



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.10.2024 Bulletin 2024/43

(51) International Patent Classification (IPC):
B21C 3/12 (2006.01)

(21) Application number: **23169119.7**

(52) Cooperative Patent Classification (CPC):
B21C 3/12

(22) Date of filing: **21.04.2023**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

• **DE WAELE, Jan**
8550 Zwevegem (BE)
• **VAN HOECKE, Hendrik**
8550 Zwevegem (BE)
• **KUIJKEN, Valentijn**
8550 Zwevegem (BE)

(71) Applicant: **NV Bekaert SA**
8550 Zwevegem (BE)

(74) Representative: **Seynhaeve, Geert Filiep**
NV Bekaert SA
IPD - PC6030
Bekaertstraat 2
8550 Zwevegem (BE)

(72) Inventors:
• **DE SCHUYTER, Giovano**
8550 Zwevegem (BE)

(54) **ORIENTABLE DRAWING DIE HOLDER FOR WIRE DRAWING**

(57) An orientable die holder for holding a wire drawing die in a metal wire drawing machine has a carrier in which the die is received. The carrier has a centre axis going through the centre of the die. The carrier is mounted angularly adjustable by a first pivot means defining a first axis that is perpendicular to the centre axis of the die. In one embodiment the carrier is mounted rotatable around the centre axis. In another embodiment the carrier and the first pivot means are mounted angularly adjustable around a second pivot means defining a second

axis. The second axis is in the first plane perpendicular to the first axis. The first plane contains the centre axis. Various advantageous embodiments are described that implement this easily orientable configuration. In one embodiment that orientable die holder has first and second adjustment devices that allow for a precise adjustment of the bi-axial orientation of the die. The die holder allows for easy adjustment of the centre axis and hence for a straight metal wire.

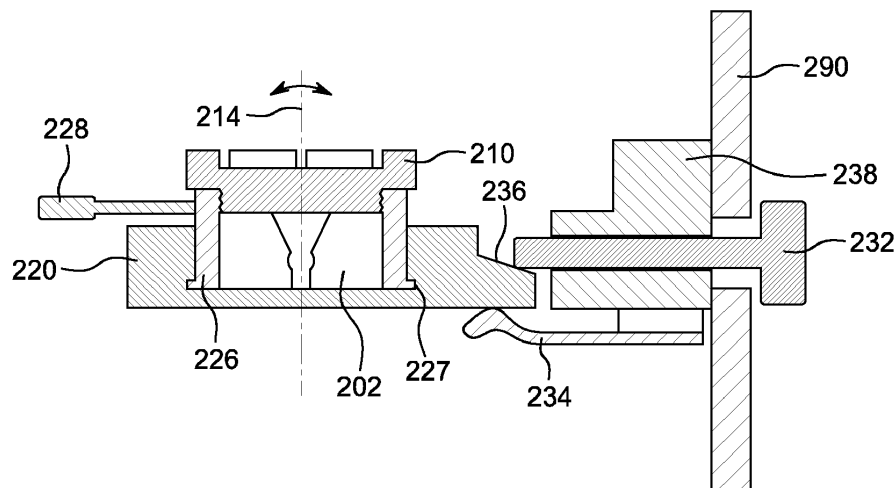


Figure 2b

Description

Technical Field

[0001] The invention relates to a drawing die holder for use in a metal wire drawing machine. The drawing die held in the drawing die holder can be easily oriented.

Background Art

[0002] The drawing of metal wire is performed by gradually reducing the diameter of the metal wire by drawing the wire through a succession of dies. The dies have an orifice, the diameter of the orifices becoming successively smaller. The dies comprise a nib - made of a cermet or diamond or a diamond compound - that is held in cylindrical casing. The nib has an entrance cone, a bearing and an exit cone. The bearing diameter determines the diameter of the exiting metal wire. The cylindrical casing defines the axis of the drawing die. Note that for small bearing diameters, it becomes difficult to have a perfect alignment between the die axis and the axis of the bearing.

[0003] In order to ease the passage of the wire through the bearing a lubricant must be used. The lubricant can be a dry lubricant such as a fine powdered soap. In that case one speaks of 'dry metal wire drawing'. Typically this is used for large diameter wires - above about one millimeter - and the number of dies is less than fifteen, possibly twelve. Alternatively, the wire can be lubricated with a liquid such as an oil or an emulsion thus called 'wet wire drawing'. This is typically used for smaller wire diameters below about one millimetre. The number of dies may vary from about ten to well over twenty. Although the invention is described for a wet wire drawing machine, the principles can equally well be applied in a dry drawing machine.

[0004] In a wet wire drawing machine the dies are held in 'die holders' in between the capstans that pull the wire through the dies. As there are many dies a collective die holder comb can be used such as described in CN211990300U. In such combs the dies are loosely held in a cavity. The problem in such combs is that the wire axis is not well aligned with the die axis.

[0005] This alignment problem is solved by making an orientable die holder: see e.g. WO 2019/042937 A1. A die is held in a holder with spherical mantle held in tight fitting in a cavity. The spherical mantle allows to precisely adjust the orientation of the die and to fix it subsequently. Hence it allows to align the die axis with the wire axis. As such holder is quite bulky and the adjustment requires the frequent release and tensioning of at least three and more frequently four set screws, it can only be used for the last die, also called 'head die'. The head die is that die where the drawn wire exits the machine and is wound on the spool. Moreover the orientation adjustment requires the frequent release and tensioning of those set screws which makes aligning the head die a job requiring

skill and patience.

