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Small Scale Cement Manufacturing Projects

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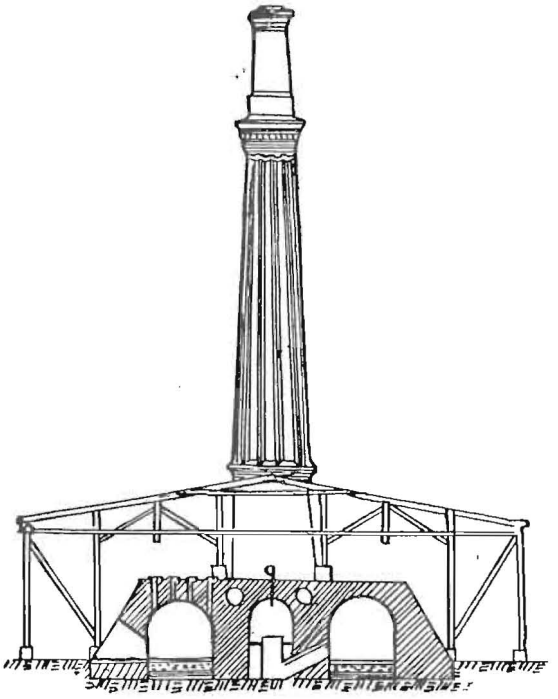
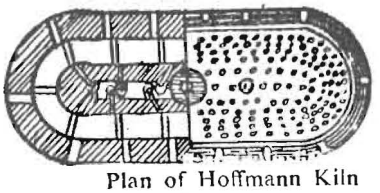
Cement has to be transported hundreds of miles for use in minor and major Projects at places such as Assam or Kashmir. The cost of transport makes its use almost prohibitive and practically doubles its controlled price. The demand of cement in those areas is moreover comparatively small and does not justify the provision of a standard cement factory producing one lakh ton a year. A small scale cement manufacturing plant having a flexible production capacity suitable to local needs would in a number of places be an attractive proposition.

It is not feasible to have any great adjustibility in a cement manufacturing plant having a rotary kiln. Experience in Germany indicates that the necessary flexibility can be obtained by using a tunnel or vertical shaft or Hoffmann-ring kiln. This form of kiln has been extensively used in Germany for cement manufacture. The "HOFFMAN-RING-KILN" Fig. 1. is simple in construction and running,and effects economy in fuel. It, however, requires considerably more manual labour for each ton of cement than that required in the larger type factories. The over-all cost of the cement manufacture is of the same order as that produced by big combines and as labour is plentiful and cheap in India, their use has definite advantage.

Fig.2 shows a vertical shaft kiln which has recently been successfully adopted for cement manufacture in Germany. One of the advantages claimed for this



Section of Hoffmann Kiln

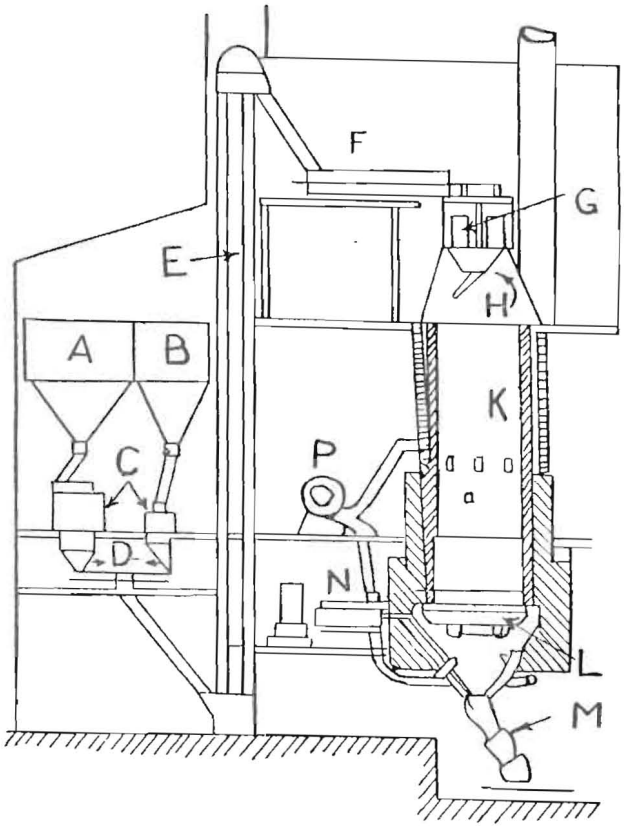


Plan of Hoffmann Kiln

Fig. No. 1

The author expresses his thanks to the Director, Central Building Research Institute, and Shri Bhailalbhai Patel, Vice-Chancellor, Vallab-bhai Rural University, Gujrat for their help.

