Section 8
Textile Industry

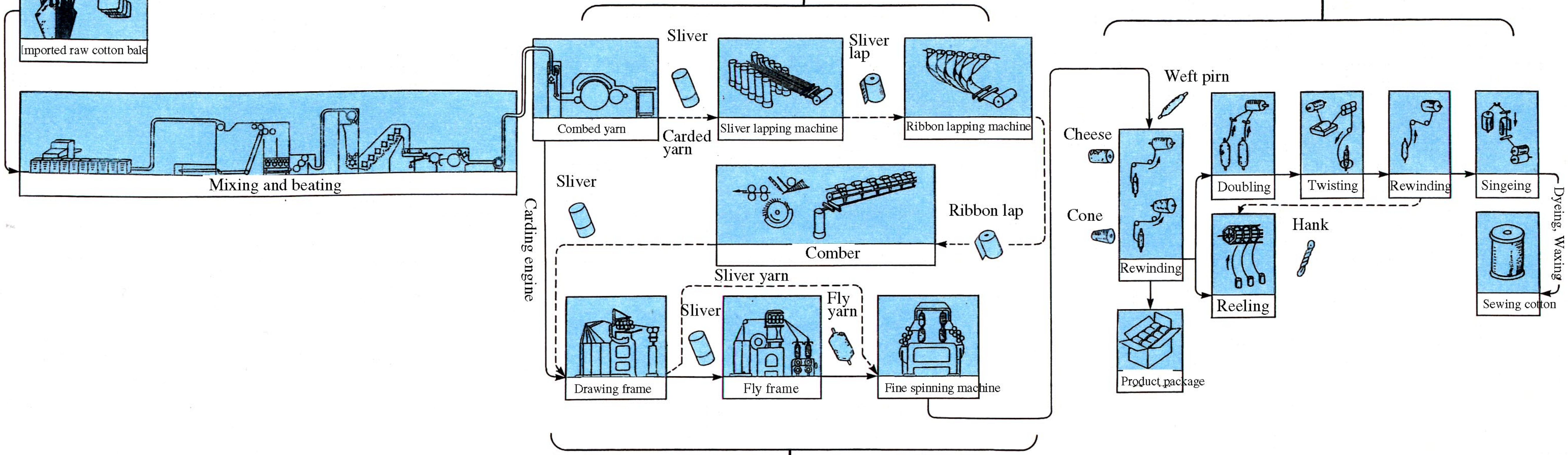
Process Flow
8-1 Fiber
8-2 Dyeing

Textile (Fiber) : Production Process and Energy Saving Technology

Cotton Thread Process

Item No.	Technology Item/Title
TF-PE-7	High speed carding machine

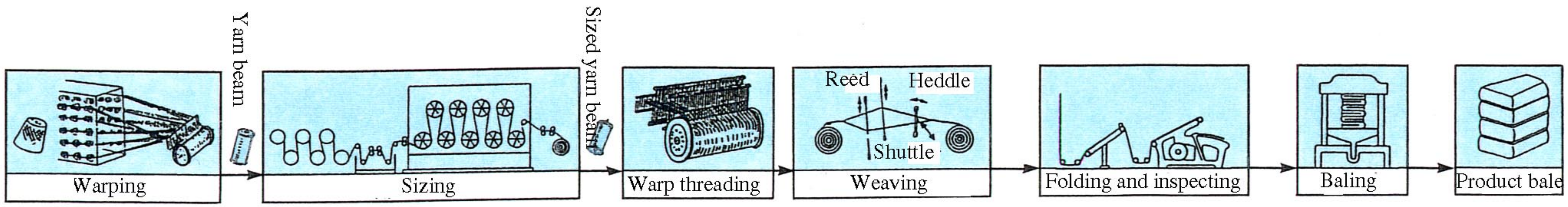
Item No.	Technology Item/Title
TF-ME-1	Highly efficient driving system for draw-twist yarn machine



Item No.	Technology Item/Title
TF-PE-1	High performance Rapier Loom
TF-PE-2	Water Jet Loom
TF-PE-3	High speed comber
TF-PE-4	High speed ring-type fine spinning apparatus

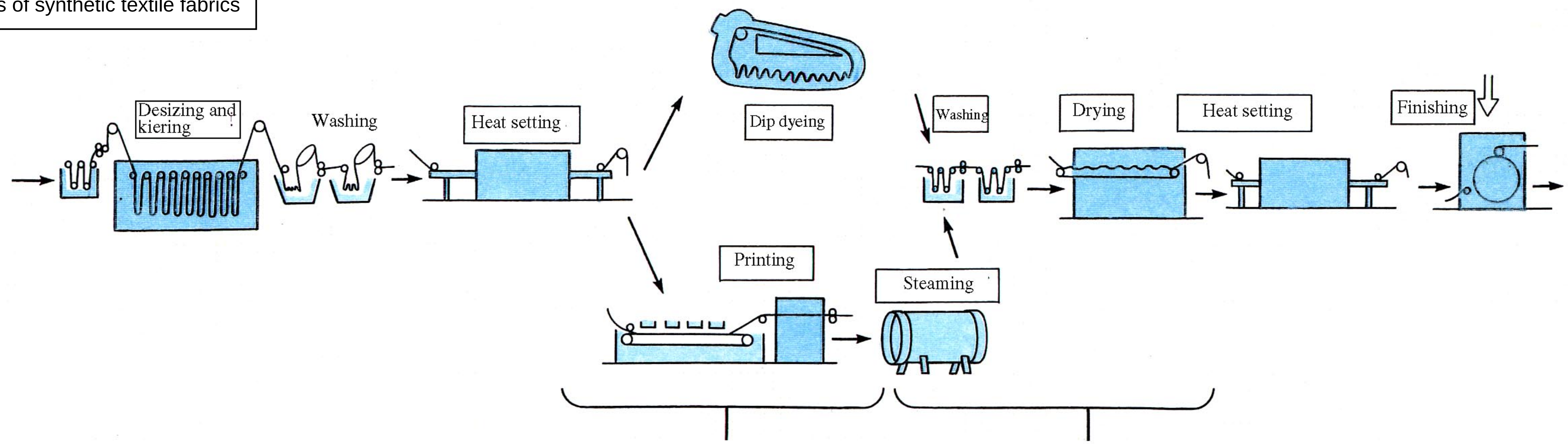
Item No.	Technology Item/Title
TF-PE-5	High speed spinning apparatus of a dope spinning type (except for urethane polymer)
TF-PE-6	High-speed, multi-filament, spinning apparatus of a melt spinning type (for nylon and polyester filament production)

