

Dec. 9, 1952

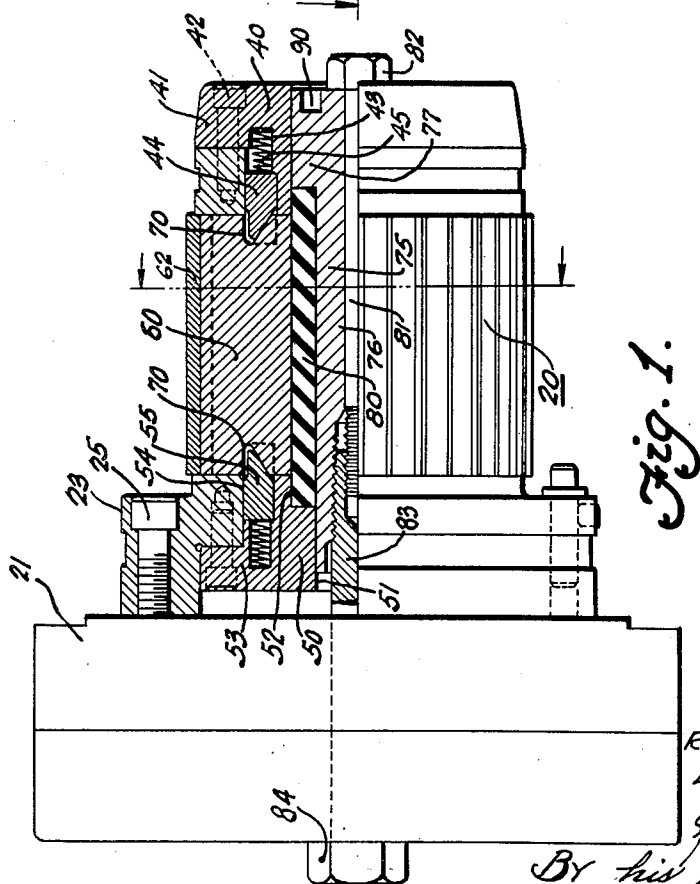
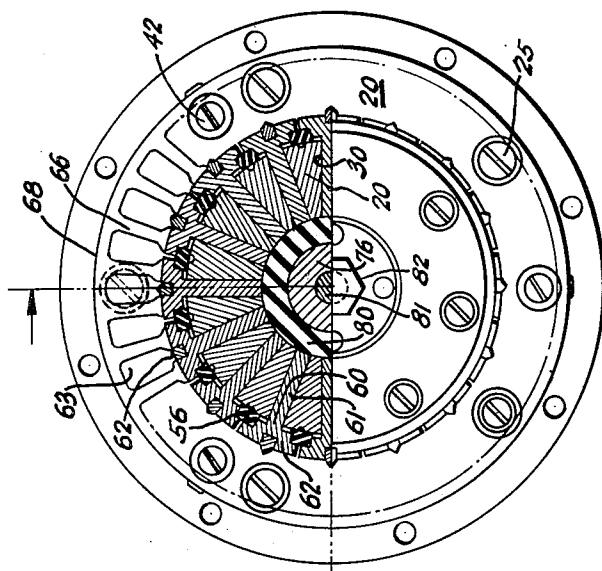
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2,621,052

MACHINE ELEMENT

Filed Sept. 13, 1949

2 SHEETS--SHEET 1



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2 SHEETS—SHEET 2

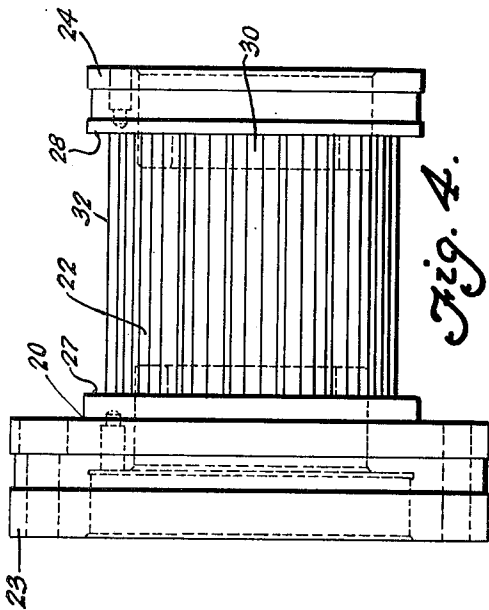


Fig. 4.

