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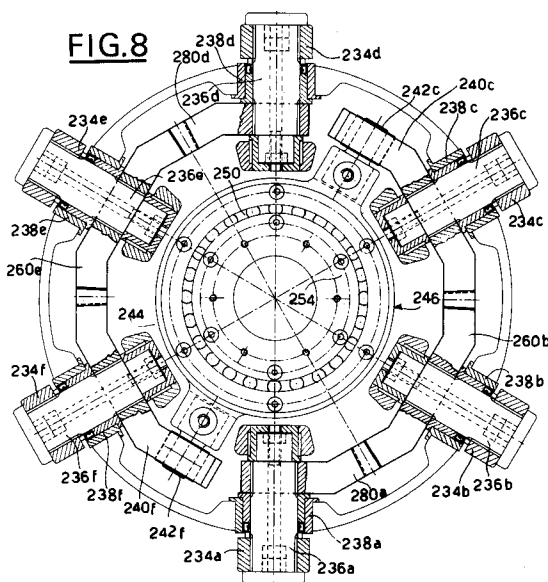
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54 **Improvements to a lapping and polishing head for granites and similar stones.**

57 In a rotary lapping and polishing head (110, 210), of the type comprising grinding segments (32) operating tangentially and oscillating about axes arranged radially with respect to the axis of rotation of the said head (110, 210), the head being used for the processing of slabs or panels consisting of hard stone, such as granites and similar ceramic materials, use is made of means capable of compensating the variation in the mutual position of the grinding segments (32) so as to reduce imbalances associated with centrifugal forces applied to the said grinding segments (32) as a result of the variation in their mutual position. For a first partial compensation, use is made of an equal number of grinding segments (32) moved in pairs in mutually opposite directions, while for a second substantially total compensation use is made of grinding elements (32) moved in threes also in mutually opposite directions.



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The present invention relates to improvements to a lapping and polishing head for slabs and panels of granite and similar ceramic materials of the type described in Italian Patent No. 1,175,191 filed on 14 March 1983 (with Application No. 85541 A/83) in the name of Marcello TONCELLI.

The lapping head described in the aforementioned patent is of the type comprising a certain number of oscillating grinding segments (six in the preferred example of embodiment) rotating together with the head about a central shaft of the latter and made to oscillate by a mechanism formed by an inclined disc rotating at a speed varying by a few per cent with respect to that of the said head and connected to crank mechanisms ensuring oscillation of the said segments of the head. The operating principle of said head is illustrated, for the sake of clarity, in Figures 1 to 3 of the drawings accompanying the present patent application.

The idea of having grinding segments oscillating about axes arranged radially on a lapping and polishing head dates back several years, as can be seen from the vast literature on the subject, starting from US Patent No. 2,105,634 granted on 18 January 1938, continuing with German Patent No. 800,112 filed on 15 July 1949, German Patent No. 2,105,385 filed on 1 April 1970 and the published application of German Patent No. 2,607,804 filed on 26 February 1973, up to at least the aforementioned Italian Patent in the name of Marcello Toncelli. In particular, in the aforementioned German patents and applications the said grinding segments are made to oscillate by a cam mounted coaxially with respect to the lapping head and moved at a speed varying by a few per cent with respect to that of the said head.

The grinding segments which are made to oscillate, both by a cam according to the aforementioned German patents and patent applications, and by the inclined rotating disc mechanism illustrated in the aforementioned Italian patent of Marcello Toncelli, perform a complete angular oscillation, over an amplitude of the order of a few tens of degrees for about every ten revolutions of the said head.

It can be understood that, since the grinding segments move forwards and backwards with respect to a central oscillation axis of theirs, at certain moments the oscillating velocity is added to the rotational velocity of the grinding elements, while at certain other moments the same oscillating velocity is subtracted from the rotational velocity; furthermore, since the oscillating movement is derived from different positions on the circumference of the inclined disc, the oscillating movements of the said grinding segments are mutually phase-displaced by angles corresponding to a trigonometric function (sine or cosine) of the respective an-

5 gular positions on the circumference. This means, taking for example the type of lapping head with six oscillating radial grinding elements of the aforementioned Italian patent, that the angular velocity vector not only varies in terms of modulus from grinding element to grinding element by a percentage amount, due to the oscillating velocity, which in specific cases can be equal to about 10%, but also varies with time between a maximum value and a minimum value corresponding to the angular velocity of the casing of the head to which is added or subtracted 10% of the said angular velocity. Since the centrifugal forces on the periphery of the lapping head are directly proportional both to the radius of rotation and the square of the angular velocity, the result is that the effect of variations in the angular velocity equivalent to about 10% are translated into variations of centrifugal forces on the radial grinding elements equivalent to about 20% with moreover an advance or delay of these variations with respect to rotation of the casing of the head, which results in flexural stressing of the shaft of the latter which rotates with an advance or delay with respect to the casing of the said head and hence with a rotational imbalance which is practically impossible to compensate through the application of balancing masses, disastrous for the wear of the said head, unless extraordinary measures are adopted for damping said vibrations which would greatly affect the robustness and structural complexity and cost of a lapping head without adding substantial operational advantages. Moreover, it is not possible to dispense with oscillation along radial axes of the oscillating grinding segments so as to ensure as uniform as possible wear of the latter and contact with the stone material extending along a radial line of the said grinding elements.

40 It is known moreover that Italian Patent Application No. PD 91A000078, filed on 23 April 1991, describes and illustrates in particular in Figure 1 thereof a lapping head provided with a mechanism comprising a cam of the type described in the aforementioned German applications and patents, on which there rests in a rolling manner at least one roller which, by means of a crank mechanism, transmits its movement in an axial direction with respect to the head to at least one shaft, arranged radially, about which one of the grinding segments oscillate, and a plurality of pairs of toothed members, meshing with each other, which reverse the direction of oscillation to adjacent shafts so that adjacent grinding elements oscillate in mutually opposite directions.

55 By way of an alternative, it is possible to envisage using several rollers rolling on the cam, each connected by means of a crank mechanism to a respective radial shaft.

The pairs of toothed members connect together all the adjacent radial shafts and form an internally closed system for transmission of the oscillating movement of the said shafts because, if the radial shafts mounted on the same head are counted and provided that the number of said shafts is even, the first and last shaft are connected directly by a pair of toothed members, as well as indirectly by all the pairs of toothed members located in between.

This system consisting of a closed series of toothed members is able to function correctly in only two cases, namely if a single rolling roller is used against the cam so that all the radial shafts are driven by the single radial shaft connected by a crank mechanism to the said connecting roller, or else, if there is more than one roller (for example four), the crank mechanisms must take account of the phase differences which exist between the different rollers. In the first case there is the drawback that, by actuating all the radial shafts via a single roller and a single crank mechanism, the mechanical stresses on them may be so severe as to give rise to the risk of breakage of the roller, its supports or the crank mechanism, or there is the risk of premature wear of the cam caused by the excessive stresses on the said roller. In the second case, either use is made of a cam which is machined to within very small tolerances and hence very costly, or allowances must be made for play between the cam and rollers so as to compensate for the machining tolerances of the cam, but in this case to the detriment of the symmetry of speed of the individual radial grinding segments with consequent variations in the overall speed of the individual grinding elements and unbalancing of the said head. It should be remembered also that a cam and roller system is always limited, as regards the maximum permitted speed, by problems of cooling of the rollers which work against the cam and, as in the present case, when several grinding segments are moved by a smaller number of rollers and crank mechanisms and by a single closed system of toothed members, the energy losses may be so great that they give rise to not insignificant problems as regards cooling inside the said lapping head.