Cotton Textile Process



Textile (Dyeing) : Production Process and Energy Saving Technology

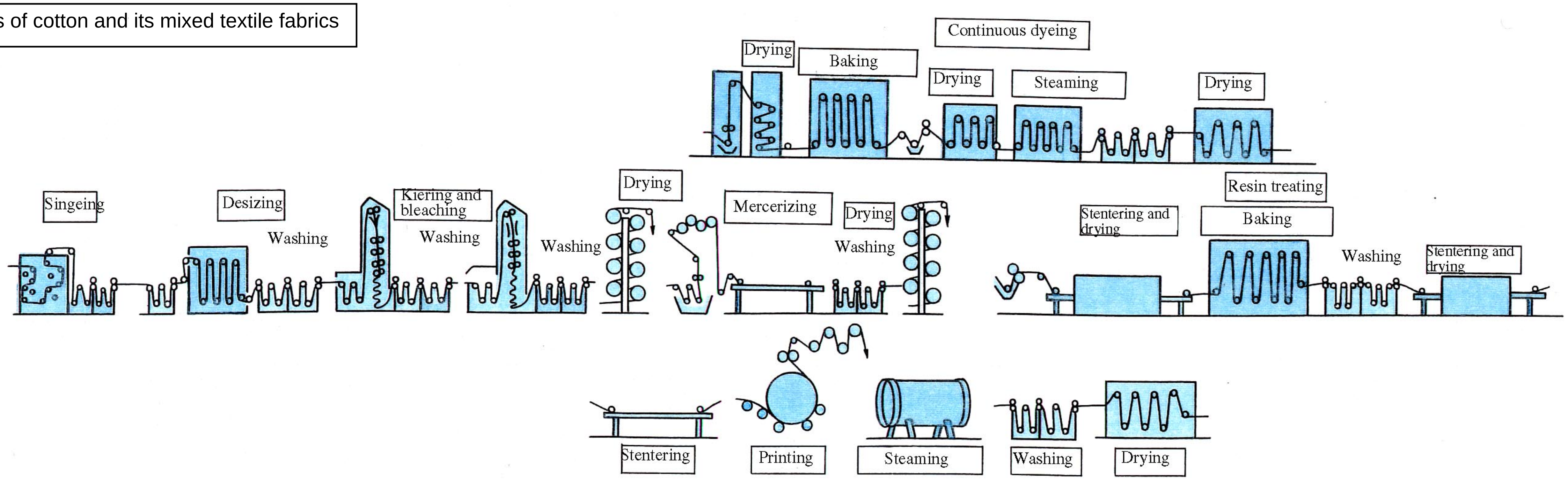
Dye process of synthetic textile fabrics



Item No.	Technology Item/Title
TD-PE-1	Micro-wave dyeing machine
TD-PE-2	Jet dyeing machine
TD-PE-3	Counter flow cleaning machine

Item No.	Technology Item/Title
TD-PE-4	LP microwave drying machine for cheese dyeing
TD-ME-1	Steam consumption saving by adopting a steam heating unit at dyeing process

Dye process of cotton and its mixed textile fabrics



Data Sheets

8-1 Fiber

8-2 Dyeing

TF-PE-1

Energy Conservation Directory

[Industry Classification] Textile:Fiber	High performance Rapier loom	[Energy Source] Electricity
[Technology Classification] Production Equipment		[Practical Use] 1997

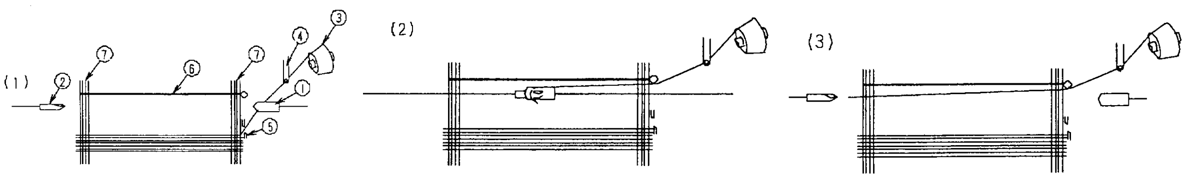
Outline

A type of weaving machine which transports the weft through the opened space between the warp curtains by means of the rapier which is equipped with a small metal fitting at its tip to hold the weft. In a conventional machine, a shuttle is used for this purpose.

Principle & Mechanism

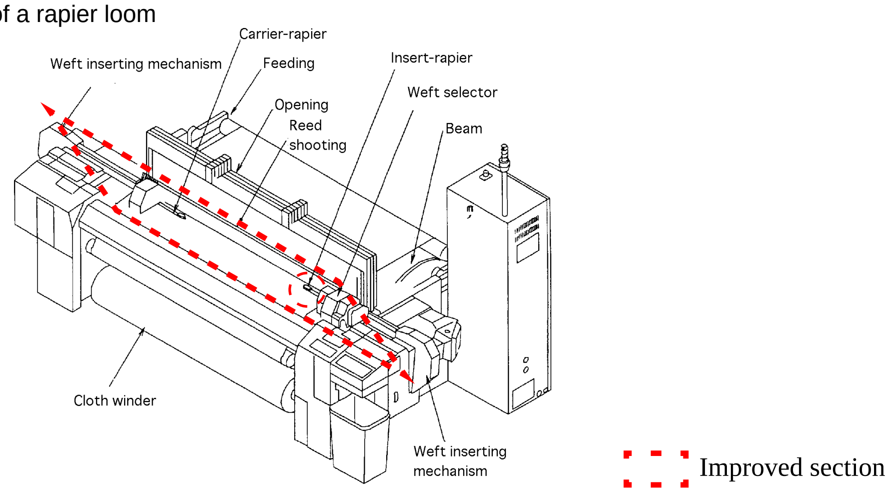
1) The weft selected by the weft yarn selector ④ is gripped by the insert-rapier ①running forward. At the same time, this weft is cut by the feeding cutter ⑤, pulled out from the corn ③, and inserted into the opened space.
2) The inserted weft is transferred to the carrier-rapier ② running in from the opposite side. This weft is inserted further into the opened space by the retreating carrier-rapier ②.
3) The weft is released from the carrier-rapier ② just after running out from the warp curtains, and fixed by the entangled yarn ⑦so as not to loosen. After the weft finishes its insertion, the reed ⑥ shooting is executed.
4) The warp threads are opened into two curtains, upper and lower, and the above procedure is repeated.

Fig. 1 Description of motions in each step



[Description] Structure explanation, Shape, and/or System diagram

Fig. 2 Basic construction of a rapier loom



Energy saving effects

Table 1: Performance comparison between the new and conventional machines

	Before improvement	After improvement	Effects
Power consumption of A-type (a hypothetical name)(450 rpm)	5.5 kwh	5.0 kwh	Saving of 0.5 kWh (10%)
Power consumption of A-type (a hypothetical name)(400 rpm)	4.5 kwh	4.3 kwh	Saving of 0.2 kWh (4.6%)

Although power saving by one unit is small, total saving is significant when a large number of machines are operated for a long period of time.

[Economics] Equipment cost

Investment amount(A): million yen
Improvement effect(B): million yen/year
Investment payback (A/B): years

Remarks

This machine has many applications. It is applied mainly to weave general cloths, interior textiles, industrial textiles, etc.

[Example sites]	[References]	[Inquiry]
Applied at many sites.	Technical report of Tudakoma Shokki	NEDO/ECCJ(JIEC)

TF-PE-2	Energy Conservation Directory	
[Industry Classification] Textile:Fiber	Water Jet Loom	[Energy Source] Electricity
[Technology Classification] Production Equipment		[Practical Use] 1997

Outline

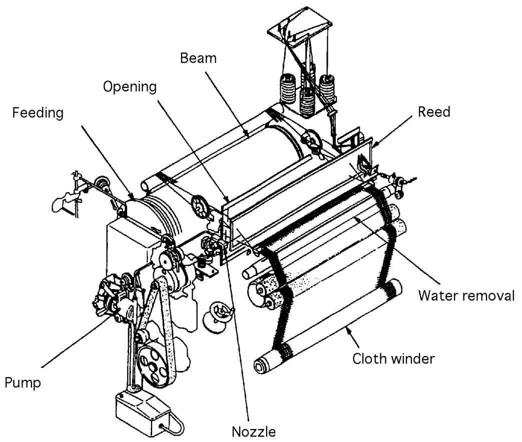
A loom which transports the weft through the opened space between two warp curtains by high-pressure water jet injected through a small nozzle. The water jet replaces a conventional shuttle.

