

Dec. 21, 1965

J. DUŠÍK ET AL

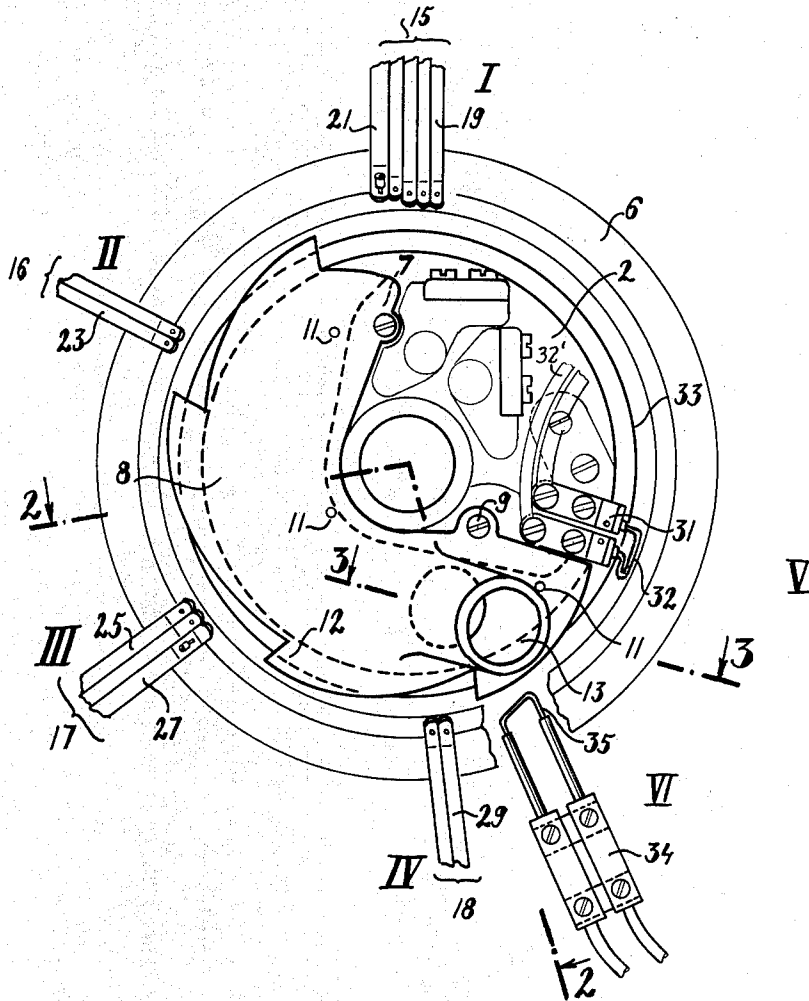
3,224,230

DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE

Filed Feb. 25, 1963

7 Sheets-Sheet 1

Fig. 1.



INVENTORS

Josef Dušík, Ivan Martiš, Václav Oboril,
Milan Mejstřík, Jaroslav Javorek
by Karel Černý

Dec. 21, 1965

J. DUŠÍK ET AL
DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE

3,224,230

Filed Feb. 25, 1963

7 Sheets-Sheet 2

Fig. 3.

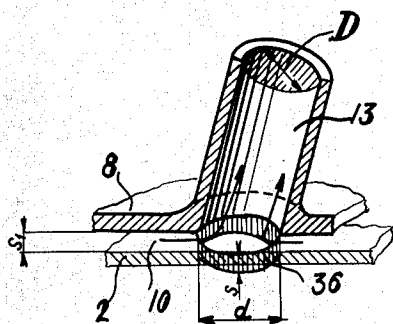
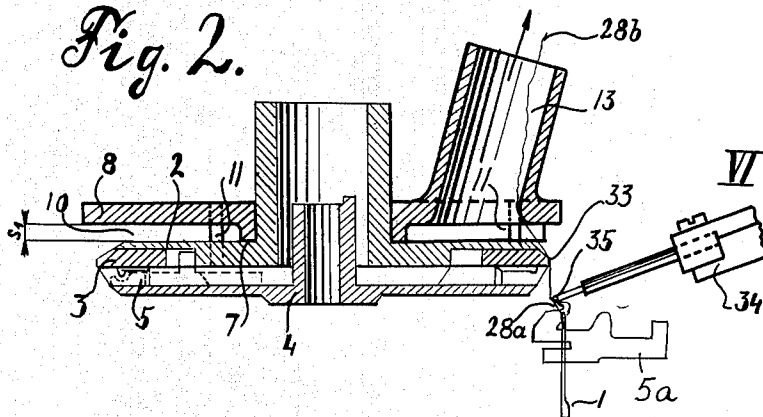


Fig. 2.



