Metallic Wire for High-Speed and High-Production Cotton Card

Part 5: Effects of the Stationary Flats on the Sliver Qualities

This paper reproduces the 38th lecture meeting of Textile Machinery Society of Japan held in 1985.

Kanai Juyo Kogyo Co., Ltd.

by Y. Ogita
K. Yagyu
T. Mitsuyoshi
S. Kanazawa

by J. Hosokawa
(Kyoto Institute of Technology)

— Abstract —

A stationary flat was mounted on either side of the taker-in or the doffer, or on both sides of a flat card to examine the effects of stationary flats on the sliver quality.

Result

(1) The carding action is improved by mounting the stationary flats, but on the contrary the fibre breakage tends to be increased.

(2) Fibre orientation is improved in either case with the stationary flats mounted on the taker-in side or the case with those on the doffer side as compared with the case without any stationary flat. Improvement in fibre orientation in the trailing direction, in particular, means the reduction of the trailing hooks which can hardly be removed in the drawing process.

(3) As for U% of the slivers, it is more effective to mount the stationary flats on the doffer side.

(4) The peak of force produced in the vicinity of the third top from the inlet can be eliminated by mounting a stationary flat on the taker-in side.

1. Introduction

As is well known, the preliminary opening device in the taker-in part in regarded as important for high-speed and high-production card to improve the sliver quality. The effects of use of a toothed mote knife and reduction of taker-in speed to reduse the fibre breakage in the taker-in part and to improve the yield rate of sliver were already reported earlier.

In this study, carding tests were carried out by mouting a stationary flat, which is a kind of preliminary opening devices. Stationary flats have so far been mounted on the taker-in side and those results have been reported.

Here, the stationary flats were mounted on either side of the taker-in or the doffer, or on both sides to examine the effects in each case.

2. Test conditions

2-1 Specifications of the metallic wire and top card clothing usd for the test.

Table 1 shows specifications of the metellic wires for the cylinder, the doffer and the taker-in used for testing.

Alphabets used in Table 1 indicate dimensions of each parts described in figures of the

Table 1 Specifications of metallic wire

Dimension / Roller and drums	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	X (degree)	Y (degree)	M (teeth /in)	P (points /in²)
Cylinder	2.8	0.5	0.63	2.15	0.08	0.3	0.05	68	40	16	645
Doffer	4.0	2.2	0.85	1.3	0.2	0.5	0.15	60	40	13	388
Taker-in	5.6	3.5	1.1	1.5	0.25	0.65	0.1	80	38	4.5	—

metallic wire in Fig. 1.

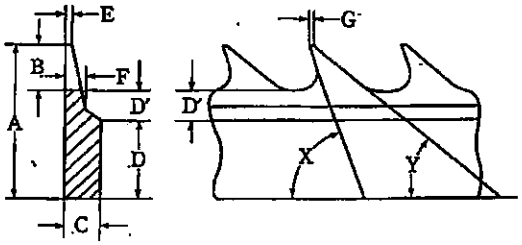


Fig. 1 Profiles of metallic wire

The cylinder wire used in this test has the depth of teeth (B) (=0.5mm) and the part of no teeth (D') (=A−B−D=0.15mm).

The other dimensions and the angles are considered to be suitable for high-speed and high-production at present.

The wires of the doffer and the taker-in for the test are the type used ordinarily in cotton carding.

Fig. 2 shows the specifications of top card clothing. As show in Fig. 2, the total height is 9mm, working angle is 75°, point density is 450 points /(inch)² and wire profile is diamond shaped (F type).