Principle & Mechanism

1) When put alongside the jet stream, the yarn receives thrust by fluid friction between its surface and the jet stream. By this thrust, the weft is inserted .
2) The tip of the yarn, measured and prepared to the length of the web width, is introduced to the high-pressure nozzle, which injects the water jet so as to envelope the yarn. By its thrust, the weft is inserted through the opened space between the weft curtains.
3) On reaching the opposite web end, the tip of the traversing weft is caught and entangled by the end treatment yarn, and the reed shooting is executed.
4) Then, the weft is cut at both ends of the web. The warp rows are opened again, and a series of motions as above is repeated.

[Description] Structure explanation, Shape, and/or System diagram

Fig. 1 shows the basic construction of a water jet loom and Fig. 2 , a high-pressure water nozzle.



Improved section

Fig. 1 Basic construction of water jet loom

[Nozzle's function]
High-pressure water is injected through the clearance between the orifice 1 and needle 2. The weft is enveloped by the water

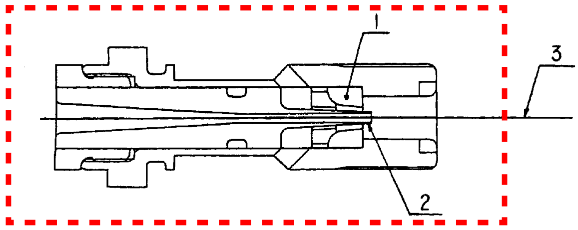


Fig. 2 High-pressure water jet nozzle

Energy saving effects

1) Owing to the integration and high efficiency of the power transmission system, the adoption of a timing-belt drive for the yarn feeder, and the direct drive mechanism for the cloth winder, etc., power consumption is saved by about 25% in comparison with a conventional loom.
2) The highly convergent nozzle, the improved pump, and the soft-picking system workable in a stable manner even with a small amount of water injection can save the water consumption by 40% in comparison with a conventional machine.

[Economics] Equipment cost

Investment amount(A): 270 million yen
Improvement effect(B): 10.7 million yen/year
(when the powe cost is 16 yen/kw, and the water cost is 70 yen/m^3)
Investment payback (A/B): 25 years

Remarks

Main usage is to weave the web of thin to middle thickness, and of low to high density mainly from synthetic fiber filaments.

[Example sites]	[References]	[Inquiry]
Applied at many sites.	A loom maker's technical document	NEDO/ECCJ(JIEC)

TF-PE-3

Energy Conservation Directory

[Industry Classification] Textile:Fiber	High speed comber	[Energy Source] Electricity
[Technology Classification] Production Equipment		[Practical Use] 1990

Outline

A machine to produce high-quality yarn. It gives the combing effect at a high speed (above 200 nips/min.) to the wrap formed by orientating the several slivers (fiber bundles) after processed by the carding machine, and removes the impurities like leaf-dregs, seed-grounds, naps, and short staples, and produces a highly orientated and uniform sliver from only the fibers of uniform length.

Principle & Mechanism

Sliver gripping devices are equipped in the front and rear, and repeat the following motions;

1) Combing: The sliver fixed by the rear gripper and extending forward is combedorward. Likewise, the sliver fixed by the front gripper and extending backward is combed backward. In this manner, short staples and impurities mixed in the slivers are removed.
2) Piecing: Two grippers come nearer, one combed sliver partially overlaps the other and both are jointed together
3) Detaching: The front gripper is opened, and the rear gripper which is still holding thesliver is moved toward the front gripper. After the front gripper catches the end of the sliver, the rear gripper is opened and moved back.

[Description] Structure explanation, Shape, and/or System diagram

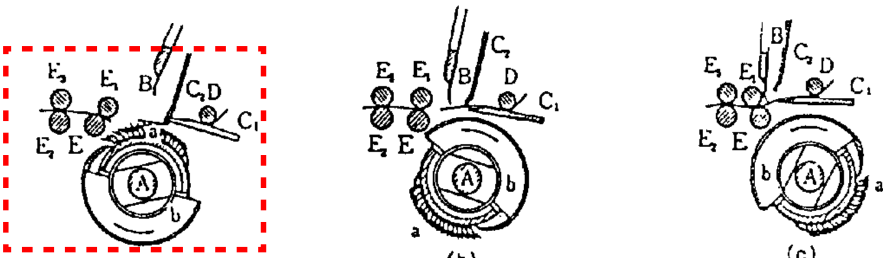
As an example of the apparatus that automatically executes the basic motions of combing, piecing and detaching, the mechanism and motions of a Nasmyth-type comber are shown below. This device continuously drives the cylinder A which is equipped at its front with a comb "a" for combing the sliver and a segment "b " for guiding it.

1) Combing
The sliver is fed by D, gripped by C1 and C2, and combed by "a." D, C2, and C2 go forward.

2) Piecing
After "a" passed under the roller E, E and E2 reverse their rotation backward andthe rear tip of the combed sliver overlaps the front tip of the next one. After opening C1 and C2, the silver is fed by D.

3) Detaching
C1 and C2 move forward. E and E2 reverse their rotation forward. The sliver pulled in is combed by the comb B. C1 and C2 move backward.

Improved section



(a) (b) (c)

Energy saving effects

1) A conventional comber has a complicated mechanism where revolving and reciprocalmotions are combined, and consumes relatively much electric power accounting for 8 to 9% of total electric power consumption (37kWh per bale) in the spinning process. A large amount of energy saving can be expected by applying this type.
2) Energy saving effect by reducing the weight of the cylinder needle segment through the use of special steel, and by decreasing the cylinder diameter is expected to be more than 15%.
3) Additional energy saving is expected by improving the collecting method of the exhausted waste.

[Economics] Equipment cost

Investment amount(A): million yen
Improvement effect(B): million yen/year
Investment payback (A/B): years

Remarks

At a fine carding process for spinning high-grade yarn, such a comber can be applied to spin about No.40 count cotton thread, or the fine thread above No.80 count.

[Example sites]	[References]	[Inquiry]
		NEDO/ECCJ(JIEC)

TF-PE-4

Energy Conservation Directory

[Industry Classification] Textile:Fiber	High speed ring-type fine spinning apparatus	[Energy Source] Electricity
[Technology Classification] Production Equipment		[Practical Use] 1990

Outline

An apparatus which drafts the sliver or coarse yarn, twists it by a ring-and-traveler-type device into the yarn with the specific twisting number and count (yarn thickness), and then winds it into a pirn.

Principle & Mechanism

1) The sliver or coarse yarn is drafted into a fiber bundle of a specific thickness by a set of rollers in the draft section, the speed of which increase gradually.
2) The drafted fiber bundle is introduced onto the bobbin supported by a spindle at the ring center and revolving at a high speed, through a traveler at the ring edge. It istwisted by the traveler sliding along the circular ring guide, and wound up by thebobbin as the yarn.
3) The yarn is formed into a spindle-shaped pirn by the up and down motion of the ringwhile winding .

