Project Planning for Small and
Medium Scale Industries No.14

Retreading Tire Manufacturing Plant

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JAPAN CONSULTING INSTITUTE

This technical brochure was compiled to help in the drafting of a suitable plan for the construction of a Retreading Tire Manufacturing Plant.

The production scale and manufacturing process have been described in this brochure on the basis of a typical instance.

The profitability was estimated by fixing certain required conditions, which may differ from country to country.

We hope that the data contained in the brochure will help you to draw up the most suitable plan for the industrialization of your project.

In case a government or public organization requests the Japan Consulting Institute to conduct a feasibility study of the above industry for the purpose of establishing the most suitable plan, it is possible for us to carry this out free of charge.

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1. Outline of Product

The part of an automobile tire, that touches the road (hereinafter called tread) wears gradually when the car runs, and finally the tread pattern disappears.

Such a tire causes to slip and loses operability while running. Therefore, the use of such a worn tire must be prohibited. However, even if the tire has been worn, it can be restored like a newly manufactured tire (here under called a new tire) by bonding new rubber onto the worn tread so long as the carcass is still sound. To restore the worn tire to the original condition of a new tire is called 'retreading'. The tire, that was thus restored to the original condition, is called the retreading tire. (See Fig. 1)

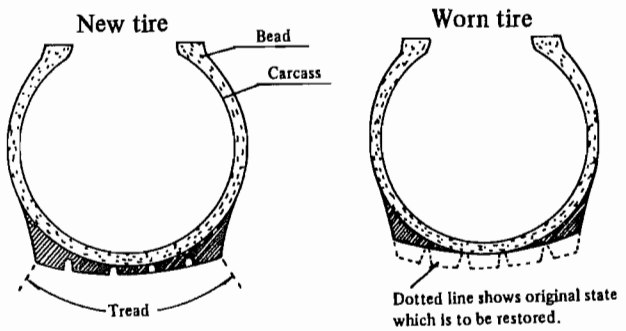

Fig. 1 Sectional View of New Tire and Worn Tire

Modern automobile requires a quality tire. Excellent rubber and fiber for tire have been developed recently.

Also, the designing and production technique of a tire have been greatly improved. Therefore, a new tire can be used twice at least by retreading. Now, retreading is the most cost-effective and raw material saving alternative to recycling and burning rubber. The retreading tire is widely used for city transportation such as bus, trolley-bus and truck.

There are two production methods, one is the hot method (or the matrix method) and the another is the low-temperature method (or the precured method). The hot method has three kinds as Fig. 2. (The slanting line shows new material rubber to be capped.)

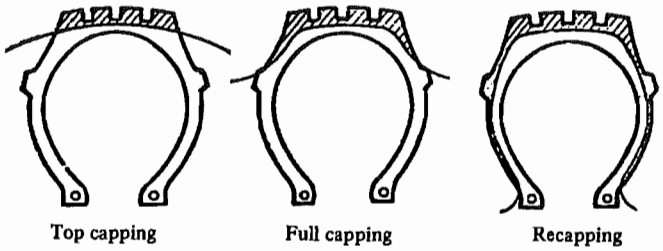

Fig. 2 Type of Rubber Capping

Recently, the steel radial tire has become popular worldwide. The retreading technique of a tire has already been established. For the steel radial tire, it is recommended to apply the low-temperature method than the hot method. In the low-temperature method, top capping process only is applied.

2. Raw Materials

In retreading a worn tire, the worn casing, rubber, solvent and other repairing materials are used.

(1) Worn tire (hereinafter called casing)

The quality of a retreading tire needs good casing. Any good retreading tire can not be made of the casing which has a defect. Therefore, it is necessary to select better casing carefully than some standard. The casing is classified into three types from its structure, i.e. bias tire, radial tire, and steel radial tire.

(2) Rubber

The compounded rubber for retreading and repairing is being used for retreading a tire. The property of the rubber is stipulated in the Japanese Industrial Standard (JIS).

Table 1 shows the property of the compounded rubber to be used for retreading and repairing a worn tire in JIS.

Table 1. Property of Compounded Rubber for Retreading and Repairing Tire

Type \ Test item		Tension test		Aging test	Hardness test	Scorching test
		Tensile strength (kg/cm^2 [MPa])	Elongation (%)	Decreasing rate of tensile strength (%)	Hardness of spring (degree)	Scorching time (minute)
Class I	Tread rubber	> 120 [11.8]	> 300	< 20	55 – 70	> 6
	Rubber for cushion	> 150 [14.7]	> 450	–	–	> 3
	Filling up stock rubber	> 150 [14.7]	> 450	–	45 – 60	> 3
Cement stock rubber		> 150 [14.7]	> 450	–	–	> 3

The following materials are used for retreading tire.

(a) Tread rubber

Tread rubber is used for making tread that contacts the ground, which has such properties as abrasion resistance, cut resistance and low-heat generation. Natural rubber and/or synthetic rubber are used together with carbon black and other materials.

(b) Cushion rubber

This is used for bonding the tread rubber onto the casing. Cushion rubber has adhesiveness and tear resistance with high vulcanization rate. Cushion rubber is made from natural rubber in general.

(c) Filling up stock rubber

Filling up stock rubber is used for filling up the skived part of the tire carcass, and has adhesiveness.

(d) Cement stock

Cement stock is used for making rubber cement, which is made from natural rubber in general.

Compounded rubber is kneaded from raw rubber (natural rubber or synthetic rubber) mixed with carbon black, process oil, antioxidant, vulcanization accelerator, accelerator activator, and sulfur. (Plant specification in this brochure does not include the production equipment of compounded rubber.)

