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DEVELOPMENT OF AN AUTOMATIC FERTILIZER PACKING HANDLING AND DISTRIBUTION SYSTEM

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SUMMARY

The prevailing limitations imposed by labour structure, and handling and transport systems were key considerations in the design layout, machinery specification and handling arrangements for a new bagging line.

The objectives were to achieve a plant design with a high reliability factor and with continuous throughout independent of labour constraints associated with a flexible bagged storage system and an efficient and reliable transport system.

INTRODUCTION

Nitrigin Eireann Teoranta, a State owned Company established to produce nitrogenous fertilizer, started manufacturing at the Arklow factory in 1965. Two fertilizers were initially produced, Calcium Ammonium Nitrate 21 %N, which was sold in plastic bags, and Ammonium Sulphate 21% N, which was sold in both plastic bags and in bulk.

Tonnages produced during the first two years, coupled with the sales off-take patterns and the available bulk storage capacity, allowed direct bagging to transport, both rail and road, throughout the fertilizer year. It was not necessary to store fertilizer in bags for subsequent sale.

During 1967the capacity for producing Calcium Ammonium Nitrate was increased and a new N.P.K. concentrated complete fertilizer (C.C.F.) plant was brought on line. As a result of this extra production capacity it gradually became more necessary to bag product to bagged storage. This operation had to be carried out manually and in a very inefficient manner due to the layout and design of the existing bagging facilities which were meant only for direct loading to transport. At first large stacks of unpalletised bags were stored and covered with plastic sheets in the open.

Subsequently skid-palletisation, using plastic skid pallets were tried. Both systems were found to be quite unsuitable in our conditions and high losses due to handling damage were incurred. The standard wooden pallet as used by the existing fertilizer manufacturers in Ireland was then adopted. Bags were palletised onto these wooden pallets to give a 2 ton (40 bags) unit load made up of 8 layers with 5 bags per layer.

During 1968/69 N.E.T. undertook an investigation, the purpose of which was to establish the packaging and handling techniques which would best suit its existing and projected production and distribution requirements. The existing system, which involved direct handling to road and rail transport along with some inefficient manual palletisation, was incapable of coping satisfactorily with the wide fluctuations in fertilizer demand experienced at Arklow (see Fig.1).

The following points should be made concerning the bagging, handling and distribution system existing at that time :

1. Due to the existing wage structure there was no scope to increase bagging output by the use of an incentive bonus scheme.

2. Production in excess of sales requirements and bulk store capacity had to be stored in plastic bags.

3. Manual palletisation onto wooden pallets, in common with other Irish fertilizer manufacturers, had been established.

4. At the railhead depots bagged fertilizer arrived in ten ton capacity ra wagons and was manually palletised while being emptied, then stacked into storage in the open and covered with plastic sheets. A very poor standard of palletisation was achieved.

5. Excessive breakages and damage to bags occurred due to :

   (a) unsuitable design of rail wagon

   (b) handling of each bag into the wagon, out of the wagon onto the pallet and off the pallet to road transport

   (c) lack of skill of the casual untrained labour used at depots.

6. The type of rail wagon being used was old, of low capacity and available in insufficient numbers to cater for the growing fertilizer production from Arklow. The railway company had started the development of a rail wagon suitable for carrying palletised 2-ton loads of fertilizer.

7. The offtake pattern (Fig. 1) was not expected to change significantly which meant that with increased production greater stocks of bagged fertilizer would have to be carried for several months of the year. It would be desirable to have much of these stocks located throughout the country at locations readily serviced by rail.

8. The existing bagging, handling and distribution system would be quite unsuitable to meet the needs of the projected throughputs at Arklow.

Criteria for design of a new system were formulated.

1. Higher bagging outputs could only be achieved by automating the output controlling operations i.e. sack hanging and sealing.

2. Higher bagging outputs would first be necessary to fully justify a high capacity palletising machine.

3. Plastic bags of fertilizer with excessive quantities of air trapped in them would require special preparation to make them suitable for palletisation by machine.

4. The highest standard of palletisation would be required to achieve successful transportation of the pallet loads by rail.

5. Pallet loads should be capable of being stored in the open without damage for at least six months.

INSTALLATION OF FIRST AUTOMATIC BAGGING SYSTEM

In 1970 an American made automatic bagging machine was installed to replace one of our manually operated filling spouts. This machine was at first operated in loading the existing type wagons. During the following twelve months a lot of experience was gained in the operation of the machine. Many problems had to be solved concerning the operation of the machine itself and the quality of plastic film reels at first available. Bags filled from the machine had excessive quantities of air in them. The bags were quite unsuitable for palletising . In the Autumn of 1971 a bag flattening machine engineered to our requirements by a British company was installed in one of our bagging lines. Around the same time a British manufactured semi-automatic palletiser was installed. Some months later a shrink-wrap tunnel made in England was installed. By early 1972 the systems available to us were a choice of either a fully manual bagging or automatic bagging through a bag flattener to a semi-automatic palletiser with subsequent shrink-wrapping of the unit load.

Both the manual and automatic machines could also feed bags to rail wagons. To allow the excess air to be expelled from the bag by the bag flattener, it was necessary to have 8 pairs of microholes within the 0.3 - 0.5 mm. range.

FURTHER INCREASE IN PRODUCTION CAPACITY

In the latter half of 1971 a further increase in fertilizer production was being planned. Studies were carried out to establish what bagging facilities would be required to meet the projected increase. The design criteria to be satisfied were those already outlined. Specifications for the new plant were drawn up by our Technical Department in consultation with the various departments which would ultimately be involved in operating and maintaining it. Many of the features included in the specification were based on the experience built up over the period of operation of the existing automatic bagging system. Air conditioning and spillage recovery systems were features to be included.

A decision was made in August, 1972, to proceed with the installation of a new Automatic Bagging Plant. The plant was to be located at a separate location to the first Bagging Plant.

Contractors were asked to tender to a plant specification which included nominated items of equipment, i.e. Bagging Machine, Weighers, Top Heat Sealer, Palletiser and Shrinkwrap Tunnel. These nominated items of equipment were included because of preferences on the part of N.E.T. and where possible, to achieve standardisation of equipment in the factory.

The contract was awarded to a British company. This contract included a "Performance Guarantee" with provision for "Test Runs" to be carried out to demonstrate the guaranteed performance.

The "Performance Guarantee" for the plant was as follows :

"The guarantee will be based on an output of 2,700 m/tons (54,000 bags) in 72 hours. This capacity being achieved under the following :

1. A continuous run of 24 hours in which time 1,000 m/tons (20,000 bags) will be packed and during which time a 30 minute test will produce a minimum of 25 m/tons (500 bags).

2. A further continuous run of 48 hours during which time an output of 1,700 m/tons (34,000 bags) will be produced".

The Performance Guarantee test run was carried out one month from start-up and was successfully completed at the first attempt.

DESCRIPTION OF THE NEW AUTOMATIC BAGGING PLANT

Screened fertiliser discharged from a storage bin in the existing bagging plant is conveyed to the new bagging plant a distance of 140 metres. The fertiliser is elevated to a storage bin of 20 tons capacity in the new bagging plant. Both of the bins are fitted with automatic level controls. The level controls in the new plant control the operation of a slide gate at the outlet of the storage bin in the old plant. In this way fertiliser is automatically brought forward to the new plant as required.

Once the slide gate on the bin in the old plant has been closed due to high level signal the take-away conveyor feeding the new plant stops after a time interval. This allows the conveyor to be purged of the remaining fertiliser on it.

Weighers

Two electronic weighers manufactured in West Germany were installed. Each weigher can give 1200 weighments per hour at an accuracy of ± 50 grams. However, the two weighers operating alternately have been found to give well in excess of the required 1200 weighments per hour with an accuracy ± 30 grams or better. The high accuracy is obtained by automatic correction of no-load (empty bucket) tare errors and automatic correction of full load tare errors. All parts in contact with the product are fabricated in stainless steel.

