Drafting Devices of Japanese High-Draft Spinning Frames

Chapter 1. Introduction

By Teruwaka Ogawa
Member, Kanegafuchi Spinning Co., Ltd.


They supply different types of drafting devices, each with characteristic features. One feature common to all the different types of devices is that they are equipped with one or two pairs of double aprons which are supported by an individual cradle. Due consideration is given to sliver-holding. Easier mounting and cleaning are among the advantages obtainable from all these drafting devices. As the pendulum type roller-holder is not used, no troubles inherent in this type can occur. Every part of each drafting device is precision-made, which conduces to easier adjustment. Easier adjustment makes it possible to adopt the rollsetting best suited to each value of fiber length of raw cotton.

All of these factors contribute to production of high-quality, uniform yarns, and to reduction of end breakdowns.

Either leather or synthetic aprons are used. Leather aprons are manufactured with great care, and are very flexible and uniform. They are little liable to damage and keep long. Leather aprons, therefore, spin finer quality yarns.

Japan depends on imports for raw cotton. Occasionally we have low quality cotton to process. The drafting devices herein introduced are so designed as to process low quality cotton, too. In countries where spinners can pick and choose and use only high quality cotton, our drafting devices would give higher efficiency.

Draft of 15 to 30 is easily obtained with "high draft" drafting devices; draft of 50 to 300 is widely used with "super high draft" drafting devices. In Japan, about one million spindles of "super high draft" spinning frames are in operation and produce high quality yarns. Frames of this type are exported in large quantities and favorably received wherever they go.

Detailed descriptions of the drafting devices will be given in the following chapters by the respective manufacturers. Here brief introductory notes are given.

Howa Machinery, Ltd. are the oldest firm of spinning machinery manufacturers in Japan. They supply Japan's textile industries with excellent machines. Deserving special mention is their three-line drafting device equipped with a special cradle. The cradle is divisible into upper and lower parts and its aprons are of single spindle type. Its front and back top rollers are of double-spindle type. With a total draft of between 15 and 30 fine quality yarn can be spun.

Ishikawa Iron Works, Ltd., manufacturers of three-line "high draft" drafting devices and four-line "super high draft" devices. Each device is equipped with a double apron. Ishikawa's TN-C-type cradle with a long bottom tenser is used for their three-line drafting devices. The second top roller is of single-spindle type; front and back top rollers are of double-spindle type. Four-line drafting devices have single-spindle-type rollers, and are spring-weighted. Usual draft is 8 to 30 for three-line drafting devices, and 20 to 200 for four-line.

Nittoh Iron Works, Ltd., drafting devices of Nittoh's make are of three-line type, but they are improved so as to increase draft. Their salient features are a back bottom apron and a light-weight third carrier top roller, placed between the second top roller and self-weighted back top roller. A double apron is used as the second roller. The tenser of the top apron is of elastic type, and the tenser gage is adjusted automatically. The back top roller and third carrier roller are of double-spindle type; the front and second top rollers are of singlespindle type, supported by a single cradle and spring-loaded. Draft is 20 to 80.

OM Spinning Machinery Mfg. Co., Ltd. long experienced in the super high draft spinning frame field and now manufacturing drafting devices of OM-S and OM-K types. More than 500,000 spindles of these types are at work in various mills. Drafting devices of both types are five-line, and have two sets of double aprons. Every top roller is of single-spindle type and spring-loaded. OM-S drafting device is used for the sliver-to-yarn spinning system, and consists of two parts. The front and second rollers are mounted on an
inclined roller stand. The second roller has a double apron. The third, fourth, and back rollers are arranged in a vertical line, so that finisher draw frame sliver is easily fed to drafting devices. The fourth roller is a double apron. It is a matter of practical interest that OM-S and OM-K drafting devices dispense entirely with the roving process. Finisher draw frame sliver is fed from small cans. As the finisher draw frame is equipped with automatic can-changing devices, the use of smaller cans does not lower the efficiency of the drafting process. OM-K type is used for feeding simplex fly frame roving. It is five-line and is mounted on an inclined roller stand.

Draft of the OM-S drafting device is 140 for 20's yarn and 480 for 100's. With draft of 480 fine quality yarn is obtainable. Draft of the OM-K drafting device is 40 for 20's yarn and 120 for 80's.

Osaka Kiko Co., Ltd., like Howa Machinery Ltd., are among the oldest spinning machinery manufacturers in Japan. Osaka Kiko's high draft roving frames, OKR-VII type (draft 12 ~30), as well as their spinning frames with not so high draft, produce high-quality yarn at low cost. Osaka Kiko manufacture three-line spinning frames complete with a cradle of TN-C or TN-A type. They also manufacture four-line spinning frames with cradles of OK-C type. The second, third and back top rollers of the four-line frame are all of single-spindle type; the front top rollers are of double-spindle type. The cap-bar section is simple in mechanism in spite of the relatively large number of rollers. The four-line frame is easy to operate and produces high quality yarn with comparably high draft.

Toyoda Automatic Loom Works, Ltd., pioneers of the manufacture of four-line "super high draft" drafting devices in Japan. They already have a production record of more than 300,000 spindles for mill use. They now turn out Ja type three-line "high draft" drafting devices and four-line "super high draft" drafting devices. The four-line device can be fitted with a cradle of any of the different types, namely, BB, CC, SB, RB, LCB.

Toyoda's four-line drafting devices are designed for the sliver-to-yarn spinning system, and have a double apron. On the finisher draw frame, delived sliver is divided in two, packaged in small cans, and fed directly to the spinning frame. The optimum draft is 60 for 20's yarn and 100 for 40's.

Ja Type cradle has special features all its own. The front top roller and second apron top roller are of single-spindle type, and loaded with a dead weight through the lever system. Not weighted by springs, they are free from troubles inherent in the spring system. The third and back top rollers are of double-spindle type, and spring-loaded by means of saddles. This type of cradle can be mounted and disengaged very easily.

Cradles of types BB, CC, SB, RB, etc. are an improved spring-loaded type, and are for three- or four-line drafting devices. Cradles of LCA and LCB types are used for longer staples, such as three-inch synthetic fibers.

Chapter 2. Descriptions by Manufacturers

Howa Machinery, Ltd.

