

[54] **FLUID SELF-BALANCING ROTARY
SCREEN TENSIONING MOUNT**
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[22] Filed: **Aug. 25, 1972**
[21] Appl. No.: **283,816**

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[52] U.S. Cl. **101/127.1, 101/128.1, 308/140**
[51] Int. Cl. **B41f 15/38, B41l 13/04**
[58] Field of Search..... **101/116, 127.1, 128.1;
308/187.2, 184, 9, 29, 72, 140, 194**

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[57] **ABSTRACT**
This disclosure is directed to a rotary screen printing head for a rotary screen printing machine and more particularly to a fluid balancing system for maintaining proper tension on a rotary screen and/or to compensate for any eccentricity of the head end portion of the screen during rotation. Also this disclosure is directed to the utilization of a radial thrust bearing for rotatably supporting the screen relative to its end thrust supports.

15 Claims, 9 Drawing Figures

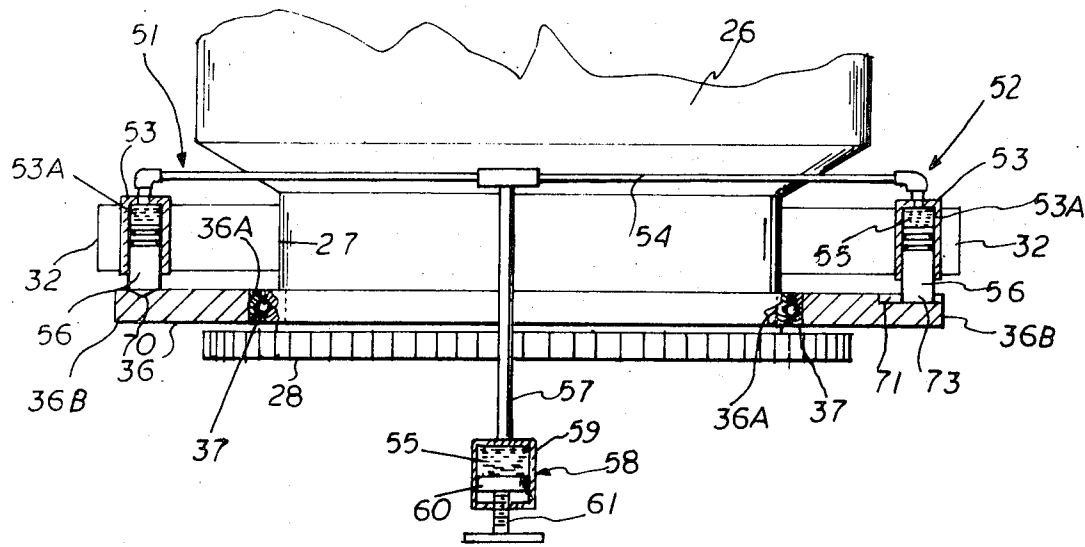


FIG 2

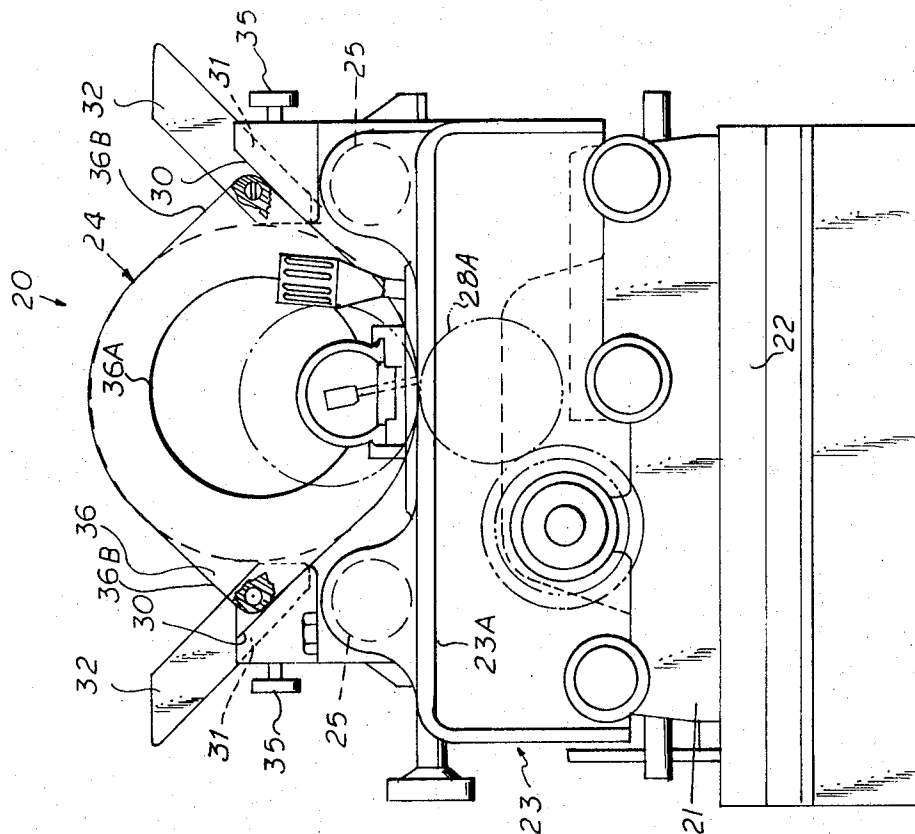
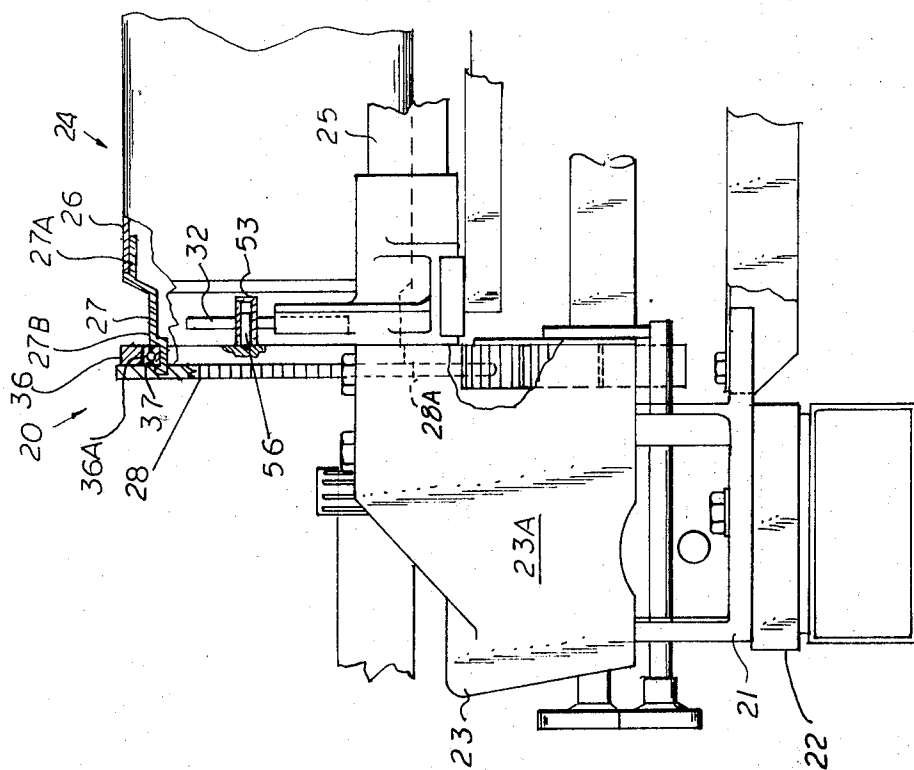


