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Colloque sur les perspectives du traitement industriel
de la viande dans les pays en voie de développement
Vienne (Autriche), 13-17 octobre 1975

RESUME

LES MACHINES MODERNES DANS L'INDUSTRIE DU TRAITEMENT DE LA VIANDE^{1/}

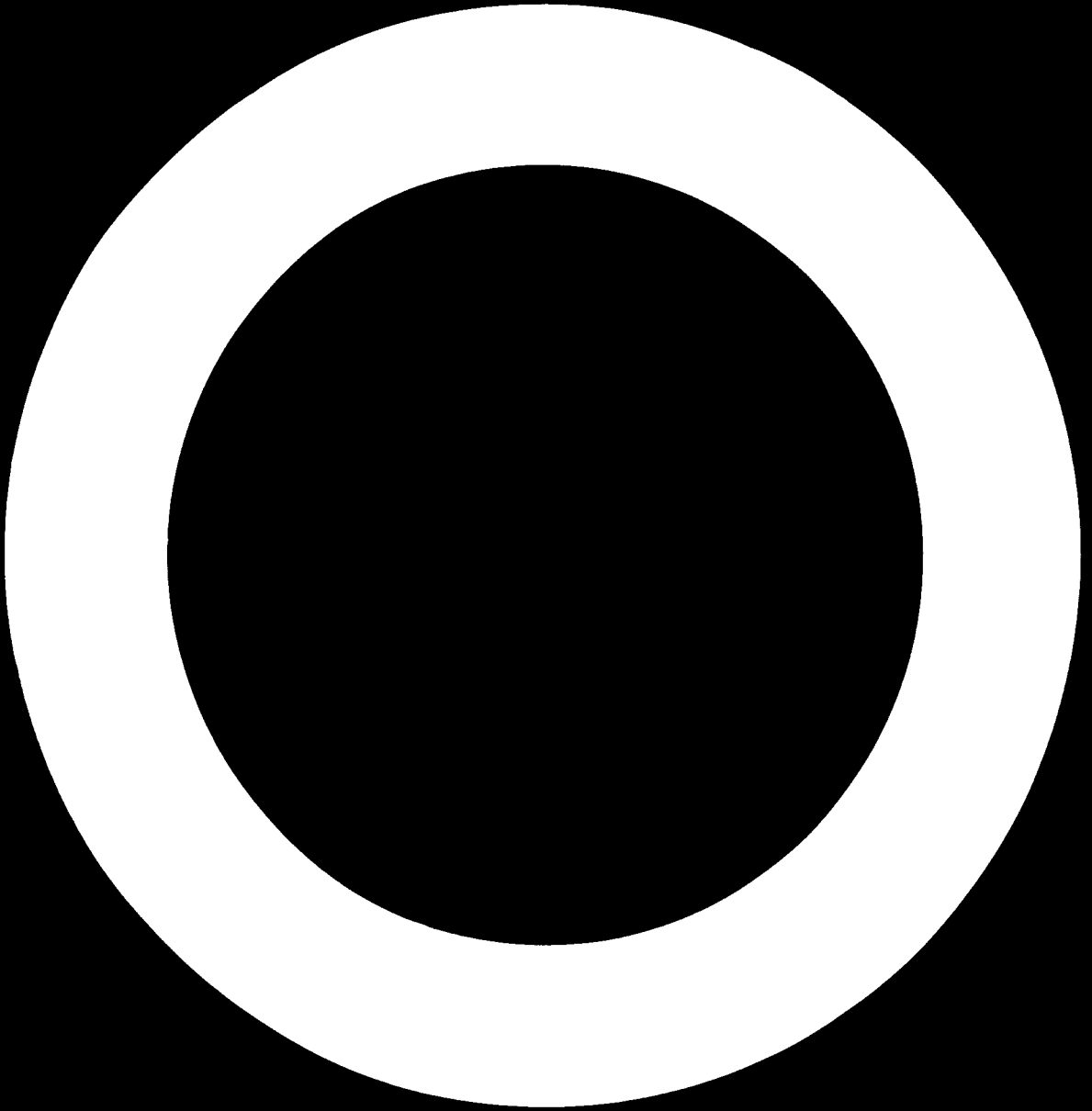
par
F. Laska
et
Andreas Klein**

L'amélioration du niveau de vie dans les pays développés et dans les pays en voie de développement entraîne une demande croissante de produits alimentaires et des exigences plus grandes au point de vue qualité. L'utilisation extensive et rationnelle de toutes les possibilités permettrait d'accroître considérablement la production industrielle de viande. Il est évident cependant que les problèmes posés par la production alimentaire mondiale ne pourront être résolus que grâce à l'utilisation de techniques modernes de traitement.

^{1/} Les vues et opinions exprimées dans le présent document sont celles des auteurs et ne reflètent pas nécessairement les vues du Secrétariat de l'ONUDI. Le présent document est la traduction d'un texte anglais qui n'a pas fait l'objet d'une mise au point rédactionnelle.

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Pour fabriquer de bonnes préparations de viande, il est nécessaire de doter les abattoirs et les installations de traitement de l'outillage le plus perfectionné possible. Les machines modernes permettent d'utiliser au mieux les matières premières disponibles et présentent en outre l'avantage d'avoir une capacité élevée, ce qui donne la possibilité de desservir un marché très étendu.

Nous recommandons l'emploi des machines spéciales suivantes pour le traitement industriel de la viande et la fabrication de saucisses :

Machines à découper la viande congelée, hachoirs, machines à découper automatiques à dévaloir, mélangeuses à viande avec ou sans appareils à vide, machines à remplir et à ficeler les saucisses. La dernière opération, pour les saucisses, est le passage dans les installations de fumage.

Les jambons peuvent être préparés dans les conditions les plus hygiéniques et sans aucune perte de poids grâce à des installations automatiques comprenant des pompes à saler et des tambours.