kiln is its simplicity of working and the robust character of its mechanical parts. The bunkers 'A' and 'B' contain, respectively, the raw material and the fuel. Materials are weighed automatically at 'C' and are discharged on the conveyors 'D'. The materials move down a chute to the boot of the elevator 'E' which raises the materials



A Vertical Shaft Kiln

Fig. No. 2

and discharges them to the mixer 'F', from which they pass to a briquetting machine 'G'. The briquettes are distributed uniformly in the kiln 'K' through the apparatus at 'H'. The discharge is made through the grilles 'L' to the hoppers 'M'. The grilles are operated by the mechanism at 'N'. The fan 'P' forces air into the cavity in the walls and into the bottom of the kiln.

In places where coal or oil fuel are not readily available and where hydel power is cheap and plentiful an electric tunnel kiln might be adopted for the cement manuacturing unit. The electric tunnel kiln would normally be 100 to 150 ft. in length. The heating elements are of $1\frac{3}{4}$ inch, dia sprials each of which rests in refractory brick work grooved to receive them. Bogies loaded with briquettes are passed through the tunnel one after the other and time of passge is so regulated as to give the heat treatment necessary for clinkering the briquettes. The temperature in these kilns is controlled at every stage with the of help electric pyrometers and the movement is so adjusted as to ensure the maximum utilisation of the heat energy.

To demonstrate the feasibility of the proposal, an experimental kiln was set up at Central Building Research Institute, and the following proceedure adopted for manufacturing cement.

Lime-stone from the Dehra-dun area and clay available at a distance of three miles from Roorkee were selected as suitable for cement manufacture. The lime stone and clay were mixed in the proportion of 3. 6 to 1 i. e. 18 lbs. of lime stone to 5 lbs. of clay. Calculations were made as per the method explained in the Cement Chemist and Works Managers Handbook page 63, by Watson and Craddock Concrete Publications Ltd., London. The materials were fine ground in a ball mill and mixed with a small quantity of water in the edge runner (mortar mill). A brick making machine was used to cast bricks with the mixture of lime-stone and earth. The bricks manufactured were of the dimensions 9 "x$4\frac{1}{2}$" x$1\frac{1}{2}$". The

Fig. 3.

bricks were allowed to dry and weather for three days and were loaded in a small chamber kiln (equivalent to one chamber of a continuous ring kiln of the Hoffmann type). The kiln was fired with an oil burner with furnace oil. The following schedule of temperature was maintained.

Up to	100°C	2 hours period.
	100 to 200°C	2 ,,
	200 to 300°C	1 ,,
	300 to 400°C	1 ,,
	400 to 500°C	1 ,,
	500 to 600°C	1 ,,
	600 to 700°C	1 ,,
	700 to 750°C	1 ,,
	750 to 800°C	1 ,,
	800°C constant	4 ,,
	800 to 900°C	1 ,,
	900 to 1100°C	1 ,,
	1100 to 1200°C	1 ,,
	1200 to 1300°C	1 ,,
	1400°C	2½ ,,

The burnt bricks which were nothing but clinker, were powdered in ball-mill with the addition of 4 per cent gypsum to the standard fineness. All chemical and physical tests were carried out and the cement manufactured complied with the Indian Standard Specifications for cement. The table below gives the chemical analysis of the raw materials and the cement manufactured.

Constituents	Lime-stone	Clay	Cement
1. Insoluble Sio_2	...	63.88	0.18
2. Soluble Sio_2	...		19.26
3. $Fe\,0_3$	...	19.96	2.46
4. $Al_2 0_3$	...		5.52
5 Cao	54.63	1.97	64.77
6. Mgo	1.56	2.27	2.38
7. $P_2 0_5$	Trace	...	...
8. Chloride	,,	...	...
9. Sulphate	,,	...	...
10. Loss on ignition	43.38	7.18	2.25
11. Other by difference	0.43	4.74	1.64

With the background of the experimental work done at this Institute and consultations with experts the author is now in a position to present proposals for three different types of cement manufacturing units.