(3) Solvent

The industrial gasoline, which is called rubber solvent, is used. Rubber cement is made by dissolving natural rubber with solvent. This solvent is also used for cleaning the surface of rubber.

(4) Repairing material

This is used for filling up the piercing part through carcass after skiving onto the inside of a tire. It is named "patch".

3. Production Process

For retreading a tire, there are two processes: the hot method (or the matrix method) and the low-temperature method (or the precured method). The production processes are basically the same except valcanization.

The production process of a retreading tire is shown in Fig. 3.

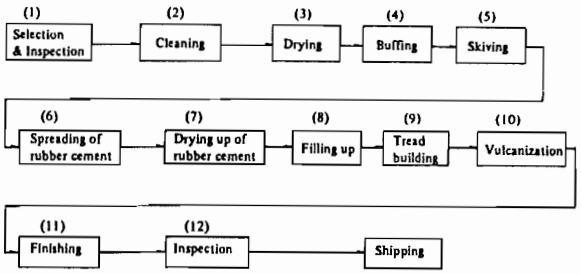

Fig. 3 Block Diagram of Retreading Tire Production

(1) Selection and inspection of a worn tire

Usable casings as raw material are selected in accordance with some standard. The tire which has any defect that might cause a trouble must be eliminated. Also, the tires are classified in size and type.

(2) Cleaning

Cleaning mud and oil on the surface of the casing is necessary to eliminate such contamination in the processes which may cause defect.

(3) Drying

The moisture existing in the plies of casing will cause the ply separation trouble while vulcanization. Drying is necessary to prevent such trouble.

(4) Buffing

Buffing is the most important and this process determines the quality of product. The part of a tire to be retreated (the part where new rubber is sticked) is rasped off to the specified shape and size by a buffing machine. The recent buffing machine is equipped with a size indicator and a profiling device. These have made buffing work easier and surer.

(5) Skiving

A used tire has many cuts, stabs, scratches and holes. It is necessary to skive the part of them carefully. If not, break and separation will cause from such part. Then the part of them are cleaned or rubbed with a buffer to get a rough surface. The through holes and stabs into the inside of a carcass should be made clean, and mud and the like are removed, and the surface of such parts are made rough. Also, the inside of a tire, where patches are to be adhered, is made rough to ensure adhesion.

(6) Cement work (adhesive work)

Rubber cement is spread by a spray gun or by a brush over the part where new rubber is sticked so that the rubber can easily adhere.

(7) Drying of rubber cement

Before the solvent of rubber cement volatilizes off, the remained solvent will vaporize and gasify at the time of vulcanization, and will cause separation. Accordingly, solvent must be dried enough.

(8) Filling

The cut and scratched part, which was treated in the preceding process (5) is stuffed with rubber by using a gimlet and a hand roller.

(9) Sticking of tread rubber

Rubber, which builds new tread, is sticked onto casing. There are two different methods, i.e. the hot method and the low-temperature method. Hence, explanation will be made respectively.

(a) Hot-method (Matrix method)

Tread rubber (compounded rubber) is bonded onto the part which builds the tread. There are two methods as below.

① Camelback sticking method

Camelback is a belt-shaped rubber (compounded rubber) and its sectional view is shown in Fig. 4. The camelback is sticked on around the outside of a casing manually. Recently, a cold feed extruder is being used, from which camelback is extruded out continuously. And it is sticked on to the casing. This method is introduced in this brochure.

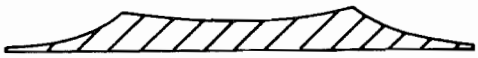

Fig. 4 Sectional View of Camelback

② The cold feed extruder presses out continuously the rubber ribbon which is thinner than camelback. Such ribbon is sticked on around a casing. Though the machine is high in price and its structure is so complicated that it requires a high maintenance ability, this method can make a quality product with greater output and less labor.

(b) Low-temperature method (Precured method)

Instead of the compounded rubber above mentioned, the vulcanized tread rubber is adhered in this method.
Cushion rubber is applied between the vulcanized (precured) tread rubber and the casing.

(10) Vulcanization

Vulcanization is made after the processes of (1) to (9).

(a) Hot method (Matrix method)

This method is to vulcanize the unvulcanized rubber such as camelback or ribbon rubber, and at the same time, to mold a tread pattern. The tire is sealed tightly into the matrix (mold) of a vulcanizer, and internal pressure is applied by steam or hot water, and then heated. The heating temperature and time is important to obtain a good product.

(b) Low-temperature method (Precured method)

The low-temperature method is applied to vulcanize the cushion rubber between the casing and the vulcanized (precured) tread, so as to complete the adhesion process. The tire, described in (9) (b) is put into a rubber envelope, which is sealed with rim, and is heated in the vulcanizing chamber under a certain pressure and temperature. Electricity or steam is applied for heating.

(11) Finishing

The spew is removed by a cutter. And black rubber paint is applied for the external appearance.

(12) Product inspection

If a retreading tire have any defect, it would cause a trouble while running. Hence, the inside and outside of the finished tire are carefully inspected, and if any defect should be found, it must be mended properly or rejected as a defective product.

4. Outline of Model Plant

4.1 Production Scale

The retreading tire is being used mainly for trucks and buses. Therefore, plan is made in this brochure as a plant capacity 100 pieces of truck and bus tires (T-B tire) of 10:00-20 size per day. The machinery recommended here is of easy maintenance and high productivity.