Pour que les saucisses, le jambon et autres préparations de viande se conservent pendant plus longtemps, il est recommandé d'utiliser des machines modernes pour le remplissage des boîtes et des machines à emballer sous vide. L'emballage sous vide de la viande fraîche et de différentes sortes de saucisses permet de prolonger de plusieurs mois la durée de conservation de ces produits si le système de réfrigération est adéquat. Cette méthode permet aussi de réduire la perte de poids de la viande - 2 % au lieu de 10 % - ce qui contribue à accroître le rendement.

La construction d'installations modernes de traitement de la viande est évidemment très coûteuse mais les investissements nécessaires pourraient être réalisés grâce à une collaboration entre pays industriels et pays en voie de développement. Ces investissements seraient sans nul doute amortis en peu d'années et contribueraient à améliorer la situation alimentaire mondiale.



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Meat Processing in Developing Countries
Vienna, Austria, 13-17 October 1975**

Summary

MODERN MACHINES IN MEAT PROCESSING INDUSTRIES ✓

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The improvement of the living standard in the developed countries as well as in the developing countries is reflected in the increasing demand for high quality and quality of food products. At present we need to make use of all possibilities the presently existing meat production has to offer to solve the existing problems. It is however evident, that only by means of modern industrial techniques the highest success in solving the problems of the world's food production can be achieved.

For the purpose of increasing the amount of high quality meat it is necessary to furnish the slaughterhouses as well as the processing plants with essential technical equipment. The modern industrial machines allow the most efficient utilization of the available raw materials and offer practically the only means of highest capacity for the best possible supply of large populations in groups with preserved meat products.

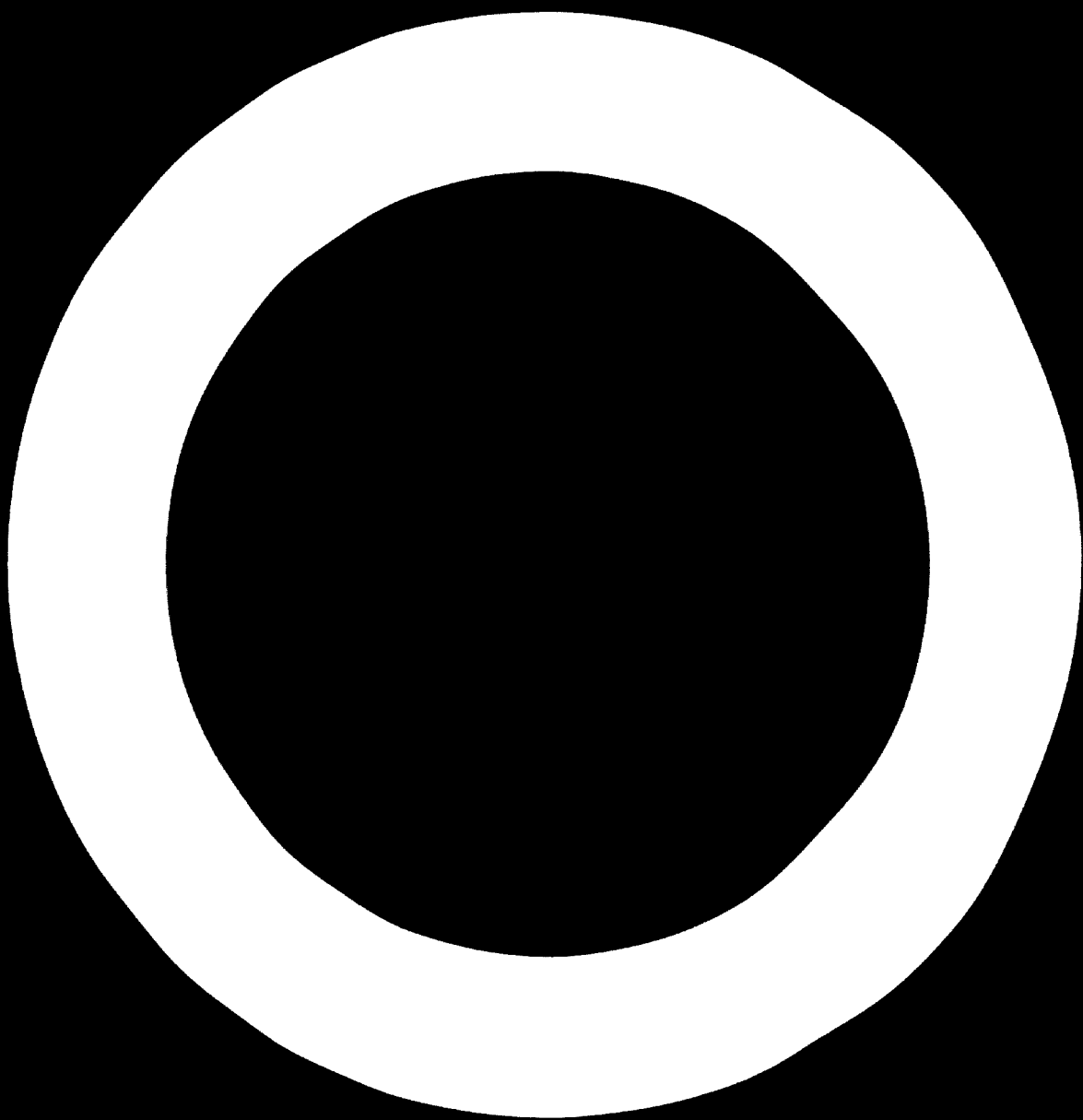
We recommend the use of the following special machines for the purposes of industrial processing of meat and sausage products:

Frozen meat cutters, mincers, automatic bowl cutters, mixing machines with and without vacuum mechanism, sausage cutters and fillers. The working procedure is finished with the preservation of the sausage in smokehouses.

Ham products are processed by automatic lines, consisting of pickle injectors and tumblers, on most hygienic conditions and without any losses of weight.

For preserving the quality of sausages, ham and other meat products throughout a longer period, the utilization of modern can-filling units and vacuum packaging machines is very recommendable. The vacuum packaging of fresh meat and various sausage products enables the hygienic prolongation of the durability period by several months, if an adequate refrigeration is provided. By this method the loss of weight of stored meat is reduced from 10 to 2 percent, which means a further improvement in the attainment of a higher yield.

