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3,286,081 11/1966 Scowcroft 219/469

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[54] **HEATED ROLL ASSEMBLY**
5 Claims, 5 Drawing Figs.

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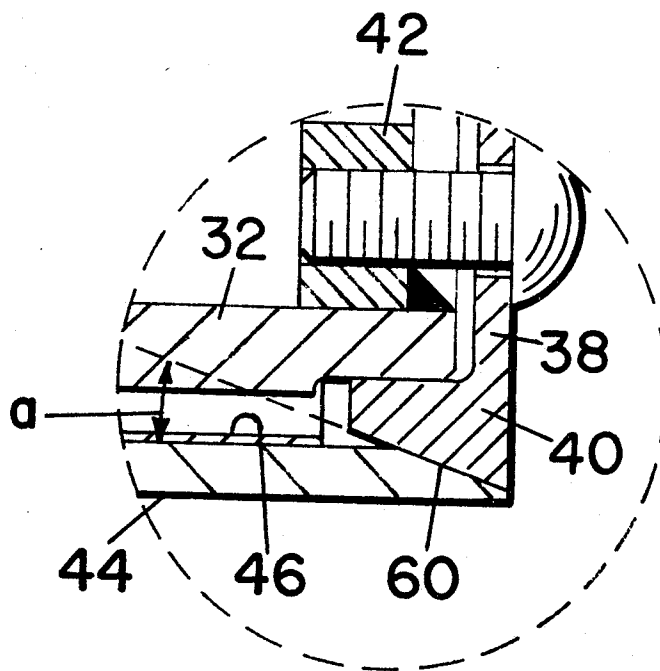
[50] Field of Search. 219/469,
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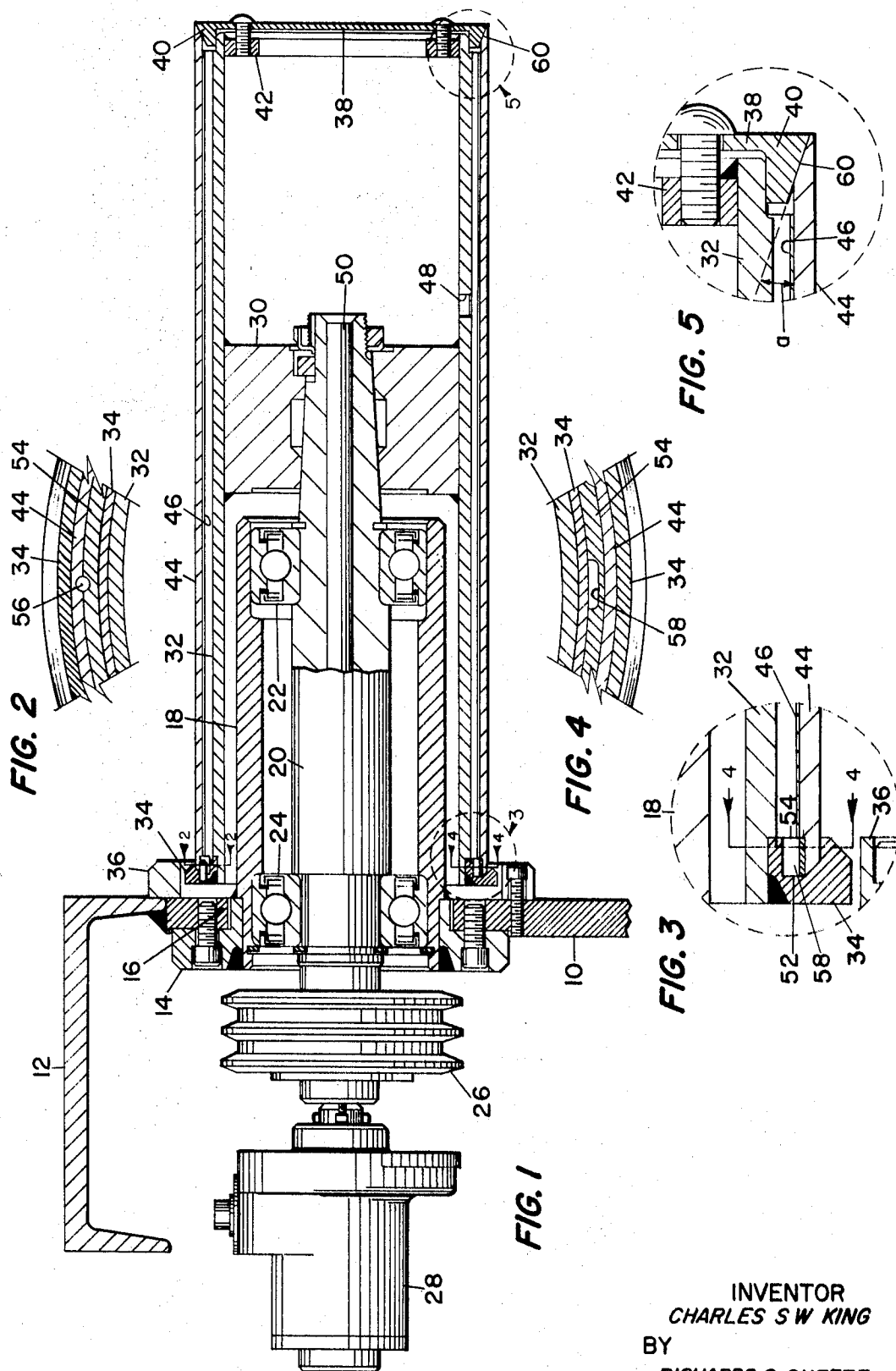
[56] **References Cited**

