

Aug. 27, 1946.

W. W. BARDSLEY

2,406,525

KNITTING MACHINE

Filed Dec. 28, 1943

2 Sheets-Sheet 1

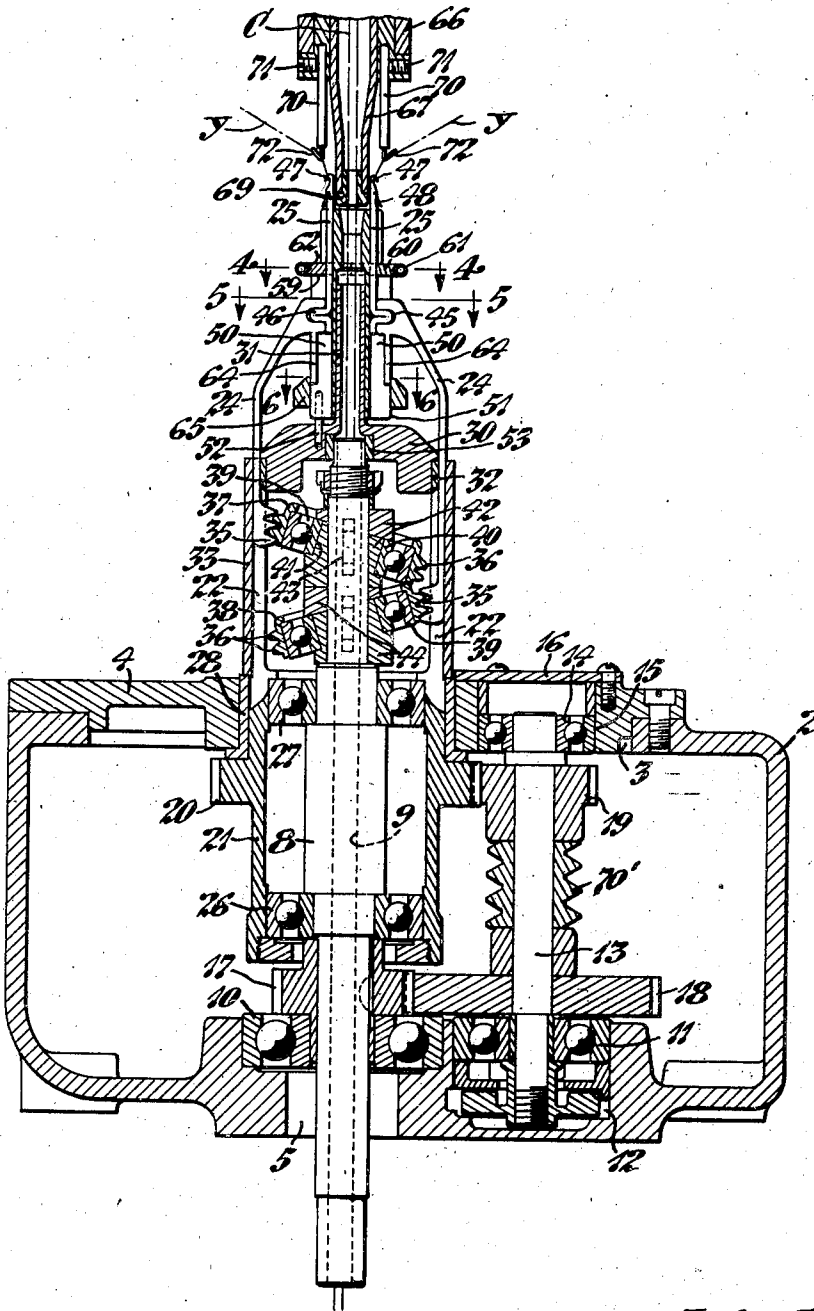


Fig. 1.