Here, both hot method (matrix method) and low-temperature method (precured method) are introduced. The operating hour to produce 100 pieces of tire is assumed to be 12 hours per day and working day to be 300 days per year.

4.2 Quantity of Raw Materials

(1) Hot method (Matrix method)

Casing :			100	pcs./day
Compounded rubber :	15.5	kg/pce.	1,550	kg/day
Rubber solvent :	0.5	ℓ/pce.	50	ℓ/day
Repairing material :	Differs depending on the damage of tires.			

(2) Low-temperature method (Precured method)

Casing :			100	pcs./day
Precured tread :	12.2	kg/pce.	1,220	kg/day
Cushion rubber :	0.5	kg/pce.	50	kg/day
Rubber solvent :	0.5	ℓ/pce.	50	ℓ/day
Repairing material :	Differs depending on the damage of tires.			

4.3 Required Machinery and Equipment

(Inspection) with 8-hour operation				
1.	Full spreader : (tire inspecting machine, air operated)		1	set
2.	Hand grinder (sander) :	0.2 kW	1	set
(Buffing) with 9-hour operation				
3.	Buffing machine (motor drive) :	26.25 kW	1	set
(Skiving) with 8-hour operation				
4.	Tire stand (with castor) :		20	sets
5.	Hand grinder (sander) :	0.2 kW	2	sets
(Spreading of rubber cement) with 8-hour operation				
6.	Rubber cement making machine :	0.4 kW	1	set
7.	Rubber cement applying machine : (air operated)		1	set
8.	Tire rotating machine : (for applying rubber cement)	0.75 kW	1	set
(Filling) with 8-hour operation				
9.	Table with tire stand :		1	set

Up to the above process, both hot and low-temperature methods are the same. Hereafter, explanation will be made separately.

[Hot method]

(Sticking of tread rubber) with 10-hour operation				
10.	Low-temperature extruder : (with tread builder and sticking device)	40 kW	1	set
(Vulcanizing) with 12-hour operation				
11.	Watch-type vulcanizer with matrix : (air operated)		20	sets
12.	Tire spreader (air operated) :		2	sets
13.	Air compressor :	37 kW	1	set
14.	Boiler :	2 tons/hr	1	set
(Finishing) with 10-hour operation				
15.	Tire rotating machine for removing spew and painting device :	0.75 kW	1	set
16.	Mending tools :		1	set
(Others)				
17.	Consumable materials such as air bags and others :		1	set
18.	Meters and piping materials : (pipe, valve, coupling, fitting, etc.)		1	set
19.	Tools :		1	set
(Quality control)				
20.	Hardness tester for rubber :		1	set
21.	Temperature recording controller :		1	set
22.	Measures (Jig) :		5 to 10	pcs.
23.	Calipers :		1	set

[Low-temperature method]

(Sticking of tread rubber) with 9-hour operation				
10.	Tread building machine :	0.75 kW	2	sets
11.	Tread stitcher :	0.75 kW	1	set
(Vulcanizing) with 12-hour operation				
12.	Envelope handling machine (air operated) :		2	sets
13.	Curing rim :		80	pcs.
14.	Vulcanizing chamber :		2	sets
15.	Air compressor :	37 kW	1	set
16.	Boiler :	1 ton/hr	1	set
(Making of precured tread) with 12-hour operation				
17.	Cold feed extruder :	40 kW	1	set

18.	Precured tread vulcanizer :	3.75 kW	1	set
19.	Precured tread buffing machine :	3.75 kW	1	set
20.	Rubber cement applying machine :		1	set
21.	Green tread shelf :		2	sets

(Finishing)
(Other machines and tools)
(Measuring instrument for quality control) } the same as the hot method

Note: The compounded rubber making machine is excluded.

The following photos show example of the machines which are allowed to use in the retreading tire manufacturing plant.

