
mobility and sealing. Indeed, as a result of the high
temperature of the preheated air (temperature of the
order of 1200°C or more) and of the high temperature
prevailing inside the furnace, the wall of the latter and
the bustle pipe and the blast connection are subject to
25 thermal expansions and deformations causing significant
relative displacements between the bustle pipe and the
wall of the furnaces. The blast connection must therefore
be capable of compensating for these relative displace-
ments or of adapting to them, at the same time avoiding
30 leaks of gas or preheated air to the outside.

In addition to these stresses of thermal origin,
there are stresses caused by the internal pressures.
Indeed, the preheated air which is injected through the
blast connection into the furnace is, in particular in
35 modern furnaces, at a high pressure which, given the
sections presently adopted, subjects the blast connection
to forces of the order of several tons, which pressures
come from both the blast pipe and the inside of the

furnace.

The known blast connections designed in order to meet these requirements comprise either two points of articulation or three points of articulation with, in each case, a ball-and-socket joint generally between the tuyere and the nozzle, the other articulation, or the two other articulations, depending on the type, being situated in the oblique portion connecting the bustle pipe to the gooseneck of the blast connection.

The articulations in the oblique portion are generally provided with a flexible sealing pad and with a bellows expansion joint joining together the movable portions.

The blast connections with three points of articulation, disclosed, for example, in the US Patent 3,766,868, generally have the advantage as compared with those with two points of articulation of having more possibilities of adapting to, or compensating for the deformations and stresses, both of the radial components and the axial components. The two articulations situated in the oblique portion of these blast connections generally comprise means, such as universal joints, which have the advantage of absorbing the force components generated by the pressure of the hot air in such a way that these forces are not transmitted to the articulation between the nozzle and the tuyere. However, these blast connections with three points of articulation have the disadvantage of being relatively expensive, which is of no little importance in the light of the large number of blast connections with which a blast furnace is equipped.

The blast connections with two articulations ~~disclosed, for example, in the document DE-GBM 7325087,~~ have for their part the advantage of being simpler and less expensive. However, these blast connections are much more sensitive to the stresses and deformations, in particular to the radial components which cause the sealing pad of the articulation in the oblique portion to be crushed, and more rapid wear. The blast connection proposed in the abovementioned document is, furthermore,



subjected to the force caused by the pressure of the hot air. In order to prevent these forces from causing the articulation between the nozzle and the tuyere to come out of joint with concomitant leaks, the oblique portion of this blast connection must be attached to the wall of the furnace. The location of this attachment is not, however, ideal owing to the excessively large displacements of the blast connection and owing to the difficulty of access to it.

The object of the present invention is to provide a novel device for injecting preheated air into a shaft furnace which is relatively simple and inexpensive and which adapts satisfactorily to deformations and stresses.

In order to achieve this objective, the device proposed by the present invention is essentially characterised in that the lower connection piece and the tapered tube can move mutually in the axial direction and have means for limiting their radial mobility.

In other words, the problems of mastering the radial components of the forces, and the displacements which caused the sealing pad to be crushed at the articulation of certain blast connections according to the prior art are eliminated using means for limiting the radial or angular mobility of the tapered tube and of the lower connection piece, and compensated for by a relative axial mobility, or telescoping, of these two elements.

It has been established that if these means are designed to prevent an axial misalignment of more than 2" between the tapered tube and the lower connection piece, satisfactory results can be foreseen.

According to a first embodiment, these means consist of two flanks integral with a flange of the upper connection piece which extend laterally, when viewed in the direction of the furnace, on either side of the expansion joint and are guided in corresponding recesses of a flange of the lower connection piece.

According to a second embodiment, these means consist of an internal guide ring integral with an upper flange of the lower connection piece and surrounding the

lower cylindrical part of the tapered tube.

The sealing at the level of the ball-and-socket joint between the nozzle and the tuyere can be maintained by a pair of tension rods with adjustable springs tensioned between the wall of the furnace and the nozzle or the gooseneck.

These tension rods are preferably arranged in such a way that their axis forms an acute angle, towards the bottom, with respect to the axis of the nozzle.

Other features and characteristics will emerge from the detailed description of an advantageous embodiment given below, as an illustration, with reference to the attached drawings, in which:

Figure 1 shows a side view of a blast connection according to the present invention;

Figure 2 shows an axial vertical section through the blast connection of Figure 1;

Figure 3 shows diagrammatically the force components which are present;

Figure 4 shows diagrammatically and in partial section a side view of the means for limiting the radial mobility of the tapered tube with respect to the lower connection piece;

Figure 4A shows a horizontal section through the plane of section A-A in Figure 4;

Figure 4B shows a section through the plane of section B-B in Figure 4;

Figure 5 shows diagrammatically, in axial section, a second embodiment of the means for limiting the radial mobility, and

Figures 6 and 6A illustrate diagrammatically the possibilities of movement in the case of a freedom of axial misalignment of 2° between the tapered tube and the lower connection piece.