FIG 1



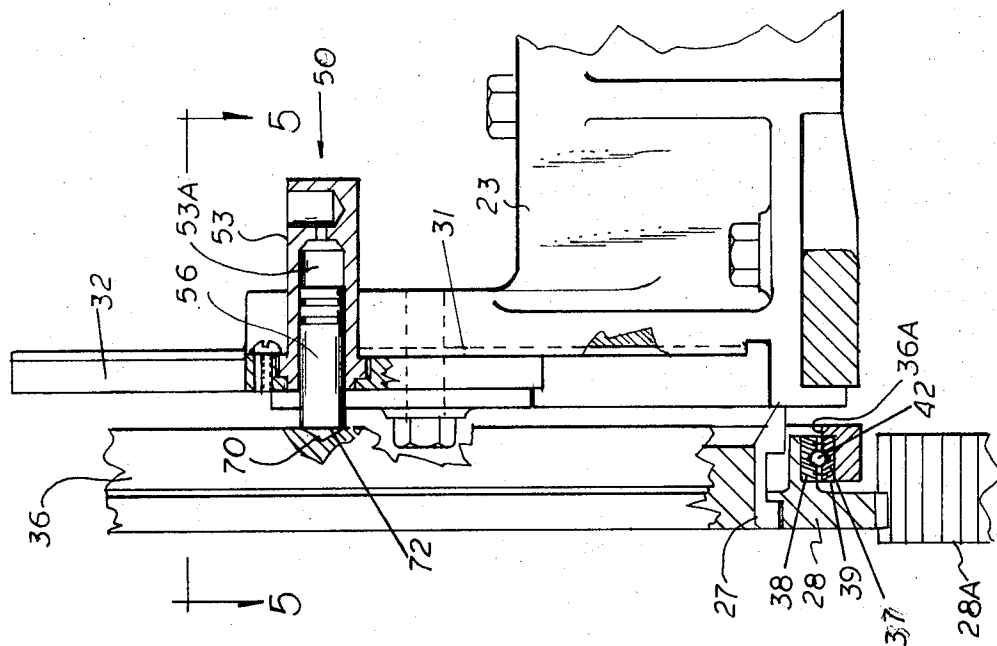


FIG. 3

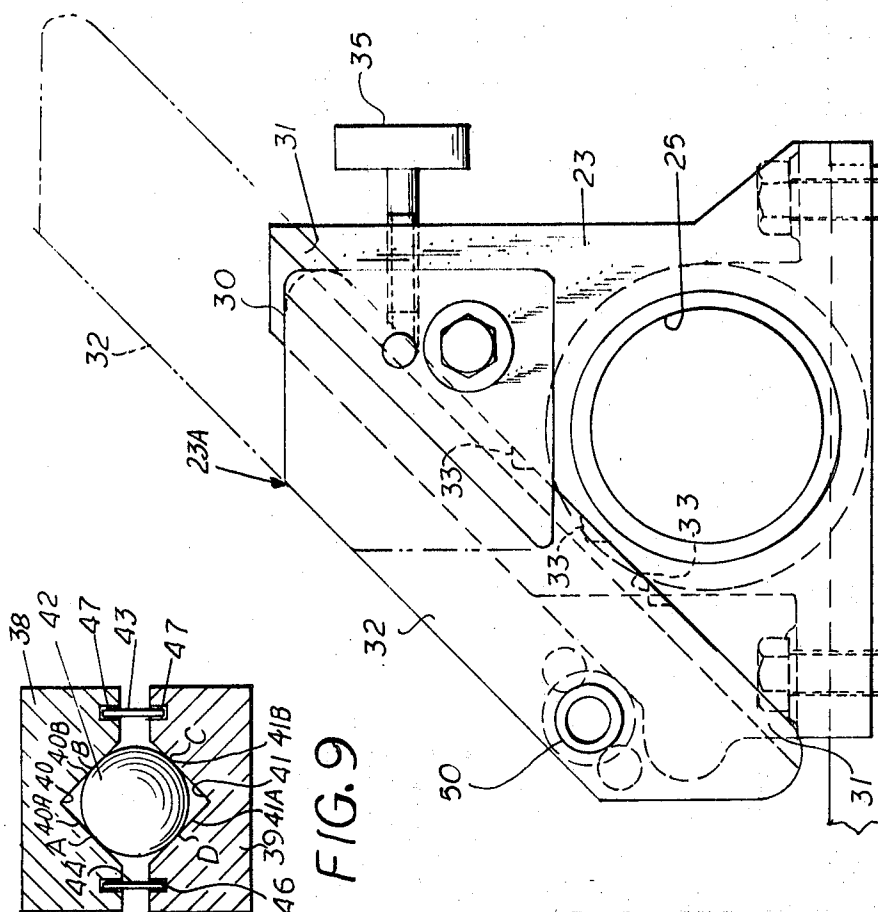
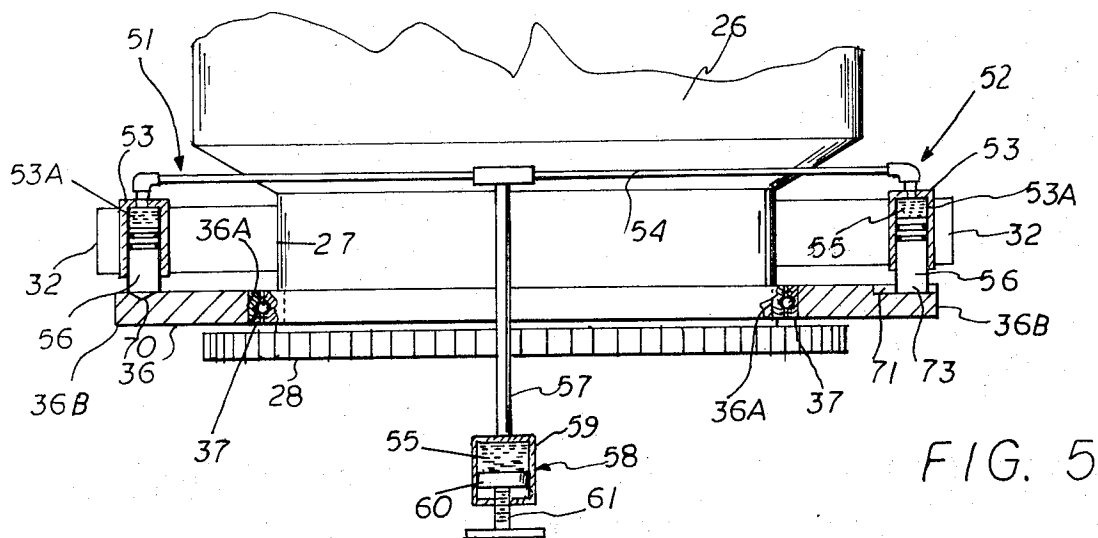
