CHAPTER (4)

EXPERIMENTAL WORK

1. Introduction

Studying the best method for producing O.E yarns Nm 10/1,17/1, 20/1 by using five blends from different hard wastes and polyester ratio ,two blends from yarn waste and polyester ratio and three blends from knitting waste and polyester ratio.

The work has been carried out at the usual working conditions without affecting the productivity or quality of the mill.

2. Machines and Equipments

The production line applied in the experimental work is represent in table (4-1)

Table (4-1) Represents the types of machines used in the factory

Machine Name	Model	Manufacturing Data	Country of origin
Cutting Tearing M/C	Rolando line	1983	Italy
BlendinM/C	Ommi	1985	Italy
Carding M/C	Risqué	1987	Spain
Open End Spinning M/C	Ru14A Anglostadate Reiter	1990	Switzerland

3. The Production line of waste recycling

The production line of waste recycling figure (4-1) is consist of three main sections, the Blow Room section, the carding section and the spinning section and each of these sections are carrying out different operations.

3.1 The Blow room Section

To attain a homogenous material the blow room is carrying out three operations cutting, tearing and mixing by using three different machines, cutting machine, tearing machine and mixing machine.

3.1.1 The Cutting Machine

The cutting machine is consist of two main parts, the Bale Cutter machine and the Rotary Cutter machine, the Bale cutter machine is designed to take bales of hard waste either knitting waste or yarn waste and automatically cut it through feeding evenly to a conveyer belt to a tow powerful hydraulic knife, which minimized the hard waste material to a very small pieces. Then the cutting material is fed to the the rotary cutter machine which consist of two feeding rollers, stationary knife and three rotating cutting knives figure (4-2). A built in grinder allows sharpening the knives right on the machine .A very sensitive metal detector installed on the feeding conveyor.

