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54 **A two-plate lapping machine with comparator for continuously measuring the workpiece thickness.**

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56 References cited:
DE-A- 3 213 252
US-A- 3 097 458
US-A- 3 304 662

PATENT ABSTRACTS OF JAPAN vol. 8, n 258
(M340)(1695), 27 th November 1984 & JP-A-59
129 664 (FUJIKOSHI KIKAI KOGYO)
26-07-1984

PATENT ABSTRACTS OF JAPAN vol. 1, n 99
(M-77), 31st August 1977, page 2770 & JP- A -
52 39889 (TOSEI ENGINEERING SERVICE)
28-03-1977

PATENT ABSTRACTS OF JAPAN, vol. 9, n 7
(M350)(1730), 12th January 1985 & JP - A - 59
156 665 (SUPIIDO FUA MU) 05-09-1984

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Description

Several lapping machines or superfinishing grinders have been on the market for a long time. Such machines are intended for lapping at the same time two faces of all workpieces they are able to machine, said workpiece being disposed between two lapping surfaces under the form of concentric plates laying at a distance over each other, the upper plate acting as pressure means, the lower plate as supporting means.

Both plates having lapping surfaces are rotated contrariwise to each other, thus being subjected to wear together with the workpieces.

In order to cause the path of the workpieces to continuously change by approaching and moving away from the axis of rotation of both plates, the workpieces to be lapped are put on a predetermined number of circular jigs so-called "satellites" which are arranged about the axis of the lower plate at a constant angular phase to one another.

Of course, in order to cause the path of the workpieces to continuously change with respect to the plates, thus avoiding each workpiece be at a constant distance from the centre of the lapping plate during the lapping operation, the jigs should be rotated about their axis.

This is achieved causing the jigs to be engaged by an inner crown gear rotating about the central axis of the lower plate as well as to roll on an outer stationary rack.

Each jig is then constrained to an epicyclical motion about the axis of the lapping machine.

The above described lapping machine is known for example from the document US-A-3304662, which forms the base for the pre-characterising part of the claims.

The main problem of these lapping machine is the setting of the thickness of the workpiece to be lapped, i.e. the vertical size thereof.

In fact, until now, it was needed to stop the operation of the lapping machine so as to be able to carry out a millesimal measurement of a workpiece by manual check after having drawn it from the jig.

Even if this operation is made easier nowadays by the use of millesimal measuring instruments, the problem of worn out lapping plates is still laying heavy on said machines, as the wear cannot be quantified in the order of thousandths and involves several restarts always and exclusively relying on the capability of the operator.

Some attempts have been made in order to avoid this drawbacks by providing a two face lapping machine with means to automatically carry out a continuous measurement of the workpieces.

In order to carry out such measurement it should be appreciated that the jigs consist each of

a circular plate and are arranged on the lapping surface of the lower lapping plate having the form of a circular crown, the central opening of which is defined by a rotating crown gear transmitting to the jigs the above mentioned epicyclical motion about the axis of the lapping machine.

From JP- A-59129664 it has been known a device to effect an automatic sizing wherein a non contact sensor, such as a hydraulic micrometer or the like for measuring the thickness of the piece to be lapped is arranged at a position where the piece in a carrier, rotating under revolving between a sun gear and an internal gear, are protruded out of upper and lower level blocks. Axially revolving with the sun gear, the device may measure sequentially the thickness of respective workpieces.

The main object of this invention is to avoid this drawbacks by providing during the lapping operation the continuous measurement of the vertical size of the workpieces arranged on the jigs rotating by an epicyclical motion between the lapping plates, compensating the wear of the lower lapping plate.

In one preferred embodiment, when the workpieces to be lapped are small and numerous, if the ratio between the number of revolutions of each jig about its axis and the number of revolutions of said jig about the axis of the machine is suitably chosen, it is known for certain that each measurement carried out on a first workpiece by the measuring device is carried out, after a revolution of the jig about the axis of the machine, on a second workpiece located in the same jig at a diametrically opposite position of said first workpiece.

Thus, when the thickness of a workpiece is measured it is known for certain that at the radially opposite position of said workpiece there is another workpiece which offers the same resistance to both lapping plates as the first workpiece being measured.

According to this invention, the measurement of the workpieces is carried out by a comparator having two arms facing each other, between which the edges of the jigs projecting from the lapping plate run after one another during the lapping operation, a workpiece to be lapped being at least partially arranged at said edges.

The upper arm is slidably mounted on a vertical guide and rests on the upper surface of the workpieces at the edges of the rotating jigs.

The lower arm is hinged at the opposite end of that brought into contact with the lower surface of said workpieces at the edges of the rotating jigs.

A self-setting system for the arms of said comparator means is provided according to another feature of the invention.

The arms of the sensing means should be set for following reasons.

As a consequence of the lapping operation both lapping plate are subjected to wear, thus changing their positions with respect to both arms of the sensing means, between which the work-piece to be measured is running.

Both arms are perpendicular to the running workpieces at the beginning of the lapping operation, i.e. the upper arm to the upper surface of the workpieces, the lower arm to the lower surface of the same.

When the lower lapping plate has being lowered, the upper arm fo the sensing means resting on the workpieces follows that lowering along the path of its vertical guide.

The lower arm, which is hinged at the opposite end far away from the end in contact with the workpieces, tilts about its hinge point.

At this moment the self-setting system is operated in order to cause said hinge point to be lowered, thus aligning the lower arm of the comparator under the vertical of the upper arm.

In a preferred embodiment of this invention an electronic system is used for aligning both arms to each other.

Said electronic system operates an electro-mechanical device the operation of which is as follows.

The inclination of the lower arm with respect to the upper arm, which is always perpendicular to the workpiece to be measured, is sensed so as to provide an electrical signal at the output of a circuit connected to the comparator. Such electrical signal is received by a suitable device generating a pressure in a fluid which acts on a piston and causes by a jack the rotation of a lead screw, which in turn causes the hinge point of the lower arm to be lowered, thus aligning both arms again in their positions perpendicular to the workpiece to be measured.