It can be understood therefore that the grinding segment oscillating shaft system described in the aforementioned Italian patent application is not so attractive after all.

Consequently, a main aim of the present invention is to provide a roughing, lapping and polishing head for stone material such as granites or the like and ceramic materials, in which the aforementioned problems of an imbalance are reduced as far as possible or even eliminated entirely.

Another aim of the present invention is to provide a roughing, lapping and polishing head, as defined above, which reduces or eliminates imbalances using means which are as simple, cheap and efficient as possible.

The above and other aims are achieved by a head of the type provided with an inclined rotating disc for oscillation of the grinding segments, in which the number of spindles which receive the movement of oscillating grinding segments from the said inclined mobile disc is reduced, by replacing a certain number of spindles with a corresponding number of pairs of toothed members having the function of reversing the oscillating movement of adjacent oscillating grinding segments, whereby the series of toothed members must not form an internally closed system.

In particular, the number of spindles is halved and the number of pairs of toothed members becomes equal to the number of remaining spindles.

By way of an alternative, in order to achieve a perfect balance, the number of spindles is reduced to a third and the number of pairs of toothed members becomes equal to twice the number of spindles.

By way of a further alternative, the number of spindles is reduced to two and the number of pairs of toothed members becomes equal to the difference between the number N of grinding segments used and the number of spindles, equivalent to 2, i.e. $N-2$, whereby N must be an even number divisible by two but not by four.

In particular, with two spindles it is possible to use six grinding segments and four pairs of toothed members, i.e. two pairs of toothed members per spindle.

By way of an alternative, with two spindles it is possible to use ten grinding segments with eight pairs of toothed members, hence four pairs of gears for each spindle.

By way of a further alternative, with two spindles it is possible to use fourteen grinding segments with twelve pairs of toothed members, hence six pairs for each spindle.

The characteristic features of the present invention are described in detail in the claims which form the concluding part of the present application. However, other characteristic features and advantages will emerge from the following detailed description of examples of embodiment of the invention, to be considered solely as non-limiting examples, in which:

Figure 1 is a sectioned side view of a type of roughing and lapping head of the prior art to which the improvements according to the present invention can be applied;

Figure 2 is a partial sectioned plan view of the same head according to the prior art;

Figure 3 is a basic diagram of the same head according to the prior art illustrating the presence of six spindles for causing oscillation of six corresponding oscillating grinding segments;

Figure 4 is a basic diagram of the head according to the prior art illustrated in the aforementioned Italian patent showing operation of this head and how the pairs of toothed members end up forming an internally closed system with all the drawbacks mentioned above;

Figure 5 is a basic diagram of a first example of the head according to the invention which halves the number of spindles and introduces as many pairs of toothed reversing members as there are spindles left;

Figure 6 is a basic diagram of a second and preferred example of the head according to the invention, in which the number of spindles has been reduced to two, and four pairs of toothed reversing members, i.e. a number of pairs of toothed members double the number of spindles, have been introduced;

Figure 7 is a partial sectioned plan view of the first example of the head according to the invention, in which the three remaining spindles and the corresponding three pairs of toothed reversing members actuated by them can be clearly seen;

Figure 8 is a partial sectioned plan view of the second example of the head according to the invention in which the two remaining spindles and the corresponding four pairs of toothed reversing members actuated by them can be clearly seen;

Figures 9 and 10 are a sectioned side view and a front view, respectively, of a first crank mechanism member and toothed member which can be used both in the first and in the second example of embodiment of the present invention;

Figures 11 and 12 are a sectioned side view and a front view of a second toothed member mechanism with two opposite circular segments which can be used in the second example of embodiment of the invention; and

Figures 13 and 14 are a sectioned side view and a front view of a third mechanism consisting of a toothed member of the so-called truncated type or with a single circular segment which can be used both in the first and in the second example of embodiment of the invention.

Let us consider first of all Figures 1 to 3 in order to understand clearly the problem of the prior art which the present invention intends to resolve.

According to this prior art, a roughing and lapping head 10 comprises a central rotating shaft 12 descending from a connection flange 14 accommodated inside a housing 16 for moving parts, said

housing 16 being connected at the bottom by means of a flange 18 to a fixed cover 20 which with an external guard 22 and an internal gasket 24 forms a hermetically sealed system for a casing 26 of the said head 10.

The casing 26 consists of two half-shells located one on top of the other, i.e. an upper one 28 and a lower one 30, and encloses all the mechanisms which perform rotational driving and oscillation about radial axes of grinding segments, such as the grinding element 32a which can be seen in Figure 1. The grinding element 32a (like other similar grinding elements not shown herein) is fixed to a lug 34a connected to a shaft 36a penetrating into the lower half-shell 30 of the casing 26. Obviously, the number of grinding segments must be greater than one, six being a usual number which also facilitates the design.

The shafts 36a-f, about which the lugs 34a-f of the grinding segments 32a-f oscillate, are accommodated inside bush bearings 38a-f passing through the lower half-shell 30 and are connected to lever arms 40a-f which, by means of spindles 42a-f fixed to an outer ring 44 of an inclined rotating disc 46, receive from the same oscillating disc 46 an alternating movement substantially along the direction of the central axis 48 of rotation of the head 10. The said oscillating disc 46 comprises, in addition to the outer ring 44, a ball bearing 50 and an inner ring 52 connected integrally to a hollow shaft 54 rotating coaxially with the central shaft 12 of the head 10, but at a different speed which is determined by a system of toothed members 56, 58, 60 and 62, known for some time in the prior art, for example already described in the aforementioned German Patent No. 800,112 to which the reader is referred with particular reference to Figure 1 thereof.

In fact, the inclined rotating disc 46 is substantially identical to the disc 7 which is shown in Figures 1 and 2 of the aforementioned Italian Patent No. 1,175,191 in the name of Marcello TONCELLI, compared to which it offers only an improved system for receiving the spindles 42a-f and an improved articulated connection 64 between the spindles 42a-f and the lever arms 40a-f.

The operating principle of this head of the prior art is illustrated in particular in Figure 3 in which identical parts shown in Figures 1 and 2 have been given the same numbers.

As can be seen in the aforementioned Figure 3, the inclined disc 46, formed by the outer ring 44, the ball bearing 50 and the inner ring 52, carries, fixed to its periphery, six spindles 42a-f, each of which engages with a lever arm 40a-f which operates respectively a shaft 36a-f of each of the lugs 34a-f carrying the grinding segments 32a-f (not shown in Figure 3). From this Figure it can be

understood how the fact of having to receive the movement of the inclined disc 46 from different points indicated by the letters A, B, C, D, E and F results in the amplitudes and oscillating velocities of the various grinding segments being phase-displaced with respect to one another by about 60° and this is evident in particular in the oscillating velocities of the individual grinding elements which are phase-displaced with respect to one another, not being equal along the circumference of the head.