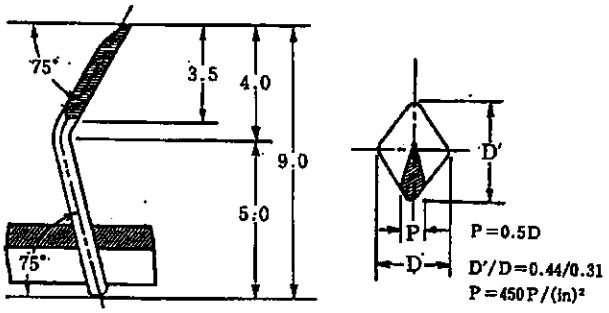


Fig. 2 Specification of Top card clothing

Fig. 3 shows the profiles of metallic wire used for the stationary flat. The metallic wire of 90° working angle means to prevent the fibre from accumulating on the teeth while carding.

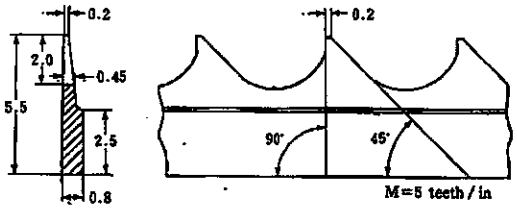


Fig. 3 Profiles of Metallic wire for Stationary flat

2-2 Carding conditions

Table 2 shows the carding conditions for this test.

Table 2 Carding conditions

Speed (rpm) Surface speed (m/s)			Top speed (m/min)	Sliver weight (grains /6yd)	Production rate (lbs/hr)
Cylinder	Doffer	taker-in			
300 (20.3)	18 (0.66)	792 (10.2)	104	590	60
450 (30.4)	27 (0.98)	1,187 (15.2)	156	〃	90
650 (43.9)	39 (1.42)	1,715 (22.0)	226	〃	130

In this table, speed for each drum or roller is shown in the upper column, and the surface speeds in the parentheses in the lower column.

The cylinder speed was increased while keeping constant the ratios of surface speed of each part of the card.

The cylinder speed was changed in the range from 300 rpm to 650 rpm. The maximum surface speed was 44/s. If this maximum speed is converted to the speed per hour, it is equivalent to 150 km/hr. As the taker-in roller was accelerated while keeping the surface speed to the cylinder at 2:1, the speed of taker-in roller became 1, 715 rpm at the cylinder speed of 650 rpm.

Sliver weight produced was kept constant at 590 grains/6yd, because a heavy sliver weight is considered to be sensitive to the sliver quality.

The maximum production rate in this case was 130 lbs/hr (60 kgs/hr).

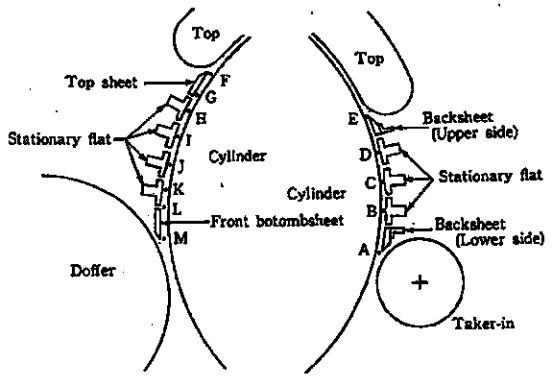
2-3 Settings

Table 3 shows the settings between the stationary flat and the cylinder.

As shown in Table 3, three and four stationary flats were mounted respectively on the taker-in side and the doffer side, each setting was adjusted at the point of B, C and D, and H, I, J and K.

When the stationary flats were mounted on the taker-in side, the tests were carried out at four setting conditions I, II, III, and IV. When they were mounted on the doffer side, the tests were carried out at two setting conditions V and VI.

Setting condition I : The setting points of B,



	A	B	C	D	E	F	G	H	I	J	K	L	M
I	26	12	12	12	23	38	38	—	—	—	—	38	20
II	26	18	15	12	23	38	38	—	—	—	—	38	20
III	26	26	25	12	23	38	38	—	—	—	—	38	20
IV	26	26	25	24	23	38	38	—	—	—	—	38	20
V	26	—	—	—	23	38	38	10	10	10	10	38	20
VI	26	—	—	—	23	38	38	15	15	15	15	38	20
VII	26	26	25	24	23	38	38	15	15	15	15	38	20
VIII	26	—	—	—	23	38	38	—	—	—	—	38	20

Table 3 Settings between the Stationary flats and the cylinder

C and D were set at 12/1,000 in.