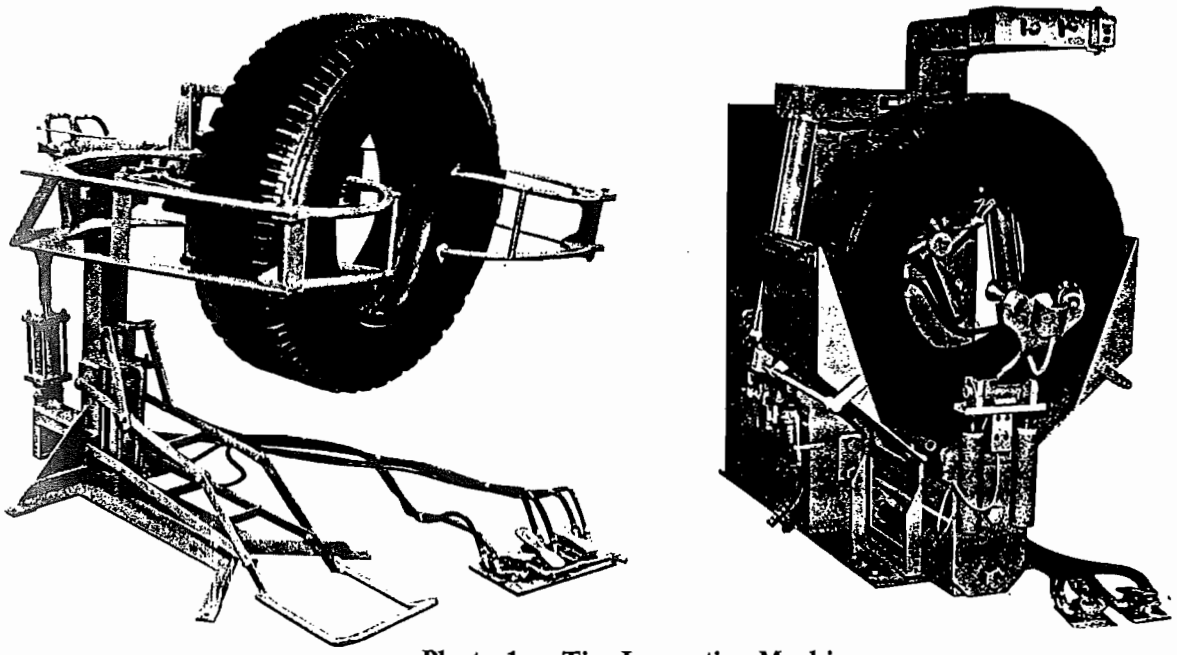

Photo 1 Tire Inspecting Machine

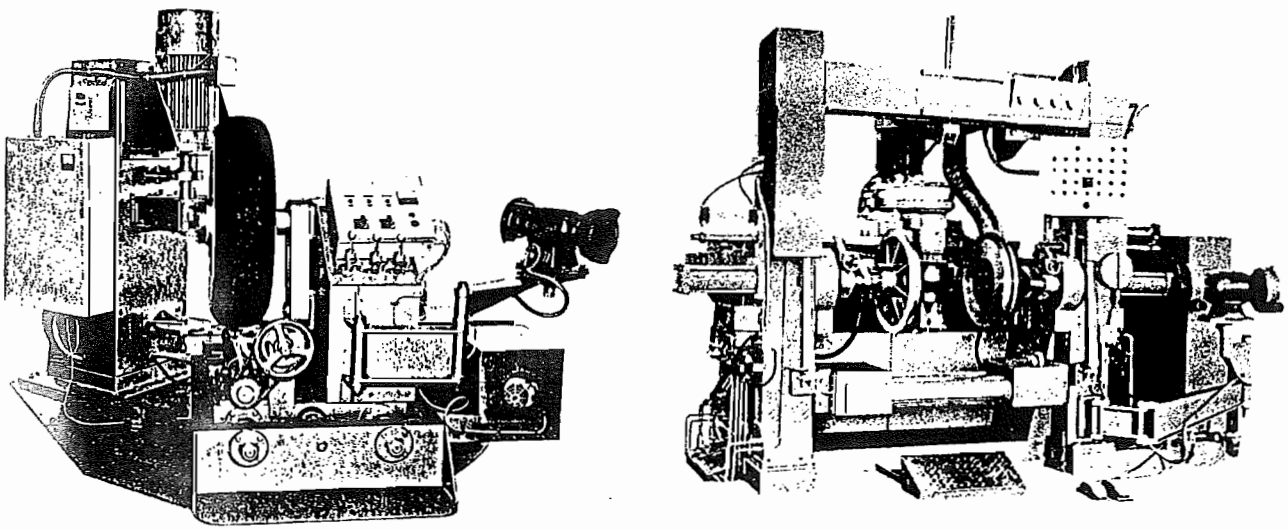

Photo 2 Buffing Machine

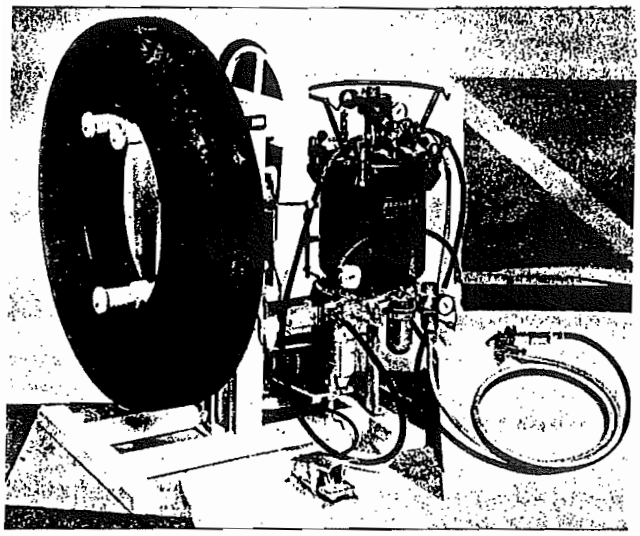

Photo 3 Rubber Cement Applying Machine

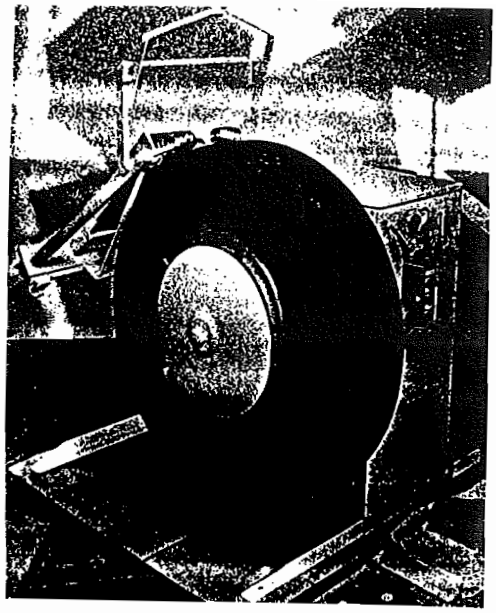

Photo 4 Tread Builder

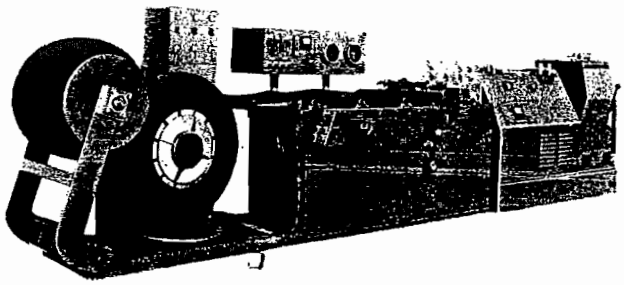

Photo 5 Low-Temperature Extruder

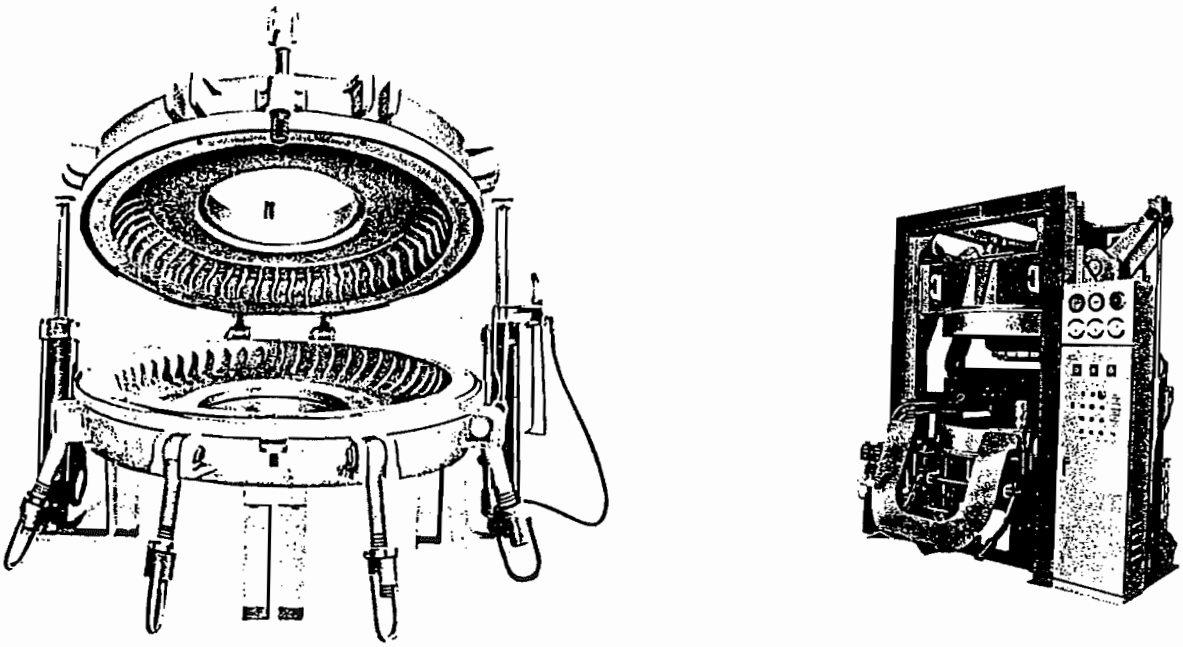

Photo 6 Vulcanizer (Hot method)

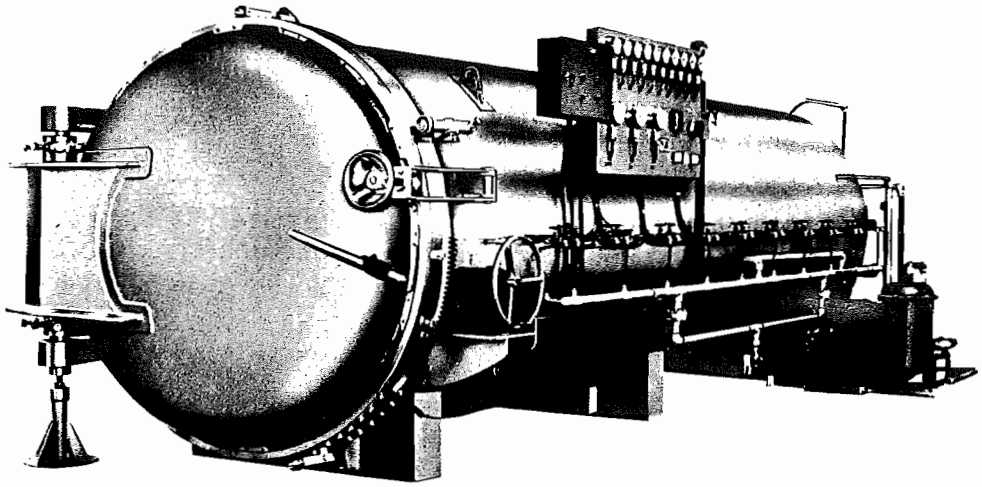

Photo 7 Vulcanizing Chamber (Cold method)

4.4 Machinery and Equipment Cost

The equipment cost, which is necessary to produce 100 retreading tires (with the maximum operation of 12 hours), is roughly estimated as below.

(1) Hot method

		US$
* Full-admission tire inspecting machine :	3 sets	6,500
* Drying chamber equipment :	1 set	12,500
* Buffing machine (motor drive) :	1 set	35,000
* Tire stand (with castor) :	20 sets	4,500
* Rubber cement making machine :	1 set	1,300
* Rubber cement applying machine and tire rotating machine :	1 set	4,000
* Table with tire stand :	1 set	500
* Cold feed extruder (with a sticking device) :	1 set	67,000
Watch-type vulcanizer (together with matrix) :	20 sets	270,000
Air compressor (37 kW) :	1 set	10,500
Boiler (2 tons/hr) :	1 set	37,500
Tire rotating machine for removing a spew and paint applying device :	1 set	3,500
Consumable materials such as air bag :	1 set	5,000
Manufacturing tools necessary for all processes :	1 set	4,000
Piping materials (pipe, valve, couple, meter, etc.) :	1 set	5,000
Measuring instrument for quality control :	1 set	4,000
	Total	US$ 470,800

Note: 1. Hand grinder is included in the manufacturing tools.
2. Transport vehicles, service facilities and fire-extinguishing facilities are excluded.

