Oct. 13, 1959 P. W. JACOBSEN 2,908,452

AUTOMATIC EXPANDING SHAFTLESS CHUCK

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Fig. 1

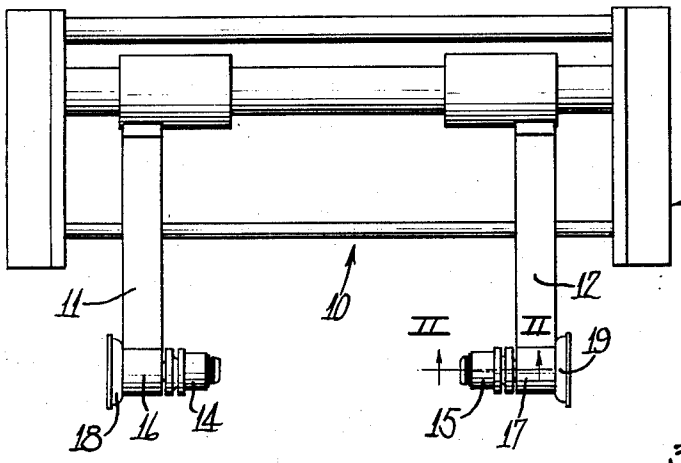


Fig. 4

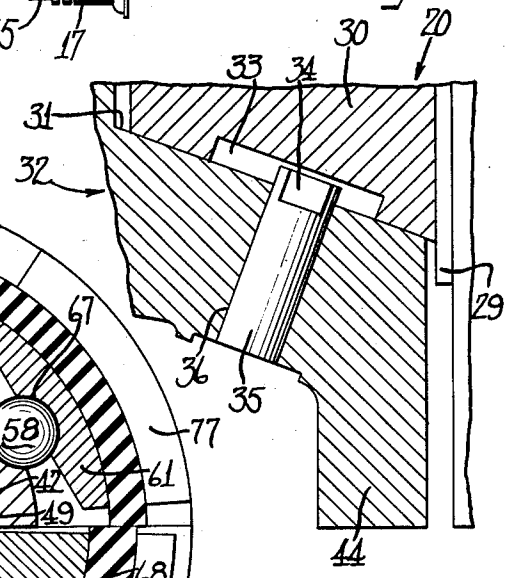
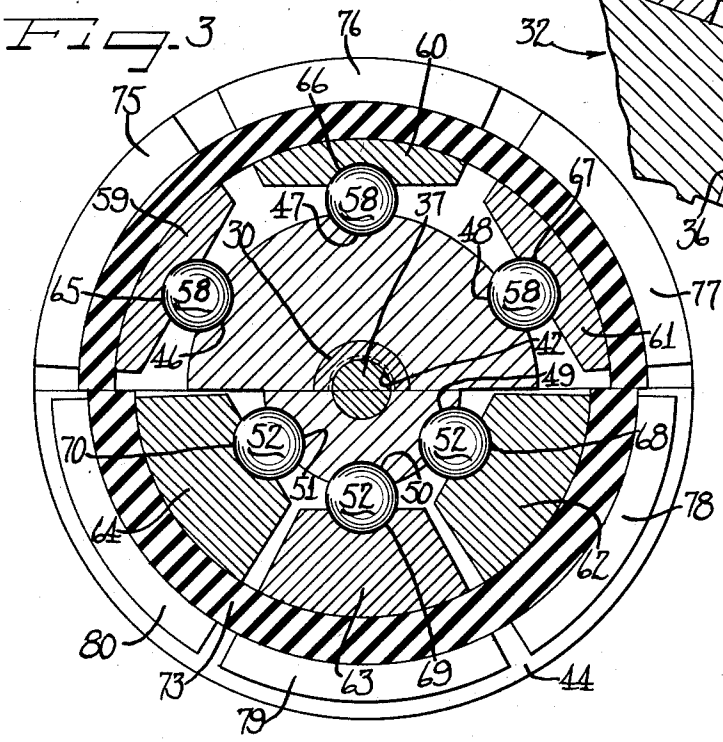


Fig. 3



Inventor

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AUTOMATIC EXPANDING SHAFTLESS CHUCK