[0006] When the wire axis enters the head die, or any intermediate die, that is not in line with the die axis asymmetric residual stresses are induced in the drawn wire.

As a result the wire will show 'cast' that is: it will assume a non-straight, curved shape when held freely. Cast must be well controlled for 'finished wire products' that are products that will be delivered to customers for further processing. For example spring wires need to be straight for supply to the spring making machine. Also very fine steel wires with a diameter of between 30 and 150 micrometre that are used as substrate wire for diamond coated wire must also be very straight. Brass plated wire used for reinforcement of high pressure hoses on the contrary must have a controlled cast: when a piece of wire is cut from the spool it must assume a circular shape the diameter of which is between limits. In contrast thereto 'monofilament wires' that are brass plated wires with a diameter between 0.30 mm to 0.50 mm for direct use of the wire in the belt of tires must be very straight (EP 3 027 337 B1).

[0007] There is also the desire that not only the head die is mounted adjustable but also the dies preceding the head die can be controlled as these also have an impact on the residual stresses inside the drawn wire.

Disclosure of Invention

[0008] The main object of the invention is to overcome the problems of existing die holders. A first object is to provide a die holder that can easily be adjusted with a minimum of set screws. A further object is to have a die holder that does not take a lot of space. A further object of the invention is to have a remotely controllable die holder. A still further object of the invention is to provide a wire drawing machine with the die holder or holders.

[0009] According a first aspect of the invention a die holder with the features of claim 1 is described. The die holder is for integration in a metal wire drawing machine. The metal wire drawing machine is preferably a wet wire drawing machine, although the principles of the inventive die holder can also be implemented in a dry drawing machine.

[0010] The die holder comprises a carrier. The carrier receives the drawing die or die hereinafter. The carrier is typically a piece of metal with a bore hole wherein the die tightly fits, seats and is held. The fit can e.g. be ensured by using an elastomeric O-ring. Or a counter nut can be used, although this may take more space and is therefore less preferred. The die must be held because when the machine is stopped, the wire may recoil and the die should not be drawn out of the seat of the carrier.

[0011] The axis of the bore hole of the carrier is the centre axis of the carrier. The centre axis of the carrier goes through, comprises the centre point of the bearing of the die hereinafter called 'the centre of the die'. Note that the axis of the bearing does not need to coincide with this centre axis. Indeed, there may be a deviation

between the axis of the bearing in the nib and the axis of the die holder, in particular for very small diameter dies. But these deviations can be compensated by the die holder as will become clear later on.

[0012] The carrier is mounted angularly adjustable relative to the metal wire drawing machine around a first axis with a first pivot means. The metal wire drawing machine is the fixed reference frame. The first axis is oriented perpendicular to the centre axis. In this way the centre axis can be inclined, tilted, pivoted around the centre of the bearing of the die i.e. the centre axis of the carrier rotates in a single plane that is called the first plane. The first plane is thus perpendicular to the first axis and contains the centre axis.

[0013] In a first preferred embodiment, the carrier is mounted rotatable around the centre axis of the carrier. This means that if the die is held in the carrier, the die can rotate with the carrier around the centre axis. In this way the orientation of the axis of the bearing - that may deviate from the centre axis - can be adjusted over all space angles by the combination of tilting around the first axis and turning of the die carrier.

[0014] To align the bearing axis with the wire, one puts the plane of the carrier - that is the perpendicular plane to the centre axis - about perpendicular to the wire. After drawing the wire through the die with an inch movement, the wire will follow the orientation of the bearing. By cutting the wire so that a short tail of the wire remains, one may find the true direction of the bearing. Firstly the carrier is rotated until the tail is in the first plane perpendicular to the first axis. Secondly, the carrier is angularly adjusted by pivoting the carrier around the first axis, in the direction opposite of the tail direction. The wire will now come straight out of the die.

[0015] The advantage is that only two adjustments must be made to orient the wire: rotation of the die around the centre axis and tilting around the first axis.

[0016] According a second more preferred embodiment, both the carrier and the first pivot means are mounted angularly adjustable around a second axis with a second pivot means. The second axis is in the first plane. A technical mind will readily understand that by this mounting the centre axis can be oriented in any direction desired by adjusting two angles.

[0017] The rotatable mount of the carrier around the centre axis is thus no longer necessary i.e. is dispensable although it still may offer a third degree of adjustment.

[0018] In a third preferred embodiment the carrier comprises a die receiving piece that is mounted to a first base plate. This first base plate is hingeably connected to a second base plate through the first pivot means. 'Hingeably' in the current context means: pivotable, rotatable, tiltable by means of a hinge. So the first base plate can adjustably rotated, tilted, pivoted relative to the second base plate. The second base plate on its turn is hingeably connected to a support through the second pivot means.

[0019] The support is fixedly connected to the metal wire drawing machine. The centre axis is orientable rel-

ative to the metal wire drawing machines. The available space angle for adjustment is around the perpendicular to the support and within a square pyramid of plus or minus 30°, or 20° or even 10° may suffice, in both directions that is: perpendicular to first and second axis.

[0020] Adjustment of the tilting of first and second axis is by means of a first and second adjustment device. The adjustment device must allow for small changes in angle and at the same time be robust in order to withstand the forces exerted on it during drawing.