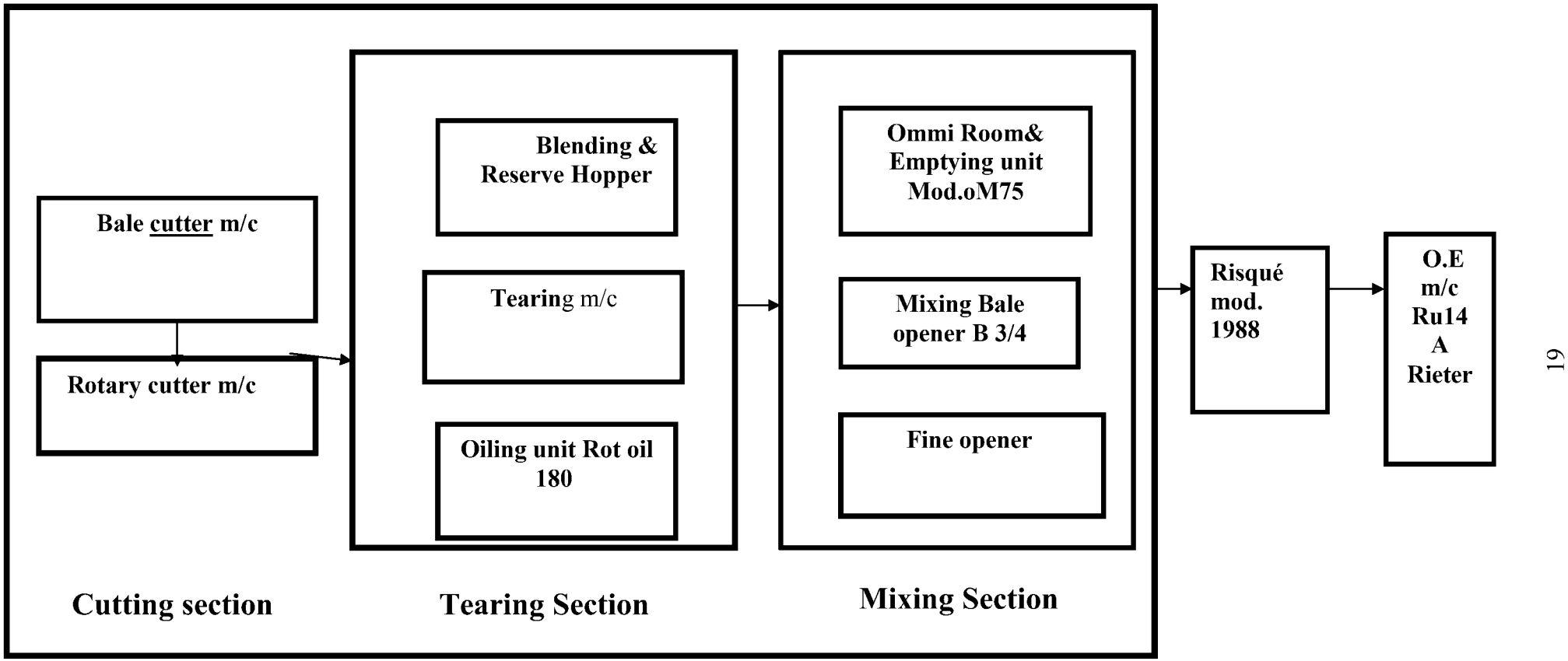

Fig. (4-1) Represents the production line diagram of waste recycling

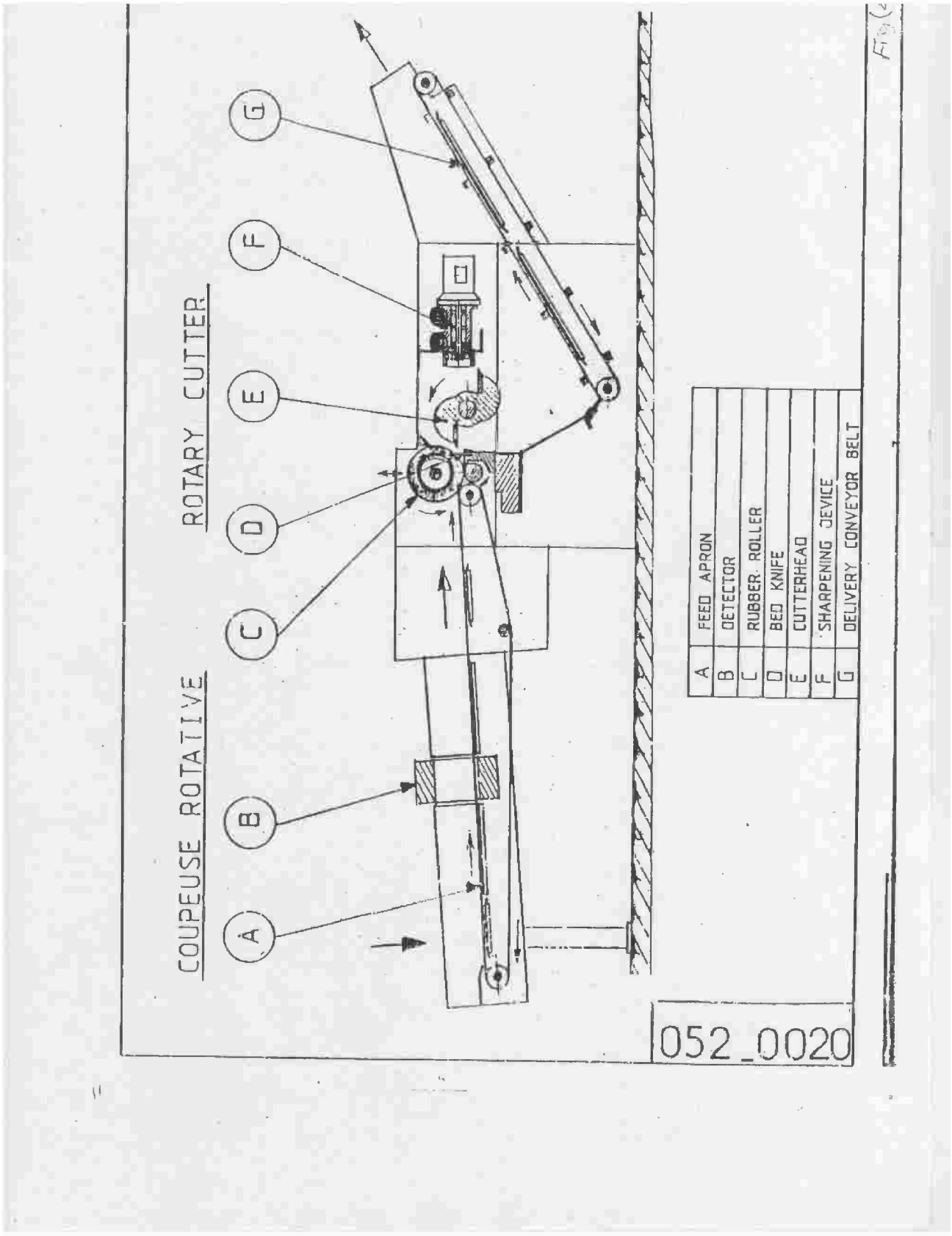

Fig.(4-2) Represents the Rotating Cutting Knives

3.1.2 The Tearing Section

The tearing section is consisting of 3 parts:

A-The Blending and Reserve hopper

The cutted material is transferred by air suction to a blending and reserve hopper; this allows to blend the material and to have a buffer between the cutting and the Tearing line.