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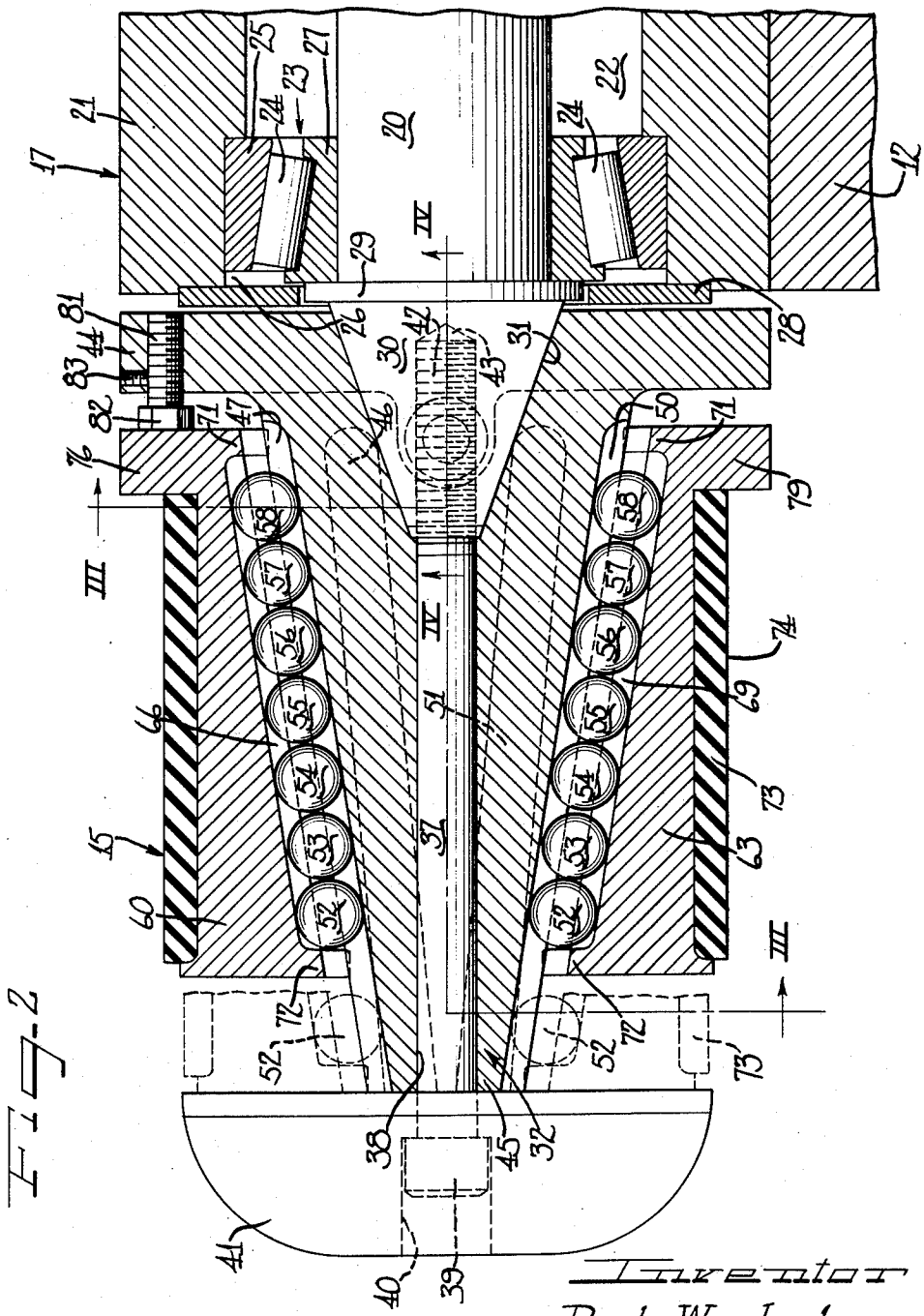


Fig. 2

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AUTOMATIC EXPANDING SHAFTLESS CHUCK

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Application June 15, 1955, Serial No. 515,587

4 Claims. (Cl. 242—72)

The present invention relates to an automatic expanding shaftless chuck, and more particularly to an automatic chuck mechanism such as one for a shaftless roll stand.

In the handling of rolls of sheet material, for unwinding the rolls or pulling the web or sheet material therefrom, the rolls are usually supported on a roll stand having arms carrying a shaft passing through the center core of the roll. The roll stand supports the roll, which is carried on the shaft, off the floor so that the roll may be unwound and the sheet material or web pulled therefrom.