Setting condition II : The setting points of B, C and D were set at 18/1,000, 15/1,000 and 12/1,000 inches respectively.

Setting condition III : The setting point of B, C and D were set at 26/1,000, 25/1,000 and 12/1,000 inches respectively. In this case, the clearance setting between the stationary flat at the outlet side and the cylinder was made narrower to 12/1,000 in steeply.

Setting condition IV : The setting points of B, C and D were set at 26/1,000, 25/1,000 and 24/1,000 inches respectively. In this case, the settings were gradually changed from the lower end to the upper end of the back sheet along the cylinder surface.

Setting condition V : The all setting points of H, I, J and K were set at 10/1,000 in. In this case, these settings have intermediate clearance between the cylinder-top and the cylinder -doffer settings.

Setting condition VI : The all setting points of H, I, J and K were set at 15/1,000 in. In this case, the settings were the same as those between the cylinder and the top.

Setting condition VII : When stationary flats were mounted on both sides of the taker-in and the doffer. (corresponding to the setting condition II and V), the setting points B, C and D on the taker-in side were set at 26/1,000, 25/1,000 and 24/1,000 inches respectively (setting condition IV) and the setting points of H, I, J and K on the doffer side were set at 15/1,000 in (setting condition VI). The combination of those two setting conditions IV and VI means to decrease the fibre breakage to improve the

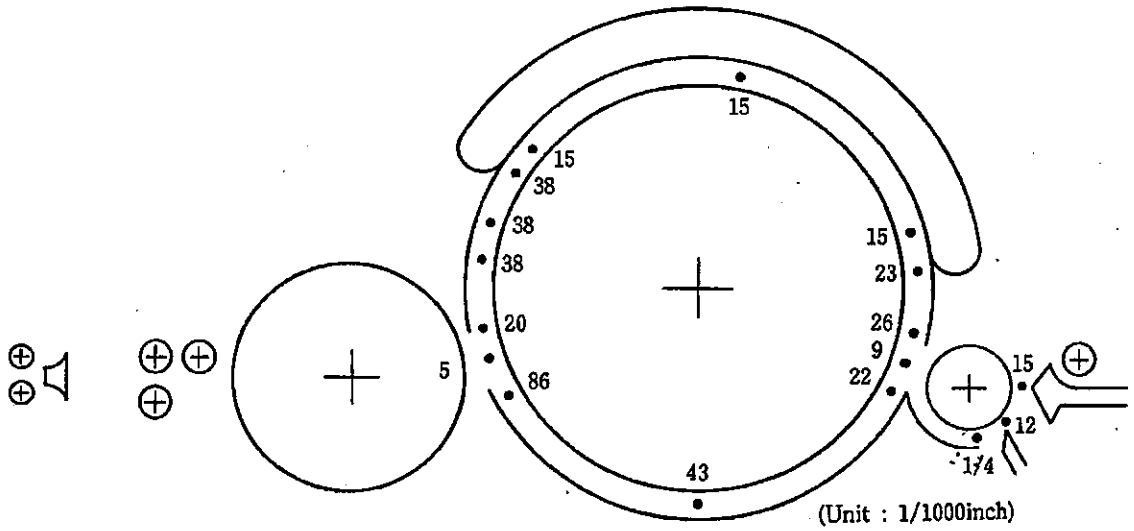


Fig. 4 Main setting

carding efficiency while carding.

Setting condition VIII : When no stationary flat is mounted on neigher side of the taker-in nor the doffer, tests were carried out as the setting condition VIII to compare with the data in all cases mentioned above.