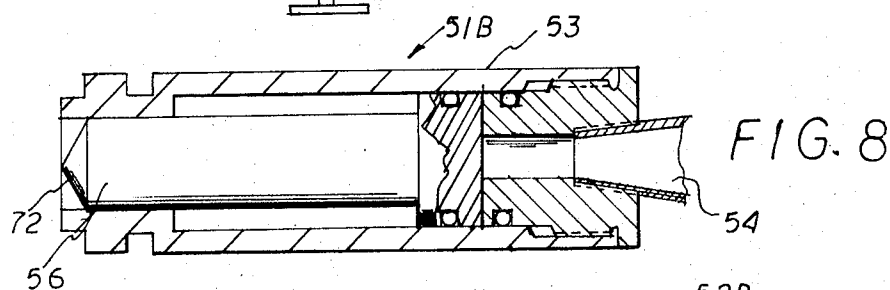
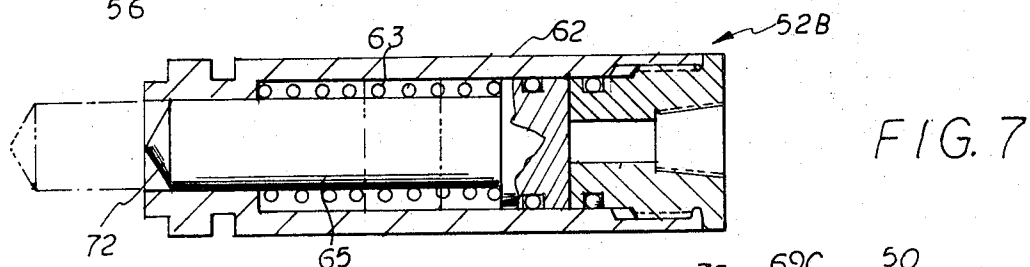
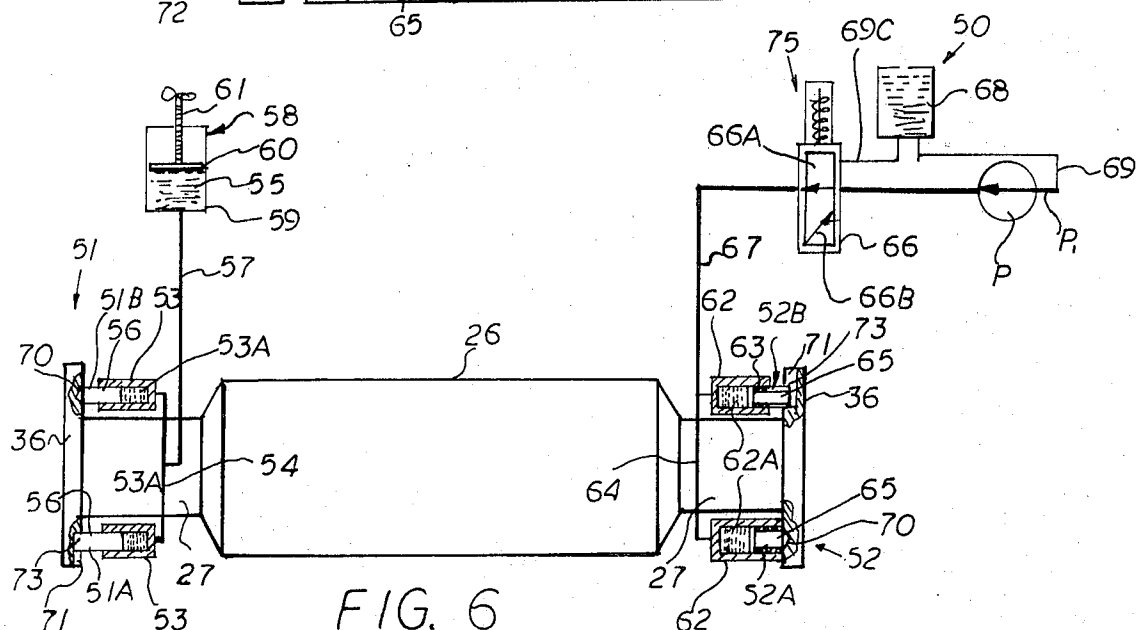


