OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

07717

Distr.
LIMITED

ID/WG.248/13
27 October 1977

ENGLISH

United Nations Industrial Development Organization

Workshop on Adhesives used in the
Wood Processing Industries

Vienna, Austria, 31 October - 4 November 1977

MIXING EQUIPMENT FOR GLUE COATING OF WOODEN CHIPS OR IRREGULAR PARTICLES OF SIMILAR SHAPE[1/]

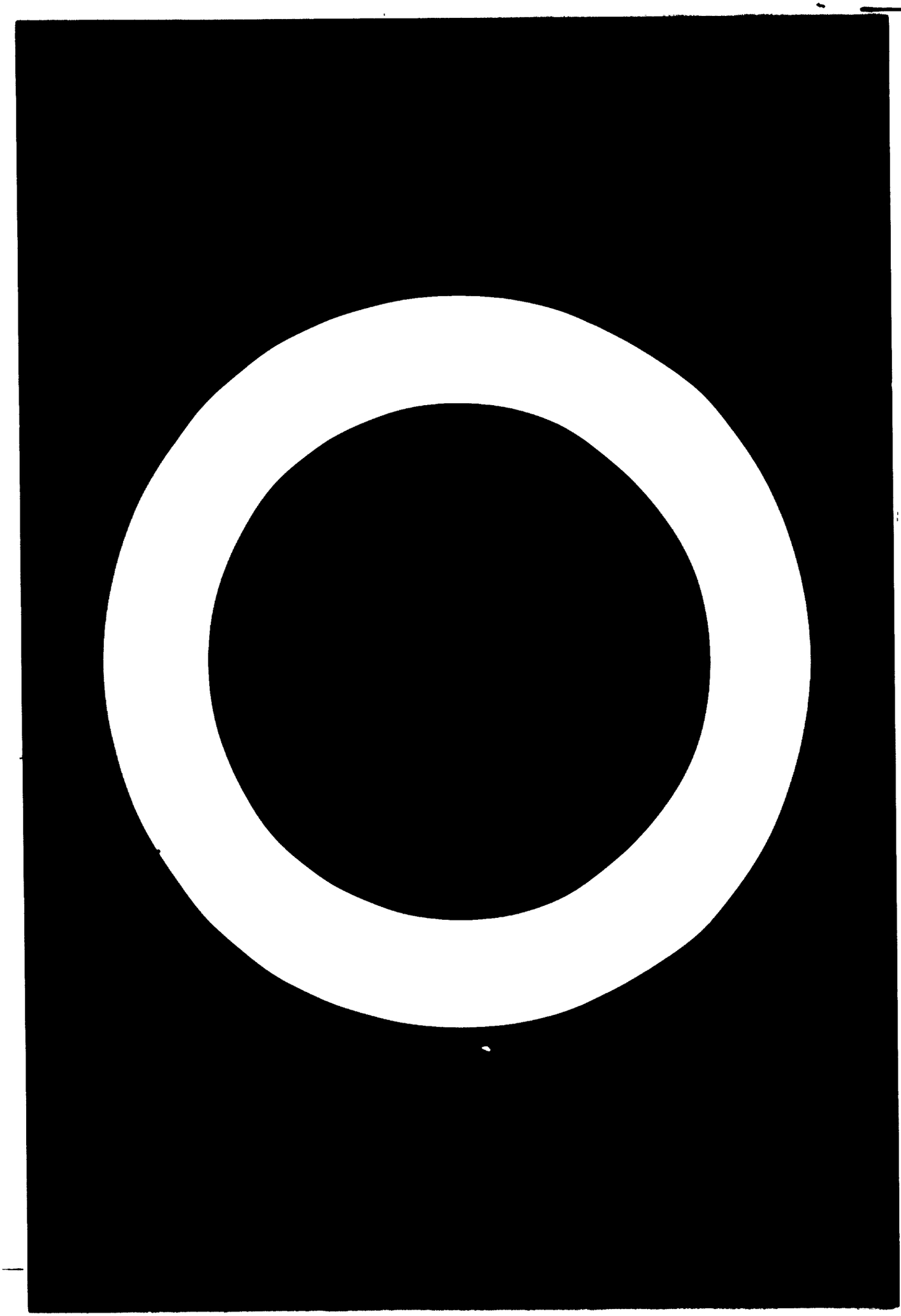
by

K. Engels*

* Chief Engineer, Dreiswerke GmbH. Mannheim-Waldhof

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.77-7657



CONTENTS

1. Introduction

The subject of this paper deals with "mixing equipment" for the highly automated particle board production. The predominantly continuously working glue chip mixers and their coating results largely depend upon the dosing systems of glue and chips and their ratio control units because of the required particle glue coated quality. Here it has to be stated why different end products apply different kinds of chips and why these chips require different glue coating systems.

2. Type of Boards - Type of Chips

This paper includes only the most important board types and those which probably become important in the near future. Also molded boards and boards made from annual plants such as sugar cane bagasse, flax, straw, etc. cannot be discussed in detail.

2.1 Standard Chipboards

These boards developed to a high extent after the Second World War are being known as a quality product in the wood working industry all over the world and literature available includes detailed information about production and properties of the various board types. At this stage it is unimportant to give details on the manufacturing process whether they are of the single-layer or multi-layer type, whether the mat has been air or impact spread, whether they have been manufactured in hot platen presses with single or multi-openings, whether the continuous extrusion press or band pressing system is applied.

It is important to know that all standard chipboards are consisting of more or less variable particles. The size of the individual wooden chips varies between 30 mm x 15 mm x 0.6 mm for coarse chips down to screen meshed size smaller than 0.2 mm like dust. It is known that these chips can be statically loaded to a great extent. Slight chip destructions are of no importance which will to a certain extent influence the bending strength, whereas the transverse tensile strength and the homogenity of the boards can be considerably improved. Glue coating of these chips can

be performed without any exception, in the high-speed ring chip glue blender which will be described later.

2.2 Plychip Board System SCHWIERTZ

This board consists of cut thin flat "flake like" chips with the dimensions of approximately 15 mm x 15 mm x 0.2 mm. It is mentioned here, because it is in practice the only chip coated by spraying achieved inside the chip glue spraying blender generally used during the past years. In many cases boards based on flake-like chips can replace high quality plywood. But this paper cannot deal with quality and/or cost of a board or any other features influencing various board types.

2.3 Strand boards system "WILHELMI".

Boards with aligned long chips have a high bending strength along the chip direction. Besides a low weight and other features boards with straight long chips should have a good bending strength in all directions. The boards are based on thin and long chips up to 80 mm. These chips have to be glue coated with care. Blenders with standard mixing elements are not suitable for glue coating of long chips appropriate units are gravity feed drums, such as the DRAIS glue coater drum with spraying device for liquid glue.

2.4 Waferboard-System DEYM-MOELTNER

This kind of board contains the largest flat chips called "wafers" 50 mm x 20 mm x 0.6 mm insiss. A chip destruction during the glueing process has to be avoided by all means. Application of these boards should be possible in fields which have in the past only been supplied with plywood of lower value. The low proportion of 2.5 per cent solid resin in relation to the wafer mass in the "atro" stage favours the addition of dust-like dry resin that is made in the DRAIS gravity feed drums, system DEYM, with spraying of resin.

2.5 Medium-Density Fibreboards

These boards - briefly called MDF-boards - consist of defibrated fibres. These boards are in competition with chipboards, of high quality, having a particularly good homogenity over the entire board thickness. MDF boards are based on phenolic formaldehyde resin as well as with urea formaldehyde resin. Phenolic resin is already added during the defibrating operation. Because of the heat sensitivity of urea resin a special mixer is required. All fibres, varying in their spread density from 20 to 40 kg/m3 tend to felting. Thus glue coating mixers applied have to avoid the pressing of the fibres. High-speed mixers with a fibre-air dispersion and the glue spraying units are used, e.g. the DRAIS-TURBOPLAN mixer in special design for fibre glue blending.

2.6 Boards made of particles from annual plants or other particles

The particles of these boards which have to be glue coated can be classified according to size and trickling ability in comparison to wooden particles mentioned before.

Fig.1 includes a particle classification developed by the author and published by Scheibert in 1958. It had to be completed according to further developments in particle board production based on the spread weight in kilogram per cubic meter. It is important that the particle spread weight for standard chipboards has considerably increased because of using smaller and highly disintegrated particles. The earlier figures are more related to soft wood chips such as spruce, fir and poplar and consequently they have to be adapted by a corresponding conversion factor for the heavier wood particles such as pine, beech, oak, etc.

3. Mixer for glue coating

In this chapter, mixers of certain importance in particle board production will be today described in detail. All these mixers have troughs or drums arranged horisontally (with the exception of laboratory mixers). The particle glue blending is a continuous operation. Feed of chips is generated by rotating agitators in stationary troughs or by rotating drums without agitator. Mixers with agitators are adjusted for three

different speed ranges: range below the critical speed with thrust effect (thrust mixers), slightly over-critical speed range with throwing effects (throw mixer) and by far over-critical speed range with ring thrust effect (ring mixer). At the critical speed level all free circulating particles, tunned with the agitator's peripheral speed, have a centripetal acceleration equal to the acceleration of gravity.

Fig.2 - Technology of Drum Mixers for glue/particle blending with agitator system.

3.1 Ring Mixer

Ring mixers are the first to be described because they are at present the most important machines applied for all kinds of chips for standard chipboards

Fig.3 - Ring mixer, type TURBOPLAN with the following sections: chip in feed section, glue spreading section and re-mixing section.

It is important that within the spreading section the coating nozzles apply the glue directly into the annular flow of the chips; the nozzle system is simultaneously the mixing unit which maintains the annular flow.

The glue flows without pressure into the glue nozzles through a stationary distributor tube located inside the shaft. An essential advantage of ring mixers is that inconvenient pollution is avoided by the cooling of through, mixing shaft and re-mixing implements. A certain difference between the inner temperature of the chip-glue-air blend and the temperature of the inner machine surfaces causes a condensation effect preventing pollution.

Fig.4 - Maximum water cooling temperature above chip in feed temperature.

The high mixing intensity effects a good glue distribution on to the chip surface which is by far better than effected in throw mixers used formerly.

Fig. 5 shows that coarse chips are coated better with the ring system

compared to formerly applied systems. This is probably the reason for saving glue when using these ring mixers.

Another advantage causing high mixing intensity in ring mixers is the small size. The specific loading capacity is approximately 25 kg per 1 litre mixed volume, thus fifty times higher than generated in throw mixers and a hundred times higher than in gravity feed mixers.

Instead of glue feeding through the shaft which is also called internal glue coating or active glue coating it was recently discussed to feed the glue through the trough wall which is called external glue coating or passive glue coating.

Already in 1963, the Company DRAISWERKE have bulk ring mixers with external glue coating but the real know how about this sytem was established in 1970: That glue coating <u>within</u> the annular chip flow is better than <u>on</u> the outer circumferance of the annular flow. It has not yet been proven whether the advantages resulting from a simpler handling will compensate possible disadvantages as for instance a more difficult pre-distribution.

3.2 Throw Mixers

From 1952 to 1970 this kind of mixers were known as standard glue coating machines for all types of chips. For glue coating of the thin, flake like chips for ply chip boards, speed and shape of these mixers had to be tuned so that redisintegration is avoided.

Fig.6 shows a throw mixer; agitator running at medium speed, oval and tiltable trough, with overflow bucket wheel and spraying of the glue from outside with overhead nozzles along the trough - these are the main characteristics.

3.3 Gravity feed Mixers

Gravity feed mixers, for industrialuse, operating continuously. The drums are rotating while the material is passing through from the infeed to the outfeed end. Gravity feed mixers will be applied for glue coating when chips should not be exposed to any mechanical force.

The frequently used DRAIS glue coating drum type FTR is operating as follows:

Driven friction rollers on the base carry the drum and maintain the rotation. Fixed drum bottoms permit the charging and discharging, if required an overhead discharge outlet will bebuilt in at the drum centre. The chip flow is maintained by inclining the drum with its base frame and by varying of the drum speed.

Fig. 7 - Gravity feed mixer, type FTR.

Certain requirements for intensifying the chip movement inside the drum, combined with an optimum of spreading of the binding agents DRAISWERKE have succeeded in further developing the gravity feed mixing drum to increase the blending capacity from 0.05 kg per liter drum volume to 0.5 kg per liter drum volume - which resulted also in improved glue coating quality.

For strand boards and oblong chips the glue is usually sprayed as liquid into the blending chamber. Pressure nozzles are predominantly used. The necessary spraying pressure is about 30 bar.

Fig.8 shows the nozzle system at the in feed chute of the chip glue blending drum.

The advantage of the pressure nozzles is the fact that they are spraying without air. The disadvantage is the narrow cross section of the pressure nozzles with their danger of clogging. The trouble free two component nozzles, however, operating with compressed air are still required. The disadvantage is that the compressed air used for glue spraying has to be drawn off the drum.

For glue coating of the large-surface chips (wafer size) for Waferboard production, the glue is preferably injected in form of powder.

Fig.9 shows the system of batch type powder dosing by means of a feedscrew part of the injector. This injection process permits a very good resin distribution on to the chips without running the risk of a decomposition because of the low solid resin ratio of only 2 - 3 per cent

to the absolutely dry catrol chip. A further advantage of powder injection compared to wet spraying is the less pollution of the interior of the drum. Again and again the liquid glue application for waferchips will be discussed but the injection system requires less maintenance.

3.4 Turbo-Mixer for Fibres

While chips in the ring mixing system rub each other during the annular movement, fibres would tend to felt. Thus all fibroue materials require special mixing equipment like the "TURBOPLAN" mixer. Special pointed slim implements generate a picking effect within the annular layer and an intensive air circulation maintains the disaggregating condition to avoid fibre felting. The glue is sprayed from the centre into this fibre-air mix. The intensive air circulation is achieved by vent paddles at the entry of the mixer as well as by star-shaped radial paddles along the shaft; the pointed implements are arranged outside these venting paddles.

Fig.10 gives an impression of this construction.

4. Dosing

Independent of its efficiency, each mixer can maintain a blending ratio only according to the loaded particle quantity. The tuning of the components to be blended in the batch mixer causes no problem. It is more difficult with continuously working mixers. In this case, the feeding ratio between the components, viz: chip and glue, has to be constant within the unit of time. The tolerance will be tighter the smaller the mixer volume is in relation to the through-put capacity. While large mixers hold the blended mix up to 15 minutes, this time has been decreased to 10 seconds in the modern ring mixer. In the first case, short time dosing errors or ratio divergences are automatically compensated, a batch feeding of chips and/or glue is possible without any unfavourable effect to the glue coating result. Thus direct and batch feeding by means of batch weighing machines has been applied in large mixers without any equalisation of the blended material. In low volume ring mixers deviations of more than two seconds in dosing accuracy or dosing ratio can no longer be compensated

nor modulated. Chip charging controlled by batch weighing machines thus requires an equalization to guarantee a continuous operation.

4.1 Chip Dosing Systems

Two systems are applied:

a) batch charging by batch weighing machines and

b) continuous charging by belt weighing machines.

4.11 Batch Weighing Machines (according to Fig. 11)

Batch weighing machines are quite frequently used in the chipboard industry. They operate as follows:
A weighing bucket, usually inside a dust proof housing, is filled with a pre-selected quantity of chips coming from a storage bin via discharge device which can be switched on and off whenever required. At certain time intervals, either according to time indicator or pre-selection of the glue quantity, the release for discharge of the weighing bucket follows. The weighed quantity together with the number of discharges per time unit indicate the throughput. The advantages of the batch weighing machine are the following:
no exact bin discharge is required, constant output without variations, insensitive against dust adhesion due to large amount weighed in, tare control at each batch with automatic signal, easy to overlook without any electronics.

A disadvantage of the batch weighing machine is the fact that the ouput of the bin discharge must exceed the maximum plant throughput by 30 - 40 per cent because 2/3 of the cycle time only is set for filling the weighing bucket. There is another considerable disadvantage when charging small mixers. Before charging the quantities of chips in batches they must be formed for a continuous flow. Trials for equalization in smaller controlled dosing bins failed because of the lack of appropriate test data. The Company DRAIS, however, developed two simple equalisation systems needing no control. The first is based on the so-called "Konti-Takt-Bunker" (continuously-cycling bin) which is indeed a mixer with large volume adjusted to constant overflow discharge, also at batch chip charging. The second is based on the so-called "Konti-Takt-Differenz-schnecke" (continuously-cycling difference screw), a double screw for large

volume adjusted for a high speed range, permitting a constant discharge over a wide throughput range, even if the batch cycles for charging have changing intervals.

Because of the necessity of equalization chip dosing by batch weighing machines are no longer low priced compared to dosing by continuously working belt weighing machines. However, batch weighing machines are still required because of their considerably lower requirement for operation and maintenance staff.

4.12 Belt Weighing Machines

In the chipboard industry the belt weighing machines register the chip flow from the dosing bins according to its throughput. The measured value is practically in all cases the basis for adjusting the liquid resin mix by a pre-set ratio control system. If required, the discharge of the chip-bin can be kept to a constant value by means of a separate control system. Of course, this kind of chip control can only be as accurate as the corresponding precision of the bin discharge device permits.

There are different belt weighing machines such as bridge-, short belt-, lever-weighing machines, etc. The Company DRAIS has developed its own, dust-proof belt weighing machine, called chain-belt weighing machine.

Fig.12: Belt Weighing Machine

High self-regulating load capacity, impossibility of belt drifting, weight neutral charging to all loading units and avoiding any dust exhaust, are further advantages.

When using belt weighing machines, it is also possible to serve several glue coating lines with the necessary ratio control system. There is an increased interest for belt weighing machines since they do not interrupt the chip flow from the dosing bin.

Disadvantageous features are: the capacity of a belt weighing machine can only be calculated after special gaging by integration of weight measurement in relation to the belt speed. Electronic control systems are not known generally. A tare control can only be effected

at load interruption. High requirement for the discharge accuracy of the dosing bins.

4.2 Metering of liquid glue resin.

The liquid glue resin is added to the glue/chip blender in metered proportions in the volumetric and continuous way only. Fine adjusted piston pumps guarantee constant conveying and can thus be connected to the batch weighing machine directly by adjusting the number of strokes and to the belt weighing machine by tuning th pump drive with the number of strokes. An instability factor is involved by clogging of the valves. The arrangement of filters and pressure control units avoid trouble or indicating them immediately. Counter checking with throughflow measuring instruments is possible for sum calculation but in order to effect an analogous control intricate compensating devices for intermittent conveying are required.

Gear Pumps are very popular for metering liquid resin. Unfortunately they are highly depending upon the pressure difference between suction and pressure side. For this reason the conveying capacity is usually controlled by a measuring instrument e.g. an oval wheel counter. The value with the pre-selected calculated volume releases the batch weighing discharge or serves for re-adjusting the gear pump if a pre-selected glue-chip ratio is no longer guaranteed. The advantage of the simple and foolproof gear pump has its disadvantage in contamination sensitivity of the measuring instruments. Filters and overload control units are necessary, by-pass lines for the period of cleaning are recommended.

The ROTADOS syetem for glue metering is based on the disc piston displacement pumps viz: gear pumps, disc piston pumps, eccentric worm pumps, etc. which have an excellent volumetric conveying efficiency provided there is no pressure difference. For this reason the ROTADOS system separates the glue metering into the actual metering without pressure difference handled by the first displacement pump which acts really for "metering", and into conveying handled by second pump balancing the feed preasure. Both pumps are jointly driven in a fixed ratio to each other; possible changes in efficiency caused by different feed preseure will be readjusted by the feeding pump through an overload capacity control system. The

conveying difference between measuring pump and feeding pump can be balanced by carrying along by-passed air. Removing this overload is a certain blockage control for glue feeding instead of a clogging control to the inlet of the mixer. The interlink between metering pump and feeding pump is maintained by gaging at any time, even during operation.

4.3 Equipment for preparing read-to-use glue. (glue kitchen) *

Before dosing the liquid glue resin certain ingredients have to be added to the crude resin. The ratio of the ingredients can be dosed volumetrically or gravimetrically. A volumetrically mixing system is schematically shown in Fig.13 which includes five stations. The actual metering is controlled in the tube stations (271 to 275). Mixing follows in the vertical stirring mixer and it is kept ready in a storage bin for each of the different glueing lines. The drawing shows on top of the tube metering station both the hardener and the emulsion unit connected with the pump and magnetic valves for filling of the tube metering station.

Gravimetric glue mixing equipment is similar to the volumetric system but without tube metering station it is based on the weighing system. According to a programme controlled system the resin and ingredients are fed into the mixing container in metered proportions. These weight ingredients can be individually computerized with print out. Of course, today's adhesive mixing equipment is fully automatic controlled nearly trouble free. The only problem is the storage of relatively big quantities of glue mixed with hardener. This could cause some difficulties during down time, at weekends and in case of immediate modification of the formulation. Thus it is mostly proposed to reduce the glue mix by proportioning the hardener and to feed it by separate metering, either directly into the mixer or via throughflow mixers.

4.4 Combination of liquid adhesive mixing and metering.

Two systems are applied:

a) the multiple piston pumping system and
b) the extended ROTADOS system.

---

* further details of this equipment are discussed in document ID/WG.248/12

When using multiple piston pumps there is one piston pump for each component installed on a joint drive. Adjustment of the components' ratio to each other and to crude resin by stroke adjustment, manually adjusted or if required remote controlled. The metered ingredients are conveyed in relation to the chip mass are mixed with stirrers or by static throughflow directly fed into the glue mixer. Advantages and disadvantages are similar to those of the piston pumps system.

The automatic dosing system "ROTADOS" is demonstrated in Fig.14. The multi-bin storage includes crude resin bin plus three bins for ingredients mounted to a frame. Each bin contains a metering pump adding without pressure the selected quantity. The metering pump for crude resin controls not only the amountof ingredients but also the appropriate mass chip. The amount of ingredients can be adjusted or modified, even during operation, in a very simple way by changing the speed relations of the pumps. All ingredients are gravity controlled by simultaneous gaging connected with the feed pump acting also as mixing pump.

The advantage of the ROTADOS system is the compact design, avoiding any additional planning and installation on the site, avoiding filters and through-flow controll instruments, the storage of small quantities of ready to use adhesive and the possibility to charge the glue mixer directly with one component only.

This compact design of the ROTADOS permits the arrangements of up to three formula lines each one with six components, in a single battery of tanks.

5. Complete Plants

Complete plants are offered in a great variety. The following systems are well applied in the wood processing industry but any of these systems are subject to be changed for special plants.

5.1 Glue coating stationcombined with batch weighing machines and liquid metering by Piston Pumps - Fig.15

The two glue mixing and coating lines are identical as described

before. The batch weighing machine (2) is charged and discharged in batches, the chips pass the equalization station (6) and flow continuously to the glue chip blender (10). The instruments (15 and 16) controlling the water coolent. A stop valve (17) for the liquid adhesive is built in at the glue coating station. The liquid adhesive is mtered by the piston pump, driven by a P.I.V. gear (52) which is remote controlled (70) and linked to the dosing pump. A cam (72) releases the charging operation of the batch weighing machine (2) by a pre-selection unit in the pump control cabinet (502). The valve sensitivity of the piston pump necessitates the interlink of a twin filter (81) and of a tube metering scale (91). This is also the connecting point for the ready-to-use adhesive prepared in equipment described above.

5.2 Gluecoating station with batch weighing machine and liquid adhesive metering by gear pump, counter controlled by oval wheel meter and with separate metering of one additional ingredient (Fig.16).

This flow diagramm corresponds to the system of Fig.15 regarding chip flow and glue coating station. It differs in the liquid adhesive flow. The adhesive metering pump (53) is a combined pump system, including a gear pump for the adhesive with throughput capacity control by oval wheel meter (71). The metered value controls the chip throughput capacity. The value releases the charging of the batch weighing machine (2) in pre-selected batch sizes automatically controlled (control cabinet 502). Here too, the liquid adhesive requires a twin filter (81). In this case not to protect the gear pump but because of the sensitivity of the measuring instruments (71) which necessitates an additional by-pass line, indicated by the change-over switch; this by-pass line renders possible to run "an emergency operation" while cleaning or breakdown of the oval wheel meter.

The piston pump, installed parallel to the gear pump in connexion with twin filter (82) and control (93), is provided for additional ingredient in-let, e.g. hardener or emulsion. This ingredient is fed directly to the mixer via stop valve (13). The most efficient facilities of feeding to the glue/chip blender are shown in Fig.18.

5.3 Glue coating station with batch weighing machine and multiple piston metering unit for simultaneous preparation and metering of the glue mix - Fig. 17.

Chip feeding and glue mixer correspond the system of Fig.15 and 16. But for the feeding of glue ingredients, a multiple piston pump is provided. For each of the glue ingredients a piston pump is provided. The piston stroke is adjustable for a proportional capacity. Twin filters (81 and 83) are built in to protect the piston pump which can be cleaned during operation. They are required for crude resin and emulsion. (82)and(84) are single filters for hardener, water and ammonia because of no danger of clogging. The capacity of the piston pump for crude resin is controlled by the oval wheel meter, the indicated value is tuned to the batch weighing machine. An overload pressure valve (90) releases a signal, as soon as the operating pressure drops below the necessary value due to breakdown of the piston pump and it switches off, at overload pressure due to clogging in the glue feeding system. All ingredients are fed into the glue/chip blender (10). This system renders possible to feed only a single ingredient directly into the glue/chip blender mixer without passing the pre-mixer.

The storage bins (241-245) are controlled by a float switch (23). Inside the pipes leading to the individual piston pumps are built in controls (232) - (235) gaging also the pump capacity (221-114). The feeding pumps (221-225) control individual ingredient flow. The magnetic valves (261-265) are required for filling the storage bins, when the main tanks or the preparation tanks for emulsion (213) or for hardener (214) are located on top of the storage bins.

5.4 Separate feeding of ingredients into the glue/chip blender, type TURBOPLAN - Fig.18

Separate metering by means of the multiple-piston units - shown in the proceeding drawings - renders possible to feed also single or all ingredients into the glue/chip blender without passing the glue mixer. This separate feeding is applied very often because of its independence in special cases, e.g. when using certain mixes of phenolic resin and emulsion.

The individual feeding lines, D 1, D 2, D 3 are, according to an invention distributor tubes rigidly installed with the rotating agitator shaft. They are predominantly used for crude resin, hardener and water. The advantage of this kind of tube arrangement - in chip flow direction - is that the water can be spread first, the hardener at last. This arrangement solves many maintenance problems of this kind of equipment. Inlet D 4 is the emulsion infeed, D 5 is the injection station for melted paraffin.

5.5 Glue-coating station with chain belt weighing machine and liquid adhesive metering by gear pump and oval wheel meter - Fig. 19

The chip flow supplied by the conveying equipment (610) is metred by the chain belt weighing machine (3) and fed into the glueing mixer (10). The computerized metered value (601) received from the chain belt weighing machine is the comparison base value for the pre-selected ratio of the oval wheel meter (73). The gear pump (61) re-adjusts until the ratio between chip and glue has been rated. The oval wheel meter (73) has a by-pass line permitting an emergency operation at breakdown or blockage of the oval wheel meter; this emergency operation can be actuated after shifting of the hand lever. The ready-to-use adhesive has to be fed to the coating station tuned to the liquid adhesive mixing station. Feeding is effected by the twin filter (81) that can be shifted while operating the system.

5.6 Glue-coating station with belt weighing machine and liquid adhesive metering unit, system ROTADOS - Fig.20

This system includes three coating lines but chip feeding and glue mixing correspondto the coating lines discussed before. Only the glue feeding is effected by the metering unit ROTADOS. The ROTADOS unit (65) transfers the metered crude resin value to the control cabinet (601) comparing the metered values of the chain belt weighing machines (3). The drive of the ROTADOS lines is adjusted to a pre-selected chip/glue ratio and is kept constant. The chip mass is always the control value. Of course, it is also possible to provide an interdependence control for feeding of the three different kinds of chips; here the core layer line is selected as the guidance value.

The mixing tanks for emulsion (213) and hardener (214) as well as the pumps and valves for supply of the ROTADOS tanks (230-265) are included.

All systems can be used without modification for all trickling chips as well as for fibres. No matter whether urea formaldehyde or phenolic formaldehyde adhesives are applied. Also isocyanat adhesives can be applied with these systems, but much effort must be given to this preparation.

5.7 Glue-coating station for WAFER chips, system DHYM - Fig.21

The essential difference compared to all preceding systems is the necessity of using a rotating glue coating drum. The plant shown in the flow diagram has an alternative or simultaneous glue coating station for powdered or liquid resin. A separate paraffin metering and water metering system is provided. All liquids are added in metered quantities accoording to the ROTADOS measuring pump system.

The chip mass supplied by the Wafer dosing bin is metered via a belt weighing machine (1) and fed into the glue coating drum. The powder resin dosing system consists of the storage bin (5) with adjustable discharge, the chain belt weighing machine (7) for resin powder and the injection screw (8). This screw (8) can be equipped at its end with a blower or with a mixtured air fed through the screw shaft of the blast exit. The metered values of this powder weighing machine (7) are computerized in the control cabinet (22) compared with the metered weight values (3) accoording to a pre-selected proportional value, and, if necessary, they are re-adjusted by corresponding speed modification of the charging screw below the bin (5).

The liquid glue which can be used, as already mentioned, alternatively or simultaneously, is stored in the bin (9), and metered by the ROTADOS metering pump (11) tuned with the wafer belt weighing machine (1) and is transferred in free flow to the feeding pump (12) or to the filter (10) connected in series to the pump. The feeding pump is a high pressure rotary pump for direct atomising into the chip/glue blender. The diaphragm manometer (23) controls the glue pressure necessary for atomising operations.

Waferboard plants are profitably working with melted paraffin instead of emulsion. The paraffin is melted and stored in a heatable bin (13) and is metered by the ROTADOS metering pump (15) tuned to the chain belt weighing machine (1). The metered paraffin is gravity fed to the pump (16) passing the filter (14). Here, too, is a high pressure rotary pump for atomizing operations. A rotary pump supplies the paraffin pumps and pipes with heating liquid.

This glue coating of wafer chips can, without any modification, also be used for glueing of strands. Experience has shown, however, that powder dosing is unnecessary. Adding powdered resin only with the higher percentage rate of solid resin, is eliminated because of insufficient powder distribution on the strand surface. A combined glue coating system is conceivable, but not yet considered.

6. Summary

It has been tried to give a comprehensive survey on the development stage of glue coating equipment for irregular bulk material. Ac rding to its importance, glue coating of wooden chips for standard chipboards has been given some priority.

Unfortunately, an absorption into specific problems or the description of outstanding features could not be handled due to the fixed outline on glue coating equipment for particle board production.

ANNEX I

(Figures 1 - 21)

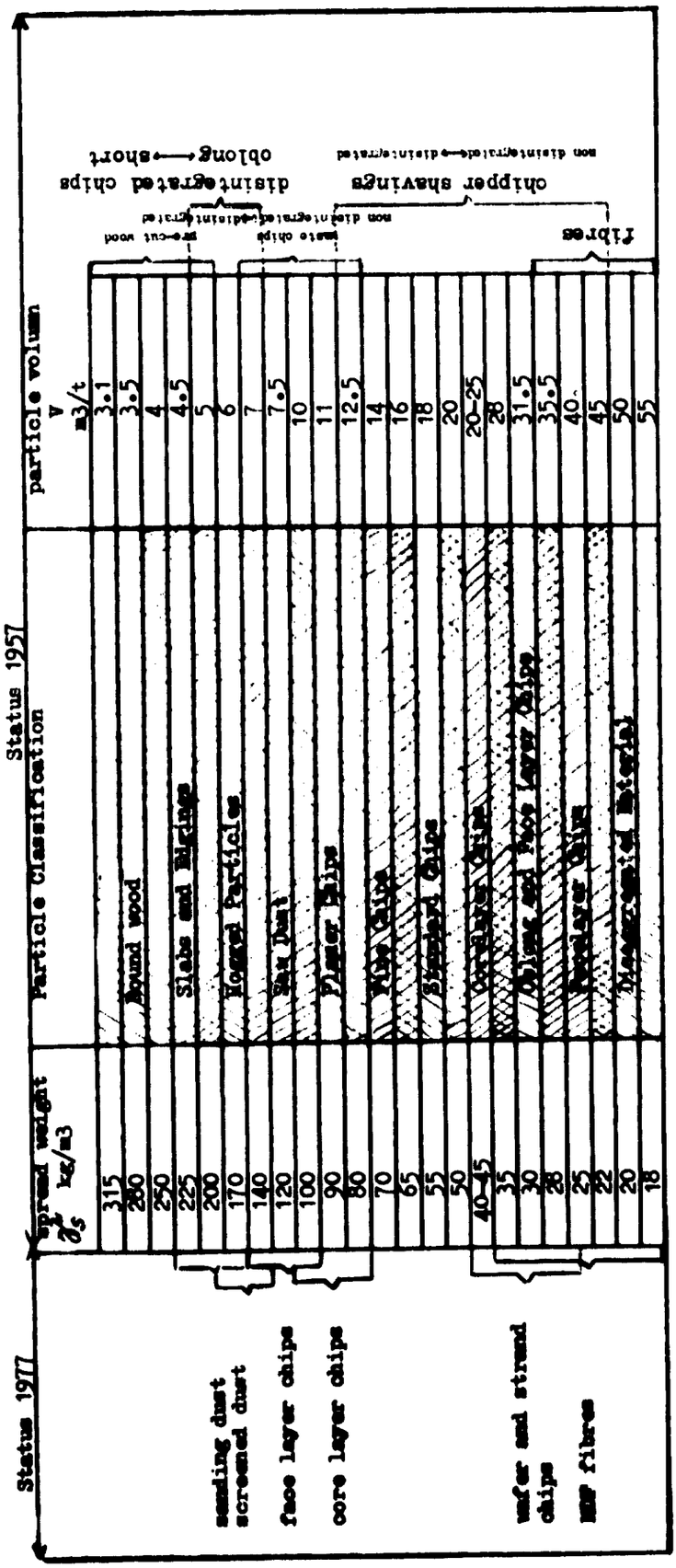
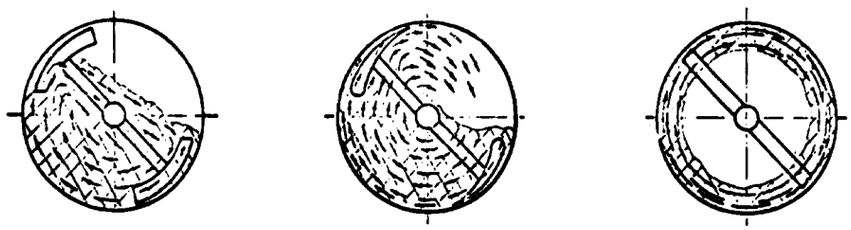


Fig.1 - Particle classification acc. to the development of particle board production technology in 1957 and 1977.



Thrust system | Throw system | Ring system

Fig.2: Technology of Drum Mixers for glue/particle blending with agitator system.

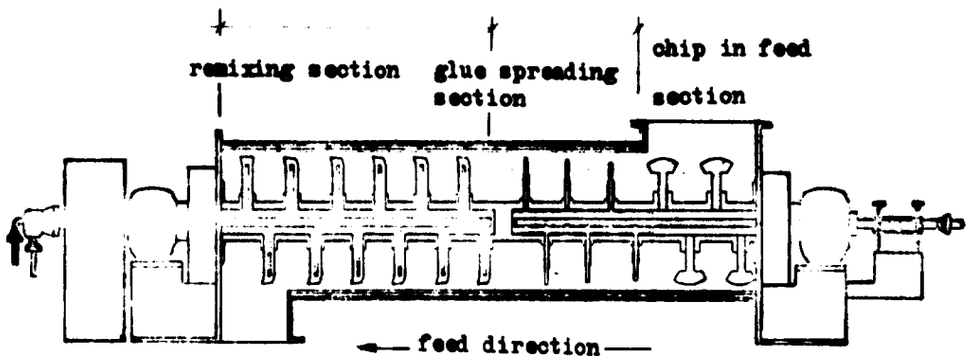


Fig.3 - Ring Mixer, type TURBOPLAN

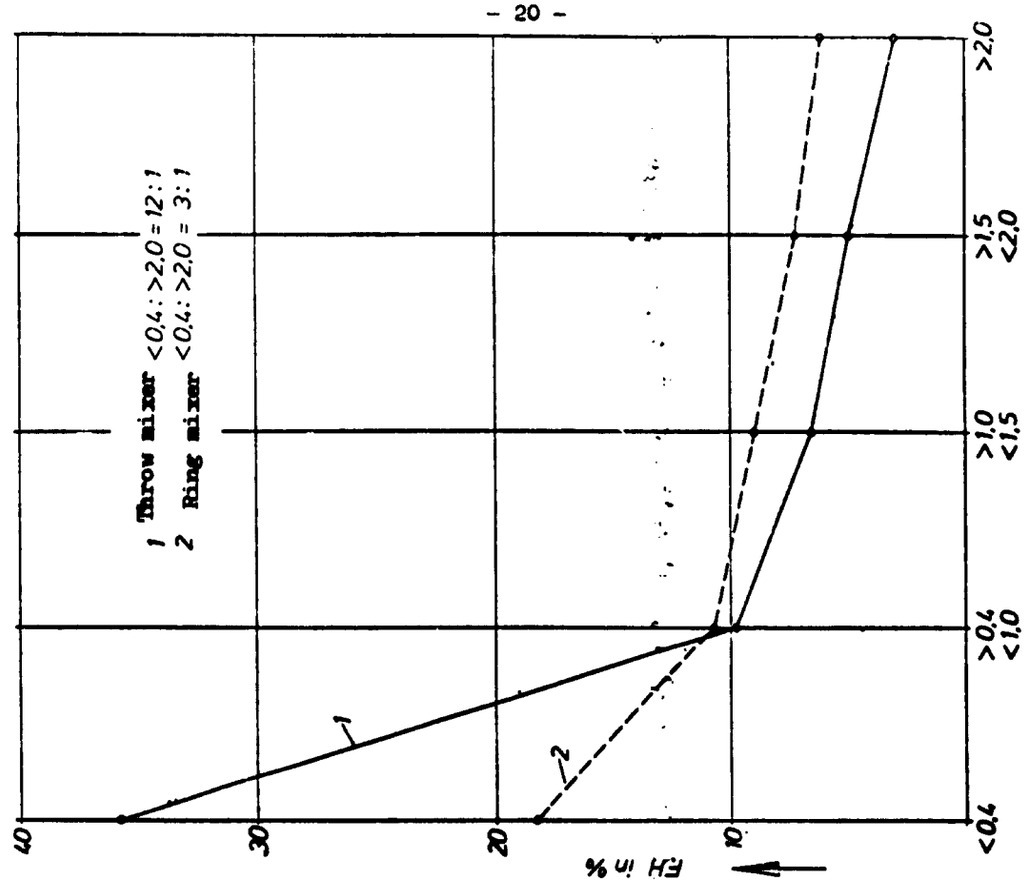


Fig.5 - Glue portion on the chip surface

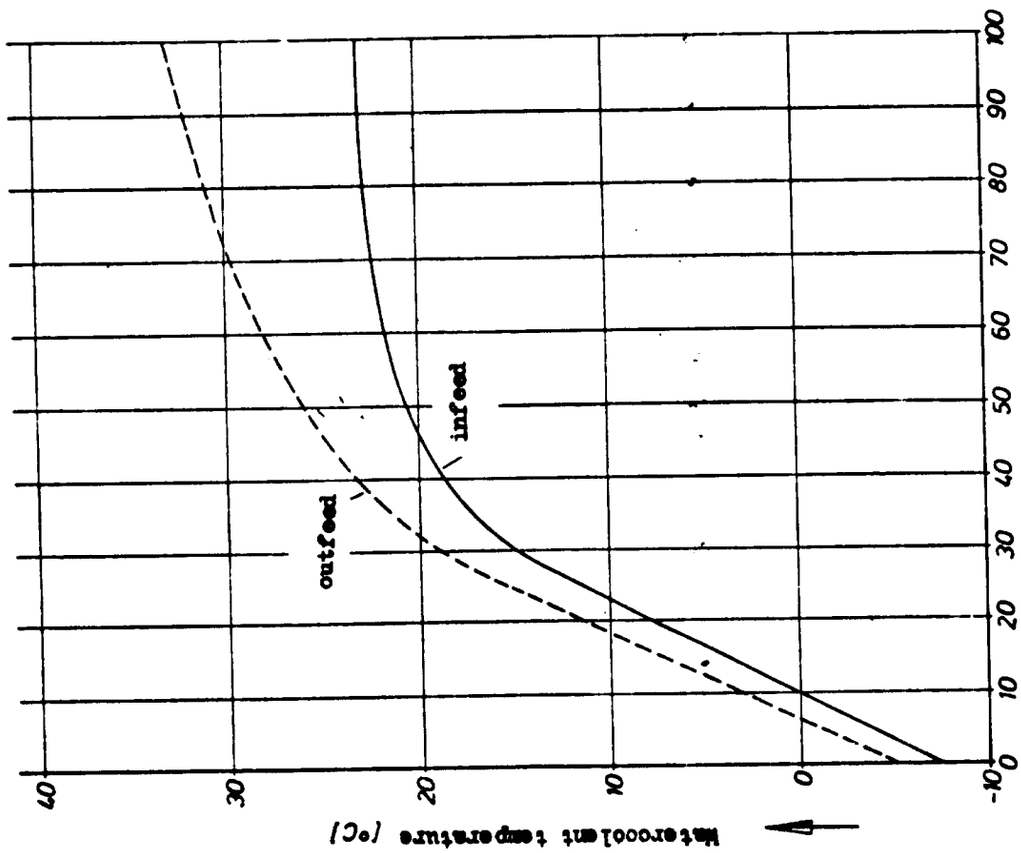


Fig.4 - Maximum water cooling temperature above chip in feed temperature

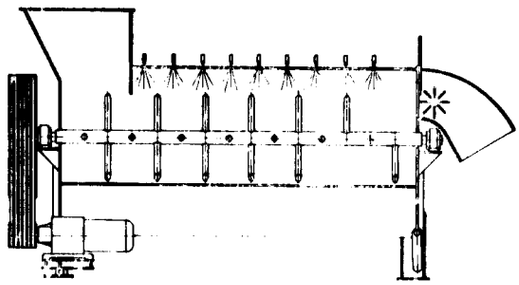


Fig.6 - Throw mixer with overhead glue spreading nozzles

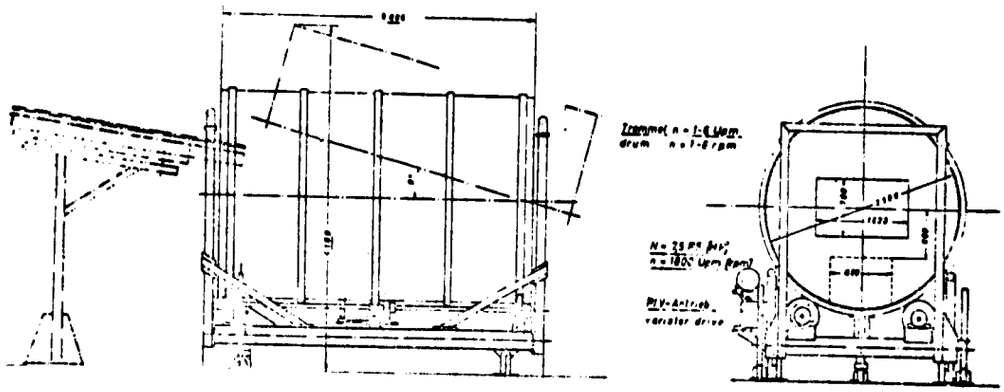


Fig.7 - Gravity feed mixer

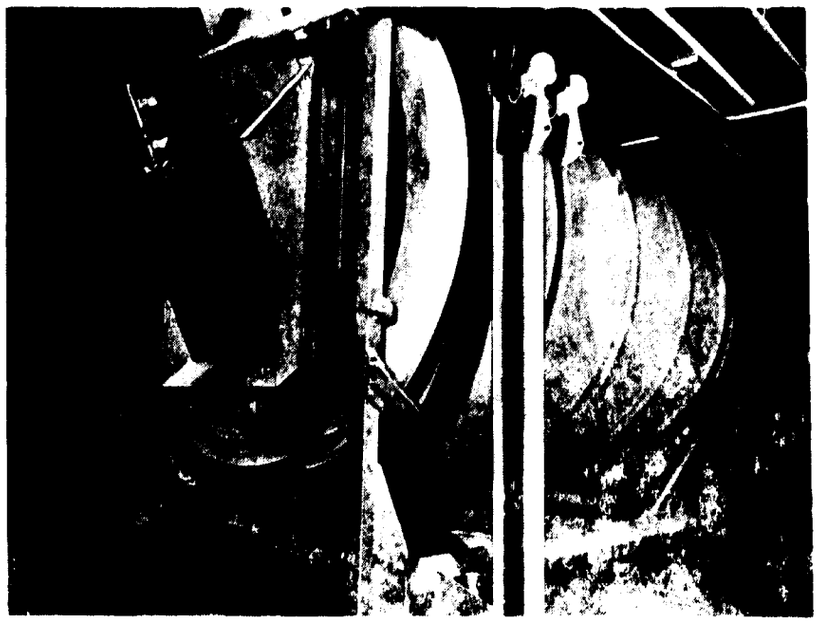


Fig.8 - Nozzle system at the infeed chute of the chip/glue blending drum

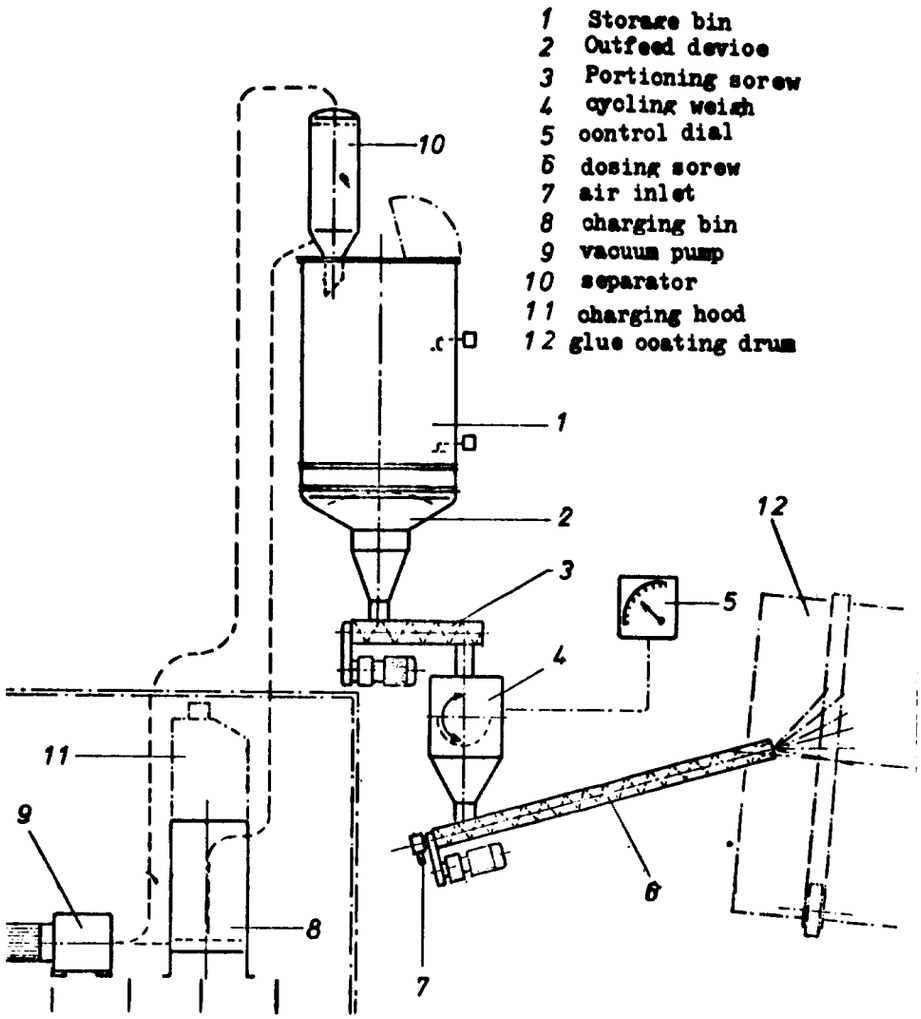


Fig. 9 Batch-Type powder dosing

Fig.10 - The pointed implements of a Turboplan mixer

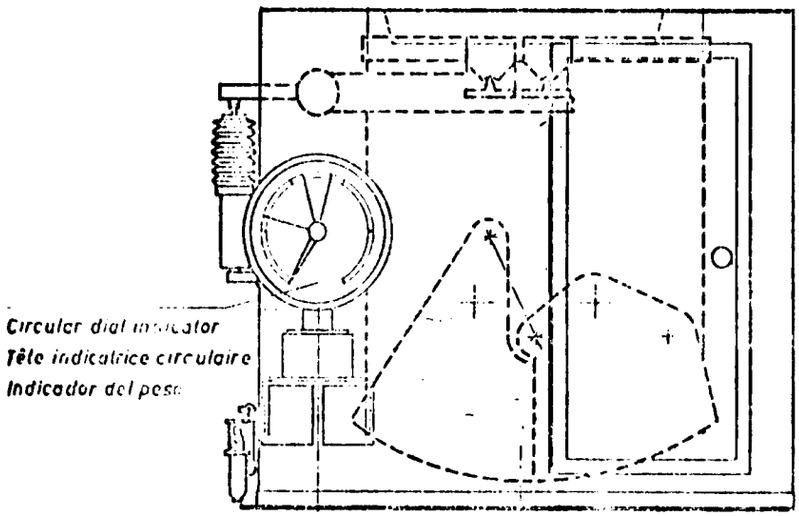


Fig.11 - Batch Weighing Machine

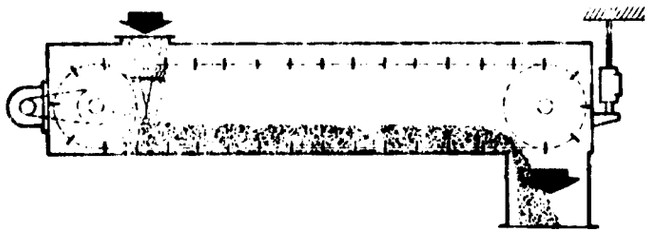
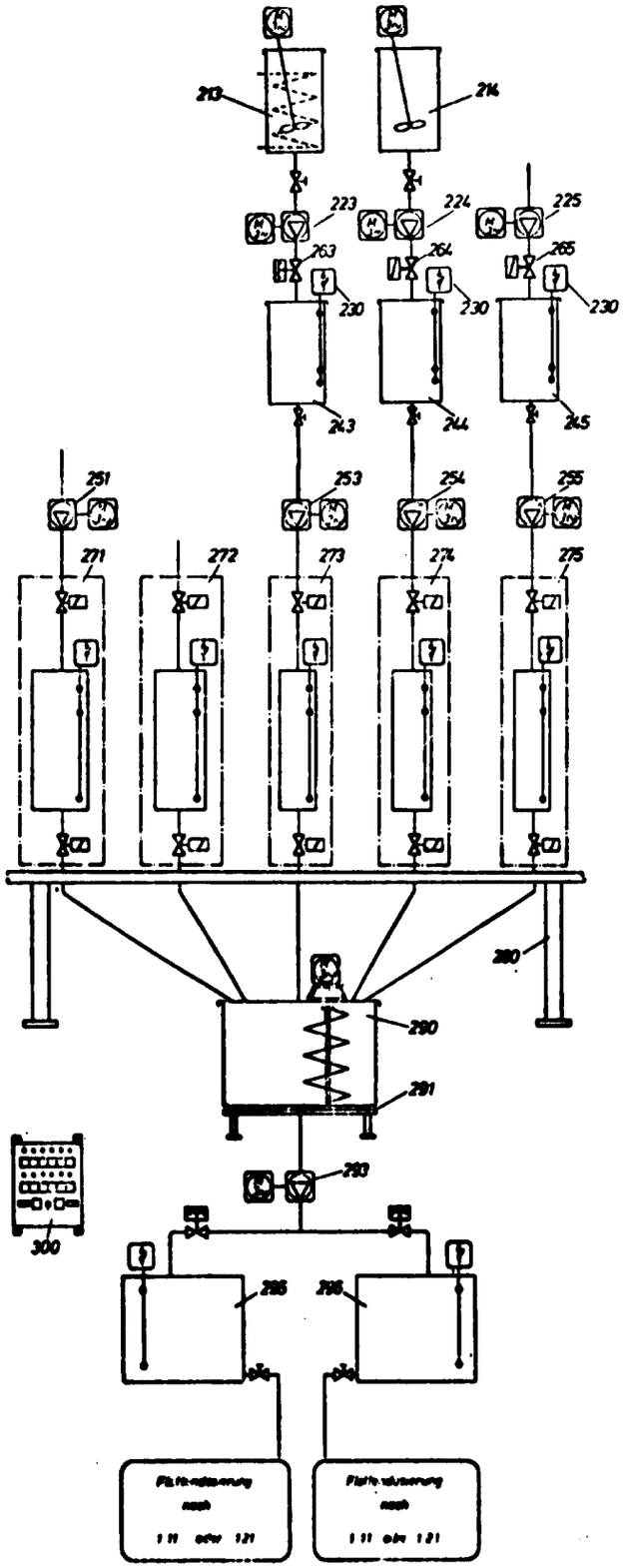


Fig.12 - Belt Weighing Machine



213 Ansatzgefäß Emulsion mit Rührwerk; heizbar
214 Ansatzgefäß Härter mit Rührwerk

223 Förderpumpe Emulsion
224 Förderpumpe Härter
225 Förderpumpe Ammoniak

230 Schwimmervorrichtung
243 Vorratsgefäß Emulsion
244 Vorratsgefäß Härter
245 Vorratsgefäß Ammoniak

251 Förderpumpe Rohleim
253 Förderpumpe Emulsion
254 Förderpumpe Härter
255 Förderpumpe Ammoniak

263 Membranventil Emulsion
264 Magnetventil Härter
265 Magnetventil Ammoniak

271 Meßgefäß für Rohleim mit elektromagnetischen Zu- und Ablaufventilen, einstellbaren Tauchsonden
272 Meßgefäß für Wasser dto.
273 Meßgefäß für Emulsion dto.
274 Meßgefäß für Härter dto.
275 Meßgefäß für Ammoniak dto.
280 Gestell für Meßgefäße

290 Mischbehälter für die abgemessenen Komponenten mit Rührwerk
291 Gestell für Mischbehälter

293 Förderpumpe Leimflotte

295 Bereitstellgefäß für Deckschichtstrang mit vorgeschalteten Füllventil, Schwimmer
296 Bereitstellgefäß für Mittelschichtstrang mit vorgeschalteten Füllventil, Schwimmer

300 Wandschaltschrank

Fig.13 - The volumentrically mixing system

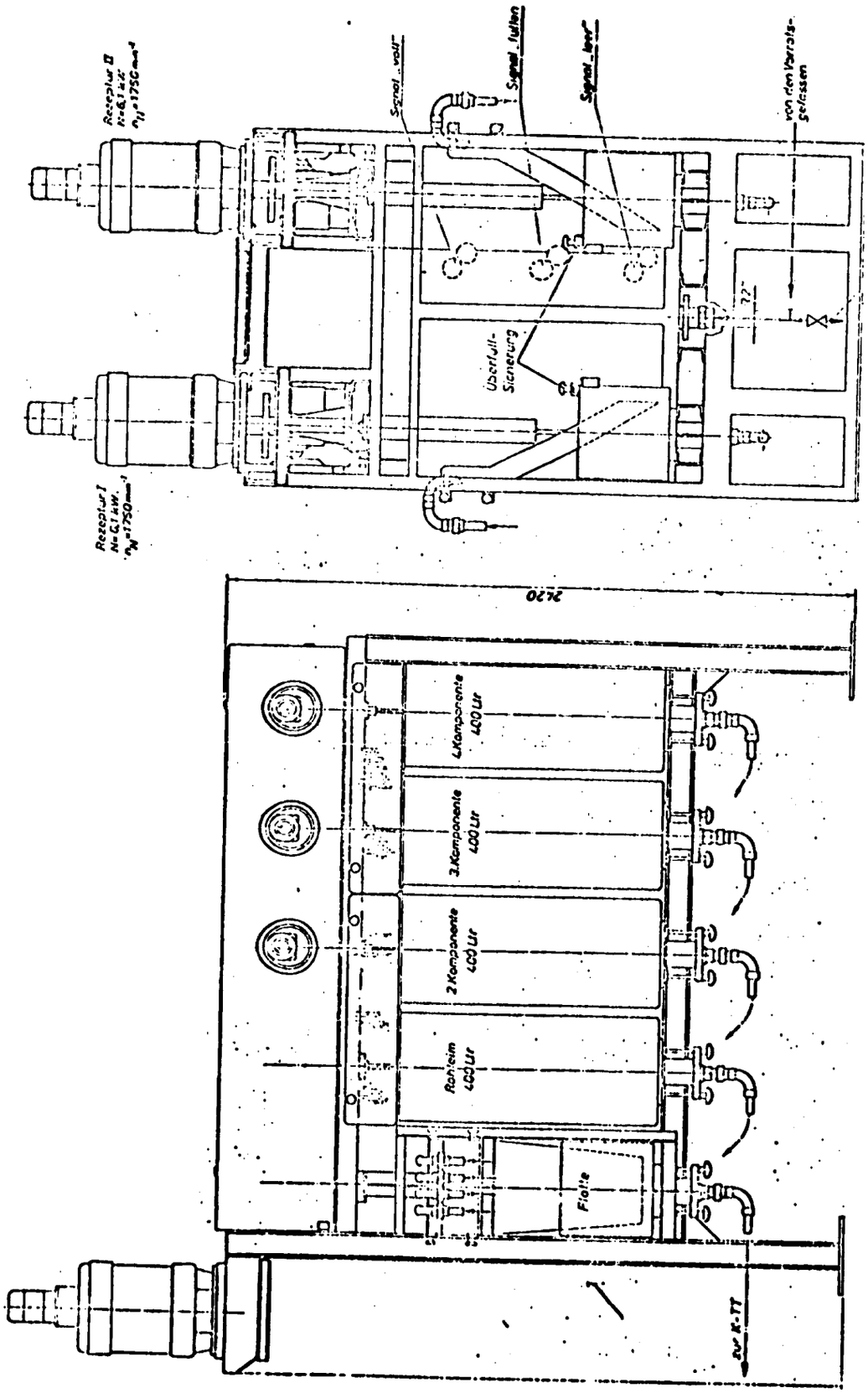
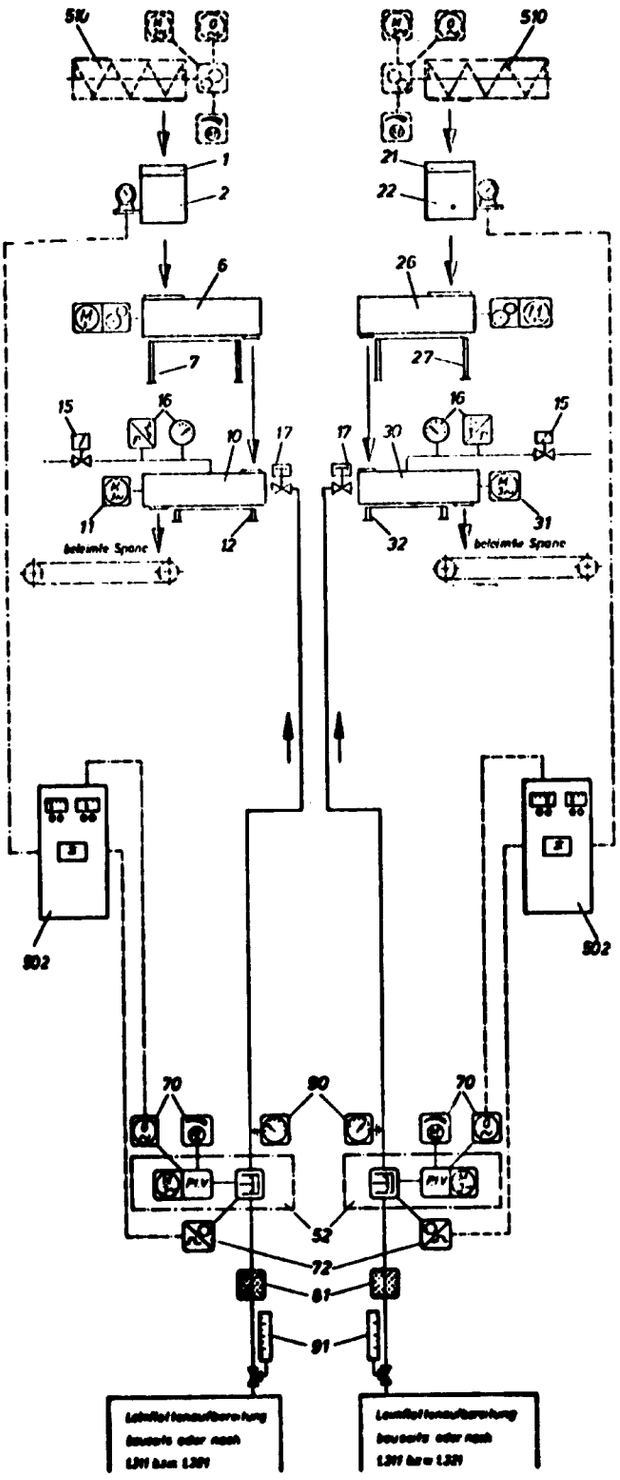


Fig.14 - Automatic dosing system "ROTADOS"



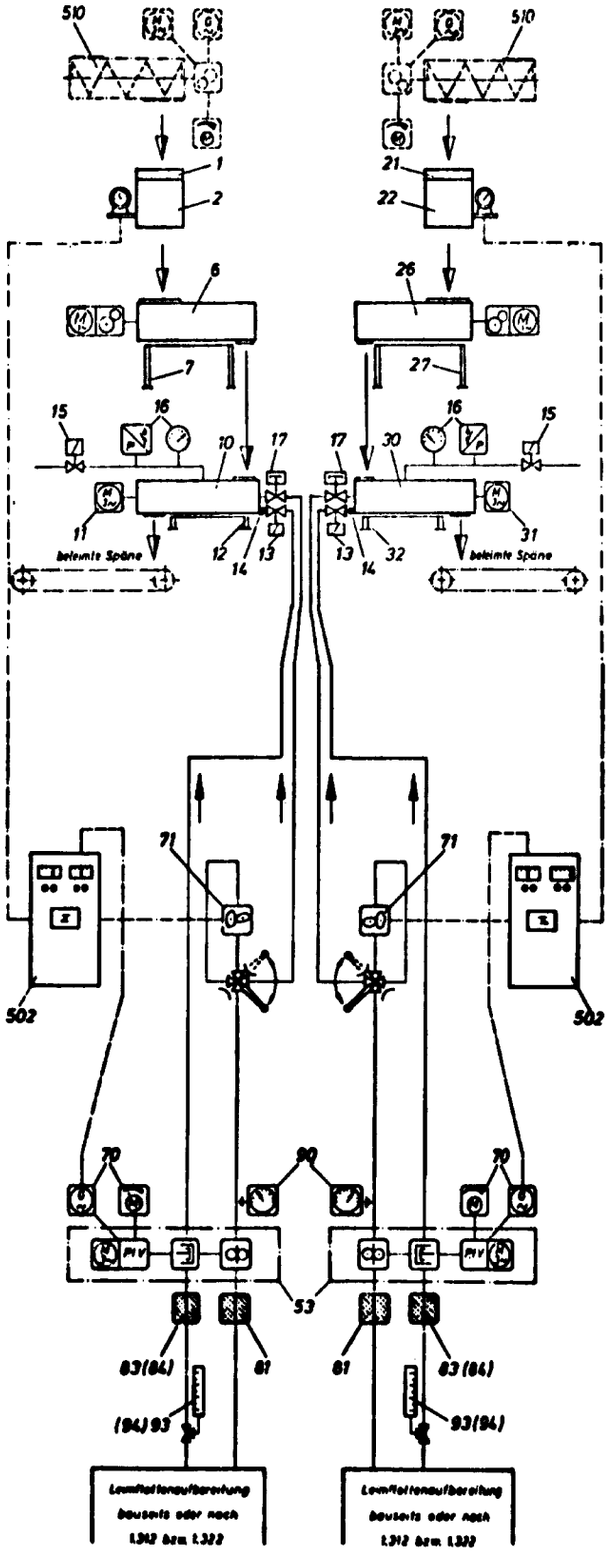
. Spanzulieferorgan bauseits
510 Einbau einer Bunkersteuerung im D R A I S - Schaltschrank

1 Sperrschieber
2 Takt- Waage TW
6 Egalisierung durch:
a) Konti- Takt- Bunker KTB
b) Konti- Takt- Differenz- Schnecke KTDS
7 Gestell für KTB
10 Beleimungmaschine K-TT
11 Motor für K-TT
12 Gestellfür K-TT
15 Kühlwasser Magnetventil
16 Kühlwasser Druckwächter mit Manometer
17 Membranventil
21 Sperrschieber
22 Takt- Waage TW
26 Egalisierung durch:
a) Konti- Takt- Bunker KTB
b) Konti- Takt- Differenz Schnecke KTDS
27 Gestell für KTB
30 Beleimungsmaschine K-TT
31 Motor für K-TT
32 Gestellfür K-TT

52 Dosierpumpenaggregat: Kolbenpumpe, P.I.V.- Regelgetriebe mit Handverstellung, Drehstrommotor
70 Fernverstellung und Fernanzeige für P.I.V.
72 Nockensteuerung: Kontaktgeber und Verwahzählgerät
81 Doppelfilter Flotte
90 Kontaktmanometer
91 MeGrohr- Leimflotte

502 Schaltschrank kompl. Steuerteil: Anzeige- Bedienungs- und Überwachungsgeräte, Steuerschütze "Ein- Aus" Bunkeraustrag Lastteil: Schütze für Antriebsmotore

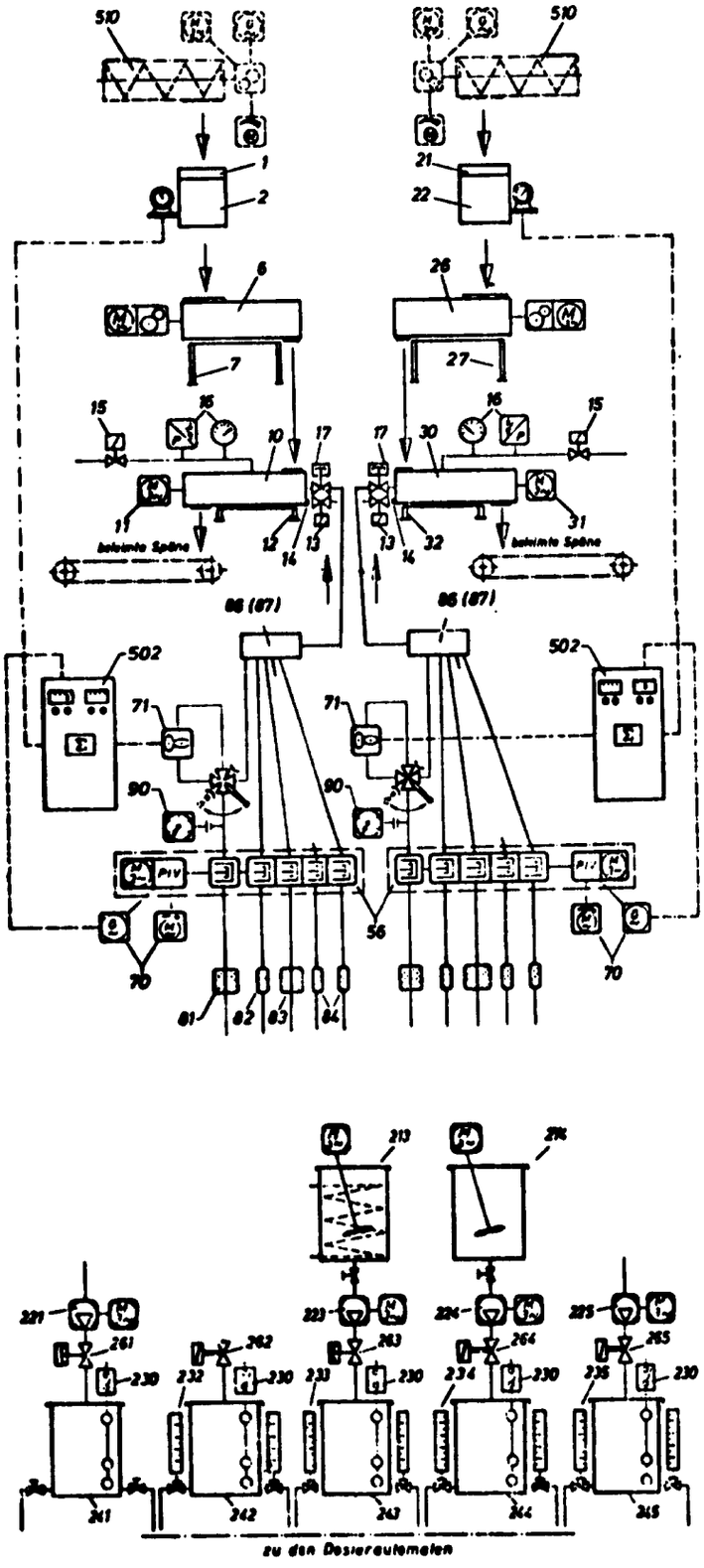
Fig.15 - Glue coating station combined with batch weighing machines and liquid metering by Piston Pumps



Spanzulieferergan bauseits
510 Einbau einer Bunkersteuerung in D R A I S - Schaltschrank

1 Sperrschieber
2 Takt- Wsage TW
6 Egalisierung durch:
a) Konti- Takt- Bunker KTB
b) Konti- Takt- Differenz-Schnecke KTDS
7 Gestell für KTB
10 Beleimungsmaschine K-TT
11 Motor für K-TT
12 Gestell für K-TT
13 Absperrventil:
a) für Härter oder Zusatzkoeponente
b) für Emulsion
14 getrennte Komp.- Zugabe:
a) über Hohlwelle
b) über Trichter
15 Kühlwasser Magnetventil
16 Kühlwasser Druckwächter mit Manometer
17 Membranventil
21 Sperrschieber
22 Takt- Wsage TW
26 Egalisierung durch:
a) Konti- Takt- Bunker KTB
b) Konti- Tskt- Differenz-Schnecke KTDS
27 Gestell für KTB
30 Beleimungsmaschine K-TT
31 Motor für K-TT
32 Gestell für K-TT
53 Dosierpumpenaggregat: Zahnradpumpe, P.I.V.-Regelgetriebe mit Handverstellung, Drehstrommotor, zusätzliche Kolbenpumpe für Härter oder Emulsion bzw. Parsffin
70 Fernverstellung und Fernanzeige für P.I.V.
71 Ovalradzählersteuerung: Zähler, Vorwahlzählgerät, Umgehungsleitung mit Zeituhr
81 Doppelfilter Rohleim
83 Doppelfilter Emulsion
84 Einfachfilter Härter oder restl. Komp.
90 Kontaktmanometer
93 Meßrohr Emulsion
94 Meßrohr Härter oder restl. Komp.
502 Schaltschrank kompl. Steuerteil: Anzeige-, Bedienungs- und Überwachungsgeräte, Steuerschütze; "Ein- Aus" Bunkerantrieb Lastteil: Schütze für Antriebsmotore

Fig.16 - Gluecoating station with batch weighing machine and liquid adhesive metering by gear pump, counter controlled by oval wheel meter and with separate metering of one additional ingredient



Spanzulieferorgan beuseits

510 Einbau einer Bunkerstsusrung im D R A I S - Schaltschrenk

1 Sperrschieber
2 Takt- Waage TW
6 Egalisierung durch:
a) Konti- Takt- Bunker KTB
b) Konti- Takt- Diff.- Schnecke
7 Gestell für KTB
10 Beleimungsmaschine K-TT
11 Motor für K-TT
12 Gestell für K-TT
13 Absperrventil für Härter
oder für Emulsion
14 gstr. Komp. Zugabe Hohlwelle
oder Trichter
15 Kühlwasser Magnetventil
16 Kühlwasser Druckwächter m. Mano.
17 Membranventil Leim
21 Sperrschieber
22 Takt- Waage TW
26 Egalisierung durch:
a) Konti- Takt- Bunker KTB
b) Konti- Takt- Diff.- Schnecke
27 Gestell für KTB
30 Beleimungsmaschine K-TT
31 Motor für K-TT
32 Gestell für K-TT
56 Aufbereitungs- u. Dosierautomat
70 Fernverstellung und
Fernanzeige für P.I.V.
71 Ovalradzählersteuerung:
Zähler, Vorwahlzahlgerät,
Umgehungsleitung, Zeituhr
81 Doppelfilter Rohleim
82 Einfachfilter Wasser
83 Doppelfilter Emulsion
84 Einf.- Filter restl. Komp.
86 Durchlaufmischer dyn.
87 oder stat.
90 Kontaktmanometer
213 Ansetzgefäß Emulsion
214 Ansetzgefäß Härter
221 Förderpumpe Rohleim
223 Förderpumpe Emulsion
224 Förderpumpe Härter
225 Förderpumpe Ammoniak
230 Schwimmervorrichtung
232 Meßrohr Wasser
233 Meßrohr Emulsion
234 Meßrohr Härter
235 Meßrohr Ammoniak
241 Vorratsgefäß Rohleim
242 Vorratsgefäß Wasser
243 Vorratsgefäß Emulsion
244 Vorratsgefäß Härter
245 Vorratsgefäß Ammoniak
261 Membranventil Rohleim
262 Magnetventil Wasser
263 Membranventil Emulsion
264 Magnetventil Härter
265 Magnetventil Ammoniak

502 Schaltschrank komplett
Steuerteil: Anzeige- Bedienungs- u. Überwachungsgeräte, Sicherungsschütze, Ein - Aus - Bunkerantrieb
Leistteil: Schütze für Antriebsmotore

Fig.17 - Glue coating station with batch weighing machine and multiple piston metering unit for simultaneous preparation and metering of the glue mix

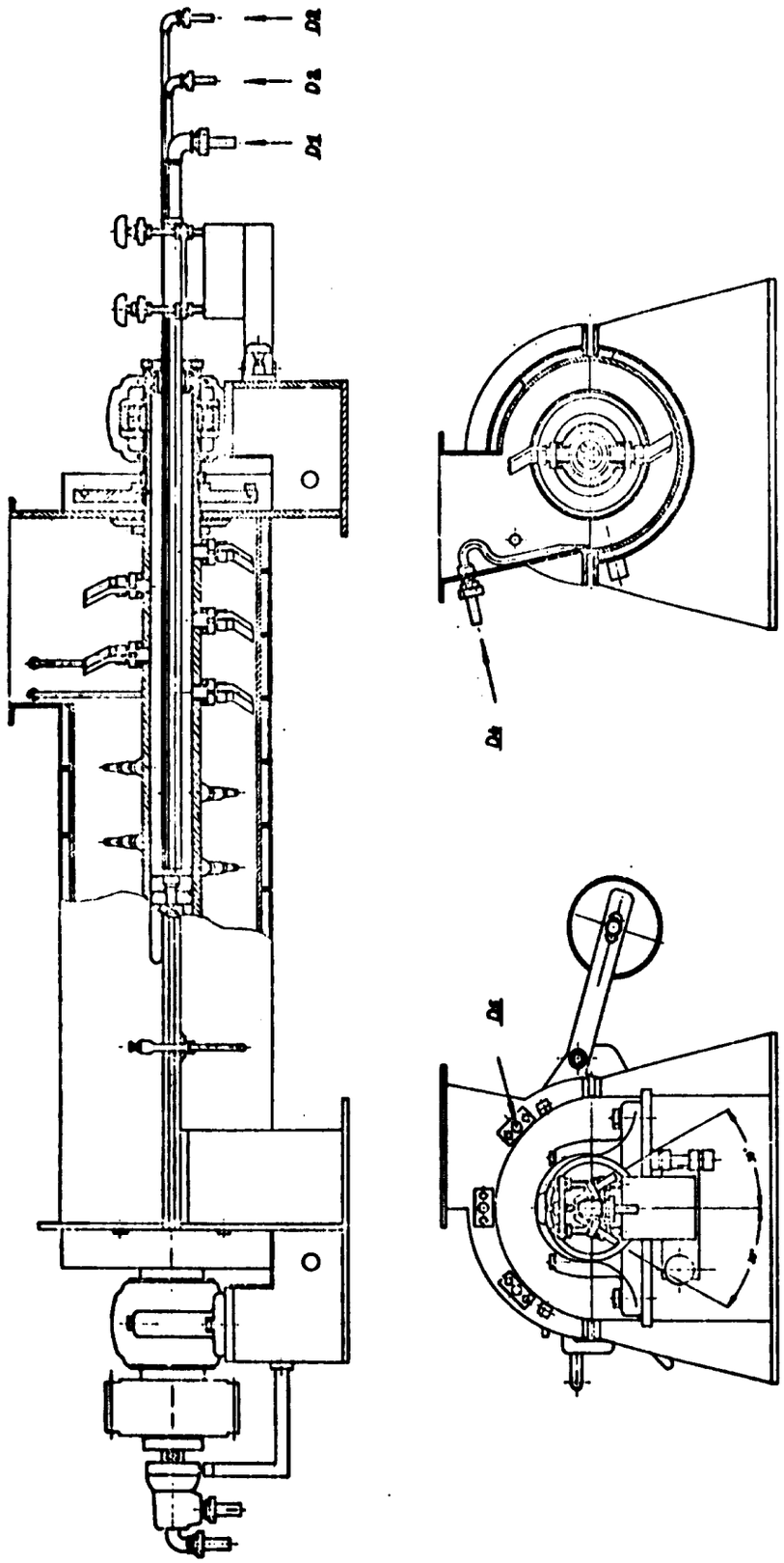
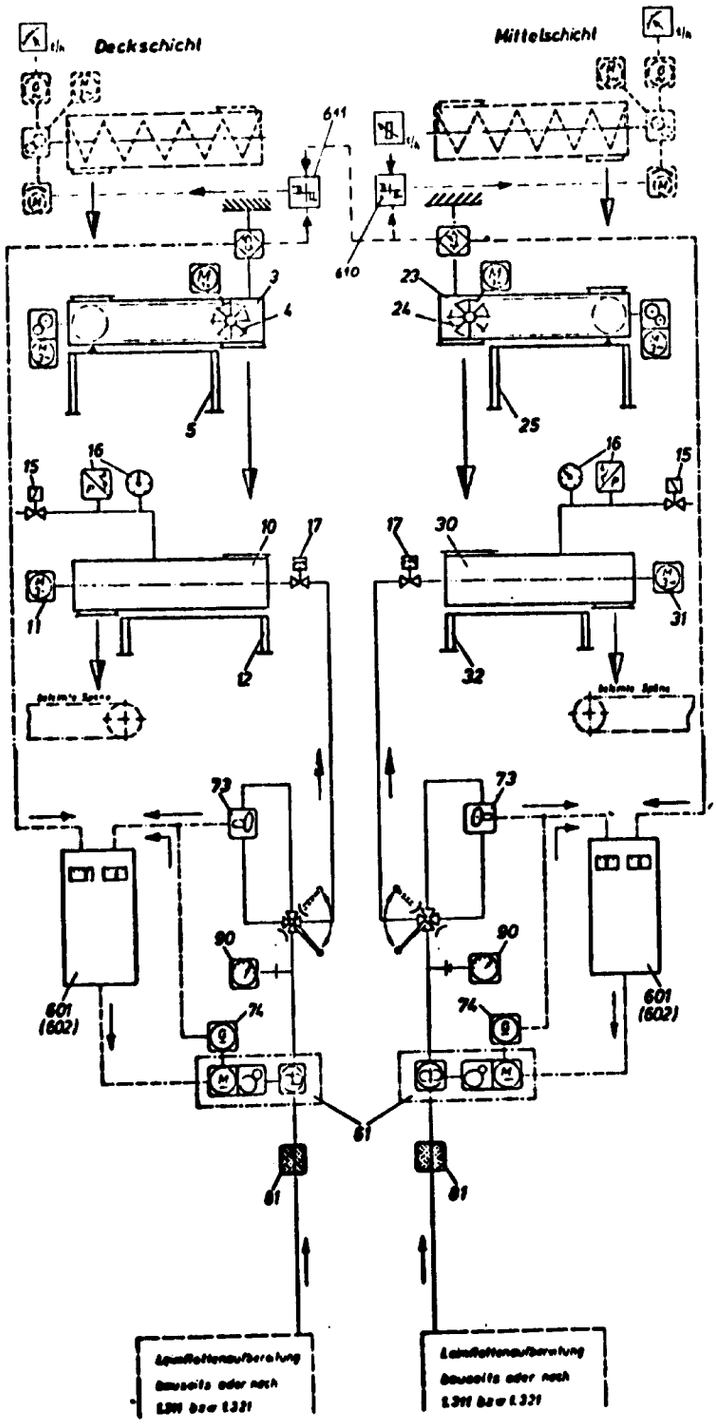


Fig.18 - Separate feeding of ingredients into the glue/chip blender type TUROMPLAN



Spanzulieferorgan bauseits

3 Bandwaage KBW
4 Ausräumfräse für KBW
5 Gestell für KBW
10 Beleimungsmaschine K-TT
11 Motor für K-TT
12 Gestell für K-TT
15 Kühlwasser-Magnetventil
16 Kühlwasser-Druckwächter mit Manometer
17 Membranabsperrventil

23 Bandwaage KBV
24 Ausräumfräser für KBW
25 Gestell für KBW
30 Beleimungsmaschine K-TT
31 Motor für K-TT
32 Gestell für K-TT

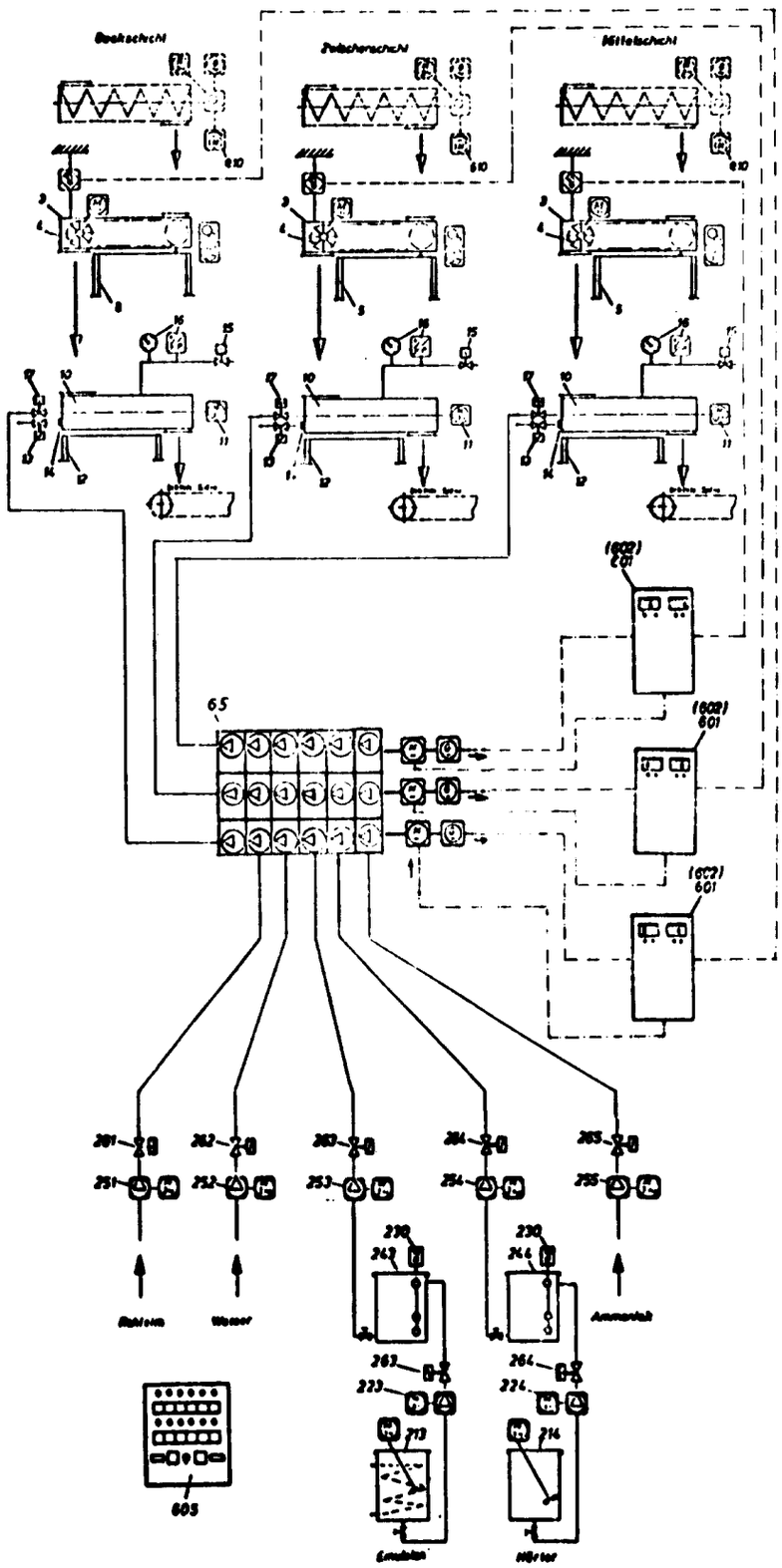
61 Dosierpumpenaggregat: Zahnradpumpe, Gleichstromgetriebemotor
73 Ovalradzählersteuerung: Zähler, Impulsgeber, Umgehungsleitung
74 Tachogeneratorsteuerung: Gleichstromgeber, Endschalter
81 Doppel-Filter
90 Kontaktmanometer

601 Span-Leim-Regelung elektrische "Bausteine" (lose Teile; ohne Schaltschrank)
602 Schaltschrank kompl., darin eingebaut:
Span-Leim-Regelung;
Steuerteil:
Anzeige-Bedienungs-und Überwachungsgeräte; Ein-Aus
Bunkeraustrag
Leistteil:
Leistschütze für Antriebe

610 Dreipunkt-Regler
für die Festwertregelung am kundenseitigen Verstellmotor des Regelgetriebes:
'Zulieferorgan-Feststoff'

611 Dreipunkt-Regler
für das Konstanthalten des Verhältnisses zweier Feststoffströme z.B. : OS-Strang zu MS-Strang

Fig.19 - Glue-coating station with chain belt weighing machine and liquid adhesive metering by gear pump and oval wheelmeter



Spenzufuhrorgan bauseite

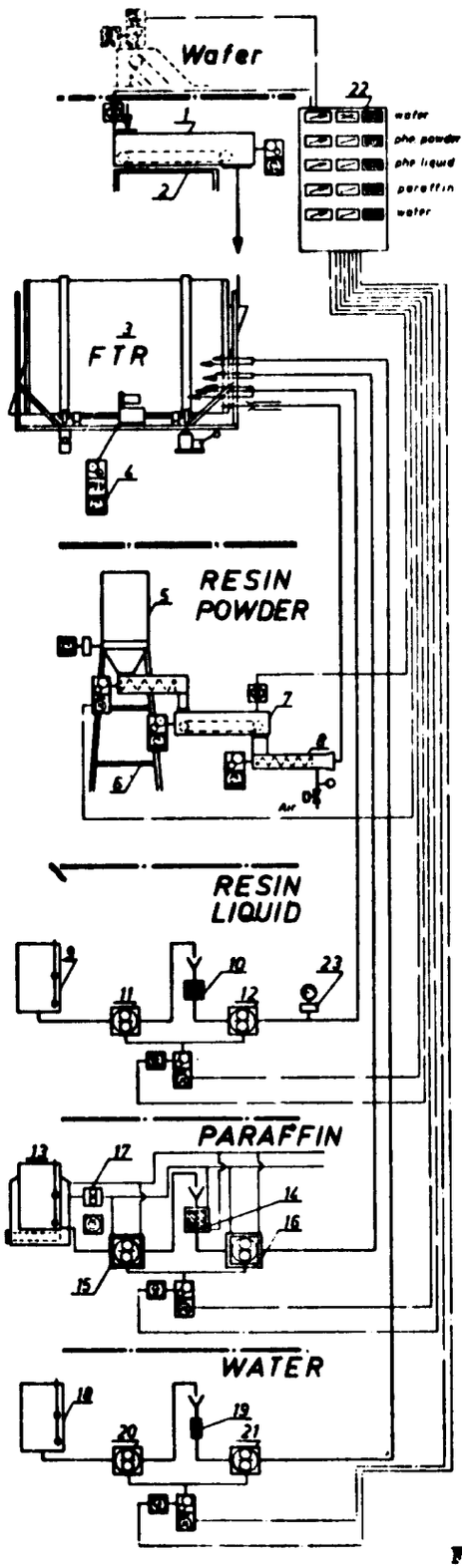
610 Dreipunkt- Regler für Bunkereustrag
3 Bandweege
4 Ausräumfräser für Bandweege; Zusatzausrüstung
5 Gestell für Bandweege

10 Beleimungsmaschine K-II
11 Motor für K-II
12 Gestell für K-II
13 Absperrventil:
a) für Harter oder Zusatzkomponente
b) für Emulsion
14 getrennte Komp.- Zugabe:
a) über Hohlwelle
b) über Trichter
15 Kühlwasser Magnetventil
16 Kühlwasser Druckwächter mit Manometer
17 Membranventil Leim

65 Aufbereitungs- und Dosierautomat System "ROTADOS", Komplexteinzeldosierung, Gleichstrommotor Summenzählung Pchleim, Hochgeneratorsteuerung.
213 Ansatzgefaß Emulsion
214 Ansatzgefaß Härter
223 Förderpumpe Emulsion
224 Förderpumpe Härter
230 Schwimmervorrichtung
243 Vorratsgefaß Emulsion
244 Vorratsgefaß Härter
251 Förderpumpe Pchleim
253 Förderpumpe Emulsion
254 Förderpumpe Härter
255 Förderpumpe Ammoniak
261 Membranventil Leim
262 Magnetventil Wasser
263 Membranventil Emulsion
264 Magnetventil Härter
265 Magnetventil Ammoniak

601 Span- Leim- Regelung elektrische "Bausteine" lose Teile; ohne Schaltschrank
602 Schaltschrenk komplett darin eingebaut: Span- Leim- Regelung: Steuerteil: Anzeige- Bedienungs- und Überwachungsgeräte; Ein- Aus Bunkereustreg Lastteil: Lastschütze für Antriebe
605 Schaltschrank für Komponentenbereitstellung und Niveauüberwachung "Rotados"

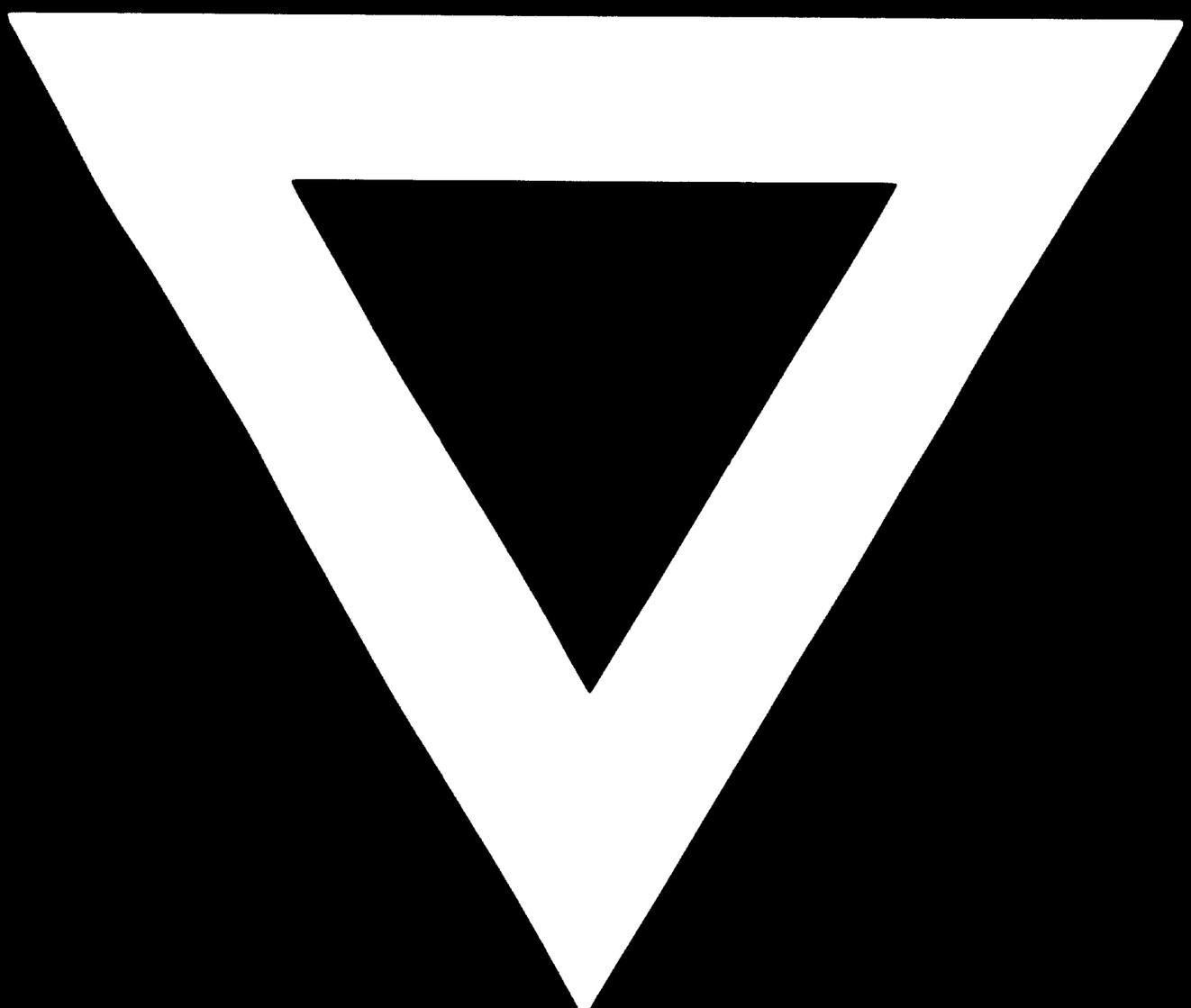
Fig.20 - Glue-coating station with belt weighing machine and liquid adhesive metering unit, system ROTADOS



1. Chain-Belt Waighar KBW dustproof with gear motor
   Kettenbandwaage KBW staubdicht mit Getriebemotor
2. Support for belt waighar
   Gestell für Bandwaage
3. Wafer-Resin-Blender with hydraulic tilting device
   Wafer-Beleimungsmischer mit hydraulischer Kippvorrichtung
4. Variable speed gear motor P.I.V.
   Stufenlos regelbarer Getriebemotor P.I.V.
5. Container for phenolic resin powder, vibration bottom with motor,and variable screw conveyor discharge with direct current gear motor
   Behälter für Phenolharzpulver mit Rührwerk und Getriebemotor, Vibrationsboden mit Motor und stufenlos regelbarer Förderschnacken-Entleerung mit Gleichstromgetriebemotor.
6. Support for 5 - 7 - 8
   Gestell für 5 - 7 - 8
7. Chain-Belt Weigher KBW dustproof with gear motor
   Kettenbandwaage KBW staubdicht mit Getriebemotor
8. Injection screw with gear motor
   Einspritzschnecke mit Getriebemotor
9. Container for phenolic resin liquid with float switch
   Behälter für Phenolharz-Flüssigkeit mit Schwimmerschalter
10. Double filter
    Doppelfilter
11. Meter pump without differential pressure,system Rotados, driven by (12)
    Messpumpe ohne Differential-Druck,System Rotados, angetrieben mit (12)
12. Pressure pump with variable direct current gear motor
    Druckpumpe mit stufenlosem Gleichstrom-Getriebemotor.
13. Double-jacket paraffin melting pot with indirect electrical heating and float switch
    Doppelwandiger Paraffin-Schmelzbehälter mit indirekter elektrischer Heizung und Schwimmerschalter.
14. Double filter heatable
    Doppelfilter heizbar
15. Meter pump without differential pressure,heatable, system Rotados,driven by (16)
    Messpumpe ohne Differential-Druck,System Rotados, angetrieben mit (16)
16. Pressure pump heatable with direct current gear motor
    Druckpumpe mit stufenlosem Gleichstrom-Getriebemotor.
17. Circulating pump with motor for the heating liquid
    Umlaufpumpe mit Motor für die Heizflüssigkeit
18. Container for water with float switch
    Behälter für Wasser mit Schwimmerschalter
19. Filter
    Filter
20. Meter pump without differential pressure,system Rotodos, driven by (21)
    Messpumpe ohne Differential-Druck,System Rotados, angetrieben mit (21)
21. Pressure pump stainless with variable direct current gear motor
    Druckpumpe mit stufenlosem Gleichstrom-Getriebemotor.
22. Controlling and regulating devices such as analogous actual indication,pre-selection for quantity resp. proportion and digital summation counter for chips, phenolic powder, phenolic liquid, paraffin, water.
    Steuer-und Regeleinrichtungen wie Analog-Istwertanzeige, Vorwahl für Menge bzw. Verhältnis und Digital-Summenzähler für Späne, Phenolpulver, Phenolflüssigkeit, Paraffin, Wasser
23. Manometer with switch contacts
    Manometer mit Schaltkontakten

Fig.21 - Glue-coating station for wafer chips system DHYM.

C-668



78.11.06