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2 Sheets-Sheet 2

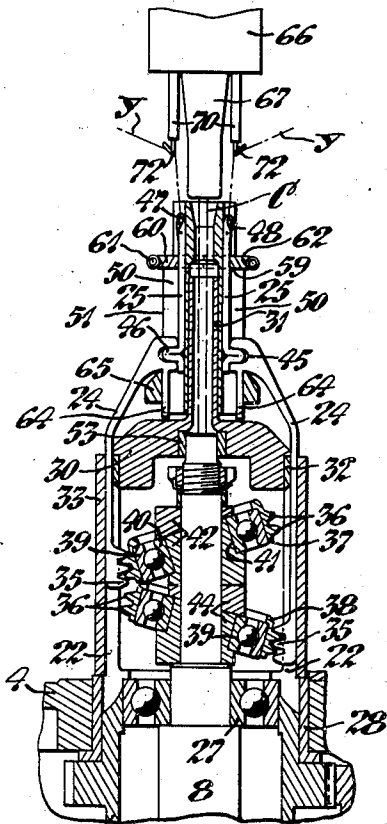


Fig. 2.

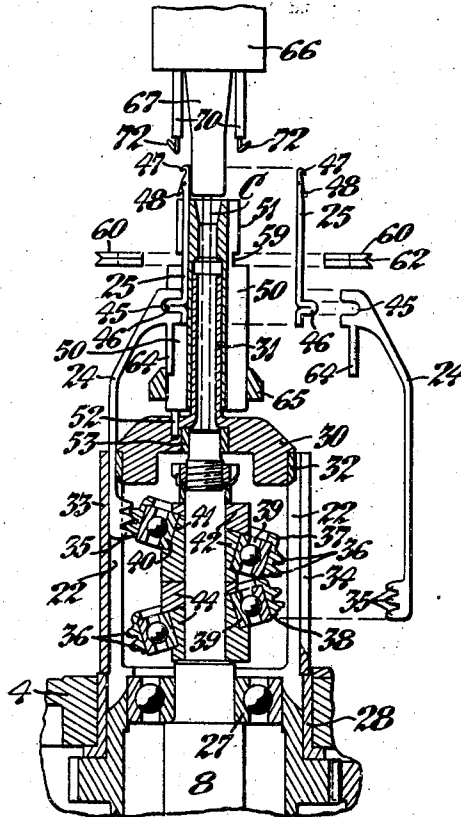


Fig. 3.

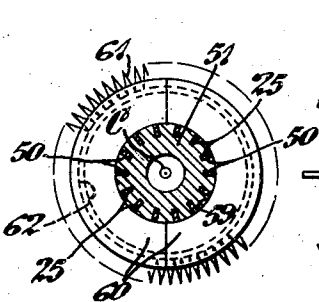


Fig. 4.

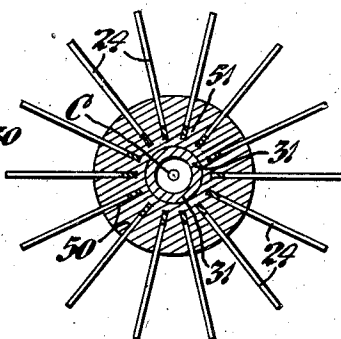


Fig. 5.

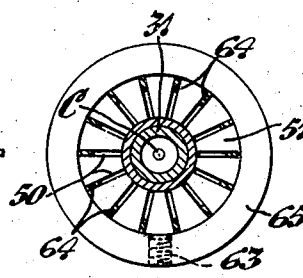


Fig. 6.

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UNITED STATES PATENT OFFICE

2,406,525

KNITTING MACHINE

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8 Claims. (Cl. 66—9)

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This invention relates to improvements in knitting machines and particularly to a high-speed machine of this type for applying a knitted, tubular sheath or covering around a central core such as a wire or other electrical conductor.

One object of the invention is to provide an improved mounting for the jacks which reciprocate the knitting needles in the machine whereof to prevent play and vibration of the needles to insure more efficient operation of the machine at greatly increased speeds.

Another object of the invention is to provide an improved bearing construction for the jacks while adapting them to be readily removed from the machine for repair or replacement.

Another object of the invention is to provide a bearing construction for steadying the jacks at their upper ends to counteract the effect of centrifugal force and prevent misalignment of the jacks liable to cause vibration of the needles.

