Sept. 14, 1965 W. F. HUCK 3,205,814

ROTARY CYLINDER CONSTRUCTION OF REMOVABLE SHELL TYPE

Filed Sept. 24, 1964 4 Sheets-Sheet 1

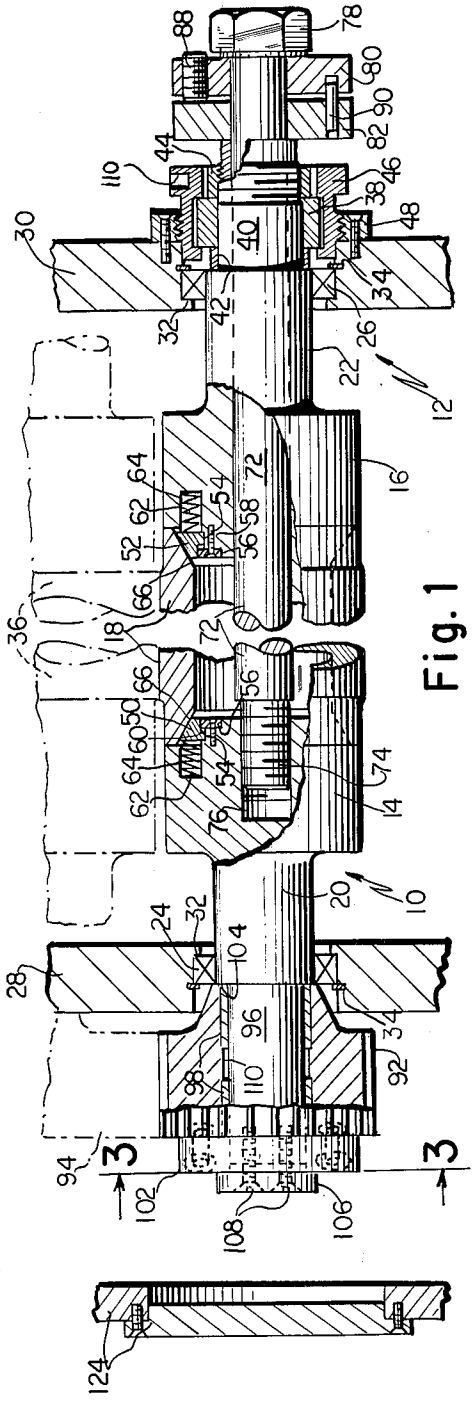


Fig. 1

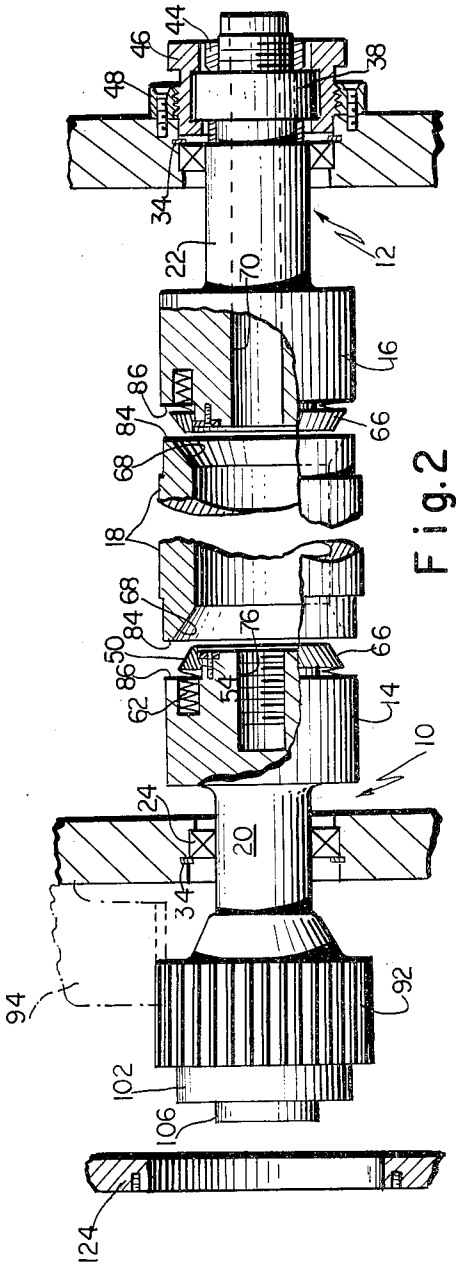


Fig. 2

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ROTARY CYLINDER CONSTRUCTION OF REMOVABLE SHELL TYPE

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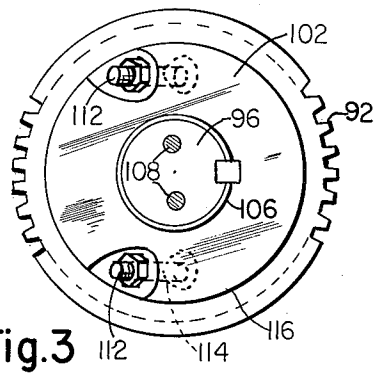