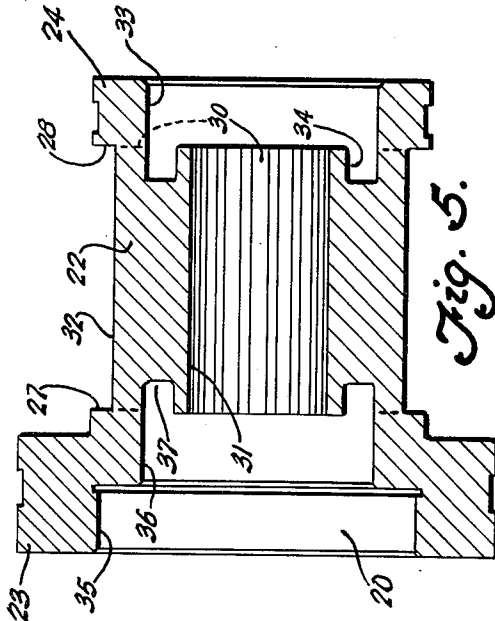


Fig. 5.

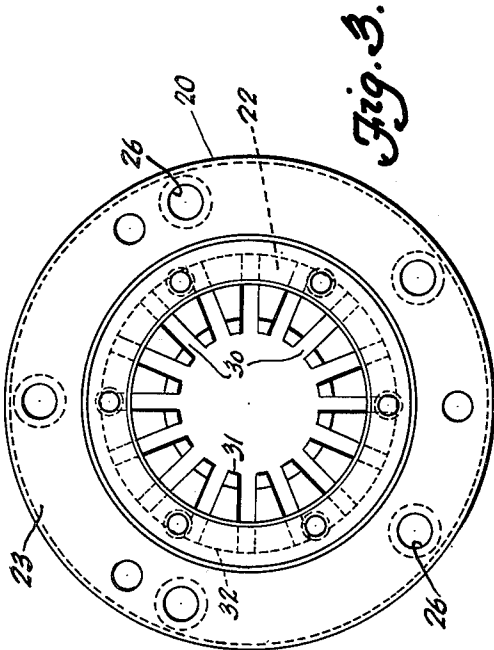


Fig. 3.

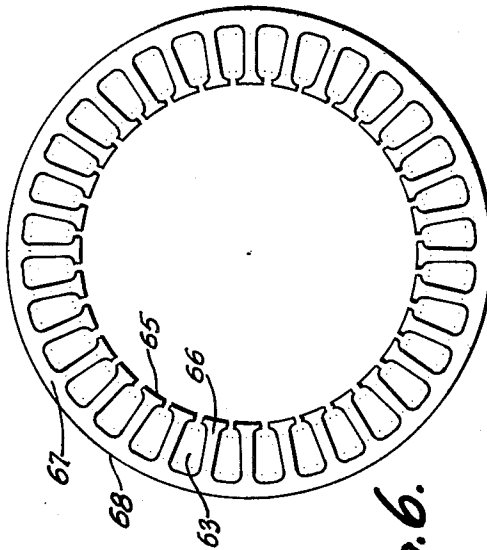


Fig. 6.

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2,621,052

MACHINE ELEMENT

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Application September 13, 1949, Serial No. 115,369

5 Claims. (Cl. 279—2)

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This invention relates to an improved arbor for supporting a work-piece during the machining of a surface thereof.

It is among the objects of the present invention to provide an arbor capable of rigidly holding a work-piece thereon without appreciably distorting the natural contour or shape of the work-piece area engaging the arbor.