[Description] Structure explanation, Shape, and/or System diagram

1) Electric power consumed by the ring-type fine spinning apparatus occupies up to 60% of that of the whole spinning process, most of which is consumed to revolve the spindles and the pirns.
2) The consumed electric power per bale is proportional to the 3.3th power of the ring diameter, and the 0.9th power of the spindle's revolving speed.
3) The optimum pirn size for energy saving which was obtained from the theory and the experiment is 38mm in diameter and 150 mm in length.
4) As for spindle driving, it is effective for energy saving to decrease the pirn diameter and to change the spindle driving method. (a tin roller to a tangential driving type).
5) Efficiency for changing and replenishing pirns decreases, as smaller pirns are applied. But, it will be compensated by adopting an auto-doffer and auto-conveyor for pirns.

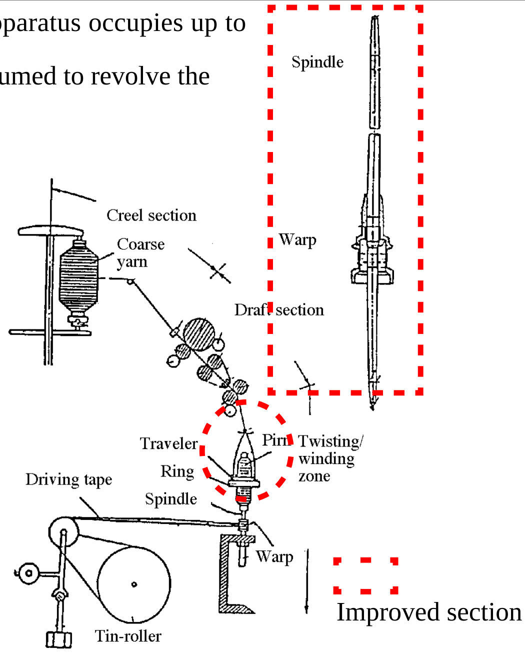


Fig. 1 High-speed carding machine

Energy saving effects

1) The operation speed with the same electric power consumption as that of the conventional apparatus can bring about the productivity improvement by 10 to 20%.
2) The spindle of a saving energy type(with a smaller warp) saves the energy consumption by about 6%.
3) The spindle of an improved type saves the energy consumption by about 6%.
4) The aero-dynamic loss by automatic removal of the residual yarn at the spindle is decreased by about 5%.

[Economics] Equipment cost

Investment amount(A): million yen
Improvement effect(B): million yen/year
Investment payback (A/B): years

Remarks

The high speed fine spinner (the maximum revolving speed of 250,000rpm) to spin No.10 to 120Ne count yarn from cotton and synthetic fibers (below about 60mm in length).

[Example sites]	[References]	[Inquiry]
	Toyota Automatic Loom Work’s catalog RX-200 Howa Machinery’s catalog, No.93-11-10G	NEDO/ECCJ(JIEC)

TF-PE-5	Energy Conservation Directory	
[Industry Classification] Textile:Fiber [Technology Classification] Production Equipment	High speed spinning apparatus of a dope spinning type (except for urethane polymer)	[Energy Source] Electricity [Practical Use] 1990-

Outline	A new spinning apparatus for "Rayon" or "Bemberg", which is to spin filaments at high speed by dipping them in spinning solution at three steps, dry up by a drier, and wind up by high-speed winders.
Principle & Mechanism	1) The main parts of this apparatus are a dope treating device and a spinning head. 2) At a dope treating device, highly polymerized materials are dissolved in the solvent,filtrated, de-aerated, and pushed out by gear pumps through nozzles. 3) At the spinning head, the dope extruded through the nozzles passes through thespinning solution at three steps, and coagulate completely with longitudinal molecularorientation.

[Description]

Structure explanation, Shape, and/or System diagram

The schematic drawing of this apparatus is as follows;

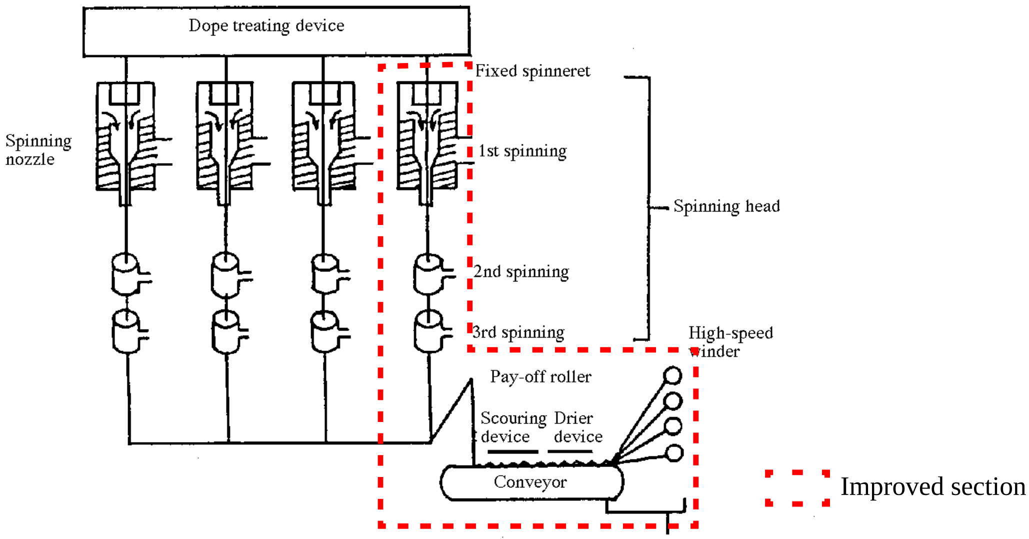


Fig. 1 High speed spinning apparatus of a dope spinning type

Energy saving effects

Table 1: Energy saving effect of the apparatus

	Conventional type	Improved type	Effects
Spinning speed	300 m/min	800 m/min	2.7 times up
Electric power consumtion	100 %	65 %	35 % reduced

[Economics] Equipment cost	Investment amount(A): million yen Improvement effect(B): million yen/year Investment payback (A/B): years
Remarks	

[Example sites]	[References]	[Inquiry]
Applied at many sites.	Industry owned technical information of a synthetic fiber maker	NEDO/ECCJ(JIEC)

TF-PE-6 Energy Conservation Directory

[Industry Classification] Textile:Fiber

[Technology Classification] Production Equipment

High-speed, multi-filament, spinning apparatus of a melt spinning type (for nylon and polyester filament production)

[Energy Source] Electricity

[Practical Use] 1994

Outline

A spinning apparatus which melts pellets of nylon and polyester resins, extrudes the molten polymer from the spinneret via the extruder, and spin filaments (75-150 de). The characteristics of this apparatus is to directly spin fully drawn yarn (FDY) owing to high speed spinning(6,000m/min.).

Principle & Mechanism

Conventionally, the spinning and drawing processes are separated; the spun filaments are wound up, and then drawn by a separate drawing machine. This apparatus can spin and draw nylon and polyester filaments at one process. The filaments spun from a single spinneret are divided into multiple spindles, and fully drawn yarn(FDY) or partially oriented yarn (POY) are produced.