The most important function in the spinning process is performed by the drafting arrangement of the ring spinning frame. Indeed, the cost and quality of finished yarn are determined largely by the amount of draft and by how well drafting is done.

Our NH-B type high drafting arrangement offers many advantages and can be confidently recommended.

Photo 1 shows the principal parts of our NH-B cradle. In the photo, the top cradle is set on the left-hand side and is removed on the right-hand side to show the bottom cradle. The upper is the top cradle.

Specifications

1. Size of cradle: 30 mm.
2. Tenser gauge: 5 mm.
3. Width of cradle: 1-3/32 inches
4. Top cradle roller:
   7/8 inch in dia. x 1-1/16 inches in width (oilless synthetic resin)
5. Weighting: Spring system
6. Cradle is cadmium-plated
7. Middle bottom roller: 7/8 inch in dia. (saw teeth or rollet)
8. Width of saw teeth or rollet:
   1-1/16 inches

9. Size of apron band:
   1.3mm thick × 27mm wide
   Inside dia.: top 33.4mm
   bottom 33 mm

   Larger size cradles for long fibers also available.

Main Features
(A) NH-B cradle remains extremely stable during operation, because, among other reasons:
   (a) It is supported by a cradle bar inserted in the front of the middle slides. This protects
       the cradle against the vibrations of the bottom roller.
   (b) The cradle bar (1/4 inch × 1 inch), being very stable against weighting, keeps the cradle
       in the correct position in relation to the bottom roller.
   (c) The cradle, made of a 5/64-inch thick iron plate, is highly durable. Cadmium-plated,
       it is good to look at.
   (d) The bottom tenser is stable against vertical force, because the back of the bottom
       tenser is fitted into the knife-edge groove.

(B) The tenser gauge always remains constant because the top tenser is pushed down
    toward the bottom tenser by the spring and, besides, the top cradle is moved down to press
    the bottom tenser during operation.

(C) Weighting is kept uniform by a coiled spring, which is weighted on both the left-hand
    and right-hand sides of the top roller with a spring, and varies hardly at all with the up-
    ward or downward movement of the top roller.

(D) The top cradle can be set or removed very easily. As shown in photos 2 and 3, it
    can be removed by pushing up the upper surface of the top cradle with the thumb toward
    the back. It can be set by pushing down the upper surface of the top cradle toward the
    front.

(E) The roller gauge can be changed in a wide range. The tenser can be brought sufficiently close to the front rollers to make
    the roller gauge setting between the cradle and the front roller small.

(F) The bottom apron band can be moved to right or left through the gap between the
    bottom cradle and the bottom roller, as shown on the left-hand side of photo 4. Therefore:
   a) The apron need not be set in the right proper position when the bottom cradle is to
       be fitted. This precludes chances of damage to the apron between the bottom roller and
       the bottom cradle.
   b) When, as sometimes happens, the bottom apron band snaps at joints, it can be easily
       rejoined after being moved along the roller. After rejoicing, it can be set again in the right
       position.
   c) The bottom roller can be cleaned without removing the bottom cradle from the roller
       stand.
   (G) Oiling is needed only at long intervals because an oilless top roller is used. An ideal
       lubrication for a long spell is made possible by self-reserved oil. This greatly helps to
       prevent slippage of the top apron band.

Drafting Roller

The drafting arrangement equipped with an
NH-B cradle is illustrated in Figure 1. Roving is extracted from the back trumpet by the back feed rollers, each consisting of a fluted bottom roller and a solid top roller. The back top roller is self-weighting.

The next pair of rollers consists of a top cradle roller and a middle bottom roller provided with saw-tooth fluting or a roller. Each of the pair drives an apron band mounted on a cradle. The apron bands completely enclose fibers and guide them to the immediate vicinity of the front roller. The back and middle lines of rollers are adjustable to each other. Each front feed roller consists of a fluted bottom roller and a loose boss top roller with an arbor. The top roller is covered with a leather or synthetic rubber cot.

The front line is weighted with hooks, wire and dead weight.

The entire drafting arrangement is covered with four cleaner rollers so that fly produced during drafting does not settle in the vicinity of the rollers and penetrate the yarn.

Total draft in the NH-B drafting arrangement is about 34, maximum. The amounts of draft for 10's, 16's, 20's, 30's, 40's and 60's are generally as follows:

<table>
<thead>
<tr>
<th>Denomination</th>
<th>Draft</th>
</tr>
</thead>
<tbody>
<tr>
<td>10's</td>
<td>13.5</td>
</tr>
<tr>
<td>16's</td>
<td>16.0</td>
</tr>
<tr>
<td>20's</td>
<td>17.0</td>
</tr>
<tr>
<td>30's</td>
<td>19.5</td>
</tr>
<tr>
<td>40's</td>
<td>21.5</td>
</tr>
<tr>
<td>60's</td>
<td>25.0</td>
</tr>
</tbody>
</table>

We have a more efficient draft system than NH-B type to recommend, but have been unable to prepare a description in time for publication in this issue. Inquiries concerning it will be gladly answered.

Ishikawa Seisakusho Co., Ltd.

Ishikawa's Three Line Type High Draft System (Type TN-C)

(A) Mechanism

As shown in the sketch (Figure 1) of the side view of the draft element, our Three-Line Type High Draft System is equipped with a double apron in the main draft zone. The front and back top rollers are uniformly pressed with a dead weight and a lever system. The middle top roller is independently weighted with springs of high quality piano wire attached to the cradle, which is fixed to the bottom
tenser bar and the holder bar.

(B) Special Features

(a) The top roller gauge can be adjusted easily and simply only by inserting the bottom tenser bar into a slot of the roller slide. Any one can do it accurately.

(b) As the top tenser is fixed in the cradle, the tenser gauge can be automatically fixed by inserting a cradle in the hole in the bottom tenser bar.

(c) The V-shaped wire spring of the cradle is bent at one end, as shown in Figure 1, so that the action of the spring may push the top roller pin forward to the front of the guide slot of the pin. Vibrations caused by the disturbing force from the apron band can be avoided.

(d) Because the load on the middle top roller is of a spring system, the draft part is very simple in construction and can be cleaned easily.

(e) The load on the middle top roller is accurate because the spring is simple in construction.