Figures 1 and 2 show diagrammatically a blast connection which connects a main bustle pipe 20 arranged around a blast furnace, not shown, to the wall of the latter with a view to the injection of preheated air into this furnace. This blast connection comprises a

descending oblique portion 22 connected via a gooseneck 24 and a nozzle 26 to a tuyere 28 which is keyed in a tymp 30 arranged in the wall of the furnace. The nozzle 26 is connected to the tymp 30 by a ball-and-socket joint, the centre of curvature of which is represented by 0. The oblique portion 22 consists of an upper connection piece 32 which forms part of the bustle pipe 20, and of a lower connection piece 34 which is fixed by a flange 38 onto the gooseneck 24. The connection between the upper and lower connection pieces 32 and 34 is ensured by a tapered tube 36 with a lower cylindrical part which is fixed by a flange 40 to the upper connection piece 32 and the lower part of which penetrates coaxially into the upper part of the lower connection piece 34. As shown in Figure 2, all the elements of the blast connection have an external metal armouring 42 and an internal refractory lining 44.

According to one of the features of the present invention, the portion 22 has a certain degree of telescopic freedom to the extent that the tapered tube 36 can, in its cylindrical region, move axially with respect to the lower connection piece 34, and vice versa. The sealing between these two elements is ensured by an annular sealing pad 46 surrounding the cylindrical part of the tapered tube 36, and a bellows expansion joint 48 extending from the upper flange 40 to a flange 50 of the lower connection piece 34. Three external tension rods 52 ensure the mechanical stability of the blast connection and relax the expansion joint 48 when the blast connection is being disassembled. For this purpose, the tension rods 52 are fixed via a nut and a counter-nut to a plate 54 integral with the upper flange 40, and extend through the flange 50 of the lower connection piece, whilst at the same permitting a relative axial sliding between the tension rods 52 and the flange 50 within the limits fixed by adjusting nuts 56.

In order to avoid leaks at the ball-and-socket joint between the nozzle 26 and the tuyere 28, or even to avoid this articulation coming out of joint, a pair of

tension rods, only one of which can be seen at 58, are tensioned between the gooseneck 24 and the wall of the furnace. These tension rods 58 comprise a spring, not shown, the tensile load of which can be adjusted by means of a nut 60.

Figure 3 shows a schematic diagram of the forces and their components which are present in a blast connection according to Figures 1 and 2. The inside of the blast connection is first subjected to a force caused by the pressure in the bustle pipe 20. This force, represented by S, is exerted axially and is proportional to the pressure and to the mean cross-section of the expansion joint 48. By way of example, if the expansion joint 48 has a mean diameter s of 580 mm, and if the pressure in the bustle pipe is 4×10^5 Pa, the force S is 10560 daN. Given that the blast connection is not supported in the direction of the force S, the latter must be broken down in such a way that it finds support, in other words in the direction of the centre O of the articulation between the nozzle 26 and the tuyere 28. This component is represented in Figure 3 by S1. This inevitable breaking down generates, however, a component S2 which is exerted radially. In the case of the abovementioned example and for the configuration illustrated, the component S1 is of the order of 13000 daN, and the component S2 is of the order of 7000 daN. One of the objectives of the present invention is to provide means, described in more detail subsequently with reference to Figures 4 to 5, intended to contain the component S2, since the absence of such means would subject the join between the tapered tube 36 and the connection piece 34 to radial bending stresses liable to damage the pad 46 and the expansion joint 48.

In Figure 3, the component S1 has been transferred towards the point O, given that it is there that it exerts its effect. The direction of the component S1, as shown, is not optimal, given that it stresses the lower part of the ball-and-socket joint directly and is liable to free the upper part of the joint and to cause leaks at this point. Fortunately, however, the

orientation of the component S1 is modified under the effects of the action of the tension rods 58 and of the pressure inside the furnace on the nozzle, the direction and the force of this pressure being represented by T in Figure 3. The force resulting from the action of the tension rods 58 is represented by Z. This component Z, transferred to the beginning of the component S1 and after subtracting the force component due to the pressure T, supplies the resultant R1 which represents the magnitude and the direction of the force exerted on the articulation between the nozzle 26 and the tuyere 28. This resultant R1 has a better orientation than the component S1, to the extent that its angle of inclination with respect to the axis of the nozzle is smaller. It should, moreover, be noted that the orientation of the resultant R1 is proportionally better, the greater the angle of inclination α of the tension rods 58 with respect to the axis of the nozzle 26.