[Description] Structure explanation, Shape, and/or System diagram

The schematic drawing of this apparatus is as follows;

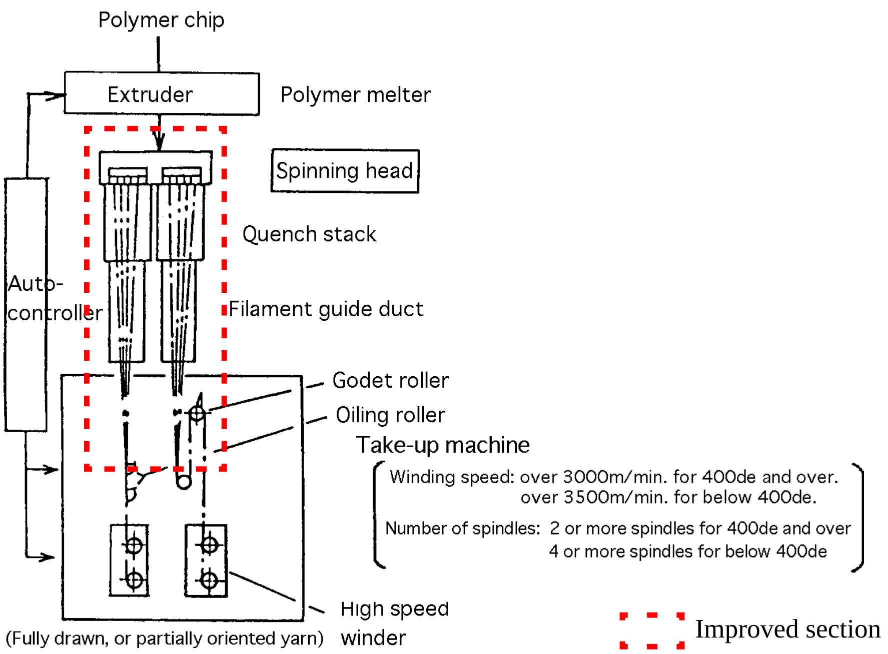


Fig. 1 High-speed, multi-filament, spinning apparatus of a melt spinning type

Energy saving effects

Table 1 Performance comparison between the new and conventional machines (when FDY filaments are spun at 16 spindles per one set)

	Conventional type	Improved type
Electric capacity	900 kVA	500 kVA
Specific electricity consumption (Ratio)	100	45

[Economics] Equipment cost

Investment amount(A): 32 million yen
Improvement effect(B): 13.1 million yen/year
Investment payback (A/B): 2.4 years

Remarks

There is a high-speed, multi-filament, spinning apparatus of a melt spinning type for materials such as urethan polymer spandex.

[Example sites]

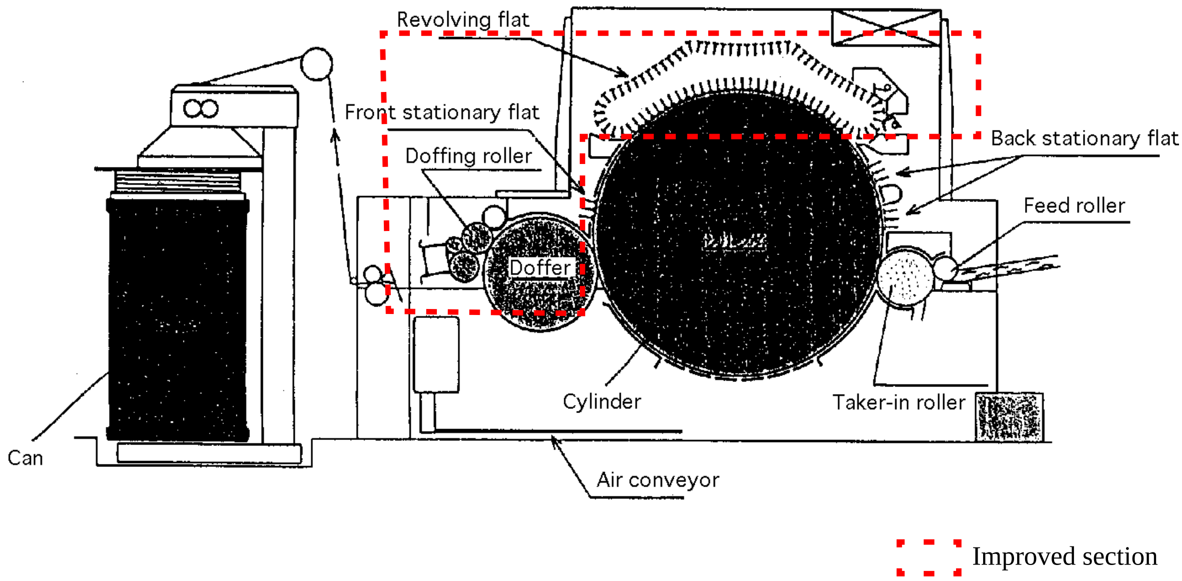
[References]
Industry owned technical information of a synthetic fiber maker

[Inquiry]
NEDO/ECCJ(JIEC)

TF-PE-7

Energy Conservation Directory

[Industry Classification] Textile:Fiber	High speed carding machine	[Energy Source] Electricity
[Technology Classification] Production Equipment		[Practical Use] 1997

Outline	This high-speed carding machine separates the tufts fed from the preceding mixing and beating process into individual fibers, removes the impurities, naps (mixed color) and shorter staples, orientates the fibers in their longitudinal direction, and forms them into a fiber bundle, or a sliver. This high-performance, high-energy-saving machine works at a high spinning speed above 100 m/min.
Principle & Mechanism	1) The tuft-like flock, fed from the mixing and beating machine, is roughly opened and its impurities are removed by the taker-in. 2) The staple fibers are combed and oriented by the cylinder and the needle cloths on the flats, and transferred to the doffer. 3) The fibers on the doffer are stripped by the roller, and formed into a web. 4) The gatherer and web are bundled into a sliver and put into the can.
[Description] Structure explanation, Shape, and/or System diagram	 Fig. 1 High-speed carding machine
Energy saving effects	1) Power consumption per machine increases due to its high speed and high productivity. Total energy consumption, however, is saved by the decreased number of machines required to produce the same volume. 2) When the sliver weighs 500 g/6yd and the machine can operate at a spinning speed above 150 m/min., the required number of carding machines is decreased to 1/3, and power consumption to about 1/2 in comparison to a conventional machine.
[Economics] Equipment cost	Investment amount(A): million yen Improvement effect(B): million yen/year Investment payback (A/B): years
Remarks	Main application is pre-processing for spinning short fiber such as cotton or synthetic fiber.

[Example sites]	[References]	[Inquiry]
Applied at many sites.	Howa Machinery, Ltd.	NEDO/ECCJ(JIEC)

TF-ME-1

Energy Conservation Directory

[Industry Classification] Textile:Fiber	Highly efficient driving system for draw-twist yarn machine	[Energy Source] Electricity
[Technology Classification] Machinery & Equipment		[Practical Use] 1982

Outline

A draw-twist yarn (DTY) machine in a polyester filament manufacturing process draws and twists undrawn filaments (intermediate products from the spinning take-up process) into final products. The motor speed control for driving the traverser of this machine is executed by the primary voltage control of the induction motor using a thyristor. The efficiency of this system, however, is low and its maintenance is rather difficult. It is changed to a frequency control system for energy saving.