FIG. 4

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FLUID SELF-BALANCING ROTARY SCREEN TENSIONING MOUNT

PROBLEM AND PRIOR ART

In a rotary screen printing machine, the printing head comprises a thin wall cylinder member which has formed on the surface thereof a stencil portion for printing a desired pattern or print. Connected to the opposed ends of the cylinder member are end mounting rings by which the screen is rotatably supported in suitable thrust mounts of the printing head assembly. Because the end rings can be rarely maintained in a squared position relative to the cylindrical screen portion due to the relatively thin walled screen, there is presented the problem of compensating for the wobble or eccentricity which occurs when the screen rotates during a printing operation and in maintaining the screen under proper tension at all times.

Also it was heretofore common to rotatably support the end rings of a printing screen in a thrust bearing. However, such thrust bearings were poor in accommodating for radial loading imposed on the screen and further were difficult to seal against contamination by the printing coloring dyes or inks which are maintained within the printing screen. Thus the thrust loading imposed on the screen by axial thrust bearing greatly increased the frictional forces acting on the screen which in turn reduced the useful life of the screen and its bearings.

OBJECTS

An object of this invention is to provide a rotary printing head for a screen printing machine with a fluid activated balancing system for maintaining a uniform pressure or tension on the rotary screen.

Another object is to provide for a floating stability on the printing screen end ring capable of compensating for any wobble non-squareness of the end rings or eccentricity which may occur thereat as the screen rotates while maintaining proper tension on the screen ends.