(2) Low-temperature method

The equipments marked with * in the hot method are also used in the low-temperature method up to the filling process. Sub-total amount of * marked is US$64,300.

			US$
Tread rubber stitcher	2	sets	12,500
Tread stitcher	1	set	3,500
Envelope handling machine	2	sets	3,000
Curing rim	80	pcs.	30,000
Vulcanizing chamber	2	sets	155,000
Air compressor	1	set	10,500
Boiler (1 ton/hr)	1	set	30,500
Low-temperature extruder	1	set	67,000
Tread vulcanizer (with matrix)	1	set	125,000
Precured tread buffing machine	1	set	10,000
Rubber cement applying machine	1	set	1,000
Green tread shelf	2	sets	1,000
Consumable materials such as envelope, etc.	1	set	6,300
Manufacturing tools necessary for all processes	1	set	4,000
Piping materials	1	set	2,000
Measuring instrument for quality control	1	set	4,000
		Total	US$ 529,600

The compounded rubber making machine is excluded.

4.5 Plant Layout

The plant layout is shown in Fig. 5. The layout is applicable to both the hot or low-temperature methods.

4.6 Workers and Placement

(1) Hot method

Factory manager (who must be versed in the whole technical matter and control the workers)	1
Engineer (who is well acquainted with all technical processes)	2
Clerical staff	3
Skilled worker (in selection and inspection)	1
Unskilled worker (in washing and drying)	1
Skilled worker (in buffing)	1
Unskilled worker (in rubber skiving and rubber cement application)	2
Skilled worker (in filling)	1
Skilled worker (in sticking tread rubber)	1
Unskilled worker (in sticking tread rubber)	2
Skilled worker (in vulcanization)	2
Unskilled worker (in vulcanization)	4
Skilled worker (in finishing and inspection)	1
Unskilled worker (in finishing and inspection)	1
Odd-job man	2

Namely, a total of 25 men are needed: 1 factory manager, 2 engineers, 3 clerical workers, 7 skilled workers, 10 unskilled workers, and 2 odd-job men.

(2) Low-temperature method

Low-temperature method requires additional two skilled workers and two unskilled workers in the precured tread making in addition to 25 workers for the hot method.

The low-temperature method needs a total of 29 men, i.e. 1 factory manager, 2 engineers, 3 clerical workers, 9 skilled workers, 12 unskilled workers, and 2 odd-job men.

5. Production Cost and Profitability

The profitability of a retreading tire manufacturing plant is taken the fixed capital, working capital, etc. into account. However, the raw materials cost, labor cost and other conditions differ in each country. Therefore, in this brochure calculation was made based on the following assumptive conditions.