While such mechanisms have been in common use for many years, the necessity of supporting the roll on a shaft has been an undesirable feature of such roll stands since initiating operation of the mechanism to support the roll has been a complex and time-consuming procedure with a result that there has been a great amount of "down time." Additionally, utilization of these shaft-type roll stands has caused some difficulty in operating the roll stand to provide for properly edge-aligning the roll so that the web pulled therefrom will pass into subsequent machinery in proper alignment therewith.

Of course, numerous other obvious and unobvious difficulties and complexities have attended the utilization of roll stands employing a shaft for passing through the roll core supporting the roll. All of these difficulties are obviated, however, by the present invention which provides a new and improved chuck operable for utilization with a roll stand and which is effective to eliminate any need for a shaft to pass through the roll core. By the principles of the present invention the roll may be conveniently gripped within the core thereof at the axial ends thereof by the chucks of this invention and simultaneous or other synchronous operation of the roll stand arms then easily permits lifting the roll. Additionally, the utilization of chucks embodying the principles of this invention easily permits grasping the roll by the roll core to support the same by the simple maneuver of axially moving the chuck through movement of the roll stand arms in a direction on the axis of the chuck.

When providing a roll stand with chucks embodying the principles of this invention, the roll is gripped merely by moving the roll stand arms towards each other so that the chucks pass into the hollow roll core and slight further movement of the roll stand arms causes the chucks to firmly and positively grip the inner surface of the roll core. Thereupon, the roll may be lifted with a minimum of down time and a minimum of operating procedure.

When the roll is being rotated by pulling the web from the roll, the chucks which already tightly grip and lock-up the roll core, are effective to increase the tightness and lock-up of their grip on the roll core thereby increasing the tightness of the grip as the web tension may increase.

A chuck embodying the principles of thi sinvention utilizes a chuck cone mounted on a bearing shaft rotatably mounted in bearings on the roll stand arm. The chuck cone is provided with ball races therein and individual chuck lugs or segments each having a ball race therein ride over rows of balls in the races or grooves in the chuck cone. A resilient tire overlies the lugs or chuck segments to hold the same in position peripherally about the chuck cone.

In operation, the chuck is inserted into the roll core until the roll core engages flanges at the bearing shaft end of the segments causing the segments to move radially and axially as they roll on the balls in the races and grooves on the cone which has a larger diameter at the bearing shaft end thereof. This expansion radially continues until the resilient tire surrounding the lugs expands to engage the inner face of the roll core and any further movement merely tightens the grip of the tire on the inner surface of the roll core. When it is desired to release the roll, mere movement of the cone axially outwardly permits the resilient tire to cause the lugs to move axially and radially inwardly until the tire is released from the roll core.

It is, therefore, an important object and feature of the present invention to provide a new and improved roll stand with new and improved roll chucks thereon.

Still another object of the present invention is to provide a new and improved roll chuck which is automatically expandable and operable on a shaftless roll stand and effective itself as a shaftless chuck.

Still another object of the present invention is to provide a new and improved expanding chuck with a chuck cone and expanding lugs axially movable thereover for radial expansion.

Yet another object of the present invention is to provide a new and improved chuck for a shaftless roll stand having a chuck cone and race member secured to a bearing shaft and provided with ball races therein with expansion lugs or chuck segments riding on balls in the ball race grooves in the cone and a resilient tire overlying all of the segments retaining the same in place.

Yet another object of the present invention is to provide a chuck cone as described operable for automatic expansion and contraction for engagement and disengagement with a hollow core.

Still another object of the present invention is to provide a new and improved chuck effective to increase the tightness of its grip on a hollow core as forces rotating the core, or the moment thereof, increases.

Still other objects, features and advantages of the present invention will become readily apparent from the following detailed description of the invention and embodiments thereof, from the claims, and from the accompanying drawings in which each and every detail shown is fully and completely disclosed as a part of this specification, in which like reference numerals refer to like parts, and in which:

Figure 1 is a plan view of a roll stand utilizing chucks embodying the principles of this invention;

Figure 2 is an axial sectional view of a shaftless chuck embodying the principles of this invention and viewed as taken substantially along the line II—II of Figure 1 with certain parts shown in elevation;

Figure 3 is a broken radial sectional view of the chuck of Figures 1 and 2 viewed as taken substantially along the line III—III, and illustrating in one half thereof the chuck in an expanded condition and illustrating in the other half thereof the chuck in a contracted condition thereof; and

Figure 4 is a fragmental sectional view of the chuck of Figure 2 viewed as taken substantially along the line IV—IV of Figure 2.