(C) Setting (7/8inch roller for cotton)

(a) Roller gauge
Front~Middle: 44.5mm (1-3/4 in.)
Second~Back: 38mm (1½ in.) minimum
Front~Back: maximum gauge 130mm (5½ in.)

(b) Draft: 8~35

(c) Roller weight
Front: 3.8kgs. (8.5 lbs.) (per spindle)
Middle: 2.1kgs. (4.5 lbs.) (per spindle)
Back: 1.0kgs. (2.2 lbs.) (per spindle)

(d) Spinning data (using TN-C 9-1 cradle type)

Temperature: 27°C
Relative humidity: 47%
Yarn count: 40's
Cotton used: American cotton, 1¼ in.
Tenser gauge: 5.5mm
Spindle r.p.m.: 10,200
Roller gauge
Front~Second: 45mm
Second~Back: 38mm

Grains: 23.37
Variation (yarn grains): 2.5
Uster %: 15.67
Lea strength (lbs.): 48.1
End breakages (No./400 sps/hr.): 15.25
Twist (per inch): 25.72
Total draft: 21.66

Ishikawa's Four Line High Draft System (Type SH-3)

(A) Mechanism

Figure 2 shows the side view of the draft element of our four-line super high draft system. Front and back cradles are used in this system. Each top roller runs independently. All drawing frame sliver or fly frame roving can be fed to be drawn in three draft zones of the drafting device, but, as a rule, only draw frame sliver is used.

The apron draft system is employed in the
draft zone between the front and second rollers. The front cradle is firmly set on the cradle holder, which is fixed on the holder bar. A tenser gauge and a cradle gauge can be correctly set only by inserting the bottom tenser in the cradle holder and setting the cradle on the cradle holder. In the front cradle, as is seen in the diagram, the second top roller is loaded with coil springs, and at the same time the front top roller is pressed through levers. In addition, loading or unloading of the top roller is done only by engaging or disengaging the weighting hook provided at the end of the levers. The front top roller can, therefore, be taken away from the cradle without detaching it during operation.

The gauge of the back cradle, composed of double casings, can be adjusted according to the roller gauge, by screwing out the fixed screw. The third and back top rollers have their own loading mechanisms (spring system).

(B) Special Features

(a) It is a drafting device of one-spindle type.
(b) No cap bar is needed.
(c) No skill is needed to keep the tenser and cradle gauges constant.
(d) Because a spring weighting system is used instead of a dead weighting system, the roller part is compact and can be cleaned easily.
(e) The parts connected with the cradle are hardly subject to tear and wear and seldom get out of order. High quality, uniform yarn is spun at lower cost.

(C) Setting (7/8 inch roller for cotton)

(a) Roller gauge

| Front~Second | 41.5 mm | Coarse count yarn |
| Second~Third | 30 mm (min.) | |
| Third~Back  | 30 mm (min.) | |
| Front~Back  | 117 mm (max.) | |
| Front~Second | 44.5 mm | |
| Second~Third | 30 mm (min.) | Fine count yarn |
| Third~Back  | 30 mm (min.) | |
| Front~Back  | 129 mm (max.) | |

(b) Total draft: 20~200

(c) Roller weight

Front: 3.9 kgs. (per spindle)
Second: 3 kgs. (per spindle)
Third: 2.5 kgs. (per spindle)
Back: 2.3 kgs. (per spindle)

(d) Spinning data

Using Ishikawa S-1 type cradle (feeding draw frame sliver)

Temperature: 20°C
Relative humidity: 55%
Yarn count: 40's

Nittoh Iron Works, Ltd.

Our “A-2” type super high draft device, with only three bottom rollers, can draft rove up to 120 times. It can supply any slubber rove directly to ring frames, because the intermediate frames and roving frames can be omitted. We shall explain the construction and efficiency of this device in detail.

Fig. 1 Nittoh's “A-2” type Super high draft device

The three bottom rollers, supported by a roller stand having an inclination of 35°, are pressed with four kinds of top rollers, as shown in Figure 1. The front and second top rollers are held by a cradle of the single-spindle system. The carrier roller and back top roller are self-weighted, and are separately held by the cap bar fingers. Two kinds of bottom aprons are hung on the second and
back bottom roller, respectively, and each is stretched with a tensor bar for every staff. The front and back tensor bars which are passed through the bottom apron are fixed to the slide metal on the roller stand. The top apron goes round the second top roller and the top tensor. Specially designed wire springs are fitted to the side-plates of the cradle. Both ends of the arbors of the front and second top rollers are separately pressed downward by the springs in a simple way. The device is designed according to the two-zone draft system, and slubber rove fed to the back rollers is first drafted between a back and second rollers (back draft zone) and later drafted mainly between the second and front rollers (front draft zone). It will be clear from Figure 2 that the back draft zone is based on Reiter's high draft system, yet it is an improvement on Reiter's. The front draft zone of our system does not seem very different from that of Casablanca's system, but the superiority of our front zone can easily be understood from the following explanation of its construction.

In our super high draft device, a special top tensor is used to stretch the top apron. A steel wire passes through a small rotative pipe, and both ends of the wire are bent in U shape at the right angle and in parallel, and the tops of the U are looped. Cover the top tensor and second top roller with the apron, and thrust the arbor through the loop and the hole of second top roller, and the apron is tightly stretched, but it can be smoothly rotated because the spring wire loosely passes through the top tensor.

Between the side plates of the cradle, there are projections, which press the wire arms of the top tensor downward, and at the same time, the lower arms slightly press the middle part of the top apron downward when the cradle unit is fitted to the bottom roller.

The wire arms of the top tensor are pressed downward by these projections and the bottom apron is pressed downward by means of the end of the top apron. The front and second top rollers with arbors, the top tensor and the top apron are all laid on the cradle on which the projected pins and the front and the second springs are fixed. One cradle unit is thus formed. To fit the cradle unit to the bottom rollers, the hind legs of the cradle must be inserted between the back tensor bar and the saw-teeth roller, while the fore legs of the cradle must be inserted in the rectangular holes of the front tensor bar. Then, the cradle unit must be pressed downward and forward at the same time with the fingers. In this way the cradle unit is fixed to two tensor bars. Thus, the front and second top rollers press each bottom roller with each spring. The back top roller presses the back bottom roller and the rear of the back apron. The front of the back apron is pressed by the carrier roller.