The width of bale cutter is 1600 $_{mm}$ and the power is 39 kw the width of rotary cutter is 500 $_{mm}$, the cut length from 15-150$_{mm}$, the power is 11 kw and the cuts per minute is 400, the width of blending and reserve hopper width is 1400 $_{mm}$ and the capacity from 13.80 to 26.70 $_{m}^{3}$

B-The Tearing Machine

The Tearing Machine is designed to open all types of textile wastes such as produced by fiber producer ,spinning ,weaving and knitting factories ,mills, garment manufactures, non woven makers , second hand clothing dealers , it includes from five opening sections, each of them is composed of :

- Chute feed with adjustable thickness, vibrating perforated plate, control of material and delivery roller.
- Feeding system with roller working with an adjustable pressure on dish.
- 1500 $_{mm}$ diameter opening cylinder with pins.
- Condensing suction with perforated cylinder and delivery roller.

Bit sorting and recycling device.-

- Filtering system
- Working width: 1820 $_{mm.}$
- Production: from 600 kg /hour to 1000 kg/hour.
- Pneumatic brakes on main cylinders
- Each of them covered by 54 wooden lags; each of them has ascending number of pins as shown in the table (4-3)

Table (4-2) Represents the number of pins for each cylinder:

No. of cylinder	No. of pins
first cylinder	81,000
second cylinder	96,500
third cylinder	130,000
fourth cylinder	165,000
fifth cylinder	198,000

Beside the difference in the number of pins of each cylinder, there are three other different in the pins the height, the angle and the thickness, the pins is starting

In the first cylinder by course, low angle of pins and towards through the cylinders to gentile action by using thin, high sharpness pins.

After the fifth cylinder the carrying fibers are adding by using a small hopper adjusted to feed a certain amount of carrying fibers, carrying fibers like polyester or acrylic with 32 $_{mm}$ x 1.2 denier.