As shown on the drawings:

There is illustrated in Figure 1, a roll stand such as

the roll stand described and claimed in the joint copending application for patent filed by myself and Robert L. Beninger, Serial No. 565,907, filed February 16, 1956, and entitled "Roll Stand," which is effective and operable to move the arms 11 and 12 of the roll stand 10 either independently or jointly selectively as desired. Thus the roll stand 10 is provided with a support structure 13 carrying the arms 11 and 12 and includes drive mechanism to move each of the arms 11 and 12 away from each other or toward each other or to move the arms 11 and 12 together in any direction such as to the right or left or upwardly or downwardly. With this roll stand a roll of paper or other sheet material may be gripped and thence raised off the floor for rotatably supporting the same so that the web may be pulled therefrom.

To support the roll, and grip the roll, chuck mechanisms 14 and 15 which are slidably movable into the hollow roll core, are mounted in bearings 16 and 17, respectively, on the outer ends of the arms 11 and 12, respectively. When the roll is rotatably supported on the chucks 14 and 15, the web may be pulled from the roll and the tension in the web may be controlled by such mechanisms as brakes 18 and 19 mounted on the ends of the arms 11 and 12 of the roll stand 10 and connected to the bearing shafts which are, in turn, connected to the chucks 14 and 15 so as to apply braking forces to the roll and the web being pulled therefrom.

As illustrated in Figures 2, 3 and 4, only one chuck being illustrated since both thereof are the same, the chuck 15 is secured to the bearing shaft 20 in the bearing 17. Particularly, the bearing 17 has a bearing housing 21 mounted on and secured by any convenient means to the end of the roll stand arm 12 and is axially hollow as indicated at 22. The bearing housing 21 is equipped with a pair of opposed combination thrust and rotary bearings 23 (only one of which is shown) here illustrated as being of the roller-type, and disposed to lockingly mount and secure the bearing shaft 20 against axial movement with respect to the bearing housing. The bearings 23 are, as stated, illustrated as being of the roller-type having a plurality of rollers 24—24 rollingly disposed on an inclined outer race 25 shouldered in a recess 26 in the bearing housing 21, and the rollers 24 further being rollingly disposed on an inclined and flanged inner race 27 fitted onto the shaft 20. A bearing retaining plate 28 is secured to the end of the bearing housing 21 and overlies the recess 26 and further overlies a major portion of the bearings 23 to prevent the bearings from displaceably moving out of the hollow 22 in the bearing housing 21. The bearing retainer plate 28 is in the form of a ring and leaves clearance in its inner periphery for a flange shoulder 29 at the chuck end of the bearing shaft 20, which flange shoulder abuts the radial face of the inner bearing race 27.

Axially outwardly from the bearing 17, the bearing shaft 20 is provided with a conically tapering end 30 to which the chuck 15 may be secured and mounted. This cone end 30 on the bearing shaft 20 is receivable in an appropriately conically-shaped recess 31 in the larger diameter axial end of a chuck cone and race member indicated generally at 32. A keyway-like slot 33 (Figure 4) in the cone end 30 of the bearing shaft 20, receives a flatted end 34 of a pin 35 which is press-fitted through an aperture 36 which is substantially radially provided in the cone and race member 32 of the chuck 15. The flatted end 34 of the pin 35 so interfits with the keyway-like recess 33 in the cone end 30 of the bearing shaft 20 as to lock the chuck cone 32 and the bearing shaft 20 together for corotation. At the same time, the pin 35 is sufficiently short that the chuck cone 32 and conical end 30 of the bearing shaft 20 may be axially separated without removing the pin 35 from the chuck cone 32 and even without imparting any axial movement to the pin 35.

This relationship between the pin 35, the chuck cone 32, and the bearing shaft cone end 30, permits convenient replacement of the chuck cone 32 when it is desirable to replace the chuck cone with a larger or with a smaller chuck cone for equipping the roll stand with a larger or with a smaller chuck. Thus, numerous chucks of different sizes would all be provided with chuck cones having conical recesses 31 therein which are of the same size to properly interfit with the cone end 30 on the bearing shaft 20 and be locked thereon for corotation by pins 35 in the chuck cones 32 and having flatted ends 34 interfitting with keyway-like recesses 33 in the conical faces of the cone ends 30 of the bearing shafts 20.