(*a*) Cement manufacturing plant with daily output of 60 tons a day with an electrically fired tunnel kiln complete not be available and where Hydel power is cheap and plentiful.
Approximate capital investment ... Rs. 30 lakhs.

(*b*) Cement manufacturing plant with vertical shaft kiln fired with coal or coke. Capacity 60 tons a day complete in every respect.
Capital investment ... Rs. 20 lakhs.

(*c*) A cement manufacturing plant, capacity 20 tons a day with Hoffmann type ring kiln fired with oil or coal, complete in every respect.
Capital investment ... Rs. 10 lakhs.

The general layout of a small scale factory and the estimate of the cost of plant as submitted by the German Firm 'LOESHE K. G. of Dusseldorf' is detailed in the appendix.

The author is confident in putting forward these proposals supported by recent quotations for the plant and machinery required for such a plant in India and hopes that early steps will be taken, by those interested in cement and small scale industries, to set up a small scale Cement manufacturing unit.

LOESHE K. G.

DUSSELDRF GERMANY

CEMENT WORKS WITH VERTICAL KILN FOR A DAILY OUTPUT OF 60 TONS.

The following is a rough estimate of the cost for the mechanical equipment and electrical motors for a cement factory with a daily production of 60 tons as shown on the *attached drawing 580-2*

The main plants of the works are :—

	kgs.	$
(*i*) Preliminary Crushing Plant	27,500	25,000
(*ii*) Store of Materials	32,000	45,000
(*iii*) Raw Meel Plant	30,500	35,000
(*iv*) Silo Group for Raw Meel	22,190	20,000
(*v*) Shaft Kiln Plant	61,960	52,000
(*vi*) Cement Mill	57,600	62,000
(*vii*) Silo Group for Cement	10,670	10,000
(*viii*) Bagging Station	12,480	17,000
(*ix*) Electric Motors	4,031	9,000
Total	258,931 kgs.	
		275,000 $

Not included in the above prices are buildings and foundations, power station and electrical installation, quarry equipment and transport of material to the works, laboratory, work-shops and office equipment.

The above machines are specified on the following pages.

The prices given are for German Port.

The delivery will be between 12 and 16 months.

The tender is based upon today's labour and material costs and may be subject to changes before an order should be effected.

A. CEMENT MACHINERY

I. Preliminary Crushing Plant :

(1) 1 Outlet Hopper 3 × 2m

(2) 1 Apron Feeder
630 mm. wide, abt. 12m. axle distance incl. drive.

(3) 1 Hammer Crusher Type HB 10 capacity abt. 16t/hr. including texrope drive.

(4) 1 Outlet Hopper
extracted by a rubber belt conveyor

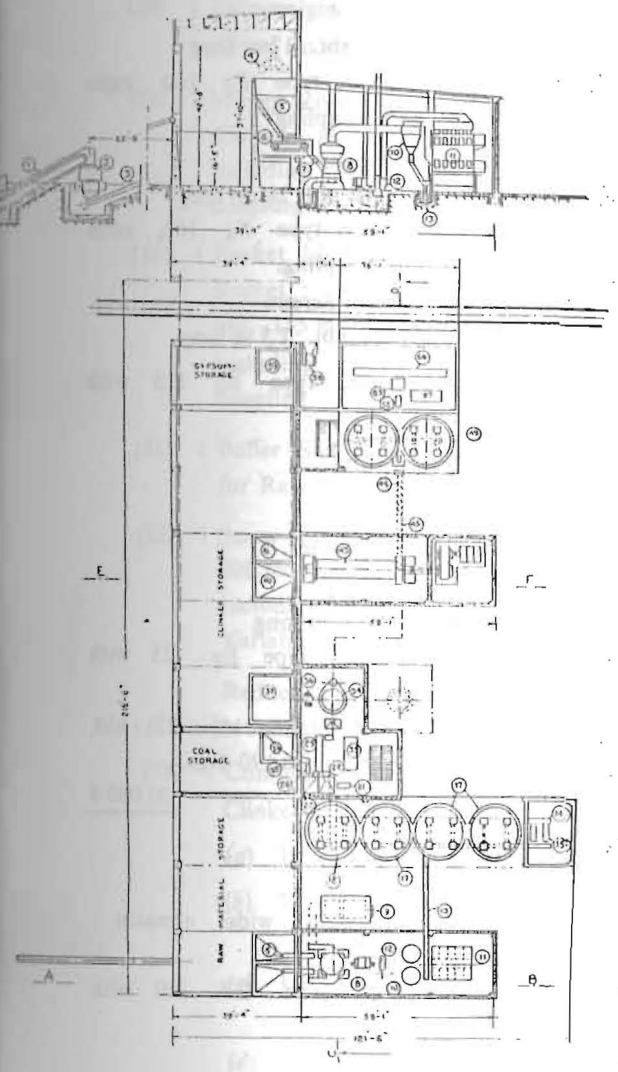
(5) 1 Conveyor Belt
400 mm. wide abt. 25m. axle distance including gear, type Bg 280