Fig.3

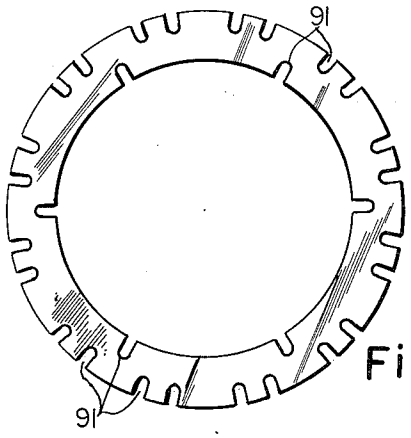


Fig.5

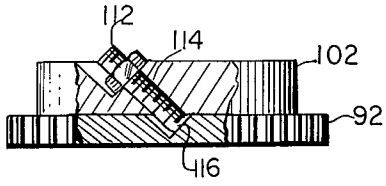


Fig. 4

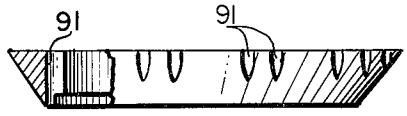


Fig. 6

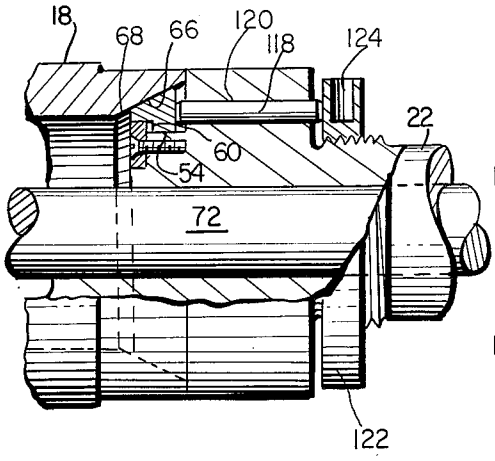


Fig. 7

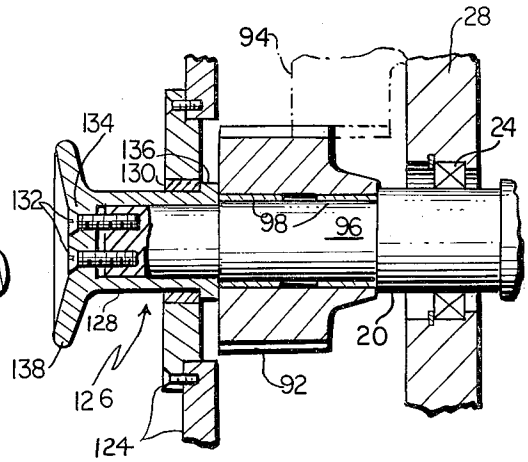


Fig. 8

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ROTARY CYLINDER CONSTRUCTION OF REMOVABLE SHELL TYPE

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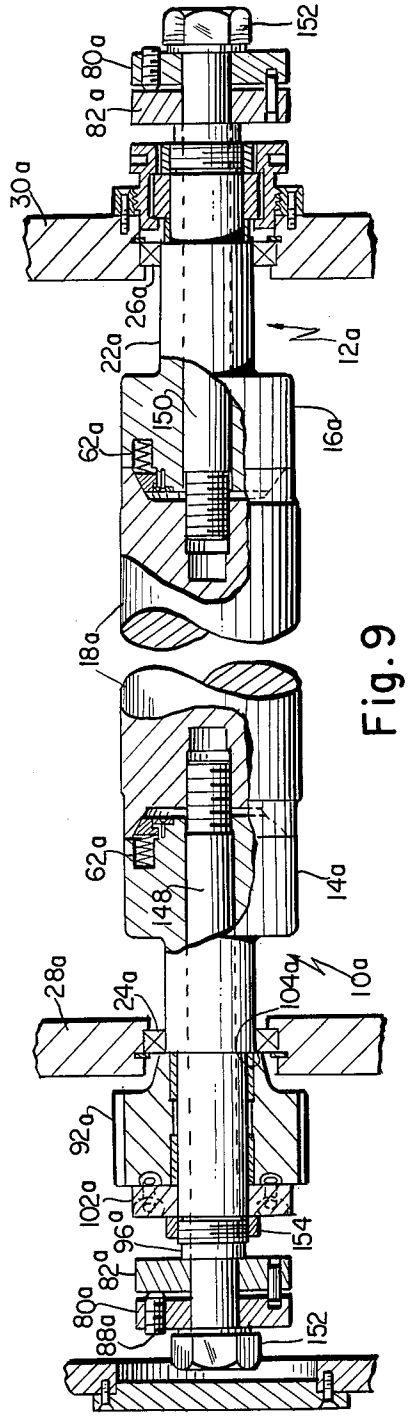