Another object of the present invention is to provide a work-piece supporting arbor having a plurality of pressure elements all moved to engage the work piece before being pressed against it with equal pressure whereby distortion of said work piece is held to a minimum if not entirely eliminated.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

The arbor illustrated in the present drawings is particularly designed to receive and hold a laminated, ring-shaped assembly such as a stator core for a dynamo electric machine. Such a core comprises a stack of ring-shaped lamina punched from sheet metal and held together by rivets, screws, or any other suitable means. A plurality of equally spaced radial slots extend from the interior peripheral edge of each lamina, each slot terminating short of the outer peripheral edge thereof. In commercial production where each lamina is stamped from a sheet of metal the outer and inner peripheral edges will not be absolutely round and in some instances may be very slightly ovate. Limited irregularities such as this are permissible in the inner annular edge because they would tend only to vary the air gap between the inner peripheral surface of the stator and adjacent annular surface of the rotor revolving within the stator. However, when, as is generally the case, the stator is assembled in a separately machined housing or between two end members of an electric machine, then the outer contour of the stator must be substantially true and unvarying so as to conform with and fit into said housing or end members. Variations allowable in the inner peripheral surface of the stator, if existing in its outer surface would prevent assembly of the stator in the housing or end members and thus tend to abnormal and expensive scrap. Thus stator cores are placed on an arbor and their outer surface machined to eliminate any malformation and make them conform to the shape and contour of the member into which the stator is to be assembled.

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An ordinary arbor in which pressure elements are positively actuated outwardly to grip the work-piece or in this case the stator ring assembly placed on the arbor will, in case the inner peripheral surface is ovate instead of perfectly round, exert distorting stresses upon the stator ring which distorts its outer peripheral surface to be machined. The pressure element engaging the higher portions of the interior surface will begin to exert pressures at these areas before other pressure elements actually contact the stator surface. By the time these latter pressure elements engage the work-piece or stator on the arbor, the elements which first engaged it are exerting an excessive, distorting pressure inasmuch as all pressure elements move concurrently outwardly. The machining of the outer peripheral surface of the distorted stator will render it regular and it will remain so as long as the stator is secured to the arbor by the pressure elements. However, when the pressure is released and the stator freed to permit its removal from the arbor, it will, to some degree, if not completely, assume its original shape, the inner contour being again ovate, the outer irregular and unable to fit into the part for which it was machined.

The arbor of the present invention is designed substantially to eliminate distortion of the work piece inasmuch as the pressure elements are all actuated by an elastic body. This body, when pressure is exerted thereupon, will move all of the pressure elements into contact with the adjacent surface of the work piece after which all are pressed against it with equal force.

In the drawings:

Fig. 1 illustrates an arbor half in section taken along the line 1—1 of Fig. 2 and half in side elevation, the arbor being attached to a rotating part of a machine such as a lathe.

Fig. 2 is an end view of the arbor, the upper half in section, the lower half in elevation. A work piece in the form of a ring shaped stator core is shown applied to the arbor in this view.

Fig. 3 is an end view of the main body portion of the arbor.

Fig. 4 is a side view of the said main body portion of the arbor.

Fig. 5 is a sectional view of the part, shown in Fig. 4.

Fig. 6 is a flat view of a stator core for which this arbor was designed.

Referring to the drawings the arbor consists of a main body portion 20 which is attachable to the rotating part 21 of a lathe or any other suit-

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able machine to be used for operating on the work piece carried by the arbor. This main body portion 20 of the arbor is detailedly illustrated in the Figs. 3, 4 and 5. It comprises a central tubular portion 22 having an outwardly extending, annular flange at each end. Flange 23, at one end of the central tubular portion 22 is of greater diameter than flange 24 at the opposite end thereof. Screws 25, passing through holes 26 in flange 23 are received by the rotating part 21 of the lathe or machine used to rotate the arbor.