The above 8 kinds of setting were applied to the carding conditions shown in table 2.

Fig. 4 shows the main settings of the card when no stationary flat is used.

3. Result

3-1 Number of neps

Fig. 5 shows the changes in the number of neps when the stationary flats were mounted.

Symbol	with or without the stationary flat	Setting condition	Symbol	with or without the stationary flat	Setting condition
—○—	with (Taker-in side)	I	—○—	with (Doffer side)	V
----●----	with (Taker-in side)	II	----▲----	with (Doffer side)	VI
—○—	with (Taker-in side)	III	—□—	with (Both sides)	VII
—○—	with (Taker-in side)	IV	—×—	without	VIII

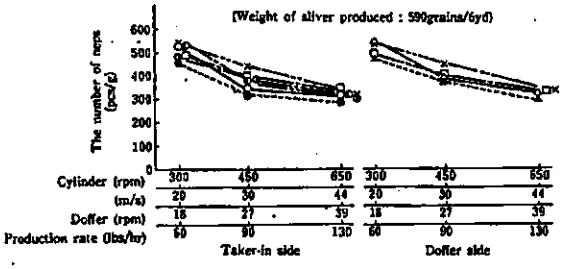


Fig. 5 Changes in the number of neps in the sliver

In either case of the stationary flats mounted on the taker-in side or the doffer side, the number of neps in the sliver is reduced as a whole. Therefore, the stationary flat are regarded fully effective as the preliminary opening device.

3-2 Fibre length

The mean fibre length of the sliver was measured with a fibrograph and the results are shown in Fig. 6.

As is known from Fig. 6, the mean fibre length of the sliver is the shortest when the stationary flats are mounted on the taker-in side in case of the setting condition I.

There is no difference in mean fibre length

Symbol	with or without the stationary flat	Setting condition	Symbol	with or without the stationary flat	Setting condition
—○—	with (Taker-in side)	I	—○—	with (Doffer side)	V
----●----	with (Taker-in side)	II	----▲----	with (Doffer side)	VI
—○—	with (Taker-in side)	III	—□—	with (Both sides)	VII
—○—	with (Taker-in side)	IV	—×—	without	VIII

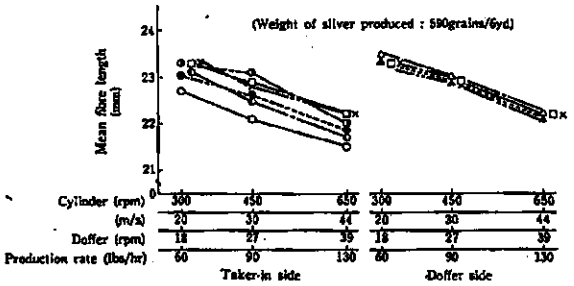


Fig. 6 Changes in mean fibre length of the sliver (with fibrograph)

between the cases of setting condition IV, setting condition VII and setting condition VIII.

In the cases of setting conditions II and III, there seems to be a tendency of breakage because narrower setting guage of 12/1,000 inch is included in the settings.

When the stationary flats are mounted on the taker-in side, therefore, it is desirable to change the setting guages gradually narrower from the lower end to the upper end of the back sheet along the cylinder surface.

When they are mounted on the doffer side, there is not significant difference in the mean fibre length between with and without the stationary flats.

3-3 Short fibre contents

Fig. 7 shows the changes in the short fibre contents in the sliver produced.

The short fibre contents are the highest when the stationary flats are mounted on the taker-in side in case of setting condition I.

Contrary to this, they are the lowest when no stationary flats are mounted (corresponding to case of setting condition VIII). This means that the fibre breakage is increased to some extent by mounting the stationary flats.

It is desirable to change the setting guages gradually narrower from the lower end to the upper end of the back sheet along the cylinder surface.