The second and back bottom rollers are supported by the slide metal, and so the gauge between the front and second rollers can be adjusted by moving the slide metal on the roller stand.

Back Draft Zone

Rove sent from the back rollers is drafted between the back and second rollers. In this draft zone, the back apron is belted over the back bottom roller and tensor bar. The rove is, therefore, passed under the carrier roller and sent near a pair of second rollers without disturbing the rove. As the carrier roller is situated near the nip point of second rollers, all short fibres included in the rove are controlled even if the rove is highly drafted, and no irregular draft will occur between the back and second rollers. The results of many ex-

Fig. 2 Roller setting of “A-2” type

Fig. 3 Front view of “A-2” type Super high draft device
Experiments in mills prove that rove can be easily drafted two to six times in this draft zone without affecting the quality of yarn and without a slip occurring between the back bottom roller and the apron. Since rove is drafted 10 to 15 times even in Reiter’s high draft system, it is clear that there is room for a still higher drafting in this zone.

Front Draft Zone

Inasmuch as rove is highly drafted in the back draft zone, as mentioned above, all fibres in drawn rove are almost parallel. To obtain higher draft, the nip points of the ends of the top and bottom aprons must be brought close to the nip points of the front rollers. For this purpose, the ordinary fixed type top tensor is replaced with a flexible and rotative tensor of a small diameter, as shown in Figure 4. As the result of this improvement, the top apron can be revolved smoothly even when tightly stretched. Consequently, the ends of the top apron draw a curve with a small radius “R”. Due to this small radius “R”, the nip point “M” of top and bottom aprons comes near the nip point of front roller “N”. Owing to these small radii of aprons, more space is found at the ends of aprons and front rollers than in the corresponding places in the ordinary fixed tensors. Therefore, the distance “G” between the front and second bottom rollers can be shortened by sliding the metal which holds the second bottom roller and two tensor bars. For these reasons, the distance between “N” and “M” can be considerably shortened. It is necessary, in cotton spinning, to press the rove positively in the middle of aprons so as to control the short fibres held between the upper and lower aprons. The press point (L) should be fixed at a point which is a little longer than the average length of fibres consisting of rove from the nip point of the front roller. To keep the pressure between “M” and “T” uniform, supporting plate “Q” is fixed on the bottom tensor bars, since “Q” has an equal width with the apron and, moreover, a long radius. The top and bottom aprons can be revolved to draw a slow curve. In this draft system, the arbors of the front and second top rollers are thrust in the slots of the side plates of one cradle. The gauge between the front and second top rollers can be changed by 2 m.m. by a 180-degree rotation of the arbor of the front top roller, because both ends of the arbor make a semi-circle. This is very helpful in adjusting the distance between “N” and “M” when row cotton of different fibre lengths has to be processed.

Top Tensor and Second Top Roller

As there is special nylon lining (L) provided at each end of small pipe “S”, as shown in Figure 6, no oil is needed for the bearings. It is enough to oil the bearings of the second top roller every three months, as the second top roller “U” is made of plastic material and the bearing “W” is made of an oil-impregnated porous plastic material.
**Weight Springs**

Our super high draft device is equipped with two weight springs of a special shape. They are coiled at both ends. These coils are fitted to the pivots projecting to the outside of the cradle. The springs press the top roller at both ends of the arbor. Made of the highest grade wire, the springs can stand use over a long period of time. The pressures of the top rollers are as follows:

- Front top roller: 8.5 lbs. single-spindle (spring weight)
- Second top roller: 4.5 lbs. single-spindle (spring weight)
- Carrier roller: 0.25 lb. per 2 spindles (self weight)

**Back top roller:** 4.5 lbs. per 2 spindles (self weight)

**Trumpet, Collector and Clearer**

Our super high draft device is equipped with a trumpet at the entrance to the back rollers, and with a collector at the entrance to the front rollers.

There are, moreover, a front under-clearer or a pneumatic clearer under the front bottom roller, also front and second top clearers on the front top roller and the top apron.

A back under-clearer under the second and back bottom rollers may be added, but it is not always necessary.

---

![Fig. 7 Draft gearing for super high drafting device](image-url)
Recommended Draft

<table>
<thead>
<tr>
<th>Yarn count</th>
<th>Front draft zone</th>
<th>Back draft zone</th>
<th>Total draft</th>
</tr>
</thead>
<tbody>
<tr>
<td>10's 20's 30's 40's 60's 80's 100's</td>
<td>10.0 11.6 13.3 14.3 15.0 15.5 16.0</td>
<td>2.5 3.0 3.0 3.5 4.0 4.5 5.0</td>
<td>25 35 40 50 60 70 80</td>
</tr>
</tbody>
</table>

Note 1. Comber rove may be increased by 20-50% over the above figures.
Note 2. Power may be increased by about 4% compared with the ordinary high draft ring frame.

Actual Result of Use of our Super High Draft Devices

Spinning tests in some mills have shown that our super high draft device gives better results than the conventional flyer and ring frame system. Counts of yarn, hank roving and draft used in the tests were as follows:

<table>
<thead>
<tr>
<th>Mills (Names substituted by letters of the alphabet)</th>
<th>Slubbing Count</th>
<th>Inter</th>
<th>Ring frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill A 30's</td>
<td>169 grains per 15 yds.</td>
<td>126 grains per 30 yds.</td>
<td>15.3</td>
</tr>
<tr>
<td>Mill B 40's</td>
<td>133 grains per 15 yds.</td>
<td>107 grains per 30 yds.</td>
<td>17.1</td>
</tr>
<tr>
<td>Mill C</td>
<td>138 grains per 15 yds.</td>
<td>103 grains per 30 yds.</td>
<td>16.5</td>
</tr>
<tr>
<td>Mill D</td>
<td>150 grains per 15 yds.</td>
<td>115 grains per 30 yds.</td>
<td>18.4</td>
</tr>
<tr>
<td>Mill E</td>
<td>166 grains per 15 yds.</td>
<td>140 grains per 30 yds.</td>
<td>22.2</td>
</tr>
<tr>
<td>Mill F 60's</td>
<td>simplex 231 grains per 15 yds.</td>
<td>231 grains per 30 yds.</td>
<td>55.5</td>
</tr>
</tbody>
</table>