Fig. 9

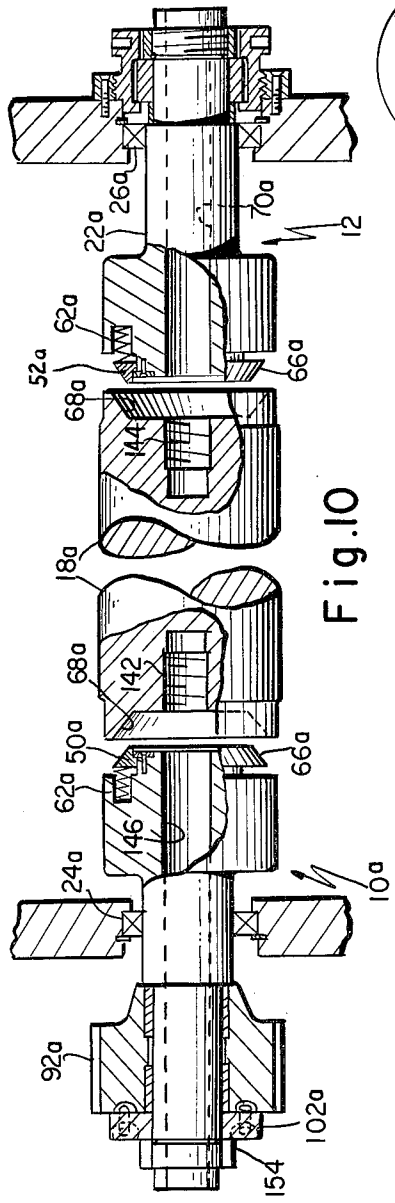


Fig. 10

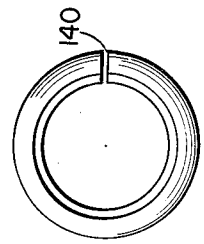


Fig. 11



Fig. 12

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ROTARY CYLINDER CONSTRUCTION OF REMOVABLE SHELL TYPE

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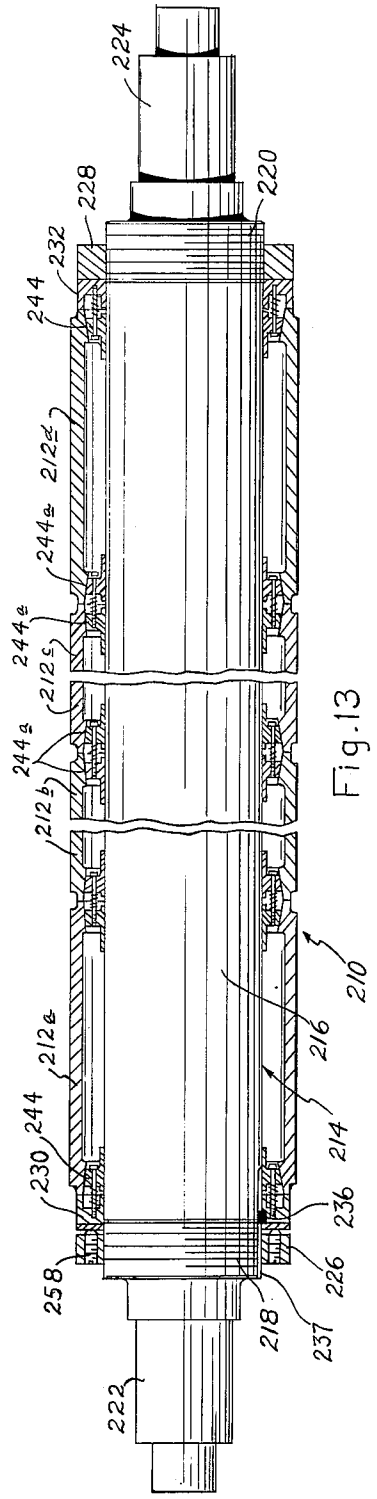


Fig. 13

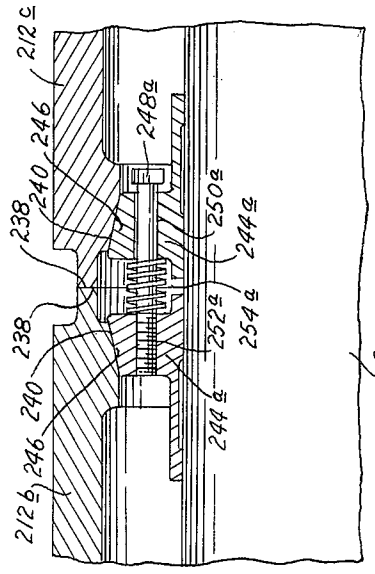


Fig. 15

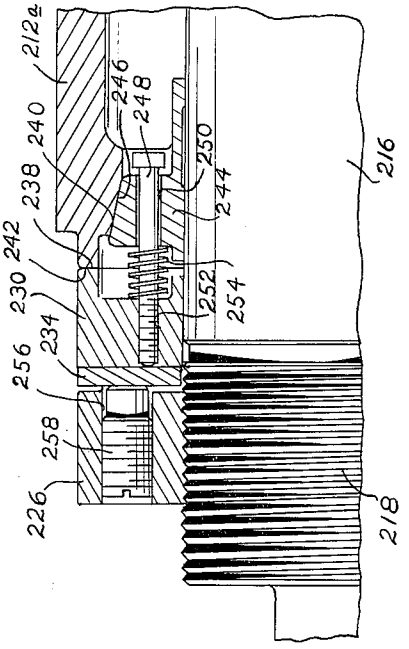


Fig. 14

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3,205,814
ROTARY CYLINDER CONSTRUCTION OF REMOVABLE SHELL TYPE

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Filed Sept. 24, 1964, Ser. No. 400,635
18 Claims. (Cl. 101—216)

This is a continuation-in-part of application Serial No. 303,571, filed August 21, 1963, now abandoned.

This invention relates to cylinders for rotary material processing machines and in particular to a rotary cylinder construction embodying a cylindrical body that is removable for replacement by another similar body while the end structures of the cylinder and the bearings and drive gears associated therewith remain in place in the machine.

While the cylindrical body will ordinarily be in the form of a shell, that is, hollow from end to end, the invention is also applicable to constructions making use of removable cylindrical bodies having hollows only at their ends. Except where otherwise evident from the context, the term cylindrical body as used herein contemplates cylindrical bodies of the latter nature as well as true cylindrical shells.

It is an object of the invention to provide a rotary cylinder construction of the removable shell or body type whereby removal and exchange of the shell or body may be effected more quickly and with less effort than in the case of known constructions.

Another object is to provide a heavy-duty rotary cylinder of the removable shell or body type which possesses greater rigidity and will withstand greater radial loads than known cylinders of this type.

It is a further object of the present invention to provide an improved rotary processing cylinder construction whereby a removable shell or body forming the working surface of the cylinder may be centered exactly and quickly on the axis of rotation and thereafter clamped securely and quickly in its centered position.

According to this invention, the working surface of a rotary cylinder is constituted by the outer surface of at least one cylindrical body having abutment surfaces and preferably recessed centering surfaces at its opposite ends in fixed relation to the outer surface of the body, the body is removably disposed between clamping heads located at the opposite ends of the body to coact with the abutment surfaces of the latter, the clamping heads are on supporting means providing journals at the opposite ends of the cylinder by which the latter can be rotatably supported, means are carried by the supporting means for converging the heads and clamping them against the abutment surfaces of the body to hold the latter securely against displacement by working loads, body centering means are converged with the clamping heads and present positioning surfaces normally in fixed positions radially of the axes of the journals, such positioning surfaces being disposed to mate with and position the centering surfaces of the body upon a convergence of the heads insufficient to clamp the abutment surfaces of the body between the heads, and the centering means includes elements yieldable to enable displacement of the heads axially relative to the positioning surfaces upon the further convergence of the heads to body clamping position.