Symbol	with or without the stationary flat	Setting condition	Symbol	with or without the stationary flat	Setting condition
—○—	with (Taker-in side)	I	—△—	with (Doffer side)	V
---●---	with (Taker-in side)	II	---▲---	with (Doffer side)	VI
-·-●-·-	with (Taker-in side)	III	-·-□-·-	with (Both sides)	VII
---○---	with (Taker-in side)	IV	---×---	without	VIII

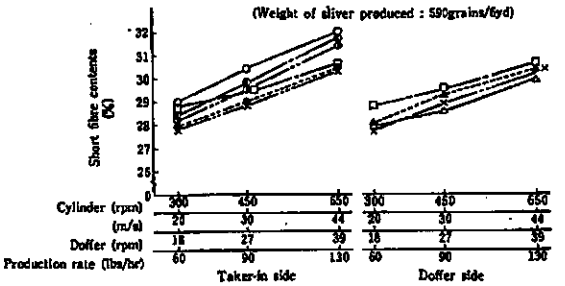


Fig. 7 Changes in the fibre contents in the sliver

When the stationary flats are mounted on the doffer side, the fibre breakage tends to be also increased to some extent.

However,the fibre breakage is greater when the stationary flats are mounted on the taker-in side than those on the doffer side. This is probably because large tufts are allowed to be fed between the stationary flats and the cylinder at the taker-in side and they are carded excessively.

3-4 Fibre orientation

Fig. 8 shows the changes in fibre orientation

Symbol	with or without the stationary flat	Setting condition	Symbol	with or without the stationary flat	Setting condition
—○—	with (Taker-in side)	I	—△—	with (Doffer side)	V
---●---	with (Taker-in side)	II	---▲---	with (Doffer side)	VI
-·-●-·-	with (Taker-in side)	III	-·-□-·-	with (Both sides)	VII
---○---	with (Taker-in side)	IV	---×---	without	VIII

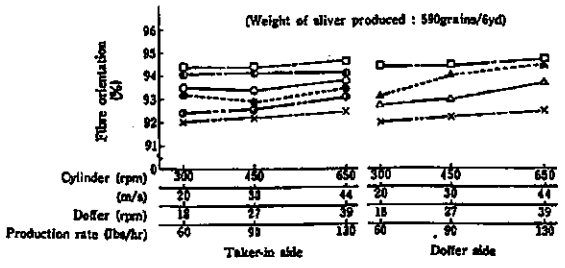


Fig. 8 Changes in the fibre orientation in the leading direction

in the sliver in the leading direction.

There are many kinds of measuring methods to evaluate the fibre orientation. In this test, the Lindsley's method which is generally used was adopted.

When the stationary flats are mounted on the taker-in side, the fibre orientation in the leading direction is improved substantially as compared with that in the case of no stationary flats.

As for the setting guages, the fibre orientation is improved when the all settings between the stationary flats and the cylinder are set at 12/1,000 in (corresponding to the setting condition I), or when the setting between the stationary at the outlet and the cylinder was made narrower steeply to 12/1,000 in (corresponding to the setting condition III).

The effect of stationary flats on the doffer side upon the fibre orientation can be known by comparing the result of setting condition IV with those of setting condition VII (the settings between the stationary flats and the cylinder on the taker-in side are same at both setting conditions IV and VII).

From those comparations mentioned above, the stationary flats on the doffer side have an excellent effect on the fibre orientation.

In comparison with no stationary flat mounted, it can be saied generally that the fibre orientation is also improved when the stationary flats are mounted on the doffer side in the same manner as the case mounted on the taker-in side.

However, it can be realized from the comparison of the those results between the setting conditions VI and VII (both setting conditions VI and VII are same guages between the stationary flat and the cylinder on the doffer side) that the stationary flat on the taker-in side have less effect on the fibre orientation.

Fig. 9 shows the changes in the fibre orientation in the sliver in the trailing direction.