INVENTORS
Josef Dušík, Ivan Martiš, Václav
Obořil, Milan Mejzlík, Jaroslav Javorek
By Richard Lund ogst

Dec. 21, 1965

J. DUSÍK ET AL

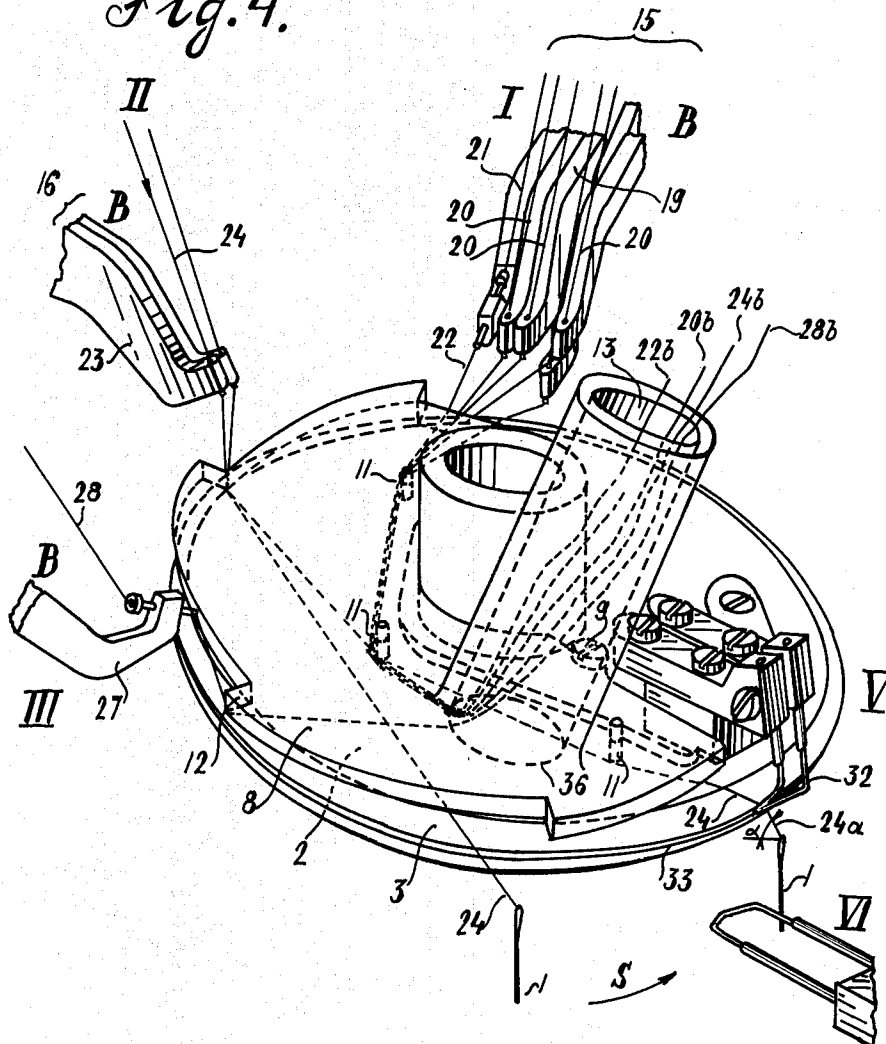
3,224,230

DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE

Filed Feb. 25, 1963

7 Sheets-Sheet 3

Fig. 4.



INVENTORS

Josef Dusík, Ivan Martiš, Václav
Obořil, Milan Mejzlík, Jaroslav Javorek
By Richard Lindtner