According to a preferred mode of carrying out the invention, the body centering means include rings which are coaxial with and slidably axially relative to the clamping heads and compression springs are provided to bear against the rings and thereby urge the positioning surfaces provided on the rings into seated position against the mating centering surfaces recessed in the adjacent ends of the removable body or shell. Thus the positioning surfaces on the rings and the centering surfaces on the body may be tightly seated to position the shell in accurate coaxial relation to the journals and the clamping heads thereafter further converged to clamp the abutment surfaces of the body between the heads, with the converging movement of the clamping heads being accompanied and made possible by movement of the rings coaxially relative to the heads against the resistance of the springs. The body is thus securely clamped between the clamping heads in accurate coaxial relation to the journals.

In another embodiment of the invention, the yieldable elements of the centering means are constituted by deformable rings having the positioning surfaces thereon. Thus, after the positioning surfaces are engaged with the centering surfaces of the body to position the outer surface of the latter in accurate coaxial relation to the journals, the further convergence of the clamping heads for securely clamping the latter against the abutment surfaces of the body is accompanied and made possible by deformation of the rings.

Where the working surface of the cylinder is constituted by the outer surfaces of a plurality of cylindrical bodies, clamping heads formed separately from the bodies may be provided to coact with only the abutment surfaces of the bodies adjacent the opposite ends of the cylinder, and each abutment surface at an end of a body remote from an end of the cylinder coacts with the abutment surface of the next adjacent body which serves as a clamping head therefor.

The convergence of the clamping heads may be accomplished by a tie rod extending axially through the body and coacting with the supporting means to draw the clamping heads axially toward each other against the abutment surfaces of the body upon movement of the tie rod relative to the supporting means. Alternatively, the clamping heads may be axially movable on the supporting means and displaced toward each other or converged for clamping the body therebetween by means of axial clamping screws adjustably carried by the supporting means. In still another construction, a solid cylindrical body is formed with axial, tapped sockets at its opposite ends and convergence of the clamping heads is effected by separate rods passed axially through the supporting means at the opposite ends of the body and screwed into the tapped sockets.

These and other objects, features and advantages of the invention will be apparent from the following detailed description of illustrative embodiments of the invention and from the accompanying drawings wherein:

FIG. 1 is a view partially in section of a portion of a rotary material processing machine embodying the cylinder of the invention with the removable body of the cylinder shown clamped between the heads of the supporting structure of the cylinder;

FIG. 2 is a view similar to FIG. 1 except that the removable body is here shown released from clamping engagement with the heads;

FIG. 3 is a view taken on line 3—3 of FIG. 1 showing details of a device for circumferentially re-registering the cylinder of the invention following replacement of the removable body;

FIG. 4 is a fragmentary side view of the circumferential registering device of FIG. 3;

FIGS. 5 and 6 are front and edge views respectively of an alternate form for one element of the body centering construction;

FIG. 7 is a fragmentary view of an alternative construction for clamping and centering the removable body with respect to the supporting structure therefor;

FIG. 8 is a view of an alternate construction of a circumferential register device;

FIG. 9 is a view similar to that of FIG. 1, but showing

another embodiment of the invention with the removable body of the cylinder in its clamped condition;

FIG. 10 is a view similar to FIG. 9 except that the removable body is here shown released;

FIGS. 11 and 12 are front and edge views, respectively, of a further alternate form for the element of the shell centering construction shown in FIGS. 5 and 6;

FIG. 13 is a view similar to that of FIG. 1, but showing still another embodiment of the invention having the working surface of the cylinder defined by a plurality of shells or hollow bodies which are illustrated in clamped condition;

FIG. 14 is an enlarged detail view showing a portion of the structure of FIG. 13; and

FIG. 15 is another enlarged detail view of a portion of the structure of FIG. 13.

Referring to FIG. 1, it will be seen that the cylinder in accordance with one embodiment of the invention includes supporting members **10** and **12** at its opposite ends which are formed with integral enlarged inner portions to form cylindrical heads **14** and **16** between which a removable cylindrical body in the form of a hollow shell **18** is releasably clamped so that its outer surface constitutes the working surface of the cylinder.

The supporting members **10** and **12** define outwardly of the heads **14** and **16** journals **20** and **22** which are supported in bearings **24** and **26** carried in the opposite frame members **28** and **30** of a rotary material processing machine. The bearings are fixed against axial movement relative to the frame members **28** and **30** as by shoulders **32** formed on the frame members and retaining rings **34** held in grooves in the frame members. The processing machine may be, for example, an offset printing press in which the shell **18** constitutes a printing or plate cylinder carrying the patterns which are to be printed and tangentially contacting an offset or transfer cylinder **36**, shown in phantom in FIG. 1, which coacts in known manner with an impression cylinder, not shown, to print a web passed therebetween.

Journal **20** of supporting member **10** is axially slidable in its bearing and is preferably accurately machined and polished to ensure accurate axial alignment with and easy sliding in the bearing. Supporting member **12** is fixed against axial sliding displacement relative to its frame member by a sleeve bearing **38** received on a shaft **40** formed as an extension of journal **22** and held against movement along the shaft by a spacer ring **42** and lock nut **44** screwed onto the end of shaft **40**. The sleeve bearing **38** rotates in an annular groove formed in a screw sleeve **46** threadably received in a nut **48** secured to the frame member **30**.

The inner ends of supporting members **10** and **12** carry centering devices in the form of wedge rings **50** and **52** which are each slidable axially along a cylindrical surface **54** projecting axially beyond the respective clamping head **14** or **16**. A retainer ring **56** is received in an annular recess formed in the inner end of each supporting member and is held in place by screws **58**. Each retainer ring extends radially beyond the related surface **54** to coact with a lip **60** formed on the related wedge ring to define the axially innermost position of that ring and prevent it from sliding off the surface **54**. Compression springs **62** received in axial sockets **64** spaced about the periphery of each head bear against the wedge rings to urge them continuously toward their axially innermost positions.

