

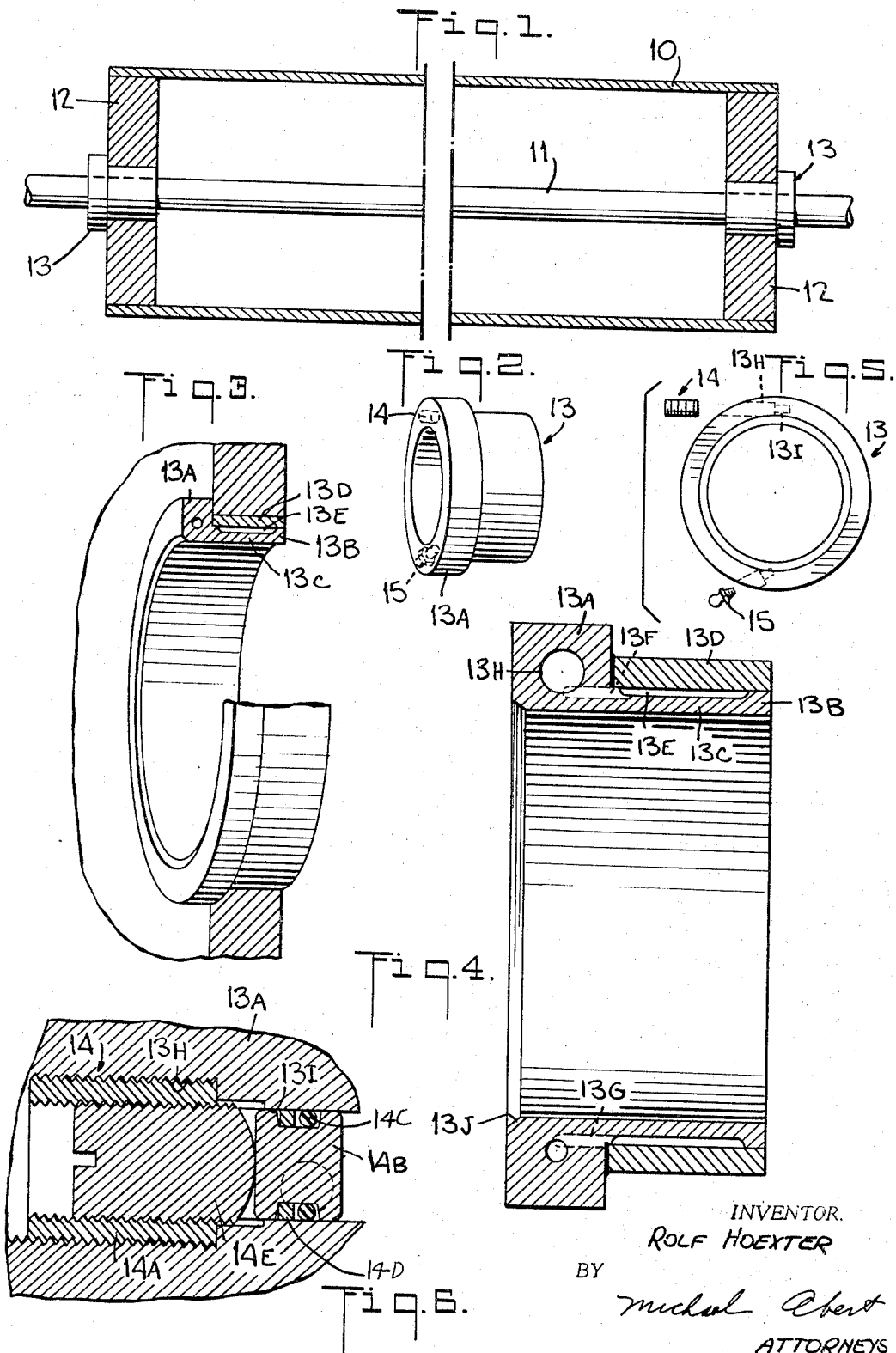
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R. HOEXTER