Further objects of the improvement are set forth in the following specification which describes a preferred embodiment of the invention as illustrated by the accompanying drawings. In the drawings:

Fig. 1 is a vertical sectional view of the operating mechanism of a knitting machine showing the present improvements applied to use therewith and illustrating certain of the needles at the upper end of their stroke;

Fig. 2 is a similar fragmentary sectional view showing certain of the needles at the lower end of their stroke;

Fig. 3 is a similar view illustrating the manner in which the needles and jacks may be removed for repair or replacement;

Fig. 4 is an enlarged plan view of the needle-retaining ring or collar applied to the slotted needle-cylinder which is shown in section on line 4—4 of Fig. 1;

Fig. 5 is an enlarged sectional plan view of the needle-cylinder taken on line 5—5 of Fig. 1 and showing the radial arrangement of the jacks; and

Fig. 6 is an enlarged part-sectional plan view on line 6—6 of Fig. 1 showing the improved bearing construction for the jacks.

The present improved knitting machine is designed particularly for use in covering electrical conductors with a cotton insulating sheath which is subsequently coated with a suitable compound having high dielectric characteristics. For certain types of conductors the knitted covering or sheath is employed in place of a braided covering as it can be applied at a higher rate of production. To secure this rapid rate of pro-

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duction, however, it is necessary that the knitting machine be operated at a much higher speed than ordinary knitters used for producing tubular textile sleeving or the like. In adapting the knitting machine for the present purpose it has therefore been necessary to improve the construction and arrangement of the operating mechanism of the machine and with this object in view the present invention provides for mounting the jacks for the needles in a novel form of bearing to prevent vibration and misalignment thereof during operation of the machine at speeds heretofore not obtainable.

Referring first to Fig. 1 of the drawings, the driving mechanism for the knitting head or unit is contained in a box-like gear-casing 2 forming the base of the machine and adapted to be mounted on a suitable stand or other support. The casing 2 is formed with an opening 3 at its top to provide access to the mechanism contained therein with the opening closed by a cover 4. The casing 2 is also provided with an aperture 5 in its base through which extends a vertical hollow spindle or shaft 8 having an axial bore 9 for the core or conductor feeding to the needles at the top of the machine as they are operated to apply the knitted sheath to the core. An antifriction bearing 10 is supported in a counter-bore in the aperture 5 in the base of the casing 2 and a second similar antifriction bearing 11 is mounted in a recess 12 in the base of the casing at one side of the bearing 10. Journaled in the antifriction bearing 11 is a countershaft 13 having its upper end supported in a smaller antifriction bearing 14 mounted in an aperture 15 in the cover 4. A flat cover or cap 16 closes the upper end of the aperture 15 to protect the bearing from dust, lint and other foreign matter.

Keyed to the spindle 8 above the bearing 10 is a gear 17, the teeth of which mesh with those of a gear 18 fast on the countershaft 13. On the upper end of the countershaft 13 is a smaller gear 19 arranged with its teeth meshing with the teeth of a gear 20 formed integral with a hollow cylindrical member 21 which constitutes the rotating carrier for the jacks 24 and needles 25 to be later described. The cylinder 21 is mounted to rotate on spaced antifriction bearings 26 and 27 surrounding reduced portions of the shaft or spindle 8.

The shaft or spindle 8 constitutes the main driving element for the machine and for this purpose it may be provided with a pulley or gear (not herein shown) at its lower end driven from a motor or other source of power. Rotation of

the shaft 8 is transmitted from its gear 17 through the gear 18 to the countershaft 13 and thence through the gear 19 back through the gear 20 to drive the jack-cylinder 21. A bushing 28 held in an aperture of the cover 4 serves as a bearing for the mid portion of the cylinder 21. Above this bearing the periphery of the cylinder 21 is slotted vertically to provide a plurality of guideways 22 for the jacks 24, there being 12, 14 or any even number of such slots or guideways in accordance with the number of needles employed in the machine.

