Nov. 2, 1965 R. B. FOULKS 3,215,357

EXPANSIBLE MANDREL

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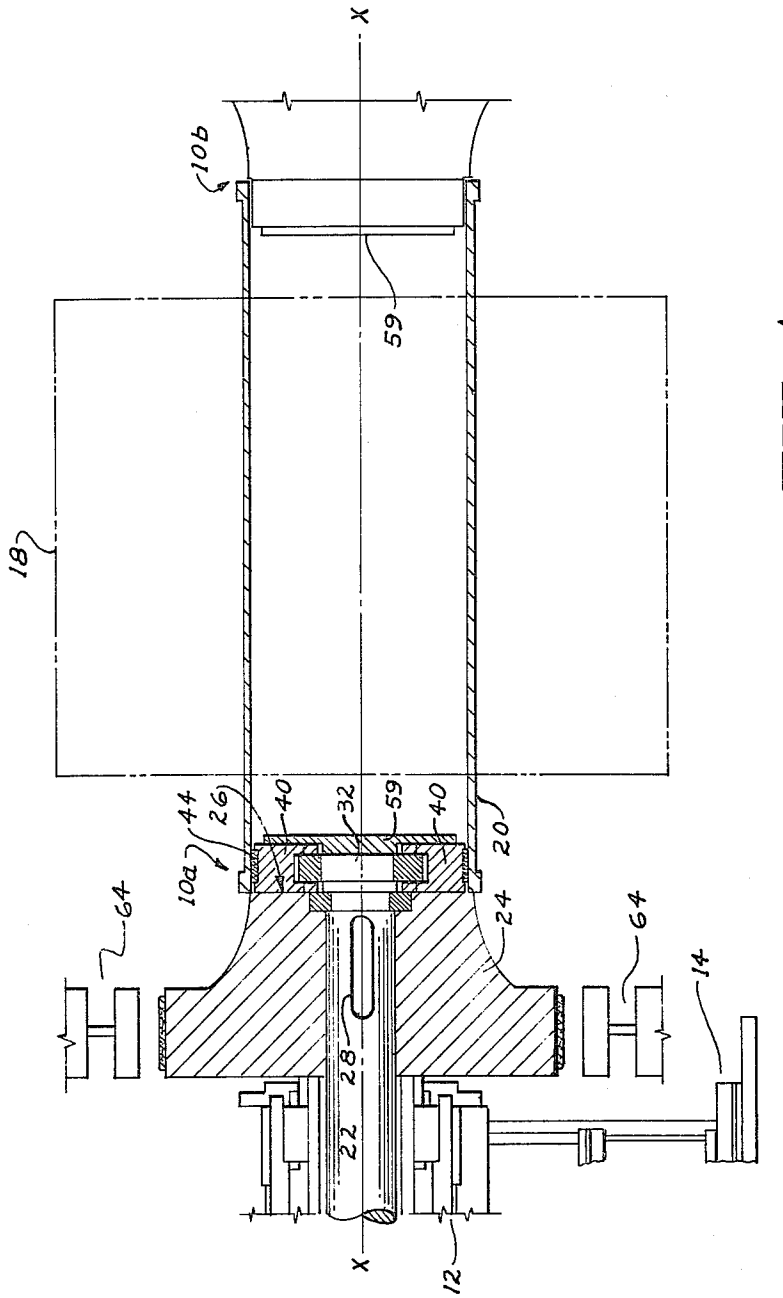