UNITED STATES PATENTS

3,227,857	1/1966	Hill et al.	219/469
3,441,702	4/1969	Bretoniere.....	219/471

ABSTRACT: A heated roll or "godet" of the type used for processing synthetic filament or film elements is provided in greater than usual lengths in relation to diameter by employing a shell member of thin-wall configuration with heating means at its inner surface to form the heated roll periphery, and supporting this shell member at both ends while mounting it for rotation on a stub shaft with one shell member end interfitted with a support member on a taper having a slope angle whose tangent corresponds to the ratio of the change of shell member radius to change in length in response to temperature change, so that the shell member remains free for diametric and longitudinal expansion under the influence of the heating means while being firmly assembled for operation.





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HEATED ROLL ASSEMBLY

BACKGROUND OF THE INVENTION

Heated rolls or "godets" are commonly employed processing means for developing necessary or desirable physical characteristics in synthetic filament or film elements, the filament or film elements being trained over or about the outer surface of the heated rolls, and the rolls being rotated so that continuous length filament or film may be received and forwarded by the rolls during processing.

Because a close control of roll surface temperature is needed during such processing the roll heating means employed is normally electric and is normally associated with a rather sophisticated temperature sensing and regulating system. A frequently used heated roll arrangement of this sort is of the so-called induction type such as is representatively illustrated and described in U.S. Pat. No. 3,417,219, and in which the substantial bulk of the induction heating means occupies the space available within the roll shell or drum to such an extent as to require mounting of the shell in cantilever fashion on the stub shaft through which it is rotated. The result of such a mounting arrangement is to restrict the length of this type of heated roll to not more than about twice its diameter, which has meant, as a practical matter, that such rolls are not suitable for use in lengths greater than about 12 to 14 inches and that they are actually employed in considerably shorter lengths as a usual thing.

A second type of heated roll arrangement sometimes used incorporates a shell or drum having a wall thick enough to allow formation of cavities therein parallel the roll surface so that cartridge-type heating elements can be installed in the wall for regulation to maintain a desired roll surface temperature. But here again, the length of roll that may be used is comparably limited by the practical problem of rotatably supporting the roll weight that results from the thick-walled form of shell or drum that is employed.

A further type of heated roll arrangement that is available employs an etched foil heating means that is embedded in a silicone rubber matrix at the inner surface of the roll shell or drum and is secured in place thereat by vulcanization. In this type of roll the wall of the shell or drum is maintained as thin as practicable in order to minimize thermal impedance from the heating means to the roll surface and thereby facilitate close regulation of the roll surface temperature. While this thin-walled form of roll shell eliminates the problem with undue weight when length is increased more than usual, and the heating means arrangement leaves the interior of the shell almost entirely free for disposition of mounting means therein, the problem encountered here when it is attempted to increase roll length is that of avoiding intolerable thermal expansion stresses in the thin-walled shell whenever the increased length makes it necessary to provide some form of support at both shell ends on the stub shaft mounting that is usually desired so as to leave one end of the roll assembly unobstructed for training or threading of the material to be processed readily thereover.

The present invention obviates this problem with thermal expansion stresses so as to allow practical use of heated roll lengths considerably in excess of those heretofore usual.

SUMMARY OF THE INVENTION

According to the present invention a thin-walled roll shell or drum of greater than usual length, having electric heating means installed at its inner surface, is mounted on a stub shaft for rotation about its axis with one shell member end seated against a fixed longitudinal abutment and the other shell member end supported on an end plate having a tapered periphery fitting an interior, inwardly extending, taper at this other shell member end, and with these interfitting end plate and shell member tapers having a slope angle those tangent corresponds to the ratio of change of shell member radius to

change of shell member length in response to temperature change, so that diametric and longitudinal expansion of the shell member under the influence of the heating means is freely accommodated while maintaining the shell member firmly mounted for rotation.