To give a significant example, if we consider Figure 3 which is a very basic illustration of the head of the head shown in Figures 1 and 2, it can be seen that arbitrarily fixing an axis of the origins 0 emerging from the centre of the said head and passing through a position A corresponding to a first spindle 42a, the lug 34a connected thereto via the lever arm 40a is moved for example forwards, with respect to the head, at a velocity V determined by the axial displacement of the inclined disc 46. The spindle 42b emerging from the point B on the circumference of the disc 46 displaced by 60° moves at a velocity equivalent to that of the spindle at the point A multiplied by the cosine of the angle between the two points and, consequently, the velocity of the lug 34b moved by the spindle 42b emerging from the point B will be equivalent to $V\cos 60^\circ$, i.e. $1/2.V$. And so, in succession, the lug 34c controlled by the spindle 42c emerging from the point C will move at a velocity $V\cos 120^\circ$, i.e. $-1/2.V$. The lug 34d controlled by the spindle 42d emerging from the point D will move at a velocity $V\cos 180^\circ$, i.e. $-V$, and so on. The next lug 34e will move at a velocity $V\cos 240^\circ$, i.e. $-1/2.V$, and the next one 34f at a velocity $V\cos 300^\circ$, i.e. $1/2.V$. It can be seen, therefore, that the oscillating velocities of the grinding segments vary along the circumference of the head depending on the position in which they are situated, being higher at certain points, and lower at others, even to the point of changing sign. Moreover, this distribution of oscillating velocity of the grinding segments rotates slowly with respect to the head on account of the system of gears 56-62 and hence the given velocity distribution advances or recedes along the circumference of the head. The rotational velocity of the said grinding elements, which is obtained from the vectorial sum of the rotational velocity of the head and the oscillating velocity about the spindles 36a-f, is variable about a mean value, obtained from rotation of the head, about which the value of the oscillating velocity of the grinding elements varies. Since the centrifugal forces acting on the grinding segments are directly proportional to the square of their angular velocity and since this angular velocity could undergo variations of the order of 10% on account of the oscillations im-

parted to the said grinding segments, it follows that there would be variations in centrifugal forces of the order of 20% on the grinding elements with the induction of dynamic imbalance vibrations. Vibrations of this type are very difficult to dampen because the velocity variations are quite considerable and the only way to reduce or eliminate them is to reduce these variations or compensate them in pairs.

A way, suggested in the prior art, of compensating these variations in pairs is described in the aforementioned Italian Patent Application No. PD91A000078 and consists in actuating the lugs of the grinding segments by means of one or more rollers resting on a cam present inside the said head and in coupling together shafts of adjacent lugs by means of pairs of toothed movement-reversal members. In this case, at least theoretically, this would result in the lugs of adjacent grinding elements moving in mutually opposite directions, thereby compensating in pairs the effects of the oscillations of the lugs on rotation of the head, and hence in the dynamic imbalance vibrations disappearing completely.

A schematic representation of this compensation system of the prior art is illustrated in Figure 4 which shows six lugs 34'a-f of grinding segments moved by four rollers 66a-d resting on a circular cam 68, obviously inclined, rotating inside a head 10' at different speeds according to the universally known method of gear groups, the rollers 66a-d actuating by means of lever arms 40'a, 40'c, 40'd e 40'f the respective lugs 34'a, 34'c, 34'd and 34'f via their shafts 36'a, 36'c, 36'd and 36'f and all the shafts 36'a-f of the lugs 34'a-f being connected together by identical gears 70a-f, whereby the gears all engage with each other so as to form inside the said head 10' a chain of toothed members forming an internally closed system.

Unfortunately, precisely because of the fact that the chain of toothed members 70a-f forms an internally closed system, the mode of operation of this head becomes extremely critical and requires either that only one of the rollers 66a-d is used or that the cam 68 and the rollers 66a-d are designed with very small tolerances, unless compensation springs are arranged on the roller supports, although this would have a negative effect on distribution of the oscillating velocity of the grinding segments and hence would be reintroduce, in an uncontrollable manner, the imbalances which are to be eliminated.

Furthermore, if the inevitable play between cam 68 and rollers 66a-d can be effectively compensated by elastic means, this results in the limitation of being able to rotate the head in one direction only, which reduces the possibilities of use of the latter.

All the aforementioned drawbacks of the prior art are partially or totally eliminated by two examples of embodiment of heads 110 and 210 illustrated respectively in Figures 5 and 7 and in Figures 6 and 8.

If Figures 5 and 7 are examined together, it can be seen that in the head 110 the oscillating movement of the lugs 134a-f is ensured by only three spindles 142b, 142d and 142f which directly ensure actuation of the lugs 134b, 134d and 134f via respective lever arms 140b, 140d and 140f and indirectly actuation of the lugs 134a, 134c and 134e via truncated toothed-member segments 180a, 180c and 180e which engage respectively with toothed profiles present on the lever arms 140b, 140d and 140f.

An inclined disc 146 is provided with an outer ring 144 of a bearing 150 and hollow shaft 154 identical to the outer ring 44 and hollow shaft 54 of the embodiment of the prior art illustrated in Figures 1 and 2 and functions in exactly the same manner as the inclined disc 46 of the said two figures, with the sole exception that, instead of six spindles 42a-f, it accommodates only three spindles 142b, 142d and 142f. The distribution of the oscillating velocity of the lugs 134a-f is that illustrated in Figure 5 where, the oscillating velocity of the lug 134a having been indicated by V , for reversal caused by the pair of toothed members 180a and 140b, the oscillating velocity of the lug 134b is equivalent to $-V$. The phase-displacement, by 120° , of the spindle 142d with respect to the spindle 142b results in the oscillating velocity of the lug 134d being equivalent to $1/2.V$ and the reversal caused by the pair of toothed members 140d and 180c produces an oscillating velocity equivalent to $1/2.V$ of the lug 134c. In the same way, the phase-displacement, by 240° , of the spindle 142f with respect to the spindle 142b results in the oscillating velocity of the lug 134f being equivalent to $1/2.V$ and reversal of the pair of toothed members 140f and 180e produces an oscillating velocity equivalent to $1/2.V$ of the lug 134e. As can be understood from examining Figure 5, the distribution of the oscillating velocity, from the lug 134a to the lug 134f, is: V , $-V$, $-1/2.V$, $1/2.V$, $-1/2.V$ and $1/2.V$. It can be seen that the pair of lugs 134a and 134b compensate internally the oscillating velocity V and $-V$, as do the pairs of lugs 134c and 134d and 134e, 134f, compensating internally the oscillating velocity $-1/2.V$ and $1/2.V$, $-1/2.V$ and $1/2.V$. From this oscillating velocity distribution it can be seen that there is velocity compensation between the lugs 134a and 134b and between the lugs 134c, 134d, 134e and 134f, while there still exists a certain velocity imbalance between the lug 134b and the lug 134c and between the lug 134f and the lug 134a.

Obviously, since the velocity imbalances are reduced to only two, the dynamic imbalances of the head 110 are reduced.

These residual imbalances can be substantially eliminated from the head 210 of the example of embodiment illustrated in Figures 6 and 8.