Dec. 21, 1965

J. DUSÍK ET AL

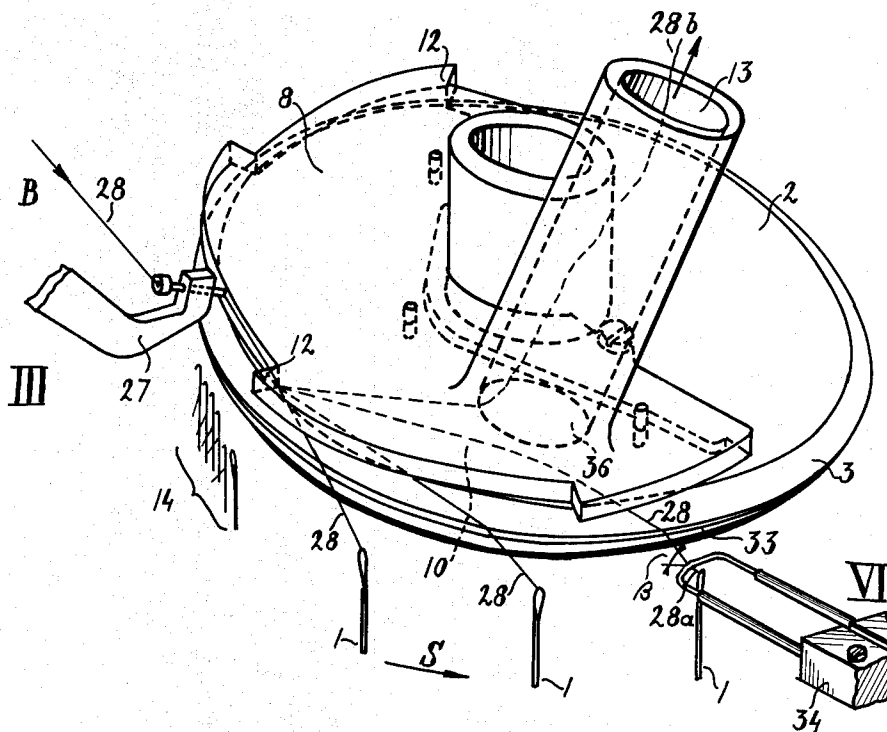
3,224,230

DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE

Filed Feb. 25, 1963

7 Sheets-Sheet 4

Fig. 5



INVENTORS
Josef Dusík, Ivan Martiš, Václav Obřil,
Milan Mejzlík, Jaroslav Tavorrek
By Richard Lund att

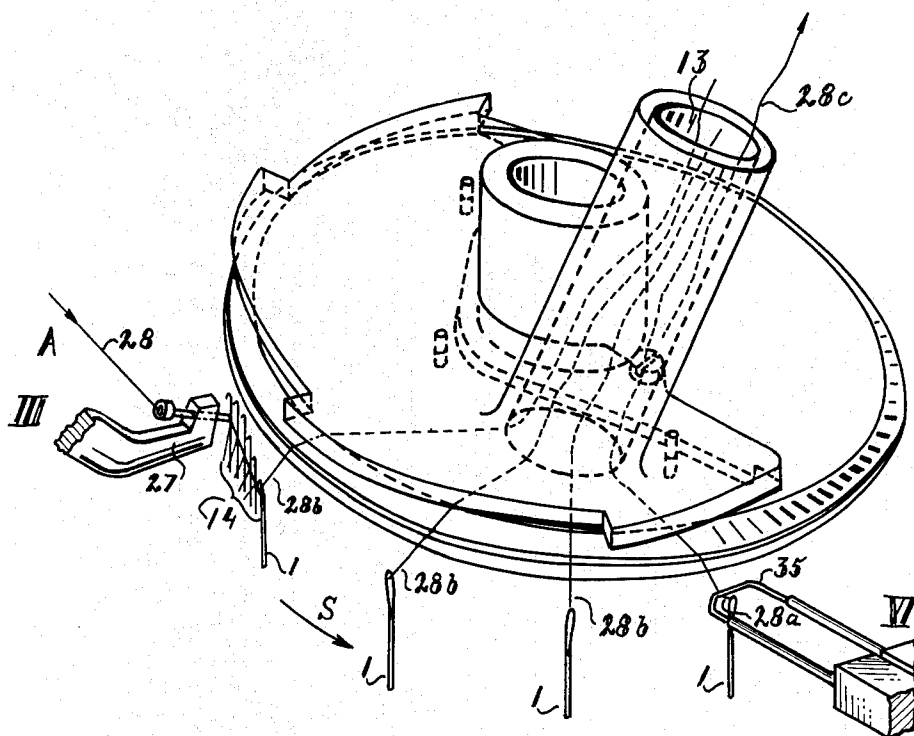
Dec. 21, 1965 J. DUSÍK ETAL 3,224,230
DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE
Filed Feb. 25, 1963 7 Sheets-Sheet 5

J. DUSÍK ETAL
DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE

3,224,230

7 Sheets-Sheet 5

Fig. 6.