Comparison between Nittoh's and other super high draft devices

<table>
<thead>
<tr>
<th>Nittoh's &quot;A-2&quot; type</th>
<th>Other devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yarn strength</td>
<td>61.59 %</td>
</tr>
<tr>
<td>Irregularity of strength</td>
<td>4.4%</td>
</tr>
<tr>
<td>Evenness by appearance</td>
<td>125/150</td>
</tr>
</tbody>
</table>

Data furnished by one of the mills using Nittoh's super high draft device

| Working hours | 8 hrs. |
| Temperature   | 25.8°C |
| Bobbin lift   | 7" |
| Raw cotton    | U. S. |
| Revolutions of spindles | 10,650 r.p.m. |
| Grains        | 31.2 |
| Draft total   | 46.67 |
| Breakage of yarn | 25 per 400 spds., hour |
| Frequency of cleaning | Every 12 days |
| Cleaning time  | 7 frames per 8 hrs. |
| Twist of rove  | 0.9 per inch |
| Count of yarn  | 32's |
| Humidity      | 55% |

OM-S type Super High Draft Ring Spinning Frame

(A) Super High Drafting:

OM-S type Super High Draft ring spinning frame has achieved super high draft up to 700, depending on the count of yarn spun. The drafting ratio, of course, varies with the weight of sliver (grains).

The following table shows the drafting ratios by counts of cotton yarn obtained by the supply of the standard grains which have been deemed most successful, each ratio shown being for two grades of cotton.

(B) Dispensing with all Roving and Speed Frames:

Even super-fine yarns can be spun on the OM-S type Super High Draft spinning frame.
Table 1

<table>
<thead>
<tr>
<th>Yarn count</th>
<th>16's</th>
<th>20's</th>
<th>30's</th>
<th>40's</th>
<th>60's</th>
<th>80's</th>
<th>100's</th>
<th>120's</th>
<th>140's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains of drawing</td>
<td>375</td>
<td>365</td>
<td>320</td>
<td>300</td>
<td>250</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>Sliver (per 6 yds.)</td>
<td>(360)</td>
<td>(330)</td>
<td>(260)</td>
<td>(240)</td>
<td>(220)</td>
<td>(200)</td>
<td>(180)</td>
<td>(180)</td>
<td>(180)</td>
</tr>
<tr>
<td>Ratio of drafting</td>
<td>(115)</td>
<td>(132)</td>
<td>(156)</td>
<td>(152)</td>
<td>(240)</td>
<td>(320)</td>
<td>(360)</td>
<td>(432)</td>
<td>(504)</td>
</tr>
</tbody>
</table>

From direct supply of draw frame sliver without changing conventional grains. Therefore, no slubbing or intermediate frames are needed. Since the sliver weight remains unchanged, the number of carding engines and drawing frames must not be increased. However, the construction of the delivery part of the finisher draw frame has to be modified to accommodate small cans 5 to 6 inches in diameter and 24 to 26 inches high (depending on the spinning frame spindle gauge).

To save the trouble of changing cans frequently, automatic can-replacing apparatus may be attached to the delivery part of the finisher draw frame. This enables two or three cans to be doffed at one time from each delivery part while the third or fourth can is being filled. Thus, no production is lost for doffing.

Furthermore, the excellent control of all fibers in the OM-S patent drafting zone maintains the highest degree of uniformity and the most parallel orientation of fibers given to sliver by the draw frame.

Table 2

<table>
<thead>
<tr>
<th>Yarn count</th>
<th>20's</th>
<th>30's</th>
<th>40's</th>
<th>60's</th>
<th>80's</th>
<th>100's</th>
<th>120's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard strength of Japan Cotton Spinning Association (lbs.)</td>
<td>68</td>
<td>48</td>
<td>37</td>
<td>28</td>
<td>25</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>Average strength prescribed by Japan Spinners' Inspection Foundation (lbs.)</td>
<td>92</td>
<td>61</td>
<td>45.7</td>
<td>35</td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenacity of yarn spun by OM-S type ring frame (lbs.)</td>
<td>98</td>
<td>70</td>
<td>51</td>
<td>37.5</td>
<td>33.5</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>Uster test results of ditto (%)</td>
<td>13.0</td>
<td>14.5</td>
<td>15.2</td>
<td>13.5</td>
<td>15.5</td>
<td>17.5</td>
<td>19.0</td>
</tr>
</tbody>
</table>

(D) Easy Operation:

One of the salient features of OM machine is the special OM patent cradle which extremely simplifies the operation of the roller parts and make the super high draft arrangement successful. The pressure imposed upon each top roller is produced not by long weights or lever weights, but by Swedish piano-wire springs of uniform quality fixed on the cradles. Each top roller can be easily fixed on, or removed from, each spindle independently, and

(C) Superior Quality of Yarns:

Yarns spun by the OM-S type Super High Draft ring spinning frame are either equal or superior in uniformity, evenness and strength to yarn conventionally spun from the same stock. Especially, OM-S-spun yarns are usually about 10 per cent stronger than yarns conventionally spun. The first reason is that the roving frame, one of the major sources of yarn difficulties, is successfully eliminated. Since draw frame sliver is directly supplied to the ring frame, the variation generally introduced by the roving frame is virtually non-existent.
the applying and releasing of pressure is also instantaneously effected.

There is no need to make individual adjustments of cap bar nebs, since the cradle ratch distances are pre-set by specially-made stoppers. The stoppers are readily interchangable, and assure uniform settings.

(E) Independence of Spindle:
Since each spindle is operated perfectly independently, spindle-interference and enddowns are naturally less compared with the conventional two-spindle system, thus improving efficiency of operation.

(F) Far better control of shorter fibers:
Because OM-S Super High Draft system is designed to eliminate the roving process, fly and invisible waste are considerably reduced, both in the carding room and the spinning room. Moreover, the perfect control of all fibers in the OM-S drafting zone enables blending of a larger percentage of shorter stock (or mixing of synthetic fibers of various lengths) without sacrificing evenness.

(G) Reduction in Production Cost:
(a) Saving of manpower:
OM-S type Super High Draft system dispenses with manpower required for the roving process.

This results in a saving of approximately more than 10 per cent in man power through the process from opening to spinning, compared with the conventional system, depending on yarn count.

(b) Reduction in initial cost:
With the roving process completely eliminated, installation expenditures for machines, power plants and floor space for mill construction are lessened and the overall cost is lowered.