When a selected size of chuck 15 is disposed on the cone end 30 of the bearing shaft 20, the assembly is locker together and in place by a screw 37 having an elongated shaft passing through an axial aperture 38 in the chuck cone 32, having a head 39 seated in a recess 40 in a chuck head 41, and having a threaded end 42 threadably engaging a threaded recess 43 axially provided in the bearing shaft 20 so that when the screw 39 is tightly engaged with the bearing shaft 20, the entire chuck mechanism 15 is locked in place on the bearing shaft 20, or at least the chuck head 41 and the chuck cone 32, with its pin 35, are locked onto the cone end 30 of the bearing shaft 20.

From immediately adjacent to a radial flange 44 on the end thereof adjacent to the bearing 17, the chuck cone 32 is conically tapered to a relatively small diameter at the end 45 thereof adjacent to the chuck head 41. Along substantially the entire length of the conical surface of the chuck cone 32 there are provided a plurality of angularly spaced, longitudinally extending ball race grooves 46, 47, 48, 49, 50 and 51, six thereof being shown, although it is readily recognized that the precise number of ball race grooves in the cone 32 is not critical. In each ball race groove 46 through 51 there are provided a plurality of roller balls 52, 53, 54, 55, 56, 57 and 58 of which the even numbered balls are slightly larger in diameter than the odd numbered balls so that alternate roller balls are of equal diameters, while adjacent roller balls are of slightly different diameters. By the provision of slightly smaller diameter balls between slightly larger diameter balls, ball spacers may be eliminated and the reversely rotating adjacent surfaces of the larger roller balls are accommodated by reversely rotating the smaller balls, whereby binding is avoided and the simplest of construction and most economical construction may be utilized.

Each row of balls supports and rollingly carries a chuck segment so that chuck segments 59, 60, 61, 62, 63 and 64 roll on the individual rows of balls and overlie the chuck cone grooves 46 through 51. For this purpose, each of the chuck cone segments 59 through 64 is provided with a ball race groove on its inner face, as at 65 through 70. Thus, the chuck cone segments are rollingly supported on the rows of balls respectively for movement longitudinally on the chuck cone 32 so that when they are rolled to the end of the chuck cone 32 adjacent to he flange 44 thereon, the segments or expansion lugs 59 through 64 will have the greatest possible radial spacing while when they are rolled to a position adjacent to the chuck head 41, they will have a minimum radial spacing since they will have rolled radially inwardly on the inclined or conical face grooves of the cone 32, while having also rolled longitudinally toward the head 41 of the chuck 15. The extremities of the positoning and spacing of the lugs or segments are readily illustrated by a comparison of the solid line positions therefor illustrating the lugs in their expandedmost positions at the maximum diameter end of the cone, and the phantom line positions therefor illustrating the lugs at the minimum diameter end of the cone 32 where the lugs will have a minimum radial spacing.

To preserve the rolling relation between the lugs and the rows of balls on which they ride, each of the lugs is provided with a pair of radially inwardly extending end

flanges **71** and **72** thereon at the bearing end and at the head end thereof respectively. These flanges retain the balls in the race grooves of the lugs. On the outer surfaces of the lugs, the lugs are recessed to receive a resilient expandable and contractible tire or tube **73**, the outer surface **74** of which has a relatively high coefficient of friction, the tire **73** overlying all of the segments and operative to retain the segments in place on the rows of balls and properly spaced about the chuck cone **32** and further tending, by resilient contracting forces therein, to move the lugs radially inwardly so as to tend to move the lugs to the minimum diameter region of the chuck cone and thereby move the lugs to the positions shown therefor in phantom outlines adjacent to the chuck head **41**. It is this resilient tire or tubular member **73** formed of any suitable material such as rubber or a rubber-like material, which grips the inner surface of a hollow roll core when the roll is supported by the roll stand and the chucks are disposed within the roll core. The outer surfaces of the lugs are configurated to form a broken, substantially cylindrical surface for receiving the tire **73** and to provide a substantially cylindrical and backed outer surface for the tire **73** for properly gripping the cylindrical inner surface of a roll core. At the same time, to cooperate with the chuck cone **32**, the inner surfaces of the lugs or segments cooperate to form a broken, substantially conical hollow or pyramidal hollow within the segments whereby the lugs may be supported rollingly on the cone and provide the above-described substantially cylindrical outer surface.