Therefore the vertical lowering of the upper arm of the comparator provides the continuous check of the lapping operation and causes the lapping machine to be stopped when the desired thickness is reached.

At the same time the self-setting system provides for the alignment of the two arms of the sensing means when a limit inclination of the lower arm is reached.

According to a further feature of this invention a simple system for manually charging the jigs in the machine is provided.

The US-A-3304662 described an apparatus for automatically loading and unloading the workpieces together their retaining members on a staging table adjacent the lapping disc.

According to the invention the jigs are arranged on a rotatable idling plate having the same form of the lapping plate.

Such idling plate is approached to a chute connected to the lower lapping plate at an opening in the circular guard wall of the lapping machine.

Thus each jig is caused by the operator to slide up on the chute and to reach the lower lapping plate.

Of course, in order to allow the jigs carrying the workpieces to be charged in the lapping machine the outer racks surrounding the lower lapping plate is lowered by the operator.

This invention will be described in further detail with reference to the accompanying drawing, in which:

Fig.1 is a side view of the lapping machine of the invention;

Fig.2 is a plan view of the machine of Fog. 1;

Fig.3 is a top plan view of a jig having six seats;

Fig.4 is a partial section of the lapping machine of the invention including the comparator and the system controlling said comparator for the vertical alignment of the measuring arms;

Fig. 5 is a perspective view of the lapping machine with the jig loading plate;

Fig. 6 shows a detail of the comparator with two measuring arms and a workpiece to be lapped therebetween;

Fig.7 is a vertical section of a detail of the system for the vertical alignment of the measuring arms; and

Fig.8 is a section along the line A-A of fig.7.

With reference to the figure, in Fig.5 the machine of this invention comprises a mount 2 from which an upper presser 4 descend downwards. In a underlaying position a round iron sheet bucket which surrounds a lower lapping plate 8 on which a certain number of piece-holders 10 or satellites are arranged at constant angle distances. Plate 8 has at its center a large circular cavity at the center of which a wheel is disposed which is provided at its periphery with a crown of vertical dragging studs or teeth 2 with which the peripheries 10a are engaged of the satellites disposed on the lower plate.

Satellites 10 are also surrounded by a crown of stationary studs 14 with which they engage always with the exterior periphery.

Such studs can be lowered below the plate plane for allowing the satellites to slip out.

Satellites 10 are pressed between the lower plate and the upper plate and are motor driven both about the axis of the machine and about their own center.

As indicated in Fig. 1 the lapping machine 17 is provided with a motor 18 which actuates the upper plate through belt 19 and by a motor 20 which actuates the lower lapping plate through belt 24. Motors 18 and 20, provided with gear reducers 26 and 28 drive each one of the two lapping plates and have therefore the same power.

Furthermore the upper lapping plate gives the pieces to be lapped, a downwards thrust which is generated in addition to the weight, by hydraulic pressure which thrust produces the rubbing that is the lapping of the pieces contained over the satellite.

Another motor which cannot be seen in the figure 1 rotates central crown gear 12 for actuating the satellites through belt 29.

In Fig. 5 the manoeuvre is illustrated for charging the satellite on the lower plate.

In correspondence of the opening which is provided along the circular guard wall which surrounds the lower plate a table 30 is approached which supports the satellites which table is rotatable about its own axis.

Suitable handles facilitate the operator's task for rotating the table in the suitable direction. Supposing that the lapping machine comprises six satellites as illustrated in Fig. 5 the support table will have the capacity of seven satellites.

In correspondence to the charging and discharging opening 32 a plane 34 provided with a side slide 35 is inserted between the same support table and the lapping machine.

At the end of each cycle, while the upper plate 21 is kept lifted, the outer crown gear is lowered and one of the satellites with the lapped pieces thereon will be made to slide until the slide 35 and subsequently the support table is rotated through a seventh of a turn whereby a satellite with the pieces to be lapped is offered to the opening of the machine on the plane 34 in lieu of the satellite precedingly withdrawn.

With consecutive operations all the lapped pieces will be extracted and only six satellites will be present on the support table with the finished pieces and only one place will be left void.

For measuring the thickness attained by each piece which takes part on the lot being machined, a device (Fig. 4) is provided which is called comparator 50 adapted for measuring the distance between a point (point A) of the tangential horizontal upper plane of the piece and the point (point B) which lies (at the beginning) on the same vertical but belongs to the tangential lower surface of the same piece.

Such device operates automatically only at the final stay of the working cycle.

The comparator 50 device (Fig. 2 and 6) is provided with an upper point 36 and a lower point 38, both being diamond points which hold therebetween, as shears, a limb circularly projecting from each of the rotating satellites in which limb at least one of the pieces to be lapped is partially included. The comparator can for instance be located at the place of one of the studs or teeth 14 with which the outer periphery of each satellite is

engaged.

It is to be kept in mind that while the upper point 36 (Fig. 4) can be displaced only vertically, the lower point, because it is hinged at a distance from its point of contact with the lower surface of the piece it can rotate about said point thus forming an angle with respect to the straight line which passes through the upper point when the contact point gets lower.

The comparator device verifies the lowering of the piece and then of its vertical dimension and consequently it interrupts the working cycle and at the same time it sums successive rotations, that is angular lowerings and activates the recovering of the plate wear device.

Such device, which allows the re-alignment of the two comparator points is illustrated in Fig. 4, 6, 7.

It comprises substantially a transducer 52 which transforms an electrical signal at the output of the comparator 50 into a control for the piston 46 which, through a jack 48 produces the rotation of a screw 45 which lowers the support assembly 47, 49 of comparator 50.

It has been described as an example a preferred embodiment of the invention. However it is obvious that a number of variants can be introduced by those skilled in the art without sorting from the scope of the present invention as defined by the following claims.