The force of the tension rods 58 is adjusted approximately so as to contain the effect of the pressure on the tuyere 28 from inside the furnace. The force resulting from this pressure is represented by the vector U. When the diameter of the exposed portion of the tuyere 28 is 450 mm, the force U is 6360 daN for a pressure inside the furnace of 4×10^5 Pa. Consequently, each of the two tension rods 58 will be adjusted so as to exert a force of the order of 3000 daN. By combining the effect of the force of the tension rods Z and the force U with the component S1, the resultant R2 is obtained which is the force of the tuyere 28 on the tympan 30.

Figure 4 shows a first embodiment of the means provided by the present invention for containing the radial component S2 of the force S explained with reference to Figure 3. In this first embodiment, the upper flange 40 has two flanks 62, 64 which extend laterally, when viewed in the direction of the furnace, on either side of the expansion joint 48 and which are guided by their narrowed lower part in two corresponding recesses 66, 68 of the lower flange 50. The guidance of

these flanks 62, 64 in the recesses 66, 68 consequently prevents any substantial radial movement of the flange 50 with respect to the flange 40, whilst at the same time permitting a mutual axial displacement between these two flanges, in other words a certain telescoping between the tapered tube 36 and the connection piece 34. In other words, the radial components of the forces corresponding to the force S2 are transmitted by the flanks 62, 64 to the bustle pipe.

It should, however, be noted that both the guidance of the flanks 62, 64 in the corresponding recesses 66 and 68, and the passage of the tension rods 52 in the flange 50 and the penetration of the tapered tube 36 into the connection piece 34 are effected with a certain play so as to permit an axial misalignment of the order of 2° between the tapered tube 36 and the connection piece 34, which, as will be explained in more detail with reference to Figure 6, permits degrees of freedom which are reasonable for permitting the blast connection to effect the movements required for compensating for the differential displacements.

In the second embodiment illustrated in Figure 5, the external guidance of Figure 4 is replaced by an internal guidance of the tapered tube 36. This guidance is effected by a ring 70, for example made from silicon carbide, which surrounds the lower cylindrical part of the tube 36. As in the previous case, this ring 70 is arranged with a certain play around the tube 36 so as to compensate for the radial forces but to tolerate an axial misalignment of the order of 2° between the tube 36 and the connection piece 34.

Figure 6 illustrates diagrammatically the mobility of the blast connection according to the present invention in the hot state for an axial misalignment tolerance of 2° between the tapered tube and the lower connection piece. The figure shows more particularly the movements of the centre O of the articulation between the nozzle and the tuyere following the movements of the wall of the furnace, and that of the centre Y of the flange 50

relative to an imaginary fixed point X, assuming that the
bustle pipe and the tube 36 remain stationary. In the
example illustrated of a distance of 2364 mm between O
and Y, and of a misalignment tolerance of 2° , the maximum
5 deviation of the centre O, in a vertical plane, is
represented by the quadrilateral 72. Any movement inside
this quadrilateral 72 takes the form only of an axial
displacement of the point Y. Taking into account the fact
that the point O can also be displaced axially, in other
10 words in the plane of Figure 6, the mobility quadri-
lateral 72 becomes a parallelepiped 74 as illustrated in
Figure 6A. In practice, this parallelepiped is a cube of
edge length of the order of 80 mm, which corresponds to
a mobility of the point Y of the order of 85 mm.

The claims defining the invention are as follows:

1. A device for injecting preheated air into a shaft furnace, consisting of a plurality of separate elements, each consisting of an external armouring and an internal refractory lining, and including ^{in serial connection} an oblique portion connected by a gooseneck, a nozzle, a tuyere and a ball-and-socket joint to the wall of said furnace, in which said oblique portion includes a tapered tube flange-mounted by its upper part onto an upper connection piece forming part of a bustle pipe and the lower part of which dips axially into a lower connection piece integral with said gooseneck, a bellows expansion joint ensuring sealing between said tapered tube and said lower connection piece, and tension rods ensuring mechanical connection between said tapered tube and said lower connection piece, wherein said lower connection piece and said tapered tube are adapted to move mutually in the axial direction and have means for limiting their radial mobility.
2. The device according to claim 1, wherein said means are designed to prevent an axial misalignment of more than 2° between said tapered tube and said lower connection piece.
3. The device according to claim 1 or claim 2, wherein said means consist of two flanks integral with a flange of said upper connection piece and which extend laterally, when viewed in the direction of said furnace, on either side of said expansion joint and are guided in corresponding recesses of a flange of said lower connection piece.
4. The device according to claim 1 or claim 2, wherein said means consist of an internal guide ring integral with an upper flange of said lower connection piece and surrounding said lower cylindrical part of said tapered tube.