FIG_1

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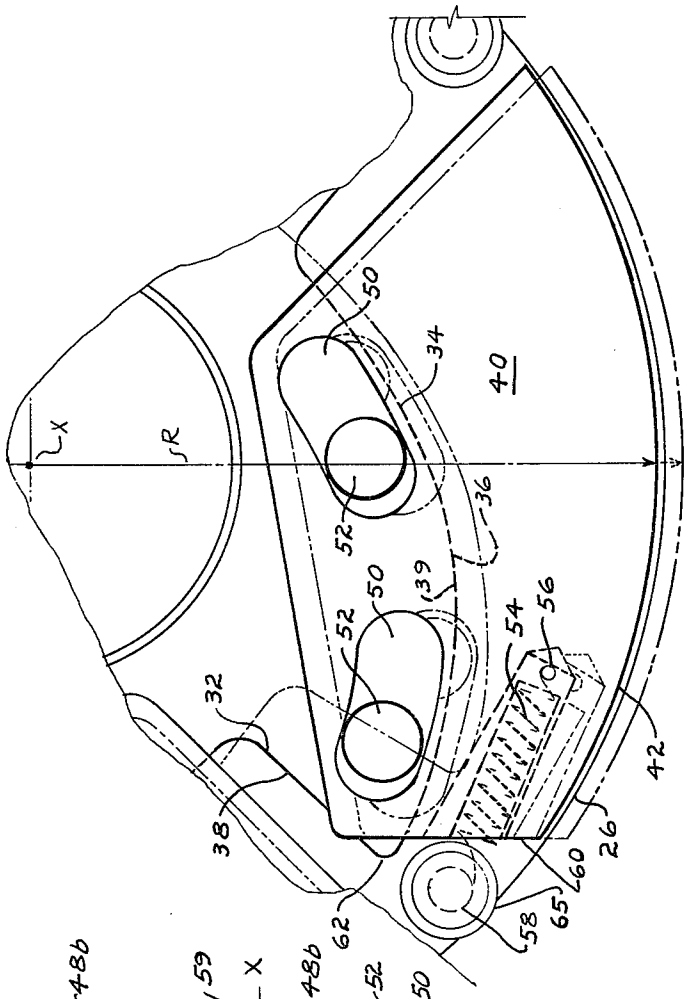