In fact, examining Figures 6 and 8, it can be seen that in the head 210 the oscillating movement of the lugs 234a-f is ensured by only two spindles 242c and 242f which ensure directly actuation of the lugs 240c and 240f via respective lever arms 240c and 240f and indirectly actuation of the immediately adjacent lugs 234b and 234e via double toothed-member segments 260b and 260c and of the successive lugs 234a and 234d via truncated toothed-member segments 280a and 280d which engage, respectively, with toothed profiles present on the double gear segments 260b and 260c.

As can be noted in the two aforementioned figures, the spindles 242c and 242f are connected at diametrically opposite points of the outer ring 244 of the inclined disc 246 which is similar to the inclined disc 46 of the prior art, but is provided with only two opposite spindles, i.e. phase-displaced by 180° .

As can be easily understood by considering Figures 6 and 8, the movements, in the axial direction, of the two opposite spindles 242c and 242f are also opposed so that the oscillating velocities of the opposite lugs 234c and 234f are V and $-V$, respectively. The pair of toothed members 240c, 260b reverses the oscillating movement so that the oscillating velocity of the lug 234b is $-V$ and hence the pair of toothed members 260b, 280a again reverses the oscillating movement so that the oscillating velocity of the lug 234a is V again. In the same way, the pair of toothed members 240f, 260e reverses the oscillating movement so that the oscillating velocity of the lug 234e is equal to V and hence the pair of toothed members 260e, 280d again reverses the oscillating movement so that the oscillating velocity of the lug 234d is $-V$ again. By way of conclusion, examining the lugs 234a-f it can be seen that they are made to perform alternately opposite oscillating movements having in succession the velocities V , $-V$, and V , $-V$. This means that each lug has an oscillating velocity exactly opposed by that of the adjacent lug and hence that the oscillating velocities compensate each other exactly in pairs, not reversing substantially in any way the equilibrium of the grinding segments of the head 210.

Let us now examine Figures 9 and 10 which show the lever arms 140 and 240 provided with gears.

Said lever arms 140 and 240 comprise a stirrup section 310 provided with a recess 312 designed to receive an articulation of one of the

spindles 242c or 242f, for example, such as the articulated joint 64 shown in Figure 1, followed by a flat section 314 provided with a central hole with grooved walls 316 designed to engage with one of the shafts 136b, 136d and 136f of the lugs 134b, 134d and 134f, of the head 110, or one of the shafts 236c and 236f of the lugs 234c and 234f of the head 210. The flat section 314 has connected to it an inclined section 318 provided with teeth designed to couple the lever arm 140 with the truncated gear 180 or the lever arm 240 with one of the double-toothed member segments 260, depending on whether they are used in the head 110 or in the head 210.

Figures 11 and 12 show one of the double-toothed member segments designed to transmit movement to the shafts 236b and 236c of the lugs 234b and 234c of the head 210. Said segment 260 comprises a flat central zone 320 provided with a central hole 322 with grooved walls designed to engage with one of the shafts 236b or 236c and connected to two inclined sections 324 and 326 provided with teeth for receiving the movement from the lever arms 240 and transmitting it to the truncated toothed-member segments 280.

Figures 13 and 14 show the truncated toothed-member segments 180 and 280 designed to transmit the movement from the shaft 136b to the shaft 136a, from the shaft 136d to the shaft 136c and from the shaft 136f to the shaft 136e in the head 110, or from the shaft 236b to the shaft 236a and from the shaft 236c to the shaft 236d in the head 210. Said truncated toothed-member segments comprise a flat zone 330 provided with a hole 332 with grooved walls for engagement with one of the shafts 236a or 236d of the respective lugs 234a and 234d and connected to an inclined section 334 provided with teeth driven by the teeth 318 of the lever arms 140 in the head 110 and by the teeth 326 of the double toothed-member segments 260 in the head 210. These segments 180 and 280 are truncated at their ends to prevent closure of the chain of toothed members inside the head 110 and 210 so as to accommodate all possible manufacturing tolerances in the lever arms 140 and 240, the teeth 318, 324, 326 and 334 and the angular positions of the spindles 142b, 142d and 142f of the head 110 and the spindles 242c and 242f of the head 210.

Hereinabove two examples of embodiments of the present invention have been described and illustrated and are provided by way of a non-limiting example.

Any logical and equivalent variation and changes which may occur to a person skilled in the art following reading of the aforementioned examples of embodiment must all be regarded as protected herein.

For example, the lever arms 140 and 240 must not necessarily be made in the form of segments with flattened sides, but, if there is sufficient space, they could also be made so as to have a circular shape or in the form of a circular segment with diverging sides. The same is applicable to the double toothed members 260 or the truncated toothed members 180 and 280. Also, the connection between the spindles 142 and 242 and the lever arms 140 and 240 must not necessarily be of the spherical type 64 shown in Figure 1, it being possible to use in their place other joints well known to persons skilled in the art.

Claims

1. Improvements to a rotary lapping and polishing head (110, 210) for granites and similar stones, of the type provided with an inclined rotating disc (146, 246) for causing oscillation of grinding segments (42), characterized by a reduction in the number of spindles (142b, 142d, 142f; 242c, 242f) which receive the movement for the oscillating grinding segments from the said mobile inclined disc (146, 246), by replacing a certain number of spindles (142, 242) with a corresponding number of pairs of toothed members (140, 240; 180, 280; 260) having the function of reversing the oscillating movement of adjacent oscillating grinding segments (42), whereby the series of toothed members (140, 240; 180, 280; 260) must not form an internally closed system.
2. Improvements to a lapping and polishing head, according to Claim 1, characterized in that the number of spindles (142) is halved and the number of pairs of toothed members (140, 180) becomes equal to the number of remaining spindles.
3. Improvements to a lapping and polishing head, according to Claim 1, characterized in that, in order to obtain a perfect equilibrium, the number of spindles (242) is reduced to one third and the number of pairs of toothed members (240, 260, 280) becomes equal to twice the number of spindles (242).
4. Improvements to a lapping and polishing head, according to Claim 1, characterized in that the number of spindles (242) is reduced to two and the number of pairs of toothed members (240, 260, 280, etc.) becomes equal to the difference between the number N of grinding segments (32) used and the number of spindles (242), equivalent to two, i.e. N-2, whereby N must be an even number divisible by two

but not by four.