INVENTORS
Josef Dusík, Ivan Martiš, Václav Obo-
řil, Milan Mejzlík, Jaroslav Jarošek
By Richard Lund og

Dec. 21, 1965

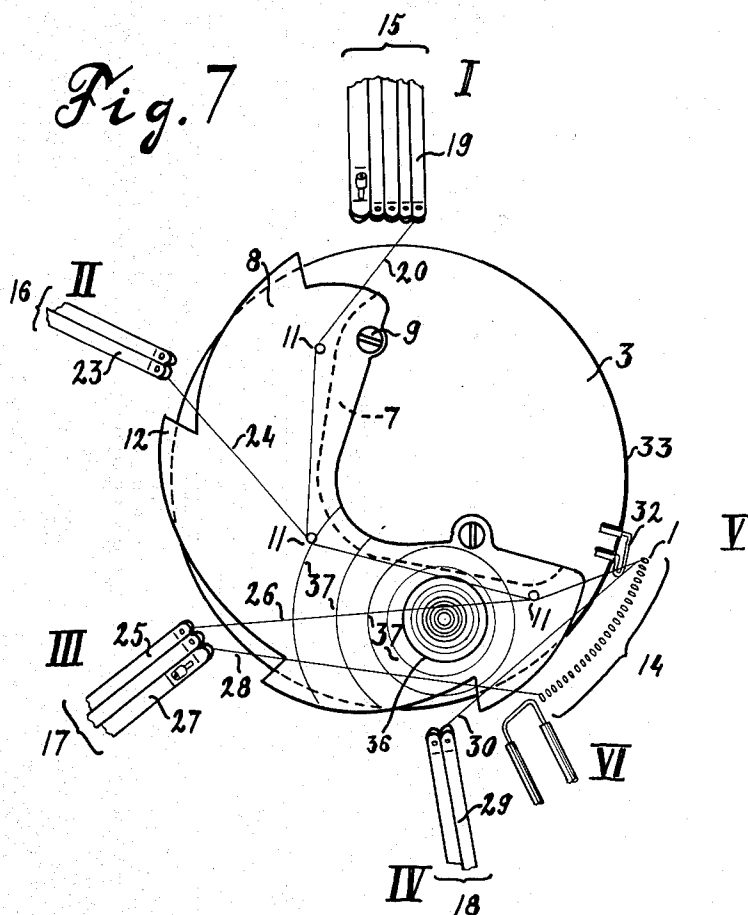
J. DUSÍK ET AL

3,224,230

DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE

Filed Feb. 25, 1963

7 Sheets-Sheet 6



INVENTORS
Josef Dusík, Ivan Martiš, Václav
Obořil, Milan Mejzlík, Jaroslav Javorek
By Richard Ernst OBT

Dec. 21, 1965

J. DUSÍK ET AL

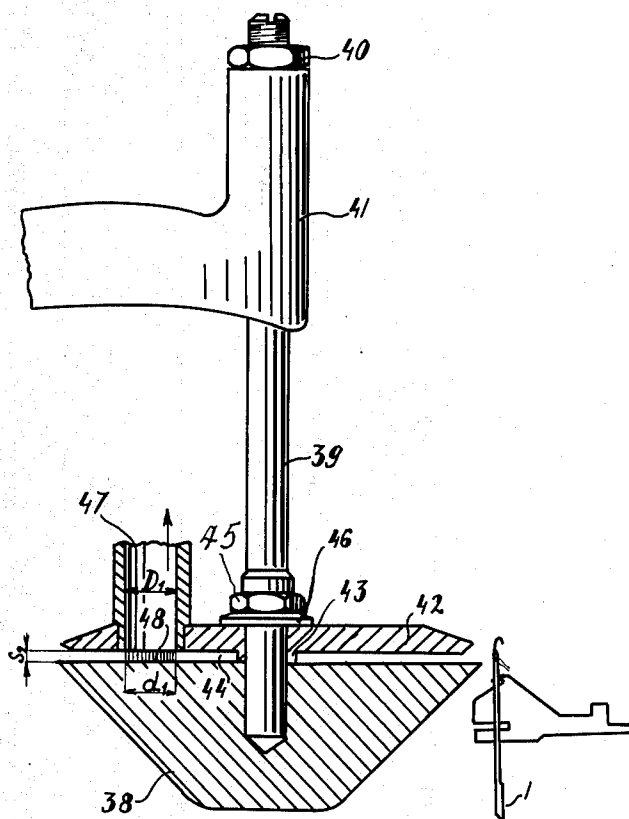
3,224,230

DEVICE FOR PNEUMATIC HOLDING OF INACTIVE
YARNS IN A CIRCULAR KNITTING MACHINE

Filed Feb. 25, 1963

7 Sheets-Sheet 7

Fig. 8.