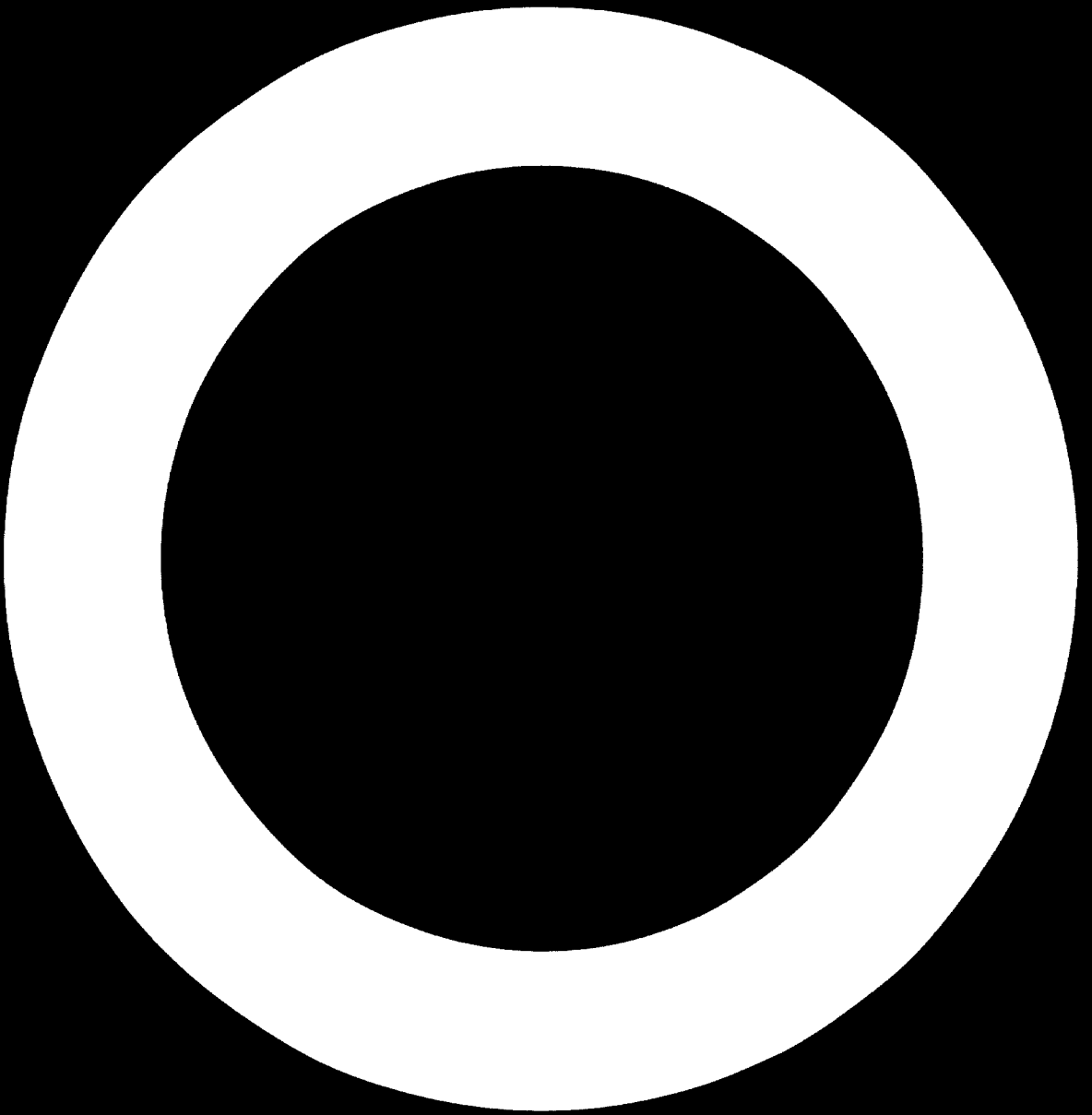
It is obvious that the erection of modern meat processing plants requires the raising of major capital, which could surely be produced in collaboration of the industrial and the developing countries, and which would undoubtedly amortize itself within a period of a few years for the benefit of the whole world's nourishment situation.



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INTRODUCTION

With the rising consumption per head of the population, industrial meat processing will be steadily increasing in the future. To meet the requirements of the near future, an efficient flow of material, savings in manpower as well as new technologies are to be brought in harmony with the need for automation and economic production. These aspects must be considered in the planning and construction of modern and efficiently operating conveyor belts for slaughter animals.

In the case of belts for slaughter pigs, electric short-time stunning, which takes about 5 seconds, has proved useful. A circular conveyor takes the pigs through a whip washing machine to the scalding device and unchains them automatically. Today, the range of scalding possibilities comprises not only the traditional scalding tub, but also scalding tanks, where the extended conveyor for exsanguinating the pigs passes them automatically through the scalding water to the scalding tunnels and the combined scalding and unhairing machines. In the future, the scalding tunnel will undoubtedly be given preference for hygienic reasons, provided that an equal scalding of all pigs and a reasonable limitation of water consumption costs can be achieved.

During the last few years, the tests with a view to developing machines for vertical unhairing have unfortunately not led to the desired results. No satisfactory degree of unhairing could be produced without the pressure caused by the pig's own weight as is the case with horizontal unhairing. On the contrary, the searing machines as well as the combined unhairing and searing machines, which have been on the market for 3 years, might be regarded as novelties; here we do not speak of the well-known flaming furnaces, but of machines based principally on the traditional unhairing machine. An extremely high degree of unhairing is achieved by a searing device which is introduced into the machine with the effect that the usually following rubbing procedure may be reduced to a minimum; this means true rationalization by saving manpower. Another novelty was introduced at the Internationale Fleischerei - Fachausstellung IFFA 74 (International Fair for Meat Processors) in Frankfurt: a pneumatic machine for halving pigs. This is not an automatic saw, but a proper splitting machine. A split head - applied to the animal's spine - divides the pig into exactly two halves. The machine is operated by one worker who can easily achieve a performance of up to 200 animals per hour without considerable effort. In the case of manual splitting, at least 2 workers have so far been necessary, to achieve a result of 200 animals per hour.