Between the side wall surfaces 27 and 23 of flanges 23 and 24 respectively, the central, tubular portion 22 is radially slotted. In the present design this portion of the arbor has sixteen equally spaced, radial slots 30 the ends of said slots all terminating in the inner and outer peripheral surfaces 31 and 32 respectively.

The flanged end 24 of the main body portion of the arbor is recessed as at 33 and at the bottom of said recess 33 there is an annular groove 34 counterbored therein. The flanged end 23 has a recess of two different diameter portions 35 and 36, the smaller diameter portion 36 having an annular groove 37 provided in its bottom surface.

Recess 33 receives the end ring 40 having a central opening aligning with the central opening in the main body portion 20 of the arbor. An annular flange 41 on the end ring abuts against the end of the arbor and has a series of openings for receiving screws 42 which threadedly engage the arbor to secure the end ring thereon. The portion of end ring 40 which extends into the recess 33 is of two diameters, the larger fitting into said recess, the smaller diameter portion forming an annular space corresponding to and aligning with the annular recess 34 in the arbor body portion 22. This space is occupied by a retractor ring 44 whose outer end extends from ring 40 into the annular recess 34 of the arbor body. The inner, annular edge of the retractor ring 44, which extends into the recess 34 is tapered, presenting a sloping, camming surface for purposes to be described. Springs 45 in holes 43 provided in ring 40, constantly urge the retractor ring 44 outwardly of ring 40 and into the recess 34 of the arbor body.

At the opposite end of the arbor body a ring 50 similar to ring 40 is provided. A flange 53 on ring 50 has provisions to receive screws by means of which said ring is secured to the arbor body. Ring 50 has a central opening of two different diameters, the smaller one 51 and the larger one 52 both coaxially aligning with the central opening in the arbor body portion 22. The larger diameter portion 52 is substantially the same as said arbor body opening. Like ring 40, ring 50 has a smaller diameter portion at its inner end, forming an annular space 54 which coincides with the annular recess 37 in the arbor body. This space is occupied by a retractor ring 55 which is spring urged outwardly so that its wedge shaped outer end extends into said recess 37. Retractor rings 44 and 55 constantly urged into their respective arbor body recesses 34 and 37 respectively, provide means operative yieldably to maintain the several pressure elements 60 in normal retracted position.

Each slot 30 in the main body portion 22 of the arbor provides a receptacle in which a pressure element or segment 60 is slidably supported. Each pressure element or finger 60 comprises a trunk portion 61 and a cross-head portion 62 so that, as shown in Fig. 2, segment 60 is T-shaped

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in cross-section. The trunk portion 61 fits slidably in its respective radial slot 30 and its end surface is normally, substantially flush with the surface 31 in the body portion 22. The cross-head portion is arcuate to correspond to the curvature of the outer surface of arbor body 22 and normally rests upon longitudinal sealing strips 56 secured to said arbor body. Each cross-head portion of a pressure element or segment has a wedge-block 62 secured thereto, which aligns with the adjacent entrance to a stator core slot 63 so as to be able to enter therein when the segment 60 is moved radially outwardly of the arbor body 22. The segmented, annular surface presented by the group pressure elements 60 conforms with and is of slightly less diameter than the segmented annular surface 65 presented by the inner edges of the slot teeth 66 of the stator core 67 shown in Fig. 6 and adapted to be placed on the arbor for machining the outer peripheral surface 68 of said stator core.

Every segment or pressure element 60 has a wedge shaped notch 70 in each end thereof. The notch 70 at one end of a finger 60 has the wedge shaped end of spring loaded retractor ring 44 extending therein to the engaging sloping surfaces of the notch and the ring therein cooperating yieldably to urge the respective segment inwardly and hold it in normal position. The notch 70 at the opposite end of the segment 60 has the retractor ring 55 extending into it, and the engaging sloping surfaces of said notch and ring 54 also cooperate to urge this end of the segment yieldably into normal position in which the inner end of the segment is substantially flush with the inner annular surface 31 of the arbor body and the cross-head portion is yieldably held upon sealing strips secured to said body.