INVENTORS
Josef Dusík, Ivan Martiš, Václav Obořil
Milan Mejzlík, Jaroslav Tavorček
By Richard Lamb, att

1

2

3,224,230

DEVICE FOR PNEUMATIC HOLDING OF IN-ACTIVE YARNS IN A CIRCULAR KNITTING MACHINE

Josef Dusík, Ivan Martiš, and Václav Obořil, Trebic, Milan Mejzlík, Rokytnice N/Rok., and Jaroslav Javorek, Trebic, Czechoslovakia, assignor to Sdružení podniků textilního strojírenství, Liverec, Czechoslovakia

Filed Feb. 25, 1963; Ser. No. 260,689

Claims priority, application Czechoslovakia,

Mar. 24, 1962, 1,815/62

8 Claims. (Cl. 66—145)

The invention relates to a pneumatic device for holding nonworking yarns in a circular knitting machine of the single-feed or multiple feed type employed for knitting hosiery and similar goods.

The invention relates more particularly to improvements in knitting machines having a rotary needle cylinder with or without a rotary dial, and either yarn carriers capable of swinging movement toward and away from the cylinder needles or stationary yarn carriers cooperating with needles which are lifted to different heights for selectively taking yarn.

It is known to equip multiple-feed circular knitting machines with a pneumatic nozzle whose orifice extends along the needle race in an arc from a feed zone equipped with yarn carriers to a yarn cutting mechanism. The known nozzle is shaped in such a manner that the suction is approximately uniformly distributed over the entire nozzle orifice.

The air velocity increases in the known device in a direction away from the orifice, and the resulting turbulence unfavorably affects the ability of the air current to hold a yarn tail severed by the afore-mentioned cutting mechanism. If the known device is applied to a four-feed knitting machine, with the orifice of the nozzle extending from the first to the fourth feed station and thence to the cutting mechanism, a yarn tail extending from a yarn carrier at the third station, and therefore rather short, may not be reliably positioned for engagement by the hook of a needle when the yarn is again to be worked.

The known pneumatic holding devices also are of complex structure, and therefore relatively expensive. They are also bulky, obstruct the space above the dial cap of the knitting machine, and therefore interfere with such common operations as the manual threading of a yarn carrier.

It is an object of the invention to provide a suction nozzle for holding yarn tails in a circular knitting machine which is free from the afore-described shortcomings of the prior art.

It is another object of the invention to improve the reliability of a knitting machine equipped with a pneumatic yarn holding device.

Yet another object is the provision of a yarn holding nozzle which is of simple, flat shape, and can be produced at a relatively low cost. Because of its simple shape, the nozzle of the invention can readily be made of transparent plastic, permitting observation of the yarn carriers and of the yarns during knitting.

With these and other objects in view, the invention, in its more specific aspects, resides in a knitting machine having a cylindrical needle race and a plurality of yarn carriers angularly spaced about the axis of rotation of the needles in the race. The carriers are capable of axial movement relative to the needles between respective operative and inoperative positions respectively within and outside the yarn taking range of the needles. Two axially spaced plate members define a gap extending in a plane transverse of the axis and open in a radially outward di-

rection in an arc about the axis, the feed stations being adjacent the arc.

A conduit whose axis angularly intersects the plane of the gap defines with the plate members an annular orifice about the conduit axis, and communicates with the gap through the orifice. A yarn cutting mechanism is arranged adjacent the arcuate opening of the gap and is spaced from the feed stations in the direction of needle movement for cutting a yarn which extends outward of the gap to one of the needles.

The orifice which connects the conduit to the gap is offset from the axis of needle rotation, and much nearer the cutting mechanism than at least one of the feed stations. The conduit axis is obliquely inclined to the plane of the gap in such a manner that the conduit extends from the orifice in a direction radially away from the afore-mentioned one feed station. The flow section of the orifice is smaller than that of the conduit and the height of the orifice in the direction of the axis of needle rotation is substantially equal to the substantially uniform axial spacing of the plate members.

Circumferential guide teeth on one of the plate members guide yarn extending from the yarn carriers to corresponding needles into the gap when the needles rotate and the yarn carriers are in their inoperative position.

If the knitting machine is equipped with a dial for guiding knitting implements toward and away from the needles in the race, at least one of the afore-mentioned plate members may constitute an element of the dial.