[0021] The first and/or second adjustment device can be implemented in a number of ways. A non limiting list is:

- By means of a simple set screw, or
- A set screw with a counter spring may be needed in order to push the first and/or second base plate against the set screw,
- Alternatively a set screw with ball joint can be used to avoid to having a counter spring, or
- A set screw with a counter screw or counter nut can be used, or
- Alternatively adjustment can be done by means of a wedge type adjustment device, or
- By means of an actuator. Within the context of this application with 'actuator' is meant any device that can generate controlled motion by means of electrical, pneumatic or hydraulic power. 'Controlled' means that there is a feedback loop to ensure correct positioning of the actuator end. Examples are piezo electric actuators, micromotors, servo motors or the like..

[0022] The first and second pivot means can be implemented in a number of ways. A non-limiting list is:

- Mechanical hinges e.g. a butt hinge, or a ball bearing hinge, or
- Integral hinges. Within the context of this application 'integral hinges' are hinges that are integral to the two parts that hinge to one another. Integral hinges are made by providing a local weakening that allows controlled bending at the weakened spot. Integral hinges may - depending on the material - allow larger or smaller pivot angles. Integral hinges do offer the advantage that they provide a spring back, a counterforce that resists the bending at the hinge. In this way a counter spring may be obsoleted in the case of simple set screw adjustment.
- Alternatively blade springs can be used to provide a pivot means. Disadvantage of this is that the pivot point must be calculated and may vary for too high pivot angles. Also the forces that can be taken by blade springs are lower than that of an integral spring;
- Also pivot hinges may be used. Pivot hinges comprise a conical hole at the one part of the hinge wherein a pin is pushed and turns that is connected to the other part. In the die holder two opposite push-

ing pivot hinges can be conveniently used to form one pivot means.

[0023] Materials used for the die holder are preferably metals like machine steel. Alternatively high performance polymer materials like poly oxy methylene or poly amide can be used when the forces acting on the die holder are not excessive that is for the drawing of very fine wires. The drawing die holder can be machined out of the polymer material or even 3D printed directly into shape and form as desired.

[0024] In a further preferred embodiment a pointer means for controlled adjustment of the first and second adjustment means can be used. This can take the form of a longer pin, like a nail or pin, mounted perpendicular to the carrier or to the first base plate of the die holder. The pointer may point to a two dimensional surface to accurately determine the position of the pointer. Alternatively a mirror spot can be provide on the carrier on which a laser beam reflects. The laser beam is fixedly connected to the machine. The reflection can be caught on a screen for precise adjustment of the die holder.

[0025] In a further preferred embodiment, the first and/or the second adjustment device is/are electrically driven and can be remotely controlled by a dual axis controller. The remote control can be wired or wire less. In this way fast and accurate adjustment of the die holder becomes possible without the operator having to put his hands on the machine.

[0026] According a second aspect of the invention, a wire drawing machine is claimed. Such wire drawing machines are know per sé. They can be of the dry drawing type or the wet wire drawing type. The latter is more preferred. Such a machine generally accommodates between ten and thirty dies and one head die. Characteristic about the wire drawing machine is that at least one of the dies is held in a die holder as previously described.

[0027] In a preferable embodiment the at least one of the die holders comprises a die holder for a head die. Indeed, the head die has the most control on the cast of the drawn wire. Preceding dies have also an influence on the wire straightness, but to a lesser extent.

[0028] In another preferred embodiment the head die and one up to five dies preceding the head die are held in a die holder as described above. Terms like 'preceding' and 'before' or 'after' and 'subsequent' are relative to the drawing direction of the wire: dies with a larger diameter are 'before' or 'preceding' a certain die, dies with a smaller diameter are 'subsequent' to the die under consideration.

[0029] The die holder offers many advantages over the prior art die holders:

- They allow for easy adjustment of the central axis: only two set screws must be adjusted;
- The set screws must not be blocked,
- The die holder can be made compact and can be used - not only at the headdie - but also on dies preceding the headdie.

- The die holder holds the dies fixed: compared to prior art die holder 'combs', the dies are held in a fixed, adjustable position without play.

[0030] In what follows a more detailed description of certain embodiments will be given.

Brief Description of Figures in the Drawings

[0031]

Figure 1 shows a prior-art die holder, that can be replaced with the invention die holder.

Figure 2a shows a first realisation of the die holder in top view

Figure 2b shows the section AA' as per Figure 2a of the first realisation of the die holder

Figure 3a shows more preferred reduction to practise of the invention die holder in top view.

Figure 3b shows a side view of the Figure 3a, along the line BB'.

Figure 4 shows a schematic embodiment of an actuator driven die holder with the dual axis controller.

[0032] Like items will be numbered with equal unit and tens digit, the hundred digit referring to the number of the figure.

Mode(s) for Carrying Out the Invention

[0033] Figure 1 shows a prior-art die holder 100 as is typically used for a head die. The die 102 is fixed by a nut 110 with centre bore in carrier 104. The carrier 104 is received in a support 106 that is fixedly connected to the machine frame of the metal wire drawing machine 190. The spherical surface 105 of the carrier 104 fits in a fitting spherical cavity 107 of the support 106 and can swivel therein. The carrier is held fixed by means of three set screws 108, 108', 108" with a bushing and springs 112, 112". The set screws are arranged in a 120° angular configuration. The adjustment of this die holder requires at least adjustment of three set screws. Also the fact that set screws or in a 120° angular configuration makes it difficult to adjust the wire in planes perpendicular to one another. It takes quite some skill and experience before an operator can adjust such a die holder.