In operation, when the chuck is free or fully disengaged from any roll core, the tire **73** contracts the chuck segments to the phantom outline position where the outer surface of the tire **73** has a diameter slightly less than the outside diameter or maximum diameter of the chuck head **41**. This permits convenient free insertion of the chucks into the hollow roll core of a roll. When inserted into a roll core, the outer edge of the roll or roll core will engage radially outwardly extending flanges **75** through **80** on the chuck segments or expansion lugs **59** through **64**, respectively, and continued movement of the chuck into the roll core, axially, will drive the lugs toward the bearing shaft with a resulting expansion in the spacing of the lugs and an expansion of the tire **73** until the outer surface thereof frictionally grips the inner cylindrical surface of the hollow roll core. Continued movement or force tending to move the chuck into the roll core will increase the frictional gripping force of the tire on the roll core. When so gripped, the roll will be rotatably supported without a shaft extending therethrough and the bearings **23** will permit rotation of the roll to pull the web therefrom.

The lugs are permitted to move only to a limited extent and if further movement thereof is required, it will be clearly evident that a larger chuck should be utilized. To provide for proper limiting stops for the lugs in an axial direction toward the bearing shaft and thereby provide a proper stop for expansion of the lugs, the flange **44** of the chuck cone is provided with a threaded aperture near the outer peripheral edge thereof which receives a stop screw **81**, the head **82** of which provides an adjustable stop to abut the face of any one of the flanges such as the flange **76** on the lug **60**. The screw **81**, when set at the desired stop position, may be locked in place by a set screw or the like **83**.

During operation of the roll stand when the web is being pulled from the roll supported on the chucks, and braking force is applied by the brakes **18** and **19** to tension the web, the entire chuck rotates together with the bearing shaft **20** rotating in the bearing **17**. At the same time, the lugs **59** through **64** will rotate slightly about the row of balls supporting the same thereby distorting the cylindrical surface formed by the lugs and the cylindrical character of the tire **73** to increase the grip of the tire on the roll core. Thus it will be evident that as the tension on the web and the moment thereof operating through the radius

of the roll increases, the distortion of the tire **73** will increase to automatically increase the gripping force of the chuck on the roll core and thereby operate to prevent any possible slippage between the chuck and the roll.

Release of the roll core is easily effected by moving the roll stand arms **11** and **12**, individually or simultaneously, outwardly to thereby withdraw the chuck cone from the lugs and segments to the extent of abutting the ends of the segments with the chuck head **41**. At the same time, the tire **73** will compressively move the segments radially inwardly and the core of the roll will be released by contraction of the tire **73**.

From the foregoing it will be readily observed that numerous modifications and variations may be effected without departing from the true spirit and scope of the novel concepts and principles of this invention. I, therefore, intend to cover all such variations and modifications as fall within the true spirit and scope of the novel concepts and principles of this invention.

I claim as my invention:

1. A roll supporting structure for use in a shaftless roll stand and operative to grip the core of a roll and rotatably support an end of the roll on an arm of the roll stand comprising, rotary bearings secured to an arm of the roll stand, a bearing shaft rotatably mounted in the bearings and secured therein against axial movement with respect thereto, said bearing shaft having an inner end concially configurated, a chuck cone and race member having a conical recess in an end thereof, a pin force-fitted into an aperture in one end of said chuck cone and race member and having a flattened end received in a keyway in the conical inner end of the bearing shaft to fix said chuck cone and race member and bearing shaft together for corotation, an annular chuck head coaxially secured to the other end of said member by a screw extending through said member and threadably engaging said bearing shaft, a plurality of longitudinally extending ball race grooves in the outer face of the chuck cone and race member, a plurality of bearing balls disposed in each of said ball race grooves, a plurality of chuck race segments equal to the number of ball race grooves in said member, each having a ball race groove therein to rollingly engage said bearing balls, said segments having an axial dimension less than the axial dimension of said chuck cone and race member, a resiliently expandable friction tire overlying said segments and retaining said segments in place and properly arranged, a radial flange on one end of said chuck cone and race member, radial flanges on the inner end of each of said segments adjacent to said flange on said member, and an adjustable stop cooperatively arranged with said flanges to limit movement of said segments toward said flange on said member and thereby limit radial expansion of said tire effected by rolling of said segments on said balls in the grooves in said chuck cone and race member toward one end thereof, said tire having a diameter greater than that of said chuck head when expanded and less than that of said chuck head when contracted by release of said segments to roll toward said other end of said chuck cone and race member.