As far as belt type is concerned, the most common is a so-called "difference" in performance between the two sides of the belt. In this type of belt, each requires only 2 workers per an hour, per side, as compared to the use of a single belt for slaughter cattle, however, all the hourly performance of one side of a double belt is equal to the belts used in Europe and it is under a double belt that a higher production rate works, achieving an hourly performance of up to 70 animals, not including, however, the processing of by-products. "Figure 1".

There are several other working procedures involved with the slaughtering, such as melting and preservation of fat and utilization of by-products like blood and offals for preparation of fertilizers. These subjects however will not be commented at the present symposium, which is primarily dealing with the processing of meat.

The most important procedure at the beginning of the processing is the dissection of meat. The splitting of cattle carcasses is performed with electric or pneumatic saws as well as band saws with sliding tables. The further down-cutting of the cattle - quarters and pig - halves is carried out on special conveyer tables, equipped with a conveyer belt of stainless steel or plastic material, an additional return belt for bones and a washing device. According to the length of the table there is a certain number of cutting plates situated on each side of it. Primary cut, skinning and backing are all performed on the first half of the band, while final cutting, dressing and sorting are done on the second half. Offals, bones and the like are thrown onto the return side of the band from which they are taken into transport trucks. Separate pieces of meat are placed in crates at the different working stations according to the state of processing. The main proportion of the cut meat is discharged over the terminal pulley and dropped into crates.

The cutting-up of carcasses, the removing of bones and the preparing of the meat for further processing is customarily performed by use of this continuous table. "Figure 11".

1. PROCESSING OF MEAT AND SAUSAGE WITH MODERN INDUSTRIAL EQUIPMENT

A SAUSAGE PRODUCTION EQUIPMENT

a. Frozen Meat Cutters

The processing of frozen meat for sausage production has been increasing continuously in the course of the last years, and for this reason machines for precutting became necessary. All these types which were equipped with high - speed milling- or blade - rollers proved themselves to be ineffective, because they brought forth heavy noise, irregular cuts and even meat particles as small as meal - grains; moreover there was observed a disadvantageous warming of the meat.

The gullotine - system produced indeed a substantially better cut, but there were still further problems at the processing of bale - formed frozen meat blocks to overcome, which required a skilful operator for the machine.

The latest constructions were frozen meat cutters equipped with an inclined opening hopper, where the meat block glided automatically to the cutter bar. The necessary force of pressure is caused by the own weight of the meat blocks and by the smooth surface of the opening shaft the gliding is facilitated. In this way slices of equal thickness can be cut, adjustable from 20 to 50 mm, and the machine can be set on permanent stroke. By a second throughfeed it is possible to cut strips of the same thickness.

All parts coming in touch with the meat material should be manufactured of stainless steel. Silent operation, simple servicing and a control by unskilled personnel are further demands.

The power demand with hydraulic drive is 5 to 6 HP; the cutting width 500 mm and the cutting height 200 mm. The output is 2 to 3 tons per hour, depending on the adjusted thickness of cuts. In order to achieve a continuous cutting process with spherical or bulky blocks it is sufficient to push in a second block and prop it up against the upper slide surface, for increasing the force of pressure. These frozen meat cutters are appropriately suited for standard transport trucks and on request also equipped with platform - loading.

There are also frozen meat cutters with hydraulic drive for processing of large meat blocks on the market, having a cutting width of 600 to 700 mm and a cutting height up to 400 mm. These are equipped in series with hydraulic loading; the cutting height can be adjusted variably according to the block size, and there is further a hydraulic pressure pad present for bulky blocks. The output of these types is 8 to 10 tons per hour, dependent upon the thickness of cuts.

For industrial meat processing, the use of special knives of 270 mm length and 20 mm thickness were developed. The knives are supplied with two or three rows of knives made of stainless steel with a ground edge. Usually, the knives are fixed on rotating shafts with special meat bits with a diameter of 30 mm. The knives are used in a fixed position for working under conditions, for processing blocks of frozen meat, which is a few minutes operation. Great advantages are the little noise, the zero wear on the knives and the knives edges. Service - works are hardly required. The machines are of an overall capacity of 10 tons per hour, and are equipped either with hand lifts or with conveyor - belt loadings. "Figure III".

b. Automatic Bowl Cutters

The cutter is one of the most important machines in meat processing. It is used for production of emulsions, raw sausage, stuffed sausage and cooked sausage. The simplest model consist of a rotating bowl, in which a set of knives is revolving on a shaft. Within the last years the development of these cutter types has been pushed up to machines of highest efficiency. Cutters of more than 4,000 rpm and a power up to 70 HP per 100 litres bowl capacity were brought onto the market. The development of noise can be held to tolerable limits by sound dampening boxes.

By use of high speed cutters it is nowadays possible to achieve a degree of fineness of emulsion, as it was before only possible with emulsifying machines. There are no disadvantages to observe, such as loss of volume, caused by greater quantities of air inclusions or loss of binding ability by extreme friction and warming.

A modern cutter is equipped today with 2 or 3 speeds of the knifeshaft in order to adapt itself to the various meat products. A separate bowl drive with also 2 or 3 speeds is advantageous for the precutting, as well as for the regular cutting process, making possible several variations of operation. Thereby the cutting procedure can be adapted to every meat - quality and working - method, and even a pre-cutting of frozen meat can be performed without important blocking of the strating. The machine can happen without power load by respective switching. An additional milling speed is used for blending larger pieces of meat and bones in one working process with the emulsion, without cutting them into smaller bits. Knife - heads with ground groove and borehole allow a more precise adjustment of the knives than those with hexagon serr. The knife-head - types are especially important at higher speeds. Very advantageous is the simultaneous balancing of two knives by a special seat, where also the change of the number of knives to 2, 4, 6 or 8 can be done without new balancing.

Unloaders should be suitable for ejecting emulsion as well as raw sausage. " Figure IV ".

