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EXPANDING CORE SHAFT

Filed April 11, 1960

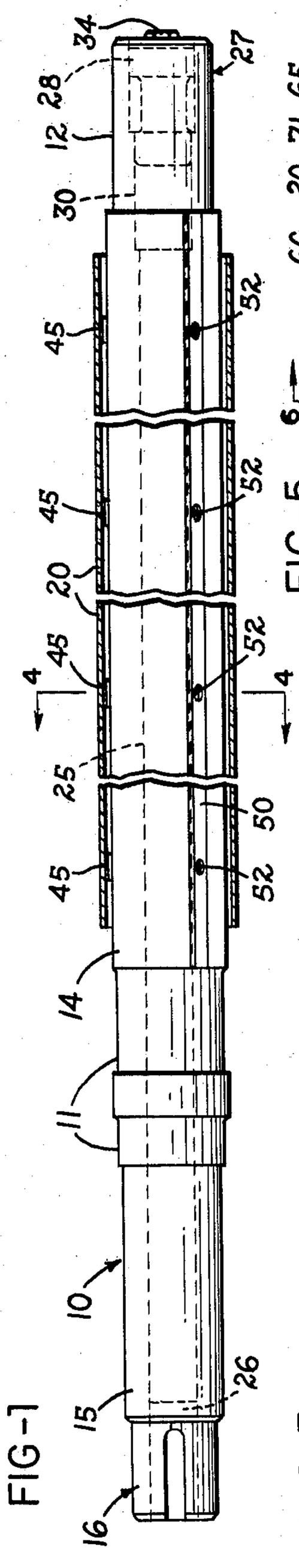

FIG-1

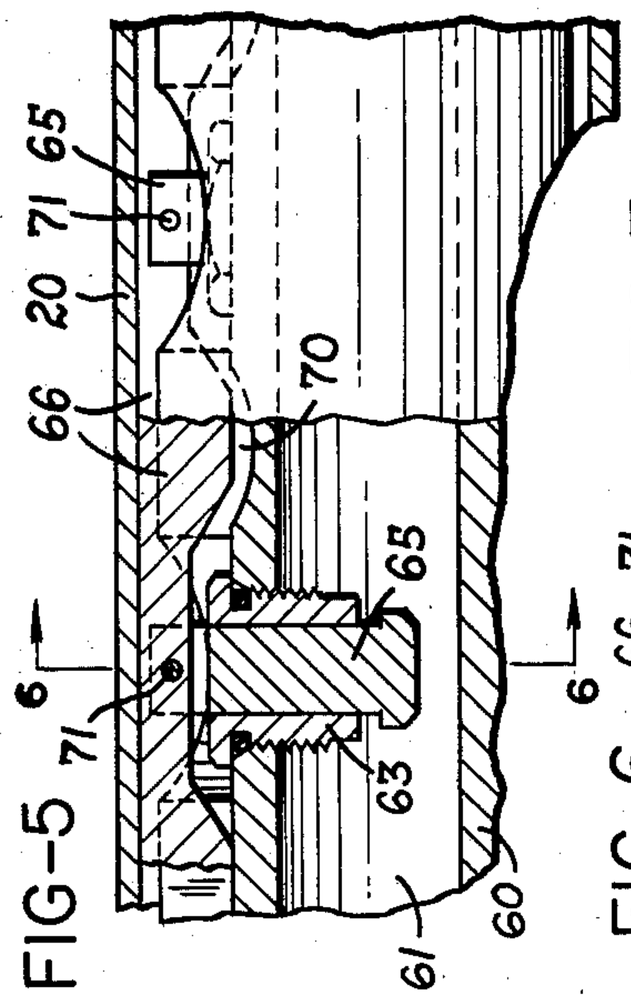

FIG-5

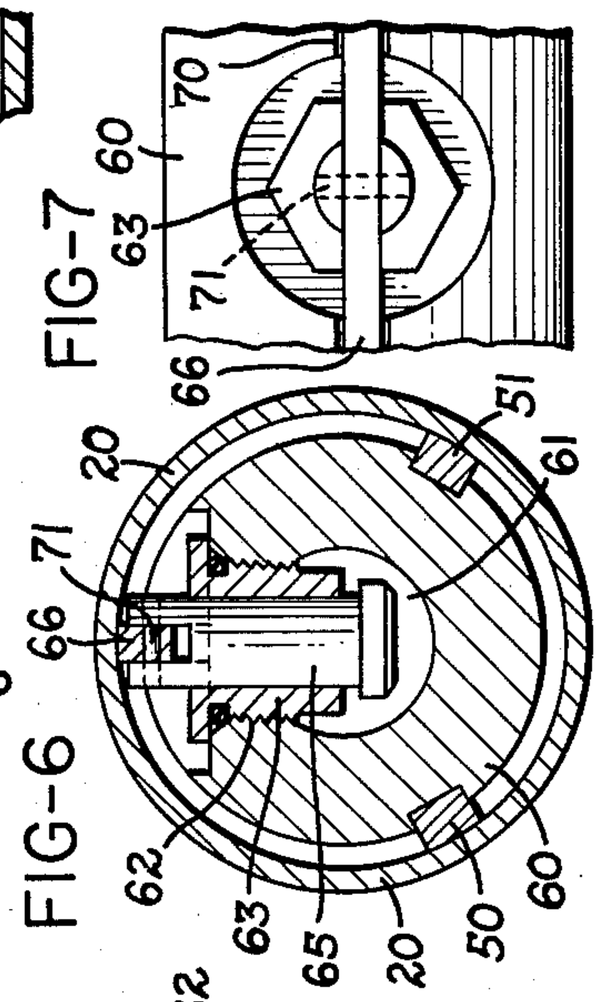

FIG-6

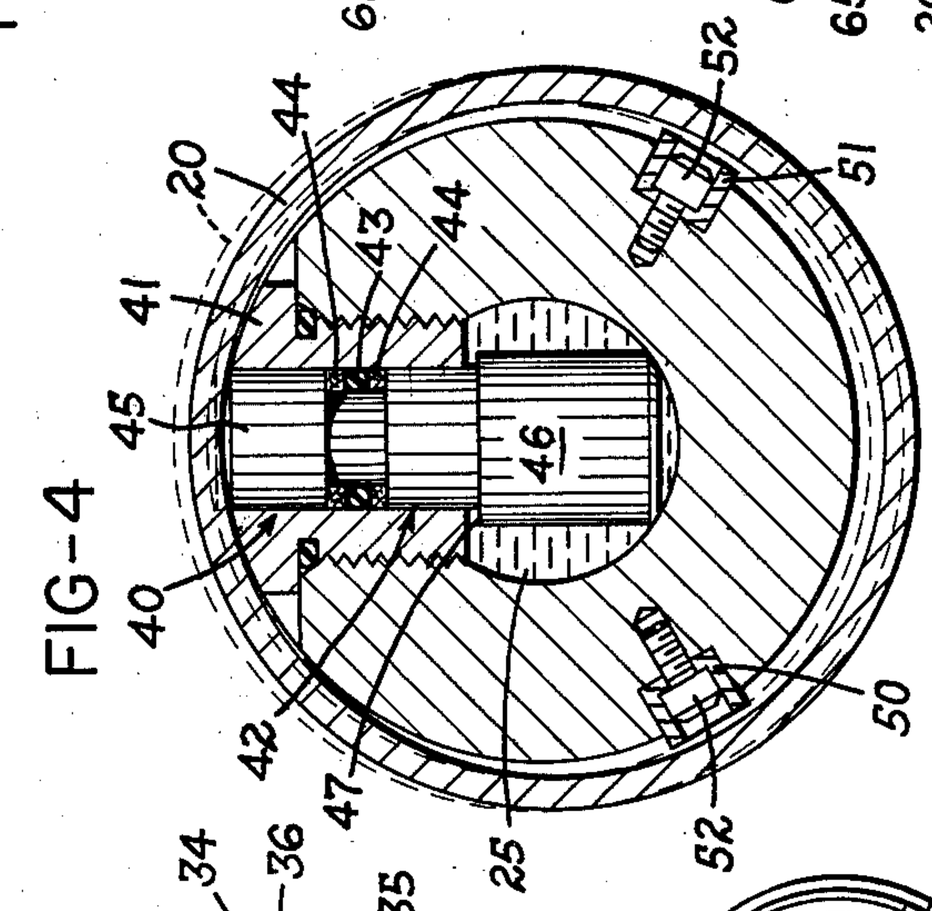

FIG-4

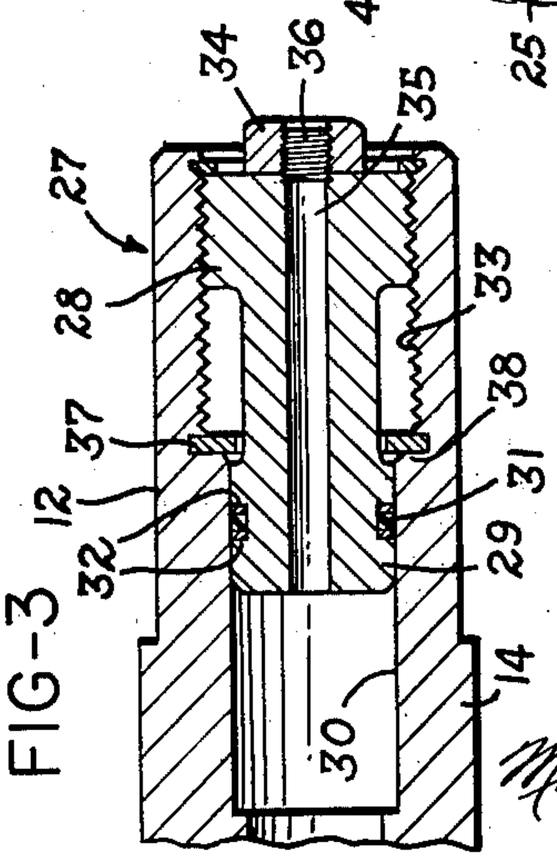

FIG-3

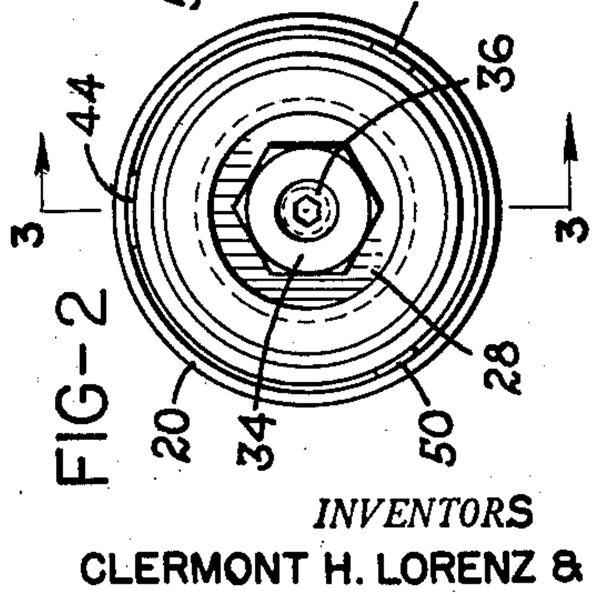

FIG-2

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EXPANDING CORE SHAFT

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This invention pertains to expanding shafts and more particularly to an expanding shaft for supporting a hollow core on a winder or unwinder for web material.

An expanding shaft for removably supporting a hollow core should have positively operating core gripping elements to provide for ease in the assembly of the core and for a firm grip on the inside surface of the core once the core is assembled over the shaft. Such a shaft is particularly useful, for example, in the paper making industry where a continuous web of paper is to be wound onto or unwound from a core suitably mounted on a winder shaft. This invention provides an expanding core shaft including one or more driven piston elements arranged for radial extending movement to effect positive engagement with a removable core.