Automatic Bagging Machine

The product is discharged from the weighers into a connecting hopper which has an electro-pneumatically operated valve fitted at its outlet. This valve when opened at the appropriate time in the bagging cycle lets the product flow via a flexible connecting hose into the filling spout of the bagging machine. A level switch in the connecting hopper prevents a second weigher being discharged into the hopper if the previous weigher discharge is still in the connecting hopper. The bagging machine is suitable for handling bags of the following dimensions:

	Maximum	Minimum
Length	1,130 mm	650 mm
Width	650 mm	520 mm

The machine works intermittently in that the film is moved across several points always by one bag length. The machine includes a mechanism which allows the reel to rotate continuously when the film stops for sealing. This is achieved by intermittent temporary storage of the film over a set of rollers. The machine is driven by an infinitely variable speed transmission incorporating a breked motor. A detailed description of the operating function of the machine is given in appendix attached.

Bag Presenter

The bag presenter automatically folds the open mouth of the sack after filling and presents it automatically to the sealing machine which makes the top seal of the bag. The bag is folded by pneumatically controlled steel fingers which are inserted into the open bag.

The presenter fingers and side forming plates continue to hold and support the top of the bag until the heat sealer unit takes over. The bag presenter was manufactured in West Germany.

Sealing Maching (top seal)

A radiant heat sealer of West Germen manufacture was installed. The top of the open bag which has been prepared by the bag presenter, is conveyed into and held between chains of the bag transfer unit of the sealer. The top edge of the bag is cut straight before passing into next section of the sealer. The new top edge of the bag now passes into the cleaning sectior of the sealer. The free edges of the bag above the transfer chains are opened by rotating suction wheels, thus exposing the inner surfaces which are first cleaned by a rotary nylon brush followed by a rotary felt disc. In this way clean uncontaminated polymer is exposed ready for sealing. The two seams now pass through the pre-sealing station where they are heated and pressed together to avoid the shifting of the two seams. The top of the bag now passes into the main sealing section of the sealer. This consists of three main heating elements which radiantly heat the bag top and cause it to melt. The molten top of the bag is then pressed and at the same time cooled by the two cooling chains which move with the bag to the outlet of the sealer.

Take-Away Conveyor

This conveyor transports the bag from the bagging machine through the bag presenter, the top sealing machine to a position where it is pushed off at right angles with printed face uppermost onto an air slide. It is a slat type conveyor about 11 metres long and is driven by a geared motor and variable speed unit.

Air Slide

This air slide conveyor is about 1.5 metres long and is in line with the bag tipping unit and at 90° to the take-away conveyor. The inlet of the air slide is fitted with a motorised pulley which ensures positive transfer of the bag onto the air slide. The air slide is supported on an adjustable frame suitable for varying the angle of inclination of the unit. The function of this short air slide is to centralise and align the bag properly prior to its entry into the bag flattener.

Bag Flattener

This unit comprises two sections, a horizontal vibratory section with seperate vibrator drive at the inlet end and the squeeze section which is inclined. Individual variable speed drives are fitted to the top and bottom conveyors and the entire unit is mounted on a free standing, rigidly constructed mild steel structure. The bottom belt at approx. 13.6 metres long is 3 metres longer than the top belt. Both belts are 600 mm. wide and are "grip-pace" type because the unit is inclined. The bottom belt is longer so that it may be vulcanised more readily. To ensure that vibrations are not transferred to other equipment the vibratory section sits on air tyre anti-vibration units. The top conveyor construction and method of support is such that its position above the bottom conveyor can be adjusted to achieve the squeeze pressure required.

Magazine Air Slide

A 9 metre long air slide receives the bag from the bag flattener and conveys it to the feed-in conveyor of the palletiser. This air slide also acts as a temporary storage magazine for bags awaiting feed-in by the palletiser. The air slide is fitted on each side with rigid polythene tube for centralising and guiding the bag. A narrow polythene tube diameter was chosen to avoid snagging of the bag corners as it slid down the air slide. The bag corners are higher and override the polythene tube sides.

Semi-Automatic Palletiser

The palletiser which was manufactured in Scotland is designed to take pallets of 5 ft. x 4 ft. size and to load them with 8 layers of 5 bags per layer. The palletiser consists of a feed-in conveyor, a bag pattern forming table, a layer transfer system, a stripping table, a scissors lift and a pallet magazine.

(a) Feed-in Conveyor

This belt-type conveyor with motorised head pulley is used to control the bag input to the bag layer forming table.

(b) Bag Layer Forming Table

This is an air slide table with a stainless steel perforated top plate. Air is supplied by an independently controlled fan blower fitted with a heater unit.

(c) Bag Layer Transfer Mechanism

The bag layer is transferred to the stripping table by means of a twin chain conveyor fitted with pusher bars. Once transfer of the bag layer has been achieved the bag format is consolidated by pneumatically operated front and side squeeze flaps.

(d) Stripping Table

The consolidated layer of bags is held in position by the front and side squeeze flaps and the stripping table retracts dropping the layer onto the pallet (or previous layer of bags) which is supported by the scissors lift.

(e) Scissor Lift

This has a safe working load of 2.5 tons and is fitted with a safety trip bar around the underside of the scissors table.

(f) Pallet Magazine

This is designed to take 12 off 5 ft. x 4 ft. x 6 inches deep pallets. The unit is fully automated, with the palletiser and its control system includes proximity switches.

(g) Product Reject Hopper

A reject hopper for collecting spillage and burst bags is included in the palletiser adjacent to the Operators' platform. Damaged or improperly sealed bags are rejected by the Operator into this hopper. Spillage passes from this hopper through a grid to the spillage reclaim conveyor and back to the main storage hopper of the bagging unit.

Pallet Conveyors

There are six pallet conveyors supplied by a Scottish Company.

(a) Empty / full pallet conveyor of the palletiser itself.

(b) Connecting conveyor between palletiser and change speed conveyor.

(c) The change speed conveyor which delivers the loaded wrapped pallets to the shrinkwrap tunnel conveyor.

(d) The shrink tunnel conveyor,

(e) The connecting conveyor between the shrink tunnel and the accumulator conveyor.

(f) The accumulator conveyor.

Conveyors (a) (b) (d) and (e) above are of similar construction consisting of deep link chain type with the chain wheels at 1080 mm. centres. Conveyors (c) and (b) are of similar construction consisting of two strands of hollow pin chain fitted with cross rollers at four inches pitch.

The shrinkwrapped pallet load is conveyed to the end of the accumulator conveyor where a restraining bar holds it until it is removed by a forklift truck. A mechanical hinged pair of stop bars are fitted approximately 2 metres from discharge end of the conveyor. Once one full pallet is at the extreme end of the accumulator conveyor the pair of hinged stop bars operate in over the conveyor and prevent any further pallets moving forward until the forklift truck removes the pallet load at the end of conveyor. Once this pallet has been removed the hinged stop bars swing back and allow the next pallet load to move forward to end of the accumulator conveyor. This system is actuated by a photo electric cell.

Shrinkwrap Equipment

The tunnel was supplied by an English Company.
The shrinkwrap tunnel is of welded steel frame and is lined and clad with 16 gauge mild steel sheet giving a 4 inch (100 mm) cavity which is fitted with semi-rigid mineral wool insulation. Self-closing doors are fitted at each end of the tunnel. Heating is provided by a gas fired unit with maximum output capacity of 7.5 therms per hour. The electrical equipment includes automatic ignition flame failure protection and thermostatic control of the tunnel temperature. The tunnel conveyor is driven by an electric motor through a variable speed unit giving a conveyor speed range from 7.5 to 22.5 ft. per minute (2.3 to 6.8 metres per minute).

SPILLAGE RECOVERY SYSTEM

This system has three conveyors of the scraper chain type with a capacity of 10 tons/hour. The whole bagging line is in an elevated position to facilitate spillage recovery. The spillage recovery conveyors are also installed above ground level. Spillage occurring anywhere from the bag filling point to the air slide to the palletiser is contained and passed to the spillage recovery conveyors. As already mentioned, the palletiser includes a spillage reject hopper and spillage from this is fed to the spillage recovery conveyors. All spillage entering the recovery conveyors is returned to the main bagging plant hopper via the plant elevator.

The drive unit for each conveyor comprises a geared motor unit with an enclosed chain drive shear pin device. A rotational sensing device is fitted to provide interlock signals for automatic control.

CONTROL OF PLANT ENVIRONMENT

Bag Filter

A bag filter using reverse air jet bag cleaning complete with dust hopper and rotary discharge valve is included. Dust offtake points include the filling spout of the bagging machine, the weighers, the main storage hopper and a number of other sources of dust.

Dehumidifier

A dehumidifier is installed to give a relative humidity of 50% at 15.5° C dry bulb. This dehumidifier is a dessicant type having a drying wheel of honeycomb structure formed with corrugated asbestos sheets impregnated with lithium chloride.

ACKNOWLEDGMENTS

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DESCRIPTION OF OPERATING FUNCTIONS OF AUTOMATIC BAGGING MACHINE

(See figure 3)

The machine works intermittently, i.e. the film is moved on across several points always by one bag length.

Swivelling down, the stock stripper (56) pulls a bag length of film from the film stock which has been previously unwound from the holding shaft of the film reel (125) by means of the stripper roll (item 57). With this the compensating lever (item 59) which determines the infinitely variable speed of the stripper roll is swivelled to its topmost position. (High unwinding speed). Having swivelled up again the stock stripper lever (item 56) and opened the film clamping jaw (item 18), another bag length will be stripped off by the film stripper from the formed film loop, due to the synchronously rotating conveyor rolls (items 6 and 93). In case of printed films, the length of the bags is controlled by a photoelectric cell (item 11). This type of delivery system allows the conveyance of the film to continue with the already welded bottom seam. The length of the bottom seam can be progressively changed as desired by changing the position of the "divert roll for adjusting the cutting width" (97) handwheel operated.

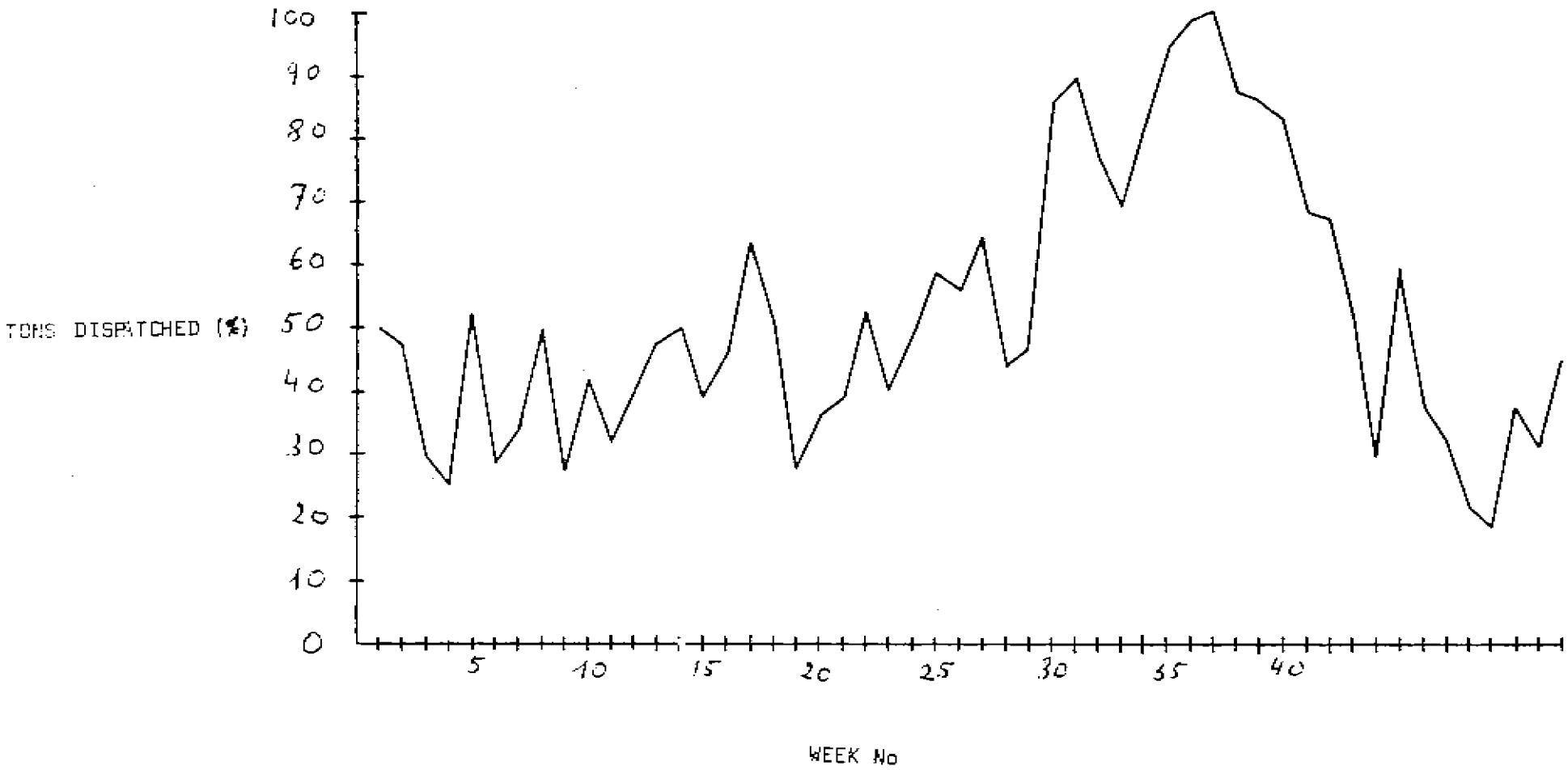
At the end of the machine the bag is cut at the cutting edge (item 107) and transferred to the take-off grippers at the suction bar (item 108) where it will be opened. The bag once being opened, the transfer grippers (item 28) take over the bag when it passes over the divert roll (item 3) for suspending it at the bag filling pipe (item 1). The filling product coming down through the filling pipe (item 1) pulls the bag over the divert roll (item 3). This type of filling system provides for an essential reduction of air inlet, so that the bags can be well loaded and piled.

The operation of the bagging machine is synchronized with the fill weighers.

EXPLANATION OF THE NUMBERS

1	bag filling pipe
3	divert roll
6	conveyor roll, in front
11	photoelectric cell
18	film clamping jaw
28	transfer grippers
56	stock stripper
59	compensating lever
76	take-off gripper
93	conveyor roll, rearward
99	contact pressure roll, rear
97	cutting length adjuster
57	stripper roll
24	film end switch
106	contact pressure roll, in front
107	cutting edge
108	suction bar
125	wrapping film shaft
135	air cooler 11
136	air cooler 1
137	air cushion
138	welding apparatus

WEEKLY DISPATCH OF BAGGED FERTILISERS SHOWN AS A PERCENTAGE OF MAXIMUM WEEK



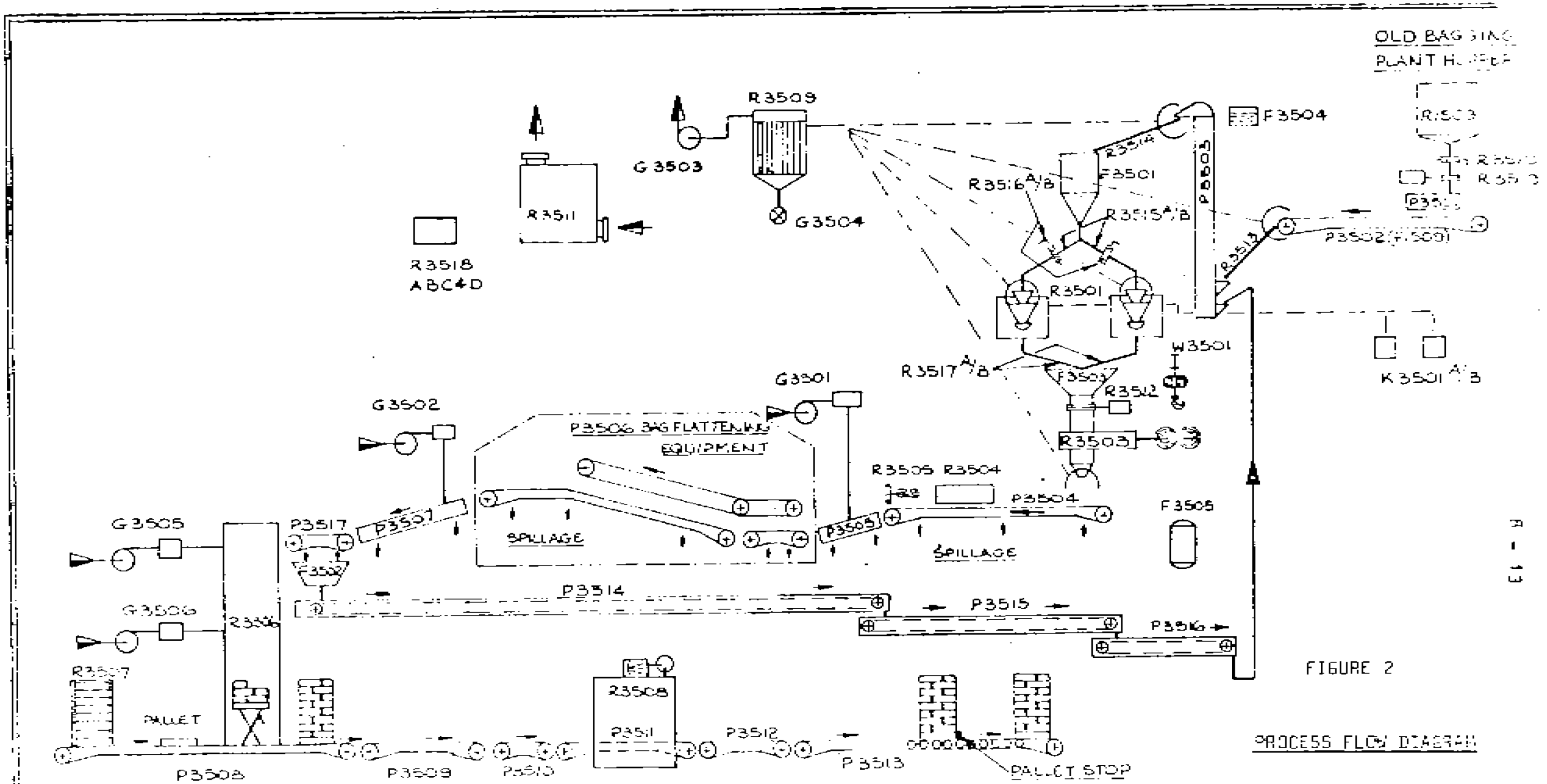


FIGURE 2

PROCESS FLOW DIAGRAM

EQPT	DESCRIPTION	SPEC CODE	EQPT	DESCRIPTION	SPEC CODE	EQPT	DESCRIPTION	SPEC CODE	EQPT	DESCRIPTION	
[illegible]	[illegible]	[illegible]				R3518	HEATER UNITS A B C D	[illegible]	F3501	STORAGE HOPPER 20 TONS CAP	[illegible]
[illegible]	[illegible] CONVEYOR (P1509)	[illegible]				R3509	[illegible]	[illegible]	F3502	[illegible] HOPPER AT R3506	[illegible]
[illegible]	BUCKET ELEVATOR	[illegible]							F3503	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	LIBRA WEIGHER	16-701				F3504	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	LIBRA WEIGHER	16-702				F3505	AIR RECEIVER	
[illegible]	[illegible] STACKER	[illegible]	[illegible]	AUTOMATIC BAG [illegible]	16-703						
[illegible]	[illegible]	[illegible]		[illegible]	16-704						
	[illegible] PALLET [illegible]	[illegible]	[illegible]	BAG PLACER	[illegible]						
[illegible]	[illegible] CONVEYOR	[illegible]	[illegible]	[illegible] PALLETISER	[illegible]						
[illegible]	[illegible]	[illegible]	[illegible]	PALLET MAGAZINE	[illegible]	G3501	FAN FOR AIR SLIDE P3505	16-301	K3501	A/B WEIGHER CONTROL PANEL	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible] TUNNEL	[illegible]	G3502	FAN FOR AIR SLIDE P3507	16-302			
[illegible]	[illegible] PALLET [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	G3503	FAN AT R3509	16-303			
	PALLET [illegible]	[illegible]	[illegible]	[illegible] MANUAL OFF [illegible]	[illegible]	G3504	ROTARY VALVE	16-304			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	G3505	FAN AT R3506 [illegible]	16-305			
[illegible]	[illegible]	[illegible]	[illegible]	BLOCKAGE [illegible]	[illegible]	G3506	FAN AT R3506 STRIPPING [illegible]	16-306	[illegible]	HOIST FOR REEL [illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	CHUTE TO P3515	16-713						
[illegible]	[illegible]	[illegible]	[illegible]	CHUTE FROM R3503 P3507	16-714						
			[illegible]	[illegible]	16-715						
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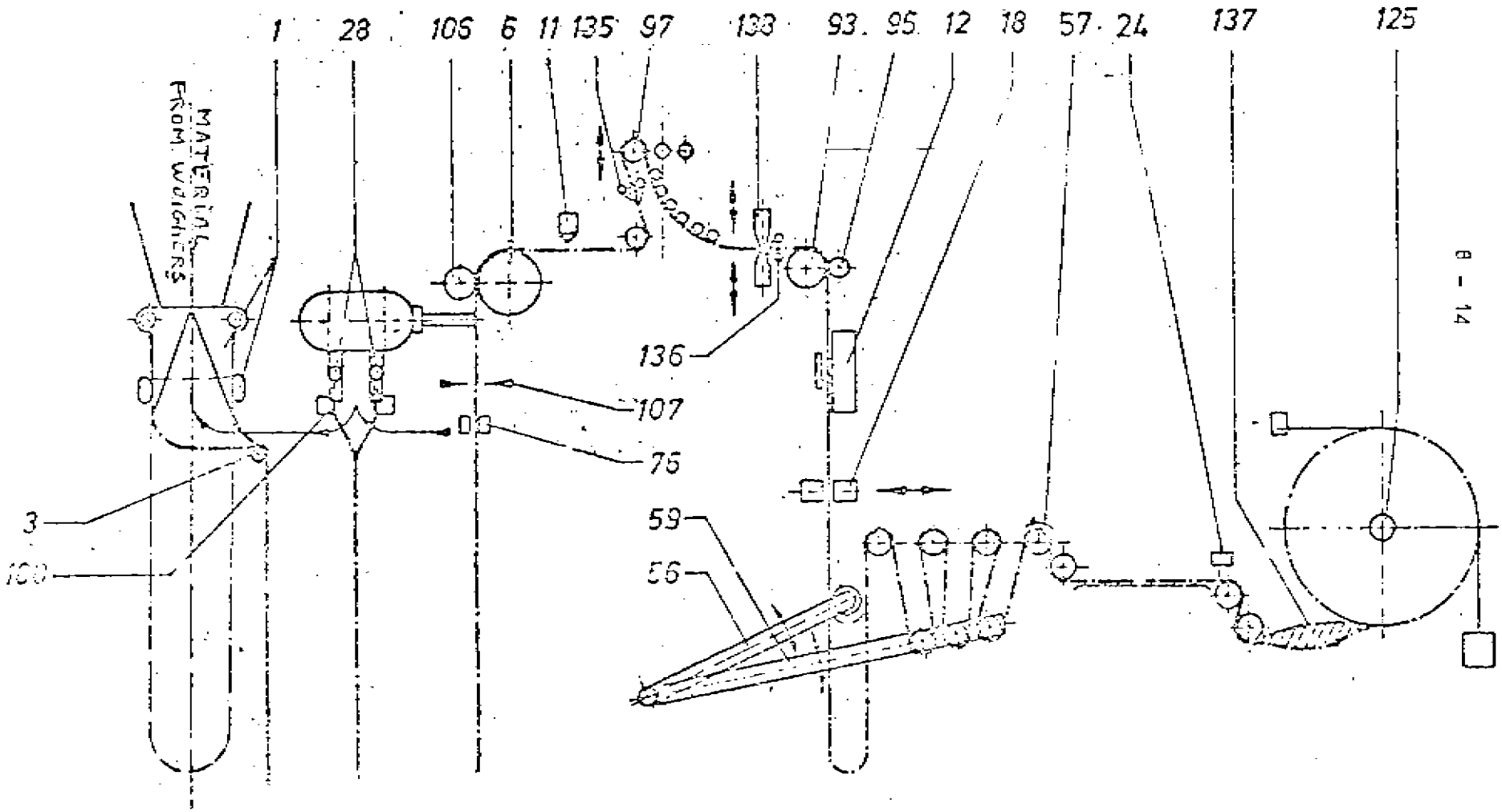
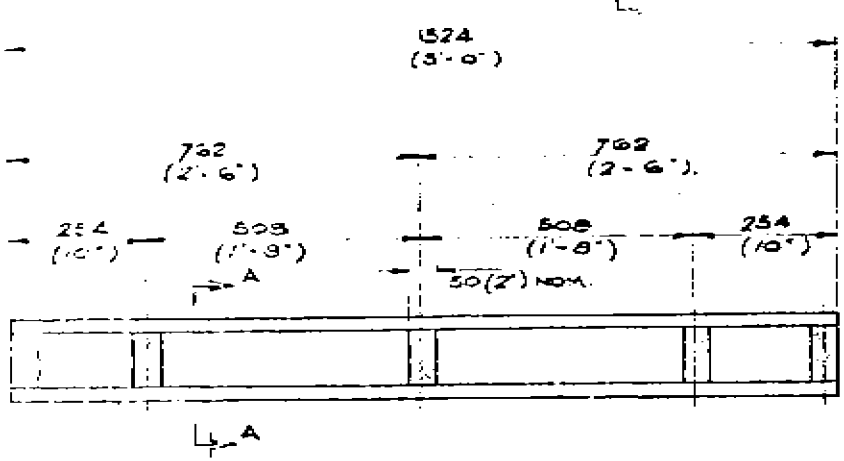
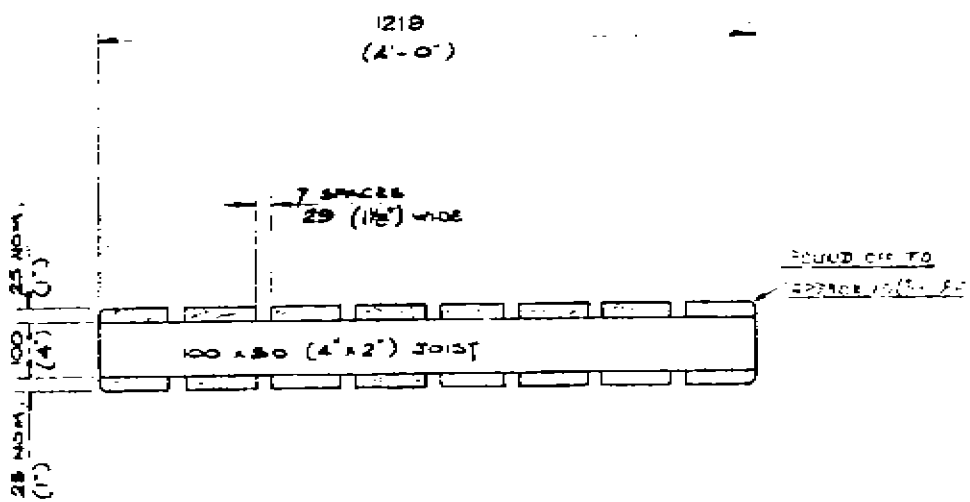


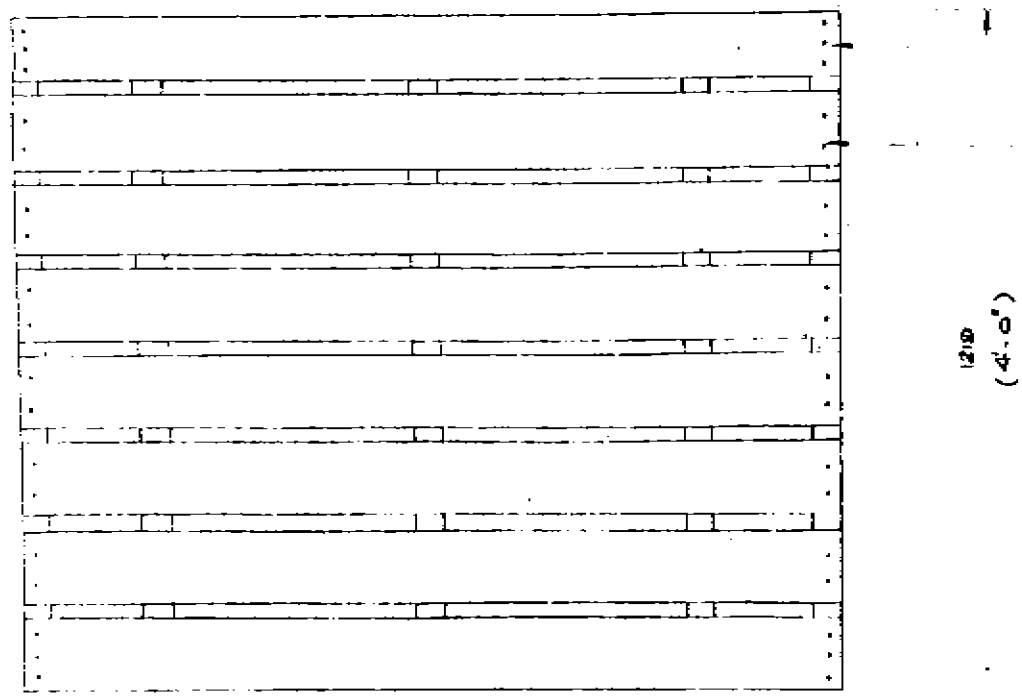
FIGURE 3

SCHEME OUTLINING BAGGING MACHINE OPERATION





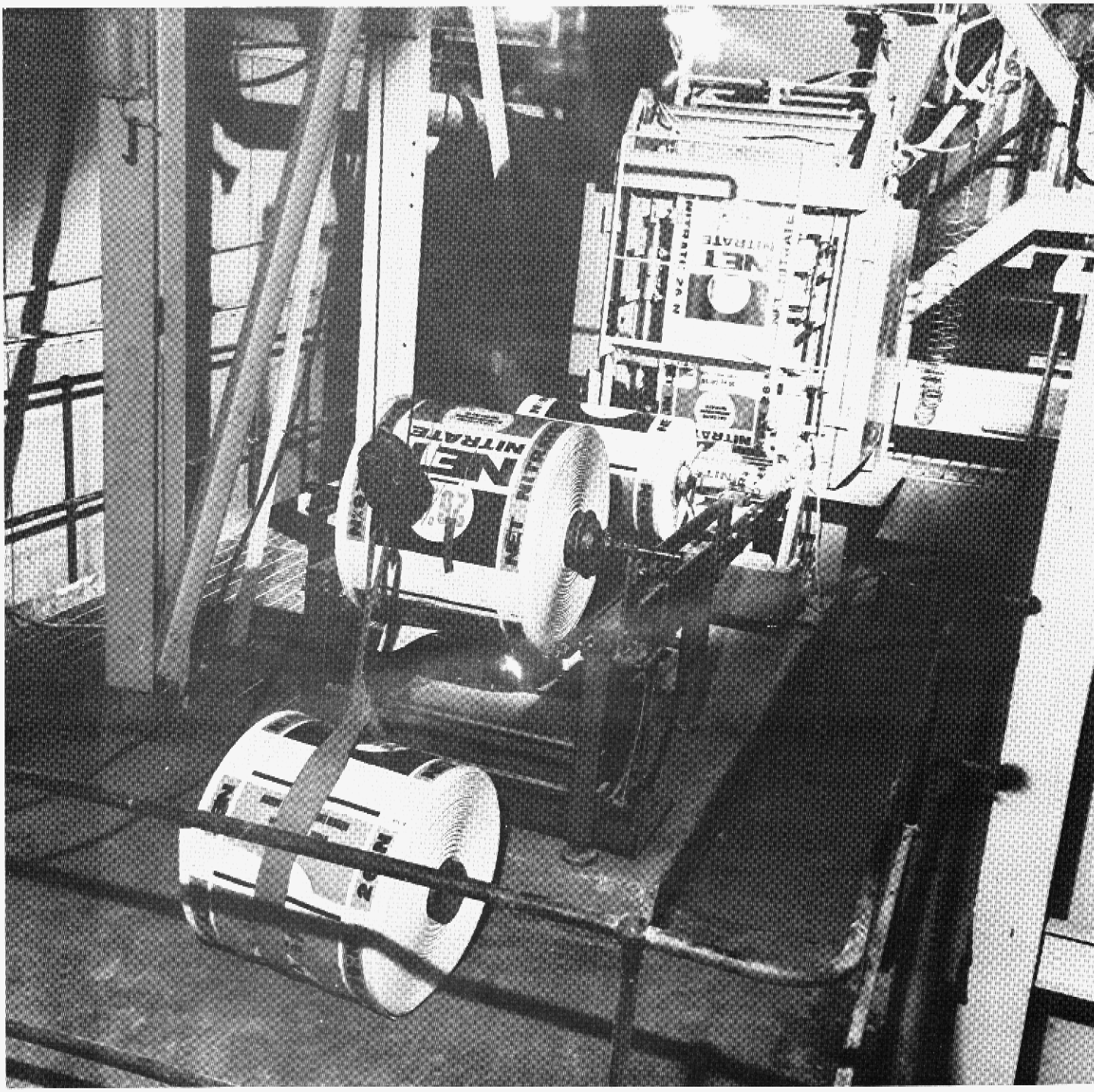
SECTION A-A



57 (2¼") OR 65 (2½") LG. RESIN COATED DFF FASTENERS
3 N LEADING EDGE BOARDS -
- 2 N ALL OTHERS

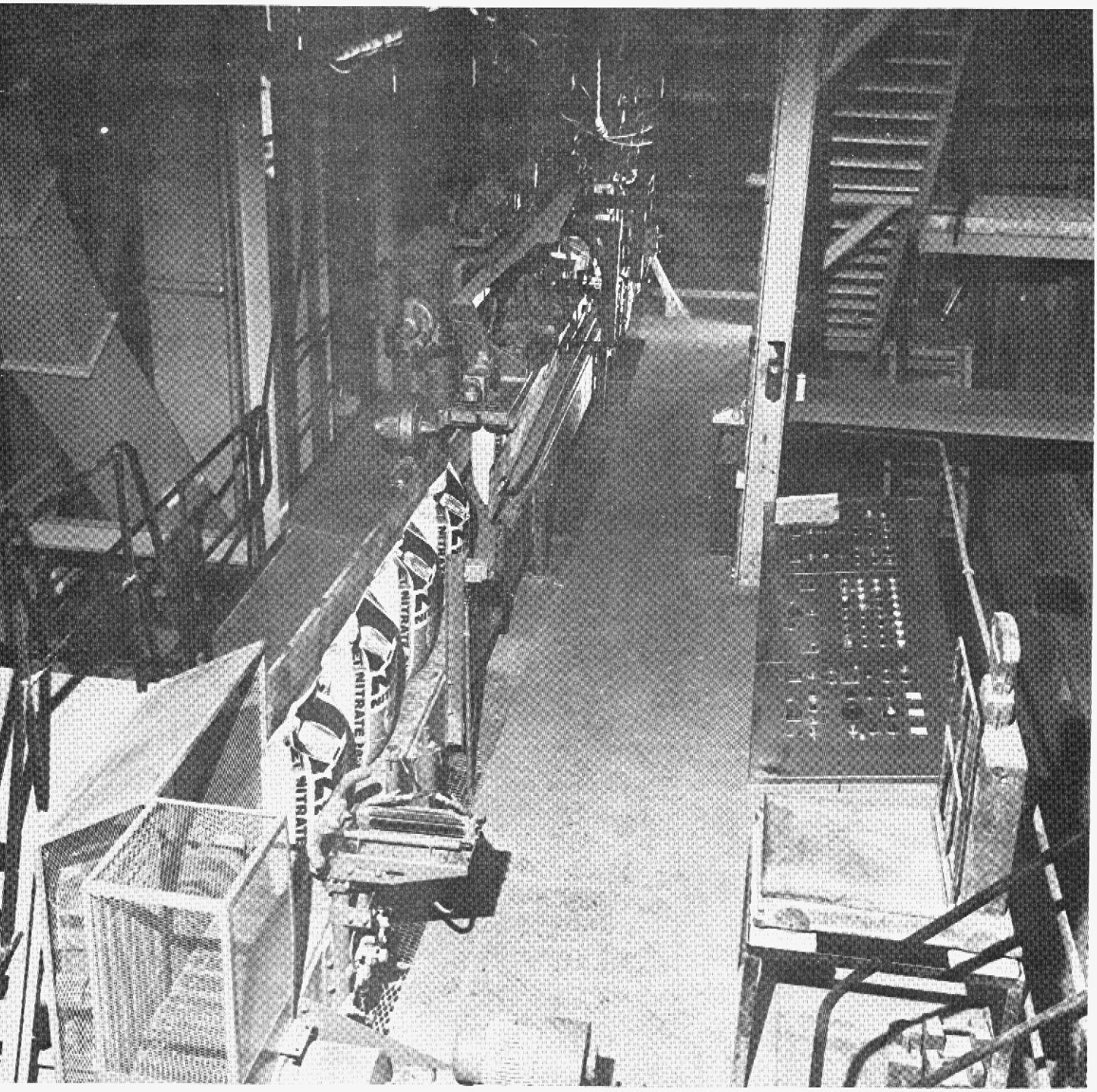
FIGURE 4

STANDARD DOUBLE DECKED
TWO-WAY ENTRY PALLET



VIEW OF THE BAGGING MACHINE SHOWING FILM UNWINDING STATION

FIGURE 5



GENERAL VIEW OF THE BAGGING MACHINE OPERATING
PLATFORM SHOWING BAG FILLING, TOP SEALING AND TAKE-AWAY CONVEYOR

FIGURE 6

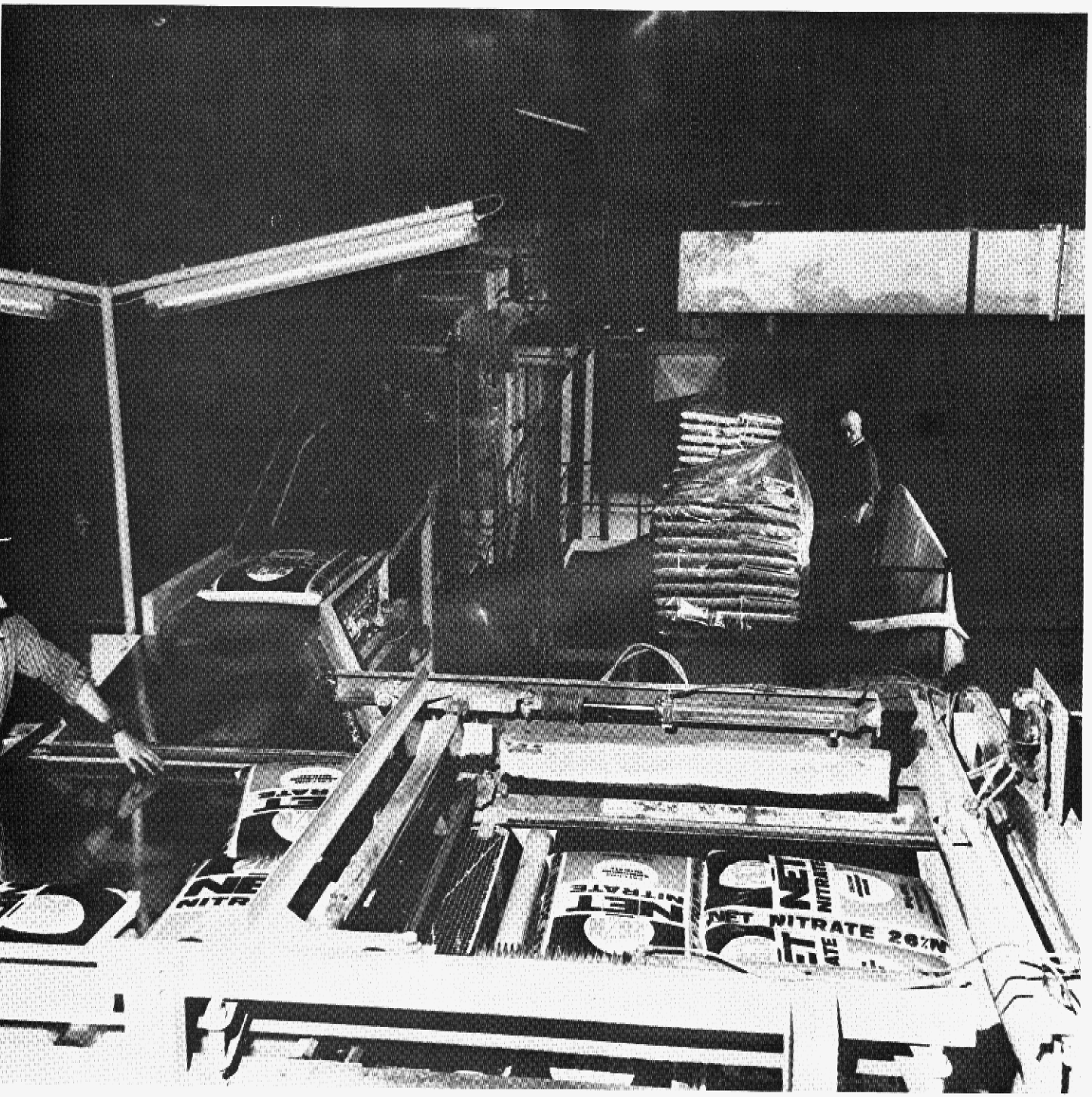


FIGURE 7

GENERAL VIEW FROM ABOVE PALLETISER SHOWING

(a) Pattern forming table

(b) Top layer of bags with stripping table retracted and

(c) Shrinkwrap hood being manually put over pallet load

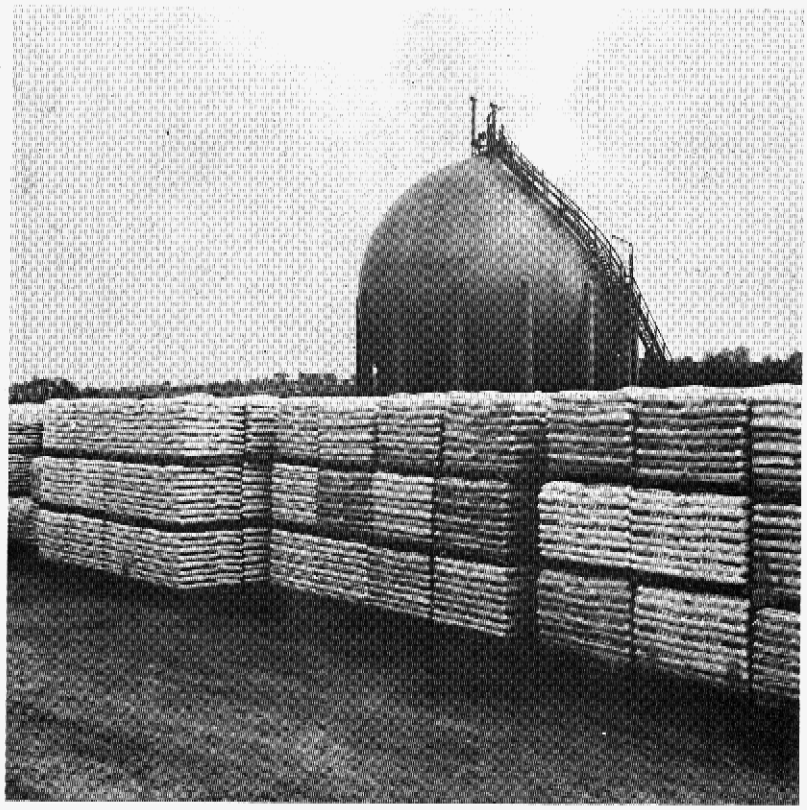


FIGURE 8

GENERAL VIEW OF SHRINKWRAPPED FERTILISER STACKED IN THE OPEN.

FIGURE 9

VIEW OF FIXED AXLE PALLET WAGONS CURRENTLY IN USE

FIGURE 10

OPEN TYPE RAIL WAGON MANUALLY LOADED WITH BAGGED FERTILISER AND COVERED BY PLASTIC SHEET CAPACITY 10/12 TONS

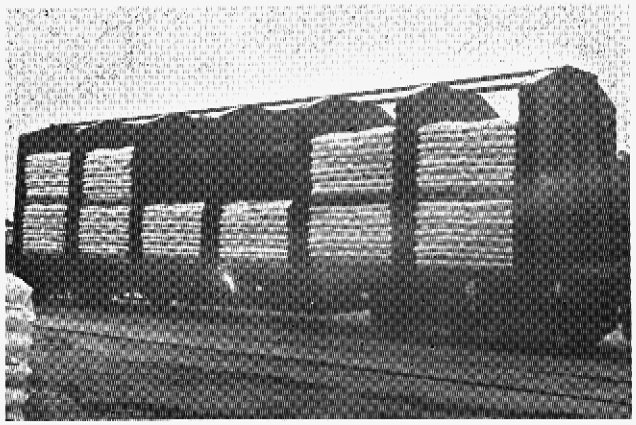


FIGURE 11

VIEW OF 40 TON PALLET WAGON WITH DOORS OPEN AND RECESSED BETWEEN COMPARTMENT PARTITIONS
(ultimate capacity of 48 tons payload)

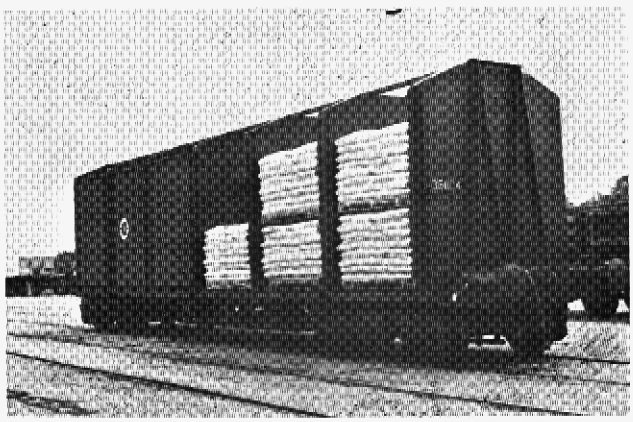


FIGURE 12

VIEW OF 40 TON PALLET WAGON WITH DOORS OF THREE COMPARTMENTS CLOSED AND DOORS OF THE REMAINING THREE COMPARTMENTS OPEN

DISCUSSION

Mr. GOWRAN (Nitrigin Eireann Teoranta, Ireland)

Since we commissioned the plant our experience with it has generally been very good. It reached its performance guarantees very soon after commissioning, but because of our recent production patterns we have not to put pressure on the new plant to produce continuously at its guaranteed rate or indeed above it. We feel, however, that higher rates can be achieved on this plant in the future.

The total system we have described has been developed as a solution to our particular problems in Ireland. Parts of this will be applicable to other countries, but a lot of it is only applicable to Ireland where the N fertiliser industry is very new and is expanding at a very rapid rate.

Mr. Gowran then presented a short film of the packing plant to illustrate what they have done in Arklow as described in the paper.

Mr. KABIL (Donau-Chemie, Austria)

The problem of bagging and handling fertilisers within a factory gets increasing importance especially with regard to efficient fertiliser storage and fertiliser transport to the customer. As a matter of fact, the handling and transport problem represents a major aspect in fertiliser manufacture itself, being an important factor influencing to a high degree the economics of production. Particularly the shortage of man power on the one hand and the high investment generally necessary for creating storage room have made increased efforts necessary to develop efficient systems of fertiliser handling and storage. Furthermore, the rythm of delivery of fertilisers to customers which is the subject to wide seasonal fluctuations in summer, autumn, etc. demands very flexible handling, storage and dispatch systems at the fertiliser works. There cannot of course be any general solution to these problems because of the different aspects and the particular needs of production and of the customers in different areas or in different countries. Generally a certain equilibrium has to establish within a factory between the storage room, bulk storage, bag storage, the bagging system and the dispatch system.

The present paper and especially the film have given a very comprehensive account of a highly automized bagging and palletizing unit for nitrogen and NPK fertilisers in Ireland, fertilisers which are rather sensitive to caking on storage. As a similar unit is also used in our works, in Austria we could also get already some practical experience in this field. So consequently I may pose now a few practical questions with regard to the system as adopted. First of all to the general aspects, what is the distribution between palletized fertilizer prior to dispatch and fertilizer being directly dispatched either in bulk or in bags ? The second question relates to the shrink wrapping. We all know the shrink wrapping is becoming very popular but has not generally been adopted by the fertiliser industry because of its rather high cost and so what the reason was that you adopted shrink wrapping and, attached to this question, how fertilisers do behave when shrink wrapped and stored in the open, knowing that polythene sheet

has a certain permeability for water vapour? And the third question is also important:what is the personnelrequirement for the plant which is making according to the paper about 4 tons an hour ?

Mr. GOWRAN

To answer the first question which is : how much fertiliser do we palletize ? At present, we are palletizing in excess of 70% of our outputs. Why did we adopt shrink wrapping ? We adopted it certainly so that we could store fertilizer in the open. As I mentioned earlier the N fertiliser industry is new in Ireland, so there were no traditional stores for storing this product around the country and, as a result, new storage areas had to be developed for the product and it was in conjunction with the transport company who is handling the fertiliser and who is storing this in depots at rail heads around the country. That was with this purpose that we went into shrink wrapping. So we store fertiliser for may be 6 months out in the open with shrink wrap. We don't shrink wrap during the season when the fertiliser is going out directly on the land. For a good part of the year we have to shrink wrap for storage purposes. With regard to the behaviour of the fertiliser, we do have caking problems like everybody else and in general the problems with the 26% product have been very good. We did have some problems with break down of this product during the summer but again the climate in Ireland is favourable from this point of view. It never gets too hot. We do have some break down of our 26%. And again I must say that this problem is continuing with us and we are looking at ways of stabilizing our ammonium nitrate. We do have bigger problems with the NPK product if we store it for long periods. So we have to have a very good coating as well. With this system now we don't get very much ingress of moisture into the pellets, but as a further development we are installing a machine on this line to close off the microholes that we have in the bag. This is the last place that the moisture can get in. So we are installing a machine to close off these microholes.

With regard to personnel on the plant, 6 people are employed, a senior operator who is in charge of the whole plant, a bagging machine operator who looks after the reels and bagging machine, a palletizer operator, a shrink-wrap operator, a fork lift truck driver and a relief operator who can moved round the various jobs to make the operation continuous.

Dr. KOPPER (B.A.S.F., Germany)

I have a question. Is there any material sent in bulk or is everything bagged and 70% palletized ?

Mr. GOWRAN

Yes everything is bagged.

Mr. CHAUMERLIAC (Azote et Produits Chimiques, France)

You indicated performances of your plant of about 1000 and 850 t/day. In spite of the reservations you expressed when you began your talk, could you

give us the recent delivery capacities on an 8 hour shift or on a 24 hour day ? Other question : in your talk you mention 120 x 150 cm pallets. Is this the only type of pallet you use irrespective of the fertiliser shipped, ammonium nitrate or complex fertiliser ? I repeat the question of the distribution network you have after your bagging and storage system, that is do you ship mostly by rail, by truck and do you store a lot ?

Mr. GOWRAN

I did preface my statement saying that we have not got a lot of pressure at this plant at the moment so our shipping recently is in the region of 850 t per day but it is very possible to get an excess of 1000 t which was the guaranteed figure. The second question was with regard to pallets. They are single pallets and we use the same pallet for all of the products. The third question about the distribution. We send out again about 70% of our output by rail and the remainder goes out by road.

Mr. ROLFSEN (Norsk Hydro, Norway)

We heard you closed the breathing holes of the bags. We never do that when we are using shrink wrapping. Why are you doing it ? Is it necessary to do it when you have the shrink wrapping on top of the bag ?

Mr. GOWRAN

We certainly want to do this when we are not using the shrink wrapping because the climate in Ireland is rather damp and it means that we can use the shrink wrap less often for a short period of the year if we cover the holes at that time.

Mr. TAPLIN (Seabright, U.K.)

I would like to know if you have any problem regarding friction on your air slide particularly on to the palettizer end, if you have,what have you done to overcome that problem ?

Mr. BROWNE (N.E.T., Ireland)

Yes, we do have some problems and we use a releasing type material at times to release the bags and make them slide more readily.

Mr. DE BONTRIDDER (Fisons UCB, Belgium)

There is one thing which is not clear in my mind regarding the stage of shipping pellets. Do you ship them to a further distribution stage or directly to the consumer and, in the latter case, how do you handle and depalletize ?

Mr. BROWNE

We have arranged with the transport company a system whereby they come with block train and take loads from the factory and we are getting to the stage with the new type of waggon of having a 24 hour turn around. This means that we store into storage space and load over a short time something in the region of 2-3 hours to load a 400 ton block train and it is shipped to our railhead storage point or to our customers storage point directly.