Claims

1. A lapping machine comprising a lower lapping plate (8) and an upper pressing plate (21) both superimposed concentric and rotated each by a motor so as to rotate contrariwise to one another where the pieces to be lapped are subdivided in equal groups, each group being distributed within the limits of a satellite (10) which is fed into the lower plate, said satellites (10) being distributed over the lower plate (8) so as to cover at least a space equal to the surface included between the maximum circle and the minimum circle of the same lapping plate, each satellite (10) being provided with a peripheral circular crown (10a) engaged with a crown of studs or teeth (14) stationary with respect to said satellites and with a crown of studs (12) located at the inside of said satellites crown and driven by a third motor means, the pieces to be lapped being charging and discharging along a handling plane (30) of the piece-supporting satellites (10), characterized by the fact of further including at least a comparator means (50) adapted for measuring the vertical dimension of a piece to be lapped by means of two opposed points

(36,38) between which a circular limb projecting from each satellite (10) is passing in succession during the lapping operation, at least a piece to be lapped being contained in said limb;

a device (52, 46, 48, 45, 47, 49) adapted for restoring the alignment of said two points of the comparator (50) for compensating the wear of the lower lapping plate.

2. A lapping machine as claimed in claim 1 wherein said comparator means (50) is a gauge provided with two points an upper one (36) and a lower one (38) with respect to the pieces to be lapped for measuring the vertical dimension of a piece being lapped, the upper point (36) being bound to follow a rectilinear path and the lower point (38) being hinged upon a spot which is exterior with respect to the lapping plates and at a distance with respect to the latter and subjected to rotate in a vertical plane about such spot or vice-versa.
3. A lapping machine as claimed in claim 1 wherein said toothed circular satellites (10) are all included in a single turn around the axis of the machine.
4. A lapping machine as claimed in claim 1 and 3 wherein the ratio among the teeth of the inner crown (12), the teeth of the outer crown (14) of the lower lapping plate and the teeth of the satellites (10) is chosen in such a way that the measurement by the comparator (50) on a piece is repeated after a turn of a satellite (10) around the axis of the machine on a piece which was located on the same satellite in a diametrically opposed position with respect to that position where the measurement is actuated.
5. A lapping machine as claimed in the preceding claims characterized by the fact that the device for restoring the alignment between the comparator points (36,38) comprises a transducer (52) whereby the outcoming electric vertical disalignment signal of the comparator points (36,38) issuing from the latter is transformed into the pressure of a liquid which acts on a piston (46) through a pawl (48) which rotates a screw (45) for lowering the support assembly (47,49) of the comparator (50), so that the points are restored to their vertical position that is aligned and perpendicular to the piece.
6. A lapping machine as claimed in the preceding claims wherein the handling plane (30) of the

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piece-supporting satellites is a circular plane manually rotatable where as many places are provided as are the satellites (10) to be loaded on the lapping machine plus one whereby, wherever a circular satellite (10) with lapped piece is to be withdrawn from the lower lapping plate (8) the device is approached to the lapping machine in front of an opening (32) provided at the circular vertical wall (6) by which the machine lapping plates are guarded and a satellite (10) with lapped pieces is made to slide towards said one empty place of the handling plane (30), this being then rotated in order that a novel satellite with pieces to be lapped be made to slide into the place left free on the lower lapping plate by the withdrawn satellite.

7. A lapping machine as claimed in claim 2 wherein said satellites (10) project all around said lapping plate (21,8) in a measure which is sufficient for obtaining that said pieces being lapped can become inserted in succession, when the machine is rotating, between said two comparator points (36,38) least for a portion of said piece.
8. A lapping machine as claimed in claim 6 which machine includes also a supporting plane (34) having a lateral flat slide (35) interposed between the lower lapping plate (8) and the satellite loading plane (30), at the opening (32) of a circular wall (6) arranged as a protection of the lapping machine.

Patentansprüche

1. Läpp-Maschine mit einer unteren Läppplatte (8) und einer oberen Anpressplatte (21), die konzentrisch übereinander angeordnet und jeweils durch ein Antriebsorgan bzw. einen Motor so antreibbar sind, daß sie in Bezug zueinander entgegengesetzt rotieren, bei der die zu läppenden Artikel in gleiche Gruppen aufgeteilt sind, von denen jede innerhalb der Grenzen einer in die untere Platte fuhbare Trabantenplatte bzw. eines Satelliten (10) verteilt und die Satelliten (10) so über der unteren Platte (8) verteilt sind, daß mindestens ein Raum bedeckt ist, der der Oberfläche zwischen dem maximalen und minimalen Kreis der gleichen Läppplatte entspricht, und bei der jeder Satellit (10) mit einer peripheren, kreisförmigen Erhöhung (10a) bzw. Kranz von Erhöhungen und Vertiefungen versehen ist, die bzw. der an einer Erhöhung bzw. einem ebensolchen Kranz von Stutzen oder Zähnen (14) in Bezug zu den Satelliten stationär angreift und an einer Erhö-