(c) Saving in power cost and in expenditure for supplies:
As a result of the complete elimination of speed frames, maintenance expenses for ma-
chinery and power charges can be diminished, while no less a saving in accessories and supplies is realized. Naturally, no roving bobbins or skewers are needed.

(d) Cut in expenditure for raw cotton:

As there is no roving process involved and nothing is needed for that process, the turnover of raw cotton is speeded up and switch-over of products can be readily effected. The latter advantage applies particularly in mills spinning a wide range of yarns from the same sliver. In addition, expenditures for raw cotton can be reduced, because increased blending of shorter fibers is possible, as mentioned above.

OM-K type Super High Draft Ring Spinning Frame

Whereas draw frame sliver is used in the OM-S type Super High Draft system, OM-K type Super High Draft ring spinning frame is designed to spin from roving bobbin.

In this system, a single process of roving frame is used. The OM-K system is quite as good as the OM-S system in respect of the easiness of handling, super high drafting, control of shorter fibers, low production cost and high quality of yarn spun.

Osaka Kiko Co., Ltd.

Our roving OKR-VII frame give draft as high as 12~30, so our ring spinning frame is designed to give draft of 13~25 for the 3-line system and 25~50 for the 4-line.

The functions of the drafting part have a direct bearing on the quality and cost of yarn. It is very important that the drafting part be stable in build and easy to operate and control. In other words, whether the drafting part performs its functions satisfactorily depends on the quality of the cradle, which is the heart of the drafting part.

We shall describe the mechanism and special features of the types of cradles which we can confidently recommend and also the method of setting and removing them. Finally, we shall explain the roller part for these cradles.

TN-C type Cradle

(A) Mechanism

As shown in Figure 1 and photos 1, 2 and 3, the body of TN-C type cradle is made of a gate-shaped iron plate 2 mm thick and has four legs—two each in the front and on the back.

The front legs are hitched, by means of \( \square \) shaped indents, to the bottom tensor bar inserted in the middle slide. The back legs are held in place by pressing them against the pin of the cradle holder bar with the springs on both sides. The bottom tensor bar and cradle holder bar are designed to have sufficient rigidity against distortion by the pressure of the springs, as such distortion will disturb tensor gauge and adversely affect spinning.

A nylon-covered pin is inserted in the top roller placed on the bottom roller. Both ends of the pin are flattened and can be moved up and down along the arc-shaped slots in the
body of the cradle by the pressure of the V-shaped springs which hold the apron band between them. The top tensor bar is made of a flat iron plate rounded on both sides. It has a hole at each end through which the spring is passed to hold the bar in place and keeps the bar from slipping out of the body of the cradle.

(B) Special Features

(a) Each spindle is perfectly separated, so that “spindle interference” and “enndown” can be remarkably lessened and efficiency of operation is raised as compared with the two-spindles-a-pair system.

(b) The body of the cradle is supported by both the bottom tensor bar and the cradle holder bar, so it is absolutely proof from vibrations.

(c) The back legs incline toward the pin of the holder bar and are brought into contact with it by pressure. There, the component force of the upward pressure of the V-shaped springs produces a forward pressing force and then a combined force forward and upward. The combined force strongly presses the V-shaped indents, cut in the front legs, against the back and also against the front edge of bottom tensor bar. Thus, the indents are held fixedly in place during operation.

(d) The body of the cradle slips to neither left nor right, because the front legs are kept from slipping by the inside of the rectangular holes drilled in the bottom tensor bar.

(e) The top tensor bar, 3.2 mm thick and 9.5 mm wide, is rounded to the extent of a 1.6 mm radius on both sides. This makes the radius curvature of the apron band small and makes it possible to bring a nip point close to the front roller.

(f) The V-shaped spring is simple in construction and has a balanced lead. It is made of good quality piano wire.

(C) Controlling

To remove the body of the cradle, press it down with the thumb and push it slightly toward the back to let the front legs get cut of the bottom tensor bar (see photo 4). To
set the cradle in place, push the back legs into the pin of the cradle holder bar, so that the front legs are inserted into the holes of the bottom tensor bar. Then press down the body of the cradle and push it slightly toward the front (see photo 5). As mentioned above, the method of setting and taking off the cradle is very simple and requires no trouble or skill.

Each top apron may be removed from the fixed position per spindle and is, therefore, easily exchangeable. When the bottom apron breaks, the band has to be slid to right or left toward the saw-toothless portion and pieced up with a joiner (see photo 6).

Note: Photos 4, 5 and 6, showing the roller parts of the 4-line system, are given here to show the cradle parts of the front zone.

**TN-A type Cradle**

(A). Mechanism

As shown in Figure 2 and photos 7 and 8, the body of the cradle of TN-A type consists of two parts—top and bottom. The lower end of the V-shaped spring is hitched to the bottom cradle and the upper end to the fixed pin of the top cradle. The pin is movable up and down along the slot, which is cut in the bottom cradle, and keeps the top and bottom cradles from separating after they are set up. The front legs on both sides of the bottom cradle are hitched to the bottom tensor bar by L-shaped indents. The bottom cradle has no back leg, so there is no cradle holder bar for TN-A type cradle. Instead of having back legs on the bottom cradle, the top cradle has long legs which are hitched to the rounded end of the vertical flange of the L-shaped bottom tensor bar with the springs pressed upward as shown in Figure 2. One end of the top tensor bar, 3mm thick, has an L-shaped cut which limits the length to which the bar is inserted into the hole of the bottom cradle. The other end has a slit which keeps the bar from slipping out of the hole, the slit being made slightly wider as a double precaution against the bar slipping out of the hole.

(B) Special Features

As shown in Figure 2, there is a gap between the position of the top cradle pin (with the top and bottom cradles set up) and the position where the legs of top cradle are hitched to the bottom tensor bar. Therefore, the cradle which is set up in place receives a combined force which pulls it diagonally and forward. By this force the L-shaped indents of the bottom cradle are firmly fixed on the top of the bottom tensor bar and also in the front of
the rectangular holes which are drilled in them (see Photo 8).