Larger types of cutters should be equipped with hydraulic system for loading, unloading, lifting of knife - hood and operation of the sound - dampening hood. " Figure V ".

Within the last time special attention was paid to the development of noise, and it was considerably reduced, especially at highest speeds, by cast - iron machine construction, massive knife protection hood, balancing of all driving elements and new knifeheads as well as altered shapes of knives.

For sake of hygiene the knife head, knives and the bearing arm in the cutter bowl should be made of polished stainless steel. A polished surface of the knife protection hood and smooth surface of the machine itself is necessary for ensuring an easy cleaning and preventing the development of bacteria.

The program control makes a rapid adjustment for automatic processing from loading until unloading possible, provides for uniform production and enables the adaptation of variations in quality or temperature of the meat material.

Vacuum procedures were initiated at the cutters for the purpose of reducing the oxygen in the emulsions for sausage production. This extraction of oxygen leads to longer durability of sausages, better colour stability and improvement of flavour. A further advantage is the saving of casings and more weight in the can. All these improvements in quality however must be paid by expensive constructions and higher costs of investments. The problems of the vacuum procedure lie in the different fat contents of the processed materials, as far as these cannot be standardized by special preparation previously, in their temperature differences and also in the adjustment of the knives. Besides these machines are more complicated in operating and cleaning.

According to the single methods of production the vacuum percentage is to be regarded precisely, because a vacuum of more than 50 percent causes a solid and rubber - like consistency of scalded sausages, which makes the finished products shrink considerably and does not at all come up to the customer's demands. Canned Frankfurters with intense evacuation are rather inclined to burst, because the gas - free emulsion brings a stronger compression to bear on the casings. For production of raw sausage the vacuum procedure is not suitable.

Since the oxygen can only be extracted to some extent at the evacuation, procedures of nitrogen admission have been tested. At machines with sound dampening hood a concentration of nitrogen, by admission with little overpressure, is sufficient to displace the oxygen and create an atmosphere of protective gas, which prevents all quality - damaging

Influences of oxygen.

All previously mentioned cutting procedures can be performed in the same way as in normal cutters, because a nitrogen admission for a period of 5 to 10 seconds at the end of the cutting is sufficient.

The nitrogen admission creates considerably faster reddening, saving of chemical additives such as reddeners or ascorbic acid and furthermore prevents the developing of bacteria. The produced sausage is attractive in colour and flavour, and meets all demands of quality and especially durability, without any risk in manufacture. The grey colouring, caused by air - inclusions, is absolutely prevented, and the products show best consistency and are fine - pored, suiting the consumer's expectations. The influences of the protective gas atmosphere also present very positive results at the production of raw sausage, where the ripening time could be reduced by one third of the normally required period.

c. Meat Mincers

Meat mincers, automatic mincers and industrial mincers were among the first machines for meat processing. At the standard types the transport of the material to the working worm is performed by an operator, whereas it is done automatically at the automatic mincers. These machines are equipped with a larger feeding hopper, from where a feeding worm takes the material and transports it to the working worm. This means an increase of capacity compared with the standard type, which may even be raised by use of several cutting sets. Feeding worm and working worm should operate with coordinated speeds, in order to guarantee the best possible transport of the material. An adjustable speed of the feeding worm is advantageous for adaption to the material to be cut, whereby any blocking or warming in the area of the cutting set is prevented.

Large automatic mincers for the meat industry are nowadays built with plate - diameters up to 400 mm, making an output of more than 15 tons per hour. Most important for the meat processing are best efficiency and quality of cutting. For this reason special attention must be paid to the cutting set. Stainless cutting sets with exchangeable blade - knives, where the cutting plates are seldom to be reground, and the blades grind themselves automatically, have proved to be excellent.

Industrial mincers are often equipped with 2 speeds of the working worm, and in such a case the speed of the feeding worm must be increased simultaneously.

For preparation of Hamburgers or mincemeat the mincers with mixing device in the hopper or double mixing arms are advantageous, which enable the complete mixing of coarse meat and precut material with all additives prior to the mincing process. By this method a further working procedure can be saved.

Mincer types with high output are mostly equipped with loading devices, in order to provide for a continuous working. There are used the standard transport trucks also in this case, as with the other machines. " Figure VI".

For the mincing of fat and suet it is advantageous to equip the housing of the cutting set with a steam-jacket, whereby the fat material is warmed by steam-injection.

Automatic cooking mincers consist of an automatic mincer with feeding worm, special mincer housing and additionally with a steam-cooking tube. This machine can be fed with all sorts of meat except rinds of bacon. After passing the cutting set the meat is transported continuously through the steam cooking-tube by spiral wings, which are driven by the knife holder. Steam of 6 to 10 atm. overpressure is admitted through several joining boreholes into the tube. The meat mass, consisting of only smallest grains, is rapidly and carefully cooked, because the steam can act upon it from all sides equally. The ready-cut and cooked meat emerges continuously from the swivelling discharging tube. By this cooking procedure a saving of time and wages can be achieved. Also the cooking-losses are prevented, which arise inevitably at normal cooking cabinets, cooking units or autoclaves. The steam condensate increases the weight of the product by approximately 6 percent. The short cooking period effects the full conservation of flavour and nutritive substances, and a high-quality product is obtained.

d. Emulsifiers

Emulsifiers are working with a throughfeed system and are suited for every subsequent grinding of precut material. The material passes through the feeding hopper to the cutting- or grinding mechanism into the outlet. According to the method of grinding there are discernible the holeplate-machines, colloidal mills and centrifugal cutters. At the holeplate machines the cutting set consists of a stationary holeplate, over which a propeller knife is rotating. The grade of grinding can be chosen by the use of the respective holeplate. For greater output machines with two knives or two holeplates in different combination are used.

Colloidal mills grind the material by a cutting-grinding system. A cone, equipped with edged elevations, rotates in a housing with tooth-farmed elevations. The grade of grinding

is chosen by stepwise regulation. For easier filling all these emulsifiers are also built in mobile and horizontal construction. "Figure VII".