- hung bzw. einem Kranz von Stutzen (12) angreift, welche sich an der Innenseite der Satellitenerhöhung bzw. -Kranzes befindet und durch ein drittes Antriebsorgan antreibbar ist, und bei der die zu läppenden Artikel längs einer Bedienungsebene (30) des Artikelabstütz-Satelliten (10) zu- und abführbar sind, **gekennzeichnet durch** mindestens einen Komparator (50) zum Abfühlen bzw. Messen der Vertikaldimension (Dicke) eines zu läppenden Artikels mit Hilfe zweier entgegengesetzter Punkte (36, 38), zwischen denen beim Läppen ein kreisförmiges, von jedem Satelliten (10) abstehendes Organ während des Läppens in Aufeinanderfolge bzw. Sukzession vorbeitrifft, wobei mindestens ein zu läppender Artikel in dem Organ aufgenommen ist, und eine Ausrichteinrichtung (52, 46, 48, 45, 47, 49) die Ausrichtung der zwei Punkte des Komparators (50) zur Kompensation der Abnutzung der unteren Läppplatte wiederherstellt.
2. Läpp-Maschine nach Anspruch 1, bei der der Komparator (50) ein Kaliber ist, der mit zwei Punkten, in Bezug zu dem zu läppenden Artikel einem oberen Punkt (36) und einem unteren Punkt (38), versehen ist zum Abfühlen bzw. Messen der Vertikaldimension eines zu läppenden Artikels, bei der der obere Punkt (36) so abgegrenzt ist, daß er einem gradlinigen Weg folgt, und bei der der untere Punkt (38) an einer Stelle angelenkt ist, die sich in Bezug zu den Läppplatten außerhalb im Abstand von diesen befindet und in einer Vertikalebene um eine solche Stelle, oder umgekehrt, drehbar ist.
3. Läpp-Maschine nach Anspruch 1, bei der sämtlich gezahnten, kreisförmigen Satelliten (10) in einer Schleife bzw. einem Kreis rings um die Maschinenachse angeordnet sind.
4. Läpp-Maschine nach Anspruch 1 und 3, bei der das Verhältnis zwischen den Zähnen des inneren Kranzes (12), den Zähnen des äußeren Kranzes (14) der unteren Läppplatte und den Zähnen der Satelliten (10) derart gewählt ist, daß das Abfühlen bzw. Messen durch den Komparator (50) an einem Artikel nach einer Umdrehung eines Satelliten (10) um die Maschinenachse an einem Artikel wiederholbar ist, der sich auf dem gleichen Satelliten in einer diametral entgegengesetzten Position (in Bezug zu der Position, bei der das Abfühlen bzw. das Messen stattfindet) befindet.
5. Läpp-Maschine nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**,
- daß die Ausrichteinrichtung zwischen den Komparatorpunkten (36, 38) einen Transducer (52) bzw. Wandler aufweist und das elektrische Ausgangssignal für die vertikale Abweichung der Komparatorpunkte (36, 38), welche von dort abgegeben wird, in den Druck einer Flüssigkeit transformiert wird, welche auf einen Kolben (46) durch einen Sperrhebel (48) einwirkt, der eine Schraube (45) zum Absenken der Stützeinrichtung (47, 49) des Komparators (50) derart rotierend antreibt, daß die Punkte in ihre Vertikalposition, d.h. in Ausrichtung und rechtwinklig zu dem Artikel, zurückgestellt werden.
6. Läpp-Maschine nach einem der vorhergehenden Ansprüche, bei der die Bedienungsebene (30) der Artikelabstützsatelliten eine kreisförmige Ebene ist, welche manuell gedreht werden kann, so daß so viele Stellen wie auf der Läpp-Maschine zu beladende Satelliten (10) zuzüglich einer weiteren Stelle derart vorgesehen sind, daß immer dann, wenn ein kreisförmiger Satellit (10) mit einem geläppten Artikel von der unteren Läppplatte (8) der Einrichtung abgenommen ist, die Einrichtung an die Läpp-Maschine vor einer Öffnung (32) heranführbar ist, welche sich an der kreisförmigen Vertikalwand (6) befindet, wodurch die Maschinenläppplatten geschützt werden und ein Satellit (10) mit den geläppten Artikeln dazu gebracht wird, in Richtung zu einer leeren Stelle der Behandlungsebene (30) zu rutschen, die daraufhin rotierend antreibbar ist, damit ein neuer Satellit mit zu läppenden Artikeln veranlaßt wird, an die vom zurückgezogenen Satelliten freigewordene Stelle auf der unteren Läppplatte zu rutschen.
7. Läpp-Maschine nach Anspruch 2, bei der alle Satelliten (10) rings über die Läppplatte (21, 8) in einem solchen Maß vorstehen, das ausreicht, daß die zu läppenden Artikel beim Rotieren der Maschine aufeinanderfolgend zwischen zwei Komparatorpunkten (36, 38), mindestens für einen Teil des Artikels, einsetzbar sind.
8. Läpp-Maschine nach Anspruch 6, die auch eine Stützplatte (34) mit einer seitlichen, flachen Gleitbahn (35) aufweist, welche zwischen die untere Läppplatte (8) und die Satellitenbedienungsebene (30) an der Öffnung (32) der als Maschinenschutz angeordneten kreisförmigen Wand (6) eingesetzt ist.