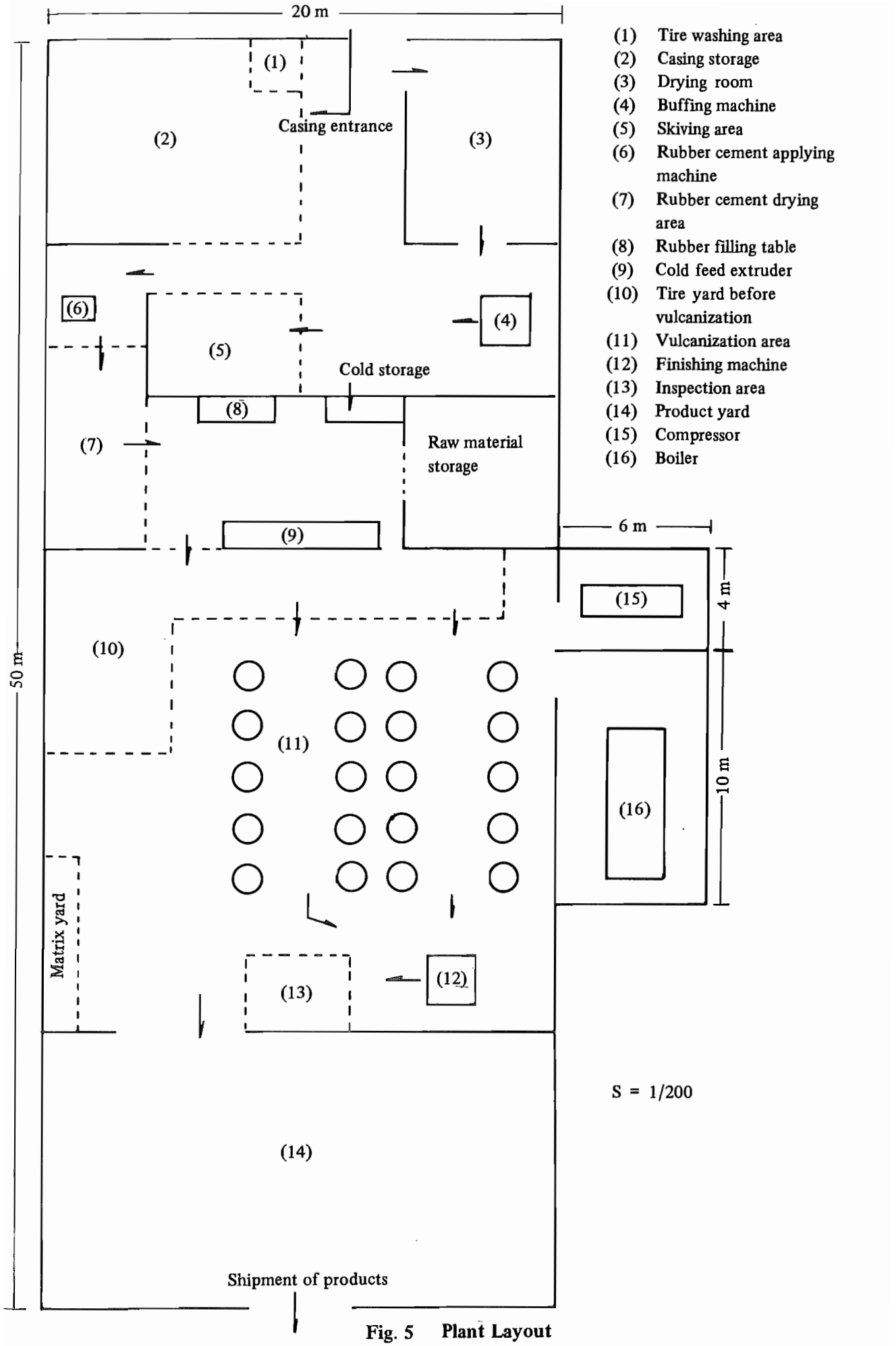

Fig. 5 Plant Layout

5.1 Basic Conditions for the Calculation of Fixed Capital, Working Capital and Production Cost

(1) Fixed capital

(a) Land cost is excluded.

(b) The unit construction cost of office, factory, and warehouse: US$200/m^2

(c) Machinery and equipment cost based on the FOB Japanese port as of September 1985.

(d) Spare parts cost is assumed to be 10% of the FOB price of machinery and equipment.

(e) Freight and insurance cost is assumed to be 10% of the FOB price of machinery and equipment.

(f) Erection cost is assumed to be 5% of the FOB price of machinery and equipment.

(g) Civil engineering cost is assumed to be 10% of the FOB price of machinery and equipment.

(h) Supervision and guidance cost is assumed to be 10% of the FOB price of machinery and equipment.

(i) Test run cost is assumed to be 5% of the FOB price of machinery and equipment.

(j) Training cost is assumed to be 5% of the FOB price of machinery and equipment.

(k) Contingency is assumed to be 10% of the FOB price of machinery and equipment.

(2) Working capital

Raw materials cost and products in stock for one month.

(3) Production cost

(a) Compounded rubber for hot method US$1.5/kg

(b) Compounded rubber for low-temperature method US$1.8/kg

(c) Unit price of casing US$11/pce.

(d) Unit cost of utilities

Electricity	US$0.06/kWh
Industrial water	US$0.2/ton
Fuel oil (Heavy oil)	US$200/kℓ

(e) Labor cost

Direct labor cost (per head a year) is as follows.

	US$
Factory manager	14,000
Engineer	8,000
Clerical worker	7,000
Skilled worker	4,000
Unskilled worker	2,000
Odd-job man	500

(f) Maintenance and repairing cost is assumed to be 3% of the FOB price of machinery and equipment.

(g) Depreciation cost

Straight-line method will be adopted. Depreciation cost of machinery and equipment is as follows:

(Fixed capital − building construction cost) x 7%

Depreciation cost of buildings is assumed to be 3%.

(h) Insurance cost is assumed to be 0.5% of fixed capital.

(i) Selling and administrative expenses are assumed to be 5% of annual sales.

(j) Interest

One-second of fixed capital is equity capi-

tal, and the remaining half is covered by a long-term loan, and its annual rate of interest is 10%.

Note: The exchange rate of the US dollar to the Japanese yen is assumed to be US$1 = ¥240. as of September 1985.

5.2 Annual Sales

(a) By hot method, the plant produces 10:00 – 20 size truck and bus tire of 30,000 pieces at US$60 per piece, amounting to US$1,800,000 per year.

(b) By low-temperature method, the plant produces 10:00–20 size tire 30,000 pieces at US$70 per piece amounting to US$2,100,000 per year.

5.3 Capital Required

(1) Fixed capital

(a) Hot method (40kW low-temperature extruder is applied)

	US$
Plant site: 3,300m²	–
Factory: 1,200m² (including office)	240,000
Machinery and equipment	470,800
Spare parts	47,080
Freight and insurance	47,080
Civil engineering	47,080
Erection	23,540
Supervision and guidance	47,080
Test run	23,540
Training	23,540
Contingency	47,080
Sub-total	US$1,016,820

(b) Low-temperature method

	US$
Plant site: 3,300m²	–
Factory: 1,200m² (including office)	240,000
Machinery and equipment	529,600
Spare parts	52,960
Freight and insurance	52,960
Civil engineering	52,960
Erection	26,480
Supervision and guidance	52,960
Test run	26,480
Training	26,480
Contingency	52,960
Sub-total	US$1,113,840

(2) Working capital

(2)-1 Raw material cost for one month

(a) Hot method

	US$
Compounded rubber: 38,750 kg (US$1.5/kg)	58,125
Auxiliary raw materials and consumable materials	5,000
Casing: 2,500 pcs. (US$11/pce.)	27,500
Sub-total	US$90,625

(b) Low-temperature method

	US$
Compounded rubber: 32,500 kg (US$1.8/kg)	58,500
Auxiliary raw materials and consumable materials	7,000
Casing: 2,500 pcs. (US$13/pce.)	32,500
Sub-total	US$98,000

(2)-2 Products in stock for one month

(a) Hot method products	US$115,296
(b) Low-temperature method products	US$122,596

(3) Capital required total

(a) Hot method	US$1,222,741
(b) Low-temperature method	US$1,334,436

5.4 Selling Cost

The annual selling cost will become as follows.