Fitted to the upper end of the cylinder 21 is a disk-like member 30 formed with a tubular extension 31 reaching upwardly above the end of the spindle 8 with its bore forming an extension of the axial bore 9 in the spindle. It will be noted that the slots 22 in the periphery of the cylinder 21 are not cut clear through the upper portion of the latter, an annulus or ring 32 of the metal being left at this point to serve as a bearing for the legs of the jacks 24. The jacks 24 are retained in the slots or guideways 22 by means of a cylindrical shell or casing 33 fitting closely around the cylinder. This shell or casing 33 is provided on one side with a longitudinal slot 34, shown in Fig. 3 of the drawings, through which the jacks 24 may be removed from the slots 22 in the cylinder 21 in the manner illustrated in this latter view. That is to say, the shell 33 may be rotated about the cylinder 21 to position the slot 34 opposite any one of the jacks which it is desired to remove, the slot being of sufficient width to allow the jack to be withdrawn laterally therethrough.

The jacks 24 have relatively narrow legs terminating at the bottom in inwardly-directed projections 35 shaped substantially like gear-teeth and adapted to engage with annular projections or teeth 36 on one or the other of cam-like rings 37 and 38 called "wabblers"; it being noted that the jacks are of two different lengths, the shorter ones engaging with the teeth on the upper wobbler 37 and the longer ones engaging with the teeth on the lower wobbler 38. The long and short jacks are arranged alternately around the periphery of the cylinder 21 in the manner and for the purpose as explained hereinafter. The upper wobbler or cam-ring 37 is journaled on a bail-bearing 39, the inner race 40 of which is free to turn in an inclined recess 41 of a two-part hub 42 secured rotatably with the spindle 8 by means of a key 43. The lower wobbler-ring 38 is mounted on a similar bearing 39 held in the angular recess of a two-part hub 44 also keyed to the spindle 8. The two parts of the hubs 42 and 44 form oppositely-inclined cam-faces which act on the antifriction bearings 39 to impart an up and down oscillatory movement to the wobbler-rings 37 and 38 during the rotation of the hubs relatively of the wabblers. The hubs 42 and 44 are rotated with the spindle 8 while the wobbler-rings are held non-rotatively due to the frictional engagement between their teeth 36 and the teeth 35 on the jacks 24; these motions being explained more particularly hereinafter. It will be understood that the spindle 8 drives the hubs 42 and 44 to cause them to operate as cams to oscillate the wobbler-rings 37 and 38 while the cylinder 21 is being rotated in the same direction as the spindle through the gears 17, 18, 19 and 20 but with a variation in speed between these parts, the cylinder being rotated at a slower speed than that of the spindle. The arrangement of the jacks 24 around the cylinder 21 and the manner of their operation by the wabblers 37 and 38 is such that

they are raised and lowered alternately in series around the circumference of the cylinder to impart to the needles 25 connected to the jacks the same alternate rising and lowering motion.

The upper portions of the jacks 24 are inclined inwardly and formed at their ends with enlarged heads provided with lateral openings in the nature of sockets 45 for receiving the bent loops 46 at the lower ends of the needles 25. The upper ends of the needles 25 are formed with the usual hooks 47 and below the hooks are pivoted latches 48 which close against the hooks 47 after the yarn strands have been engaged therein.

The needles 25 are mounted to reciprocate in vertical slots 50 formed in a cylindrical needle-carrier 51 which forms an extension of and rotates with the main cylinder 21 carrying the jacks 24. The needle-cylinder 51 is mounted on the tubular extension 31 of the member 30 and keyed rotatively therewith through the means of a pin 52 projecting from the bottom of the cylinder and engaging a hole in the member. The upper end of the tubular spindle 8 is reduced in diameter and fitted within a bushing 53 in the bore of the member 30.