FIG. 5

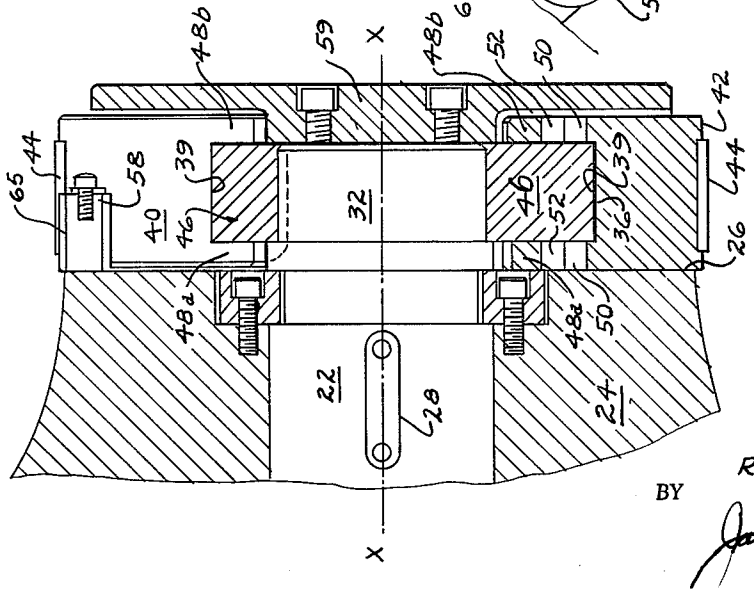


FIG. 2

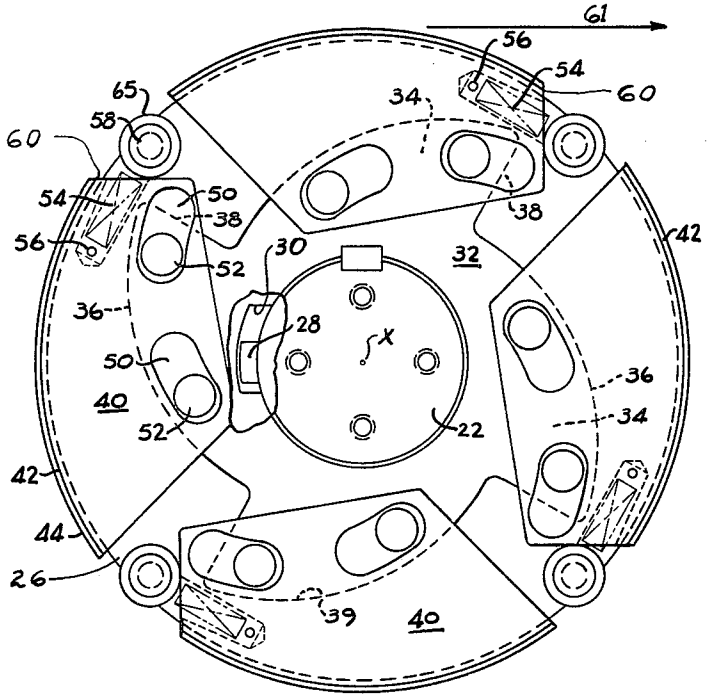
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FIG. 4



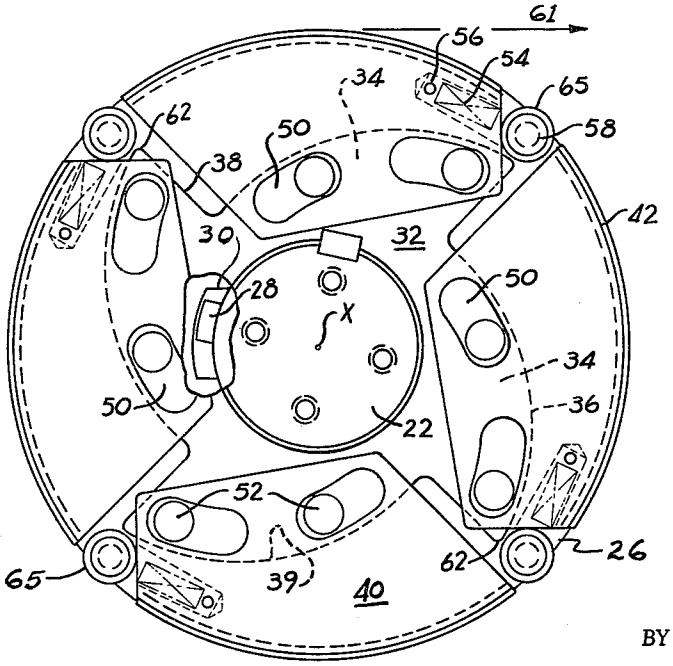


FIG. 3

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EXPANSIBLE MANDREL

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5 Claims. (Cl. 242—68.2)

The present invention relates to apparatus for rotatably holding coils of strip material, such as metal sheets. More particularly, the present invention relates to mandrels for rotatably holding the supporting sleeves for coils of strip material during unwinding of these coils when the strip material is delivered at high rates of speed to processing stations, such as a rolling mill or a pickling line.

The present invention aims to provide a simple yet dependably operating mandrel arrangement, which upon insertion into the supporting sleeve of a coil of strip material may readily be operated to grip the sleeve from the inside and which will adhere to the sleeve securely no matter how fast the sleeve is turned during the uncoiling operation.

These and other purposes and aims of the present invention will become apparent from the following specification taken with the accompanying drawings which together describe and illustrate a preferred embodiment of the invention. Other embodiments of the invention may readily suggest themselves to those having the benefit of the teachings disclosed herein and such other embodiments are intended to be reserved especially as they fall within the scope of the subjoined claims.

In the drawings:

FIG. 1 is a fragmentary front elevation, partly in section, of an apparatus for rotatably holding the supporting sleeve of a coil of strip metal embodying the improvements of the present invention;

FIG. 2 is a fragmentary axial section through the left mandrel of the apparatus shown in FIG. 1;

FIG. 3 is an end view of the mandrel shown in FIG. 2 with a cover plate removed to expose its interior construction;

FIG. 4 is an end view of the same mandrel illustrating a different operational position thereof; and

FIG. 5 is an enlarged detail view illustrating corresponding parts of FIGS. 3 and 4 in superposition.