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HYDRAULICALLY ACTUATED DEMOUNTABLE PRINTING CYLINDERS

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1

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HYDRAULICALLY ACTUATED DEMOUNTABLE PRINTING CYLINDERS

Rolf Hoexter, Fort Lee, N.J., assignor to Mosstype Corporation, Waldwick, N.J., a corporation of New York
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ABSTRACT OF THE DISCLOSURE

A printing cylinder having a pair of hydraulically-actuated collets mounted concentrically at opposing ends thereof, the mandrel for supporting the cylinder being slidably receivable within the collet and securely locked thereto when hydraulic pressure is applied. Each collet includes a cylindrical sleeve having a thick-walled hub section and a relatively long thin-walled pressure section. A broad circumferential channel is cut in the pressure section to form a bendable pressure wall, the pressure section being surrounded by a collar of high tensile strength whose edges are welded to the pressure section to define an annular fluid chamber bounded by the collar and the pressure wall. A pressure cartridge is fitted into a cavity in the hub section, the cartridge communicating with the fluid chamber in the pressure section and including a piston which is advanced inwardly by an adjusting screw. When the annular chamber is filled with hydraulic fluid and the piston is advanced inwardly, the resultant hydraulic pressure causes flexure of the pressure wall, thereby subjecting the mandrel to radially-directed stresses which are uniformly distributed and serve to lock the mandrel to the collet and at the same time to maintain proper concentricity.

This invention relates generally to demountable printing cylinders, and in particular to a hydraulically-actuated locking collet for releasably coupling a printing cylinder to a mandrel.

In gravure printing, use is made of a printing cylinder whose surface is etched with cup-like cells which, as the cylinder passes through an ink fountain, pick up and carry the ink. When the cylinder engages an impression roller, the ink is transferred to the surface of the paper running therebetween. Flexographic printing uses similar inks, but the ink is picked up by rubber printing plates attached to a cylinder.

Since in the course of such printing operations, it is frequently necessary to replace one cylinder by another, various expedients have heretofore been proposed to provide demountable cylinder structures whereby the same mandrel may be coupled to different cylinders for use in the printing machine.

The simplest mechanical expedient for this purpose is set-screws to attach a cylinder to the mandrel. While set-screw arrangements are uncomplicated, they have many serious practical drawbacks. It is difficult to achieve proper concentricity with set-screws, and as a consequence, the printing is of poor quality. Moreover, set-screws tend to vibrate and work loose. Other more complicated mechanical locking devices, such as split-lock clamping collars and expanding collets, have been suggested, but these are generally more expensive and equally inaccurate.

One may obtain accurate mounting for printing cylinders using a heat-shrinkage procedure to attach and detach a cylinder to or from a mandrel. This procedure involves end closures on the cylinder having a relatively high coefficient of thermal expansion with respect to the mandrel, and it requires special heating equipment. Not only is the procedure time-consuming, but should axial

2

or side-to-side adjustment of the cylinder on the mandrel be necessary, the heating procedure must be repeated, with a further loss of time.

Another recent approach makes use of hydraulically-actuated collet locks for demountable cylinders. However, known devices of this type require grease guns to pump fluid into the lock each time a locking action is to be effected, the grease being bled off each time the mandrel is to be released. The use of grease in the environment of printing operations is obviously undesirable. Moreover, it is not possible with such known devices to determine without the use of additional expedients, the amount of hydraulic pressure that is being imposed on the mandrel, and whether it is sufficient to afford adequate torque resistance. As a consequence, cylinder creep or slippage may be encountered in the course of printing, with deleterious effects.

Accordingly, it is the main object of this invention to provide demountable printing cylinders incorporating quick-acting, hydraulically-actuated locking collets having a self-contained, piston-controlled fluid supply which is adapted to impose a predetermined amount of pressure on the mandrel, thereby insuring adequate torque resistance.