An advantage of this invention resides in an ability to provide accurate centering of one or more hollow cores on a shaft which is important in achieving proper balance in high speed winding and unwinding operations. In a preferred embodiment, the shaft is arranged with a totally enclosed hydraulic system including a driving piston movable therein for effecting the desired locking of a core through the movement of the driven piston elements. The use of hydraulic fluid for the operation of the driven piston elements provides for positive and uniform force application to the core as well as positive retraction out of engagement with the core. The invention may be incorporated in stub shafts or mandrels for the support of one end of a core, or a single shaft may be used to support one or more cores in true axial alignment to the mandrel.

It is therefore a principal object of this invention to provide an expanding shaft as outlined above having positive core gripping elements for the releasable support of a core thereon.

A further object of this invention is to provide an expanding shaft as outlined above having a mechanism which effects substantially uniform force engagement with an inside surface of a core to hold the core on a mandrel against slippage.

A still further object of this invention is to provide an expanding shaft as outlined above arranged to hold a removable core concentric with the center line of the mandrel.

Another object of this invention is to provide an expanding shaft as outlined above including an enclosed hydraulic force transmission system for effecting engagement with, and disengagement from, a hollow core.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing—

FIG. 1 is a side view of a shaft constructed in accordance with this invention showing a core in section positioned thereon;

FIG. 2 is an end view of the shaft of FIG. 1;

FIG. 3 is a section taken generally along the line 3—3 of FIG. 2 through the end of the shaft and showing the details of the driving piston;

FIG. 4 is a cross section through the shaft taken generally along the line 4—4 of FIG. 1 showing the details of the core engaging mechanism;

FIG. 5 is a fragmentary view partly in side elevation and partly broken away in axial section showing a

shaft constructed in accordance with the invention wherein the several driven pistons are connected by an axially extending bar;

FIG. 6 is a section on the line 6—6 of FIG. 5; and

FIG. 7 is a fragmentary elevational view looking down on FIG. 6 with the core removed.