5 6. The device according to claim 5, wherein said tension rods are arranged
in such a way that their axis forms an acute angle α , towards the bottom, with
respect to the axis of said nozzle.

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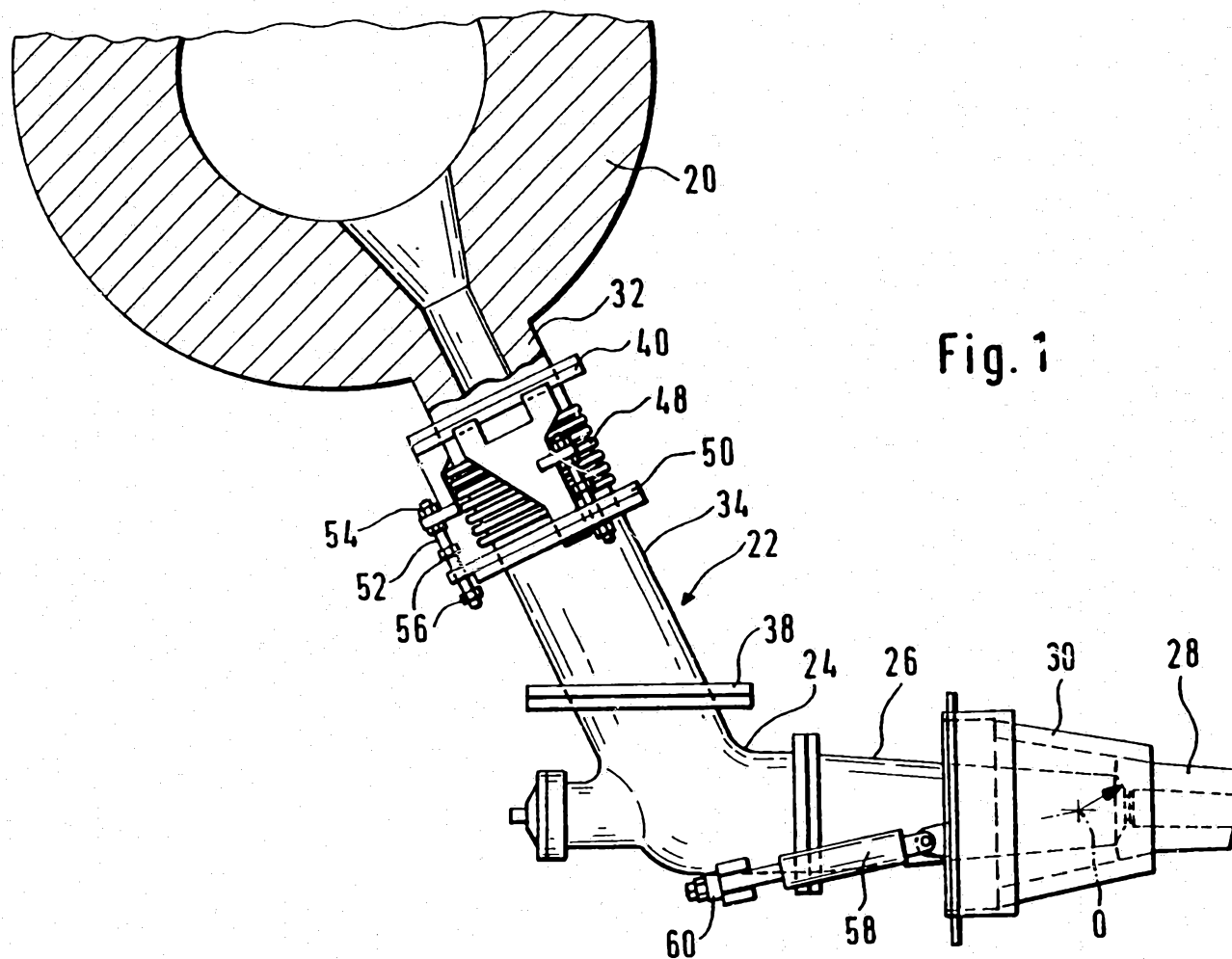
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John G. Bunch