5. Improvements to a lapping and polishing head, according to Claim 4, characterized in that with two spindles (242) it is possible to use six grinding segments (32) and four pairs of toothed members (240, 260, 280), i.e. two pairs of toothed members per spindle (242). 5
6. Improvements to a lapping and polishing head, according to Claim 4, characterized in that with two spindles (242) it is possible to use ten grinding segments (32) with eight pairs of toothed members (240, 260, 280), hence four pairs of toothed members for each spindle (242). 10
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7. Improvements to a lapping and polishing head, according to Claim 4, characterized in that with two spindles (242) it is possible to use fourteen grinding segments (32) with twelve pairs of toothed members (240, 260, 280), hence six pairs for each spindle (242). 20

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Fig. 1

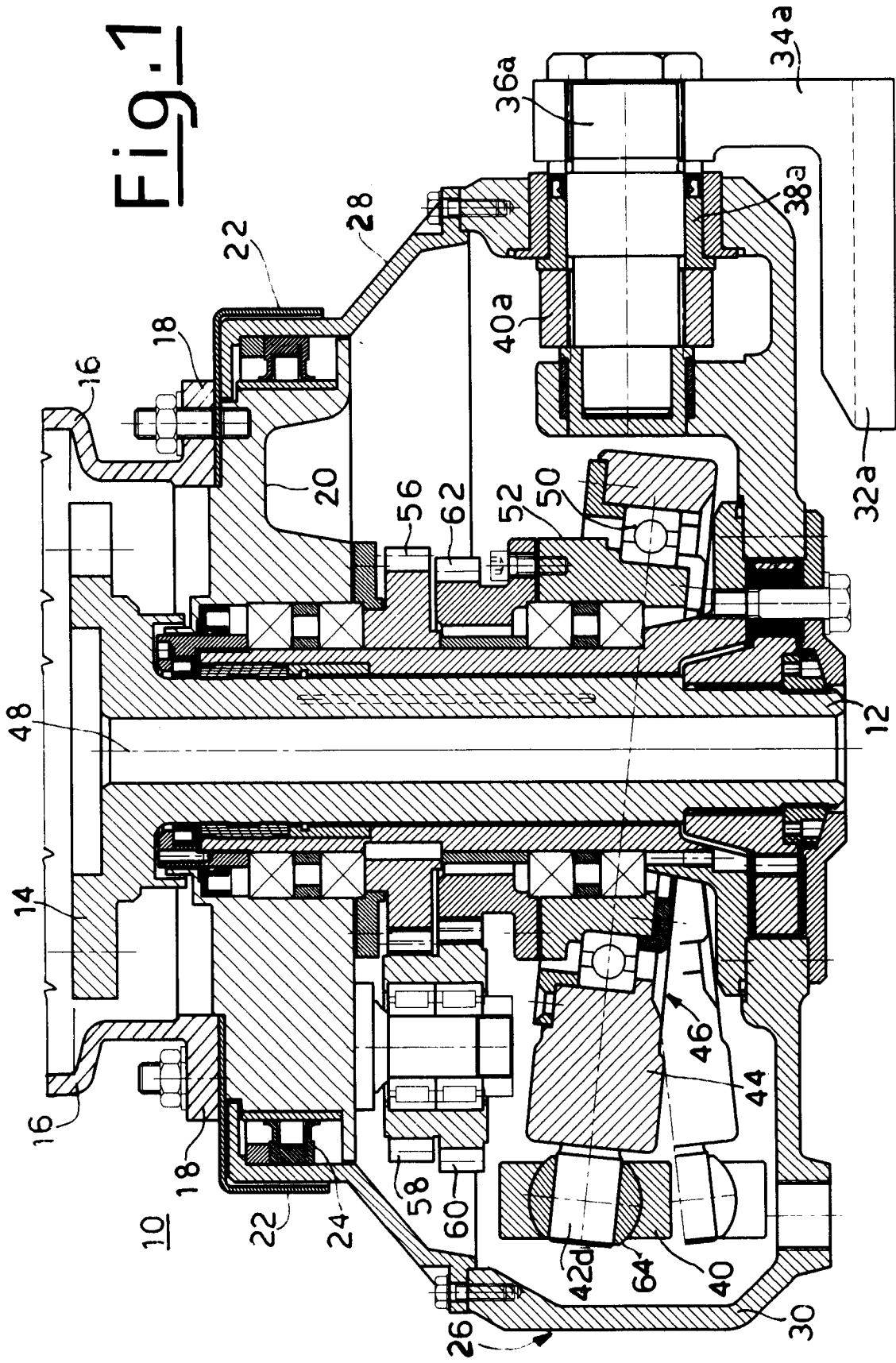
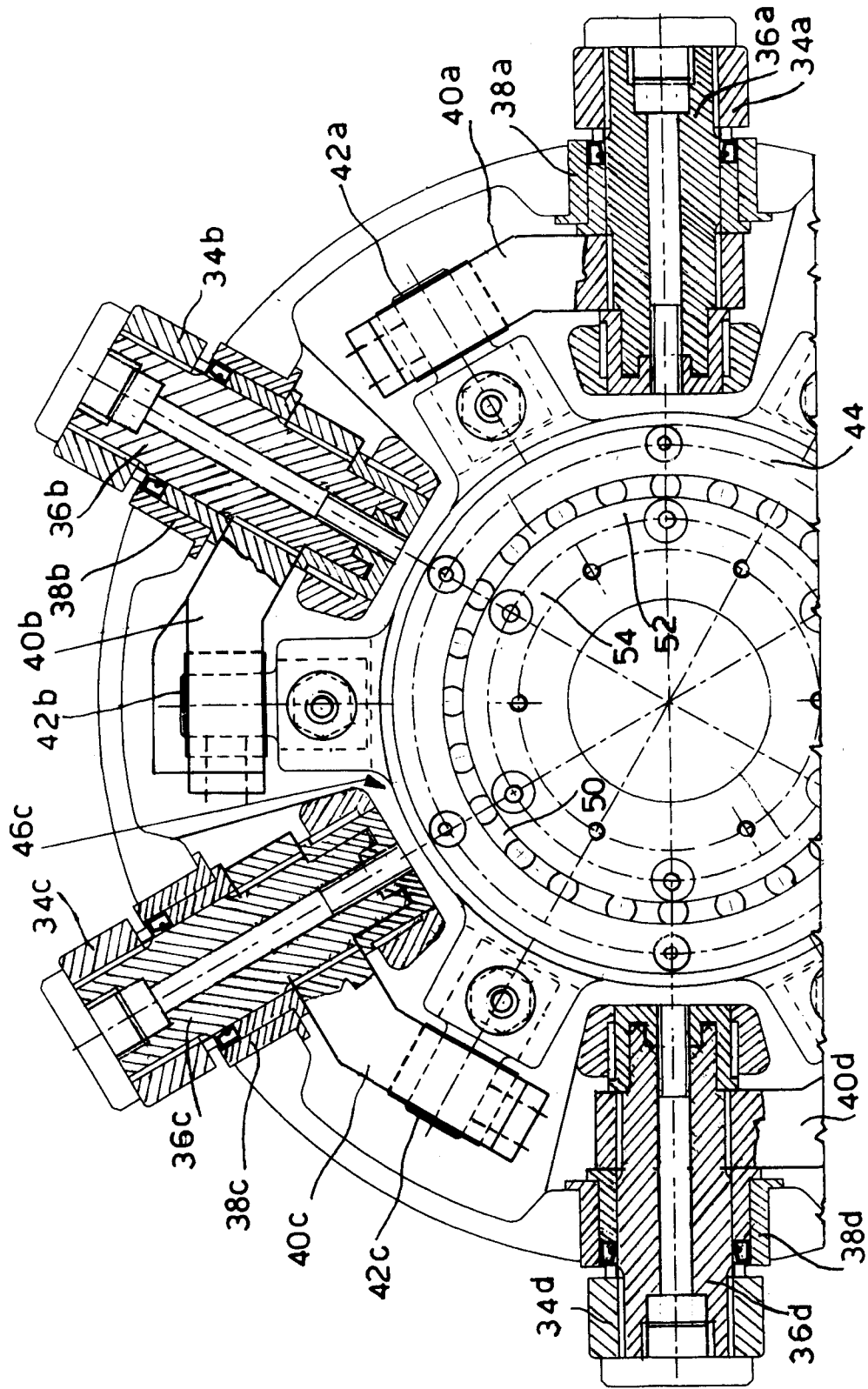