The radial slots 50 in the needle-cylinder 51 are relatively deep to accommodate the enlarged socketed heads of the jacks 24 engaged with the loops 46 of the needles 25. The upper end of the cylinder 51 is reduced in diameter and at a point above the ends of the jacks 24, when the latter are in their uppermost position, the cylinder is formed with an annular slot 59. Seated in the slot 59 is a two-part split ring 60 formed with a V-shaped groove 62 in its periphery in which is held a helical spring 61 surrounding the ring to clamp its two sections together in abutting relationship in the slot 59, see Fig. 4. The inner periphery of the ring 60 serves as a bearing for the needles 25 to retain them in the slots 50 in the needle-cylinder 51. The two-part construction of the ring 60 provides for its removal from the needle-cylinder 51 by stretching the spring 61 and releasing it from the groove 62 in the ring. Upon removal of the bearing ring 60 the needles 25 may be withdrawn from the slots 59 in the needle-cylinder 51 coincidentally with the removal of the jacks 24 from the cylinder 21 in the manner previously explained and indicated in Fig. 3 of the drawings.

As one improvement of the present invention, the jacks 24 are provided with bearing means at their upper ends to resist any tendency for them to spring outwardly from the grooves 50 in the cylinder 51 under the effect of centrifugal force and thereby cause undue vibration at the upper limit of their throw. As shown most clearly in Figs. 2 and 3, this bearing means comprises a vertical finger 64 projecting downwardly from the socketed upper end of each jack 24 in the manner of a "beard" and engaging with the inner surface of a collar 65 surrounding the needle-cylinder 51. The collar 65 is secured fast on the lower end of the needle-cylinder 51 by any suitable means such as a set-screw 63, shown in Fig. 6, located between adjacent slots 50. As the jacks 24 play up and down in the slots 22 and 50 in the cylinders 21 and 51, respectively, a firm bearing is provided for their upper ends to prevent them from springing radially outwardly or becoming otherwise misaligned. Through this means the jacks are caused to reciprocate with a straight-line motion and the needles connected to their upper ends are prevented from undue play at their points of connection.

tion to eliminate vibration during their reciprocation.

Mounted above the knitting head on a framework or other support, not herein shown, is a cylindrical member 66 formed with a depending hollow stem 67 communicating with a bore in the member. The lower end of the stem 67 is positioned slightly above the flaring open end of the needle-cylinder 51 to guide the covered or sheathed core as it feeds past the knitting needles. Preferably, the stem 67 has a thimble 69 of hardened metal inserted in the lower end of its bore and provided with a relatively small bore adapted to accurately guide the covered core as it feeds therethrough. Projecting downwardly from the cylindrical member 66 are a plurality of thread-guides 70 held in bores in the member by means of set-screws 71. The thread-guides 70 are equal in number to the number of strands to be knitted and are provided at their lower ends with guiding loops or pigtails 72 through which the strands *y* pass to the needles 25. The strands *y* of yarn or other textile material may be supplied from cops or packages mounted above the knitting head in any suitable arrangement, and usually suitable tension-devices, not herein shown, are positioned to act on the strands delivering from the supply cops to apply tension thereto as they feed to the needles.

Any suitable arrangement of capstan and wind-up mechanism, not herein shown, may be provided for feeding the core through the machine and winding it onto a reel or spool after it has been covered with the knitted sheath. The capstan and wind-up mechanism may be driven from the countershaft 13 by means of a worm 70' operating through gearing, not shown, in the casing 2. The core may pass either upwardly or downwardly through the machine to apply the covering thereto in accordance with the type of tubular fabric to be produced for different requirements.

The essential mechanism of the knitting head with the present improvements applied thereto having been described in detail, the operation of the machine is explained as follows:

Assuming that a core such as a wire or other conductor C, indicated by dash lines in Fig. 1, has been drawn upwardly through the bore in the hollow spindle 8 and continued up through the center of the needle-cylinder 51 and the stem 67 with its end attached to the capstan or other take-up device, the strands *y* of yarn from the supplies are threaded through the guides 72 and fastened to the core between the thimble 69 and the top of the cylinder 51. Power is applied to rotate the shaft or spindle 8 and the latter will drive through the gears 17, 18, 19 and 20 to rotate the cylinder 21 and thereby the cylinder 51 in the same direction as the spindle. Rotation of the spindle 8 causes the cam-grooves in the hubs 42 and 44 to oscillate the wabblers-rings 37 and 38 in opposite directions and the motion of the wabblers is transmitted to reciprocate the jacks 24; it being understood that the wabblers-rings are prevented from turning with their cam-hubs by the engagement of the jacks therewith. The reciprocatory motion of the jacks is communicated to the needles 25 to cause the latter to rise and fall in alternate order as they revolve about the core C with the rotation of the cylinder 21. The reciprocation of the needles 24 effects the knitting action by causing the hooks to engage with the strands *y* leading through the eyes