Revendications

1. Machine de rodage comprenant un plateau inférieur (8) et un plateau supérieur de pression (21) superposés de manière concentrique l'un par rapport à l'autre et entraînés chacun en rotation au moyen de moteurs de manière qu'ils tournent en sens contraire, les pièces à roder étant subdivisées en groupes égaux, chacun d'eux étant disposés entre les limites d'un satellite (10) qui est logé sur le plateau inférieur, lesdits satellites (10) étant répartis sur le plateau inférieur de manière à recouvrir au moins un espace égal à la surface limitée par la circonférence maximale et la circonférence minimale de ce plateau, chaque satellite (10) étant pourvu d'une couronne circulaire périphérique 10a en prise avec une couronne de goujons ou dents (14) fixe par rapport auxdits satellites, tandis qu'une couronne de goujon (12) située à l'intérieur de ladite couronne de satellites est entraînée par un troisième moteur, les pièces à roder étant alimentées et expulsées le long d'un plan de manutention (30) de l'organe supportant les satellites (10), caractérisée en ce qu'elle comporte en outre :
- au moins des moyens comparateurs (50) propre à mesurer la dimension verticale d'une pièce à roder au moyen de deux touches opposées (36-38) entre lesquelles passent successivement des bras circulaires s'étendant à partir de chaque satellite (10) pendant l'opération de rodage, ce bras contenant une pièce à roder ;
 - un dispositif (52, 46, 48, 45, 47, 49) propre à rétablir l'alignement des deux touches du comparateur (50) en vue de compenser l'usure du plateau inférieur.
2. Machine suivant la revendication 1, caractérisée en ce que le comparateur (50) est une jauge pourvue de deux touches l'une supérieure (36) et l'autre inférieure (38) par rapport aux pièces à roder et destinée à mesurer la cote verticale d'une pièce à roder, la touche supérieure (36) étant arrondie pour suivre un trajet rectiligne, tandis que la touche inférieure (38) est articulée autour d'un point qui est extérieur aux plateaux de rodage à une certaine distance par rapport à ces derniers, cette touche pouvant tourner dans un plan vertical autour dudit point ou vice et versa.
3. Machine de rodage suivant la revendication 1, caractérisée en ce que les satellites circulaires dentés (10) sont tous compris dans une simple rangée circulaire autour de l'axe géométrique de la machine.
4. Machine de rodage suivant l'une quelconque des revendications 1 et 3, caractérisée en ce que le rapport suivant lequel les dents de la couronne intérieure (12), les dents de la couronne extérieure (14) du plateau inférieur et les dents des satellites (10) est choisi de telle manière que la mesure par le comparateur (50) sur une pièce est répétée après un tour d'un satellite (10) autour de l'axe géométrique de la machine sur une pièce qui est située sur le même satellite mais dans une position diamétralement opposée par rapport à la position dans laquelle la mesure est effectuée.
5. Machine de rodage suivant l'une quelconque des revendications précédentes, caractérisée en ce que le dispositif pour rétablir l'alignement entre les touches (36, 38) du comparateur comprennent un transducteur (52) afin que le signal de décalage vertical de sortie des touches (36, 38) du comparateur, issu de ces dernières soit transformé en une pression de liquide qui agit sur un piston (46) par l'intermédiaire d'un cliquet (48) entraînant la rotation d'une vis (45) propre à abaisser l'ensemble support (47-49) du comparateur (50) de manière que les touches soient ramenées à leur position verticale qui est alignée et perpendiculaire à la pièce.
6. Machine de rodage suivant l'une quelconque des revendications précédentes, caractérisée en ce que le plan de manutention (30) de la pièce supportant les satellites est un plateau circulaire tournant manuellement et qui est pourvu d'autant d'emplacements qu'il y a de satellites (10) à charger sur la machine de rodage plus un de manière que quel que soit le satellite circulaire (10) avec sa pièce rodée qui doit être extrait du plateau inférieur (8), le dispositif est approché de la machine de rodage en face d'une ouverture (32) ménagée dans une cloison verticale circulaire (6) qui protège les plateaux de la machine, tandis qu'on fait glisser un satellite (10) avec les pièces rodées en direction de l'emplacement disponible du plan de manutention (30) qu'on fait ensuite tourner afin qu'un nouveau satellite avec les pièces à roder soit introduit dans l'emplacement laissé libre dans le plateau inférieur par le satellite retiré.
7. Machine de rodage suivant la revendication 2, caractérisée en ce que le satellite (10) se projette tout autour des plateaux (21, 8) dans une mesure suffisante pour obtenir que les pièces à roder puissent être introduites les unes après les autres lorsque la machine tourne, entre les deux touches (36, 38) du compa-

rateur pour au moins une partie desdites pièces.

8. Machine de rodage suivant la revendication 6, caractérisé en ce qu'elle comporte aussi une plaque support (34) comportant une glissière plate latérale (35) disposée entre le plateau inférieur (8) et le plan de manutention (30) des satellites au niveau de l'ouverture (32) de la cloison circulaire (6) protégeant la machine de rodage.