2. A roll supporting structure for use in a shaftless roll stand and operative to grip the core of a roll and rotatably support an end of the roll on an arm of the roll stand comprising, rotary bearings secured to an arm of the roll stand, a bearing shaft rotatably mounted in the bearings and secured therein against axial movement with respect thereto, said bearing shaft having an inner end conically configurated, a chuck cone and race member having a conical recess in an end thereof, a pin force-fitted into an aperture in one end of said chuck cone and race member and having a flattened end received in a keyway in the conical inner end of the bearing shaft to fix said chuck cone and race member and

bearing shaft together for corotation, a plurality of longitudinally extending ball race grooves in the outer face of the chuck cone and race member, a plurality of bearing balls disposed in each of said ball race grooves, a plurality of chuck race segments equal to the number of ball race grooves in said member, each having a ball race groove therein to rollingly engage said bearing balls, said segments having an axial dimension less than the axial dimension of said chuck cone and race member, a resiliently expandable friction tire overlying said segments and retaining said segments in place and properly arranged, a radial flange on one end of said chuck cone and race member, radial flanges on the inner end of each of said segments adjacent to said flange on said member, and an adjustable stop cooperatively arranged with said flanges to limit movement of said segments toward said flange on said member and thereby limit radial expansion of said tire effected by rolling of said segments on said balls in the grooves in said chuck cone and race member toward one end thereof.

3. A roll supporting structure for use in a shaftless roll stand and operative to grip the core of a roll and rotatably support an end of the roll on an arm of the roll stand comprising, rotary bearings secured to an arm of the roll stand, a bearing shaft rotatably mounted in the bearings and secured therein against axial movement with respect thereto, said bearing shaft having an inner end conically configurated, a chuck cone and race member having a conical recess in an end thereof, an annular chuck head coaxially secured to the other end of said member by a screw extending through said member and threadably engaging said bearing shaft, a plurality of longitudinally extending ball race grooves in the outer face of the chuck cone and race member, a plurality of bearing balls disposed in each of said ball race grooves, a plurality of chuck race segments equal to the number of ball race grooves in said member, each having a ball race groove therein to rollingly engage said bearing balls, said segments having an axial dimension less than the axial dimension of said chuck cone and race member, a resiliently expandable friction tire overlying said segments and retaining said segments in place and properly arranged, a radial flange on one end of said chuck cone and race member, radial flanges on the inner end of each of said segments adjacent to said flange on said member, and an adjustable stop cooperatively arranged with said flanges to limit movement of said segments toward said flange on said member and thereby limit radial expansion of said tire effected by rolling of said segments on said balls in the grooves in said chuck cone and race member toward one end thereof, said tire having a diameter greater than that of said chuck head when expanded and less than that of said chuck head when contracted by release of said segments to roll toward said other end of said chuck cone and race member.

4. A roll supporting structure for use in a shaftless roll stand and operative to grip the core of a roll and rotatably support an end of the roll on an arm of the roll stand comprising, rotary bearings secured to an arm of the roll stand, a bearing shaft rotatably mounted in the bearings and secured therein against axial movement with respect thereto, said bearing shaft having an inner end conically configurated, a chuck cone and race member having a conical recess in an end thereof, an annular chuck head coaxially secured to the other end of said member by a screw extending through said member and threadably engaging said bearing shaft, a plurality of longitudinally extending ball race grooves in the outer face of the chuck cone and race member, a plurality of bearing balls disposed in each of said ball race grooves, a plurality of chuck race segments equal to the number of ball race grooves in said member, each having a ball race groove therein to rollingly engage said bearing balls, said segments having an axial dimension less than the axial dimension of said chuck cone and race member, a resiliently expandable friction tire overlying said segments and retaining said segments in place and properly arranged, said tire having a diameter greater than that of said chuck head when expanded and less than that of said chuck head when contracted by release of said segments to roll toward said other end of said chuck cone and race member.

References Cited in the file of this patent

UNITED STATES PATENTS

537,789	Sinclair	Apr. 16, 1895
1,527,539	Damon	Feb. 24, 1925
2,075,192	George	Mar. 30, 1937
2,298,759	Fouse	Oct. 13, 1942