Fig.2



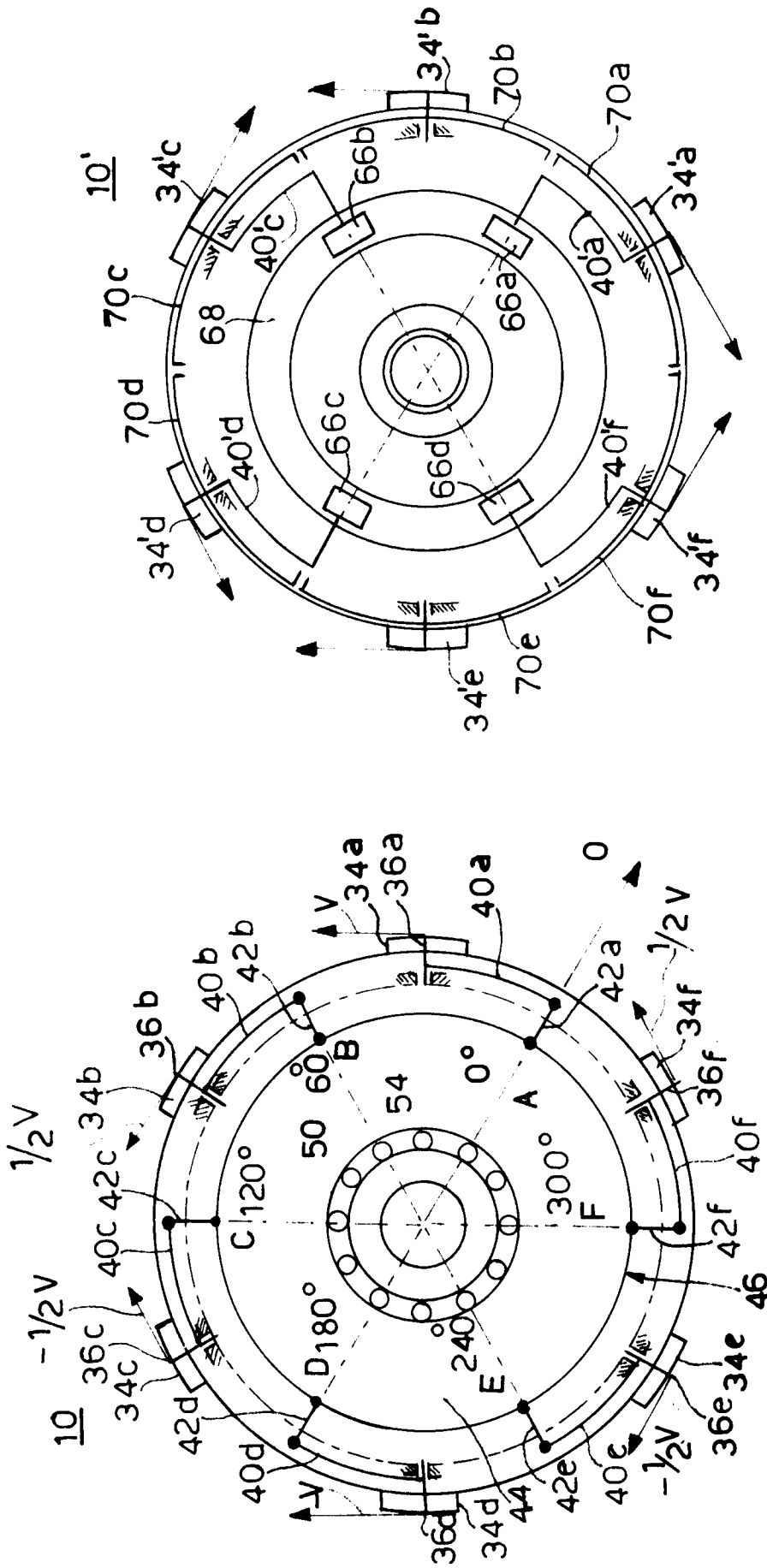


Fig. 4

Fig. 3

Fig.5

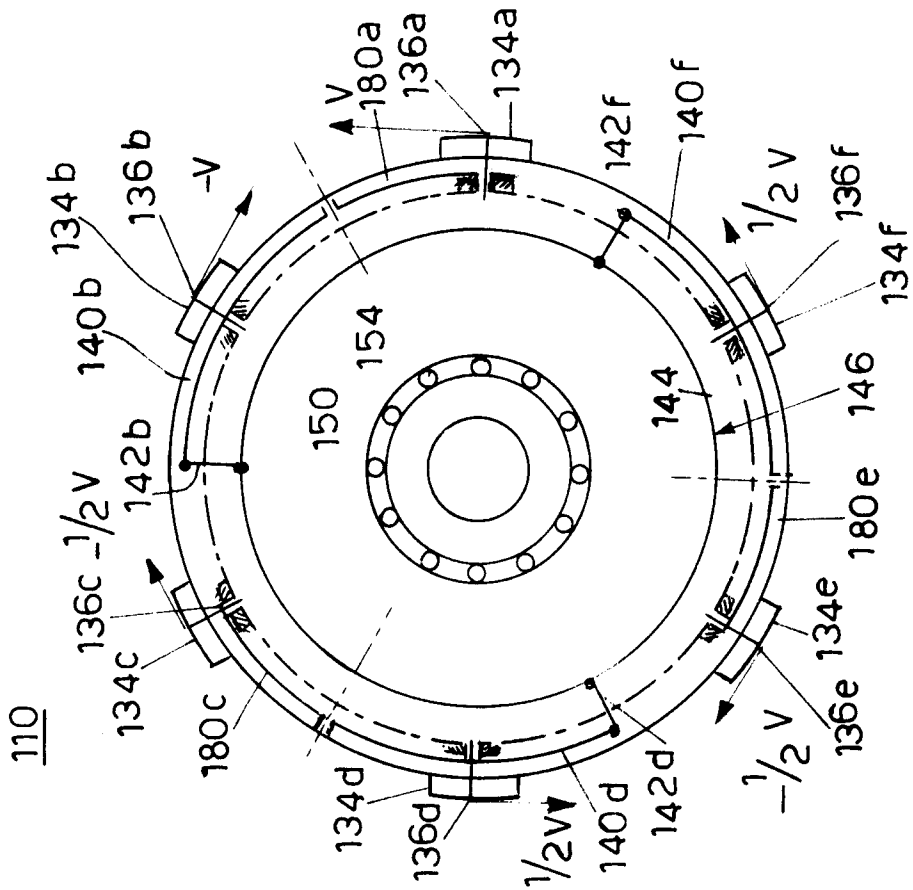