Total weight for Items (1-5)abts. 27.500 kgs.
25.000 $

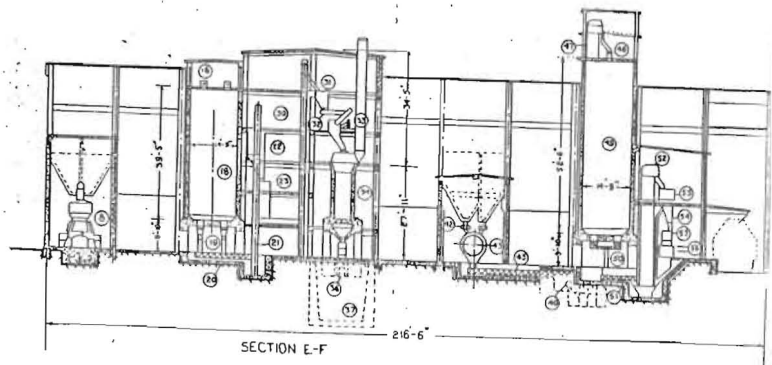
II. Store of Materials :

(6) 1 Completey electricall operated Overhead Travelling Crane

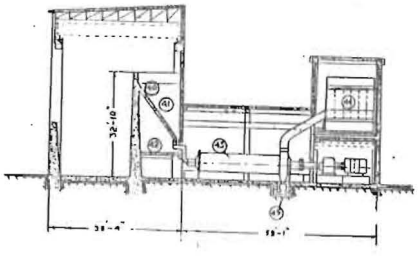
SECTION A-B



SECTION C-D



SECTION E-F



1. APRON FEEDER
2. CRUSHER
3. CONVEYOR
4. OVERHEAD CRANE
5. RAW MATERIAL SILOS
6. APRON FEEDERS
7. AIR LOCK
8. LOESCHE MILL
9. HEATER
10. CYCLONE
11. DUST PRECIPITATOR
12. FAN
13. RAW MEAL TRANSPORT
14. SCREW CONVEYOR UNDERNEATH SILOS
15. BUCKET ELEVATORS
16. DISTRIBUTORS
17. MIXING SILOS
18. READY MIX SILOS
19. SILO EXTRACTION
20. TRANSPORT
21. ELEVATOR
22. RAW MEAL BIN
23. WEIGHT FEEDER
24. COAL BIN
25. FEEDER
26. ELEVATOR
27. COAL BIN
28. WEIGHT FEEDER
29. MIXING WORM
30. ELEVATOR
31. BIN
32. FEEDER
33. GRANULATOR
34. SHAFT KILN
35. DUST PRECIPITATION
36. CLINKER CRUSHER
37. CLINKER PIT
38. GYPSUM CRUSHER
39. GYPSUM PIT
40. CLINKER BIN
41. GYPSUM BIN
42. FEEDER
43. COMPOUND MILL
44. DUST PRECIPITATION
45. TRANSPORT
46. WEIGHT FEEDER
47. ELEVATOR
48. DISTRIBUTORS
49. CEMENT SILOS
50. EXTRACTION
51. TRANSPORT
52. ELEVATOR
53. SAFETY SCREEN
54. SILO
55. BAGGING MACHINE
56. SHIPPING CONVEYOR
57. DUST PRECIPITATION

PORTLAND CEMENT

PLANT CAPACITY 60 Tons

PER DAY

LOESCHE

HARTZERL—ZEMENTMASH.-E.G.
DUSSELDORF

Drawing No. 580-2

Span length : 11 m, includings its complete electric equipment.
Carrying capacity : 5000 kgs.
Contents of the grab : 1, 5 cu. m:

(7) 1 Gypsum crusher
Jaw Opening : 200 × 400 mm.