Another object is to provide for hydraulically balancing the opposed end portions of a rotary printing machine for maintaining the screen under a constant force.

Another object is to provide radial bearing for rotatably supporting the end portions of a rotary printing screen.

Another object is to provide radial bearing for the end portion of a rotary screen which is sealed against contamination and/or clogging by the printing inks or color used during a screen printing operation.

Another object of this invention is to hydraulically compensate for the non-squareness of the end rings of a rotary printing screen.

Another object is to provide a fluid actuated system for maintaining a rotary printing screen under substantially constant pressure and which is capable of providing for a quick disconnect to facilitate the removal and/or interchangeability of the printing screen.

Another object is to provide an end support for a rotary printing screen in which the radial frictional loading on the screen during rotation is reduced to a minimum.

Another object of the invention is to provide for positive screen location of the printing screen relative to its mount assembly.

BRIEF SUMMARY OF THE INVENTION

The foregoing objects and other features of this invention are attained in a rotary screen printing machine having a printing head assembly which includes a printing mount or yoke for rotatably supporting the screen therebetween. A slide support is slideably disposed relative to the yoke which can be readily adjusted to accommodate a thrust bearing member for rotatably supporting rotary printing screens of varying diameters.

The printing screen comprises a relatively thin, stencilled wall cylinder having end rings or collars secured to each of its opposed ends. The end rings are rotatably supported on the thrust bearing member by a sealed radial bearing. The radial bearing is specifically constructed to reduce the radial frictional forces imposed on the screen during rotation.

Included in the printing head mount is a pair of fluid acting piston and cylinder assemblies operating on each of the opposed thrust bearing members which rotatably support the end portions of the screen for maintaining a uniform axial loading on the screen. The fluid chamber of the respective pairs of cylinders of the piston and cylinder assemblies are interconnected by a conduit to define a U-tube connection between the respective paired cylinders so that the pistons of the respective paired cylinders bearing on the thrust members are free to float to compensate for any wobble, eccentricity or non-squareness of the end rings while at the same time maintaining the screen under constant pressure. Means are operatively connected to each of the paired cylinders for adjusting or equalizing the displacement of the respective pistons thereof. Also the pistons in one pair of the piston and cylinder assemblies are subjected to a spring force to bias or retract the respective pistons when the fluid pressure operating thereon is relieved to provide for a quick disconnect or release of the rotary screen to permit easy removal and/or interchange of screen. A valve means is interposed in the fluid system of the latter mentioned pair of piston and cylinder assemblies to control and/or release the fluid pressure acting on the respective pistons thereof.

FEATURES

A feature of this invention resides in the provision of maintaining an axial loading on the rotary screen by free floating fluid actuated pistons acting on the end portions of the screen.

Another feature of this invention resides in the provision of controls to effect the release of the fluid pressure acting to load one end of the screen to permit for a ready disconnect of the screen from its mount.

Another feature resides in the provision of a floating piston under fluid pressure for compensating for any wobble or eccentricity in the support ends of the screen.

Another feature resides in the provision of rotatably supporting the ends of the screen in radial bearing to reduce the radial frictional load acting on the screen ends.

Another feature resides in the provision of a positive screen location.

Another feature resides in the provision of rotatably supporting the end of the screen with radial bearings

which can be readily sealed off from contamination or clogging by the printing inks or dyes.

Other features and advantages will become more readily apparent when considered in view of the drawings in which:

FIG. 1 is a fragmentary front view of a rotary printing head screen assembly embodying the present invention having portions thereof shown in section.

FIG. 2 is an end elevation view of FIG. 1.

FIG. 3 is an enlarged detail showing of the head assembly of FIG. 1.

FIG. 4 is a fragmentary enlarged detail end view of FIG. 3.

FIG. 5 is a plan view of the head assembly illustrating the arrangement of the fluid actuating means operating on the thrust bearing mount of the rotary screen taken along line 5—5 on FIG. 3.

FIG. 6 is a diagrammatic showing of the fluid circuit of the fluid activating means operating on the thrust bearing mounts of the rotary screen.

FIG. 7 is a detailed sectional view of the fluid actuating means operating on one end of the printing screen for effecting a quick release thereof.

FIG. 8 is a detailed sectional view of a fluid actuated means operating on the other end of the rotary screen.

FIG. 9 is an enlarged sectional detail view of the radial bearing rotatably supporting the screen.

This invention is directed to an improved rotary screen printing head assembly 20 for use on a rotary screen printing apparatus of the type disclosed in a copending patent application, Ser. No. 268,522, filed July 3, 1972. Referring to FIGS. 1 and 2 the printing head assembly 20 illustrated comprises essentially of a lower head or base portion 21 which is suitably mounted on the frame 22 of a screen printing machine and an upper head portion 23. The upper head portion or printing head mount 23 is preferably pivotally connected to the lower head portion 21 for permitting the rotary screen assembly 24 supported thereon to be raised between a printing and non-printing position as described in the said copending patent application. It will be understood that the upper head portion comprises a pair of oppositely disposed or spaced members 23A which are similar in construction but opposite in hand, interconnected by cross bars 25 for supporting the rotary printing screen assembly 24 therebetween.