A practical embodiment of a heated roll assembly arranged in the foregoing manner is illustrated and described as follows.

DESCRIPTION OF DRAWINGS

FIG. 1 is a central longitudinal section of a heated roll assembly embodying the present invention;

FIG. 2 is an enlarged fragmentary sectional detail taken substantially at the line 2-2 in FIG. 1;

FIG. 3 is an enlarged detail of the structure within the circle at 3 in FIG. 1;

FIG. 4 is an enlarged fragmentary sectional detail taken substantially at the line 4-4 in FIGS. 1 and 3; and

FIG. 5 is an enlarged detail of the structure within the circle at 4 in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 a mounting panel portion is indicated at 10, together with a housing cover member at 12, such as would commonly be employed for mounting a plurality of heating roll units in a processing cluster (not shown).

Mounting of the heated roll assembly of the present invention on the panel 10 is effected through an annular flange member 14 that is bolted in place at a panel clearance aperture 16 provided for the roll mounting. This flange member 14 is welded to carry integrally a cylindrical housing sleeve 18 extending through the panel clearance aperture in an extent reaching close to midway of the length of roll that is to be mounted. In this housing sleeve 18, a stub shaft 20 is carried for rotation in bearings 22 and 24, one of which (22) is disposed adjacent the extending end of sleeve 18 and the other (24) is spaced remotely towards the other sleeve end in general alignment vertically with the panel 10. Under the housing cover member 12, the extending stub shaft 20 is fitted with a pulley 26 at which a drive connection (not shown) may be made for rotating the roll during operation, and additionally extends to a readout unit 28 provided for sensing and regulating the roll surface temperature during operation. Such readout units are available commercially and form no part of the present invention.

The other end of the stub shaft 20 extends oppositely beyond the housing sleeve 18 to a keyed fitting with a centrally bored mounting block 30 that is thus disposed about (or, measuring from the mounting panel 10, perhaps somewhat more than) midway of the roll length to be mounted. This mounting block is in turn welded within a tubular assembly member 32 which is thereby disposed in concentrically spaced relation with respect to the housing sleeve 18 so as to extend thereover in one direction toward the mounting panel 10 to carry an exterior flange annulus 34 welded in place thereon closely adjacent the panel 10 and situated within a shroud ring 36 that is bolted to the adjacent face of panel 10. In the other direction, the tubular assembly member 32 extends far enough in relation to the roll length being dealt with to carry an end plate 38 at that length, this end plate 38 having a flange portion 40 formed at its periphery by which it is centered exteriorly on the assembly member 32, and being held in place by bolting to an annulus 42 welded within the adjacent end of assembly member 32 for this purpose.

The exterior flange annulus 34 and the end plate 38 are provided to support a shell member 44 in concentrically spaced relation about the tubular assembly member 32 to form the processing surface of the heated roll assembly. The shell member 44 has heating means 46 installed at its inner surface, preferably of the etched foil type previously mentioned, and the tubular assembly sleeve 32 is apertured as seen at 48 in FIG. 1 to allow circuit wires (not shown) to be run from this heating means 46 through a central bore at 50 in the stub shaft

20 for connection at the readout unit 28 to provide the control circuit for sensing and regulating operation of the heating means. The thin-walled configuration of the shell member 44 provided to minimize thermal impedance therethrough from the heating means to the outer surface is exemplified by a wall thickness of a little less than one-fourth inch in a length of about 24 inches on a diameter of about $8\frac{1}{2}$ for an operating embodiment that has been constructed, and in which a three-eighth inch wall thickness was used for the tubular assembly member 32.

The support for the shell member 44 at the exterior flange annulus 34 is provided by an annular groove 52 in the latter (see FIG. 3) in which a ring member 54 fitted interiorly of the adjacent shell member end is also received. A dowel pin 56 is employed at the position indicated in FIGS. 1 and 2 to key both the ring member 54 and the shell member 44 for rotation with the flange annulus 34, while the ring member 54 is recessed, as seen best at 58 in FIG. 4, in alignment with the circuit wire aperture 48 of the tubular assembly member 32 for facilitating the handling of the circuit wires as the shell member 44 is put in place.

Upon placing the shell member 44 so that its end carrying the ring member 54 is bottomed in the annular groove 52 of the flange annulus 34, the groove bottom forms a fixed longitudinal abutment against which the shell member 44 is positioned longitudinally in the roll assembly. The ring member 54 is press fitted within the shell member 34 at a seat of enlarged diameter forming a backing shoulder positioning ring member 54 for the bottoming abutment (compare FIGS. 1 and 3).