(C) Controlling

To take off the cradle, press down the top cradle with the thumb and the middle finger to let its legs get out of the end of the vertical flange of the bottom tensor bar. To set the cradle in position, press down the top cradle and push it slightly backward so as to hitch the legs of the top cradle to the end of the vertical flange of the bottom tensor bar. Other details are the same as for TN-C type cradle. (See Photo 9.)

![Photo 9](image)

*OK-C type Cradle (usable for four-line system only)*

(A) Mechanism

As shown in Figure 3 and photos 10 and 11, the top cradle consists of the upper and lower part—making a double system. The upper part has two slots along which it is slid backward and forward. After the gauge between the third and back rollers has been adjusted by this sliding, the upper part is fixed in place with set-screws. The bottom cradle is fixed, per spindle, on the L-shaped bar whose slide sticks firmly to the legs of the lower part of the top cradle. (See photos 11 and 12.)

![Photo 10](image)

![Photo 11](image)

![Photo 12](image)

Setting the top cradle or removing it from the bottom cradle is very simple. By the wire spring double-coiled in the middle, two top rollers are pressed down at the same time (see photo 10). This pressing method by the cradle system for single spindles is designed to replace methods such as pressing down the top roller as a self-weighting roller of the two-spindles-a-pair system or the lever system, both of which are used mainly for the back
zone of the 4-line system roller part.

(B) Special Features

The self-weighting top roller is for the two-spindles-a-pair system and requires a two-step process. The lever system is not simple in mechanism. With the OK-C type cradle which is designed for the single-spindle system, it is possible to set up or remove two top rollers at the same time. It is very easy to disjoin these rollers from the bottom cradle. (See photo 13.)

The cradle, top and bottom tensor bars and cradle holder bar are all cadmium-plated and good to look at.

(C) Controlling

The mechanism of the OK-C type cradle is simple. The pressure on the two top rollers is fixed, which makes periodical cleaning easy.

Figures 4 and 5 show TN-C type and TN-A type cradles which are set in place on the roller part of the three-line system.

The following shows test results on yarns produced by using three-line system roller part with TN-C type cradle.

<table>
<thead>
<tr>
<th>Counts</th>
<th>20's</th>
<th>30's</th>
<th>40's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft</td>
<td>17.01</td>
<td>21.09</td>
<td>21.27</td>
</tr>
<tr>
<td>Twist/inches</td>
<td>19.50</td>
<td>22.13</td>
<td>25.20</td>
</tr>
<tr>
<td>Lea strength in pounds</td>
<td>93.0</td>
<td>74.3</td>
<td>55.2</td>
</tr>
<tr>
<td>Spinning grain</td>
<td>48.78</td>
<td>32.87</td>
<td>24.30</td>
</tr>
<tr>
<td>Coefficient of variation in yarn counts</td>
<td>2.6%</td>
<td>2.3%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Spindle revolutions per minute</td>
<td>10,000</td>
<td>10,500</td>
<td>11,000</td>
</tr>
</tbody>
</table>
In the light of our long years' study, we recommend a roller stand inclination at 45 degrees as the most suitable angle for all spinning conditions.

For illustrations of the four-line system roller part, see Figure 6 and photos 4, 5, 6, and 13.

When yarn breaks between the front roller and the ring bobbin frame, the yarn comes out of the front roller in the shape of the so-called "straight yarn," which is apt to wind round the front roller, top roller or under clearer. Unless this straight yarn is removed and the broken yarn pieced up quickly, the yarn winding round the roller or clearer gets bulky and causes a "contagious break" of the neighboring yarns. Yarn breaks are apt to occur more frequently in the rainy season or in the spinning of low counts of yarn.

Each broken yarn must be promptly sucked up by the vacuum action to prevent a "contagious break" of the neighboring yarns and to put the sucked yarn to use again. Fly cotton floating around fluted rollers must be sucked up by the vacuum action to prevent such fly cotton from sticking to the roller surface. It was with these ends in view that we obtained the patent rights and trade mark rights of "Pneumafil" equipment from Luwa SA, Zurich, Switzerland several years ago. All our ring spinning frames sold at home and abroad since then are equipped with "Pneumafil." The excellent mechanism and high efficiency of this device are:

a. It reduces the chances of the breaking of yarn.

b. It increases output of yarn.

c. The pieced portion of yarns is made smaller and uniform.

d. It improves the quality of yarns.

e. It reduces manpower needs.

f. It shortens the training period for workers to be employed for piecing up broken yarns.

g. Therefore, the amount of labor per bale is curtailed.

h. It helps to keep the spinning room in good order.

Toyoda Automatic Loom Works, Ltd.

We manufacture a wide variety of high draft arrangements for ring spinning frames. They range from the conventional three-line rollers high draft system to five-line. They are identified by distinctive types such as Jα, BB, CC, RB, LCA and LCB. Brief descriptions of these types are given below. (We manufacture other types, but their descriptions will be omitted here for reasons of space.)

Jα Type Drafting Device

(A) Mechanism of Jα Type

(a) Inclination angle of roller stand

The inclination angle of the roller stand is made either 45 or 60 degrees, depending on the kind of fiber to be processed, the method of introducing sliver and roving, the width of the frame etc., said degrees having been found suitable after a series of experiments. (Figures 1 and 2 show side views of the device.)
(b) How to apply pressure

Insert the front and second top rollers in the slots of main cradle A. The arbors of these rollers are pressed by front cover B and top cover C. Cross stay D, situated in the lower part of main cradle A, is run through with E, to which roller weight W is hitched. The weight wire is fulcrummed at weight bar F. Consequently, the pressure of roller weight W is applied to the front and second top rollers, which, therefore, operate with a suitably distributed force. The pressure is released by pushing projection P. (See Figure 3.)

(B) Features of Ja Type

(a) Weighting or weight-releasing is done easily by pressing the front cover with the thumb. The tensor is divided into the upper and lower parts, and can be easily inserted or removed.

(b) The weighting device for the front and second top rollers is of a lever weighting system which maintains uniform pressure on them.

(c) The cradle and tensor are neither deformed nor damaged during operation.

(C) Setting

(a) Roller Gauge

The gauges between the rollers on the ring spinning frame provided with the Ja drafting device vary with the staple length of fibers used, but generally they are as shown in the following table:

<table>
<thead>
<tr>
<th>Table 1. Roller gauges for Ja type drafting device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rollers</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Cotton spinning</td>
</tr>
<tr>
<td>Staple rayon spinning</td>
</tr>
</tbody>
</table>

(b) Draft

An example of draft applied to drawing sliver, using the Toyoda super high draft ring spinning frame equipped with the Ja drafting device, is shown in Table 2. (The figures marked with an asterisk show the most suitable drafts.)