Combinations of bowl cutters with automatic unloading and emulsifiers are possible, and by this system the material is transported into the horizontal emulsifier for further processing. Centrifugal cutters draw the material through a transport worm from the hopper into the cutting area, where it is pressed by means of the rapid rotation and the centrifugal force through cutting splits at the sides and is cut by rotating knives.

By vacuum installations on these types the detrimental influence of the oxygen can be prevented to a great extent.

e. Derinding - Machines

Derinding machines for processing of bacon are available in various types and sizes. These machines allow a proper derinding of bacon, and the desired thickness can be regulated. The derinding can be performed on slaughterwarm, fresh, cooked, smoked or salted bacon. The handling is simple and the machines are easy to operate. Automatic derinders with self-acting infeed and first cut are available. "Figure VIII".

f. Bacon Slicers and All - Purpose - Cutters

Bacon slicers and all - purpose - cutters are used for cutting of bacon, meat as well as vegetables. According to the several cutting frames the machines are capable of cutting dice, strips or slices. The material may be cut in raw, slaughterwarm or cooled condition, but also scalded or cooked. Bacon slicers and all - purpose - cutters are built with vertically or horizontally working pressing- and cutting devices, and all parts coming in touch with the material are made of stainless steel. "Figure IX".

g. Mixing Machines

Mixing machines are chiefly used in industrial meat processing plants and are built in various sizes, according to the respective intended purpose of use. The sizes from 1000 to 6000 litres are used as preparing machines for raw materials, the types from 130 to 1000 litres as normal mixing machines.

Mixers for preparation of raw materials are mostly constructed as spiral mixers and are employed for fat - rendering in order to obtain a standardized working process. The mixing shafts are equipped with spiral shaped worm - like transport - fittings or inclined paddle - arms, for ensuring a gentle processing of the material. The loading of these large types is performed with palettes or loading devices, the unloading through pneumatic slides into palette - containers.

Mixing machines for meat processing are usually constructed as tiltable mixing containers of stainless steel. The mixing itself is carried out by Z - shaped or other stainless mixing arms in a gentle and effective way. In contrary to the mixing machines with rotating drum and moving kneading arm the new models produce the three- or fourfold output, better cohesive ability and intensive mixing. Thereby a real improvement of quality can be achieved for the production of scalded sausage, noticeable in smooth slices and less air - pockets.

Mixers with double - jacket for heating or cooling are specially built for production of pulverized soups or similar material.

Vacuum mixers make possible a multi - purpose employment in the meat industry. Scalded sausages, which were produced by vacuum - mixers, receive a distinctly deeper and more attractive smoked colour by means of the air - extraction. At longer preservation in cold storage rooms they keep a fresh and appetizing look. Pores and raw spots are prevented through vacuum - mixing, and the forming of wrinkles on the sausages is considerably reduced. There is no discolouring of the emulsion for reason of lacking oxygen, and the reddening is also promoted. By the elimination of air - inclusions a considerably better preservation is achieved, which offers great advantages for clear-vision-packages and sausage cans, which are stored sometimes at unfavourable temperatures. The oxygen extraction effects a more intense flavour at identical spicing. Further advantages are a better cohesive ability of the emulsion, quality - improvement and saving of 5 to 8 percent of the volume-weight.

Vacuum - mixers are also suitable for ham - production, where the brine is added under vacuum and is massaged completely into the meat. Modern vacuum mixers may also be used as normal mixing machines at any time. " Figure X " .

b. Continuous Vacuum Filling Machines

The most advantageous and efficient machine for sausage stuffing is the continuous vacuum filler. Its vane cell pump guarantees gentle and exemplary treatment of all sausage meats that are fed with it. The sausage meat is under constant vacuum during the entire filling process. The meat is compressed within the pump to the absolute minimum so that delicate types of sausage meat do not smear. The meat travels a short way only and has very few touching points. It is fed gently to the outlet, not squeezed or pressed. With other feed systems the sausage meat has to travel a much longer way, for example through a worm system. The way for the meat corresponds with the stretched length of the feed worm. The wear occurring on all feed systems can be compensated at the vane cell pump on the vanes which are adjustable from outside. The vane cell pump is suitable for all fluid, paste-like, fine, coarse, frozen and hot products. With the larger size of vane cell pump that is fitted into the filler there is the added advantage of being able to fill out larger meat pieces of up to 1 kg. There is no warming up of the product during the entire filling process. " Figure XI a, b, c "

The built-in portion control is designed for 1 to 10,000 cm³. The hydraulic and electronic combination guarantees best weights independent of all influences. The portion control has no couplings or brakes or other wearing parts. Thus the accuracy remains during the whole service life of the machine. Also the weight does not change during a whole day's operation. Vacuum fillers start and stop without push. This technique cores for sausage meat, casings and machine. The portioning speed is infinitely variable and can be set for all casings and sausage products. The portion control is controlled by a step motor which guarantees a switching accuracy of plus/minus 1 cm³. The transmission between the step motor and the meat pump is made so that one step equals 1 cm³ output of meat. The number of single steps which the step motor has to make for one portion is given with the weight control knob at the instrument panel. " Figure XI d "

The vacuum stuffers increase the production per man hour up to 100 percent, cut down casing costs through product-density, eliminate down time to reload. The machines provide for a continuous high output without skilled labour, feed one or two other machines automatically. The hydraulic operation guarantees low maintenance and dependability.

The capacity of the stainless steel hopper is 200 or 300 litres; the output per hour can reach a maximum of 6500 kg, dependent upon the filling material, size of casing, product weight etc.

1. Clipping Machines

The "fill - clip" system is an example for the success in replacing high - quality working personnel by a machine. In former times the working procedures of drawing up the guts, filling in and closing had to be done by three workmen, from which two had to be experts. Nowadays the whole procedure is done without effort by one instructed person in much less time. For the further treatment of sausages, as smoking, cooking etc. there were needed mostly loops on the single sausages. They had been produced during the closing procedure or had been delivered by the manufacturer of the guts. Those possibilities can be neglected for there are now the inputs of gut treating caterpillars and the double - clip systems. On this procedure the prepared loops had been inserted in the open clip by hand, and on the closing procedure these loops had been fixed too. This method has been partially automated by the invention of the "fill - clip" system, which has been invented for a better accident prevention.