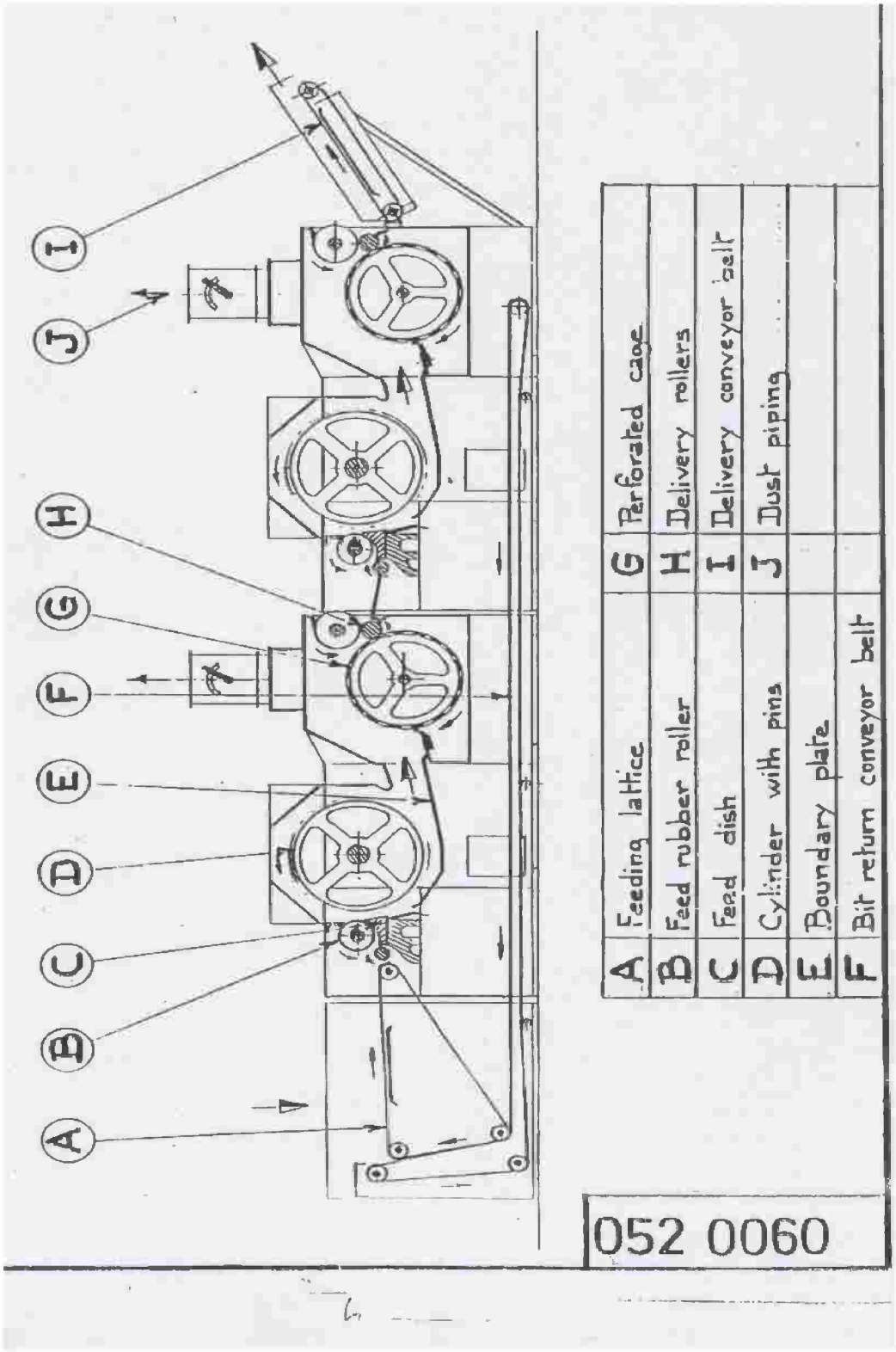

Fig. (4-3) Represents the Tearing Machine

After the tearing machine the fibers goes to the oiling unit rotoil 180 fig (4-4) which is employed in preparatory side for all the spinning process in order to obtain in homogeneous and continuous distribution of water and emulsified-oil over the fibers machine is composed by following parts:

a- Feeding system

That can be connected or by means a simple cyclone, cyclone at air recovery or by means a rotary-condenser or feeding conveyor.

b- Transport fiber: movable surface for

Built up in stainless steel and rotating on a central axis, Fiber are delivered on this surface by the feeding system, The slow rotation of surface brings fibres to go in first time under the nozzle-device then under the suction -hopper for the discharge, A central cone avoids the mixing of treated Fibres with those to be treated.

c- Nozzle Device:

Built up with special nozzles connected to distribution pump.

d- Control Device Of Fiber presence upon movable surface:

Built up by a feeler moved by material transported in the movable surface.

The movement of feeler drives the inlet and locks in of an electro-valve by control the liquid-passage.

The feeler is placed after the feeding group and before nozzles

e- Delivery hopper:

Connected with suction for to take off fiber from movable surface.

f- Movable surface motor group:

Realized by means Moto reducer, type M V F 80 /N placed upon special base and sprockets connected with the shaft of movable surface shaft is assembled upon a fit bearing housing . Figure (4-4) represents the oiling unit rot oil 180.

The factory is using the water as a treatment material and ether to reduce the fiber heating after the tearing machine.

3.1.3 The Mixing section:

The mixing section is consisting of three parts:

A- Ommi bin and emptying unit Mod. MO 75 machine fig.(4-5)

B- Mixing bale opener B 3/4 machine

C- Fine opener machine.

C. The Oiling Unit and Emptying unit model OM 75

It is function can be described as follows:

A) Positioning
B) Entering
C) Emptying

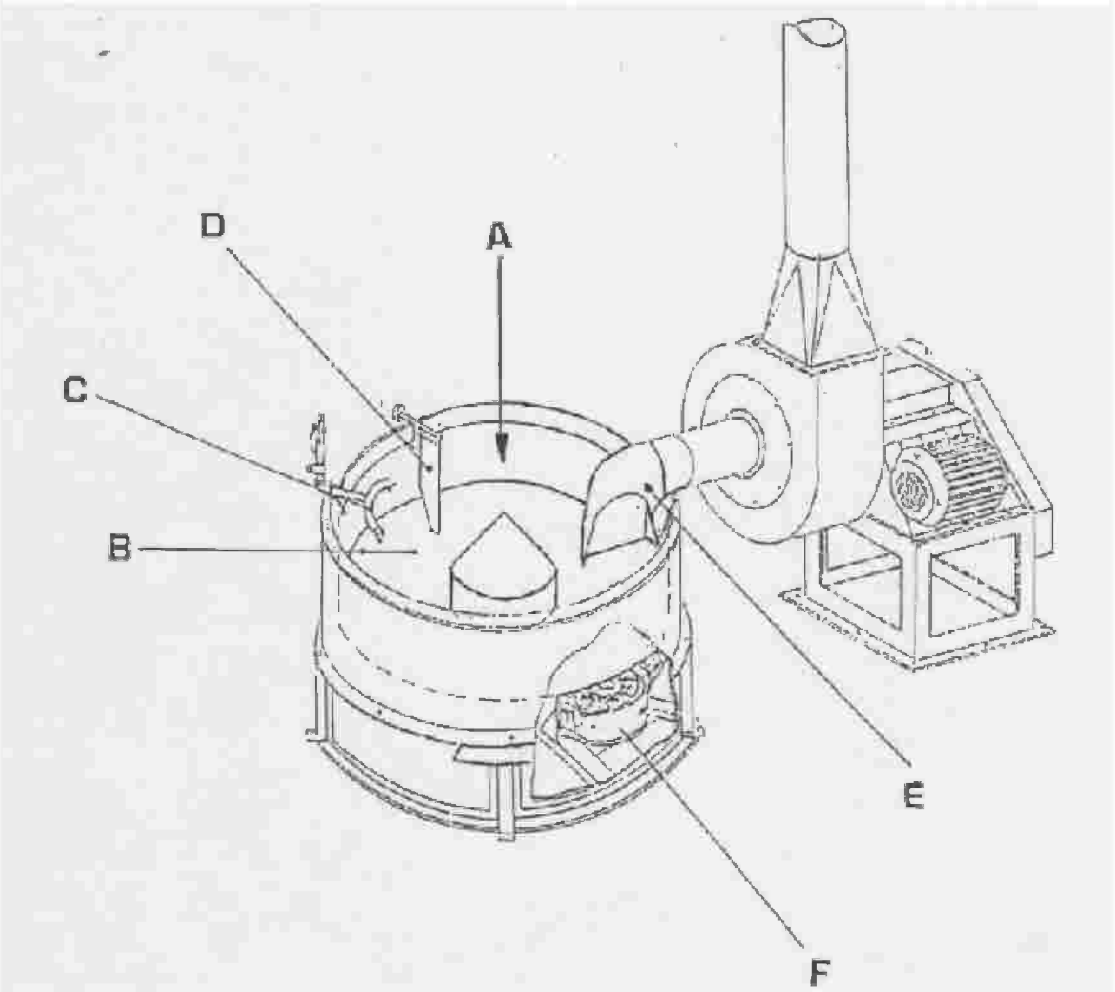

Fig. (4-4) Represents the oiling unti rot oil 180

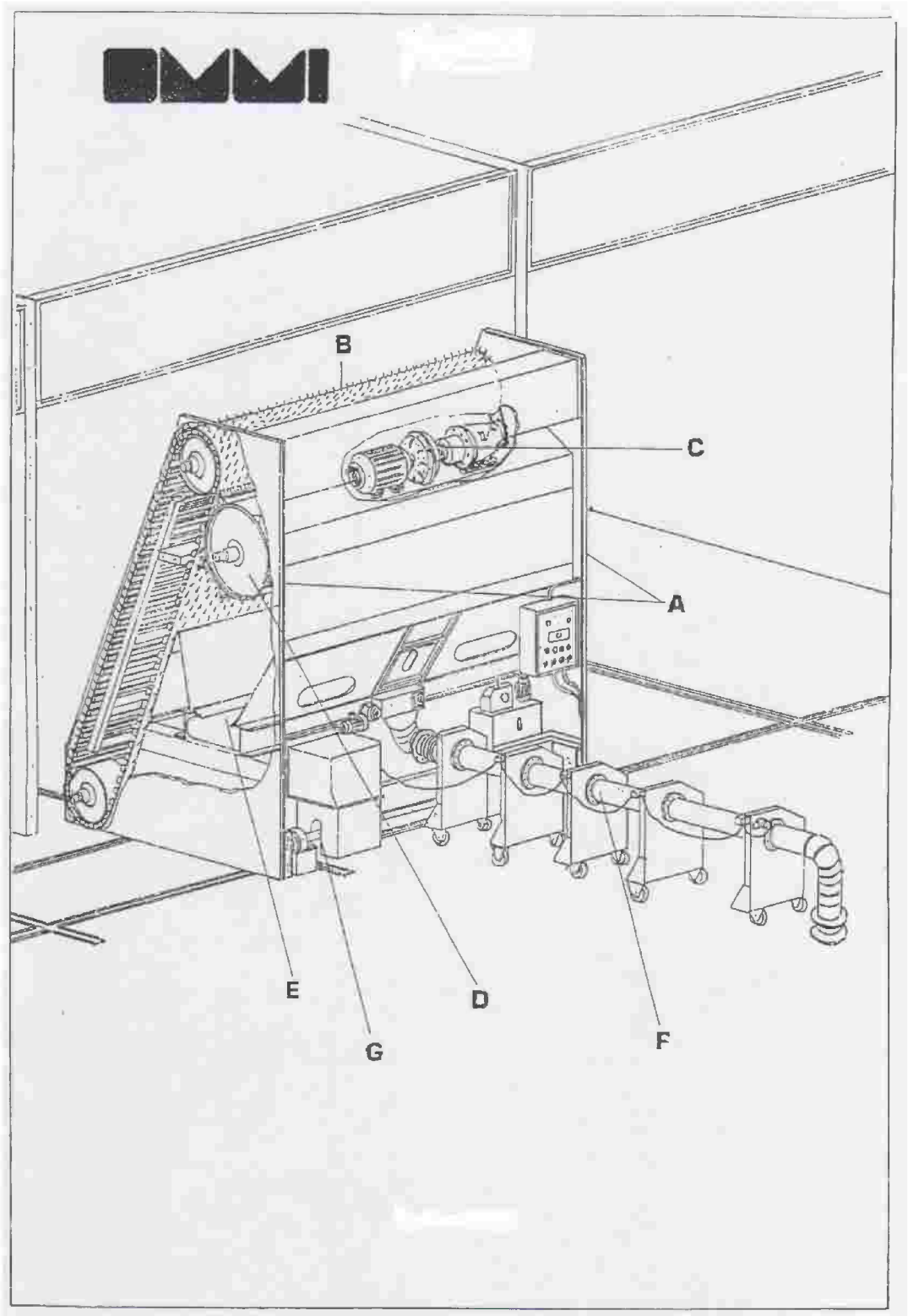

Fig. (4-5) Represents the Ommi bin and emptying unti mod, MO75 machine

1- Functioning of the machine

Briefly the functioning of the machine can be described as follows:

a) Positioning of the machine in direction of the bin, which must be emptied.by using the suitable drives ,you have the lowering of an equipment with 4 wheels, which thanks to their own motor , allow the advance on rails.

b) Entering of the emptying unit into the blending bin.
When the machine is well placed in front of the bin and the advancing wheels are placed in the rails, the door of the bin is opened and the emptying unit enters into the bin. The advancing bin is intermittent and it can be adjusted by stop and start timers device.

c) Emptying of the blending bin. The emptying is effected by a combined action of the intermittent advancing of the machine and the continuous running of the pins bench.

The action of this lattice allows taking the fibres from the bulk and it leaves them on asystem of transporting conveyors, which bring them to the central hopper.

2- The Emptying unit is made up of:

a) Strong frame

This frame holds all the parts. It was particularly designed to have a right weight and balance to allow the penetration in the material bulk without any problem .

b) Pins bench

It is made up by a strong antistatic PVC tape assembled on wooden bars and it has a high diameter cylinder of which the upper one effects the movement and the lower one allows the adjustment and the tensioning.

c) Drive of the pins bench

It is realized by a suitable reducer connected to the cylinder by means of a chain. The motor is connected to the reducer by means of a suitable hydrodynamic coupling to eliminate the sharp over loadings of the starting up.

The motor has suitable thermo -controls.

d) Discharging cylinder

This cylinder has a big diameter and it is complete with blades having wooden clothing's with nylon spikes, suitable for the elimination of the fibres from the lattice spikes. Its drive is given by a suitable independent Moto -reducer.

e) Discharging system

It permits the fiber collection and it transports them to a recovery fan.

It can be built by p v c conveyor, placed on a suitable frame and driven by an independent Moto-reduction gear or by a collecting hopper.

f) Telescopic pipe

It is realized by a set of pipes having different diameters assembled in a telescopic system and placed on trolleys with wheels.