72 to intermesh loops of the yarn and form the knitted fabric surrounding the core C.

The core C is fed through the machine at a very rapid rate and it is necessary to actuate the needles at a speed many times that of the needles in the usual type of circular knitting machine. Therefore, unless the reciprocating parts are controlled in their motions and undue play or back-lash prevented at their connections, rapid vibration may be set up in the needles liable to damage or break them and further cause skipped stitches in the fabric. To prevent such vibration due to misalignment of the jacks 24 and play or lost motion where their heads connect with the needles 25, the present improvement provides for steadying the motion of the jacks at their upper ends. That is to say, as the jacks 24 reciprocate vertically in the slots 50 in the cylinder 51 the fingers or beards 64 depending from their heads play up and down within the ring or collar 65 to thereby restrain them from springing outwardly under the effect of centrifugal force. In this way, the jacks are held to a straight-line motion so that they will be maintained in accurate alinement and their connection with the needles 25 prevented from becoming shakily. Due to this improved bearing construction for the jacks, vibration of the needles is practically eliminated and it has been demonstrated that the cause of needle breakage and skipped stitches in the fabric is thus removed. Stated another way, with the present improvements applied to the machine it can be operated at much higher speeds than ordinary knitting machines without damage to the needles and with a material reduction in skipped stitches and faults in the knitted fabric.

Heretofore, in knitting machines of the present type it has been a more or less common practice to remove the needles from the machine by springing the upper ends of the jacks outwardly after they have been raised to the upper end of their stroke. This practice is objectionable since the jacks frequently become bent and misaligned and to overcome this difficulty the present improvement provides for the removal of the needles with the jacks without springing or bending the latter. To remove the needles when they become worn or broken the split ring 60 is first removed from the cylinder 51 by releasing the spring 61 and separating the parts of the ring. The shell or casing 33 is then rotated on the cylinder 21 to register its slot 34, see Fig. 3, with any one of the jacks 24 after which the jack may be withdrawn through the slot and the needle disconnected from its upper end or head. Broken or damaged needles may be discarded and replaced by new ones by simply inserting the needle in its proper slot in the cylinder 51 and replacing the split ring 60 in the annular slot 59 with the spring 61 stretched around its periphery in the groove 62. The jack 24 is then inserted through the slot 34 in the casing 33 and connected to the needle 25 by engaging its loop 46 in the socket 45 of the jack while the needle is raised above the limit of its normal stroke. The jack 24 is placed in the slots 22 and 50 of the cylinders 21 and 51 with its finger or beard 64 in engagement with the interior periphery of the bearing collar 65 and the teeth 35 at the lower end of the jack are engaged with the teeth 36 on the appropriate wabblers-ring 37 or 38. The cylindrical shell or casing 33 is then rotated sufficiently to locate its slot 34 between two of the jacks and the machine is ready to operate again.

It will be observed from the foregoing specification that the present invention provides an improved bearing construction for steadying the jacks and controlling their reciprocating motion to prevent misalignment thereof and play and back-lash at their connections with the needles. The improvement thus prevents vibration and improper timing of the operation of the needles liable to cause damage thereto and faults in the knitted covering or sheath applied to the core. In this way the improvement provides for high speed operation of the knitting head to materially increase the rate of production and insure the application of a more perfect covering to the core or conductor.