[0034] In a first preferred embodiment of the inventive die holder of which a top view is shown in Figure 2a, the die holder 200 holds the die 202 in carrier 220 by means of a nut 210. Figure 2b shows that nut 210 threads into a bushing 226. The bushing 226 is held in the carrier 220 by means of circlip-groove fitting 227. The bushing 226 can rotate in the carrier 220 by turning the handle 228 as indicated by the arrows in Figure 2a around the centre axis 214. The centre axis 214 corresponds to the axis of the bushing 226. This allows to precisely set the rotation of the die 202.

[0035] The carrier 220 is held by two spring actuated

pivot hinges 222, 222' mounted opposite to one another in a support 238. The support is fixedly connected to the metal wire drawing machine 290. The pivot hinges 222, 222' show a pin that is received in respective recesses 224, 224'. This allows to rotate the carrier 220 around the first axis going through the pivot hinges 222, 222' relative to the machine.

[0036] The adjustment means for adjusting the tilting around the first axis is in the form of an inclined wedge surface 236 machined out of the carrier 220. By adjusting the set screw 232 the angle of the centre axis in the first plane - that is the plane perpendicular to the first axis i.e. the axis through the pivot hinges - can be precisely adjusted. This is indicated by the arrows in Figure 2b. A large displacement of the set screw 232 results in small angular rotation of the carrier. In order to hold the carrier 220 against the inclined wedge surface 236, a mechanical spring 234 pushes the carrier 220 back.

[0037] A third preferred embodiment is described in Figure 3a and 3b. Again the die 302 is held in a carrier 320 that consists of a die receiving piece 311 (Figure 3b) that is mounted to a first base plate 321. Like before a nut 310 holds the die in the die receiving piece 311. The centre axis 314 is indicated.

[0038] The first base plate 321 is hingeably connected to a second base plate 321'. In this embodiment integral hinges 340 and 340' have been used. In this manner the hinges 340, 340' form a first axis. Rotation around the first axis is precisely controlled via the first adjustment device 331. As shown in Figure 3b, the first adjustment device 331 consists of a set screw 332 that threads into holder 333. The holder 333 is fixedly connected to first base plate 321. At the opposite side of first plate 321, spring holder 336 is fixedly connected. The springs 338 exert a counterforce when the set screw 332 is turned.

[0039] In a similar way the second base plate 321' is hingeably connected to the support 338 through integral hinges 342 and 342'. Integral hinges 342 and 342' define the second axis. The support 338 can be screwed to the metal wire drawing machine 390. Likewise a second adjustment device 331' allows to rotate the second base plate 321' around the second axis. Again the second adjustment device 331' comprises a set screw 332' threaded in a holder 333' that is fixedly connected to the second plate 321'. At the opposite side of the latter, a spring holder 336' is fixedly connected for exerting a counterforce through springs 338'.

[0040] The whole system of support 338, second base plate 321', first base plate 321 is laser cut out of a single steel plate. The hinges 340, 340' and 342, 342' are implemented by partially cutting away material at the first and second axis. So these hinges 340, 340', 342, 342' are integral hinges to the steel plate. These hinges have the advantage that they can be conveniently implemented. However, some after treatment - laser hardening - may be needed to prevent plastic deformation of the hinges, although for the small angular rotations involved, plastic deformation is not expected.

[0041] The die holder of Figures 2a, 2b and even more of Figures 3a, 3b are easier to adjust as they allow to identify easily the planes in which the die is made to rotate. It is much easier for the operator to adjust such a die holder than the prior-art die holders.

[0042] Figure 4 shows a similar embodiment 400 according to Figures 3a and 3b. Therefore the individual parts will not be explained in detail. The difference with the Figure 3a, 3b embodiment lays in the use of micromotors 431, 431' as the first and second adjustment device. These micromotors 431, 431' are controlled through controller 492 via line 496 for the second adjustment device 431' and line 498 for the first adjustment device 431. The controller 492 receives the desired orientation from a dual axis controller 494. The actual position of the drawing die holder can be displayed on the screen 499. The 'flat' condition of the die holder i.e. the centre axis is perpendicular to the flat of the support 438 is indicated with

'' , the actual condition is indicated with a cross hair '' . It may well be that straight wire is obtained when the orientation of the die holder is not flat as the bearing axis of the die may not correspond to the centre axis of the die holder.

[0043] By these inventions the adjustment of the die holders becomes much more convenient for the operator and having a number of adapted die holders upstream from the head die results in straight wire.

Claims

1. A die holder, for holding a die in a metal wire drawing machine, said die holder comprising a carrier for receiving the die, said carrier having a centre axis comprising the centre of the die,
characterized in that
said carrier is mounted angularly adjustable relative to the metal wire drawing machine, around a first axis with a first pivot means, said first axis being perpendicular to said centre axis.
2. The die holder according to claim 1 wherein said carrier is mounted rotatable around said centre axis.
3. The die holder according to claim 1 or 2 wherein said carrier and said first pivot means are mounted angularly adjustable around a second axis with a second pivot means, wherein said second axis is in a first plane perpendicular to said first axis, said first plane containing said centre axis.
4. The die holder according to any one of claims 1 to 3 wherein said carrier comprises a die receiving piece mounted to a first base plate, said first base plate being hingeably connected to a second base plate through said first pivot means, said second base plate being hingeably connected to a support

through said second pivot means, said support being fixedly connected to the metal wire drawing machine.