When the stationary flats are mounted on the taker-in side, the fibre orientation is improved considerably. The orientation of fibre in the trailing direction is improved more when all settings between the stationary flats and the cylinder were made narrower or the clearance setting between the stationary flat at the outlet side and the cylinder was made narrower steeply.

As compared the results of setting condition IV with those of setting condition VII (the settings between the stationary flats and the cylinder on

Symbol	with or without the stationary flat	Setting condition	Symbol	with or without the stationary flat	Setting condition
—○—	with (Taker-in side)	I	—△—	with (Doffer side)	V
---●---	with (Taker-in side)	II	---▲---	with (Doffer side)	VI
-·-○-·-	with (Taker-in side)	III	-·-□-·-	with (Both sides)	VII
---○---	with (Taker-in side)	IV	---×---	without	VIII

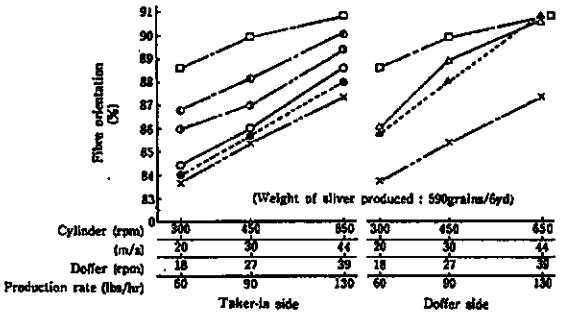


Fig. 9 Changes in the fibre orientation in the trailing direction

the taker-in side are same at both settings IV and VII), the stationary flats on the doffer side have the considerable effect on the fibre orientation in the trailing direction.

When the stationary flats are mounted on the doffer side, the fibre orientation is improved considerably in comparison with the result of no stationary flats mounted.

However,changes in settings between the stationary flats and the cylinder have almost no influences on the fibre orientation.

On comparing two cases of setting conditions VI and VII (the clearance between the stationary flats and the cylinder on the doffer side are same in both setting conditions VI and VII), it shows a tendency that the effect of stationary flats on the taker-in side upon the fibre orientation is decreased gradually with increasing in the cylinder speed, and there is almost no effect when the cylinder speed is 650 rpm.

As the above mentioned, the fibre orientations are improved in the both leading and trailing directions when the stationary flats are mounted.

However, the effect is the most excellent when the stationary flats are mounted on the both sides.

If the stationary flats are mounted only on one side, the effect of stationary flat on the doffer side is higher than that on the taker-in side.

When the clearances between the stationary flats and the cylinder on the taker-in side are made narrower, they serves for improving the fibre orientation in some degree. It is regarded preferable, however, to improve the fibre orientation by mounting the stationary flats to the doffer side, because there still remains some problems on the fibre breakage while carding caused by the narrow clearances mentioned above.

3-5 U% of the sliver

Fig. 10 shows the changes in U% of the sliver.

Symbol	with or without the stationary flat	Setting condition	Symbol	with or without the stationary flat	Setting condition
—○—	with (Taker-in side)	I	—△—	with (Doffer side)	V
---●---	with (Taker-in side)	II	---▲---	with (Doffer side)	VI
-·-○-·-	with (Taker-in side)	III	-·-□-·-	with (Both sides)	VII
---○---	with (Taker-in side)	IV	---×---	without	VIII

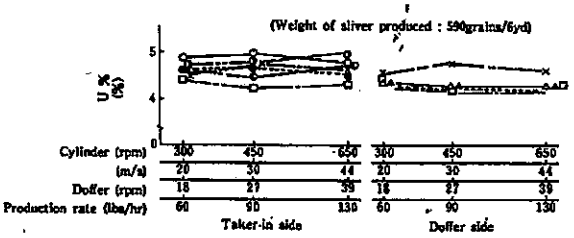


Fig. 10 U% of the sliver

U% of the sliver is lowest when the stationary flats are mounted to the both sides of the taker-in and the doffer, and if the stationary flat is mounted only on one side, the effect of the stationary flats on doffer side upon U% of the sliver are higher than those on the taker-in side.