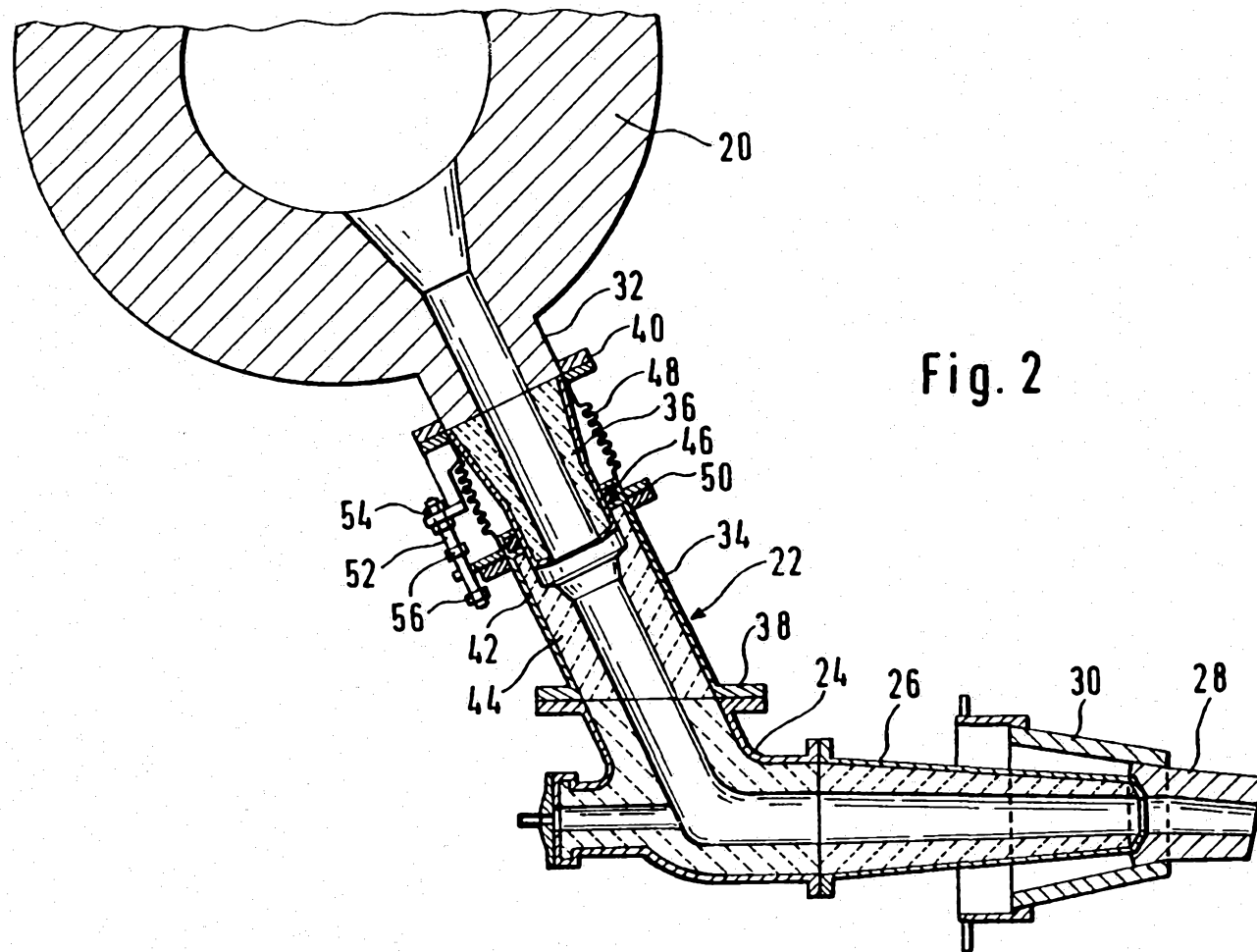


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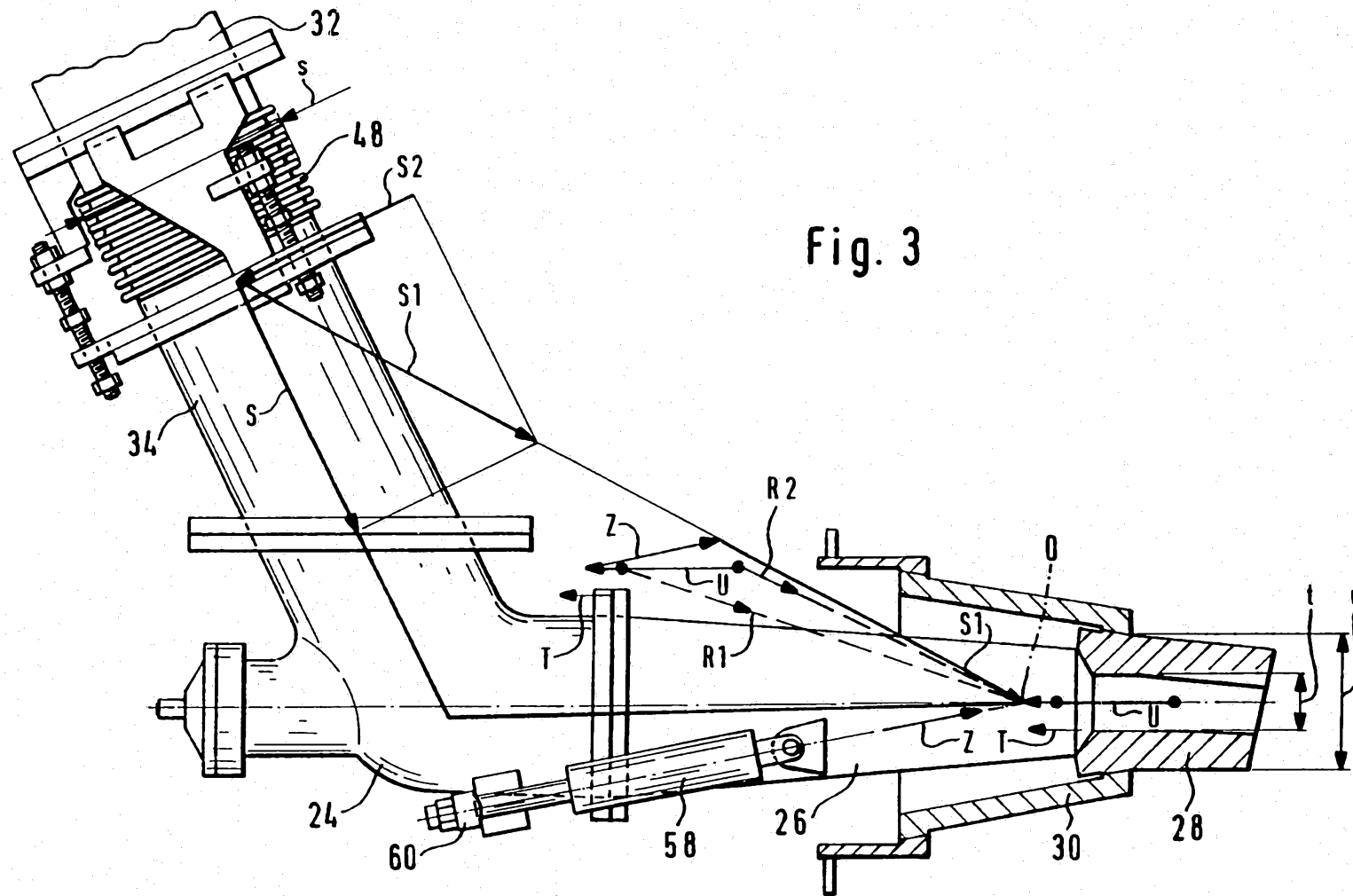