Referring to the drawing, which illustrates preferred embodiments of this invention, the body of a shaft suitable for use in a paper winding or unwinding machine is illustrated generally at 10. The shaft 10 includes a pair of spaced apart bearing surfaces 11 and 12 and an intermediate mandrel portion 14. The shaft 10 has an extended end 15 upon which is formed a connection 16 by means of which the shaft may be operatively connected with a clutch brake, or any drive or holding connection, as desired. The bearing surfaces or land areas 11 and 12 are arranged to work with suitably removable bearings (not shown) for the ready removal and mounting on a winding or unwinding machine.

The mandrel portion 14 of the shaft 10 is adapted to receive a hollow core 20 thereon. The core 20 may be formed of paper, plastic, steel tubing, or any other material as desired, according to its intended use. The dimension of the mandrel portion 14 is such as to permit the ready insertion of the core 20 thereover.

The shaft includes a coaxially extending bore forming a hydraulic fluid chamber 25 within the shaft 10. The chamber 25 is closed at the end 15 of the shaft 10 by an integral wall 26 and is closed at the other end 27 of the shaft by a threaded plug 28 having a plunger portion on its end which forms a driving piston 29. The plunger piston 29 forms means by which hydraulic fluid may be displaced from within the chamber 25, and it is arranged for reciprocal movement within a cylinder 30 formed in the shaft. A fluid tight seal is effected between the piston 29 and the cylinder 30 by means of suitable packing, such as a single elastomeric ring 31 arranged in an appropriately formed groove on the piston 29. The ring 31 may, if desired, be provided with a pair of leather back-up washers 32.

The end 27 of the shaft 10 is internally threaded as indicated at 33, and forms a means by which the axial position of the plug 28 may be adjusted to regulate the position of the piston 29 within the cylinder 30. A drive nut 34 is welded to the exposed end of the plug 28 by means of which the plug 28 may be turned either inwardly to displace fluid from within the chamber 25 or outwardly to increase the displacement of the chamber. Entrapped air in the chamber 25 may be removed through a bleed passageway 35 in the piston by removing a plug 36 in the nut 34. A retaining ring 37 cooperates with the shank portion 38 of the plug 28 which is of reduced diameter to prevent the plug from being screwed all the way out of the shaft.

Means for effecting a positive gripping engagement with the inside of a core 20 upon the displacement of hydraulic fluid within the chamber 25 includes a plurality of driven piston assemblies indicated at 40. The piston assemblies include hardened plugs 41 tapped into threaded openings radially formed at spaced intervals along the length of the mandrel and into the chamber 25. A driven piston 42 is mounted within each of the plugs 41 for limited radial extended and retracted movement therewithin. Suitable packing, such as an elastomeric ring 43 positioned between a pair of leather back-up washers 44 on each of the pistons 42, effects a fluid tight seal between the chamber 25 and the plug 41.

The pistons 42 each include a core gripping outer end 45, and an enlarged inner end portion 46 received within the chamber 25. In the fully retracted position as shown in FIG. 4, the portion 46 of the piston 42 is bottomed

in its inner limit position against the inside wall of the chamber 25. Means for limiting the maximum outward extended movement of the piston 42 in relation to the mandrel portion 14 includes a shoulder 47 on the portion 46 engageable with the bottom of the plug 41 in the extended position of the piston 42. The end 45 of the piston 42 is preferably spherically curved for smooth engagement with the inner surface of the core 20.

The number of the piston assemblies 40 is determined by the length of the mandrel portion 14 of the shaft 10 and the desired distribution of the clamping force effected thereby, satisfactory results being obtained with these assemblies spaced approximately 3 inches apart when many narrow cores are used and 6 to 8 inches apart when longer and fewer cores are used. The force on each piston 42 is a function of pressure build-up by piston 29. Also, the force effected by each piston 42 against the inside surface of the core 20 will be equally distributed by each of the assemblies 40 to obviate the likelihood of distortion of the core.