(8) 1 Inlet Hopper
3 x 2 m with texrope drive

(9) Pushing Feeder with drive
Total weight for items 6) - 9) abt.
32.000 kgs.
45.000 $

III Raw Mill

(10) 1 Table Feeder Type TA 10

(11) 1 Complete Loesche-Mill-Aggregate consisting of :
(*a*) 1 Loesche-Mill Type LM 1048
(*b*) 1 Reduction Gear Type KSG 90
(*c*) 1 Rotary Separator Type LLS 18
(*d*) 1 High pressure Fan type GH 10 capacity of air 11,200 cu. m./hr.
(*e*) 1 Cyclone Type Z 20
(*f*) 1 Complete Piping 450 mm. dia. abt 20 m. long

(12) 1 Complete Filter Unit Type 96 SKS/6 filter surface 185/155
capacity of air : Max. 13000 cu. mm. p. hr.

(13) 1 Complete Heating Plant
(Producing hot air for the simultaneous grinding and drying process)

(14) 1 Screw Conveyor
250 mm. dia. abt. 13 m long
incl. gear, Type Bg 160
ratio 18 : 1, including coupling
Total weight for Items 10) - 14) abt.
30,500 kgs.
35,000 - $

IV Raw-Meel-Silo Group

(15) 2 Screw Conveyors
250 mm dia. abt 17m long
incl. gear, type Bg 160, ratio 18 : 1

(16) 2 Bucket Elevators,
Bucket : 250 mm. wide
elevator : abt. 17m. hight
including gear, type KA 160, ratio 10 : 1

(17) 1 Screw Conveyor
250 mm. dia. abt. 17m. long
including gear, type Bg 160 ratio 18 : 1 with coupling

(18) 1 Screw Conveyor
250 mm. dia. abt. 20 m. long
including gear, type Bg 160, ratio 18 : 1 with coupling.

(19) 4 Silo Extraction Screws
150 mm. dia. abt. 2.5 m long
including gear, type Bg 125 with coupling

(20) 8 Bin Slide Gates
300 x 300 mm

(21) 4 Distributing Chutes.

(22) 1 Screw Conveyor
250 mm. dia. 6 m long
including gear, type Bg 125 with coupling
Total weight for Items 15) - 22) : abt.
22,190 Kgs.
20,000 $

V Shaft Kiln Plant

(23) 1 Bucket Elevator
Bucket : 250 mm. wide, elevator : abt 13 m high
including gear, type KA 160 with coupling

(24) 1 Buffer Silo
for raw meel

(25) 1 Bucket Elevator
Bucket : 250 mm. wide, elevator : abt. 13 m high
including gear, type KA 160 with coupling

(26) 1 Pushing Feeder
for coal including drive

(27) 1 Buffer Silo
for coal

(28) i Twin-weight Feeder complete with dirve ; to weigh raw meel and coal

(29) 1 Mixing Screw
400 mm. dia. x 4 m long
including gear, type Bg 180 with coupling

(30) 1 Bucket Elevator
Bucket : 250 mm. wide, elevator : abt. 155 m high
including gear, type KA 160 with coupling

(31) 1 Buffer Silo
for Raw-Meel-Coal Mixture

(32) 1 Screw Feeder
200 mm. dia., abt. 25m long
including gear, type Bg 125 and Variable

Reduction Gear, Type MA 1, with coupling and texrope ;

(33) 1 Complete shaft Kiln Plant for 60 to Clinker per day :

(*a*) 1 Noduliser, type GT 20

(*b*) 1 Kiln Hood with Revolving Feeder Chute and Stack

(*c*) 1 Klin Shell with Sheel support and Armour Plating

(*d*) 1 Complete lining

(*e*) 1 Complete Roller Grate with complete hydraulic drive.

(*f*) 1 complete set of 3 alternate Discharge
Grates with Gear HCK 6a and coupling.

(34) 1 Filter Unit, type 96 SKS/6
filter surface 186/155 sq. m.
capacity of air 13.000 cu. m. p. hr. for dust
collection of the complete conveying plant
Total weight for Items (22) - (34) abt. 61960 kgs.
52.000

VI Cement Mill

(35) 1 Table Feeder, type TA 10
for clinker

(36) 1 Table Feeder, type TA 8
for gypsum.

(37) 1 Record Multiple Compartment Mill, type RMM 6, 1600 mm. dia. 8000 mm. long, including armouring, the necessary breaking bodies, with central drive, with gears and couplings.