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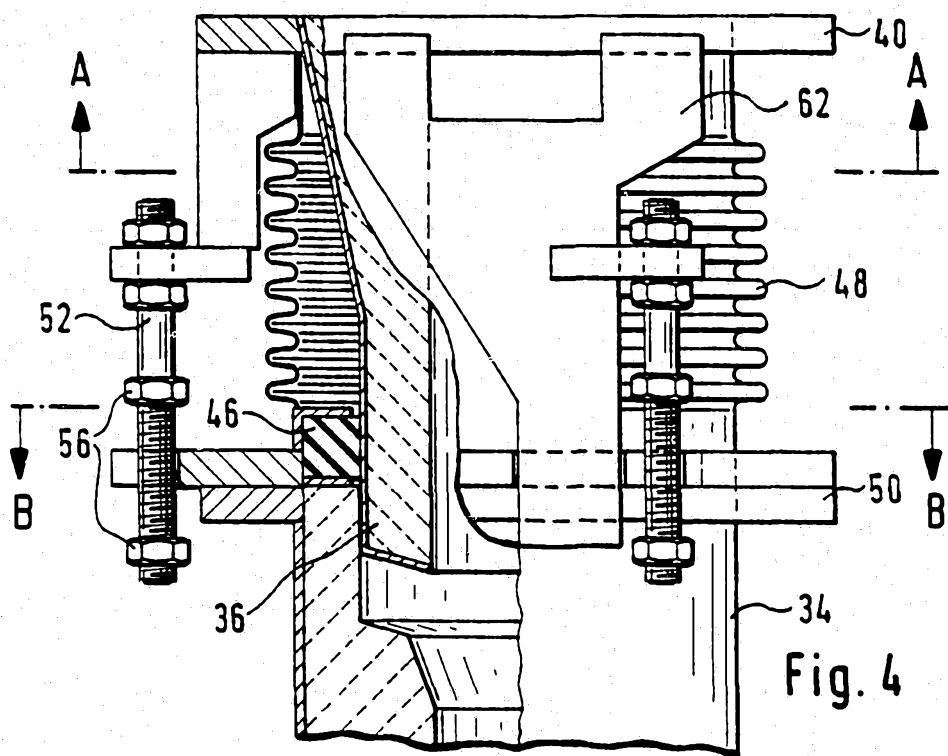