The apparatus wherein my invention is embodied comprises a pair of expansible mandrel structures **10***a* and **10***b* of symmetrically identical construction which are rotatably supported in axial alignment with each other for movement along their common axis *x*—*x* toward and away from each other. For this purpose, each of the mandrel structures rests upon a carriage **12** (only one being shown in FIG. 1) which slides on a track **14**. Initially, the carriages **12** are in positions withdrawn from each other to leave sufficient space between the mandrel structures for a coil **18** of strip material wound upon a metal sleeve **20** to be raised from below into axial alignment with the mandrel structures, whereupon the carriages are moved towards each other so that the mandrel structures may enter the opposite ends of the sleeve as illustrated in FIG. 1.

Each of the mandrel structures comprises a horizontally disposed shaft **22** that is rotatably supported upon its carriage **12** and which may be driven in either direction from a suitable source of rotary power (not shown). Rotatably supported upon the projecting inner end of said shaft **22** is a centrally apertured housing **24** which forms a flat circular mounting base **26** adjacent the end of shaft **22**. Relative rotation between the shaft **22** and the housing **24** is limited by a key **28** that is formed on

and projects radially from shaft **22** and which engages a race **30** provided in the housing **24**, that is of a somewhat greater width angularly of the common center axis *x*—*x* of shaft **22** and housing **24** than the angular width of the key. Thus, the housing and the shaft are permitted to turn a limited distance, say 12°, independently from each other before they are constrained to rotate in unison. Secured to the inner end of the shaft **22** exteriorly adjacent the base **26** of housing **24** is a rotary cam **32** that forms four angularly equi-spaced dwells or lobes **34** that resemble saw teeth in shape, each having a gradually ascending convex slope or ramp **36** followed by an abrupt drop or decline **38**. Each of said lobes bears against the bottom surface **39** of a brake shoe segment **40** that has a cylindrical outer surface **42** which corresponds in curvature to the cylindrical inner surface of the coil supporting sleeve **20**, and which may be provided with a suitable brake lining indicated at **44**. Said surface **39** lies at the bottom of a cam follower groove **46** formed by two shanks **48***a* and **48***b* of the segment **40** (FIG. 2) that straddle the ramp **36** of the cam lobe **34**. The surface **39** conforms with and overlies the surface of the cam ramp **36** as best seen in FIGS. 3, 4 and 5; and to maintain the surface **39** of the brake shoe segment **40** in effective engagement with the ramp **36** of cam lobe **34**, a pair of slots **50** arranged in tandem relation are provided in each of the two shanks **48***a* and **48***b*, and are engaged over shoulder studs **52** that project laterally from the cam lobe **34**; and lest said inter-engaged slots and studs interfere with the free relative slidability of the coacting shoe surface **39** and cam lobe **34**, the slots **50** follow in form and location a spiral path parallel to the contour of the ramp **36** of cam lobe **34** and the cam follower surface **39** of the brake. To urge the brake shoe segments yieldably into a position relative to the cam lobes, wherein their cylindrical outer surfaces **42** may lie within the periphery of the base **26** on housing **24** and may thus readily enter the end of coil-supporting sleeve **20**, a spring **54** is tensioned between a point **56** of each of said brake shoe segments and a stud **58** that is secured to the base **26** near the peripheral edge thereof adjacent a flank **60** of the shoe segment, and which engages said flank and acts as guide therefor during movement thereof as compelled by operation of cam **32**. The described mandrel structure may be covered by a lid plate **59** that is bolted to the cam **32** as illustrated in FIG. 2.