The radially outer surfaces of the wedge rings define positioning surfaces **66** of frusto-conical form adapted to seat against mating frusto-conical centering surfaces **68** recessed in the opposite ends of the removable shell.

The supporting member **12** and its head **16** are provided with an axial bore **70**. A tie rod **72** is adapted to be passed through the bore **70** and through the hollow of the shell **18** for coaction at its threaded end **74** with a screw threaded socket **76** extending axially in the supporting member **14**.

When tie rod **72** is passed through the bore **70**, a head **78** on the other end of the tie rod bears against discs **80** and **82** carried on the rod, which discs in turn bear against the outer end of the axially fixed supporting member **12**. Thus, when the rod is turned, as by engagement of a suitable tool with the head **78**, to screw the end **74** into the socket **76**, the journal **20** of supporting member **10** will slide in the bearing **24** and the head **14** will be gradually drawn toward the head **16** to engage the positioning surfaces **66** with the mating centering surfaces **68** at the ends of the shell held therebetween. As these surfaces engage, further convergence of the heads will compress the springs **62** so that these springs will exert a force thrusting the positioning surfaces on the wedge rings into tight seating engagement with the mating centering surfaces on the ends of the shell, whereby to position the shell in accurate coaxial relation to the journals **20** and **22**. The springs **62** are chosen in number and size such that they will exert a large axial force, for example one of 720 pounds, upon each of the rings and they will apply through the rings radial forces sufficient to achieve the accurate centering of the shell against any radial loads that may be applied to the shell, through, for example, its contact with the transfer cylinder **36**.

Further convergence of the heads by continued turning of the rod **72** further compresses the springs **62** and moves the annular clamping surfaces **86** extending radially near the peripheries of the heads **14** and **16** into abutting relation with the annular surfaces **84** on the opposite ends of the shell, and thereby clamps the shell securely between the heads with a force sufficient to resist all the torsional, radial and other loads to be applied to it in the use of the cylinder.

Thus, the shell, after having been fixed in accurate coaxial relation to the journals by the seating engagement of the positoning surfaces **66** against the mating centering surfaces **68**, is held clamped immovably between the heads by the abutting engagement of the mating annular surfaces **84** and **86**.

The axial clamping force on the shell may be increased if desired by tightening set screws **88** threaded in disc **80** and bearing against disc **82**. Pins **90** interconnect discs **80** and **82** to preclude relative rotation therebetween.

In order to ensure that the assembled cylinder will be perfectly rigid in the structional sense and that the shell will be exactly concentric to the journals, the wedge rings are preferably formed of a material which is rigid but softer than that of the shell so that the wedge rings may be deformed by the force exerted through the tie rod as the heads reach their final clamping position. For example, the shell may be formed of hardened plate steel, and the wedge rings of nodular iron.

Alternatively, and as shown in FIGS. 5 and 6, the wedge rings may be provided with a plurality of axially extending slots **91** spaced about their conical surface and inner bore whereby to weaken the rings and allow them to be deformed and to conform to the configuration of the mating surfaces as the final clamping action occurs. As a further alternative, and as shown in FIGS. 11 and 12, the wedge rings may be split as at **140** so that they may close up at the split during the clamping action to ensure conformance to the mating surfaces.

The assembled cylinder is rotatably driven through a spur gear **92** which meshes with a driving gear **94** (shown in broken lines on FIGS. 1 and 2) and is mounted on a shaft **96** formed as an extension of journal **20**. The gear **92** is mounted on the shaft **96** by sleeve bearings **98** which allow the gear to be rotated on the shaft and are maintained in spaced relation on the shaft by a circumferential rib **110** on the internal periphery of the gear. The gear **92** is normally held from such rotation relative to shaft **96** by a ring or sleeve **102** which is keyed to the end of the shaft and is pressed against the gear **92**, to clamp the latter

between the ring and a shoulder **104** at the juncture of journal **20** and shaft **96**. Pressing of ring **102** against gear **92** is effected by an end cap **106** clamped to the end of the shaft by screws **108** threaded into axially extending sockets in the end of the shaft.

If upon the clamping of a new shell **18** in the manner above described it is found that printing elements on the new shell are laterally out of register with respect to the remainder of the machine, the screw sleeve **46** may be turned in the nut **48**, as by engagement of a suitable tool in radial bores **110'** provided for that purpose in the periphery of the screw sleeve, to displace the complete cylinder assembly axially relative to the frame members **28** and **30** to bring the shell into its lateral position corresponding to correct register.

Similarly, if upon the clamping of a new shell it is found that printing elements thereon are circumferentially (i.e., longitudinally) out of register with the rest of the machine, the screws **108** may be loosened to release the gear **92** from clamping engagement, whereafter the cylinder assembly may be rotated relative to the gear **92** by turning of one or the other of two set screws **112** threadably received in bores **114** extending obliquely through the wall of the ring **102** at spaced locations in the latter and projecting at their tips into notch-like depressions **116** formed in the adjacent face of the gear **92** (FIGS. 3 and 4). It will be evident that turning of one screw **112** in tightening direction will rotate the cylinder assembly in one direction and turning of the other screw **112** will rotate the cylinder assembly in the opposite direction, so that by selective turning of these screws the new shell may be moved to a circumferential position relative to the remainder of the machine corresponding to correct longitudinal register.

When it is desired to replace the shell **18** with another and different shell, the tie rod **72** is unscrewed from the socket **76** and the supporting member **10** slid axially outward from its position shown in FIG. 1 to that of FIG. 2, to release the shell and allow its removal. The journal **20** slides in its bearing **24** and the toothed face of gear **92** slides along that of gear **94** during such outward movement. After a new shell has been placed in position between the clamping heads of supporting members **10** and **12**, it is centered and clamped in its working position in the manner previously described.