Fig. 4

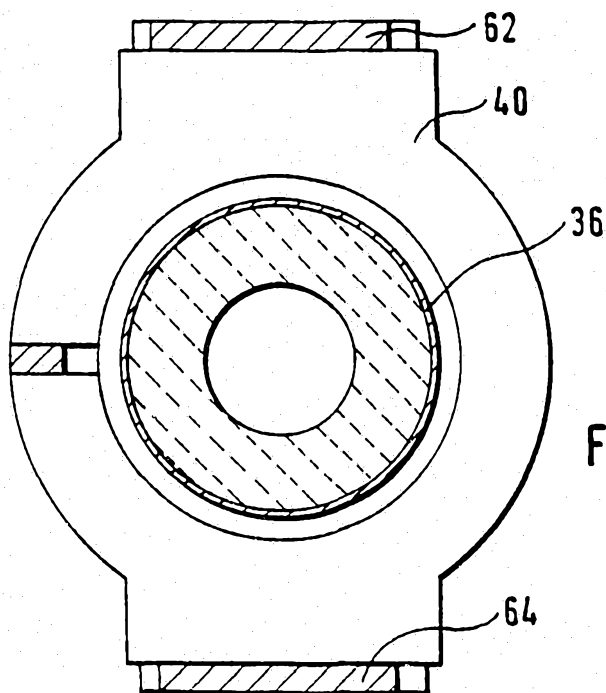


Fig. 4 A

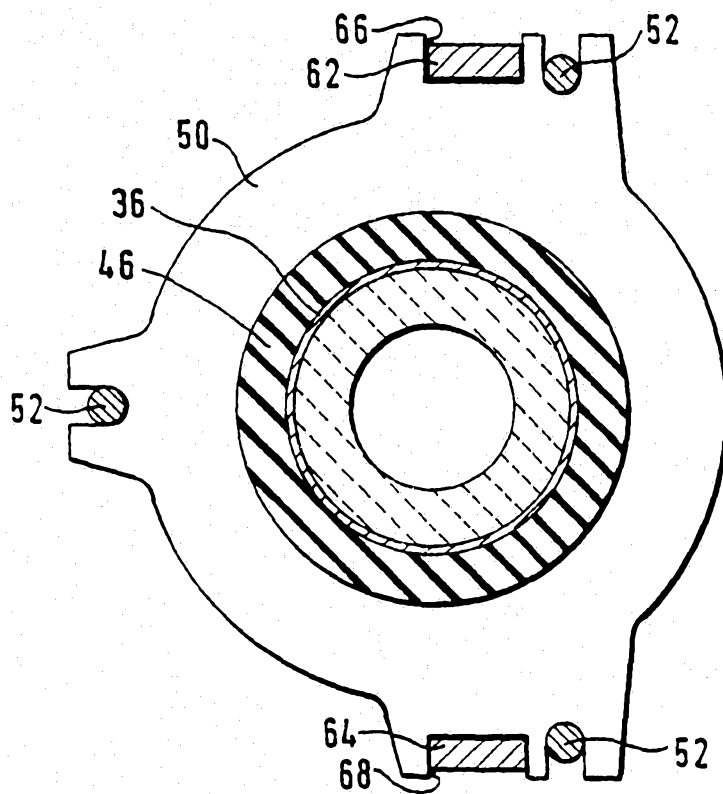


Fig. 4B

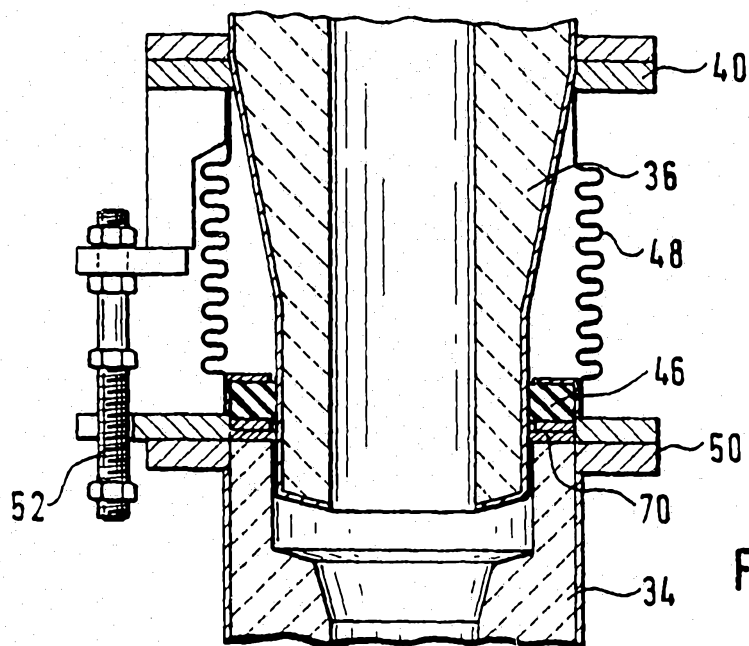