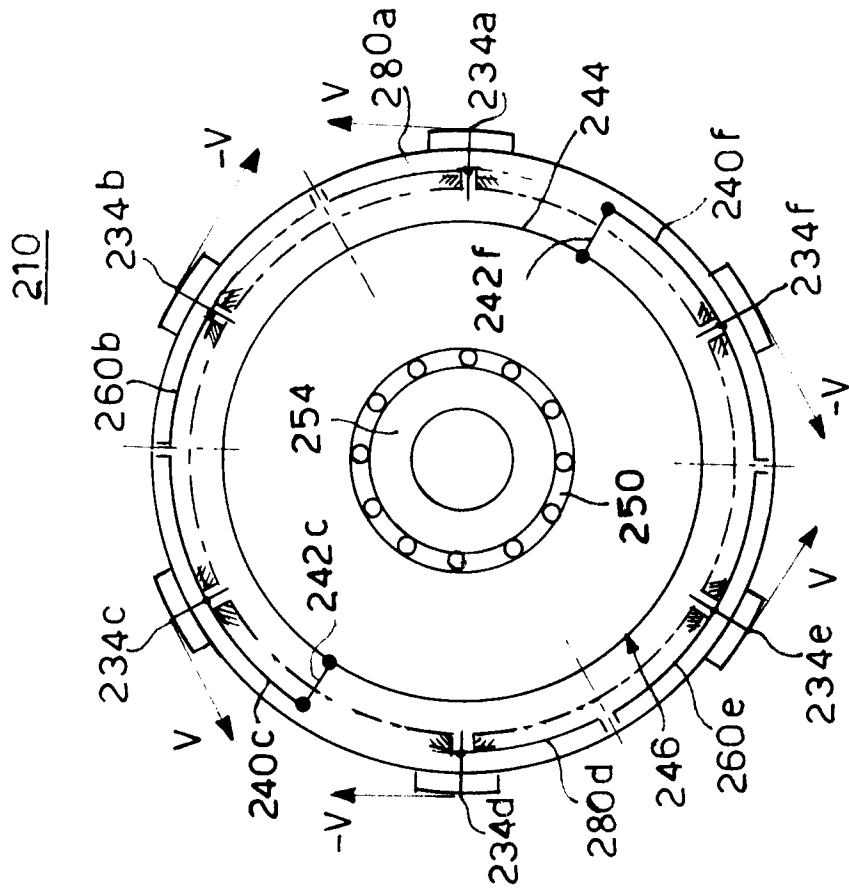
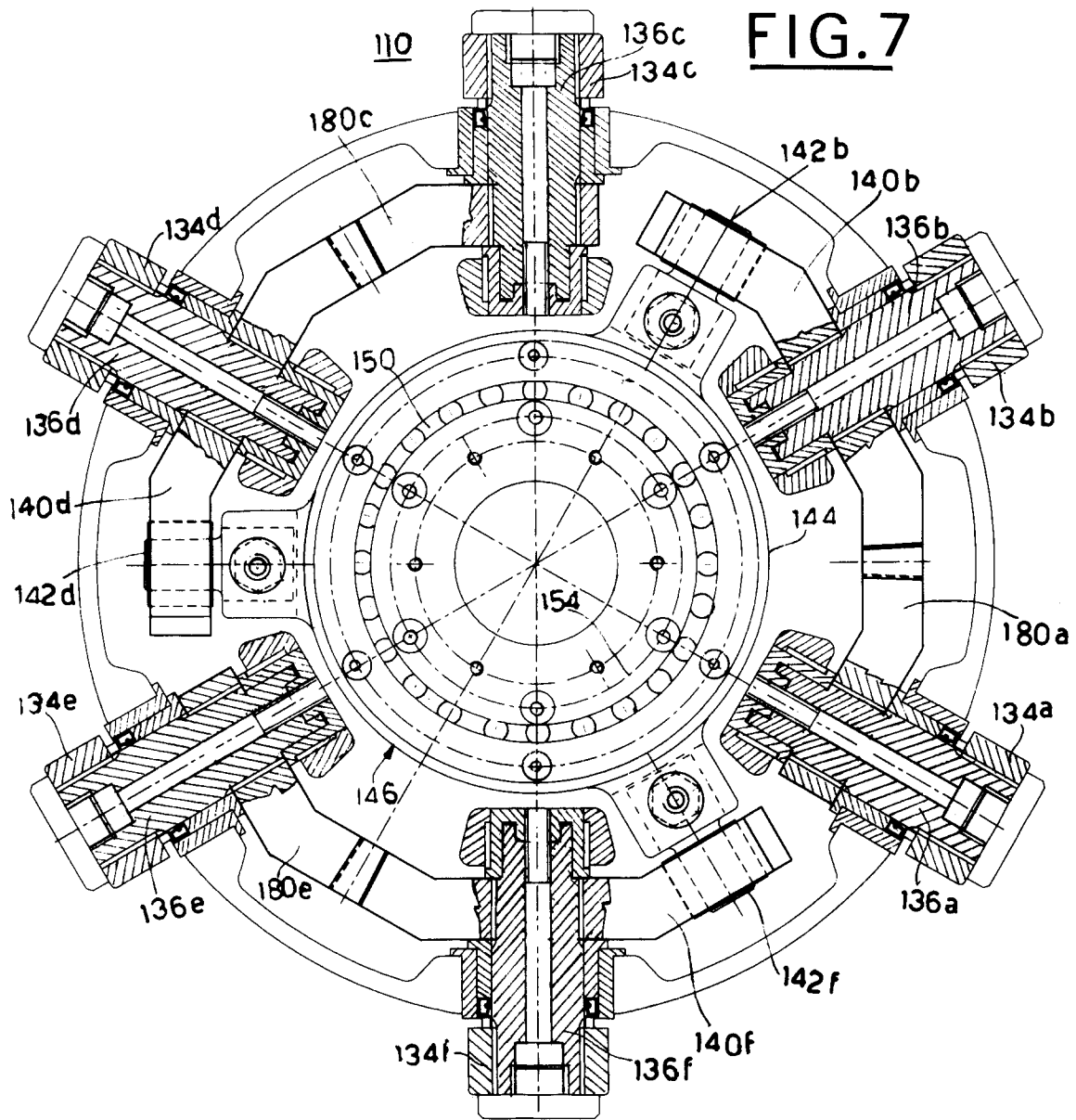
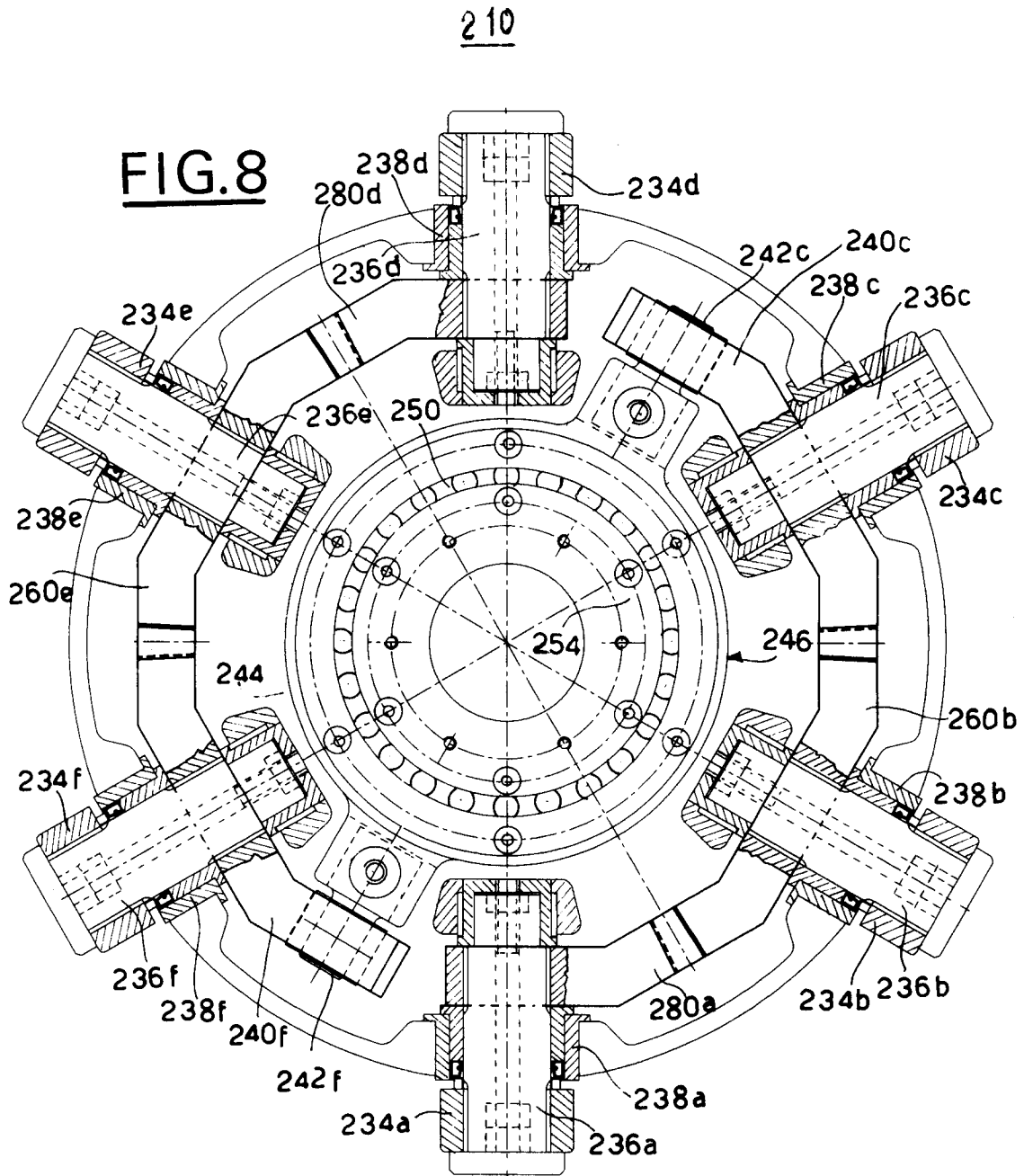