Principle & Mechanism

The motor speed control for driving the traverser of this machine is executed by the primary voltage thyristor control of the induction motor. But this system results in:
- low efficiency and high power consumption at the low speed range,
- high power consumption by the motor cooling fan.

Resulting high heat release frequently causes burning seizure of the motor bearings and yields a waste yarn loss. This trouble is accompanied with the high maintenance cost.

[Description]

Structure explanation, Shape, and/or System diagram

[Before improvement]

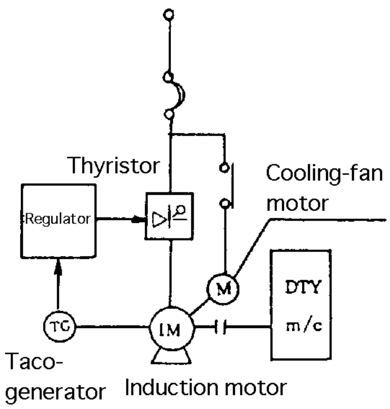


Fig. 1 Conventional control system

[After improvement]

As shown in the figure below, the thyristor control is replaced by the frequency control system consisting of the transistor-inverter unit.

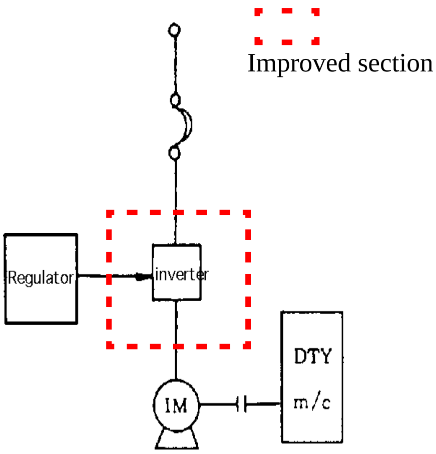


Fig. 2 Inverter control system

Energy saving effects

Table 1 Energy saving effect (per year)

	Before improvement	After improvement	Saving effects (%)
Equipment capacity	99 kW	90 kW	
Power consumption	703,200 kWh/y	289,200 kWh/y	Decreased by 414,000 kWh/y (59%)
Reduction in crude oil equivalent			101 kL/y

[Economics] Equipment cost

Investment amount(A): 32.3 million yen
Improvement effectt(B): 14.8 million yen/year
Investment payback (A/B): 2.2 years

Remarks

Inverter control is adopted to various fiber processing machines.

[Example sites]
Toyobo Co., Ltd., Miyagi plant

[References]
"Collection of Improvement Cases at Excellent Energy Management Plants (1984)," National committee for the effective use of electricity

[Inquiry]
NEDO/ECCJ(JIEC)
National committee for the effective use of electricity

TD-PE-1	Energy Conservation Directory	
[Industry Classification] Textile:Dyeing [Technology Classification] Production Equipment	Micro-wave dyeing machine	[Energy Source] Electricity [Practical Use] 1980-

Outline

The machine to realize rapid dyeing treatment. The cloth, saturated by dyestuff or other chemicals, is guided into an autoclave which is filled with saturated steam and allows the rapid diffusion of dyestuff into the inner part of the cloth by micro-wave heating.

Principle & Mechanism

1) Electro-magnetic wave (micro wave) can penetrate into the cloth instantaneously, and heat it up in a very short time.
2) Heat is generated by dielectric loss and absorbed proportionally to an amount of the loss, Therefore, the micro-wave heats up just the required portion.
3) As the material to be heated generates heat, there is no loss to heat ambient air or the equipment. Therefore, high heating efficiency is obtainable.
4) As every portion of the cloth is heated simultaneously, the cloth is dried up uniformly without temperature difference between its surface and inside.

[Description]

Structure explanation, Shape, and/or System diagram

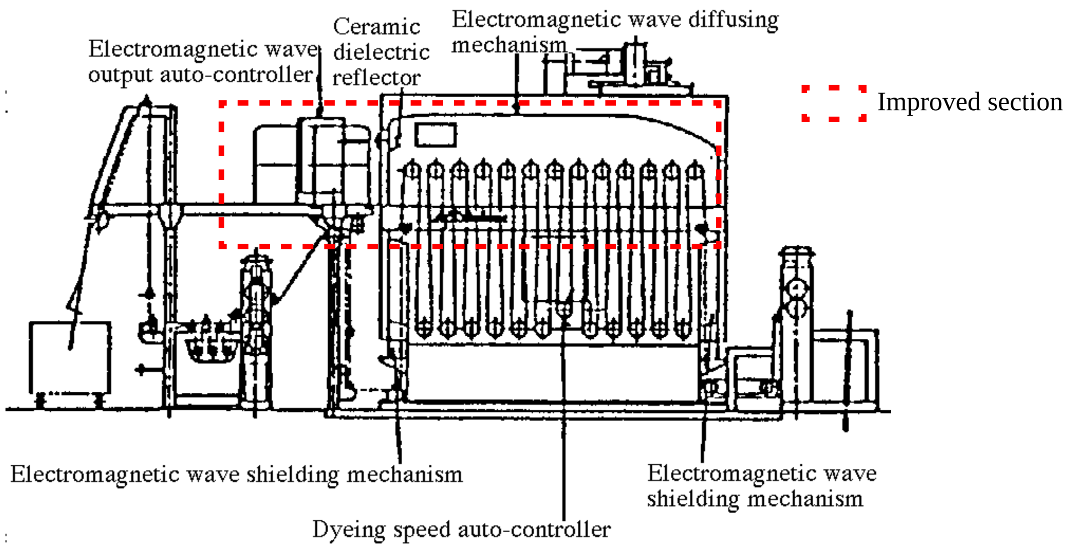


Fig. 1 Micro-wave dyeing machine

Energy saving effects

Since this is newly developed machine, comparison with conventional ones is not possible. Therefore, following table is a comparison with beam dyeing machine, that has much similarity with micro-wave dyeing.

Table 1 Energy saving effects of Miro-wave dyeing in comparison with Beam dyeing

	Beam dyeing	Micro-wave dyeing	Effects
Specific power consumtion	50 kWh/h	5 kWh/h	45 kWh
Steam consumption	3,600 kg/h	150 kg/h	3450 kWh/y
Reduction in crude oil equivalent *			1,169 kL/y reduced

(*Note: assumed working hour is 4,000 h/y)

[Economics] Equipment cost

Investment amount(A): million yen
Improvement effect(B): million yen/year
Investment payback (A/B): years

Remarks

[Example sites]	[References]	[Inquiry]
Applied at many sites.	Technical report of a synthetic fiber manufacturer	NEDO/ECCJ(JIEC)

TD-PE-2

Energy Conservation Directory

[Industry Classification] Textile:Dyeing	Jet dyeing machine	[Energy Source] Fuel(general), Electric power
[Technology Classification] Production Equipment		[Practical Use] 1970-

Outline

A dyeing machine which dyes the cloth by forcibly contacting the jet flow of dyestuff solution. It executes efficient dyeing in such a manner that the tension on the cloth is decreased as much as possible, and that the cloth dyes evenly with a relatively small amount of dyesuff.

Principle & Mechanism

1) Dyestuff solution is partially taken in from the bath, and released from a venturi-tubeinto the flow of the dyestuff solution circulating through an enclosed bent passage.
2) The cloth is guided into the central zone of the circulating dyebath, conveyed through the bath, and dyed.
3) As the cloth is naturally circulated along the flow, the tension of the cloth is much decreased from that of other dyeing methods.