(38) 1 Filter Unit, type 40 SKS/5
filter surface 70/56 sq. m.
capacity of air 4500 cu. m. p. hr.

(39) 1 Screw Conveyor
250 mm. dia. abt. 10 m. long
including gear, type Bg 160 with coupling
Total weight for items 35)-39) : abt. 57. 600 kgs.

62.000$

VII Silo Group for Cement

(40) 1 Bucket Elevator
Bucket : 250 mm. wide
Elevator : abt. 24 m. height
including gear, type KA 183 with coupling.

(41) 4 Silo Extraction Screw.
dia. 150 mm. 2.5 m long
including gear, type Bg 125 with coupling.

(42) 8 Bin Slide Gates
300 x 300 mm.

(43) 4 Distributing Chutes

(44) 1 Screw Conveyor
250 mm. dia., abt. 8 m, long
including gear, type Bg 125 with coupling

(45) 1 Screw Conveyor
250 mm. dia. abt. 3.5 m. long
including gear, type Bg 125 with coupling

Total weight for items(40-45): abt. 10,670 kgs. 10,000$

VIII. Bagging Station.

(46) 1 Bucket Elevator
Bucket : 250 mm. wide
Elevator : abt. 10 m. height
including gear, type KA 160 with coupling

(47) 1 Single Deck Vibrating Screen with texrope drive

(48) 1 Silo for Bagging Machine

(49) 1 Automatic 2-Spouted Bagging Machine type 2 BB
including texrope drive

(50) 1 Conveyor Belt
800 mm. wide 5 m axle distance
including rubber belt and worm gear.

(51) 1 Filter Unit, type 50 SKS/5
fillter surface 70/56 sq.m.
capacity of air 4500 cu. m. p. hr.

(52) 1 Complete Pipeline

(53) 2 Tables.

Total weight for items (46) - (53) : abt. 12,480 kgs. 17.000 $

(54) Motors, to drive the above mentioned machines,
(in closed construction), V=380, 50 Cycles, which are not included in the prices :

for item

(2) 1 Motor N=6.3 Kw. = 1450 r.p.m.
(3) 1 „ „ 21 „ „ „ „
(5) 1 „ „ 6.3 „ „ „ „
(6) included in the price
(7) 1 Motor N=10 Kw. = 1450 r.p.m.
(9) 1 Motor Gear N=1.6 Kw. „ 20 „
(10) 2 Motors N=1, 6 Kw. „ 1000 „
(11) 1 Motor with 2 shaft ends „
1 Motor N=1, 6 Kw. 1450 „
(12) Included in the price
(14) 1 Motor N=2,2 Kw. „ „ „
(15) 2 Motors,, „ „ „ „ „ „
(16) 2 „ „ „ „ „ „ „ „
(17) 1 „ „ „ „ „ „ „ „
(18) 1 „ „ 3.5 „ „ „ „ „
(19) 4 Motors,, 1 „ „ „ „ „
(22) 1 Motor ,, 2.2 „ „ „ „ „
(23) 1 „ „ „ „ „ „ „ „
(25) 1 „ „ „ „ „ „ „ „
(26) 1 Motor gear N=1.6 Kw „ 20 „
(28) Included in the price
(29) 1 Motor N=3.5 Kw „ „ 1450 „
(30) 1 „ „ 2.2 „ „ „
(32) 1 „ „ 1.6 „ „ 1000 „
(33 (a) 1 „ „ 6.3 „ „ 1450 „
(b) included in the price
(c) 1 Motor N=3.5 Kw. „ 1000 „
(34) Included in the price
(35) 1 Motor N 2.2 Kw. „ „ 1000 „
(36) 1 „ „ 1.6 „ „ „ „ „
(37) 1 „ „ 190 „ „ „ „ „
(38) included in the price
(39) 1 Motor N=2.2 Kw. „ „ 1450 „
(40) 1 Motor N=3.5 Kw. „ 1450 r.p.m
(41) 4 Motor „ 1 „ „ „ „
(44) 4 Motors,, 2.2 „ „ „ „
(45) 1 „ „ „ „ „ „ „
(46) 1 „ „ „ „ „ „ „
(47) 1 „ „ „ „ „ „ „
(49) 1 „ „ 8 „ „ „ „
(50) 1 „ „ 2.2 „ „ „ „
(51) Included in the price.

Total Weight: abt. 4,031 Kgs. 9000 $