The inner diameter of ring member 54 is further proportioned for a close centering fit within the annular groove 52 upon initial assembly, while the outer diameter of the groove 52 is proportioned at a looser initial tolerance in relation to the outer diameter of shell member 44 so that the expected diametric thermal expansion of the latter during operation will be tolerated within groove 52 as the bottomed shell member end is held at a fixed longitudinal position and maintained on center.

The support for the other end of shell member 44 at end plate 38 is characterized by a tapered interfitted at this point as illustrated in FIGS. 1 and 5 at 60, the periphery of end plate 38 at its flange portion 40 being tapered to fit an interior, inwardly extending taper at this shell member end, and the bolting of end plate 38 to the assembly member annulus 42 serving to complete the supported assembly of shell member 44 as well as making it possible to disassemble and remove shell member 44 readily whenever desired for repair or replacement purposes.

The tapered interfitted of shell member 44 with end plate 38 at 60 is provided to avoid the thermal expansion stresses that would develop in the thin-walled shell member intolerably under the influence of the heating means 46 if the resulting dimensional changes in shell diameter and length were resisted.

Accordingly, the taper 60 on which the shell member 44 and end plate 38 are interfitted is shaped on a slope angle α (see FIG. 5) whose tangent corresponds to the ratio of change of shell member radius (dr) to change of shell member length (dl) in response to temperature change from idle to operating conditions. That is, for any given temperature change $dr/dl = \tan \alpha$, at least theoretically. Some empirical adjustment of the slope angle α may be needed in relation to the particular size and shape of a given roll structure, but in any event it will be determined essentially by the theoretical relation noted above.

What a taper 60 at such a slope angle α does is to maintain the shell member 44 firmly supported in the roll assembly while at the same time allowing it to change in diametric and longitudinal dimension freely as a result of expansion induced by the heating means 46. Upon such expansion, as the roll surface is brought up to processing temperature, the tapered end of shell member 44 simply walks or slides up the interfitted taper at the peripheral surface of end plate 38, and adjusts

reversely along the taper 60 upon cooling, without disturbing the supporting grip on the shell member 44 between the flange annulus 34 and the end plate 38 that is established upon assembly.

With a heated roll assembly of this sort it is entirely practical to provide roll processing surfaces up to about 40 inches in length, as compared with the 12 inches to 14 inches lengths that have heretofore been maximum possibilities. Such increased roll lengths are often needed, for example, on monofil lines where as many as 80 filament ends are apt to be handled. Film or slit film lines also often require longer than usual roll lengths.

The elements of the roll assembly of the present invention may be fabricated of steel, largely steel tubing and preferably of the centrifugally cast type for the advantageous surface characteristics that are provided in this way. Also, a low carbon variety of steel is preferably used to facilitate the welding done in forming the various elements. A further feature of the structural arrangement disclosed above is a relatively low heat loss at the shell member ends and a consequent relatively flat temperature profile along the shell member 44. In this latter connection, the effect of the heating means 46 can be further concentrated at the shell member 44 by providing a heat reflective surface exteriorly on the tubular assembly member 32.

The present invention has been described in detail above for purposes of illustration only and is not intended to be limited by this description or otherwise to exclude any variation or equivalent arrangement that would be apparent from, or reasonably suggested by, the foregoing disclosure to the skill of the art.

I claim:

1. A heated roll comprising an elongate, cylindrical shell member having electric heating means at the inner surface thereof and being of thin-wall configuration for minimizing thermal impedance from said heating means to the outer shell member surface, and means mounting said shell member for rotation about its axis with one shell member end seated against a fixed longitudinal abutment and the other shell member end supported on an end plate having a tapered periphery fitting an interior, inwardly extending, taper at said other shell member end, said interfitted end plate and shell member tapers having a slope angle whose tangent corresponds to the ratio of change of shell member radius to change of shell member length in response to temperature change, whereby diametric and longitudinal expansion of said shell member under the influence of said heating means is freely accommodated while maintaining said shell member firmly mounted for rotation.

2. A heated roll as defined in claim 1 and further characterized in that the length of said shell member is at least twice its diameter.

3. A heated roll as defined in claim 1 and further characterized in that said first mentioned shell member end is carried in an annular groove on a ring member therein and the bottom of said groove forms said fixed longitudinal abutment.

4. A heated roll as defined in claim 1 and further characterized in that said fixed longitudinal abutment and said end plate are carried on a tubular assembly member arranged concentrically in spaced relation within said shell member and fitted internally with a centrally bored mounting block about midway of its length, and in that said mounting mean further includes a stub shaft having one end keyed within the bore of said mounting block and extending therefrom, through adjacent and remote support bearings housed in concentrically spaced relation within said tubular assembly member to a drive fitting for rotating said shell member.

5. A heated roll as defined in claim 4 and further characterized in that said end plate is removably carried on said tubular assembly member for allowing disassembly of said shell member whenever desired.