[Description] Structure explanation, Shape, and/or System diagram

1) The machine consists of a treatment bath, a dyestuff solution feeder, a heat exchanger, an auto-controller, and a pump.
2) The heating steam energy is saved by a small dyebath rate realized by circulating thecloth at a high speed and increasing its contact chance with the dyestuff.
It enables the cloth to be evenlydyed without a large amount ofdyebath.
3) Electric power consumption is saved by an invertertype variable-speed pump.

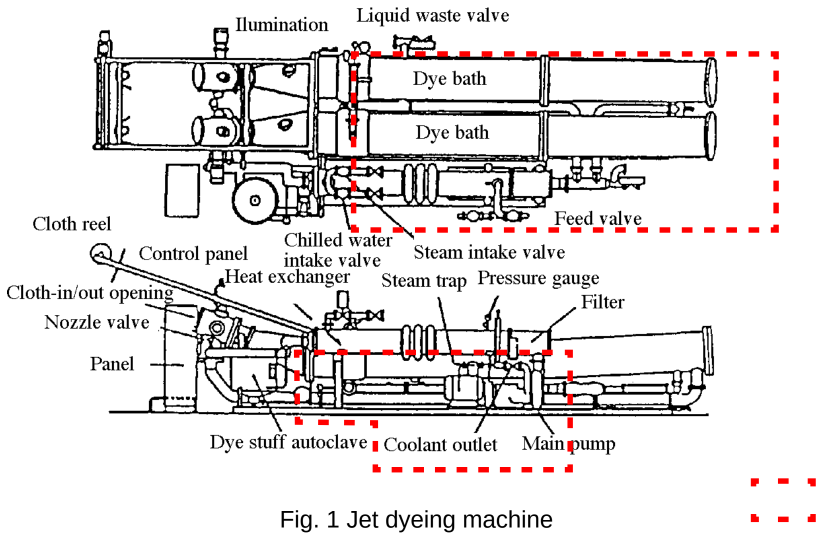


Fig. 1 Jet dyeing machine

Energy saving effects

Table. 1 Energy saving effect of the apparatus

	Conventional type (High dyebath ratemachine)	Improved type (Jet dyeing machine)
Water and chemicals	100%	30%, respectively
Steam(for heating and drying)	100%	78%
Electric power	100%	20%

[Economics] Equipment cost

Investment amount(A): 45 million yen
Improvement effect(B): 13 million yen/year
Investment payback (A/B): 15 years

Remarks

This machine has a wide variety of application at site as follows:
- Lightweight treatment for polyester fabrics
- Application to special treatment by fermentation, etc.
- Wet treatment of fine-thread fabrics

[Example sites]

Applied at many sites.

[References]

1) "Description of Investment Tax for Energy Demand Structure Revolution" p.88, The Energy Conservation Center, Japan
2) "Sen-i Kako (Fiber processing journal)"
3) Company brochure of the manufacturer

[Inquiry]

NEDO/ECCJ(JIEC)

TD-PE-3	Energy Conservation Directory	
[Industry Classification] Textile:Dyeing [Technology Classification] Production Equipment	Counter flow cleaning machine	[Energy Source] Fuel(general), Electric power [Practical Use] 1980-

Outline

This machine serves for removing impurities and residual chemicals from the cloth in down-burning, desizing, scouring, bleaching, dyeing, printing and finishing processes for cloth dyeing. There are two types of cleaning methods in dyeing treatment; one handles a sheet of unfolded cloth, and another a rope of folded cloth. This machine is a former type.

Principle & Mechanism

1) This machine is equipped with many small baths of multi-step type, which increases the contact chance between the cloth and fresh water, and brings about a high cleaning efficiency.
2) The fresh water is supplied against the running direction of the cloth.
3) An amount of the impurities contained in the supplied water is detected, and an amount of replenished water is adjusted automatically.

[Description] Structure explanation, Shape, and/or System diagram

1) This machine consists of a main cleaning machine, a dehydrate device, a filter device, a sensor, and a pump.
2) It is equipped with a dehydrate device to increase the cleaning efficiency by preventing the fresh water from moving along with the running cloth.
3) By reducing the amount of 60-90˚C fresh water supply, energy consumed for heating is saved.
4) The wasted yarns and dusts contained in the supplied fresh water is automaticall removed.

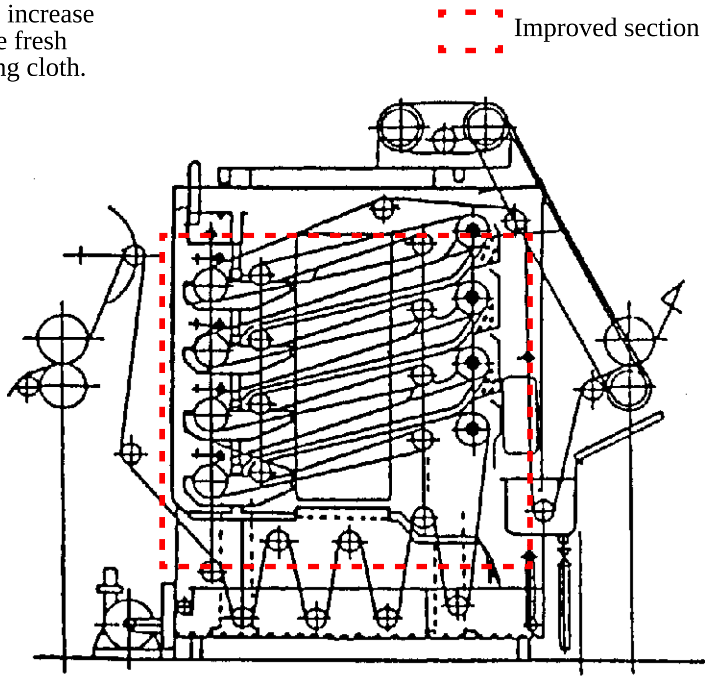


Fig. 1 Counter flow cleaning machine

Energy saving effects

Table. 1 Energy saving effect of the apparatus

	Conventional type	Improved type	Effects
Cleaning capability (rate)	1	3 times	
Energy saving consumption	100 %	50 %	50 % reduced

[Economics] Equipment cost

Investment amount(A): 10 million yen /unit
Improvement effect(B): 1 million yen/year
Investment payback (A/B): 10 years

Remarks

[Example sites]	[References]	[Inquiry]
Applied at many sites.	1) "Description of Investment Tax for Energy Demand Structure Revolution" p79, The Energy Conservation Center, Japan 2) Technical information from manufacturers	NEDO/ECCJ(JIEC)

TD-PE-4

Energy Conservation Directory

[Industry Classification] Textile:Dyeing	LP microwave drying machine for cheese dyeing	[Energy Source] Electricity
[Technology Classification] Production Equipment		[Practical Use] 1992

Outline

A case of improving the drying process of cheese products in the dyeing industry. Conventionally, cheese products are dried by the hot-air drying method using a dry-steam heater. Instead, the low pressure (LP) microwave drying method was adopted, which showed excellent results in efficiency and energy saving.

Principle & Mechanism

The LP microwave drying method features good drying efficiency and the capability to prevent products from over-drying, which the hot-air dryer tends to do. Therefore, this method is suitable to dry natural fibers. It also improves the product quality.