A salient feature of the invention resides in the fact that a locking action is obtained simply by turning a piston screw in a pressure cartridge combined with the collet, and a release action just as easily, by reversing the direction of turn. No external source of hydraulic fluid is required and no bleeding is necessary. Thus the hydraulic fluid is always sealed within the collet, and contamination of the cylinder printing surfaces is avoided.

More specifically, it is an object of the invention to provide a locking collet of the above-described type which is adapted to subject the mandrel to uniform radial pressure throughout its circumference, without imposing undue pressure on the cylinder head surrounding the collet, whereby distortion of the cylinder is avoided and proper concentricity is maintained.

Yet another object of the invention is to provide a locking collet made of a material having an exceptionally high friction factor with respect to the material of the mandrel, thereby affording increased torque resistance for a given amount of hydraulic locking pressure.

Also an object of the invention is to provide a hydraulically-actuated locking collet which may be manufactured at low cost, which is readily installed on a printing cylinder and thereafter requires no maintenance, and which is efficient and reliable in operation.

Briefly stated, these objects are attained in a printing cylinder having a pair of hydraulically-actuated locking collets mounted concentrically at opposing ends thereof, the mandrel for supporting the cylinder being slidably receivable within the collets and being securely locked thereto when hydraulic pressure is applied. Each collet is constituted by a cylindrical sleeve having a thick-walled hub section and a relatively long, thin-walled pressure section. A broad circumferential channel is cut in the pressure section to form a bendable pressure wall, the pressure section being surrounded by a collar of high tensile strength whose edges are welded to the pressure section to define an annular fluid chamber bounded by the collar and the pressure wall.

A pressure cartridge is fitted into a cavity in the hub section, the cartridge communicating with the fluid chamber in the pressure section and including a piston which is advanced inwardly by an adjusting screw. When the annular chamber is filled with hydraulic fluid, and the piston is advanced inwardly, the resultant hydraulic pressure causes flexure of the pressure wall, thereby subjecting the mandrel to radially-directed stresses which are uniformly distributed and serve to lock the mandrel to

the collet and at the same time to maintain proper concentricity.

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein:

FIG. 1 is a longitudinal section taken through a printing cylinder mounted on a mandrel by means of hydraulically-actuated locking collets in accordance with the invention;

FIG. 2 illustrates one of the locking collets in perspective;

FIG. 3 is a perspective cut-away view of one collet mounted within the cylinder head;

FIG. 4 is a section taken through the collet;

FIG. 5 is a front view of the collet, the hydraulic fitting and the pressure cartridge being separated from the collet; and

FIG. 6 is an enlarged sectional view of the pressure cartridge;

Referring now to the drawing, and more particularly to FIG. 1, there is shown a standard gravure or flexographic printing cylinder 10, releasably mounted on a mandrel 11 of a printing press, the mandrel being coaxially disposed within the cylinder. While the invention is described in the context of demountable printing cylinders, it will be appreciated that the hydraulically-operated locking collet in accordance with the invention is usable in other applications requiring an efficient, low-cost locking action.

Cylinder 10 has a uniform circular cross-section, and is enclosed at opposing ends by head pieces 12 which are welded or otherwise secured to the inner surface of the cylinder. Received within the central bore of each head piece and bonded thereto, is a hydraulically-actuated collet in accordance with the invention, the collet being generally designated by numeral 13. Mandrel 11 is slidably receivable within the collets, the inner surface of the collets being carefully machined to close tolerances to avoid any play between collet and mandrel.

The collets are each provided with a screw-operated pressure cartridge, generally designated by numeral 14, the arrangement being such that when hydraulic pressure is applied by turning the cartridge screw inwardly, the mandrel is firmly locked to the cylinder, and when the screw is reversely turned, pressure is relieved and the mandrel is released. The collet is also provided with a removable hydraulic fitting 15 having a unidirectional check valve to facilitate filling the fluid chamber of the collet with hydraulic fluid.