5. The die holder according to any one of claims 1 to 4 wherein said carrier is angularly adjustable around said first pivot means by means of a first adjustment device and/or said carrier and said first pivot means is angularly adjustable around said second pivot means by means of a second adjustment device. 5
10
6. The die holder according to any one of claims 1 to 5 wherein said first and/or said second adjustment device are one out of the group comprising a set screw, a set screw with ball joint, a set screw with counter screw or counter nut, a set screw with counter spring, an adjustable wedge, an actuator. 15
7. The die holder according to any one of claims 1 to 6 wherein said first and/or second pivot means are one out of the group comprising mechanical hinges, integral hinges, blade spring hinges, pivot hinges. 20
8. The die holder according to any one of claims 1 to 7 wherein said carrier is provided with a pointer means for controlled adjustment of the first and second adjustment means. 25
9. The die holder according claim 8 wherein the pointer means is a pin parallel to the centre axis or wherein the pointer means is a mirrored surface means for reflection of a light beam. 30
10. The die holder according to any one of claims 6 to 9 wherein said first and/or said second adjustment device are electrically driven actuators that are remotely controlled by a dual axis controller. 35
11. A wire drawing machine for drawing metal wire, wherein said wire drawing machine holds one or more dies, **characterized in that** 40
at least one of said dies being held in a die holder according to any one of claims 1 to 10.
12. The wire drawing machine according claim 11 wherein the head die and one up to five dies preceding the head die are held in a die holder according to claim any one of claims 1 to 10. 45