[Description]

Structure explanation, Shape, and/or System diagram

1) The temperature control of the drying process is changed from the constant temperature profile to the programmed temperature profile, where the drying autoclave is operated with the temperature following a pattern selected from among the registered optimum temperature profiles based on the material and its volume.
2) The old system was equipped with just one pressure switch, and the pressure was uniform all over the system. As the pressure loss is high when the air flows through the cones, the air tends to follow the easiest pass to flow, and the products are dried unevenly.
   To solve this problem, the 2-step pressure setting system was adopted, where an additional pressure switch was installed and the initial pressure was lowered. This method prevents uneven drying and shortens the drying process time.
3) The flow sheets of the drying system before and after improvement are shown in Fig. 1 and 2.

[Before improvement]

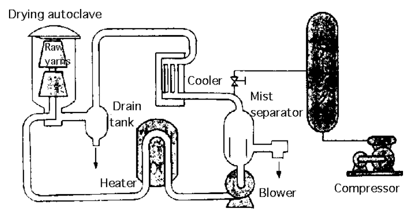


Fig. 1 Hot-air dryer

[After improvement]

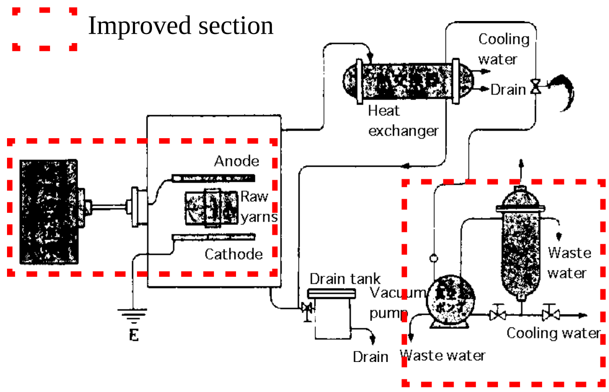


Fig. 2 LP microwave dryer

Energy saving effects

Tabel 1 Energy saving effect of LP microwave dryer for cheese products

	Before improvement	After improvement	Effects
Specific power consumtion	0.898 kWh/kg	0.791 kWh/kg	Reduction by 0.107 kWh/kg (12%)
Power consumption			212,556 kWh/y
Reduction in crude oil equivalent			52 kL/y

[Economics] Equipment cost

Investment amount (A): 50 million yen
Improvement effect(B): 17.6 million yen/year
Investment payback(A/B): 2.8 years

Remarks

This drying technology is applicable not only to drying in the dyeing process, but also to many other drying processes in general. In addition to the above method, energy saving can be achieved by High-pressure drying kiln

[Example sites]	[References]	[Inquiry]
Benisan Co., Ltd., Ashikaga Plant	"Collection of Improvement Cases at Excellent Energy Management Plants (1997)," p.4	NEDO/ECCJ(JIEC)

TD-ME-1

Energy Conservation Directory

[Industry Classification] Textile:Dyeing	Steam consumption saving by adopting a steam heating unit at dyeing process	[Energy Source] Fuel (steam)
[Technology Classification] Machinery & Equipment		[Practical Use] 1992

Outline

Acryl-fabricated blankets, etc. are directly steam-treated by the steamer without drying up after textile printing. The atmosphere temperature in the steamer tends to come down from the set-up temperature due to the evaporation of the water contained in the blankets. This technology realizes energy saving by installing a steam-heating unit (radiant-tube heater) to the steamer.

Principle & Mechanism

- In the dyeing process, the printed web needs to be retained under a specified ambient condition to fix the dye agent on the web. The apparatus used in this process, which is filled up by steam, is called a steamer.
- Structural types of the steamer depend on the kind of cloth materials and their dyeing agents. The type with atmospheric inner pressure, which is used to treat acryl-blankets, etc., is called an ordinary-pressure steamer. Refer Fig. 1.

[Description]

Structure explanation, Shape, and/or System diagram

1. Adoption of a steam-flow regulator (Fig. 2)
   The steam pressure in the steamer changes according to the steam usage conditions in the plant, which causes losses.
   To prevent these losses, a steam-flow meter and a control valve are mounted to keep the set-up flow rate.
2. The structure of a steam-heating unit (Fig. 3)
   The ambient steam in the steamer is sucked out by the circulation fan, and led to the heating unit, where it is heated indirectly by the radiant-tube heater of a gas-burner type.
3. Features of the radiant-tube heating unit are that;

1) the atmosphere temperature in the steamer can be set arbitrarily,
2) the atmosphere mixing by the circulation fan improves the temperature distribution in the steamer,
3) the combustion gas does not enter the steamer due to indirect heating by the radiant tube, and
4) the modular unit construction cuts the retrofitting expense and shortens the construction period.

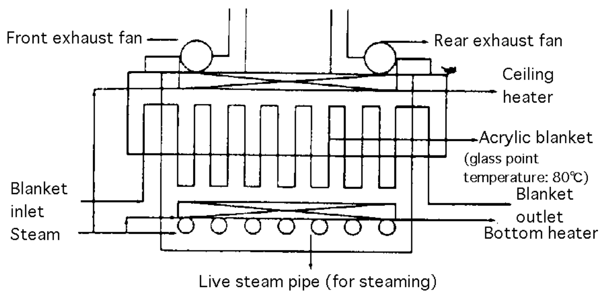


Fig. 1 The structure of a normal-pressure steamer

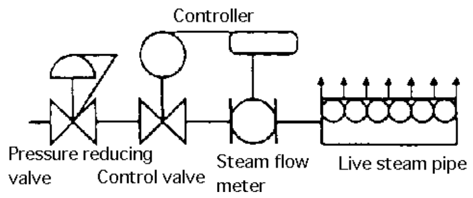


Fig. 2 The steam-flow regulator

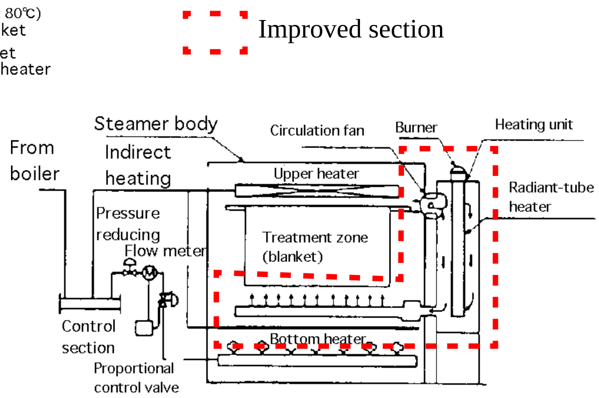


Fig. 3 The radiant-tube steam-heating unit

Energy saving effects

- Actual energy saving achieved by the steam-flow regulator was the reduction of the specific consumption by about 38 - 46%.
- Actual energy saving achieved by the radiant-tube heater was the reduction of the specific consumption by about 11%.

[Economics] Equipment cost

Investment amount(A):	5 million yen
Improvement effect(B):	0.5 million yen/year
Investment payback (A/B):	10 years

Remarks

By applying this method, quality improvement of dried products is also expected.

[Example sites]	[References]	[Inquiry]
Many cases in the dyeing and finishing industries.	Pipeline Journal (March, 1996)	NEDO/ECCJ(JIEC)