Collet 13, as best seen in FIGS. 2 to 5, is constituted by a metallic sleeve having a thick-walled front or hub section 13A, and a relatively long, thin-walled rear or pressure section 13B. In one actual embodiment, the total length of the sleeve is $2\frac{1}{4}$ inches, of which $\frac{7}{8}$ of an inch is the hub section, the remainder being the pressure section. The inner diameter of the sleeve is 3.5 inches, whereas the outer diameter is five inches at the hub section and four inches at the pressure section, thereby forming a shoulder at the juncture of the two sections.

Cut circumferentially in pressure section 13B is a broad channel forming a relatively thin and bendable pressure wall 13C. Surrounding pressure section 13B is a collar 13D, the edges of which are welded to the pressure section, thereby defining an annular fluid chamber 13E. In the actual embodiment of the collet, pressure wall 13C is $\frac{1}{8}$ of an inch thick, whereas the collar 13D is $\frac{1}{4}$ of an inch thick, the depth of the fluid chamber being $\frac{1}{16}$ of an inch. Obviously, these dimensions may be tailored as desired, and the collets may be scaled to meet different requirements.

Pressure cartridge 14 is threadably received in a lateral bore in hub section 13A, which communicates internally with pressure chamber 13E through a passage 13F. The lateral bore is constituted by an internally threaded sec-

tion 13H to receive the cartridge tube, and a cavity section 13I to receive the piston of the pressure cartridge. Fitting 15 is threadably received in another bore in hub section 13A which communicates with the pressure chamber 13E through a passage 13G. The face of the hub-section opening is chamfered at 13J to facilitate insertion of mandrel 11.

Each collet is telescoped within the bore of the associated head piece, with the collar of the collet permanently bonded by epoxy cement or similar means to the inner surface of the head. The hub section of the collet lies against the outer face of the associated head piece, providing ready access to the projecting pressure cartridge.

Pressure cartridge 14, as best seen in FIG. 6, is constituted by an internally-threaded tube 14A, which is screwed in section 13H of the lateral bore, and a piston 14B which is slidably disposed in the cavity section 13I of the lateral bore. Encircling the piston within a circumferential groove therein and engaging the internal wall of the cavity, is an O-ring 14C which is formed of rubber or similar sealing material adapted to prevent leakage of hydraulic fluid. Also encircling the piston is a back-up washer 14D, preferably of Teflon. Piston 14B is advanced inwardly in the cavity by means of a headless set-screw 14E which operates within tube 14A of the pressure cartridge.

Fitting 15 is simply a tapered and threaded plug which when screwed into the hub of the collet, prevents leakage of hydraulic fluid regardless of the pressure developed in the hydraulic chamber. Fitting 15 incorporates a check valve which permits fluid to be supplied to the fluid chamber, but prevents discharge of the fluid. Thus once the fitting is installed, it need never thereafter be removed.

In order to fill the fluid chamber with hydraulic fluid or grease at the desired pressure and to completely displace the air therefrom, the following procedure is followed.

Step A.—With the screw and piston removed from the pressure cartridge, grease is pumped through fitting 15 until grease begins to fill the cavity 13I, thereby indicating that chamber 13E and the passage 13F communicating therewith, are filled with fluid and that the air has been displaced.

Step B.—The excess grease in cavity 13I is wiped away, the piston 14B is inserted therein, and by turning-in screw 14E, piston 14B is bottomed in the cavity. In this condition, the fluid chamber is filled but is under no pressure.

Step C.—Grease is now pumped through the fitting into the filled fluid chamber, thereby producing pressure therein. The grease is pumped through a suitable pressure gauge until the desired amount of pressure is attained.

Step D.—Screw 14E is turned out to relieve pressure within the chamber, the fluid then entering the cavity to move the piston away from the bottom of the cavity. In this condition, the collet will receive the mandrel.