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FIG. 2

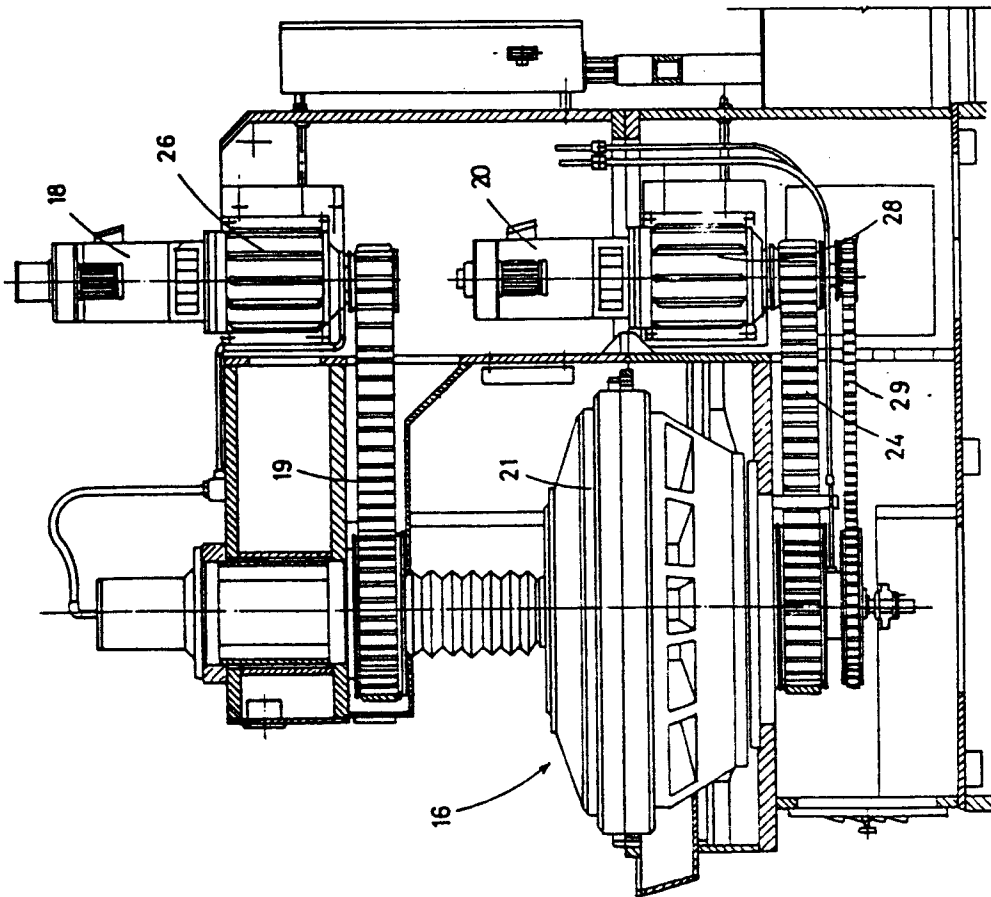
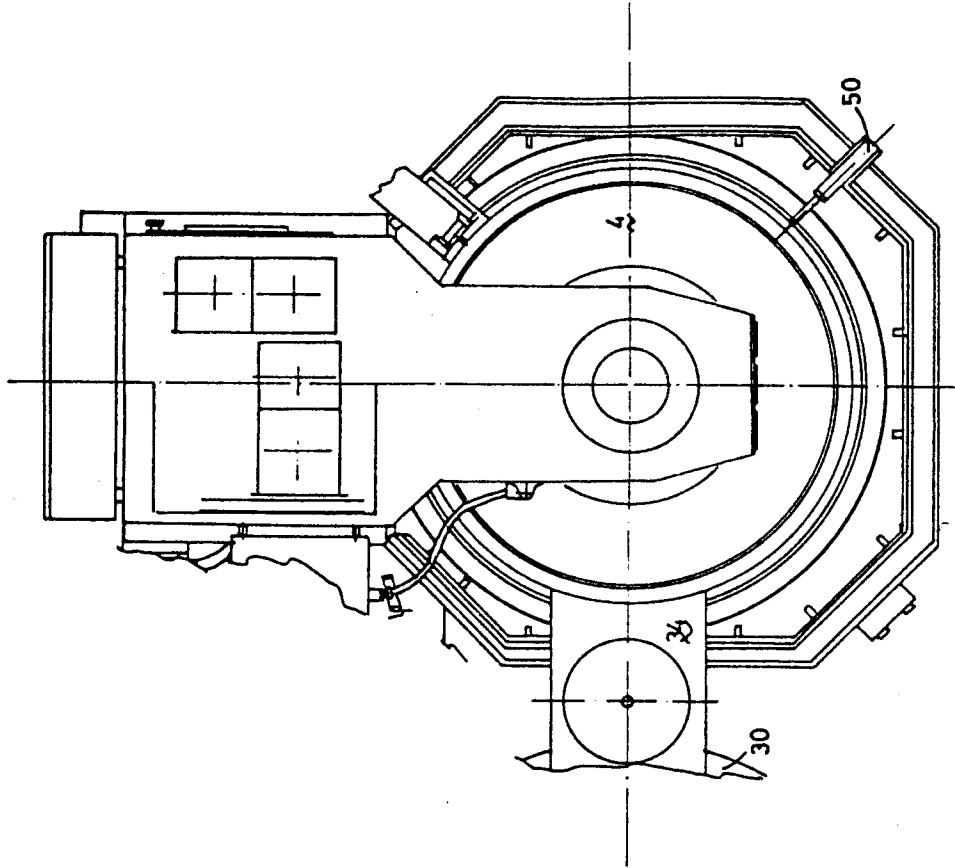


FIG. 1

FIG. 6

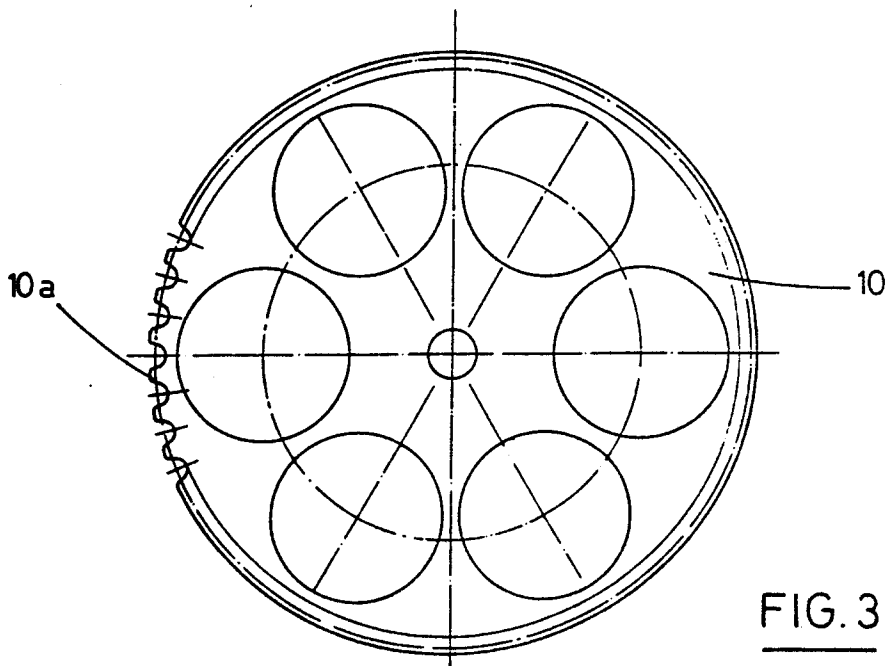
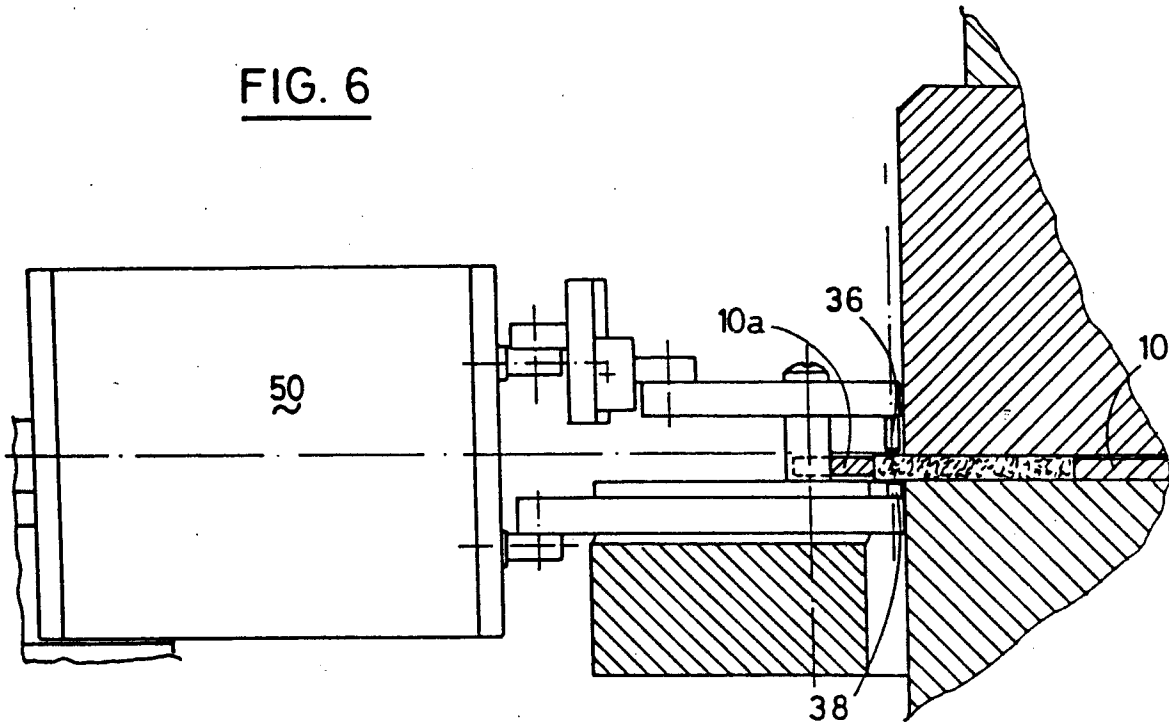