" Figure XII a "

When the gut - caterpillar, that is on the filling tube, is ended, in the common working procedure the whole system is switched off and the fill - clip - automat is turned so that the filling tube is free for the application of the next gut - caterpillar. After that procedure and after returning the clip machine, the whole procedure may start again. The "twin" effects less stillstand times. During the procedure of filling and clipping by the one filling tube, which is in working position, a second one is supplied with a new gut. The gut - caterpillar is kept by a manual applied gut - brake on the filling tube. When the gut on the filling tube, which is in working position, ends, the system is switched off as usual. But there is no more need of turning the clip - machine, for the working personnel now turns by a hand-level the twin to 180° and brings so the new - filled tube in working position. So the automatic fill-clip procedure may be started again within no time. Magazined loops, the belt - loop automate and the above mentioned twin rationalize the sausage - production in the double - clip automat essentially.

" Figure XII b "

Particular sizes of portions, calibers or kinds of sausages require up to now still the production in single working procedures. Also here have been made efforts to reduce the stillstand times of the fill - clip system, and it succeeded with the invention of the triple. Now the gut is put on the tube in front. After ending of the fill - clip operation the triple returns automatically the filled tube in reserve position, and the tube that has been in reserve position before, comes now to the working position. The turning of the clip machine is now done automatically. So the personnel has only to fill the next tube with guts while the filling procedure works.

" Figure XII c "

j. Smoking and Cooking Units

Industrial production of smoked products necessitates a continuous rationalization . Smoked products are mass products and human labor becomes increasingly scarcer and more expensive. If the efforts for cost reductions are successful, the producers as well as the consumers will share the benefits. For this reason it is mandatory to produce curing smoke by a simple pressing of a button. The effective curing period must be determinable in advance as only then the efficient operation of program - controlled smoking plants is possible.

The steam smoking method provides for these possibilities and points at the future. In this method the smoke is applied by means of condensation. An absolutely uniform and reliable application of smoke is ensured. This results in further important effects. First the smoking process occurs in a moist atmosphere. Therefore, the weight losses of the products are relatively small. Depending on its temperature the dry air, present in a smoking chamber, can absorb a certain amount of moisture which amounts per kilogram of dry air to 278 gram at 70°C, 382 gram at 75°C and 545 gram at 80°C.

The steam smoke mixes the air with moist smoke until saturation is achieved. This will necessarily result in the following : For identical atmospheric temperature in the smoking chamber there will always be available the same amount of smoke. Therefore it is possible to determine concentration of smoke and intensity of smoking effect. The smoking colour obtained by steam smoke is absolutely stable, it cannot be removed by rinsing with water nor has the cooling any detrimental effect on smoking quality. A most important information was obtained from cold smoking. Steam smoke prevents formation of mould, for instance, on Salami for at least 8 to 10 days. That means, that the products can be kept free of mould formation during the time of delivery. There is no doubt, steam smoke is favourable for a good preservation of the products. When smoking meat such as belly bacon or similar types, it was repeatedly observed that the smoke also enters the fine splits and ramifications where it results in colouring and preservation.

Best efficiency and rationalization offer the modern combined smoking - and cooking units, being equipped with program controls for the previously adjustable automatic sequence of the requested procedures. All methods of smoking, cooking, scalding, reddening etc., which are applied nowadays to meat and sausages, can be performed by one single unit. There are one - truck chambers on the market as well as larger ones for 2, 4 or 6 trucks. " Figure XIII ". Smoke - annihilating plants are available for protection of environment.

B. HAM PRODUCTION EQUIPMENT

a. Automatic Pickle Injectors

For the automatic injection of brine we recommend pickle injectors, equipped with 18, 25 or 38 pickle needles respectively. These machines are capable of continuous pickling of meat with or without bones, ham, heads and various other material. They are made of stainless steel, have electric motors for gears and injection pump, and further a stainless conveyer belt. The working speed as well as the pressure and the brine quantity to be injected can be adjusted precisely. The feeding speed of the conveyer belt is also adjustable from 20 to 45 mm per stroke. By exact dosage of the needle speed and the brine quantity it is possible to inject 3 to 40 percent of brine into the meat, according to the individual requirements. The overflowing brine is filtered automatically in the machine and led back into the tank for re-use. " Figure XIV ".

b. Vacuum - Massing Units

The industrial application of massing the meat during the production of cooked ham is already several years old. This system became rapidly common mainly in some European countries. By this massing procedure the albumen in the meat is activated and gets to the surface, which effects less weight losses by cooking and better solidity of the ready cooled ham, which means, that the ham does not fall apart when it is cut. Some years ago there were developed container machines in which the mixing device was incorporated in the middle of the container. This mixing device is supplied with mixing arms which are particularly placed so that the meat is massed totally. Even the form of the container had to be a particular one, so that the meat could be massed equally. By interval treatment of the meat - massing and resting periods - the meat remains 24 hours in those machines. By this is not only obtained a red meat, but also a tender ham meat, salt and water contents of which are exactly determined. The container massing machines which are working under vacuum can easily be incorporated in closed ham production lines in a very advantageous way. There is no need of putting them into cool rooms. The development of bacteria is very small under vacuum and the massing effect is obtained within no time. The colour is clearer, the colour-conservation and the view of the slice is better. Two movements must be made under vacuum :

1. Slipping : By controlled turning movements. Here a flattening and rolling massage is obtained.
2. Perforating : By addition of vacuum the meat, which lays on the top and at the outer sides, is totally expanded. The meat that lays on the ground and in the middle is pressed lightly. This breathing of meat can be only obtained by total treatment and steady turning of the meat under vacuum, that means that this procedure becomes only possible by vacuum massage.