In the context of the demountable cylinder arrangement, torque is the turning movement exerted by a tangential force acting on the cylinder relative to the mandrel at a distance from the axis of the rotation of the mandrel determined by the radius of the cylinder. For large printing cylinders, the turning moment produced in press operations can be considerable, and substantial pressures are necessary to prevent creepage or slippage between the cylinder and the mandrel. In practice, hydraulic collet pressures in the order of 3000 pounds per square inch and higher have been found satisfactory. Obviously, the amount of pressure required depends on the diameter of the cylinder. Hence in Step C, one may feed in that amount of fluid appropriate to the use to which the collet is put.

Once the collet is filled with fluid under the proper amount of pressure, no further pumping actions are required, and in mounting operations, all the operator need do, is to turn-in the set screw to advance the piston to

5

its maximum position, thereby being assured that the torque resistance is sufficient for the cylinder. To demount, the operator merely turns out the screw to release pressure.

The pressure created within chamber 13E exerts a force both on the pressure wall 13C and on the collar 13D, but since the pressure wall is relatively thin and bendable, this wall is caused to flex and to exert a clamping pressure on the mandrel. The stress imposed radially on the mandrel is a uniformly distributed force, so that the concentricity of the mandrel and cylinder is maintained.

The resistance to relative motion between the cylinder and the mandrel depends also on the coefficient of friction. Friction between the collet and mandrel surfaces is proportional to the force pressing the surface together, and is independent of the area of contact. The constant ratio between the friction and the force pressing the surfaces together, is known as the coefficient of friction.

The coefficient of friction between two like materials is not as great as between dissimilar materials, for the chief causes of friction are the interlocking of minute irregularities of the rubbing surfaces and the indentation of the softer by the harder body. Hence since the mandrel is generally of steel, it is desirable that the collet be formed of a dissimilar and preferably a softer metal, yet one having high mechanical strength. To this end, the collet is made of aluminum and magnesium. Aluminum is preferred, for it has a higher modulus of elasticity and higher flexural strength. Also, the collet can be made of a high-strength material having a clad surface providing the desired gripping properties.

It is important to note that the hydraulic pressure developed within the collet effects flexure of the thin pressure wall, but not perceptibly the thicker collar. Should the collar be dilated, this would act to apply a distorting pressure on the associated head piece, with a resultant growth in cylinder diameter.

While there has been shown and described a preferred embodiment of hydraulically-actuated demountable printing cylinder in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit of the invention as defined in the annexed claims.

What I claim is:

1. A demountable cylinder arrangement comprising:
 - (A) a tubular cylinder,
 - (B) a pair of heads enclosing the opposing ends of said cylinder, said heads each having a central opening, and
 - (C) a locking collet mounted on each head for re-

6

ceiving a mandrel coaxially to support said cylinder, each collet including,

(a) a sleeve having a hub section and a pressure section of reduced thickness, said pressure section having a broad circumferential channel formed therein to form a bendable pressure wall,

(b) a collar surrounding said pressure section and fastened thereto to define with said pressure wall a hydraulic fluid chamber, the exterior surface of said collar being bonded to the wall of said head opening, said hub section lying against the outer face of the associated head, and

(c) a pressure cartridge mounted in said hub section and communicating with said pressure chamber releasably to apply pressure to fluid in said chamber, thereby to impose a locking force on the mandrel.

2. A demountable cylinder arrangement as set forth in claim 1, wherein said mandrel is of steel and said collet is of aluminum.

3. A demountable cylinder arrangement as set forth in claim 1, further including a fitting having a check valve mounted in a bore in said hub section which communicates with said chamber to supply fluid thereto.

4. An arrangement as set forth in claim 1, wherein said cartridge is constituted by an internally-threaded tube receivable in a bore in said hub section, a piston slidable in said bore, and a set-screw to advance the position of said piston.

5. An arrangement as set forth in claim 1, wherein said collar has a thickness at least twice as great as that of said pressure wall.

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BILLY J. WILHITE, *Primary Examiner.*