Other features and many of the attendant advantages of this invention will be readily appreciated, as the same is better understood by reference to the following detailed description of preferred embodiments when considered with the attached drawing in which:

FIG. 1 illustrates a four-feed knitting machine equipped with the yarn holding device of the invention in fragmentary plan view;

FIG. 2 shows the apparatus of FIG. 1 in elevational section on the line 2—2;

FIG. 3 shows a detail of the apparatus of FIG. 1 in elevational section on the line 3—3;

FIG. 4 is a perspective view of the apparatus of FIG. 1 in a first operational position;

FIGS. 5 and 6 show elements of the apparatus of FIG. 4 in different operational positions;

FIG. 7 shows the apparatus of FIG. 1 in a fragmentary, partly sectional plan view; and

FIG. 8 is a fragmentary, axially sectional, elevational view of another circular knitting machine equipped with a yarn holding device of the invention.

Referring now to the drawing in detail, and initially to FIGS. 1 and 2, there is seen as much of a circular hosiery knitting machine as is relevant to the basic aspects of this invention.

The knitting needles 1, of which only one is seen in FIG. 2, are arranged for axial movement in grooves of a rotatable needle cylinder, not itself shown. They cooperate with transfer bits 5 and sinkers 5a to form the stitches of the fabric to be produced, as is conventional. The transfer bits 5 are arranged between a circular cam plate 3, a bottom plate 4, and a dial cap 2 which jointly constitute the dial of the knitting machine and are supported on the stationary frame 6 of the knitting machine in a conventional manner, not illustrated in detail, only a ring 6 of the frame being shown.

A generally flat plate 8 having an integral flange 7 along one edge thereof is attached to the dial cap 2 by means of screws 9 which pass through the flange so that the flat portion of the plate 8 is spacedly parallel to the top face of the dial cap 2 and forms therewith a gap 10. The plate 8 and the gap 10 are approximately sickle-shaped in plan view, and extend along the outer circular edge 33 of

the dial in an arc of more than 180°. The gap 10 is horizontally open along the arc in a radially outward direction, and is otherwise horizontally bounded by the flange 7.

Three guide pins 11 connect the dial cap 2 to the plate 8 at three points of the gap 10 near the flange 7. The outer arcuate edge of the plate 8 carries four teeth 12 whose leading flanks are short and steep, whereas the trailing flanks slope gently, the direction of needle movement being counter-clockwise, as viewed in FIG. 1.

The four feed stations I, II, III, IV of the knitting machine are arranged along the toothed edge of the plate 8, and are followed by yarn cutting stations VI and V, in the direction of needle movement. A suction conduit 13 extends upward from the plate 8 near the feed station IV. The conduit 13 is obliquely inclined relative to the plate 8 in a direction away from the station II. A flexible tube (not shown) connects the conduit 13 to a non-illustrated exhaust blower during normal operation of the apparatus.

Groups 15, 16, 17, 18 of yarn carriers are pivotally mounted at the feed stations I-IV respectively on the stationary machine frame in a manner conventional in itself, and not shown in the drawing. The yarn carriers are outwardly spaced from the needles 1. They are axially movable between respective operative positions A in which associated needles 1 can take yarn from the carriers, and inoperative positions B in which the yarn carriers are raised out of range of the needles. Individual yarn carriers are shown in position A in FIG. 6, and in position B in FIGS. 4 and 5.

As better seen in FIGS. 4 to 7, the group 15 at station I consists of four carriers 19 for base yarn 20, and a carrier 21 for reinforcing yarn 22. The group 16 includes two carriers 23 for base yarn 24, and the group 17 includes two carriers 25 for base yarn 26 and one carrier 27 for reinforcing yarn 28. The group 18 consists of two carriers 29 for base yarn 30.

The knitting machine shown in FIGS. 1-7 is equipped with separate cutting mechanisms for base yarns at the station V and for reinforcing yarns at the station VI. The cutting mechanism for base yarn is mounted circumferentially adjacent the conduit 13 on the dial cap 2 by means of an insulating bracket 31. As best seen in FIG. 7, the operating element of the cutting mechanism is a wire 32 radially interposed between the edge 33 of the dial and the needles 1 which form a cylindrical array or race 14 coaxial with the dial and only partly shown in FIG. 7. Conductors 32' connect the wire with a source of electric current which normally keeps the wire incandescent.

The mechanism for cutting the reinforcing yarns is arranged at station VI just behind the feed station IV in the direction of needle movement and normally outside the cylinder needle race 14. The last-mentioned cutting mechanism is movable, and is moved radially inward into operative position only when reinforcements are being knitted. It is similar to the cutting mechanism for base yarns, being provided with a bracket 34 and an electrically heated wire 35. When operative, the wire 35 is radially interposed between the dial edge 33 and the needles 1 in the manner illustrated in FIG. 2.