In FIGS. 3 and 4 of the accompanying drawings the described apparatus is illustrated in a position in which a coil of strip material supported thereon is to be unwound in a clockwise direction, as indicated by the arrow **61** in FIG. 4. When the mandrel structures **10***a* and **10***b* of the apparatus are withdrawn from each other and ready to receive a coil of strip material between them, they are in the retracted or collapsed condition illustrated in FIG. 3 wherein the key **28** of shaft **22** is located closer to the clockwise corner of the race **30** formed in the tubular interior of housing **24**. In this position, the high points of the cam ramps **36** engage the deepest areas of the cam follower groove **46** formed between the shanks **48***a* and **48***b* of the brake shoe segments **40**, and the peaks **62** of the cam lobes may in fact be located beyond and exteriorly of said grooves, as shown in FIG. 3. The urgeny of springs **54** is therefore effective to hold the brake shoe segments in a retracted position radially of the axis *x*—*x* of the mandrel structure, in which their cylindrical outer surfaces may lie within the confines of the base **26**. In this position of the brake shoe segments, the mandrel structures may readily be inserted into the opposite ends of the supporting sleeve **20** for a coil of strip material that has been

lifted into axial alignment with the mandrel structures, as illustrated in FIG. 1.

To expand the mandrel structures so that they may grip the supporting sleeve **20** for the coil of strip material from the inside, the segments of a brake mechanism schematically indicated at **64** in FIG. 1 are brought to bear against housing **24** so that said housing is unable to turn with shaft **22**. Rotary power is now applied to rotate the shaft **22** in counterclockwise direction so that it turns relative to the housing from the position illustrated in FIGS. 3 and 5 to the position illustrated in FIGS. 4 and 5 wherein its key **28** approaches the counterclockwise end of the race **30** in housing **24**. Since the rotary position of the brake shoe segments **40** remains unchanged due to the fact that they are connected to the studs **58** on the base **26** of the stationary housing **24** by the springs **54**, the described rotation of shaft **22** moves the high points of ramps **36** of the cam lobes **34** underneath shallower areas of the cam follower grooves of the brake shoe segments as illustrated in FIG. 4. This is effective to force the brake shoe segments outwardly beyond the periphery of the base **26** until their linings **44** come against, and grip, the inner surface of the coil-supporting sleeve **20**. To guide the brake shoe segments during the described camming operation precisely in the proper direction so that their cylindrical braking surfaces may remain parallel to, and fully engage the cylindrical inner surface of, the coil-supporting sleeve **20**, the flanks **60** of the brake shoe segments which engage, and are guided by, the guide studs **58** are arranged to extend parallel to the radii *r* which bisect their arcuate braking surfaces **42**, and the guide studs **58** may be provided with suitable covers **65** of a smooth plastic.

The end of the strip wound upon sleeve may now be fed into the rolling mill or whatever the processing station may be to which the strip material is to be supplied, the brake **64** upon housing **24** is released and the uncoiling operation may commence. As the strip material is pulled from the coil and turns its supporting sleeve **20** in clockwise directions, as viewed in FIG. 4, the frictional engagement of the inner surface of the sleeve with the linings on the brake shoe segments is effective to compel said segments, the housing **24** to which said segments are attached by the springs **54** and the studs **58**, and the shaft **22** to which said housing is keyed, to participate in the clockwise rotation of the sleeve. During the uncoiling operation a measure of rotary force in the opposite direction may be applied to the shaft **22** from the source of rotary power so that it may act as a dynamic brake to prevent over-running of the coil with respect to the strip that is paid out; and the greater the pull of the rotating sleeve **20** upon the brake segments the tighter they are pressed against the interior of the sleeve, for any increase in tangential force that pulls them in a clockwise direction urges them to climb higher upon the ramps **36** of the cam lobes **34**. Additionally, as the rotational speed increases, the centrifugal force urges the segments to slide higher up on the ramps **36** of the cam, all of which tends to move brake shoe segments outwardly and presses their friction-lined outer surfaces with greater force against the inner surface of the sleeve. Hence, there is no danger that the mandrel structures of the invention may suddenly release the sleeve for uncontrolled rotation as the speed increases with which the processing station pulls the strip from the coil.