FIG. 3

FIG. 4

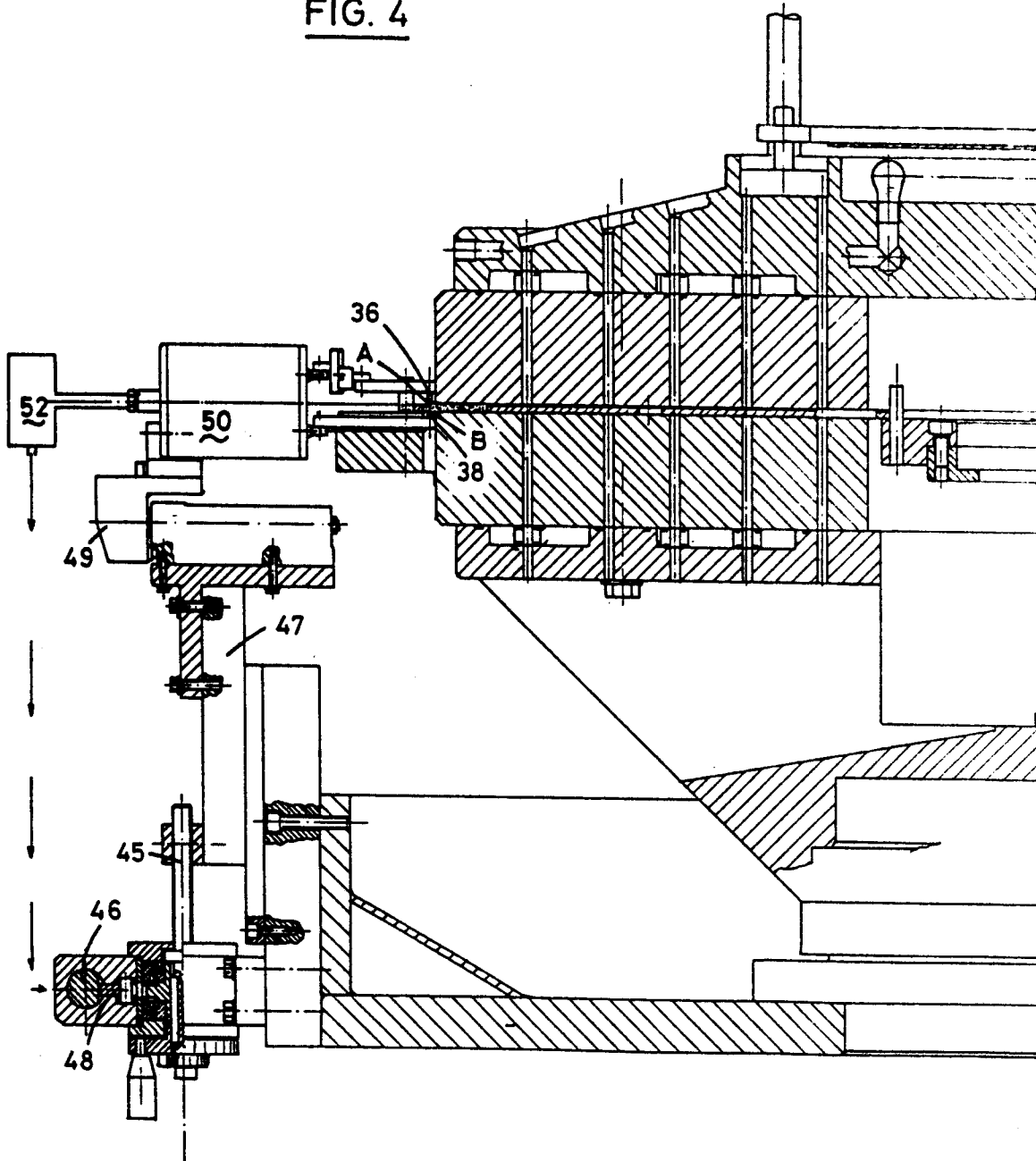


FIG. 5