As best seen in FIGS. 1, 2 and 6 the rotary printing screen assembly comprises a thin walled cylindrical portion 26 which is formed with stencilled portions to define the design to be printed thereby. As the stencilled cylindrical portion 26 defining the screen is formed of a relatively thin walled structure, end mounting rings 27 are secured to the respective open end portions of the screen to provide the end mounts for rotatably supporting the screen. In the illustrated embodiment the end mounting rings 27 include a collar portion 27A which is fitted into the adjacent opened end portion of the screen and secured to the cylindrical portion 26. From the collar portion 27A the ring 27 flares inwardly to connect to a reduced cylindrical end support portion 27B. Connected to at least one end ring 27 is a driving gear 28 adapted to mesh with a driven gear 28A so as to effect rotation of the screen during a screen printing operation.

Referring to FIGS. 1 to 4 the opposed upper head portions or printing head mount 23, each define a yoke

for supporting the respective ends of the rotary screen. As best seen in FIG. 2 each yoke is defined by oppositely inclined portions 30, 30 each having a groove 31 therein for slideably receiving a slide support 32. As seen in FIG. 4, indexing notches 33 may be provided on each slide support or bar 32 locating the position of the slide supports 32 relative to the yoke 30. The arrangement is such that variable sized screens may be accommodated between the yoke slides 32—32 by proper adjustment or positioning of the slides 32—32 relative to the yoke 30—30. FIG. 4 illustrates the minimum-maximum adjustment of the yoke slides 32. For example FIG. 4 illustrates the limits of adjustment of slide support 32 relative to its yoke portion 30. A set screw 35 is operatively associated with each yoke portion 30 to securely fasten the slide support 32 in the adjusted position relative thereto.

As best seen in FIGS. 3 and 5 a thrust bearing member 36 is supported on the adjacent complementary slide supports 32—32 of the yoke for supporting the ends of the screen assembly 24. The thrust bearing member 36 comprises a plate having a circular opening 36A therein for accommodating the end ring 27 of the printing screen and a radial thrust bearing 37. The plate portion of the thrust member 36 is provided with laterally extending ears 36B by which the thrust member 36 is supported by the slide supports 32—32.

As best seen in FIG. 3 a radial thrust bearing means 37 is interposed between either the driving gear 28 or an end support ring (not shown) which may be similar to the driving gear, but without teeth, as the case may be, and the thrust bearing member 36 for rotatably supporting the printing screen assembly thereon. The end support ring (not shown) is used in place of a driving gear 28, when the screen is driven from one end only. The radial thrust bearings 37 disposed about each end of the screen assembly 24 include an inner race 38 and an outer concentrically disposed bearing race 39, each race 38, 39 being provided with a plurality of complementary seats 40 and 41 adapted to accommodate a rolling bearing 42 therebetween. Referring to FIG. 9, the arrangement is such that the complementary bearing seats 40 and 41 in the inner and outer races 38, 39 are defined by angularly disposed faces 40A, 40B, and 41A, 41B which are arranged to tangentially engage the bearing member 42 seated therebetween. Accordingly the arrangement is such that the roller bearing member 42 is disposed between the complementary bearing seats 40, 41 in rolling engagement therewith at four tangent points of contact as indicated at A, B, C and D. With the bearing construction described friction in a radial direction is reduced to a minimum while at the same time capable of withstanding the axial loading imposed thereon. As a result the life of the screen as well as the bearing is greatly increased.

Means are also provided whereby the roller bearing members 42 of the radial bearing 37 are free of contamination or clogging by the coloring dyes or inks utilized in conjunction with the printing screen during a printing operation. This is attained by interposing side seals 43 and 44, formed as an annular member between the inner and outer races 38, 39. Referring to FIG. 9, the inner and outer races 38, 39 are provided with complementary grooves 46, 47 circumscribing the complementary bearing surfaces for accommodating end seals 43, 44 therebetween. The radial bearing 37 so disposed for rotatably supporting the screen end portion relative

to the thrust bearing 36 reduces the frictional loading imposed on the screen.

To maintain the cylindrical screen 26 under substantially constant tensile stress and to balance or compensate for any wobble or eccentricity resulting from the end rings 27 not being squared relative to the cylindrical portion 26, there is provided in accordance with this invention a fluid balancing means which supports and operates on the thrust bearing members 36 that support the screen assembly 24. The fluid balancing means 50 comprises complementary fluid systems 51 and 52, each of which includes a pair of oppositely disposed piston and cylinder assemblies 51A, 51B and 52A, 52B which are arranged to exert a tensile force on the screen 26 supported between the thrust members. The piston and cylinder assemblies 51A, 51B and 52A, 52B operating on each thrust member 36 are operatively connected so that the respective pistons thereof are in free floating relationship to compensate or balance any eccentricity or wobble of the end rings during a printing operation.