3-6 Force working on the top card clothing

The results of measurement of the force applied on the top card clothing while carding were reported earlier (1).

In this test, the force was measured in the same manner as mentioned before (1), i. e. by attaching strain gauges onto the surface of foundation of the top card clothing.

The strain generated on the surface of foundation was used instead of the force working on the top card clothing.

Fig. 11 shows the changes in strain generated on the surface of foundation when no stationary flat is used.

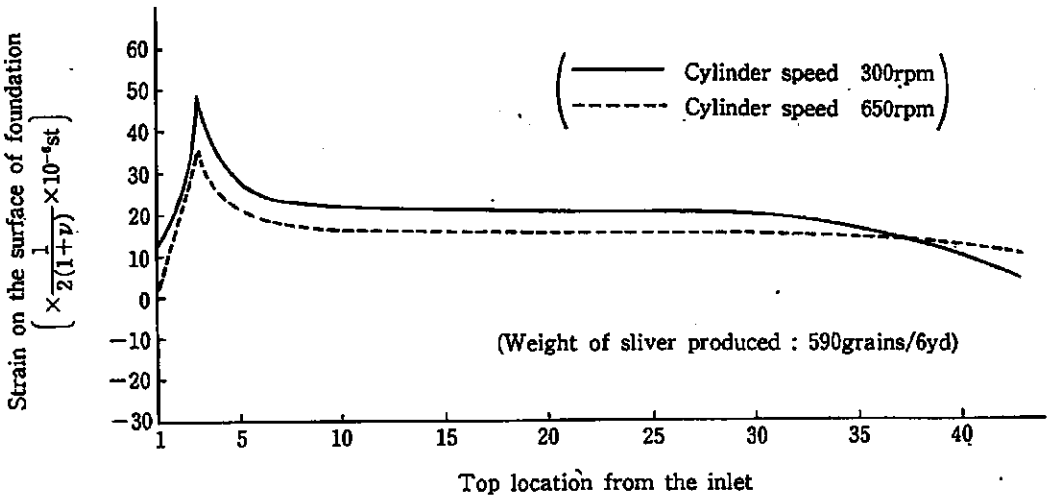


Fig. 11 Strain on the surface of foundation (without the stationary flat)

The peak of the force appears around the 3th becomes maximum position from the top inlet along the flexible bend (where the slideway of top contacts completly with the flexible bend) when no stationary flat is used.

The peak (at the cylinder speed of 650 rpm) is smaller than that at the cylinder speed of 300 rpm, but the peak of the carve can be crearly noticed.

Fig. 12 shows the results of changes in strain of the surface on the foundation when the stationary flats are mounted on the taker-in side. The maximum strain becomes smaller when the stationary flats are mounted on the taker-in side than when no stationary flat is used. This tendency becomes outstanding when the cylinder speed is increased, and the peak of the strain (i. e. the maximum force around the 3rd position from the inlet of top) is no longer visible at the cylinder speed of 650 rpm. It is considered that the peak of force is eliminated when the stationary flats are used because the largé tufts of fibres fed from the taker-in side are fully opened by stationary flats on the taker-in side before being supllied between the cylinder and the top.

Elimination of this peak has many advantages as shown below.

(1) Raising of the top card clothing can be prevented and the card clothing is made long lived.

(2) The total number of top in contact with the cylinder is 43 pieces.

When no stationary flats is mounted, 7 to 10 tops from the inlet operate mainly for opening the tufts of fibres, and the remaining 33~36 tops opetate for carding and parallelizing fibres.