It is an important feature of the invention that both cutting mechanisms are located in close proximity to the conduit 13. The advantages obtained by this arrangement do not depend on the specific nature of the cutting mechanisms, and devices not relying on high temperature for severing yarn would equally benefit.

As shown in FIG. 3, the gap 10 and the conduit 13 meet along an annular orifice 36 having a diameter d closely similar to the diameter D of the cylindrical conduit 13, and a height s corresponding to the spacing s_1 of the plate 8 from the dial cap 2. The flow section of the orifice 36 is smaller than that of the conduit 13, the illustrated ratio of flow sections being approximately 4:5. The air velocity in the gap 10 thus is highest at the orifice

36, and higher than in the conduit 13. The air velocity in the gap 10 decreases in a direction away from the orifice 36. This is indicated in FIG. 7 by circles 37 which connect points of approximately equal air velocity. It is readily apparent, that the velocity of air entering the gap 10 at the toothed edge of the plate 8 decreases from feed station IV to feed station I in a direction opposite to the direction of needle movement, and is insignificant at station I.

However, suction at the feed station I is unnecessary in the apparatus of the invention. If one of the yarn carriers in groups 15 and 16 is raised from the yarn taking range of the needles 1 to its inoperative position B, as shown in FIG. 4, the associated yarn is caught by the nearest tooth 12 as it is carried by the needles 1 around the needle cylinder, and is thereby deflected into the gap 10 whose axial height s_1 is uniform throughout, thereby avoiding abrupt changes in the velocity of the flowing air.

A modified yarn holding arrangement of the invention is shown in FIG. 8 in its application to a circular knitting machine having neither cap nor dial. In such a machine, a gap 44 for receiving yarn from non-working yarn carriers is provided between the flat circular base of a bottom member 38 of inverted frustoconical shape and a centrally apertured circular plate 42. The member 38 is fixedly fastened to a vertical rod 39 whose threaded top end carries a nut 40 abuttingly engaging a bracket 41 of the stationary knitting machine frame, not otherwise shown in FIG. 8.

The rod 39 passes through the central aperture of the plate 38 and through an annular hub 43 integral with the plate. The hub is held in close abutting engagement with the bottom member 38 by a nut 45 which threadedly engages the rod 39 and presses a washer 46 against the top face of the plate 42.

A transverse conduit 47 normally connected to a non-illustrated suction line communicates with the gap 44 through an annular orifice 48 whose diameter d_1 is similar to the diameter D_1 of the conduit 47, and whose height s_2 is equal to the uniform axial height of the gap 44. The flow section of the orifice 48 is smaller than that of the conduit 47.

The two embodiments of the invention respectively shown in FIGS. 1 to 7 and 8 operate in a closely analogous manner, and the operation of the device shown in FIG. 8 will be readily apparent from the following description of the operation of the other embodiment.

When the yarn carrier 23 of the group 16 is raised into its inoperative position B, as shown in FIG. 4, the base yarn 24 guided by the carrier slips into the gap 10, and is retained by one of the teeth 12 while the associated cylinder needle 1 travels in the direction of the arrow S about the circumference of the dial toward the cutting mechanism at the station V. The ultimate position of the base yarn 24 is determined by the two guide pins 11 on opposite sides of the orifice 36 which place the yarn directly across the orifice when the associated needle approaches the hot wire 32. The rapid air movement inward of the orifice causes the yarn to be tightly tensioned at the moment of cut-off, and it is severed cleanly close to the needle 1. The remaining tail on the fabric is practically invisible.

Satisfactory cutting is ensured by high tension in the yarn 24 which causes the yarn portion 24a to extend steeply upward from the needle 1 to the edge 33 of the cam ring 3 at an angle α to the horizontal. The free yarn end 24b secured to the carrier 23 is drawn at once into the conduit 13, and is being held there as long as the carrier 23 remains in the inoperative position B. The tail 24a disappears in the knitted fabric.

When the yarn carrier 23 returns from the inoperative position B to the operative position A, the yarn 24 is taken by the cylinder needles 1, and is carried by them toward the cutting station V as the needles move about the circumference of the dial. During this movement, the

5

loose end 24b is held under tension by the air flow in the conduit 13 and the orifice 36, and thereby extends substantially in a straight line from the conduit 13 to the needle 1. Ultimately, while still in the tensioned state, the yarn reaches the wire 32, and is severed close to the needle 1. The short length of yarn set free thereby is drawn into the conduit 13, and further into the suction system in which it may be separated from the air stream in a known manner.