This system allows keeping the emptying unit connected with the recovery fan during the operating period.

g) Translation system

It is realized by a strong trolley holding the wheels for the transversal displacement and the wheels for the longitudinal displacement. The wheels can be lifted and lowered by an hydraulic equipment.

The driver for the displacements according to the different speeds is affected by two different groups complete with reducers with motors connected by means of toothed belts.

Rosique ltd of Spain developed the rosique carding (fig.4-5) nearly of Tandom_carding , in this type of carding there are three takers- in , two cylinders , one doffer are integrated in a complete carding assemblies and four workers rolls and four small doffer cylinders over the first cylinder of the flats. Although rosique carding may give rise to intense treatment of fibers, it is designed to accomplish a progressive carding action on the fibres. On the first two takers-in the fibres are subjected to high opening On the first cylinder, fibres are subjected to a relatively high carding action exerted by the use of four worker rolls and four small doffer cylinders, on the main cylinder a much more intense carding is applied using a higher point population clothing, the clothing point population is also higher on the main cylinder than the first cylinder. The main advantages of using rosique cards is subjected the material to further carding for extra opening and homogeneity , thus the material has to be carded twice to improve opening, the high rate of very short fibres removal.The technical data of rosique carding m/c shown at the table (4-3).

Table (4-3) Represents the technical data of rosique carding m/c

Production rate	Up to 80 kg/h depending on raw material
Type of fiber	Cotton waste wool
Range of sliver count	4-7 ktex (0.15 0.088) ne
Range of total draft	80-300
Range of feed weights	400-1300 g/m
Range of can size	Standard 457 mm(18 inch)
m/c width	1000 mm= 40"
Cylinder speed	Up to 500 rpm or 35 m/c surface speed
Dust extraction	Individual suction with suction unit
Waste removal	Connected to control waste removal system or collected individual