<table>
<thead>
<tr>
<th>Table 2. Draft for Toyoda super high draft ring spinning frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yarn count</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>120</td>
</tr>
<tr>
<td>20's</td>
</tr>
<tr>
<td>30's</td>
</tr>
<tr>
<td>40's</td>
</tr>
</tbody>
</table>

(c) Roller weighting

About five kilograms of load is applied to the cradle, although there is some difference between the load for cotton spinning and the load for staple rayon spinning.

(D) Spinning Data

Rayon spun with the Toyoda super high
draft ring spinning frame is more than 6 per cent stronger than yarn spun from the same fiber with other spinning frames. This is because Toyoda's method causes fewer breakages and less fatigue to the fiber and gives a higher degree of evenness to yarn. In other words, the better conditions of fibers and the higher degree of evenness of the yarn spun by the Toyoda system are reflected in improved yarn strength. A single-yarn tension test we have made on 40's spun rayon yarn has given excellent results as indicated in Table 3.

![Table 3. Results of single-yarn strength tests](image)

<table>
<thead>
<tr>
<th>Type of inspection</th>
<th>Toyoda super high draft system</th>
<th>Other systems</th>
<th>Improvement credited to Toyoda super high draft system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breaking load</td>
<td>202 grams</td>
<td>190 grams</td>
<td>6.3%</td>
</tr>
<tr>
<td>Breaking elongation</td>
<td>10.19%</td>
<td>9.53%</td>
<td>6.9%</td>
</tr>
</tbody>
</table>

Remarks:
Testing machine used: Shimazu's single yarn tester
Temperature and humidity in the testing room: 12±2°C, 63±3%
Rate of loading: 35 cm/sec.

**BB and CC Types of Drafting Device**

In view of the general trend toward adopting multi-roller spinning frames to improve yarn quality, we have developed (in addition to the four-line rollers super high draft ring spinning frames with the Jo drafting device described above) a five-line rollers type frame with drafting devices of types BB and CC for spinning cotton and a four-line rollers type frame with the BB type drafting device for spinning long fibers.

(A) Mechanism of BB and CC Types

(a) Arrangement of rollers and inclination angle of roller stand

For cotton spinning, five-line rollers are used with two sets of double aprons, one set on the second roller and the other on the fourth roller. For spinning long staples, four-line rollers are used, one set of double aprons being provided on the second roller.

In both cases, the roller stand is given an inclination of 45 degrees to facilitate piecing operation.

(b) How to weight

In the five-line system, the front and third rollers are weighted by dead weighting, the second, fourth and back top rollers being pressed directly by the coiled springs fitted to the cradles. With the frames for long staples, a long weight is used for the front roller, and the coiled springs fitted to the cradle press the second top roller, as in cotton spinning. The effects of weighting can be distributed equally to the rollers regardless of changes in their positions required in altering the roller gauge.

(c) Cradle

To exert pressure on the top roller, many conventional types of drafting device use clip type springs, but they can neither be easily adjusted nor easily give pressure to both sides of the roller. The BB and CC types of cradles are provided with coiled springs, suitable pressure being given by adjustable screws. Furthermore, the CC type is provided with a slide at the back so that an accurate change is made in the roller gauge. (See Figures 4 and 5.)

![Fig. 4 BB type device](image)

![Fig. 5 CC type device](image)

**(B) Features of BB and CC Types of Cradles**

(a) They are simple in structure and can be easily attached or removed.

(b) Pressure is correctly adjusted, and each top roller can be uniformly weighted.

(c) Super high drafting is possible.

(d) Roller gauges are accurately changed.

**SB and RB Types of Drafting Device**

(A) Mechanism of SB and RB Types

The SB type drafting device is almost the same as the BB type already described, except that the SB has a clip spring provided as a pressure device. An improvement is made in the RB type's method of setting and remov-
Fig. 6 SE type device

Fig. 7 RB type device

Fig. 8 LCA type device

Fig. 9 LCB type device

ing and this type incorporates all the good points of both BB and SB types. (See Figures 6 and 7.)

(B) Features of SB and RB Types

(a) Fibers are held extremely accurately, thus giving good quality yarn.

b. The cradle is divided into the upper and lower parts. With the RB type, the bottom roller can be removed or set independently of the bottom cradle—a feature that considerably facilitates periodical cleaning, etc.

LCA and LCB Types of Drafting Device

(A) Mechanism

Each of the two types is divided into the upper and lower parts, i.e., upper and lower cradles. The bottom cradle is fixed to the cradle bar. The front of the top cradle is supported by the tensor of the bottom cradle, and the back by the supporting bar.

In the LCA type, the bottom cradle is fitted to the front roller in the same way as in the Ja type, and is pressed in the same manner as in the RB type. To prevent the apron from drooping, an apron presser made of plastics is applied. (See Figure 8.)

In the LCA type, the load on the front top roller is fully given by dead weighting, and the pressure on the second roller is applied by clip type springs. As in the LCA type, the drooping of its apron is prevented by an apron presser. (See Figure 9.)

(B) Features of LCA and LCB Types

(a) They are used for long fibers requiring large roller gauges. They spin excellent yarns, thanks to the firmness of their grip and the accuracy with which they transfer fibers.

(b) The top cradle can be easily applied or removed.

(C) Spinning Data

Table 4 shows an example of the results of the tests of the yarn spun by the LCA and LCB types of drafting device.

<table>
<thead>
<tr>
<th>Synthetic fiber</th>
<th>Sliver Counts</th>
<th>Total Draft</th>
<th>Twist</th>
<th>Tensile</th>
<th>Cradle strength used</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 grains/6 yds.</td>
<td>30's</td>
<td>16.5 t.p.i.</td>
<td>70-73 lbs.</td>
<td>LCA</td>
<td></td>
</tr>
<tr>
<td>100 grains/3 denier, cut 3 ins.</td>
<td>30's</td>
<td>16.0 t.p.i. or more</td>
<td>LCB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Spinning with LCA and LCB types of device