The degree to which the brake shoe segments may expand has a practical limit set by the internal diameter of the sleeve upon which the strip material is wound. It has also a positive limit set by the angular width of the race **30** in housing **24** relative to the width of the key **28** on shaft **22** (FIG. 4). In constructing the mandrel structures of the invention, care must be taken that the slots **50** in the shanks **48***a* and **48***b* of the brake shoe segments are sufficiently long to make it impossible for the studs **52** on the cam lobes **34** to come against the ends of said slots before the above-mentioned limits in the expansion of the brake shoe segments are reached lest these studs be sheared off during the uncoiling operation.

After the strip of sheet material has been completely removed from the sleeve **20**, rotation of said sleeve and of the mandrel structures upon which it is supported ceases. In order to dismount the sleeve from the mandrel structures, the brake **64** is again applied to the housing **24** to hold the housing in a stationary condition whereupon the power shaft **22** is rotated in clockwise direction to the extent permitted by the key **28** engaged in race **30** (FIG. 3) which returns the mandrel structures from the position illustrated in FIG. 4 to the position illustrated in FIG. 3. Clockwise movement of the power shaft **22**, while the housing is held stationary, withdraws the high points of the cam lobes **34** from underneath the shallow areas of the cam follower grooves **46** of the brake shoe segments **40** permitting the springs **54** to return the said segments while guided by the studs **58** to the position illustrated in FIG. 3 and withdraw their gripping surfaces from the interior of the empty sleeve **20**. The particular location of the springs **54** is such that they limit the extent to which the brake shoe segments may be retracted, and thus protect the studs **52** on the cam lobes **34** from being sheared off by the clockwise ends of slots **50** during the retraction of the brake shoe segments. The carriages **10***a* and **10***b* may now readily be moved to withdraw the mandrel structures from the sleeve ends so that the empty sleeve may be carted away. The apparatus of the invention is ready to receive another sleeved coil of strip material for delivery to the processing station.

The described mandrel arrangement for rotatably holding a sleeve upon which a coil of strip material is wound, during the uncoiling of the strip as it is drawn into a processing station, is of relatively simple construction. It may readily be set to grip the sleeve, and during the uncoiling operation it will reliably hold said sleeve and provide the proper back tension to avoid over-running of the sleeve no matter how rapidly the strip may be drawn therefrom.

While the invention has been described with the aid of a particular preferred embodiment thereof, the scope of the invention is not intended to be limited to the precise constructional details shown and described which may be departed from without departing from the spirit and scope of the invention, as defined by the following claims, wherein

What is claimed is:

1. Mandrel arrangement for rotatably holding coils of strip material comprising a shaft, a tubular housing arranged about said shaft for limited rotary movement relative thereto, a cam secured to said shaft adjacent said housing and having a number of lobes each having an ascending ramp and studs projecting from either side thereof, a separate brake shoe segment coacting with and arranged to straddle each of said lobes and having an inner cam follower surface in contact with and slidable relative to the ramp of its coacting lobe and having shanks arranged to straddle said lobe and containing slots engaged over said studs for holding said brake shoe segment with its cam follower surface in operative engagement with said ramp, and means connecting each of said shoe segments to said housing for yieldably holding said shoe segments in a retracted position wherein high points of the cam ramps engage areas of said cam follower surfaces remote from the center axis of said shaft.

2. Mandrel arrangement for rotatably holding coils of strip material during unwinding of the coils comprising a power shaft, a tubular housing arranged about said shaft for limited rotary movement relative thereto, a cam secured to said shaft adjacent said housing and having a plurality of lobes each having an ascending ramp and studs projecting from either side thereof, a separate brake

shoe segment coacting with each lobe and having an inner cam follower surface in contact with and slidable relative to the ramp of its coacting lobe and having shanks arranged to straddle said lobe and containing slots engaged over said studs for holding said brake shoe segment with its cam follower surface in operative engagement with said ramp, spring means tensioned between each of said shoe segments and said housing for yieldably maintaining said shoe segments in a retracted position wherein high points of the cam ramps engage areas of said cam follower surfaces remote from the center axis of said shaft, and means for holding said housing against rotation to cause upon limited rotation of said shaft relative to said housing the high points of said cam ramps to move underneath areas of the cam follower surfaces closer to the axis of said shaft and in this manner project the outer surfaces of said shoe segments.