50

55

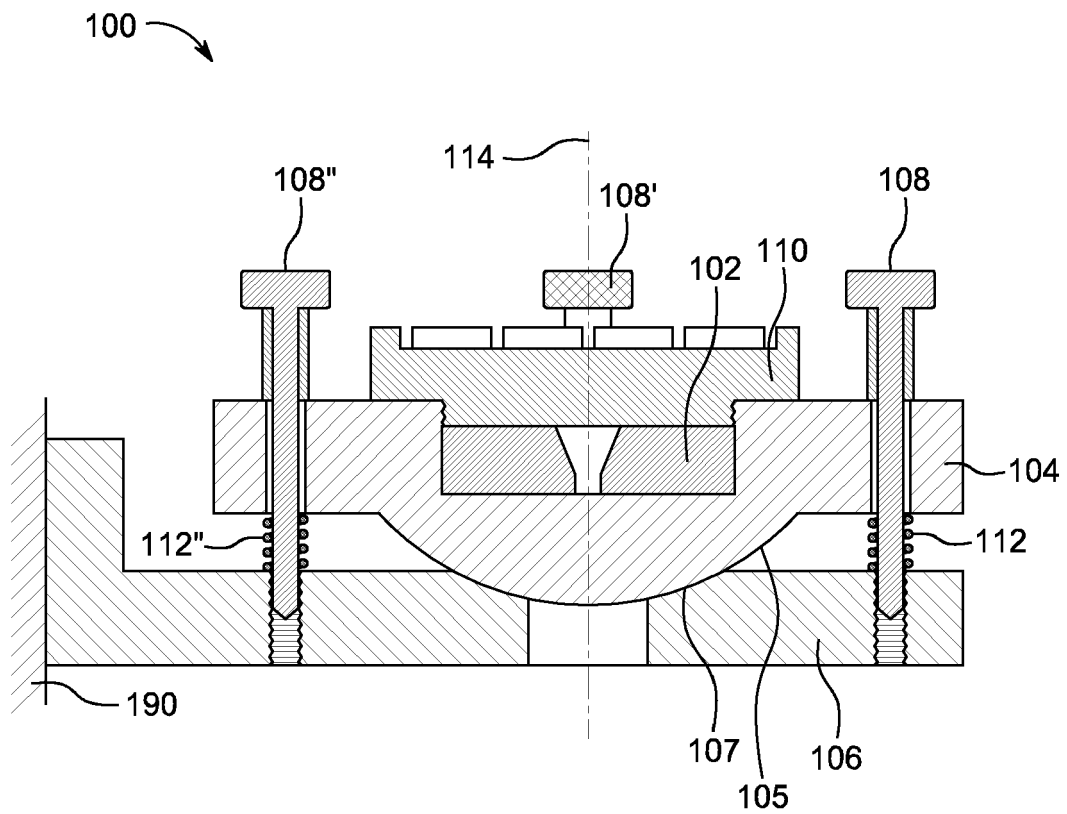


Figure 1
Prior Art

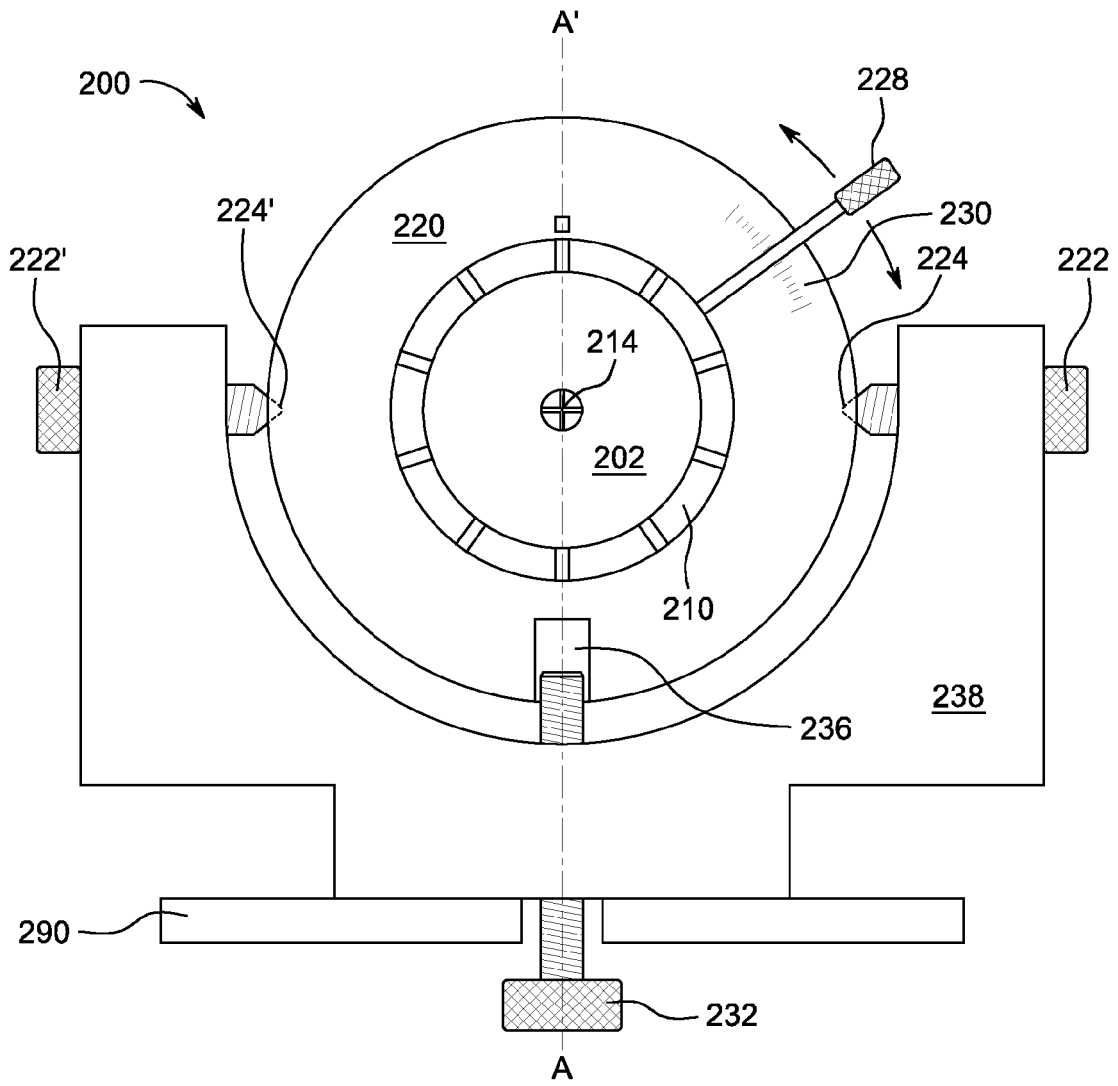


Figure 2a

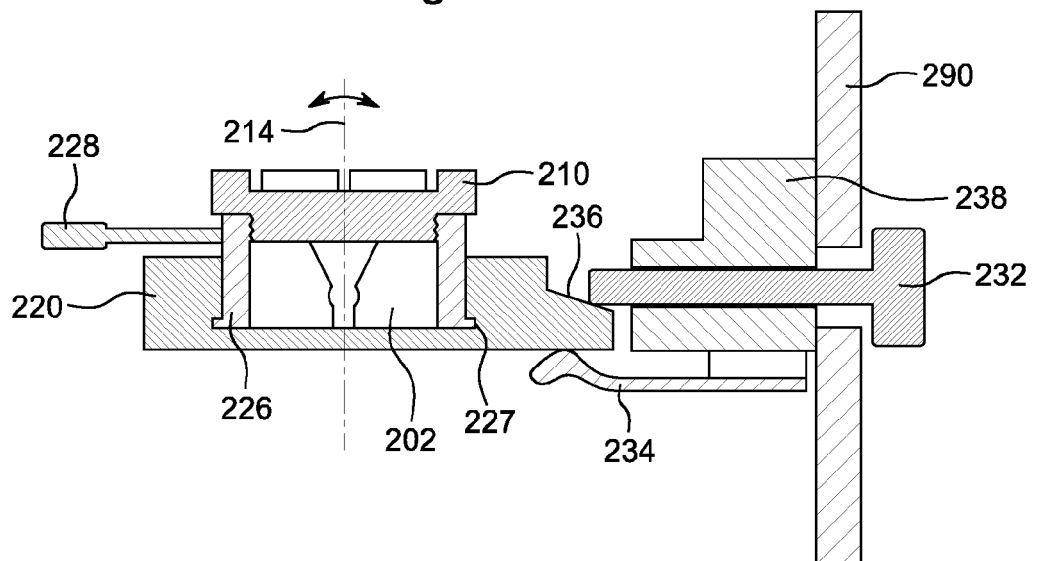


Figure 2b

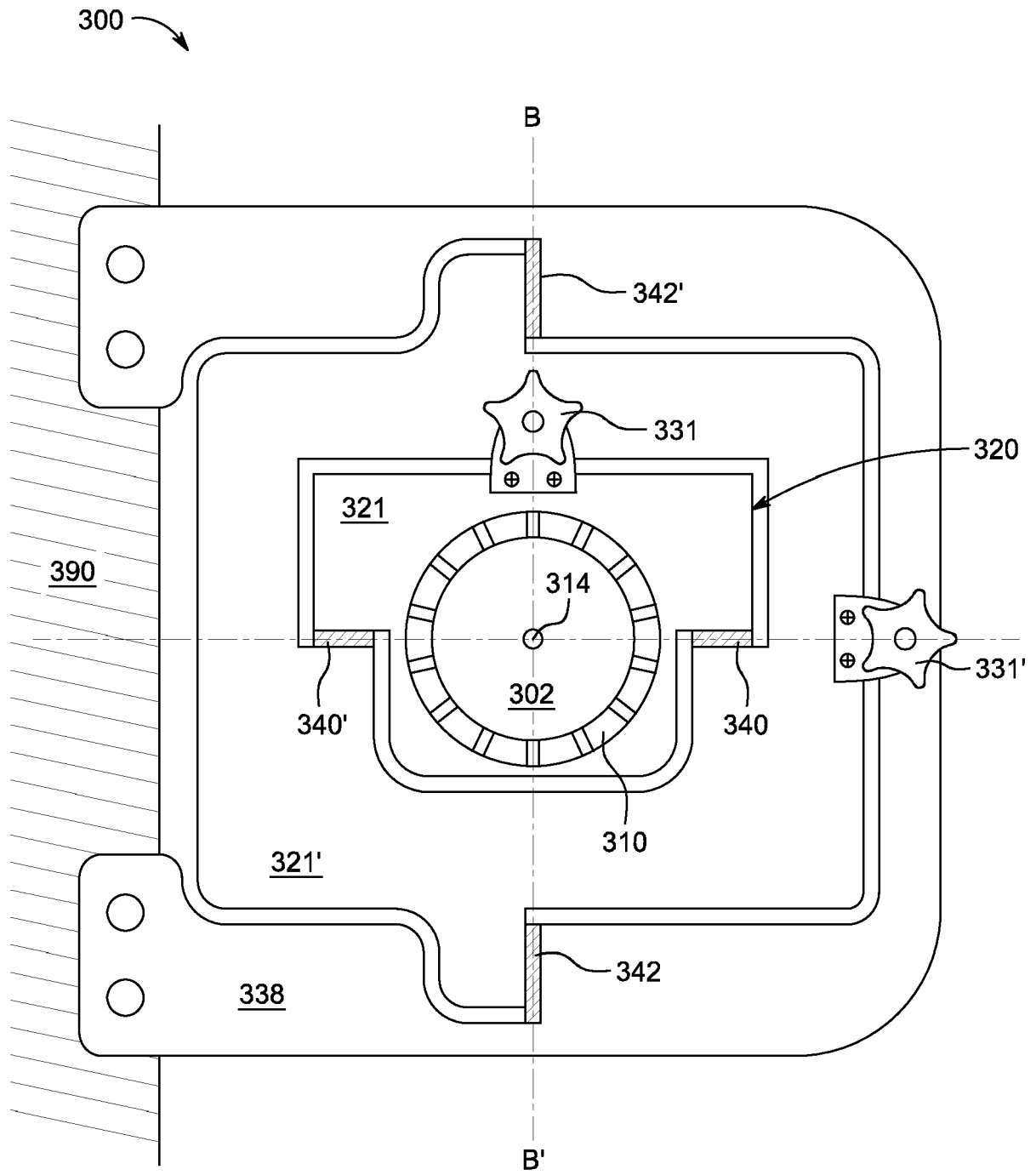


Figure 3a

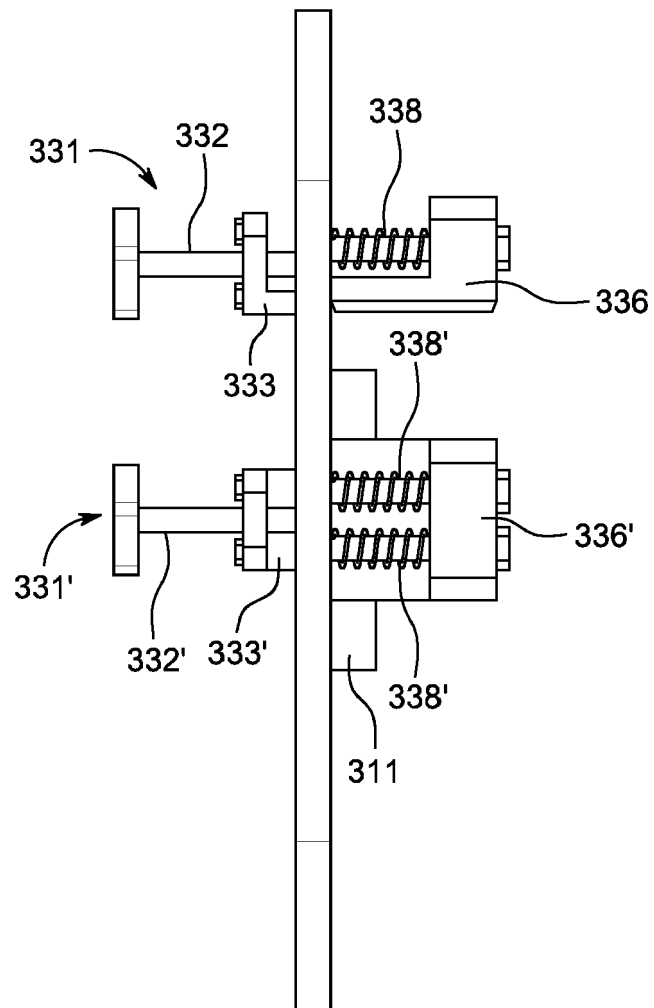


Figure 3b

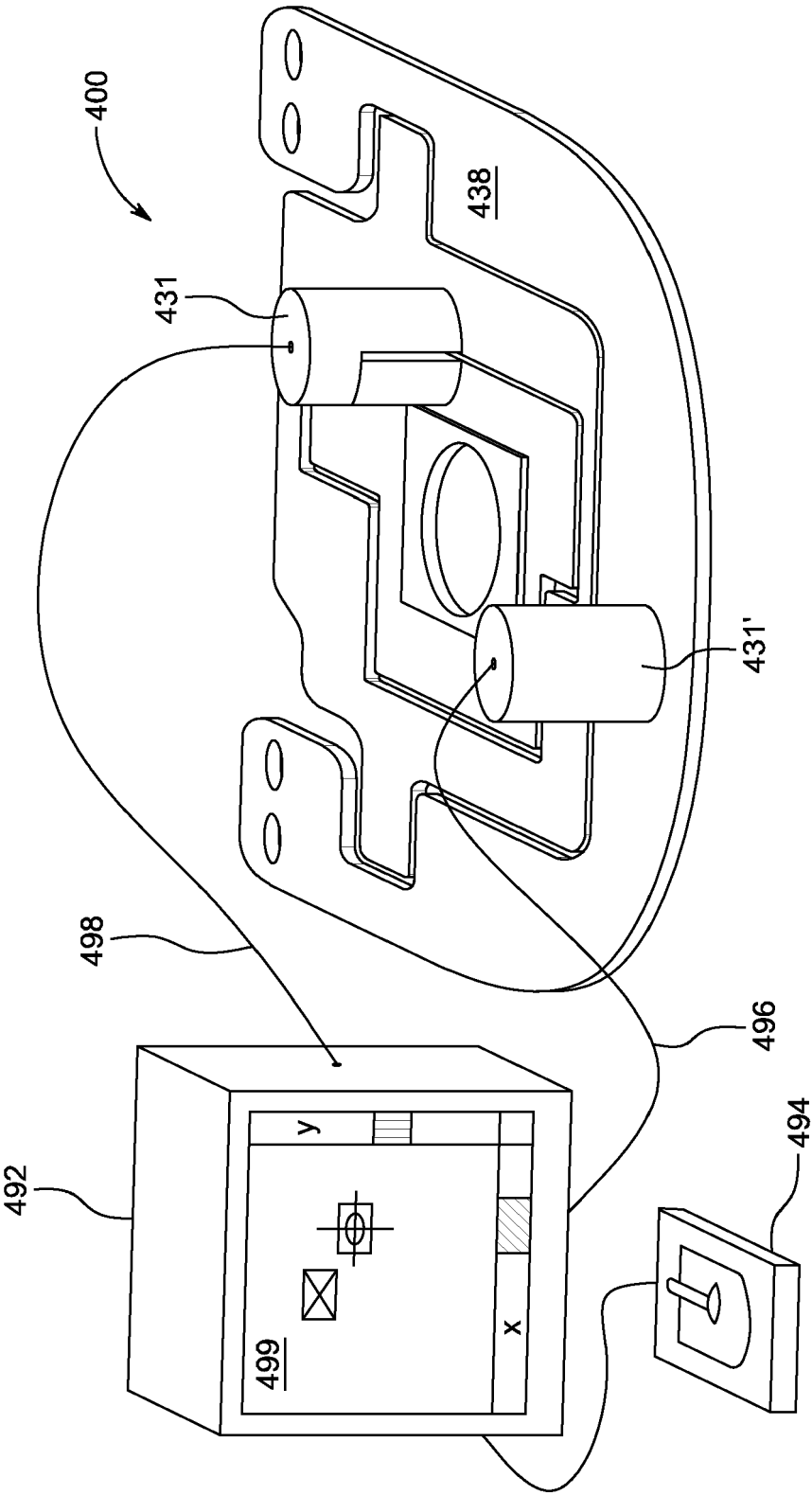


Figure 4



EUROPEAN SEARCH REPORT

Application Number

EP 23 16 9119

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 526 237 A (JOHNSON CHARLES D) 17 October 1950 (1950-10-17) * figures *	1-7, 10, 11	INV. B21C3/12