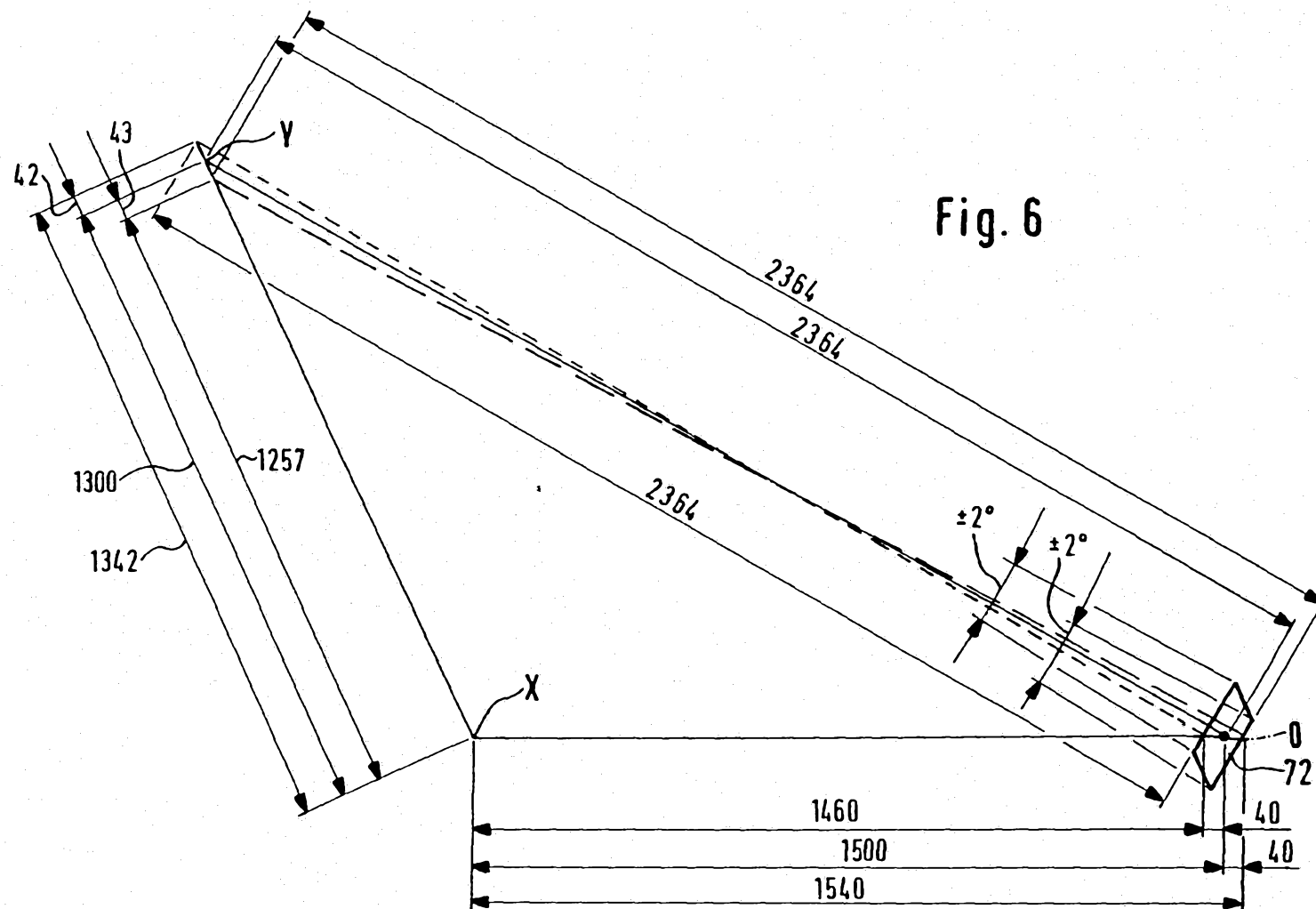


Fig. 5

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Fig. 6 A