FIG. 7 shows an alternative construction for thrusting the positioning surfaces on the wedge rings into tight seating engagement with the mating surfaces on the ends of the shell. In this construction, the compression springs **62** employed for this purpose in the construction of FIGS. 1 and 2 are replaced by a plurality of pins **118** engaging each wedge ring and extending slidably through axial bores **120** spaced about the periphery of each head for engagement with a nut **122** threaded on each supporting member. In this construction, the tie rod **72** is first screwed into the socket **76** to an extent to bring the annular clamping surfaces **84** into or near a position of abutment with the mating surfaces **86** whereafter the rings **122** are turned, as by engagement of a suitable tool in radial bores **124** provided for that purpose in each ring, to move the wedge rings axially along the cylindrical surfaces **54** and thrust the wedge rings axially relative to the heads to seat the positioning surfaces **66** tightly against the mating centering surfaces **68**. The shell is thereby positioned in accurate coaxial relation to the journals. The tie rod **72** is then further turned to further converge the heads axially and clamp the shell securely therebetween in its aforesaid coaxial relation. This further convergence of the heads following thrusting of the wedge rings into tight seating engagement is accompanied and made possible by compression or deformation of the wedge rings which for this purpose, and as previously indicated, are preferably either formed of a metal which is softer than that of the shell or are provided with weakening slots.

FIG. 8 shows an alternative form of the circumferential (i.e., longitudinal) register adjusting device. In this construction, which may be used in those applications wherein the shaft **96** formed as an extension of the journal **20** extends through the gear housing **124**, the ring **102** and end cap **106** of FIGS. 1–5 are replaced by a cup shaped member **126** which has a tubular sleeve portion **128** fitted over the end of the shaft **96** and rotatable in a sleeve bearing **130** in the housing **124**. Threaded axial bores are provided in the end of shaft **96** and screws **132** are passed through the closed end **134** of the member **126** and into threaded engagement with the shaft bores so that as the screws **132** are turned in tightening direction the member **126** is drawn along the shaft to press the radially enlarged free end **136** of that member against the gear **92** and clamp it against rotation on shaft **96**. It will be seen that when the screws **132** are loosened, the cylinder assembly may be turned, as by grasping a knob **138** formed as a radial enlargement of the closed end **134** of the member **126**, to dispose the processing elements on the newly clamped shell in a position corresponding to correct longitudinal register. The knob **138** also facilitates grasping of the supporting member **10** for axially sliding the latter to release the shell.

FIGS. 9 and 10 show a cylinder constructed according to the invention in which the removable cylindrical body is hollow or axially bored only at its end portions rather than from end to end, as in the construction of FIGS. 1, 2 and 7. In the cylinder of FIGS. 9 and 10, screw threaded sockets or bores **142** and **144** are provided in the opposite ends of the removable body **18***a* and through axial bores **146** and **70***a* are provided in the supporting members **10***a* and **12***a*, respectively. In mounting the shell **18***a*, it is positioned between the supporting members **10***a* and **12***a* and the supporting member **10***a* is slid axially in its bearing **24***a* to seat the frusto-conical positioning surfaces **66***a* provided on the wedge rings **50***a* and **52***a* against the mating frusto-conical centering surfaces **68***a* recessed in the opposite ends of the body **18***a*. The heads **14***a* and **16***a* are then converged axially against the shell ends by separate rods **148** and **150** which are passed through the bores **146** and **70***a* in the respective supporting members and are screwed at their threaded ends into the sockets **142** and **144**, respectively. Each rod is provided with a rod head **152** by which it is turned and each carries discs **80***a* and **82***a* by which the axial clamping force on the body **18***a* may be increased if desired by tightening of set screws **88***a*. The spur gear **92***a* by which the assembled cylinder is rotatably driven is releasably clamped between ring or sleeve **102***a* and shaft shoulder **104***a* by a lock nut **154** screwed onto the shaft **96***a* so that upon loosening of the nut **154** the printing elements on the removable body may be brought, in the manner previously described with reference to the apparatus of FIGS. 1 and 2, into longitudinal register with the remainder of the printing machine.

FIG. 13 shows a cylinder according to the invention having its working surface constituted by the outer surfaces of a plurality of axially aligned cylindrical bodies, rather than by a single cylindrical body or shell, as in the constructions of FIGS. 1, 7 and 9. In the cylinder generally identified by the reference numeral **210** on FIG. 13, the working surface is defined by the outer surfaces of four hollow cylindrical bodies or shells **212***a*, **212***b*, **212***c* and **212***d* removably clamped in axial alignment on supporting means **214**, but it is to be understood that a larger or smaller number of shells may be employed.

The supporting means **214** includes a support cylinder **216** extending axially through the shells **212***a–d* and having end portions that project beyond the end shells and are externally threaded, as at **218** and **220**. Journals **222** and **224** project from the opposite ends of support cylinder **216** and are accurately coaxial with respect to the outer surface of the latter to provide means by which the cylinder **210** can be rotatably supported, as in suitable bearings (not shown). Internally threaded retaining rings **226** and **228** are removably screwed on threaded end portions **218** and **220**, respectively, of support cylinder **216**,

and annular clamping heads 230 and 232 are respectively axially slidable on support cylinder 216 between retaining ring 226 and the adjacent end of shell 212*a*, and between retaining ring 228 and the adjacent or outer end of shell 212*d*. A bearing washer 234 is preferably interposed between retaining ring 226 and clamping head 230. The clamping head 230 is preferably held against rotation relative to support cylinder 216, for example, by a key 236 secured to clamping head 230 and being slidable in an axial groove 237 formed in the surface of cylinder 216.