The reinforcing yarns 22 may be cut in a similar manner during the knitting of reinforcements. The cutting mechanism for reinforcing yarns is moved toward the needles 1 into position at the station VI so that the wire 35 extends across the path of the needles 1 as shown in FIG. 2. No difficulties arise during lowering and raising of the yarn carrier 21 of the group 15 because the distance from the feed station I to the cutting station VI is relatively great, and there is a long piece 22b of yarn left hanging at the carrier 21 after cutting of the yarn 22, and the piece 22b is drawn into the conduit 13. It is more difficult to cut the reinforcing yarn 28 which is guided by the yarn carrier 27.

When the yarn carrier 27 is raised from the operative to the inoperative position, the reinforcing yarn 28 is lifted, and is carried by a cylinder needle 1 in the direction of the arrow S, as seen in FIG. 5. The yarn is led over the point of the nearest tooth 12, and then slides over the edge 33 of the cam ring 3 into the gap 10. Although the yarn does not enter the orifice 36, it comes close to the same to reach an area of rapid air flow which assists in drawing the yarn over the edge 33, and tensions the yarn sufficiently so that it reaches the hot wire 35 while extending downward from the edge 33 at a steep angle β . Only a short tail 28a remains on the knitted material. The loose yarn end 28b is drawn into the conduit 13, and is held there until the yarn carrier 27 reverts to its operative position A.

When the carrier 27 is lowered to the operative position A shown in FIG. 6, and the needle 1 taking the yarn end 28b travels about the circumference of the dial through the several positions shown in the drawing, the yarn extends as straight into the conduit 13 as intervening structures permit. The distance between the needle 1 and the conduit 13 decreases during the needle movement, so that the yarn end 28b is correspondingly moved inward of the conduit 13 by the air stream. It is held tensioned until it touches the hot wire 35, whereby it is cut, and the loose length of yarn is sucked into the conduit 13.

What we claim is:

1. In a knitting machine, in combination:

(a) a plurality of needles defining a cylindrical needle race about an axis of rotation and being arranged for rotary movement about said axis in a predetermined direction;

(b) a plurality of yarn carrier means angularly spaced about said axis, and defining respective yarn feed stations, each of said yarn carrier means being arranged for axial movement relative to said needles between an operative position in which said needles

6

can take yarn from said yarn carrier means, and an inoperative position out of yarn taking range of said needles;

(c) two members having respective faces spaced in the direction of said axis to define a gap therebetween, said gap extending in a plane transverse of said axis and being open in a radially outward direction in an arc about said axis, said feed stations being radially adjacent said arc;

(d) a conduit having an axis angularly intersecting said plane, said conduit and said faces jointly defining an annular orifice extending about the axis of said conduit and offset from said axis of rotation in such a manner as to be substantially nearer said cutting means than at least one of said feed stations, the conduit communicating with said gap through said orifice, and the flow section of said orifice being smaller than the flow section of said conduit; and

(e) yarn cutting means arranged adjacent said arc and spaced from said feed stations in said predetermined direction for cutting a yarn extending outward of said gap to one of said needles.

2. In a machine as set forth in claim 1, the axis of said conduit being obliquely inclined relative to said plane and extending from said orifice in a direction radially away from said one feed station.

3. In a machine as set forth in claim 1, dial means coaxial with said needle race for guiding knitting implements toward and away from said needles, at least one of said members constituting an element of said dial means.

4. In a machine as set forth in claim 1, said cutting means including an electrically heated cutting member.

5. In a machine as set forth in claim 1, said gap having a substantially uniform height in the direction of said axis of rotation, said height being substantially equal to the dimension of said orifice in said direction.

6. In a machine as set forth in claim 1, guide means on one of said members for guiding yarn extending from one of said yarn carrier means to one of said needles into said gap during said rotary movement of said needle when said one yarn carrier means is in the inoperative position thereof.

7. A machine as set forth in claim 6, wherein said guide means include a plurality of circumferential teeth on one of said members, said teeth being respectively associated with said yarn feed stations.

8. A machine as set forth in claim 1, wherein said arc is continuous and extends at least 180° about said axis.

References Cited by the Examiner

UNITED STATES PATENTS

3,050,970 8/1962 Billi ----- 66-140

DONALD W. PARKER, *Primary Examiner*.

RUSSELL C. MADER, *Examiner*.

P. C. FAW, *Assistant Examiner*.