While the improvements are herein illustrated and described as embodied in a preferred form of construction, it is to be understood that modifications may be made in the structure and arrangement of the mechanism without departing from the spirit or scope of the invention. Therefore, without limiting myself in this respect, I claim:

1. In a knitting machine, the combination of a needle-cylinder, knitting needles reciprocable axially of the cylinder, jacks connected to reciprocate the needles, means for reciprocating the jacks, bearing means projecting vertically from the upper ends of the jacks and offset radially inward therefrom, and a collar surrounding the cylinder and engaged by said bearing means on the jacks for preventing them from springing radially outward under the effect of centrifugal force.

2. In a knitting machine, a needle-cylinder having a plurality of axially-extending slots, knitting needles reciprocable in said slots, jacks engaging the needles and formed with bearing portions projecting from their upper ends and offset radially inward from the main portions of the jacks, a bearing ring surrounding the cylinder with its inner periphery engaging the bearing portions of the jacks to prevent their upper ends from springing outwardly, and means for reciprocating the jacks to transmit their motion to the needles.

3. In a knitting machine, the combination of a needle-cylinder formed with a plurality of longitudinal slots, knitting needles reciprocable in said slots, jacks connected to the needles and slidable in said slots, said jacks formed with vertical extensions projecting downwardly from their upper ends and offset radially inward from their main portions, an annular bearing surrounding the cylinder with its interior surface engaging the extensions on the jacks to control their motion, and means for reciprocating the jacks to transmit their motion to the needles.

4. In a knitting machine, a rotary cylinder formed with a plurality of vertical slots, jacks slidable in said slots and formed with socketed heads at their upper ends, said cylinder having an extension of lesser diameter projecting thereabove and formed with slots in alignment with the slots in its main portion, needles slidable in the slots of the extension and provided with

means engaging the sockets in the heads of the jacks, a collar surrounding the reduced extension of the cylinder, projections depending from the heads of the jacks in engagement with the inner periphery of the collar for controlling the motion of the jacks and preventing them from springing radially outward at their upper ends, and means within the cylinder for reciprocating the jacks to communicate their motion to the needles.

5. In a knitting machine, the combination of a central hollow spindle, a cylinder rotatable about the axis of the spindle and formed with a plurality of longitudinal slots in its periphery, said cylinder having an extension of lesser diameter projecting thereabove and formed with slots in alignment with the slots in its main portion, needles slidable in the slots in the cylinder extension and provided with abutments at their lower ends, jacks slidable in the slots in the main cylinder and formed with inwardly-inclined upper ends terminating in socketed heads engaged with the abutments on the needles, said heads of the jacks provided with downwardly-projecting fingers, a bearing collar surrounding the cylinder extension enclosing the slots therein with the fingers on the jacks engaging the inner periphery of said collar, cam-means on the spindle engaging the jacks to reciprocate the latter, means to rotate the spindle, and means to rotate the cylinder therefrom.

6. In a knitting machine, a rotary cylinder formed with a plurality of vertical slots, jacks having legs slidable in said slots with their upper portions inclined inwardly toward the axis of said cylinder and socketed heads at their upper ends, fingers projecting vertically from the heads of the jacks, and a collar surrounding the cylinder enclosing the fingers on the jacks to provide a stabilizing bearing therefor.

7. In a knitting machine, a rotary cylinder formed with a plurality of vertical slots in its main portion and having an extension of lesser diameter projecting thereabove and formed with slots in alignment with the slots in its main portion, needles slidable in the slots of the extension, jacks having vertical legs slidable in the slots of the main portion of the cylinder and formed with upper extensions inclined inwardly from the vertical legs, the upper ends of the jacks being engageable with the needles and formed with vertically projecting fingers slidable in the slots in the reduced extension of the cylinder, and a bearing collar surrounding said reduced extension of the cylinder and engaging the fingers on the jacks to prevent the latter from springing radially outward at their upper ends.

8. An improved jack for knitting machines comprising a vertical leg having its upper portion inclined at an angle to the vertical and formed with a socketed head, and a relatively narrow finger projecting vertically from said head in spaced relation to the main leg of the jack and adapted to engage an internal bearing on the knitting machine.

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