3.2 Carding section

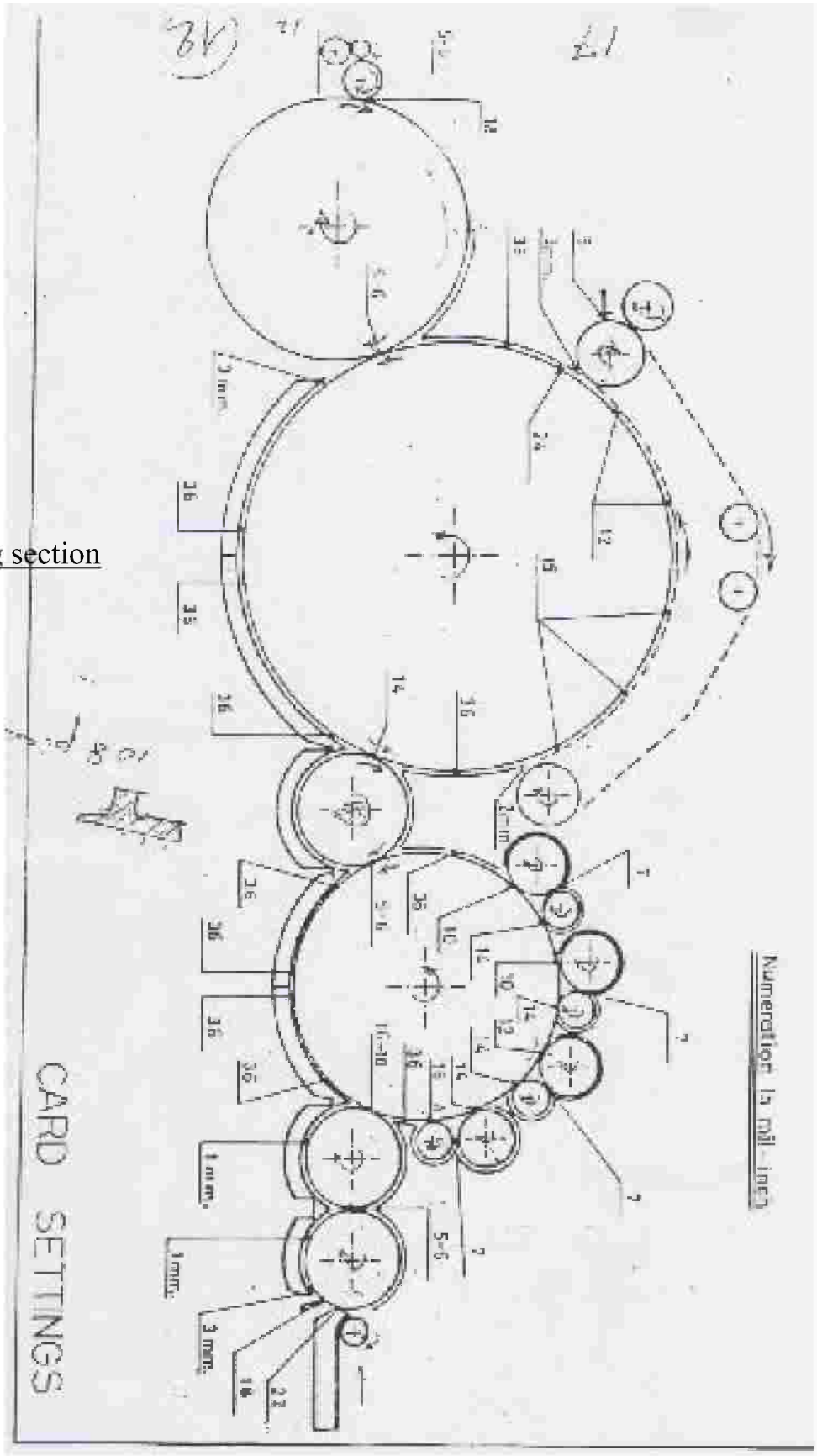

Fig. (4-6) Represents the carding setting

3.3 Spinning frame

The technical data of the O.E Reiter spinning frame RU 14 consist of the table (4-4)

Table (4-4) Represents the technical data of the O.E Reiter spinning frame RU 14

Raw material type of fiber	cotton .viscose synthetic
Drafts range	from 25-230
Twists range	300-1200 t/m
Rotor speed range	22000-60000 rpm
No of rotor	216
Combing width and rpm	8 cm(6000-8500) rpm
Rang of yarn Ne	3-30

All the tested samples was made according to ASTM standard

4. Material properties

The material applied for obtaining the open end yarn has to contain the following conditions:

1- Knitting fabric since it has an open structure, so it will be easier to open by needle of cylinder in the tearing m/c
2- Low twist
3- Individual yarns not plied yarns
4- Size of material 2*2 inch

5. Factors studied

The factors under study consist of the three factors , the first factor is the raw material of which can be divided to three types, knitted waste (clips) , yarn waste , polyester fiber , the second factor the percentage blend of these types of wastes , while the third factor is the total draft and the open end machine to obtain different counts .

The rotor speed was kept constant at 40000 rpm, while the combing speed at 8500 rpm and twist factor is 5.8 for all experimental under study

The experimental design applied is shown in table (4.5)

Table (4-5) Represents the experimental work for factors

Exp. No.	Nm	polyester fiber %	knitted waste %	yarn waste %
	x1	x2	x3	x4
1	10	12	-	88
2	10	25	-	75
3	10	10	90	-
4	10	20	80	-
5	10	30	70	-
6	17	12	-	88
7	17	25	-	75
8	17	10	90	-
9	17	20	80	-
10	17	30	70	-
11	20	12	-	88
12	20	25	-	75
13	20	10	90	-
14	20	20	80	-
15	20	30	70	-

1- From table (4.5) we can deduce that the polyester fibres is blend with one type of hard waste, depending on the consumer requirements (demands)
This is due to the fact that the hard waste are either bleached (knitted waste) or grey(yarn waste) the polyester co lour, white or grey , is chooser depending on the hard waste colour.

2- The range of percentage of hard waste varies from 70% to 90% which is three times greater than the percentage recommended in the literature which range from 10%to 30% this possible due to the type of cotton in the hard waste.

3- Since the sum of two factors in the experimental design are equal to 100, so the design consists of one independent factor, and two dependent factors the proposed relation will be in the form:

$$Y = \sum_{i=1}^{3} a_i \; x_j + \sum_{i=1}^{3} \sum_{j \neq i}^{3} a_{ij} x_i x_j + \sum_{i=1}^{3} a_{ii} x_j^2$$

6. Testing procedures

The yarn obtained was tested for yarn count. Yarn tenacity, yarn elongation, yarn evenness', yarn imperfection (thin, thick, neps) and their variability's, using the uster instruments.

1- Count we apply the autosorters, with test length 100m. And number of tested sample 10, and variability.
2- Yarn evenness and imperfection was obtained by using the uster tester 3 at 400mt/min for one minute, and their variability.
3- Yarn tenacity was carried in their tensorpied 3 for a sample of 50 m.

The yarn samples were tested according to ASTM Standards.