Referring to FIG. 6, the piston and cylinder assemblies 51A, 51B operating on one end of the screen assembly each include a cylinder 53 mounted on the respective slide supports 32. It will be apparent that the spacing between the respective cylinders 53—53 can be adjusted according to the adjusted positions of the slides 32—32. As seen in FIGS. 5 and 6, the fluid chambers 53A of the respective cylinders 53—53 are interconnected by a conduit 54 so that the fluid 55 is free to flow between chambers 53A—53A in accordance with the displacement of the respective pistons 56, 56 slideably disposed in each cylinder 53, 53. The arrangement is such that the fluid pressure operating on each piston 56 normally maintains the pistons 56, 56 projected to exert a tensile force on the thrust bearing 36 and the screen end supported thereby.

A branch conduit 57 is connected into conduit 54 to provide means for introducing a fluid, e.g., an hydraulic fluid into the respective cylinders 53, 53. A means for controlling the displacement adjustment of the pistons 56, 56 is connected in communication with conduit 57. The control means 58 includes a manually operated pressure source comprising a cylinder 59 adapted to contain a supply of the pressure fluid 55 and manually adjustable piston 60 which is displaceable relative to cylinder 59 to increase or decrease the displacement or pressure exerted by the pistons 56 against the thrust bearing 36 and/or to add the fluid necessary to maintain the desired fluid pressure on the system 51. As shown an adjusting screw or threaded stem 61 is operatively connected to piston 60 to adjust the setting thereof.

The other end of the cylinder screen is likewise subjected to a fluid pressure by system 52. System 52 also comprises cylinders 62—62 which are supported on the oppositely disposed slide supports 32—32 similar to that hereinbefore described. The fluid chambers 62A—62A of cylinders 62 are also connected in communication by a connecting conduit 64 so that the pistons 65, 65 disposed within the respective cylinders 62, 62 are freely floatable therein, and thereby free to compensate for any eccentricity or wobble occurring in the adjacent end of the cylinder screen 26.

As best seen in FIG. 7 the pistons 65—65 are normally biased by a coil spring 63 in a direction to effect a retraction of the associated pistons 65, 65 whenever

the fluid pressure operating on pistons 65, 65 is released. The retraction of the pistons 65, 65 operating on one end of the screen assembly when the pressure on the piston 65, 65 is relieved facilitates the removal or interchangeability of screen assemblies.

The means for controlling or relieving the fluid pressure on pistons 65, 65 includes a control valve 66 disposed in a branch conduit 67 that connects with conduit 64 that supplies the fluid chamber 62A, 62A or cylinders 62. As best seen in FIG. 6, the control valve 66, schematically shown, may comprise a spool valve which has a passageway 66A in the normal operating position which connects the outlet end of a fluid pump in communication with the branch conduit 67 for maintaining pressure in the supply conduit 64 and connected cylinders 62, 62. The inlet end P1 of the pump P is connected to a fluid reservoir 68 by conduit 69. Thus the operation of the pump P maintains the desired pressure on the pistons 65, 65.

To relieve the pressure in pistons 65, 65 to effect retraction thereof the spool of valve 66 is shifted to position the relief passage 66B in communication with conduit 67 and the relief outlet 69C which communicates with reservoir 68. In the shifted position of the valve 66, the pressure on the pistons 65, 65 is relieved and the springs 63 operating on pistons 65 will effect retraction of the piston 65 to effect a release of the tensile stress imposed on the adjacent end of the cylinder screen assembly 24 thereby enabling the screen to be readily interchanged and/or removed from cleaning, repair or the like.

To provide a means for positively locating the screen end relative to the yoke, the respective thrust members 36 are provided with a conical locating recess 70 formed in one ear portion thereof and a horizontal slot 71 formed in the opposite ear thereof. Also the complementary pistons 56 or 65 adapted to exert a tensile stress on the thrust member 36 are provided with a conical tip end 72 which is adapted to be received or seated in the conical recess 70, in the operative position. Thus the complementary conical piston tip 72 and the conical recess 70 cooperate to locate the respective screen ends. The other pistons 56 or 65 of the respective systems 51, 52 are provided with a wedge shaped tip 73 which is received in the opposite disposed horizontal slot 71. The arrangement is such that by centering the conical tip end 72 of one of the pistons in the complementary conical recess 70 of the thrust bearing or ring 36, accurate location of the thrust ring is provided.

In the operative position the respective piston and cylinder assemblies described provide a four point support for the rotary screen assembly 24 to maintain the same under a predetermined axial loading, depending upon the pressure of the fluid operating on the respective pistons. Also the free floating relationship of the pistons in the respective systems 51, 52 operating on each end of the screen ends is such that any eccentricity is automatically compensated.

The arrangement described further enhances the overall life of the screen by reducing the frictional loading operating thereon through the utilization of the radial bearing means 37. By maintaining the pistons 65, 65 operating on one end of the screen assembly 24 under a spring bias, a means 66 is provided for effecting a quick release of the screen assembly when the fluid pressure thereon is released.