Additional core support is provided by fixed core supports consisting of a pair of angularly spaced ribs 50 and 51 extending substantially the length of the mandrel portion 14. The ribs 50—51 are arranged for engagement with the inside surface of the core in cooperation with the piston assemblies 40 to provide for support and gripping at peripherally equally spaced points and preferably of such dimension as to hold the core concentric with the mandrel portion 14. The ribs 50—51 are secured to the shaft 10 by means of spaced countersunk screws 52.

The operation of this invention is largely evident from the preceding description. The shaft 10 is removed from its bearing supports and the driving piston 29 is retracted by application of a suitable tool to the nut 34 and rotating to withdraw the plunger 29 within the cylinder 30. This has the effect of withdrawing each of the pistons 42 of the assemblies 40 into their inner retracted positions, thereby releasing any core 20 or core multiple sections which had been mounted thereon and providing for the insertion of a new core 20 over the mandrel portion 14. The core 20 is secured in place by turning the driving piston 29, by means of the nut 34, into the cylinder 30 thereby effecting a displacement of hydraulic fluid within the chamber 25. The hydraulic pressure within the chamber 25 will displace each of the pistons 42 outwardly with equal force into engagement with the inner surface of the core 20 to secure the core against the exposed outer end 44 of the piston 42 and the ribs 50 and 51 concentric to the center line of the shaft.

It is understood that the piston assemblies 40 may be operated remotely from a remote source of fluid pressure by means of a fluid connection into the chamber 25 preferably at the plug 28 through a quick disconnect and pressure holding fluid connection. Such connection may be made by removing the plug 36 and applying the piston operating fluid pressure through the passageway 35 of the plug 28, if desired. Also, it is understood that such external source of pressure may be used to supplement the pressure within the chamber 25 as to increase or decrease a pressure established by the piston 29. It is also within the scope of this invention to provide a stub shaft supported by bearings at one end only for locking engagement with one end of a core.

In the form of the invention shown in FIGS. 5–7, the shaft 60 is generally similar in construction to the shaft 10 and includes a similar axial chamber 61 to be filled with hydraulic fluid, and one end of the shaft 60 is provided with a control piston as shown in FIG. 3 for the shaft 10. The shaft 60 is provided similarly to the shaft 10 with a plurality of tapped radial bores 62 which receive threaded annular plugs 63 for supporting driven pistons 65 in the same manner as described for the plugs 41 and pistons 42. Instead of these pistons operating individually, however, they are connected by an axially extending bar 66 to provide a gripping action over the

entire length of the interior surface of the core 20 in combination with the keys or ribs 50 and 51.

In order to accomplish this result, the shaft 60 is provided with a milled slot 70 extending axially thereof to receive the bar 66, but this slot does not extend all the way into the internal chamber 61. The outer end of each of the pistons 65 is slotted as shown in FIG. 6 to receive the bar 66, and a pin 71 forms a pivotal connection for the bar in each of these slotted pistons. With this arrangement, when the pressure is applied as described in connection with FIGS. 1–4, the pistons 65 move radially outwardly and thus carry the bar 66 into the desired gripping engagement with the inner surface of the core.

It is therefore seen that this invention provides an expanding shaft which is characterized by simplicity and positive action for gripping and centering a hollow core and for releasing such core at will. It includes a minimum of working parts and provides substantially uniform tension forces along the length of a core mounted for rotation thereon. It is preferably self-contained and includes working parts which are constructed for minimum wear in use and therefore provide a long service life.

While the forms of apparatus herein described constitutes preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claim.

What is claimed is:

A self-centering expanding core shaft for removably gripping a hollow core, comprising an elongated generally cylindrical body having a diameter less than that of said core to be received thereon and having means defining a hydraulic liquid chamber therein extending through one end thereof and terminating adjacent the opposite end of said body, means in said one end defining a driving cylinder, an operator including a driving piston formed on the inner end thereof received in said cylinder closing one end of said chamber and having an outer driving end threadedly received in said body for liquid displacing movement in said body, a plurality of spaced apart driven piston assemblies arranged in a single row on said body including means defining a radially extending cylinder bore communicating with said fluid chamber, a driven piston for each of said assemblies having a portion forming a seal with said bore and movable outwardly and inwardly in direct proportion to fluid displacing movement of said driving piston, the outer ends of each of said driven pistons being proportioned for direct engagement with the inside surface of said core at longitudinally spaced apart positions upon extending movement thereof, means on said body defining a pair of longitudinally extending grooves spaced substantially at 120° intervals from each other and from said row of piston assemblies and a separate rib fixedly received and supported along the length of each of said grooves having an outer core gripping surface proportioned to engage the inside surface of said core upon said outward movement of said driven pistons providing three point support for said core on said shaft.

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