Fig.6







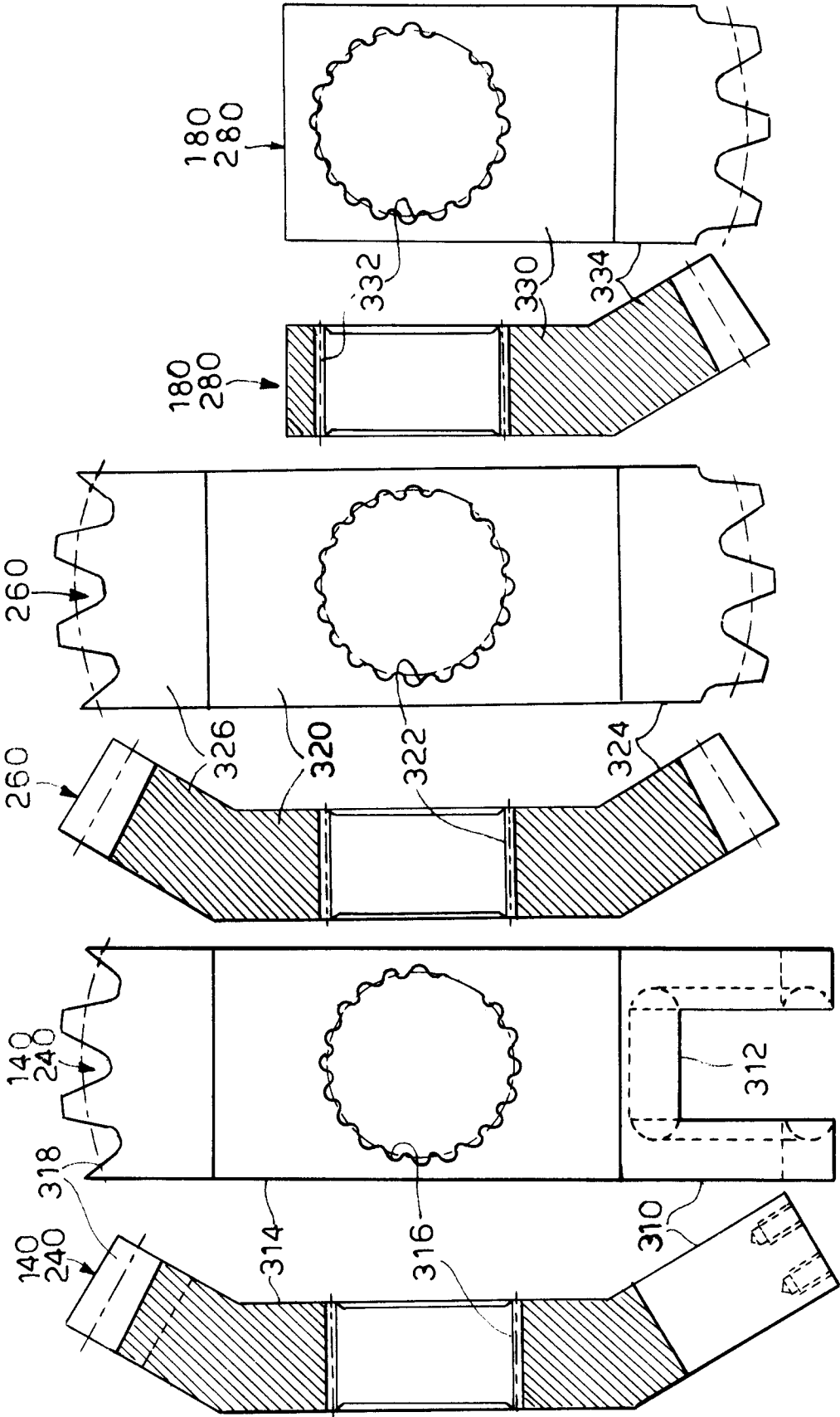


Fig.9 Fig.10 Fig.11 Fig.12 Fig.13 Fig.14



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 2683

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 510 603 (SIMEC S. P. A.) * column 1, line 37 - column 4, line 52; figures 1-9 *	1	B24B41/047
A	DE-A-34 08 443 (M. TONCELLI) * page 4, line 11 - page 5, line 20; figures 1,2 *	1	
D,A	DE-A-26 07 804 (H. FICKERT) * claims 1-3; figures 1,2 *	1	
D,A	DE-C-800 112 (K. FICKERT) * claims 1-3; figures 1,2 *	1	
D,A	US-A-2 105 634 (G. F. BRENDL) * claims 1-4; figures 1-3 *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B24B B24D
Place of search	Date of completion of the search	Examiner	
BERLIN	28 December 1994	Wunderlich, J	
CATEGORY OF CITED DOCUMENTS		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	
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