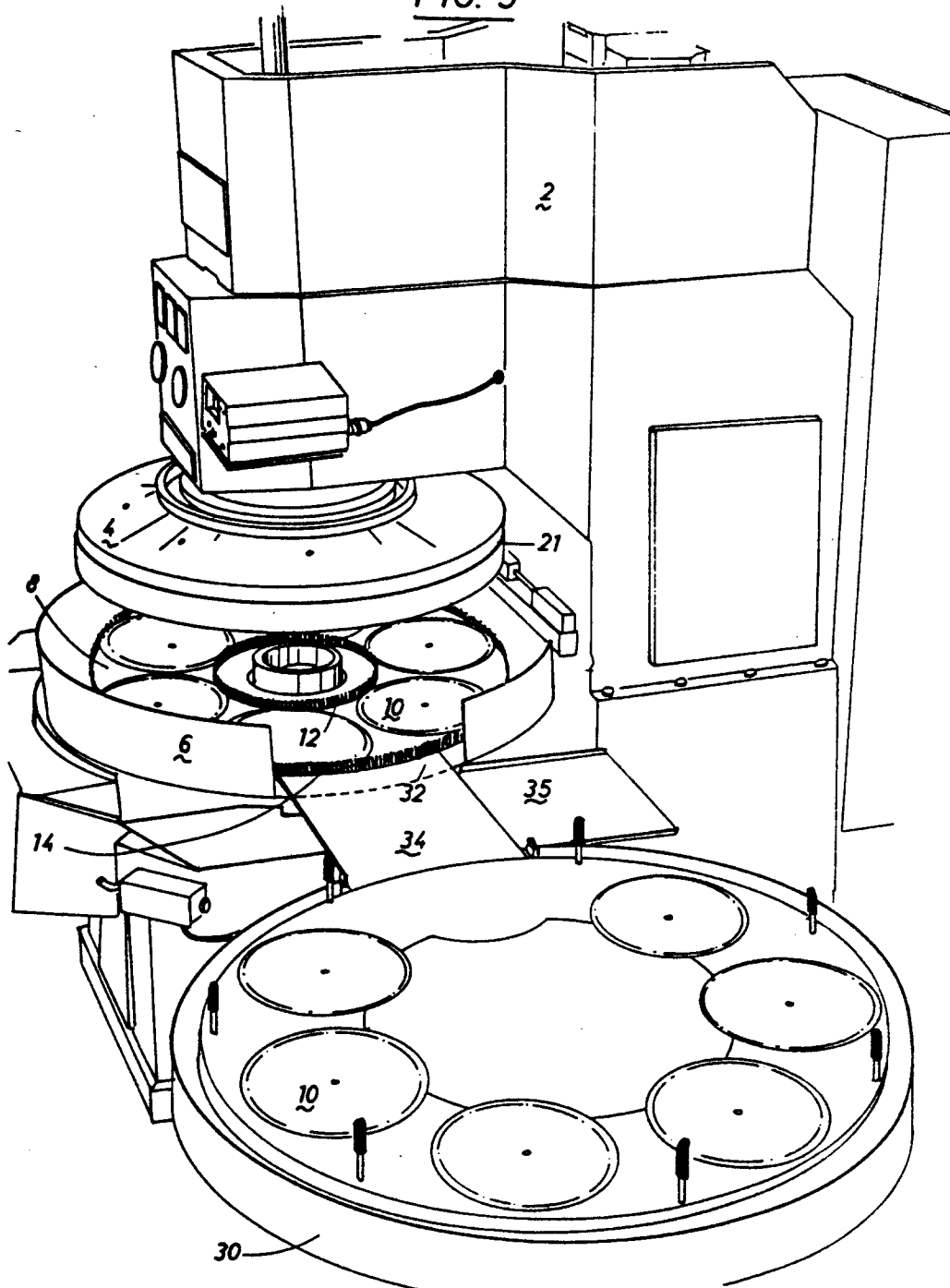


FIG. 7

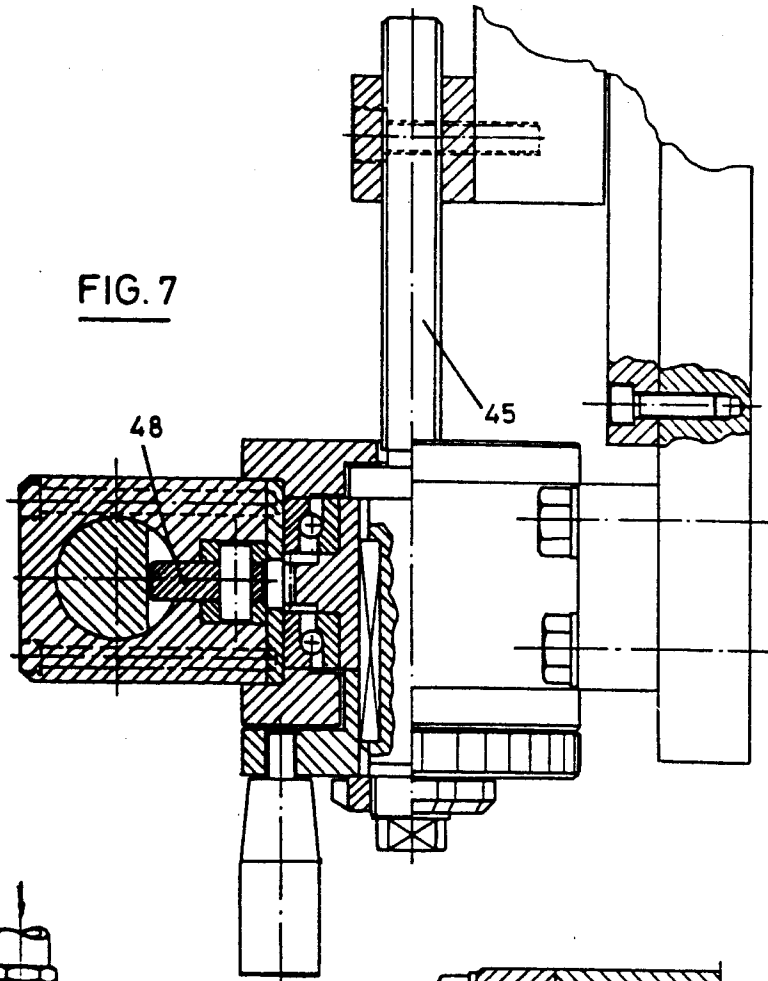


FIG. 8