Means 66 as shown in FIG. 6 comprises a spool valve which may be suitably operated, e.g., by a solenoid 75. Alternatively a hand operated valve may be employed, or the valve 66 may be operated by any suitable means. Thus by shifting the spool 66A of valve 66, the pressure of the fluid acting on pistons 65 can be readily relieved by passageway 66B of the spool connecting line 67 to the relief passageway 69C discharging to reservoir 68. With piston 65—65 of assemblies 52A and 52B retracted, it will be noted that a release of the screen assembly from its mount can be attained.

While the instant invention is directed to a particular embodiment thereof variations and modifications may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. A printing head for use on a rotary screen printing machine comprising:

- a printing head mount including opposed yoke means,
- a cylindrical printing screen,
- end rings connected to the opposed ends of said screen,
- a driving gear connected to at least one of said end rings,
- a thrust mounting bearing for rotatably supporting the opposed ends of said screen on said yoke means,

and a pair of fluid actuated piston and cylinder assemblies mounted on each of said yoke means, and means interconnecting the cylinders of the respective pair of piston and cylinder assemblies to permit the free flow of fluid between the respective connected cylinders for maintaining a self-balancing axial thrust on each of said thrust mounting bearings and associated screen ends.

2. The invention as defined in claim 1 where each of said piston and cylinder assemblies include,

- a cylinder defining a fluid chamber,
 - a piston slidably mounted in said cylinder,
 - said means interconnecting the cylinder of said respective pair of piston and cylinder assemblies comprising a conduit interconnecting the fluid chambers of said connected cylinders.
- and means for maintaining a fluid pressure on said connected chambers.

3. The invention as defined in claim 2 wherein said pistons and associated thrust bearings have complementary mating surfaces.

4. The invention as defined in claim 2 wherein the piston of one of said pair of assemblies has a conical projecting end portion and the piston of the other of said pair of assemblies has a projecting wedge shaped end portion, and associated bearing members have complementary recessed portions for receiving said respective conical and wedge shaped projecting piston end portions.

5. The invention as defined in claim 2 wherein one pair of said piston and cylinder assemblies includes means for effecting a retraction of the pistons within their respective cylinders to facilitate release of the associated screen end.

6. The invention as defined in claim 5 wherein said latter means includes a spring acting on each of said pistons of said one pair of said piston and cylinder assemblies normally biasing the respective pistons in a direction opposite to the fluid pressure acting thereon.

7. The invention as defined in claim 6 and including a valve means disposed in said conduit of said one pair of piston and cylinder assemblies for releasing the fluid pressure on said one pair of pistons.

8. The invention as defined in claim 2 and including a valve means operatively connected to said conduit interconnecting the fluid chambers of said one pair of piston and cylinder assemblies for releasing the fluid pressure acting on the piston thereof upon the opening of said valve means.

9. The invention as defined in claim 8 wherein said means for maintaining fluid pressure on the piston of said one pair of piston and cylinder assemblies includes a fluid pump.

10. The invention as defined in claim 9 wherein the means for maintaining fluid pressure on the other pair of said piston and cylinder assemblies includes a manually operated pressure pump.

11. The invention as defined in claim 1 wherein at least one pair of said piston and cylinder assemblies includes a spring in each assembly of said pair of assemblies for normally biasing the respective pistons thereof against the fluid pressure acting thereon.

12. The invention as defined in claim 1 wherein said thrust mounting bearing comprises a radial thrust mounting bearing.

13. The invention as defined in claim 12 wherein said radial thrust bearing includes a concentrically nested inner and outer bearing race circumscribing the opposed end portions of said screen, rolling bearings disposed between said concentrically disposed races and sealing means disposed between said races to seal said bearings therebetween.

14. The invention as defined in claim 13 wherein said bearing races are provided with complementary angularly disposed seating faces for accommodating said rolling bearings therebetween.

15. A printing head for use in a rotary screen printing machine comprising:

- a printing head having a pair of spaced apart yoke means,
- each of said yoke means including a base member defining a substantially V-shaped screen mount, and

a slide support slideably disposed on each leg of said V-shaped screen mount whereby said slide support may be adjustably disposed along said V-shaped mount to provide an adjustable yoke means for accommodating screens of varying sizes,

- a cylindrical printing screen,
- end rings connected to the respective ends of said screen,

a thrust bearing member having an opening for receiving the end rings for rotatably supporting the end rings on corresponding slide supports of said yoke means,

a bearing means interposed between said thrust bearing member and said screen end rings,

a driving gear ring connected to at least one end ring of said screen to effect the drive of said screen, and fluid actuating means on said slide supports for imposing a thrust loading on each end of said screen to maintain said screen in tension, said fluid actuating means including a cylinder mounted on each of said slide supports, each of said cylinders defining a fluid chamber,

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a piston slideably disposed in each of said cylinders,
 conduit means interconnecting the fluid chambers of
 said cylinders supported on the respective legs of
 slide supports to permit the free flow of fluid be- 5
 tween the connected fluid chambers,
 said piston projecting against said thrust bearing

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members under fluid pressure for maintaining a
 balanced thrust loading on the respective bearing
 members and associated screen end portions,
 means for maintaining a fluid pressure on said pis-
 tons.

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