3. Mandrel arrangement for rotatably holding coils of strip material during unwinding of the coils comprising a power shaft, a tubular housing arranged about said shaft for limited rotary movement relative thereto, a cam secured to said shaft and having a number of lobes each having an ascending ramp and studs projecting from either side thereof, a separate brake shoe segment coacting with each of said lobes and having an inner cam follower surface in contact with and slidable relative to the ramp of its coacting lobe, and having shanks at either side of said cam follower surface arranged to straddle said ramp and containing slots engaged over said studs, said slots having a conformation parallel to said ramps to maintain the cam follower surface of said brake shoe segment in effective contact with the cam ramp without interfering with the free slidability of one relative to the other, spring means tensioned between said housing and said shoe segments for yieldably holding said shoe segments in a retracted position wherein high points of the cam ramps engage areas of said cam follower surfaces remote from the center axis of said shaft, and means for holding said housing against rotation.

4. Mandrel arrangement for rotatably holding the supporting sleeves of coils of strip material during unwinding of the coils comprising a power shaft, a tubular housing rotatably arranged about said shaft for limited rotary movement relative thereto, a cam secured to said shaft and having a number of lobes each having an ascending ramp of convex contour and studs projecting from either side thereof, a separate brake shoe segment coacting with each of said lobes and having an arcuate outer surface for contact with the internal surface of coil-supporting sleeves and having an inner cam follower surface in contact with and slidable relative to the ramp of its coacting lobe and having shanks at either side of said cam follower surface arranged to straddle said ramp and containing slots engaged over said studs, said slots having a curved conformation parallel to said ramp and being of sufficient length for maintaining the cam follower surface of said brake shoe segment in effective contact with the cam ramp without interfering with the free slidability of one relative to the other, spring means tensioned between said housing and said shoe segments for yieldably holding said shoe segments in a retracted position wherein high points of the cam ramps engage areas of said cam follower surfaces remote from the center axis of said shaft, and means for holding said housing against rotation to cause upon limited rotation of said shaft relative to said housing the high points of said cam ramps to move underneath areas of the cam follower surfaces closer to the axis of said shaft and in this manner project the arcuate outer surfaces of said shoe segments.

5. Mandrel arangement for rotatably holding the supporting sleeves of coils of strip material during unwinding of the coils comprising a power shaft, a tubular housing arranged about said shaft for limited rotary movement relative thereto and having a flat end portion, a cam secured to the end of said shaft adjacent the end portion of said housing and having a plurality of circumferentially equi-spaced lobes each having an ascending ramp of convex contour and studs projecting from either side thereof, a separate brake shoe segment coacting with each of said lobes and having an arcuate outer surface for engagement with the internal surface of coil-supporting sleeves, a flank extending parallel to the radius bisecting said arcuate outer surface, an inner cam follower surface in contact with and slidable relative to the ramp of its coacting lobe shanks at either side of said cam follower surface arranged to straddle said ramp and containing slots engaged over said studs, said slots having a curved conformation parallel to said ramp and being of sufficient length for maintaining the cam follower surface of said brake shoe segment in effective contact with the cam ramp without interfering with the free slidability of one relative to the other, guide studs secured to the flat end portion of said housing and in contact with the flanks of said shoe segments, spring means tensioned between said studs and the shoe segments in contact therewith for yieldably holding said shoe segments in a retracted position wherein high points of the cam ramps engage areas of said cam folower surfaces remote from the center axis of said shaft, and means for holding said housing against rotation to cause upon limited rotation of said shaft relative to said housing the high points of said cam ramps to move underneath areas of the cam follower surfaces closer to the axis of said shaft and in this manner project the arcuate outer surfaces of said shoe segments against the urgency of said spring means, and while guided by said guide studs, into gripping engagement with the internal surface of a coil supporting sleeve placed over the mandrel arrangement.

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