Each of the shells 212*a–d* has radially directed, annular abutment surfaces 238 at its opposite ends, and is further formed with frusto-conical centering surfaces 240 which are preferably recessed in the opposite ends of the shell and accurately coaxial with respect to the outer or working surface of the latter. The clamping heads 230 and 232 have radially directed, annular clamping surfaces 242 for mating engagement with the abutment surfaces 238 at the outer ends of the adjacent shells 212*a* and 212*d*, respectively. It will further be seen that, when the shells 212*a–d* are clamped between heads 230 and 232, there is mating engagement of the abutment surfaces 238 at the adjacent ends of the cylinders 212*a* and 212*b*, the cylinders 212*b* and 212*c*, and the cylinders 212*c* and 212*d*, respectively, and that, at such mating engagement of the abutment surfaces 238 of adjacent shells, each shell functions as a clamping head for the other.

Centering or coaxial arrangement of the shells 212*a–d* relative to the axes of the journals 222 and 224 is effected by wedge rings 244 and 244*a* which are slidable on support cylinder 216 and positioned adjacent the ends of the shells. The radially outer surfaces of wedge rings 244 and 244*a* define positioning surfaces 246 of frusto-conical form mating with, and adapted to seat against the centering surfaces 240 recessed in the adjacent ends of the shells.

Axially inward movement of each wedge ring 244 adjacent clamping heads 230 and 232 is limited by bolts 248 which are slidably received in axial bores 250 spaced about the periphery of the wedge ring and being screwed into similarly spaced tapped holes 252 in the clamping head 230 or 232. Compression springs 254 extend around the bolts 248 between each of the clamping heads 230 and 232 and the adjacent wedge ring 244 to urge the latter to its axially innermost positions. The wedge rings 244*a* associated with the ends of the shells spaced inwardly from the ends of the cylinder 210 are arranged in pairs connected by bolts 248*a* slidably received in bores 250*a* formed in one wedge ring 244*a* of each pair and being screwed into tapped holes 252*a* formed in the other wedge ring of the pair, with compression springs 254*a* extending around the bolts 248*a* so as to urge the paired wedge rings 244*a* axially apart to the maximum extent permitted by the bolts 248*a*.

At least one of the clamping rings 226 and 228, for example, the ring 226, as shown, is formed with tapped axial bores 256 spaced about the periphery of the ring and receiving clamping screws 258 which can be turned to extend inwardly beyond retaining ring 226 and exert an axial force upon the bearing washer 234, and hence against the adjacent clamping head 230.

In assembling the above described cylinder 210, the retaining ring 226 and the adjacent clamping head 230, or both retaining rings and clamping heads, are removed from support cylinder 216, and the paired wedge rings 244*a* and shells 212*a–d* are successively slidably installed on cylinder 216 from either one or both ends of the latter, depending upon whether the retaining rings and heads at one or both ends have been removed. After the installation of the shells and paired wedge rings on cylinder 216, the removed clamping head 230 and the wedge ring 244 connected thereto are axially installed over the threaded end portion 218 of cylinder 216 and then the retaining member 226 is screwed onto threaded end portion 218. The bolts 248 and 248*a* are adjusted prior to installation of the wedge rings to limit the axial movements of wedge rings 244 by springs 254 relative to the clamping heads 230 and 232 and of the wedge rings 244*a* relative to each other, so that close mating engagement of the positioning surfaces 246 with the centering surfaces 240 is achieved upon convergence of clamping heads 230 and 232 which leaves gaps between the adjacent abutment surfaces 238 of the shells and between the abutment surfaces 238 of the end shells and the adjacent clamping surfaces 242 of the clamping heads. Thus, when the assembly of shells 212*a–d* and clamping heads 230 and 232 is axially compacted by turning of one or both of retaining rings 226 and 228 relative to cylinder 216, springs 254 are initially compressed and exert an axial force thrusting the positioning surfaces 246 on the wedge rings, which are machined so as to be in accurate axial alignment with journals 222 and 224 into tight seating engagement with the centering surfaces 240 machined so as to be in accurate axial alignment with the outer surfaces of the related shells, whereby to position the shells in accurate coaxial relation to the journals. Further convergence of the heads 230 and 232, as by turning of the clamping screws 258 so as to thrust the latter axially against washer 234 bearing on clamping head 230, further compresses springs 254 and moves the annular clamping surfaces 242 of the heads into abutting relation with the adjacent abutment surfaces 238 at the outer ends of the end shells 212*a* and 212*d*, while the other abutment surfaces 238 of the shells are moved into abutting engagement with each other, thereby to clamp the shell securely between heads 230 and 232 with a force sufficient to resist all loads applied to the cylinder 210 during use of the latter.

Although illustrative embodiments of the invention have been described in detail herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein without departing from the scope or spirit of the invention, which is intended to be defined by the appended claims.

What is claimed is:

1. A heavy duty cylinder for rotary material processing machines comprising

supporting means providing journals at opposite ends of the cylinder for rotation in frame members of the machine,

at least one cylindrical body the outer surface of which constitutes a working surface of the cylinder, said body having abutment surfaces thereon at its opposite ends and further having centering surfaces adjacent said ends in fixed relation to said outer surface,

body clamping heads on said supporting means at the opposite ends of said body to coact with said abutment surfaces,

means carried by said supporting means for converging said heads and clamping them against said abutment surfaces to hold said body securely against displacement by working loads, and

body centering means converged with said heads and presenting positioning surfaces normally in fixed positions radially of the axes of said journals, said positioning surfaces being disposed to mate with and position said centering surfaces upon a convergence of said heads insufficient to clamp the latter against said abutment surfaces of the body, said centering means including elements yieldable to enable displacement of said heads axially relative to said positioning surfaces upon the further convergence of said heads to body clamping position.

2. A cylinder as in claim 1;

wherein said body centering means includes rings coaxial with said journals and movable axially relative to said clamping heads, said rings having said po-

sitioning surfaces thereon, and said yieldable elements are constituted by compression springs bearing against said rings and urging the latter relative to said clamping heads in the directions for seating said positioning surfaces against said centering surfaces of the body.