As mentioned before, end ring 40 has a central opening aligning with and substantially equal in diameter to the central opening in the arbor body 22. On the other hand, end ring 50 at the opposite end of the arbor body has a central opening of two diameters, one substantially equal to and aligning with the opening in the arbor body, the other of smaller diameter but coaxial with said arbor body opening. A piston plug 75 extends coaxially through the arbor body and its end rings, the main body portion 76 being of the same diameter as the smaller opening in the end ring 50 so as to be slidable therein. A head or piston portion 77 fitting slidably within the opening in the end ring 40. The piston plug 75 forms a closed, annular chamber within the arbor said chamber being completely filled with a body of elastic material 80 such as rubber or any synthetic substitute having the same elastic properties as rubber, for instance being capable of moving or flowing when pressure is exerted thereupon. Figs. 1 and 2 illustrate this body of elastic material and show that the inner ends of the trunk portions of the respective pressure elements 60 are in constant engagement with said body.

The piston plug 75 is hollow, a screw 81 extending therethrough. The head 82 of screw 81 abuts against the outer end of the piston plug head or piston portion 77, the other, threaded end of the screw operatively engaging an interiorly threaded recess in the end of a draw bar 83 which is also threadedly connected to the body portion 76 of the piston plug 75 and has its head 84 engaging the outer surface of the rotating element 21. By this arrangement rotation of the draw bar 83 in the proper direction and

relatively to the member 21 in which it is supported, will, due to the threaded connection between the draw bar and piston plug 75, move the piston plug inwardly of the arbor body 22 and thus cause the head or piston portion 77 to exert a distorting pressure upon the elastic body 80. When desired, the screw 81 is turned to move inwardly of the draw bar 83 to which said screw is threadedly connected, thus causing the head 82 of the screw to clamp upon the end of the piston plug to lock it against inadvertent movement relatively to the draw bar or arbor body.

To machine the outer peripheral surface of a stator core such as is shown in Fig. 6, said core consisting of a stack of preformed laminae secured together in stacked relation in any suitable manner, the operator first places the stator core upon the arbor so that the core fits about the body portion 22 of said arbor as shown in Fig. 2. For purposes of this description, it will be assumed that the inner annular and segmental surface 65 of said core is slightly out of round but not sufficiently to warrant its rejection. With the screw 82 screwed partially outwardly so that its head 82 does not press upon the end of the piston plug 75, a suitable tool such as a spanner wrench is applied to the piston plug and its wrench receiving recesses 90 in the end thereof and thereby turned relatively to the draw bar which is held against rotation in any suitable manner. As the piston plug is so turned it moves inwardly of the arbor body 22 and its head portion exerts a compressing force upon the elastic body 80. This elastic body, due to its character will move or flow in any direction it can and, due to the fact that the ends of the outwardly movable pressure elements are all exposed to and engaged by said elastic body, its movement will cause the outward radial movement of all of the said pressure elements 60, against the effort of the respective pairs of retractor bars 44—55 or fingers which yieldably resist such outward movements of said elements. If, as formerly mentioned, the inner, annular wall of the stator is out of round, the pressure elements 60, adjacent the wall areas closer to the center of the arbor, will engage said wall before the pressure elements adjacent the areas more remote from said center. In ordinary arbors having positively actuated pressure elements, the full pressure would continue to be exerted upon engaging elements and thus distortion of the stator core would result. However, in the present arbor the closer pressure elements, after engaging the stator wall will merely be held in such wall engaging positions while other portions of the elastic body are caused to flow and move the other pressure elements, initially more remote from the wall of the stator, into contact therewith. After all of the pressure elements 60 have been moved to engage the contiguous wall of the stator, continued movement of the piston plug 75 to exert distorting pressure upon the elastic body 80 will cause it to flow and exert a substantially equal pressure upon all of the segments or pressure elements 60 thus causing all to clamp or press upon the stator wall with equal force, rigidly securing the stator core to the arbor with substantially little or no distortion. Now the outer wall or surface of the stator core may be machined or ground to the desired size with the knowledge that the finished stator, being held upon the arbor with no distorting stresses being exerted thereupon, will remain true as machined or ground after being removed from the arbor. No malformation of

the machined or ground surface due to "springing back" after being held by distorting stresses, will occur, for the stresses applied to the stator core to hold it on the arbor are equal in all directions and thus avoid distorting the stator core.