X	JP 4 436071 B2 (TANAKA ELECTRONICS IND CO LTD; SAIKAWA CO LTD) 24 March 2010 (2010-03-24) * figures *	1-8, 10, 11	
X	DE 12 28 581 B (FELTEN & GUILLEAUME CARLSWERK; STAHL AG) 17 November 1966 (1966-11-17) * figures *	1, 3-11	
X	JP S54 17839 U (-) 5 February 1979 (1979-02-05) * figures *	1, 3, 4, 7, 11	
X	GB 704 278 A (GEN ELECTRIC CO LTD; REGINALD EDWARD LEEDS) 17 February 1954 (1954-02-17) * figures *	1, 3, 4, 7, 11	TECHNICAL FIELDS SEARCHED (IPC)
X	US 3 402 587 A (LAWLER PHILIP E) 24 September 1968 (1968-09-24) * figures *	1, 3, 11, 12	B21C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 October 2023	Examiner Charvet, Pierre
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 16 9119

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-10-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2526237 A	17-10-1950	NONE	
JP 4436071 B2	24-03-2010	JP 4436071 B2	24-03-2010
		JP 2004344901 A	09-12-2004
DE 1228581 B	17-11-1966	NONE	
JP S5417839 U	05-02-1979	JP S5413386 Y2	07-06-1979
		JP S5417839 U	05-02-1979
GB 704278 A	17-02-1954	NONE	
US 3402587 A	24-09-1968	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 211990300 U [0004]
- WO 2019042937 A1 [0005]
- EP 3027337 B1 [0006]