3. A cylinder as in claim 1;
wherein said yieldable elements of the body centering means are constituted by deformable rings having said positioning surfaces thereon so that said further convergence of the clamping heads to body clamping position after seating of said positioning surfaces against said centering surfaces is accompanied by deformation of said rings.

4. A cylinder as in claim 3;
wherein said deformable rings are movable on said supporting means for axial displacement relative to said clamping heads; and
further comprising thrusting means on said supporting means for axially displacing said rings relative to said heads in the direction for seating said positioning surfaces of the rings against said centering surfaces of the body.

5. A cylinder as in claim 1;
wherein said centering surfaces of the body are recessed in said ends of the body relative to said abutment surfaces, and said positioning surfaces of the centering means project axially beyond said clamping heads.

6. A cylinder as in claim 5;
wherein said centering and positioning surfaces are of mating frusto-conical form, and said abutment surfaces are directed radially and coact with radially directed clamping surfaces on said heads.

7. A cylinder as in claim 1;
wherein said supporting means includes separate supporting members at the opposite ends of said body, said supporting members being relatively axially movable and each having one of said journals and one of said clamping heads thereon; and
wherein said means for converging the heads is operative to effect relative axial movement of said supporting members toward each other.

8. A cylinder as in claim 7;
wherein said means for converging the heads includes and said supporting members respectively have a through bore and a threaded socket; and
wherein said means for converging the heads including a tie rod extending axially through said bore and the hollow shell, said rod having a threaded end screwed in said socket and a head at its opposite end which projects from said through bore.

9. A cylinder as in claim 7;
wherein said body has threaded sockets opening axially at the opposite ends thereof, and said supporting members have axial through bores; and
wherein said means for converging the heads includes tie rods extending through said bores and having threaded inner ends screwed into said sockets and headed outer ends beyond said journals of the supporting members.

10. A cylinder as in claim 7;
wherein said head on each of said supporting members is constituted by a radially enlarged portion of the latter having a radial, inwardly facing clamping surface to engage the adjacent abutment surface of said body, each supporting member further has a reduced diameter cylindrical surface projecting inwardly beyond said clamping surface and slidably carrying a ring having said positioning surface thereon.

11. A cylinder as in claim 10;
wherein said yieldable elements are compression springs interposed between said ring on each supporting member and the latter to urge the ring axially inward relative to said clamping surface of the related head.

12. A cylinder as in claim 10;
wherein said ring on each supporting member is deformable to constitute said yieldable element of the centering means; and
further comprising axially movable thrust rods carried by each supporting member for engagement at their inner ends with the related ring, and means on the supporting member acting against the outer ends of said thrust rods to move the latter axially inward for engagement of said positioning surface on the ring with said centering surface at the adjacent end of the body before engagement of said clamping surface of the head with the abutment surface of the body.

13. A cylinder as in claim 1;
wherein said body is in the form of a hollow shell, said supporting means includes a support cylinder extending axially through said hollow shell and having said journals projecting from its opposite ends, said clamping heads are axially movable on the opposite end portions of said support cylinder, said positioning surfaces are on rings slidable on said support cylinder and disposed axially inward with respect to said heads, and said means for converging the heads includes removable retaining rings movable axially on said support cylinder and disposed axially outward relative to said head.

14. A cylinder as in claim 13;
further comprising clamping screws extending axially through at least one of said retaining rings to thrust the adjacent clamping head axially inward to said body clamping position.

15. A cylinder as in claim 1;
further comprising a drive shaft extending from one of said journals, a drive gear turnable on said drive shaft, and means for locking said gear in adjusted position on said shaft.

16. A cylinder as in claim 1;
wherein a plurality of the cylindrical bodies are axially arranged between said clamping heads with said abutment surfaces at adjacent ends of said bodies being engageable with each other upon said further convergence of the heads to body clamping position against the abutment surfaces at the ends of said bodies adjacent said heads.

17. A heavy duty cylinder for rotary material processing machines comprising
a support cylinder having coaxial journals projecting from its opposite ends for rotation in frame members of the machine,
a plurality of axially arranged cylindrical shells inwardly telescoped over said support cylinder and the outer surfaces of which constitute a working surface, each of said shells having abutment surfaces thereon at its opposite ends and further having centering surfaces recessed in said ends in fixed relation to said outer surface of the shell,
body clamping heads on said supporting cylinder adjacent the opposite ends of the latter to coact with said abutment surfaces at adjacent ends of said shells,
means carried by said support cylinder for converging said heads to clamp them against said abutment surfaces at said adjacent ends of the shells and, in turn, to clamp together abutment surfaces at the ends of said shells which are remote from said heads thereby to hold said shells securely against displacement by working loads, and
body centering means movable on said support cylinder between said heads and converged with said heads, said body centering means presenting positioning surfaces normally in fixed positions radially of the axes of said journals and which are disposed to mate with and positioning said centering surfaces

of the shells upon a convergence of said heads insufficient to clamp said abutment surfaces of the shells, said centering means including elements yieldable to enable displacement of said heads axially relative to said positioning usrfaces upon the further convergence of said heads to shell clamping position.

18. A cylinder as in claim 17;

wherein said centering means includes wedge rings slidable on said support cylinder adjacent the opposite ends of each of said shells and having said positioning surfaces thereon, and said yieldable elements include compression springs interposed between said heads and the wedge rings associated with said adjacent ends of the shells and compression springs interposed between the wedge rings associated with said ends of the shells remote from said heads.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,205,814 September 14, 1965

William F. Huck

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 9, line 45, for "means for converging the heads includes" read -- body is in the form of a hollow shell, --; line 48, for "including" read -- includes --; column 11, line 5, for "usrfaces" read -- surfaces --.

Signed and sealed this 22nd day of March 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents