GLASS INSULATING MATERIALS

By

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The development of technique called for the necessity of creating and maintaining adequate temperatures, irrespective of the changes in weather conditions. Under a cold climate the problems of economical heating and of heat economy, whereas in warmer parts of our world those of refrigerating and air conditioning come into prominence, but even in this latter case, heat economy is of utmost importance, as heat absorption requires the consumption of expensive electric power.

Heat insulation has a considerable impact, in case of both heating and refrigerating, on the size of the heating resp. refrigerating system required, *i. e.* on investment costs. It also greatly affects the quantity of fuel to be used resp. that of the electric or other energy required for operating the refrigerating machines, thus determining the operation costs. This is why for a long time efforts to solve the heat insulation problem have been made. The choice of the proper insulating material constitutes a problem known for a long time to thermo-technicians, refrigeration specialists and architects.

The appropriate heat insulating material has to meet manifold requirements. It has to withstand the highest temperature it is exposed to, without any change in its physical or chemical properties.

In respect of operating temperatures heat insulating materials for special industrial purposes, for temperatures over 100° C (212° C F) are classed into a separate category. In such cases mainly mineral, glass and ceramic insulating materials are applied.

The majority of heat insulating materials, however, are used for temperatures below 100° C (212° F), *e. g.* insulations of dwelling houses and industrial buildings, whether for heating or refrigerating. This group further includes insulations of refrigerating installations, refrigerators, storehouses, slaughterhouses, refrigerating waggons, etc.

The heat insulating material has to withstand all physical and chemical effects of the ambient atmosphere, thus carbonic acid and sulfurous acid contained in the vapour of the air, organic acids of foodstuffs and their vapours.

It is in first line with building insulations that vegetal fungi (mildew), species of bacteria, in certain tropics vermins are to be reckoned with, these latter attacking the heat insulating materials and by changing their physical properties, they deteriorate the heat insulation capacity.

For this very reason organic insulating materials of vegetal origin once widely used (saw dust, wood shavings, cork plates) have recently lost importance.

Up-to-date heat insulation technique, partly for this reason has recently applied insulating materials of inorganic origin, even for temperatures below 100° C (212°F).

Also other cogent reasons call for the ever spreading application of inorganic insulating materials. Do not ever let us lose from sight the essential purpose of heat insulation, *i. e.* that insulating should be effected by using the material of best heat insulating properties, of the worst heat conductivity, in order to impede the filtering through of heat, in case of heating outwards from inside, in case of refrigerating inwards from outside.

The heat insulating coefficient of materials is different even in their normal, compact state, thus *e. g.* the heat insulating properties of glass and clay widely surpass those of metals. This difference, however, is of no importance in the practical application of heat insulation but in the field of science. No material in compact state can offer the advantageous properties needed for efficient heat insulation.

The most efficient heat insulation can be effected by air, provided that there is no circulation and heat convection issuing therefrom. That is why insulating materials are applied in a porous state. The most appropriate material structure is offered when particles of a minimum wall thickness touch on the minimum surface possible, including the biggest amount of air possible, in the possibly greatest distribution. Such favourable structures can be ensured by thin fibrous materials. Only fibrous substances with a fibre thickness of fractions of a millimetre can be considered. Fibrous materials of cylindrical shape can be best applied the particles of which do not touch on their surfaces but only in the crossing points of the lines of cylindrical mantles, thus having minimum heat conductive surfaces.

From among the inorganic mineral fibrous materials all these requirements are best met by glass fibre. Experimental measurings numerically prove the foregoing theoretical considerations.

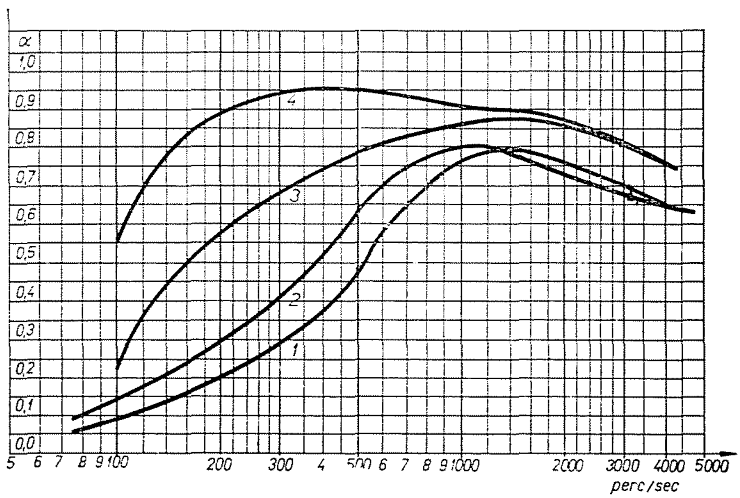

Fig. 1

The heat insulation characteristics of a few mineral fibrous materials resp. the values of their heat conductivity coefficients are shown in Fig. 1.

The thermal conductivity coefficient of the above glass fibres means in practice that in case of a workshop of a 1000 sq. m. (about 11 000 cu. ft.) area, if its corrugated sheet roofing is provided with glass fibre insulation 80 to 85 per cent of the fuel otherwise required can be saved, under European climatic conditions. A similar economy in refrigerating energy can be attained under a tropical climate.

Beside the traditional applications of heat insulating materials in industry (pipelines, boiler-room casings, tanks, refrigerators), the heat insulation of premises for human use is gaining ground more and more: the heat insulation of dwelling houses, offices, work rooms has proved excellent, be it from the point of view of economical heating or the investment and operating costs of air conditioning.

This paper is not intended to discuss in detail the first-class sound insulating properties of glass insulating materials, which also offer considerable advantages in building insulation. Information on this point is supplied by the diagram of Fig. 2.

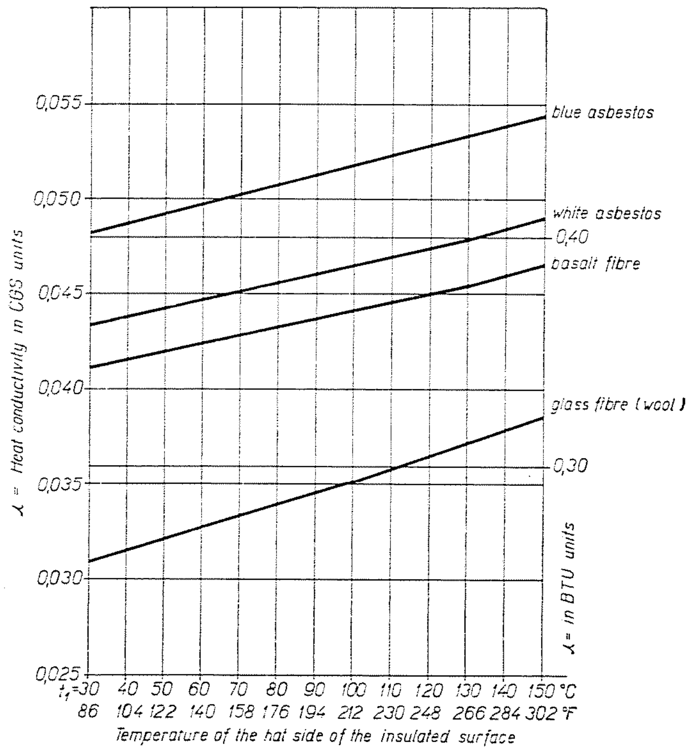

Fig. 2

Under the present trend building contractors are the biggest consumers of glass insulating materials.

Glass insulating materials can be applied for building insulation in various forms. In the simplest form loose glass wool is put between two layers of solid material. Coverings can be made also by putting glass wool together with layers of drawn glass fibre and sewing them up into sheets, so-called "quilts". For covering side-walls easy handling is ensured by the application of prefabricated panels and sheets (slabs) bonded together with synthetic resin (Fig. 3). The various methods of insulation are described in detail in the architectural literature.

In the foregoing the choice of insulating materials with respect to their physical properties was dealt with. We cannot, however, disregard the costs of the materials selected.

It is asbestos and glass fibre that are the most efficient heat insulating materials.

Asbestos is a fibrous mineral material of natural origin, its price being increased by costs of research and mining. It constitutes a valuable basic material for asbestos cement sheets and is indispensable for the thermal insulation of some industrial equipment exposed to particularly high temperature. Owing to this, it is in great demand and of a high price. For heat insulation below 100° C (212° F) its price prevents its application.

The raw material of glass wool manufacture is waste glass and cullet which can be obtained generally from dumping grounds, at a minimum cost. This cost is increased only by the heat energy required for melting and by handling costs. Thus glass fibre is not only the most appropriate but, at the same time, the cheapest heat insulating material.

As mentioned, a good heat insulating substance is of a loose structure and of a great volume. Consequently the costs of a longer continental or maritime transport are very high compared to its value. This accounts for efforts made, mainly overseas, to manufacture glass fibre insulating materials possibly in the vicinity of the important centres of utilisation, thus saving the freight. Such efforts are backed by the authorities of the countries concerned, for various reasons. On the one hand, power supply presents quite a problem all over the world, therefore heat economy in heating and reduction of electric power consumption in refrigerating is of vital importance. On the other, the inland manufacture of glass insulating materials brings about considerable economies in foreign exchange.

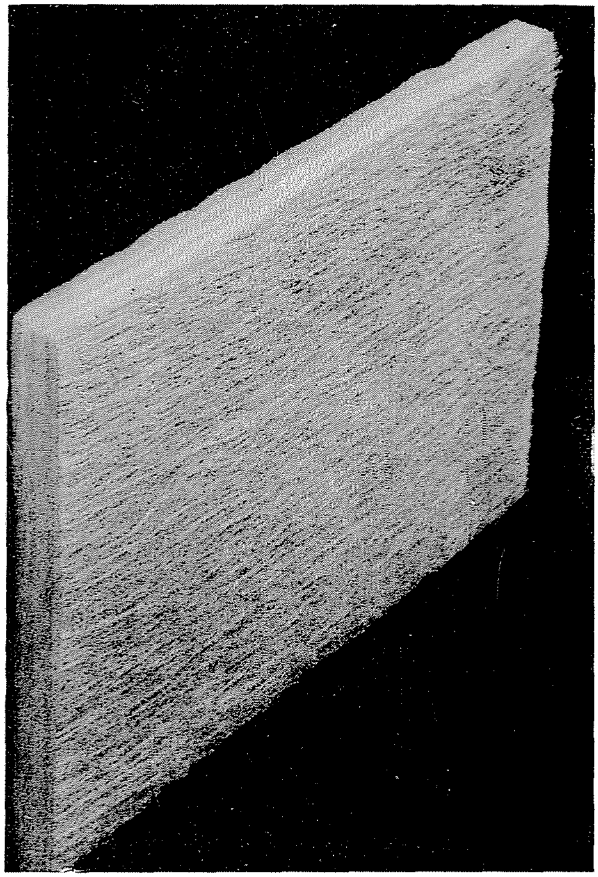

Fig. 3

Investors will find the establishment of glass insulating material plants a capital layout recovering in a comparatively short time. Whereas the inland price of such materials widely differs in various countries, mainly on account of the different tariffs, the equipment can produce, as a rule as early as within 4 to 6 months, goods to the value of the investment costs.

This industry offers a further advantage to the investor, since the plant consists of several production units, the number of which can be changed within the range of economicalness, in accordance with the sum available for investment, without affecting thereby the technological process.

In areas developing new industries some difficulties may arise with the specialists needed for introducing new branches of manufacture.

Plants manufacturing glass insulating material work generally with automatic machines the operation of which can be trained at an existing plant within 2 to 3 months. A couple of specialists trained abroad will, in turn, train the whole staff required for operating the machines.

A few specialists of a general mechanical knowledge (machine fitter, electrician) are required, the rest of the staff consisting of semi-skilled and unskilled labour.

The basic material of glass fibre manufacture, as mentioned above, is glass cullet available in large quantities in all civilized areas.

The cullet storing and preparation takes place, as a rule, in the glass house. The material is loaded from outside, and gets into the preparation (washing) shop on an endless rubber band. Leaving the washing machine the cullet drops onto a rubber band conveyor. While it travels on the conveyor foreign materials possibly getting among the cullet are sorted out.

The cullet selected is fed into the crusher whereafter it comes to a transport vessel lifted by an electric travelling crab. The material thus prepared gets into the silo and, by opening the silo lock, into the bucket-system cullet feeder and, finally, to the furnace.

The melting itself takes place in a furnace provided with gravitation outlet openings.

The air flowing into the sheet recuperator of the furnace is to a certain extent preheated. This is from where the air required for combustion is led. Furnaces are generally fired with town's gas or fuel oil. During melting only the furnace temperature has to be controlled, by means of an optical pyrometer.

The continuous flow of material coming from the furnace gets onto the centrifugal machine placed under the outlet opening (Fig. 4). The main shaft of the machine bears a fireclay centrifugal disc built into a heat-resisting steel head which, on account of centrifugal force, disintegrates the viscous glass into thin fibres of 18—22 μ. The glass wool is pressed by the air ejaculated from a nozzle to the bushing of the main shaft, where it is cut by a circular saw.

TECHNICAL DATA OF THE CENTRIFUGAL MACHINE FOR GLASS WOOL MAKING:

Capacity: approx. 60 kg (132 lbs) wool per hour = 1,44 tons per 24 hours

Fibre length: 200 to 500 m (8 to 20 in.)

Fibre thickness: 18 to 20 microns

Electrical power required: 7,5 kW

Furnace calory requirement: 68 cu. m. per hour (2400 cu. ft. per hour) of 3500 Kcal per N. cu. m. (390 BThU per cu. ft.) town's gas or: 23,8 kg (abt. 5,5 gallons) fuel oil.

The centrifugal machine is equipped with a chute welded from plates to which the suction head of a pneumatic conveyor is directly connected. Passing through a welded tube the glass wool gets into a settling chamber of alternating movement and provided with guide blades. The chamber and the whole conduct are provided with closely fitting doors and connections, to avoid vacuum losses.

In the chambers the direction of vacuum can be regulated by means of clappet-valves. While one of the chambers is being filled, the other is emptied, and vice versa. The emptying is manually performed. The glass wool discharged gets into a motor-driven baling press which presses bales of a required size. After pressing the bales are fastened up with strings and transported by truck into the storage room. In case of glass fibre manufacture the cullet is prepared in a way as described with glass wool making. The cullet is stored in small containers beside the fibre drawing machine (Fig. 5). The perforated drawing tubes of refractory material are built into iron plate cylinders and are connected to a centrally arranged melting chamber provided with a feed funnel.

The space between the plate covering and the refractory is filled with crushed waste refractory material, in order to ensue better heat insulation. Then the system is heated to operating temperature at a speed determined by the fuel characteristics and the feeding of cullet begins. When on the openings of the drawing tube a glass drop of onion shape appears, the fibre drawing drum is started, the glass drop is drawn with a steel rod to the rotating drum and the formation of glass fibre begins.

The rate of feeding depends on the output. At the end of the shift the drum is stopped,

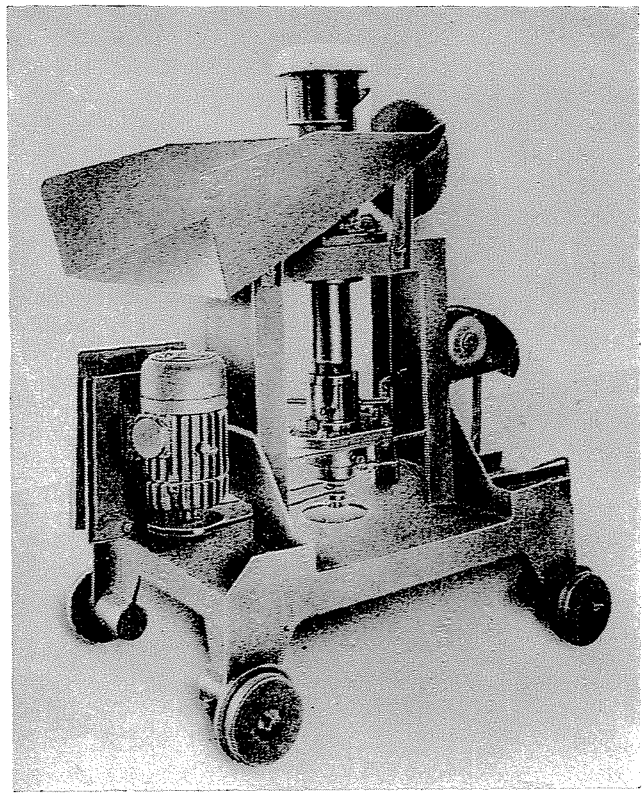

Fig. 4

the fibres winding around it are cut parallel with the shaft, and the fibres gathered are removed from the drum.

The bundles removed are rolled up, fastened with strings at the middle and the end and thus transported to the storage room.

When making glass fibre quilts the loosened glass wool fibres are laid on a paper base, previously coated with a glass fibre film.

The stuffing density of the quilts is checked by measuring the aggregate thickness of the fibres loosened.

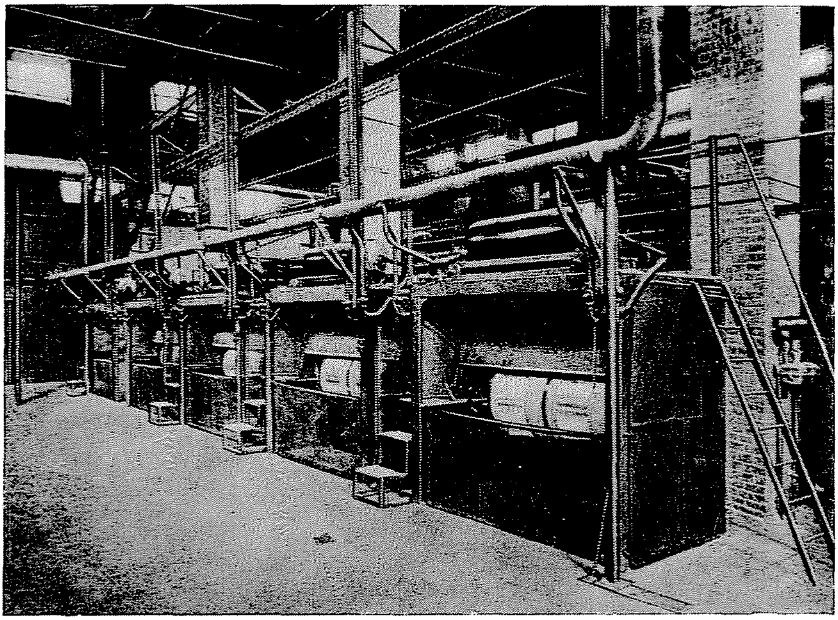

Fig. 5

TECHNICAL DATA OF THE GLASS FIBRE DRAWING MACHINE :

Output : 6,8 kg per hour (15 lbs per hour)
Electric power requirement : 3,2 kW
Heat energy requirement : 20 cu. m. (abt. 700 cu. ft.) per hour of town's gas, caloric value 3500 Kcal. per N. cu. m. (390 B. Th. U. per cu. ft.), or 6,8 kg (abt. 1,5 gallon) fuel oil.

As a covering another glass fibre film is applied, then the quilts are passed through the sewing machine.

Layers can be put together four- to tenfold, as required. Quilts are marketed in pieces of 5 sq. m., rolled up.

TECHNICAL DATA OF THE MULTIPLE-HEAD SEWING MACHINE :

Output : 120 cu. m. per 8 hours (about 4200 cu. ft. per 8 hours) Average thickness 40 mm (abt. 13/4″)
Electric power requirement : 4 kW

The technological process outlined above takes place on a fairly high level of automation, yet it requires no intricate machinery, nor specially qualified labour, neither for the production nor for maintenance.

The basic raw material, the cullet, is easily available and can be obtained at a low price, rendering a product of first-rate sound and heat insulation material of excellent properties.

PROBLEMS OF SUGAR-JUICE EXTRACTION IN THE SUGAR INDUSTRY. THE "J" DIFFUSION

By

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The classical method of obtaining sugar-juice, the countercurrent extraction by means of successively placed vessels with the so-called Robert-elements, was invented more than 80 years ago and in the majority of the sugar factories is in use even today. Notwithstanding innumerable perfections and the outstanding practical results the disadvantages of this method came into light more and more in recent years. Insufficient leaching, the sometimes occurring flowing-difficulties, the high water-requirement together with the resulting fairly large quantities of sewage, the complexity of the manipulation, the considerable labour-demand, necessity to carry out a relatively heavy work and at last the almost complete unsuitability for automation should be mentioned among them.

These disadvantages of which only a part can be eliminated and the tendency to introduce universal, continuous, mechanized and automatized equipments have led to the construction of a large number of tested and partly well proved installations. Regarding the further development of the diffusion process and with the view to construct an appropriate diffusion equipment through investigation were introduced in Hungary as well.

Many detail-questions of sugar-juice extraction were dealt with theoretically and experimentally in the Research Institute for the Sugar Industry and on basis of the results a technical apparatus was constructed. In this paper the author wishes to present a review on the work and on the results achieved.

The necessity of a possibly most perfect leaching suggested the thorough examination of the saccharose-diffusion in countercurrent from the sugarbeet slices. Theoretical examinations have shown that in clean countercurent the losses related to the introduced sugar-quantity depend — under ideal conditions — only on two non-dimensional numbers. One of these is the outflow, the other the product of leaching-time and diffusion factor. The latter is proportional to the diffusion-constant of the sugar in the beet-tissue and inversely proportional to the thickness of the slices. The diffusion-constant remains low until the beet-cells are denaturated by the heat-treatment. After the denaturation (plasmolysis) the diffusion-constant is strongly influenced by the leaching-temperature (the increase is about 2 per cent °C).

To raise the leaching temperature beyond a certain limit by increasing the outflow, is uneconomical, since too large water-quantities are to be evaporated. Although the prolongation of the diffusion-period leads to the improvement of the leaching, still the disintegration of some structural elements will produce a decrease in the mechanical solidity of the beet-slices, in consequence of which flowing difficulties will result and on the other hand materials without any sugar-character will enter by the time into the juice to an ever increasing extent; these will reduce the purity of the juice, render its purification very difficult and induce the deterioration of the molasses. It seems that beet varieties of various regions are rather different in this respect, the causes of which are of climatic nature in the first place.

The diffusion periods, which may be used in Germany and Bohemia, are inadmissible in Hungary and Slovakia and towards the South and East this "sensitivity" of the beet seems to increase even more (*e.g.* in Italy and Turkey).

The efforts should aim therefore at obtaining a good leaching in the shortest possible leaching-time and that the diffusion period after the plasmolysis should not exceed 60 minutes as a maximum. (In Hungary it is strived to obtain an even shorter diffusion period). Thus the increase of the diffusion factor is at our disposal. The examinations connected with the diffusion-constant were extended on the dependency of the plasmolytic process upon time and temperature, furthermore on the change of the mechanical properties (modulus of elasticity) and the thermal conductivity of the beet. It could be concluded from the analyses, that the most advisable process is to heat the beet rapidly, to keep it for a short while (*i. e.* from 8 to 10 minutes) at relatively high temperatures (in case of healthy beets up to 88° C or if the material is rotten, at 73 to 75° C), then bring the temperature quickly to the constant temperature of the proper leaching of 70—72 (for frozen beet 68—70° C). A slow heating is harmful also for microbiological reasons and local overheatings should be avoided altogether. Owing to these reasons a heating by steamjacket cannot be taken in consideration, since it is either too slow or the very large temperature-differences would be responsible for a strong overheating. A steam-scalding is still less recommendable. The plasmolysis should therefore take place with such a juice-scalding, which should exclude the overscalding.

In addition to developing an adeqate temperature the improvement of the diffusion factor may be attained by reducing the thickness of the beet-slice, *i. e.* by increasing Silin's slice-length. This on the other hand relates to the question of the slicing machine equipment. With the slicing equipments presently in use beet-slices of 28 to 30 mm/100 g can be prepared without any difficulty. It should be postulated that the diffusion equipment be able to work irreproachably even with very thin slices in order to realize the advantage which can be attained by means of thin slices, *i. e.* a very good leaching within a short diffusion period and to obtain hereby a sugar-syrup of good quality. This is a question of the flowing in the first place, therefore in the presently known equipment the length of the slices cannot exceed a certain value. To elucidate the problem, investigations were carried out regarding the flow of beet-slices. The compression of the slice-columns by hydrodynamic forces and the herefrom resulting resistance-increase was examined, as well as their dependence from the length of the consistent slice-column, the elasticity modulus of the beet-material, respectively from the compressibility factor of the slice-mass studied. In conclusion it appeared that the division of the beetslice columns into hydrodynamically independent part-columns allows even in case of excessively thin beet-slices or in case of bad quality, *e. g.* frozen beet, that the flowing resistance be kept at a low level and the desired uniform flow be assured.

The possibilities were also shown hereby to develop a construction which should be reliable in service from the point of view of flowing techniques.

Every phenomenon disturbing in the countercurrent the perfectly uniform flow, exerts a prejudicial influence on the losses. Any relative deviation from the direction of flowing and from the speed of the individual slices or juice particles involves an excess-loss.

These local displacements arising through transportation (*e. g.* conveyance by worm-gear) or turbulences are called remixing and may be characterized by a factor of given size. The size has a longitudinal dimension. The excess-losses arising through remixing are influenced again by a dimensionless number represented by the quotient of the remixing factor and the diffusion length.

It is uneconomic to increase the diffusion-length beyond a certain limit, since this would result in the increase of the weight and price of the apparatus, in the strengthening of the hydrodynamical resistance and it would be also very difficult to obtain the service-reliability of the too long internal transport equipments. It seems therefore that the right way is to transport the slices without any deviation or extension of the distance.

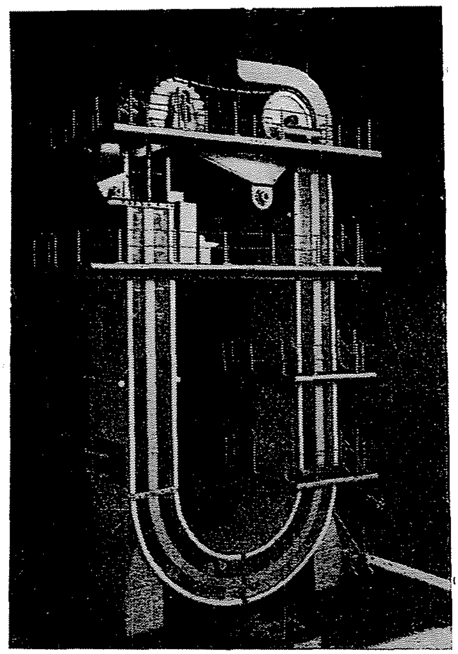


Fig. 1

The route of transportation should be free of any sudden changes in the direction and the cross-sections should be shaped in a way that — apart from the unavoidable turbulence between the slices — no remixing should take place in the juice. Under such conditions practically ideal countercurrent leachings can be attained. Without these the results will be considerably worse.

For the employment of thin beet-slices this considerate mode of conveyance is also a condition. Equipments containing transportation elements which are making great demands on the slices, cannot process thin slices on account of the strong slurry formation and of corresponding disturbances in the flow, thus the value of the leached slices, *e. g.* their suitability for drying will also decrease.

In addition to the losses discussed, the losses of so-called unknown character must be equally eliminated. Damages caused to the beets by microbes can amount only to tenths of one per cent.

Life-conditions of the microorganisms are rendered very unfavourable by the mentioned temperatures, besides this care must be exercised during the construction, that no dead spaces should be formed which could serve as centres of infection.

The losses can be significantly reduced by taking back the presswater from the leached slices. Hereby the water management will be improved as well. It must be postulated therefore that it should be made possible to lead back the presswater into the continuous diffusion simply, possibly without chemical purification.

Small power consumption should be a further requirement. By studies made on the heat requirement it was proved that the temperature distribution and the heat consumption in the diffusion, in case of countercurrent heat-exchange, depends above all upon the same non-dimensional quotient, remixing factor and length, which was already discussed together with the problem of the remixing.

Among the prescribed further characteristics a few more should be mentioned. The main dimensions are very important (particularly the smallest possible space requirement and a not excessive height). The equipment should be easy to operate and readily automatizable, the costs of production be low, *i. e.* the equipment must be simple and of a small weight. At last its work in the service should be reliable, both from the mechanical and technological points of view, that means that it should yield the desired output independently from the beet-quality.

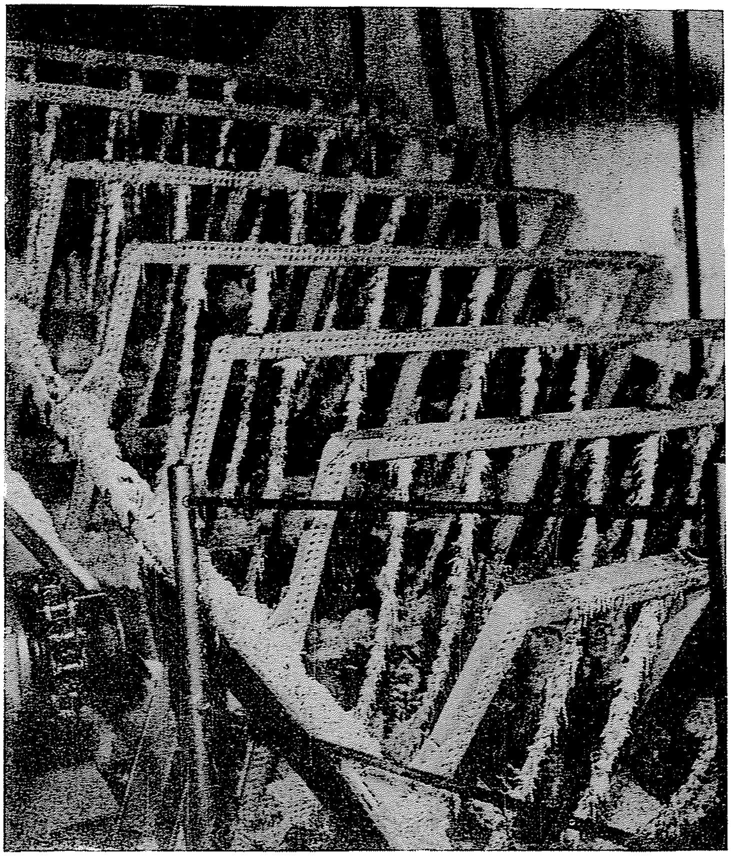


Fig. 2

It was demonstrated in a survey that none of the so far known constructions can comply with all the requirements here mentioned. This induced the co-workers of the Research Institute for the Sugar Industry that on the ground of theoretical research and a large number of experiments a new construction should be developed.

Correspondingly to its external appearance the equipment was named — "J" diffusion (Fig. 1). The leaching takes place in the "J" formed house, cross section of which is rectangular. The dimensions of an equipment for a daily output of 700 tons are the following : cross section : 1,30 × 2,60 m, maximum height : 17, 5 m, mean radius of the lower arch : 3,2 m. The whole equipment is of self-carrying execution. The slices are transported by a rake-conveyor into the interior of the equipment and by a special distribution mechanism at the shorter foot. The slice-carrying elements are supported, respectively carried with the slices by two endless drag-chains and consist in fact of an angle-steelframe, the inner surface is over-bridged by chains (Fig. 2). The distance between these chains is fixed in a way to allow a regularly even and unimpeded filling-in of the beetslices and to carry off the already filled-in slices as a coherent mass, *i. e.* entirely free of remixing. The distance between the single frames is 60 cm. By this the necessary division of the slice-columns is attained. Due to such a division of the inner transporting part the hydrodynamic resistance of the whole slice column is about 1,5 to 2 m water column pressure. The single arch of a large radius allows the considerate uniform conveyance of the slices, as well as the possible remixing-free flow of the returning leaching liquid. The latter — after flowing through a preheater — is carried, adequately distributed, to the longer foot.

From the roof of the equipment the leached slices lifted out of the water and drained are falling into a worm-gear, which conveys them into the slice-press. By leading through a pulp-receiver the presswater can be recovered.

The raw juice is extractable through a suitable filter placed below the slice-filling. It flows down entirely free of foam and pulp, thus rendering superfluous the employment of a pulp-receiver or the taking of other measures for the elimination of foaming.

The heating of the slices, the plasmolysis (scalding) and the proper diffusion are taking place in a common house. For this purpose on a suitable place of the shorter leg a large quantity of the juice is continuously removed by means of, respectively through, a sieve, preheated in a preheater and retransported to a higher level. Thus three zones are being formed in the apparatus : one heat-exchanging zone on the upper part of the shorter leg, where the slices are heated and meanwhile the raw juice coming from the opposite position cools down to the temperature of 40° C. Below this is the scalding zone, where the beet slices come into contact with a large volume of hot juice and will be thus subjected to plasmolysis. The other and largest part of the apparatus is called diffusion zone. By the adequate dimensioning of the scalding zone and by the extraction, respectively recovering of a juice-quantity of about 500 to 600 per cent. a. R. it may be obtained

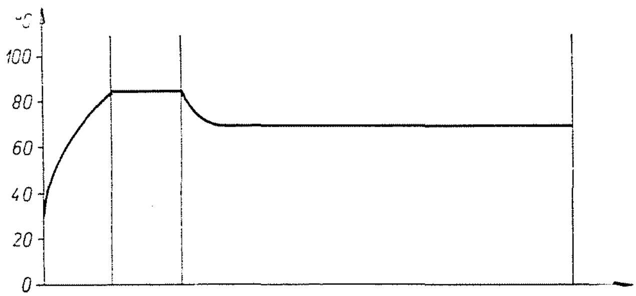


Fig. 3

that the temperature-difference between the removed and retransported juice should amount to only 2 to 2,5° C.

Consequently the highest juice-temperature exceeds only by 2° C, the temperature of scalding and a local overscalding is therefore completely excluded.

The temperature conditions of the "J" diffusion are shown on Fig. 3. As may be seen, the ideal temperature conditions are observed. At the same time the heat consumption is equally low. Heat is required for the warming up of the presswater and of the scalding zone. If quantitatively and from the point of view of temperature sufficient hot water is available in the plant, in addition to the presswater, this part of the heat consumption may be brought down below 1 kg steam/100 kg beets. The heat-requirement of the scalding is about 2,1 kg steam/100 kg of beets.

This diffusion apparatus works therefore practically without any auxiliary equipment. The otherwise usual trough, separator, raw-juice pulp receiver are built into the equipment.

Apart from the slice-press and the pulp-receiver required for the presswater, the equipment necessary for "J" diffusion consists only of the following : one container for the headwater and presswater with the pertinent pumps, water preheater, circulating pump with the single juice-preheater required for the juice scalding, as well as the necessary belts and other conveyor equipments for the fresh, respectively leached slices.

By this excessive simplicity not only the reliably safe operation is assured, but also the dimensions and weight of the equipment may be kept at a low level. The mechanical energy requirement is likewise small. The rate of power input of the driving motors in an equipment working with 700 tons daily capacity (for moving the beet slices) may be estimated at only 2 kW. The energy requirement of the whole equipment, water-, and raw juice pumps included, is also only about 37 kW.

The here mentioned data can be considered already as service data. Previously however, on the ground of calculations made, such an equipment was installed in 1954 in semi-plant scale, with 160 tons daily capacity, in the sugar manufactory at Hatvan. Seeing that this equipment worked fully up to the expectations, another — in principle the same, but enlarged — equipment for a daily capacity of 700 tons was erected at Petőháza and put into service in the last days of the 1957 campaign. This equipment was running in 1957 and 1958, in two campaigns parallel with Robert diffusion. In the first half of the 1957 campaign a large number of investigations was conducted, commencing from middle of November they worked with presswater-recovering. In 1958, at the beginning of the campaign, the equipment worked again with clean headwater and then returned anew to presswater-recovering.

The leaching results obtained are shown on Table 1.

Table 1

Diffusion results in the campaigns **1957** *and* **1958.**

	1957		1958		1958 Dec. 11—24. control-period
	average	with recovery	average	with recovery	
Sugar-content of the beet, per cent. ..	17,29	17,24	15,00	14,80	14,78
Sugar-loss per cent A. E.	0,337	0,255	0,284	0,242	0,183
Juice-extraction, weight per cent	125,9	127,1	125,7	125,1	125,9
Effective leaching time, in minutes....	56,1	56,6	56,2	56,2	55,8
Slice-length m/100 g	21	20	21	21	21,7

In the last 14 days of the past campaign the Directorate of the Hungarian Sugar Industry gave orders that the losses of both defined and undefined character should be verified. The average result of this survey during the two weeks is presented in the last column of the table shown on page 216.

Undefinable losses may occur from leakage, which in the case of "J" diffusion is excluded almost completely, and from activity of microbes. If presswater is not recovered, the activity of microbes in the case of "J" diffusion is almost completely excluded. When presswater is recovered, though the life conditions of the microbes are very much aggravated, it is still recommended to carry out a superficial disinfection (the best way is to add sodiumhypochloride into the presswater) that the activity of microbes should fall below a negligible value. The result of microbe-countings made in December 1958 are shown by the numerical data of Table 2, though this time also some frozen beets came into processing in a certain percentage. It should be observed besides this that the Robert battery serving as a basis of comparison was also continually disinfected.

In case of losses of undefined character caused by microbial acivity the most important supplementary substances of the saccharose, *i. e.* the lactic acid and invert sugar were determined both in the beet and in the juice of the Robert battery and the J diffusion. From the results of the measurements it could be concluded that the loss of sugar occurred owing to the lactic acid and the inversion remained below 0,01 per cent in case of the "J" diffusion, while in the case of the otherwise well operated and disinfected Robert battery it exceeded the value of 0,06 per cent.

In the valuation of the juice quality the purity of the raw juice in the Robert battery and that in the continuous "J" diffusion had been compared in the first place. It was demonstrated by the experiences that the purity quotients are generally of the same value, but when the presswater is entirely recovered the quotients in case of the "J" diffusion are lower by a few tenths of one per cent, in the first place when, in addition to the own presswater, instead of the clean headwater presswater from the slices of the Robert battery was led to the diffusion. (The experiments have shown namely that the "J" diffusion is able to perform an unobjectionable work even when the battery presswater is taken back, without any difficulties in the juice purification and with further reduction of the total loss.)

Table 2

Control of microorganism-activity

	pH	Germ-number/ml Mesophil	Thermophil
Robert battery medium	5,4	$100 \cdot 10^3$	$90 \cdot 10^3$
raw juice	6,6	$120 \cdot 10^3$	$60 \cdot 10^3$
"J" diffusion medium	6,0	$0,2 \cdot 10^3$	$8,8 \cdot 10^3$
raw juice	6,2	$2,1 \cdot 10^3$	$18,0 \cdot 10^3$

The presswater recovered does not require any more particular treatment. (When presswater is recovered, obviously also other materials without any sugar character are equally recovered in a larger quantity which must have an influence on the raw-juice quotients. In the practice however the quotient of the thin juice is decisive.) For the elucidation of this question thorough examinations were conducted in the 1958 campaign by the factory laboratory and the Research Institute. Simultaneously the raw juice was processed into thin juice in the laboratory by

Table 3

Verification of juice-quality

	Purity quotient raw juice per cent	Colloid-contents g/100° Bx	Invert sugar content g/100° Bx	Purity quotient thin juice per cent	Limesalt content g/100° Bx
"J" diffusion	88,42	8,32	0,32	93,73	0,183
Robert diffusion	88,65	8,96	0,51	93,35	0,197
Difference	—0,23	—0,64	—0,19	+0,38	—0,014
Difference error	—0,14	—0,30	±0,03	±0,23	±0,012

means of lime and carbon dioxide on the basis of Silin's procedure. The results of the analysis are presented in Table 3.

It may be seen from the data of the analysis, that although the purity quotient of the "J" diffusion raw juice was somewhat lower, the thin juice obtained was — in spite of the presswater recovery — of a better quality than with the Robert battery.

The advantages that may be expected from the employment of very thin beet-slices, could not come duly to a full avail at Petőháza. Namely uniform slices were cut both for the "J" diffusion and Robert battery. But on the Robert battery hydrodynamic difficulties would have already appeared if still thinner slices were employed. On the first days of experimentation in February 1957 very interesting experiences were made. Highly deteriorated, several times frozen and then again melted beets were processed. In spite of all precautionary measures a bad pressure could be noticed in the Robert battery, whereas at the same time the "J" diffusion worked faultlessly without any difficulties in the flow. During the last campaign it was generally found, that owing to hydrodynamical causes no limitation occurred in the increase of the output.

The work with very fine slices could be excellently tested in the pilot-plant scale equipment at Hatvan, where during the time of the experiment the equiment was supplied with slices by means of a special cutting machine. The plant worked faultlessly even with slices cut specially for the experiment in a size exceeding 30 m/100 g, the leaching results being naturally very good notwithstanding the short period of the leaching.

The command of the diffusion-equipment is simplified by the instruments mounted at the operator's stand, which register the temperature the liquid-flow, the speed of the conveyor-chain, and by regulating devices. The latter — in addition to the speed-governing apparatus — are : electropneumatic temperature controllers, installed on the two preheaters and a few simple float-governers for the control of the liquid-position. The slice-quantity fed into the equipment is weighed on a scale. The output of the equipment can be adjusted and varied in a wide range by a single movement of the hand. At Petőháza the capacity was varied between daily 400 and 800 tons according to necessity.

At last we may add a few characteristic data : the largest measurements are for a daily output of 700 tons 17,5 m in height ; total weight: 113 tons ; space requirement: 6×8 m^2, room requirement : 1250 m^3.

Economical examinations of the "J" diffusion in Hungary have shown that the installation of a "J" diffusion is lucrative proposition not only when new factories are built or old ones reconstructed, but should be taken in consideration also for increasing the capacity of the equipment. In recent years the daily output of Hungarian sugar factories has risen considerably. This resulted in the heavy overburdening of the Robert batteries in the majority of the sugar factories and correspondingly in the running of the losses at a rather high level. Following the increase in the quantities processed, the sewage-quantity equally augmented and the purifying plants are unable to clean this increased quantity. The solution of the sewage will encounter difficulties which also owing to the progressing industrialisation will be heavier from year to year.

The enlarging and reconstruction of sewage-treatment plants demands very heavy investments. Even the covering of the fresh water requirements represents another serious problem in some of the factories. The increase of the daily capacity, the suppression of the overburdening of the batteries and a reduction in the total loss can be achieved by the installation of "J" diffusions of adequate capacity and by the coordination of their work with that of the Robert batteries. In addition to this, especially if part of the battery-presswater is recovered into "J" diffusion, the freshwater requirement in spite of the increased total capacity, will not rise, on the contrary, it will be even lower and the sewage-quantity, will be lessened to such an extent that new investments for purification purposes will be no more required. For this reason ever more and more "J" diffusions have been installed in the Hungarian sugar factories in the last years.

For the satisfaction of inland and foreign demands another still larger equipment with a daily nominal capacity of 1500 tons will be put into service in 1960. As a matter of course the data related to the daily processing, as regards weight, space- and room-requirements, will be even more favourable. Meanwhile the Hungarian machine industry has already initiated the serial production of "J" diffusions with a daily capacity of 700 to 750 tons. These will be in part built-in in the the Hungarian sugar factories, but in their majority will be exported.

ON THE PROBLEMS OF MODERN CONSTRUCTIONS IN THE DOMAIN OF MACHINES FOR THE CANNING INDUSTRY

By

I. VARGA

In the course of the technical evolution the majority of processes used in the canning industry proved to be stable. In the beginning the processes, particularly the preparational work (*e. g.* seed-separation, slicing, etc.) were carried out prevalently by hand-power. Our modern lines working with mechanized technology equally include these processes, the works are performed however not manually but by means of machines. To carry out the manifold processes compared to the available types more simple and more complicated machines were constructed. In the development one group of the working machines took the course that the manual operations were imitated by machinery mechanisms, while in the other group the large-scale production took recourse to some kinds of processes, which were entirely different from the original manual methods. Frequently impediments were encountered in the mechanization of the manual works, *e. g.* for the reason that the raw material to be processed is not uniform in its mass and physical properties, the latter may change also in the single pieces.

Instead of circumstancial theoretic discussions we prefer to illustrate these views by one example, for which we refer to the peeling of fruits destined for preservation.

Hard-fleshy fruits, like apple, pear, quince-apple are preserved in peeled and sliced condition. In the primitive manual processing workwomen are peeling the washed fruits with normal or special knives.

For apple the characteristic data are the following. One person is peeling 5 to 6 kg in one hour, the peeling loss amounts to 12 to 13 per cent. It is a longstanding effort to mechanize this labour-consuming process. We are presenting an example for this on a very old machine, type Leonhard (Fig. 1.). The apples are pinned onto a rotating shaft, meanwhile a knife led by a model-form moves in spiral line on the apple-surface in the same way, as in a copying lathe. Since the apple very rarely has the same size and shape as the model, the resulting peeling will not be good, either too much waste will occur or the peeling will not be performed regularly. A modernised, much improved succession of this machine is the construction worked out in the VEB Maschinenbau, Burg, which is illustrated here (Fig. 2.). Also with this machine the apple is making a rotating movement, while the skin is removed by the knife, but the system is built up more progressively and the worker attending to the machine must pin simultaneously 4 fruits on each of the spindles. The carousel moves periodically with 4 and 4 divisions, the apples pinned on the spindles commence to move and during the rotation the knife pressed to the surface by a spring, passes over the profile of the apple. The thickness of the peeling is determined by a special knife, with the aid of which the thickness of the peeled layer can be adjusted. This technologic task is constructively solved by a massive machine which is provided with an intermittingly working carousel-system, different driving gears and pendular movements. The second part of the machine carries out the cutting of the fruits into radial slices or disks and

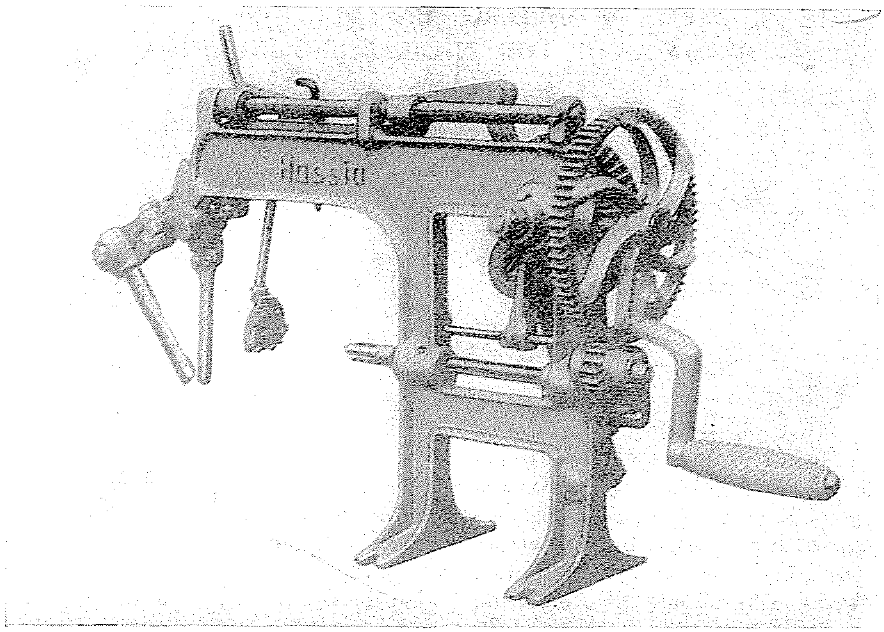


Fig. 1. Apple peeling machine, type Leonhard

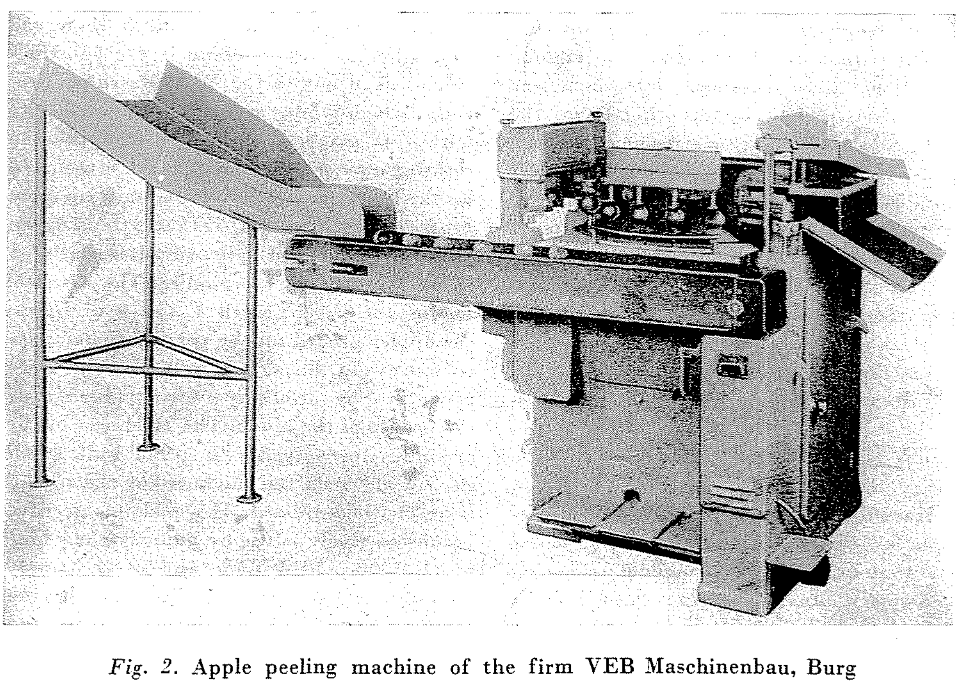


Fig. 2. Apple peeling machine of the firm VEB Maschinenbau, Burg

bores out the core. The weight of such a complete machine is about 1340 kg, with a performance of 45 pieces per minute, *i. e.* 2700 apples each hour, which in piece-weight equals 300 to 500 kg/hour. According to our opinion this construction is highly perfect and the enormous weight and the complicated mechanism are caused only by one conception : to imitate the hand-work by machinery and to compress all the work-tacts into a single machine. To this example we may add the following, which represents the opinion of one of the leading undertakings in the Westgerman canning machine-building industry. The peeling work of a mechanical peeling machine is never perfectly good. If peeling and cutting are united in a single machine, there is no possibility to carry out a human revision and a subsequent cleaning since these operations can be performed only on peeled *whole* apples and cannot be done on slices. There are therefore several firms that build peeling machine and cutting machine separately. The working process is divided also in our industry, but it is done otherwise. As was demonstrated by our experiments of many years, the peeling may be perfectly well carried out by means of chemicals. This technologic process, entirely different from those mentioned so far, was tested thoroughly in Hungary with very good results. The clever combination of chemical characteristics (*i. e.* kind of solution, concentration) and temperature allows to achieve in very small units large hourly outputs with a very high productivity.

For outputs of 300 to 500 kg/hour only three containers and a travelling, possibly electric crab are required. In the first bath the fruits are immersed in perforated baskets for 0,5 to 3 minutes at 80 to 90° C, then in a second container washed down with running water and air-mixing so that the skin parts become detached. In the third container a neutralization takes place with a weak organic acid (*e.g.* citric acid), whereby the pH value of the external tissue-parts will go back again to the original one. When an apple peeled in this way is cut through a thin ring, brownish discolorations can be seen on the margin of the cut surface. This is however by no means a dangerous phenomenon, because it disappears after sterilization. This discoloration can be eliminated almost completely, if still shorter treatment periods are used, combined naturally with suitable temperature- and concentration-values.

Of course for higher outputs of 2 to 3 or more tons per hour the mentioned equipment is no more practical. Our experiments aimed at the development of a final equipment have attained already good results, of which I cannot give yet ample information. Anyhow I may mention that the process is combined with steam and chemicals, peeling is carried out in a short time, continuously and very thoroughly not only on apples, but on other fruits equally well.

On the basis of our technological experiences we have developed a machine for cutting-up of apples and similar fruits (Fig. 3.). The fruits are placed on a continuously rotating working-disk, respectively are pinned on the points projecting from the tips of the knife-sets. The knife-sets are combined in a way that their inner circle digs out the core, whereas the corresponding radial slices are produced by the radial knives. After fruits are pinned the knife-sets proceed into the interior of the machine, where the pressbuttons moving together with them, adjusted by a forced adjuster-disk, are coming down. The pressbuttons are made of plastic, with indentation corresponding to the knife-set. All these parts are easily exchangeable for the purpose of good cleaning, As shown on the figure the machine is completely closed, compact and all the parts may be added to it by opening the door. The electric installation consists of low-voltage switches, signal lamp and electromotor of 0,6 kW capacity, whereas the strong current-switches are arranged on the distribution equipment. The output per hour is 2700 pieces, with a maximum diameter of 105 mm.

Another example for a modern construction is given by the glass-vessel locking machines. Our Figure 4 shows the old execution. Here the machine-body was made of heavy casting, the driving gear and motor were located outside, it was difficult to keep it clean etc. The new construction (Fig. 5.) shows a light stand made of steel-with exchangeable rolls and locking head, that it may be adapted also for Phönix and CKO locking systems as well.

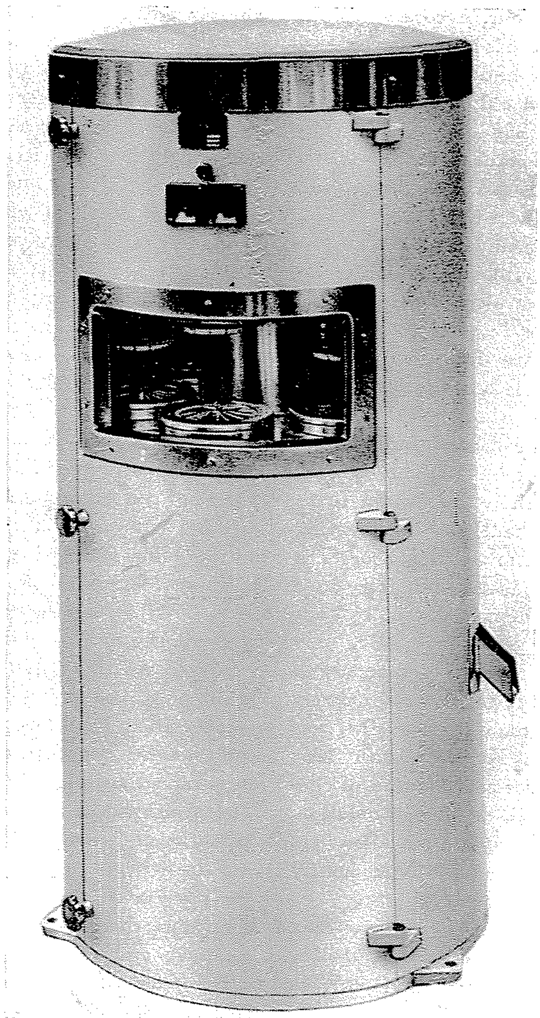


Fig. 3. Photo of the apple slicing machine

pipe and plate, the mechanical parts are protected by an easily opening cap. The locking is carried out on stillstanding glasses, *i. e.* the rolls are turning around the glasses. The rolls are governed by springy elements so that no breakages may be caused by quality- and measure-divergences. The machine is provided

These examples provide an insight into the fundamental principles of constructing machines for the food-, respectively canning industry.

As a recapitulation several points may be emphasized:

1. The machine should serve the techno-

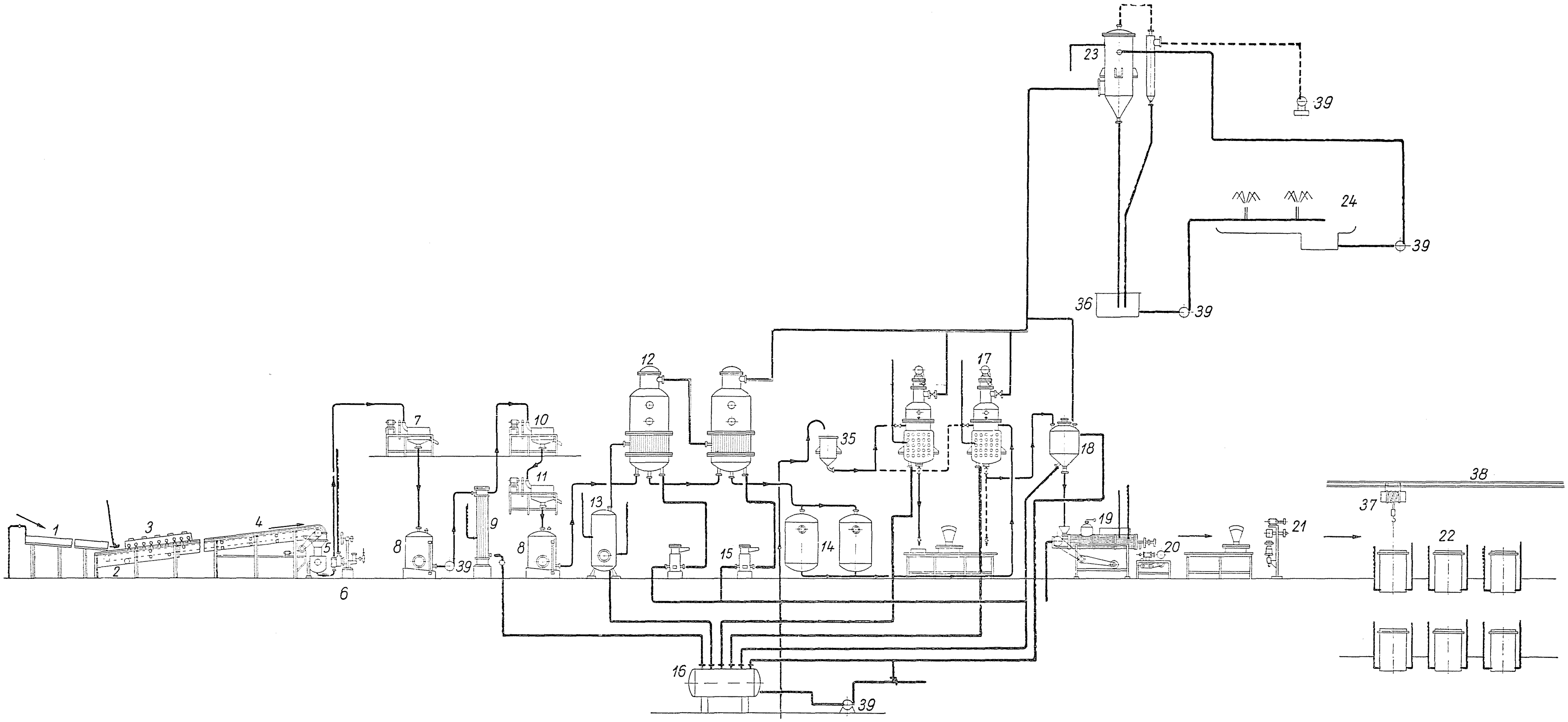


Fig. 6. Scheme of the old tomato-line

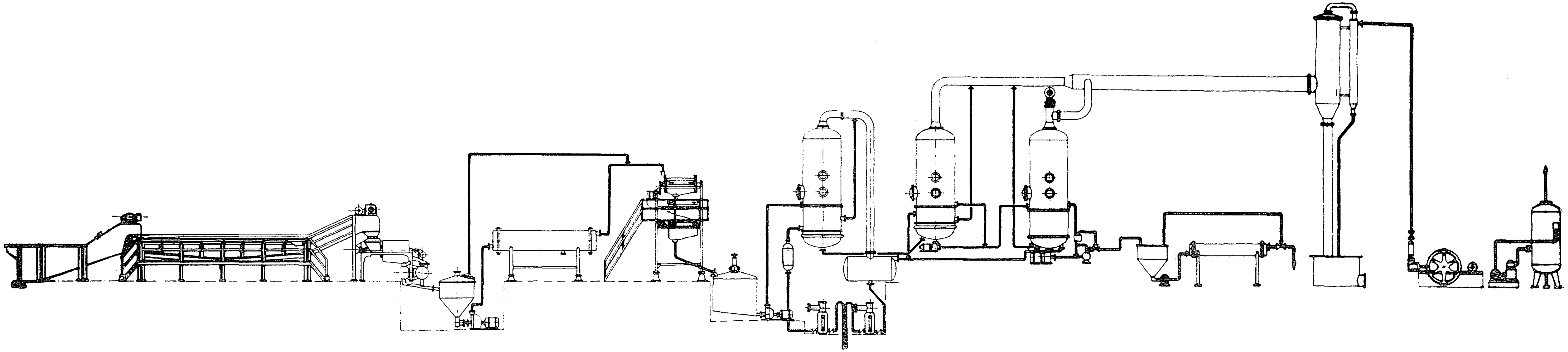


Fig. 7. Condensing equipment of the new tomato-line

logical purpose and be not destined for its own end.

2. The scope must be attained in the simplest way: the more complicated are the mechanisms, the more difficulties will occur during the operation.
3. Hygienically faultless construction in harmony with the beauty of the form: well to wash, easy to access for cleaning purposes, smooth, washable surfaces, with suitable openings on the cover or easily shapable parts of the housing.
4. Nice practical paintings and coatings, held in pleasant tints. According to our experience slight green tints are suitable for the canning factory; parts made of stainless or acidfast steel should be provided with polish or high polish. Covers and wrappers are manufactured by the leading firms of cheap steel plates poor in chrome and nickel, in which case coatings may be omitted.

These fundamental requirements are not easy to comply with, but serious efforts will not fail to produce their results in every case.

Fig. 4. Glassvessel-locking machine, old type

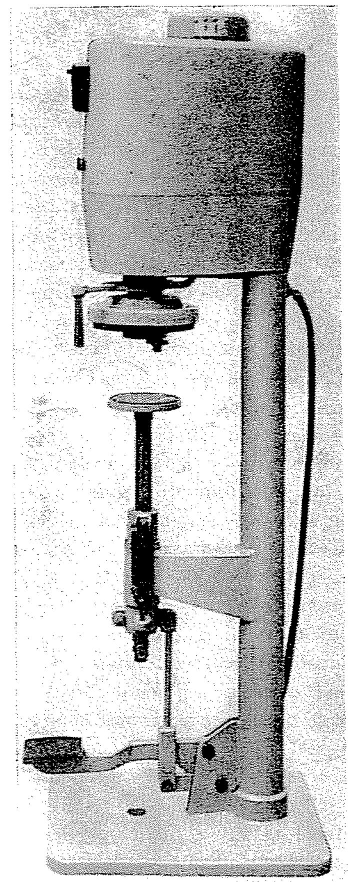


Fig. 5. Glassvessel-locking machine, new type

The construction and building of modern canning-technical machines and equipments open special problems with reference to the development of complete, consistent lines. Instead of long theoretical deliberations we prefer to elucidate the question by comparing the old tomato lines with the new ones. To produce tomato-purées the old lines worked partly continuously and partly discontinuously. According to scheme on Fig. 6. already for a long time past juice-production is not proceeding intermittently. Its contrast to the periodical system of concentrating causes the employment of large buffer-containers, which are very prejudicial for microbiologic considerations. The capacity of the receivers is kept nowadays in a size corresponding to a juice production in 5—10 minutes. The discontinuous operation of concentrators with manual service is a rather complicated solution and point of departure for many breakdowns and mistakes. In the course of evolution the experiments have shown that normal and in some cases special steamers with 40 to 50 cm pipe-diameter are adequate to obtain the concentration of 28—30 per cent dry substance. With this step the vacuum apparatuses can be eliminated and the stable working method is to be introduced. Thus the way leads to the new, continuous lines, which we are already manufacturing as follows : through the washing bench and the sorting bench the tomato arrives to the seed separating machine. The squeezed tomato is collected in a juice-tank. The tomato-juice flows into the tank by gravitation. The tomato is triturated at a previously determined temperature, for which purpose there is a juice-preheater disposed between the juice-tank and the triturating aggregate. The squeezed tomato is passed by a pump through the preheater, wherefrom it arrives on the triturating aggregate and from there in the thin-juice container by gravitation. The squeezed tomato is circulating until the required temperature is attained.

The material passes from the thin juice-container into the condensers I and II and finally into the condenser III. The tomato-concentrate circulates in condenser III until it reaches the desired dry matter content, which can be seen on a refractometer. The refractometer is actuated by a valve. By means of a pump the tomato-concentrate is carried into the pulp-collector. In order to obtain the necessary temperature, the material is circulated through the sterilizer-heatexchanger by means of a circulating pump. The desired sterilization temperature having reached the material arrives in the filling apparatus.

The technological process demands the employment of a barometric condenser and the water in- and outflow in the condenser to be adjusted by the water temperature.

The continuous operation requires four equipments which are independent each from the other :

I. Feeding- and distribution-network for power transmission, stopping of the motors in dependence upon the technological process and automatic command.

II. Temperature-control of the material between preheater and sterilizing apparatus and the maintenance of the desired temperature.

III. Level-control of the material between preheater and sterilizing apparatus.

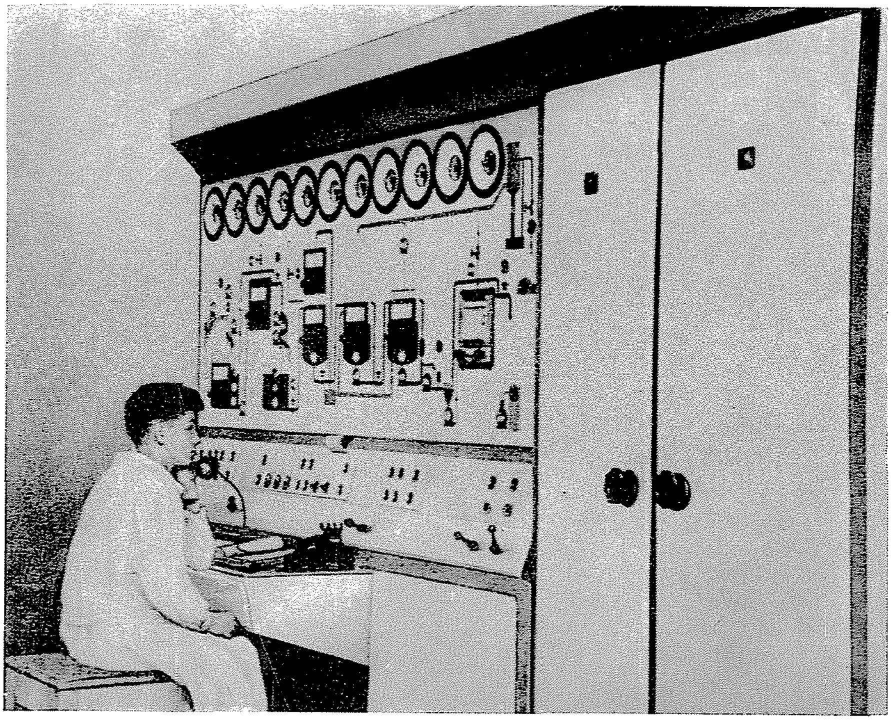
IV. Control of the pulp-removal in function of the dry matter content of the tomato.

The equipment is provided with electric switching and regulating instruments. The electric equipment contains the starting and protective equipment of the motors for the washing and triturating stations, as well as for the condensing and sterilizing stations. The switchboard contains further the automatic arresters required in case of breakdowns. Furthermore the illumination-scheme of the juice-producing station and of the condenser-sterilizer station are also contained in the switchboard. Signal lamps of various colours for the signalization of the switchings in and off are disposed on the switchboard. Should a motor come to a standstill, all the other motors will equally be stopped successively.

The adjusting instruments for the temperature-control of the material are provided for the following purposes :

The temperature of the juice leaving the pre-heater is measured with a remote controled pneumatic temperature-controller and with a registering apparatus and the heating steam-quantity is adjusted in this function.

A regulating equipment of similar exe-



Fig, 8. Switchboard of the new tomato-line

cution is provided for the temperature-control of the tomato-pulp flowing out of the sterilization apparatus and the heating gas quantity is adjusted in this function.

The cooling water temperature in the fall tube of the barometric condenser is controlled with a temperature controller and the cooling water quantity adjusted in this function. The vapour room temperature of condenser-station I is measured with a remote controled pneumatic temperature control equipment and the heating steam quantity is adjusted in this function.

The level height in the raw juice container, in the thin juice container and in the condenser bodies is measured by a pneumatic level adjusting apparatus and the juice quantity delivered with the pump is adjusted in this function.

The ready tomato concentrate is controlled by means of a refractometer, in function of the dry matter content in the concentration.

The continuous work is indivisible from a high-grade automation, which of course is rather expensive, but it will result advantages, which were unknown up to the present in the canning industry *i. e.* :

1. Stability of the quality, in the first place of the dry matter content in the ready product.

2. The continual observance of optimal operative conditions and index numbers.

3. Economy in labour, which is not too high.

4. A good adaptability to the desired hourly outputs and to the various demands put forward regarding the degree of condensity of the concentrate.

The above mentioned characteristics show a pathway for the development of the canning industry, which will be followed in an ever increasing rhythm.

THE IMPORTANCE OF GRAIN-SLICING IN THE MILLING INDUSTRY AND AGRICULTURE

By

Á. SZÉKELYHIDY

I. Theoretical bases of grain-slicing

Knowing the shape and chemical composition of the wheatgrain it is an obvious fact, that endospermium-parts, located in the centre of the grain, which contain mainly starch are the most precious material to be utilized in the milling industry for the purpose of flour-extraction. Related to the husk quantity there is less endospermium towards the extremities of the grain, therefore the end parts are less valuable. It is a longstanding effort that the mainly bran-yielding endparts should be eliminated and the less husk-parts containing middle parts should be processed in the first place in flour. This aim cannot be attained with the actual milling procedure, by using break rolls.

Moreover the break rolls cannot be suitable either for the obtainment of definitely shaped and uniformly sized grain-pieces, since the grains arrive irregularly — in haphazard position — through the feeding hopper between the rolls, thus commencing from the flour-grit to the nearly full size flattened wheat grains, differently formed and sized wheat grains will result in varying quantities. The way of their further processing cannot be directed easily, owing to the fact that in every case a technology must be adopted, which corresponds more or less to the fractions present in the largest number, consequently the processing of wheat-pieces, the size of which is different from the size of these fractions, will not proceed in the most favourable manner.

Paul Rajkai, Kossuth prize laureate, scientific departmental manager, examining the artificially produced cracks and splits which may be found on the wheat grains, has found that they are arising in a direction perpendicular to the longitudinal axis of the wheat-grain and that this best corresponds to the splitting disposition of the wheat-grains, because both skinparts and endospermium can be split respectively sliced in this direction with the least strength.

After the recognition of this regularity Rajkai commenced his slicing experiments and constructed his grain slicing machine, which, based on entirely new principles, allowed the removal of the endparts and the obtainment of primary slicing products of same size and similar shape. Rajkai solved the individually directed processing of the wheat grains and this with an output of about 40 to 45 million pieces/hour.

II. Description of the grain-slicing machine

The main parts of the slicing machine are the following:

1. Grain gathering rolls provided with pockets.
2. Brushes.
3. Disc-shaped slicing knifes.
4. Groove-cleaners.

The grain to be sliced arrives from the feeding container on the grain-gathering roll, which is provided with pockets and settles down, parallel with the longitudinal axis of the roll, in the pockets recessed in the roll-jacket.

Correspondingly to the number of the slicing knives grooves passing also through the pockets are arranged on the grain-gathering roll and assure the uni-directional cutting by the knives.

The rotating brushes located above the gathering roll remove the superfluous grains from pockets and facilitate the positioning of the grains at the same time.

The roll — turning-off after the brushes — brings the grains under the knives. The rotating disc-shaped knives passing through the pockets are carrying out the slicing. The middle parts of the grain squeezed between the knives continue their rotating movement with the knives and are removed into a collecting channel by a comb-like lifting mechanism fitting between the knives.

The two endparts remaining in the pockets are — together with the grain-gathering roll — rotating further and fall out before the groove-cleaner into a special collecting channel. This brings about the separation of the end- and middle parts.

The floury parts resulted during the slicing may sometimes block the grooves serving for the running of the knives. This is prevented by the groove-cleaners.

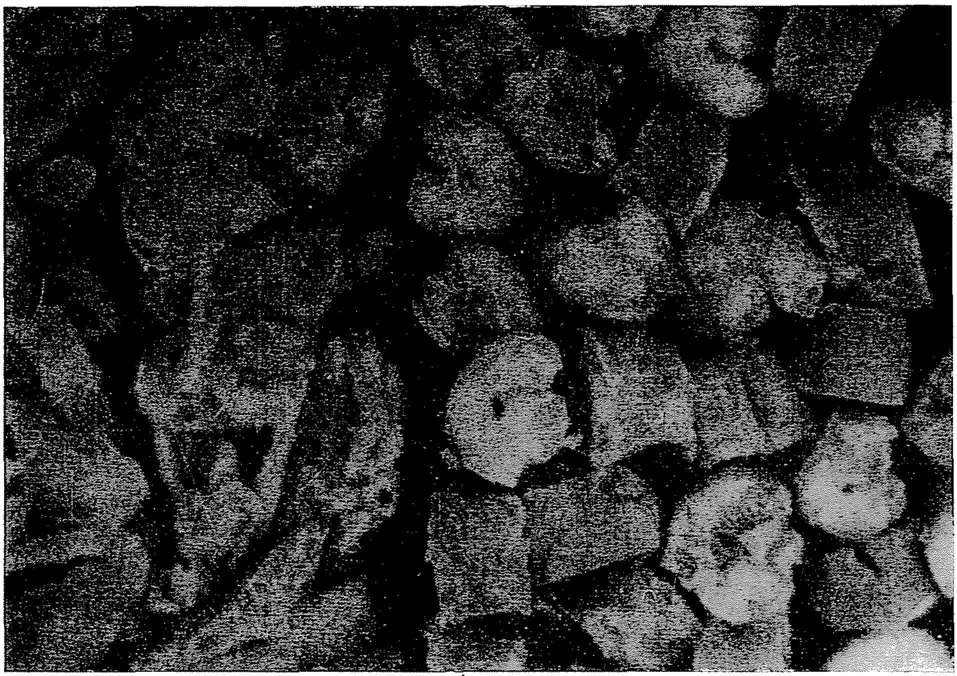


Fig. 1. First fracture produced with break rolls and the middle part obtained by slicing

III. Application in the milling industry

For flour extraction the wheat-grain is sliced to at least three, but generally to four pieces. By this procedure middleparts of minor skin-content, corresponding to approximately 85 per cent of the total grain weight and conical endparts with a larger skin content, corresponding to 15 per cent are obtained. By slicing stock wheat with 1,900 per cent ash content we are obtaining middle parts with 1,740 per cent ash-content and endparts with 2,800 per cent ash content.

The further processing of similarly formed and sized middle parts may take place already in a way which corresponds best to the purpose aimed. The knives penetrated into the wheat-grain are exercising, at the time of slicing, also a lateral pressure in the slices, the endospermium is loosened to some extent and can be readily separated from the husk. As a result flour of a significantly lower ash content may be extracted by a milling procedure, which is less severe and considerably more simplified, than that used up to the present.

For the sake of comparison I am demonstrating below the mechanical equipment of a mill working with the slicing procedure of 3 wagons/day capacity also at present and of another normal mill of 3 wagons/day capacity.

The advantage of the slicing machine consists — in addition to the shortening of the technology first of all in the reduction of the ash-content in the flour, respectively in the increase of the extractable flour-quantity in case when the ash-content is the same. As could be seen in the aforesaid the ash-content of the middle parts is considerably lower than in the stock wheat and thus possibilities are opened for the extraction of flours with a

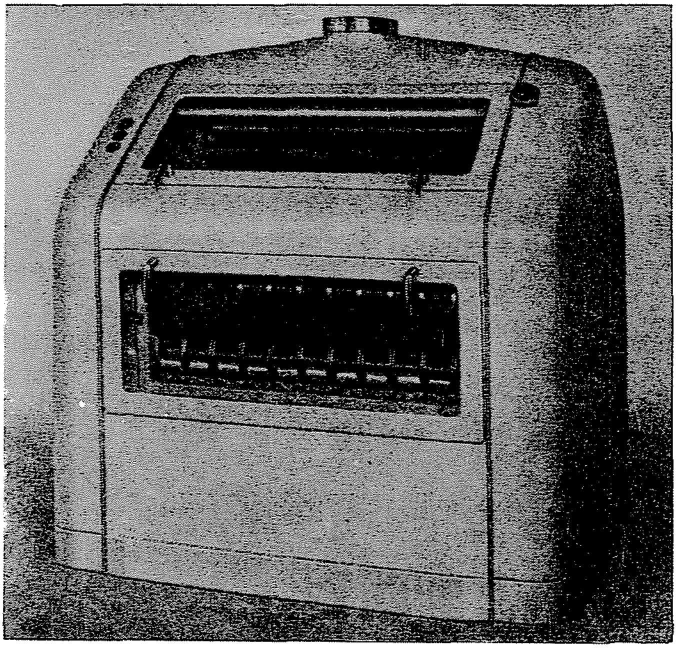


Fig 2. Grain slicing-machine, system Rajkai

Denomination of the machines	Measure-unit	Requirement with slicing machine	Requirement according to the norm
Slicing machine ..	piece	1	—
Pair of rolls	piece	8	16
Roll length	mm/wg.	1800	3600
Corundum	piece	2	2
Bran thrower	piece	1	1
Bolting surface ..	sq. m./wg.	16	27.7
Semolina purifier .	piece	3	4
Width of semolina purifier	mm	2100	2800

higher percentage of extraction and more favourable ash content. The course of the extraction and flour-quality according to the norm, as well as the course of the extraction attainable and flour-quality obtainable by means of the slicing machine is illustrated in the following :

Type of flour	With slicing: Extraction per cent	With slicing: Ash per cent	According to the norm: Extraction per cent	According to the norm: Ash per cent
B. L. 55	44.33	0.468	35—37	0.550
B. L. 112	36.30	1.080	41—43	1.120
Total	80.53	0.744	77—78	0.864
According to Mohs	80.53	0.930	78	0.812

It may be established from the table presented that the quantity of the fine flour (B. L. 55) has grown by about 25 to 27 per cent in operative scale, when at the same time the ash-content remained below the norm. The degree of extraction rose likewise considerably beyond 80 per cent. For guidance I am giving the data which are valid with the same extraction for wheat having 1.900 per cent ash content, according to the Mohs-scale accepted for basis of comparison. It is shown by the data that the results obtained with slicing are even better than the rather severe stipulations for the ash content in the Mohs scale.

The end parts may be milled separately and used either for low-grade flour as feed or for other purposes, such as vitamin starter, germoil-production, poultry feeding etc.

to develop at all and a viable, full-valued plant could develop from the sliced seed.

Before all it must be made clear that the grain sliced for the purposes of the milling industry cannot be used for sowing, since the germ is cut-off by the knives which produce

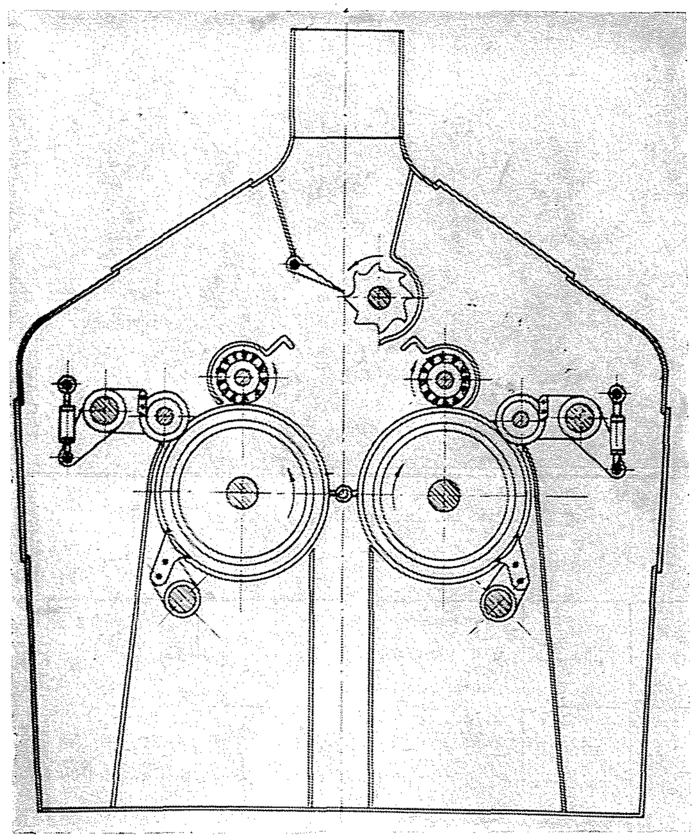


Fig. 3. Structural scheme of the grain slicing machine, system Rajkai

IV. Application in the agriculture

Besides the milling industry the grain slicing machine plays a very important role in the agriculture as well. The results achieved here may be realized in the practice even easier, partly in the form of seed-saving and increase of the stem-solidity and partly in the form of a possible surplus-yield.

At a first glance it seems unusual and unrealizable that the germ deprived of a considerable part of its nutrients should start

the end parts. The halving or the slicing made for three pieces is employed for sowing, in which case the middlepart must be cut out from the wheat-grain in such a width, that the germ should be left intact. The middle slice obtained by a slicing made into three parts and amounting to about 15 to 20 per cent of the grain-mass, may be milled similarly to the "middle part" of the milling industry.

The wheat slice for sowing purposes contains 50 percent germ-ends and the same per cent awn-ends. Before sowing these must be separated by an appropiate equipment. The separation is made possible by differences in form, specific gravity and elasticity.

The water-uptake of the sliced wheat through the surface of the cross-section is far

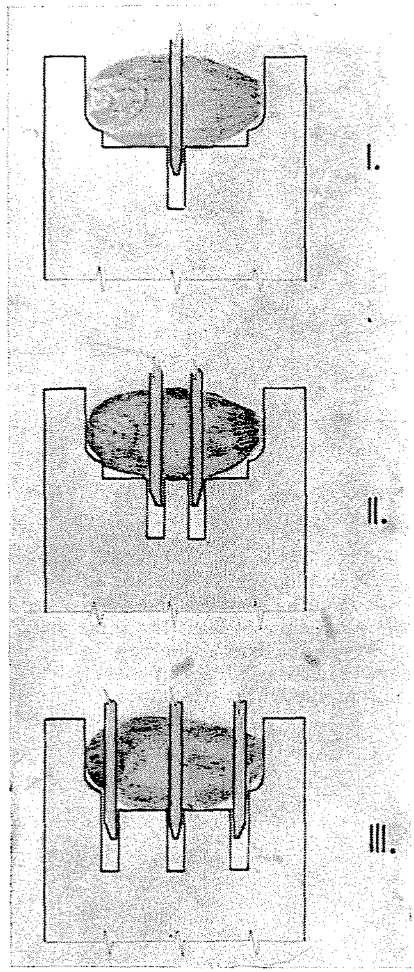


Fig. 4. Modes of slicing

better than that of the whole grain. The water-uptake is very intense particularly in its initial period and under its effect the grain swells earlier, the carbohydrate and protein-distribution is more rapid under impact of the increased enzyme-activity.

Germination starts earlier, the energy of germination is better and the date of emergence is also advanced by 1 to 3 days.

On soils of the same fertility, with application of the same agrotechnics and sowing the same number of germs per running meter, about 50 to 65 per cent seed-quantity is required, expressed in weight, depending upon the size of the germs and possibly their awn-end content, which means that 35 to 40 per cent may be saved for flour-production.

During the vegetative period very interesting physiological changes may be observed, which are taking place in absolutely positive direction. These were the following:

In the first period of growth the primary root system of the plants grown from sliced seeds is developing vigorously. The root system is longer and richer, than that of whole plants. The plant is compelled to absorb the nutrients from the soil earlier than plants grown from whole grains. This phenomenon subsists even after the root-change and appears significantly on adventitious roots as well.

The tillering of the sliced wheat is of a smaller extent, the minor number of lateral shoots give a full-valued spike, since the fewer shoots can be adequately supplied with nutrients by the more robust root system.

In our experiments made hitherto the spikes of plants which have fewer lateral shoots, but the compactedness is the same, are longer and the number of grains in one spike is larger. Likewise the thousand-grain-weight of the kernels is higher. In consideration of all these facts, higher yields were obtained from the same area both in our plot- and farming experiences. No deterioration or value reduction appears in the quality of the endospermium. The numbers for the ash-content, glutein-, protein- and starch-content are the same.

In each case considerable differences were noticed in the stem-strength of plants, on the same varieties, developed from sliced, respectively whole grains, stems of which had the same thickness and length. The bending, respectively breaking strength of the individual internodes were measured with serial examinations as to the advantage of plants grown from sliced seeds the difference in the stem-strength was very considerable on the second and third internode, which are very important from the point of view of lodging. This proved true also in the practice on the field, because after a week's rainfall of more than 250 mm the control material was lodged whereas the plants developed from sliced grains remained erect.

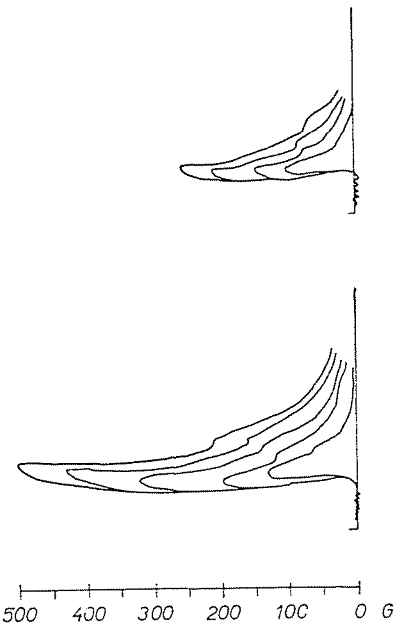


Fig. 5. Graphic illustration of stemstrength differences

Summary

Milling is placed on a new technological basis by the slicing machine, which together with a better flour extraction causes the diminution of the ordinal number and the improvement of the flour-quality. By sowing sliced grains about 40 percent of the seed quantity can be saved in the agriculture and at the same time at least the same yield can be obtained and by the increase in the stem-strength the possibilities of mechanical harvesting of the wheat are improved.

SMALL-SIZE MILL BUILT INTO TRESTLE

By

L. Ávi

The usual mill-equipments require several storied, spacious buildings, which involves not only considerable building costs, but also heavy expenses for operation and maintenance. Furthermore the assembling and putting into operation of the classical mills can be looked after only by skilled factory-mechanicians, and the accidental enlargement of reconstruction of the mill requires the cooperation of expert millwright, while the management of the milling work demands a fair professional competence.

These facts and the given conditions of individual economic areas necessitate — at a relatively low cost of investments — the construction of small-size mills, which from the point of view of assembling, management and professional knowledge of the staff are not putting forward serious claims, can be maintained and kept in exploitation with little expenditure, and in case of need may be easily moved to another site, but, offering all these advantages should nevertheless not lag behind the traditional mill as regards output and the quality of the flour produced. On the vast grain-growing territories of the Soviet-Union the construction of small-size mills, which should be simpler than the usual small-size mills, less pretentious in many respects, but *at least equivalent* from the aspect of output and quality was justified by many conditions.

The manifold problem of constructing such mills could not be solved by crowding the usual machines together in a smaller space or by making concessions at the expense of economicalness to maintain the output and quality.

The problem was solved by the Hungarian millwrighting industry in such a way that full use was made of the modern milling technique and new types of machine-constructions were applied. The so-called small-size mill built into trestle came thus into existence, the full equipment of which is built into a solid iron trestle.

The small-size mill of 10 to 20 tons/24 hours capacity can be built into a ceilingless room or hall, measurements of which are 13 m length, 8 m width and 7.5 m height.

The successful development of the small-size mill built into trestle was made possible largely by reducing the volume of the machines through applying constructions of the latest type.

The volume-reduction of the machines is duly illustrated by the following two examples : the weight of rollers of the small-size mill built into trestle does not reach even halfweight of the usual rollers, their output however is the double of the capacity of the usual rollers, while their power demand is far less. The weight of the "Liliput" semolina purifier of latest type is only 220 kg, whereas the usual type of such machines weighs about 560 kg.

The development of the milling technique is demonstrated by the fact, that in the small-size mill built into trestle a roll length of 1600 mm is appropriate instead of the usual 3000 mm, but this notwithstanding the output and the flour extraction are superior to that of the usual mills.

Consequently the small-size mill built into trestle is by no means some variation of the traditional mills, but an equipment, which employing the modern milling technique and working with the machine-constructions of latest type enjoys the following chief advantages : low building cost, small power demand, simple operation since that its mechanism is easy to survey, easy and rapid assembling, negligible requirement in spare-parts, easy possibilities for modifications and displacements and moderate purchase price in consequence of manufacturing in large sets.

With the 12-system milling equipment of the small-size mill white flour can be produced up to 10 to 25 per cent, and after its extraction 75 to 78 per cent flour for bread. The characteristics of the white flours corresponds to the characteristics of flours extracted in the large mills.

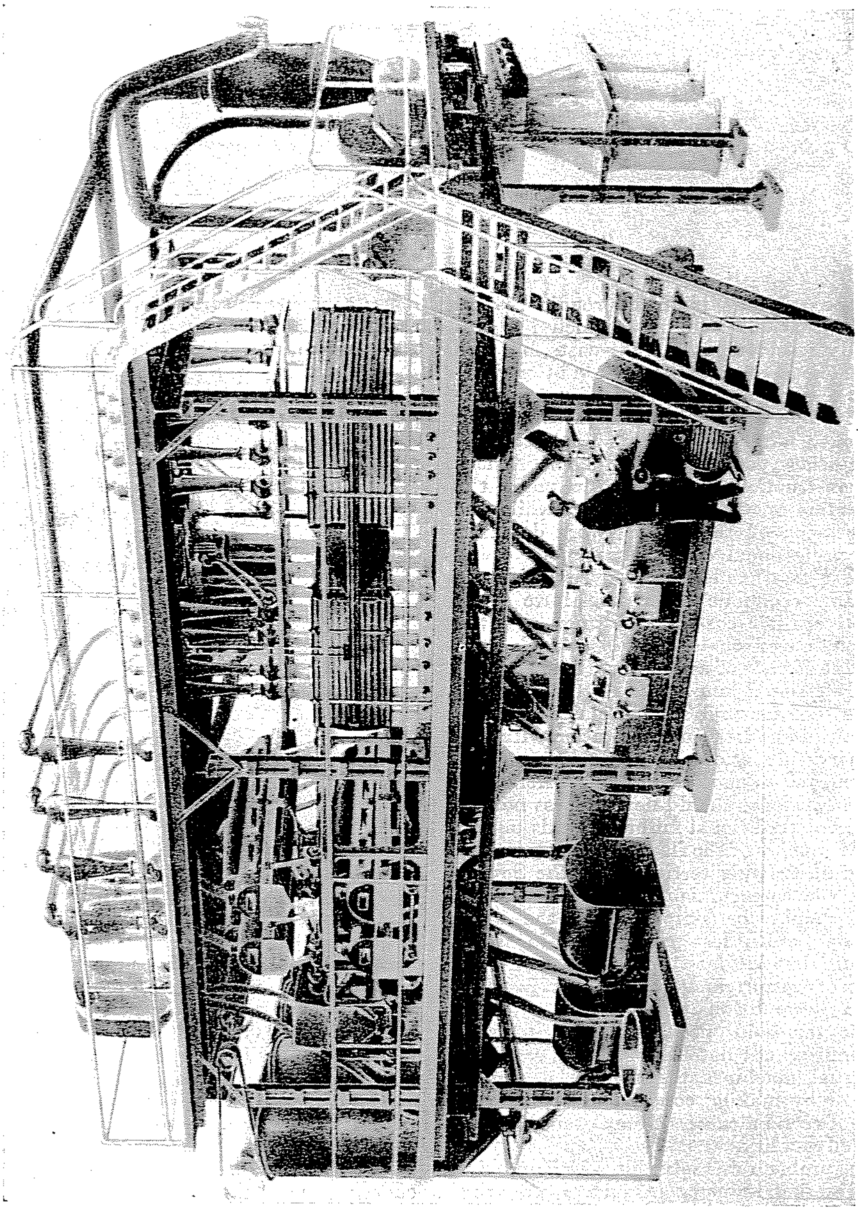


Fig. 1

The milling equipment built into a solid iron-trestle is driven by electricity and its abrasion system is entirely pneumatical.

The grain is lifted pneumatically into the mill hopper and sorted on a wind-separator according to specific gravity, on a vibration screen according to grain-size and on a sifter according to form. Thereafter it is prepared on a scrubbing machine for washing. The work performed by the washing machine is equivalent to the work done by the washing machine of large-size mills.

worm conveyors, so that simultaneously three kinds of flour can be produced.

The milled products are conveyed by pneumatic means, the semolina-purifiers are exhausted by fans and the exhausted air is filtered by cyclones.

The milling equipment is driven by nine electromotors.

Parts of the equipment are the following: double selecting, precleaning group, consisting of a vibration screen, magnet and sifter, furthermore pneumatic scrubbing machine,

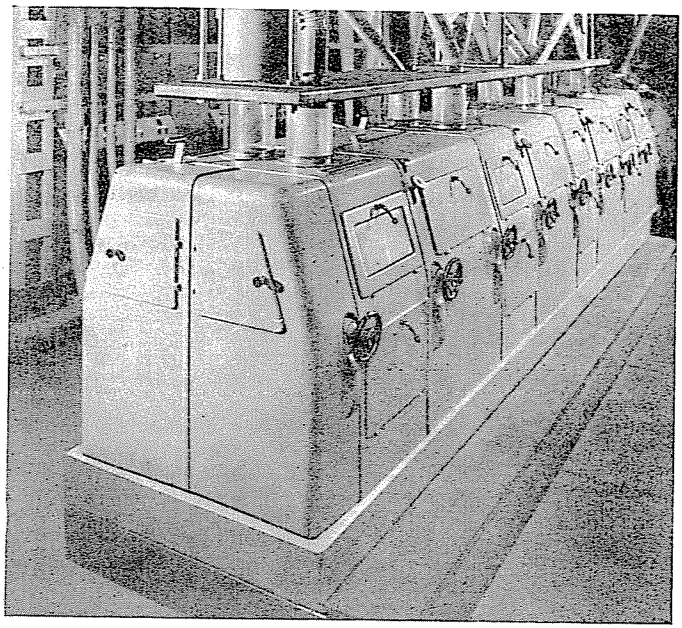


Fig. 2

After washing, the wheat is left to repose in rest-chambers then passing through the brushing machine and wind-classifier it undergoes the first breaking.

The grinding part of the mill consists of 12 systems, namely 4 breaking, 4 reducing, 2 corundum-disintegrating and 2 branning systems.

The breaking and reducing is carried out by four double reducing and breaking combined rollers, which are built together into a common block.

For screening the milled products a 12 system doublechest plansifter is provided.

The semolina is cleaned by four semolina-purifiers.

The flours are brought together by three

roller group, divided bran-extractor, simple corundum grinding machine, two-chest plan-sifter, "Liliput" semolina-purifiers, electric drive, pneumatical equipment.

The roller group is a particularly remarkable new-type construction. The four rollers and the gear drive are accomodated on a common ground-frame.

The four rollers built together into a single block have a diameter of 190 mm and a length of 400 mm and are supplied with chilled rolls.

Each time two feed rolls are serving for feeding, the feed roll and the mixing worm for the posterior breakings.

The rolls may be dismounted through the door.

The four rollers connected in series with cardan shaft couplings are driven by the gear. The differential speed of the rolls is determined by the tooth-number of two pairs of toothed wheels.

The gear is driven with V-belt drive by two electromotors. The toothwheels are running in oil, the rolls are bedded in rolling bearings.

Since there is no meshing of gears between the rolls, no toothwheel-change can occur owing to diameter-decrease caused by fluting of the rolls, as in the case of the usual rollers. The modification of the wheel-base is made possible by the cardan-couplings.

The "Liliput" semolina-purifier is an equally remarkable construction. It consists of an iron-plate wind case, wooden bolting machine and eccentric countershaft with bearings. A ventilator is provided for the exhaustion.

The group consisting of two chests is mounted on a single independent pipe-stand, in such a way that on the basement of the machine two and above these the other two should be disposed.

In each machine there are four bolt frames with different sheathings. The drive is actuated from an eccentric countershaft with a spring-arm and the machine executes 450 swingings per minute.

The nine electric driving motors are started from the distributing board, the switching-in is indicated by signal lamps. Modern installations are provided for protection against overload, short circuit and contact, as well as for emergency switching-off.

The small-size mills built in trestle are manufactured in large sets. The small-size mills delivered up to the present from the large sets which are under manufacturing for the Soviet Union were assembled without the cooperation of factory mechanicians and put into operation on the site. These mills are working impeccably and correspond fully to the requirements.

Also from other countries a lively interest is shown for small-size mills built into trestle and we feel confident that this successful new produce of the Hungarian millwrighting industry — which looks back upon a famous past — will render good services to the milling industry of many countries.

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