(1) Hot method

(a)	Raw materials cost	US$90,625 x 12 months	US$1,087,500
(b)	Utility cost		
			US$
	Electricity	US$0.06/kWh x 550,000 kWh	33,000
	Industrial water	US$0.2 /ton x 15,000 ton	3,000
	Fuel oil (Heavy oil)	US$200/kℓ x 450 kℓ	90,000
		Sub-total	US$126,000
(c)	Labor cost		
			US$
	Factory manager	US$14,000 x 1	14,000
	Engineer	US$ 8,000 x 2	16,000
	Clerical worker	US$ 7,000 x 3	21,000
	Skilled worker	US$ 4,000 x 7	28,000
	Unskilled worker	US$ 2,000 x 10	20,000
	Odd-job man	US$ 500 x 2	1,000
		Sub-total	US$100,000
(d)	Maintenance cost		US$22,513
(e)	Depreciation cost		US$52,529
(f)	Insurance cost		US$ 4,952
(g)	Selling and administrative expenses		US$10,500
(h)	Interest		US$49,521
		Total for (a) to (h)	US$1,453,515

(2) Low-temperature method

(a)	Raw materials cost	US$98,000 x 12 months	US$1,176,000
(b)	Utility cost		
			US$
	Electricity	US$0.06/kWh x 550,000 kWh	33,000
	Industrial water	US$0.2/ton x 15,000 ton	3,000
	Fuel oil (Heavy oil)	US$200/kℓ x 350 kℓ	70,000
		Sub-total	US$106,000

(c) Labor cost

		US$
Factory manager	US$14,000 x 1	14,000
Engineer	US$ 8,000 x 2	16,000
Clerical worker	US$ 7,000 x 3	21,000
Skilled worker	US$ 4,000 x 9	36,000
Unskilled worker	US$ 2,000 x 12	24,000
Odd-job man	US$ 500 x 2	1,000
	Sub-total	US$112,000

(d)	Maintenance cost	US$ 25,394
(e)	Depreciation cost	US$ 59,252
(f)	Insurance cost	US$ 5,432
(g)	Selling and administrative expenses	US$120,000
(h)	Interest	US$ 58,823
	Total for (a) to (h)	US$1,662,901

5.5 Profitability

(1) Hot method

In case the plant produces 30,000 pieces of tires per year, the annual sales will become US$1,800,000. The annual selling cost being US$1,535,126, the annual rough profit will be US$264,874, which is equivalent to 14.7% of the annual sales and 21.7% of the total capital respectively.

(2) Low-temperature method

In case the plant produces 30,000 pieces of tires per year, the annual sales will become US$2,100,000. The annual selling cost being US$1,644,518, the annual rough profit will be US$455,482, which is equivalent to 21.7% of the annual sales and 34.1% of the total capital respectively.

6. Others

(a) Selection of the retreading tire manufacturing equipment

Selection of the manufacturing equipment is important. Many modern and sophisticated machinery in this field has been developed in this ten years, which is not easy for maintenance. Therefore, we don't recommend such machinery except special cases.

On the other hand, conventional machinery which is simple and reliable have been used effectively in the retreading tire manufacturing plant up to now.

In this brochure, machinery and equipment is introduced under the consideration of easy maintenance, long life and manufacturing quality products at lower cost.

(b) Product reliability

Product reliability is provided by the standard process specification and the skillfulness of workers in the retreading tire factory.

(c) Feasibility of the retreading tire business

The retreading tire has been improved to about the same as a new tire recently. Some of retreading tire has longer life than a new tire. A large number of retreading tire is used for lower speed city transportation such as bus, trolley bus and truck actually because of economical reason.

The feasibility may be studied based on its economy, namely:

$$\frac{Y}{K} > \frac{Y'}{K'}$$

Y : Cost of a new tire
K : Mileage of a new tire
Y': Cost of a retreading tire
K': Mileage of a retreading tire

Otherwise, the retreading tire business is not feasible.

(d) Supply of raw materials

In order to manufacture retreading tire, it is indispensable to get a stable supply of casing, the main material. Accordingly, it is essential to fix the production scale in accordance with the availability of suitable casing.

(e) Pollution

When the compounded rubber is made in its factory by additional equipment, air pollution by carbon black dust and noise problems are recommended to consider before construction.

Project Planning for Small and Medium Scale Industries

No. 1 Rice Milling Plant and Rice Bran Oil Manufacturing Plant
No. 2 Plastic Woven Bag Manufacturing Plant
No. 3 Container Board Manufacturing Plant
No. 4 Plastic Blow Bottle Manufacturing Plant
No. 5 Concrete Block Manufacturing Plant
No. 6 Glassware Manufacturing Plant
No. 7 Galvanized Iron Sheet Manufacturing Plant
No. 8 Fishing Net Manufacturing Plant
No. 9 Ice Making, Refrigeration and Cold Storage Plant
No.10 Starch and Syrup Manufacturing Plant
No.11 Instant Noodle Manufacturing Plant
No.12 Surimi and Surimi-Based Food Manufacturing Plant
No.13 Polyethylene Shopping Bag Manufacturing Plant
No.14 Retreading Tire Manufacturing Plant

Project Planning for Small and Medium Scale Industries No. 14

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