The present device therefore eliminates the usual high percentage of scrap or rejected stator cores generally experienced by the use of the standard arbor having positively actuated pressure elements. This facilitates production and reduces costs, both beneficial to the producer and the ultimate purchaser.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An arbor upon which a work piece may be mounted for machining a contour thereof, comprising in combination, a rotatable work carrier having an axial opening provided with a closure at one end; equally spaced open, radial slots in said carrier provided in a portion intermediate its ends; radially movable segments in said slots the inner end of each segment being normally flush with the surface of the opening; resilient means in the arbor, engaging opposite sides of each segment and operative yieldably to maintain said segments in normal position; a plug axially slidable in the axial opening of the carrier, said plug having a portion slidably extending through the closure, said partition being of lesser diameter than the plug portion fitting into said opening, whereby an annular space is provided within the carrier said space communicating with all of the radial slots; an elastic medium in said space, expansible by pressure being exerted thereupon in response to movement of the plug; and means for actuating the plug relatively to the carrier to compress said medium and cause it to engage and move all segments radially outwardly at substantially equal pressure.
2. An arbor for supporting a work piece during machining of a surface thereof, said arbor comprising a rigid core having a coaxial opening; radial passages in the core extending from its outer peripheral surface to the coaxial opening thereon; piston like elements radially slidable in each passage; an elastic medium in the opening of the core; means movable in said opening, coaxially of the core for exerting compressing force upon the elastic medium to urge the piston like elements outwardly of the core; and yieldable means in the core, engaged by each piston like element, said yieldable means resisting movement of said elements out of normal position by the elastic medium.
3. An arbor for supporting a work piece during machining of said work piece, said arbor comprising a cylindrically shaped, rigid core having a coaxial opening; radial slots extending from said opening to the peripheral surface of said core; a plug in each slot, slidable therein; spring loaded camming rings in the core, engaging all plugs and constantly urging them inwardly of the core; an elastic medium in the core opening, engaging all plugs; and means in the opening operative to compress and cause the medium to be displaced thereby urging the plugs outwardly of the core against the effect of the camming rings.
4. An arbor for supporting a work piece during machining of a surface thereof, said arbor com-

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prising a rigid core having a coaxial opening; radial passages in the core extending from its outer peripheral surface to the coaxial opening thereon; piston like elements radially slidable in each passage; two oppositely disposed, spring loaded retractors provided in the core, said retractors engaging each piston like element at opposite points, said retractors being operative to resist outward thrust of said elements relatively to the core; an elastic medium in the core opening, constantly engaging all of said elements; a piston in the core opening engaging the elastic medium; and means supported by the core and engaging the piston therein for moving it to compress and displace the medium to urge the piston like elements outwardly of the core against the effect of the retractors.

5. An arbor for supporting a work piece, said arbor comprising a cylindrically shaped core having a coaxial, end to end opening; equally spaced radial slots extending from the core opening to the outer peripheral surface and terminating short of the ends of the core; pressure elements slidable radially in said slots; closure means for one end of the core opening; a spring loaded ring provided at each end of the core, each ring hav-

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ing a camming edge urged into operative engagement with a cooperating cam faced notch in each pressure element, said rings yieldably resisting outward movement of the pressure elements; a body of elastic material in the core opening; a piston in said core opening and actuating means engaging the piston and threaded to the closure means, said actuating means being operative to move the piston for compressing and displacing the elastic body to move the pressure elements against the effect of the spring loaded rings which return said pressure elements to normal position when pressure on the elastic body is released.

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