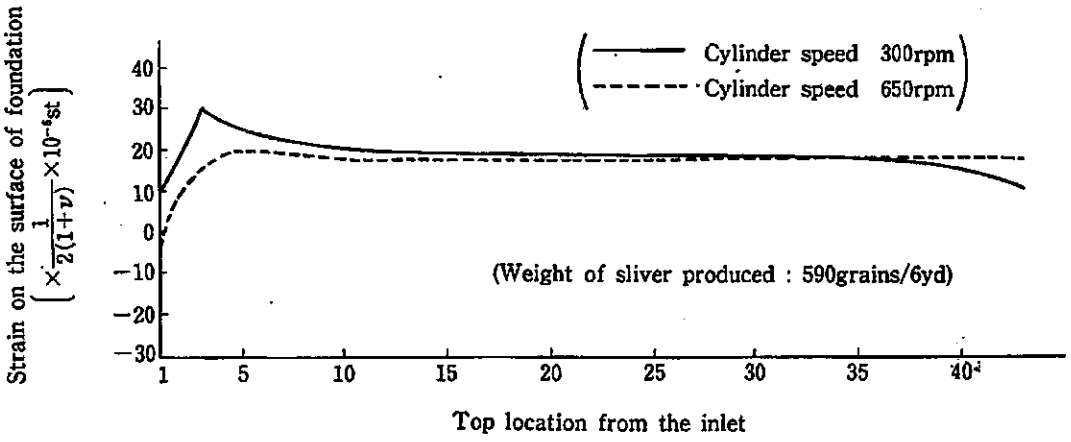


Fig. 12 Strain on the surface of foundation (with the stationary flat)

When the stationary flats are mounted on the taker-in side, all 43 pieces of top will operate for carding and parallelizing fibres.

Therefore, it is considered that the stationary flats on the taker-in side improve the carding and parallelizing efficiencies.

3-7 Yield rate of carding products

Fig. 13 shows the changes in the yiels rate of carding products.

Symbol	with or without the stationary flat	Setting condition	Symbol	with or without the stationary flat	Setting condition
—○—	with (Taker-in side)	I	—△—	with (Doffer side)	V
---●---	with (Taker-in side)	II	---▲---	with (Doffer side)	VI
-·-○-·-	with (Taker-in side)	III	-·-◎-·-	with (Both sides)	VII
--○--	with (Taker-in side)	IV	--×--	without	VIII

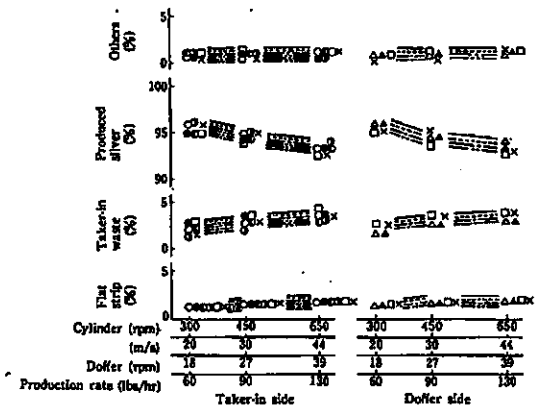


Fig. 13 Yield rate of carding products

No change is noticed in yield rate of carding products regardless of the use of stationary flats.

4. Conclusion

In this test, the effect of stationary flats on the sliver qualities was examined when the stationary flats were mounted to either side of the taker-in or doffer, or on both sides.

From the results, it was noticed that the carding action is improved by mounting the stationary flats on the card but the fibre breakage tends to be increased to some extent on the other hand.

It is quite advantageous that the fibre orientation is improved, and the trailing hooks which can hardly be eliminated in the drawing process is reduced in particular.

The maximum force generated around the 3rd position from the inlet of top can be eliminated when the stationary flats are mounted on the taker-in side. The effect of those stationary flats on the yarn qualities will be examined.

Reference

(1) Hosokawa, etc;Text of the 37th lecture meeting of Text. Mach. Soc., (A-9), 1984