A particular advantage of vacuum is the lack of oxygene and by this the paling of meat colour in the rest times before it becomes cooked, is restricted. The application of vacuum process has proved to be very important because it effects a closed vacuum process. By keeping the once chosen vacuum massage program it is possible to obtain a good homogeneity of products during the whole production period. It is no exaggeration when we speak of a total control of the working process. The savings and advantages are numerous : Personnel savings, by salting in one day no long salting periods, no brine losses, no magazine - rooms for salting and perforation, no bacteriological and chemical problems.

" Figure XV "

II. CANNING INDUSTRY EQUIPMENT

A. PRODUCTION OF CANNED SAUSAGES

We want to give you by our report a head-line like comprehension of theoretic bases of the production of conserves with special regard to canned sausages.

During the conserving process of all meat products the spoiling and poisonous bacteria and germs must be stopped in its growth, resp. in its increase or they must be destroyed.

The following procedures are common for the growth decrease of germs - deep freezing under -18°C , drying, salting, smoking, addition of nitrite, addition of polyphosphate, addition of food-acids. On the other side the bacteria and their germs must be destroyed by a sterilizing process. This can be done on two ways: by irradiation and by heating.

For the production of full conserves there are needed 100°C . These temperatures cannot be reached by an open water kettle for the water starts to boil before. Of course, in an oil bath or in a frying appliance there could be obtained essentially higher temperatures, but that would effect such a high pressure inside the conserve container, that it would be always deformed or even torn. So for sterilizing purposes over 100°C there is needed an autoclave, which also effects a pressure from the outside on the container of the conserves. By this procedure the containers remain in their original form during the whole heating process.

We may distinguish three groups of conserves in accordance to their heat-throughput:

1. Products conserved in brine or sauces (goulash, soups, sausages etc.) The heat-throughput comes from the movement of the fluid. These products have a good heat-throughput.
2. Products consisting partially of solid and fluid phases (beef or pork in own juice, canned beef with bouillon). Here the heat-throughput comes on the one side from convection and on the other side from conduction of heat.
3. Products that are solid or pasty (ham, scalded sausages, black pudding, liver sausage etc.) Here the heat-throughput only comes from heat-conduction. The heat-throughput is relatively bad and depends on the consistence of material.

It would reach too far to give descriptions of the various different types of can-filling and closing machines, washing-, drying- and labelling devices, autoclaves and packing units etc., used all in the canning industry, which will undoubtedly be referred to by another detailed report, stating full particulars of this equipment. "Figure XVI a, b".

7. ECONOMICAL PACKING IN ALUMINIUM FOIL

In the distribution of ready-cooked meals, we have to choose the suitable packing material, which is aluminium foil, since we are dealing here with a generally one-time use.

Aluminium foil is light and stable in shape, flavourless and odourless, tight as regards light, gas and water steam, impeccable as far as physiology of nutrition is concerned, clean and corrosion-resistant: an excellent packing material.

Ready-cooked meals may be delivered deep-frozen or hot for immediate consumption; in the later case, they are filled into insulating boxes of plastic foam specially developed for this purpose. The meals are arranged in ready portions on trays of aluminium foil.

The exact technical term would be aluminium sheet. There is merely a difference in metal thickness. The lids are of aluminium foil. The trays are divided into three or two parts according to the composition of the metal. There is no subdivision in the case of steaks.

The lids have a pull-up flap and are pressed mechanically around the marginal flange of the trays to prevent dripping. Deep-frozen ready-cooked meals undergo shock frost treatment of about -40°C ; afterwards they are stored at a temperature of at least -18°C .

They keep their quality for months, and they are carefully defrosted in "steaming ovens" by hot air or water-steam revolution in the course of which they are heated without being cooked.

Aluminium foil may also be used for the production of preserved food. To achieve an airtight cover, the aluminium foil is coated by a plastic material which, too, is impeccable as far as physiology of nutrition is concerned. This interesting compound material joins in itself the remarkable characteristics of aluminium foil with the capability of the thermoplastic to convert itself into a sterile layer after heat addition under pressure. In contrast to the trays for whole meals, for one or several portions, the lids have a projecting unbent pull-up flap to make their removal as easy as possible. By the way, the one part is held by the one hand, while the other is pulled open by the other hand.

Thus, the multiple use of the aluminium boxes offers a wide range of possibilities, since the production of boxes is not subject to any limitations of size.

Special machines for fully-automatic filling and hot-sealing of portion-boxes are available. They are suitable for processing fluid as well as dry material and take the lids directly from a colour-printed roller-band, marking the date simultaneously on the flap. The maximum output is 100 packages per minute, dependent upon the size of the box and the filling material. "Figure XVII a, b".

III. PACKAGING OF MEAT AND MEAT PRODUCTS

A. MATURING FRESH MEAT IN VACUUM BAGS

The vacuum method offers several decisive advantages for packaging of perishable food. Shelf - life is increased and loss of weight is avoided. This packaging technique is especially applicable for fresh red meat, processed meat, sausages, cheese, poultry, fish, ready meals and many other food items.

The transparent bags are manufactured of various patented synthetic materials and impermeable to steam and oxygen, thus providing for a prolongation of the durability of the meat.

It is generally known that beef has to be stored in cold storage rooms for 8 to 14 days for ripening, in order to obtain the desired quality. In the course of this storage period and during the despatch a loss of weight of 5 percent minimum occurs due to evaporation, and moreover the meat is drying on the surface, which must be removed afterwards before the further processing can be performed.

For the vacuum procedure the beef - quarter is cut into the required pieces immediately after slaughtering, which are vacuum - packed and stored in cold storage rooms without any loss of weight.

Beef is ripening more intensively in the vacuum bag, so that a better meat quality is achieved besides the other advantages. The storing stability depends on the meat quality and is approximately 4 to 6 weeks, on condition of suitable cooling between 0 and + 2°C. After this maturing time a subsequent deep - freezing at - 18°C to - 20°C is possible, for the purpose of a longer storage of the meat in deep - frozen condition.

All above described advantages are observed also at the packaging of ham, fresh and hard sausages etc.

Recapitulating it must be mentioned that the vacuum packaged food offers out of the same quantity of raw material a higher yield due to the saving of weight. This is an important fact for the supply of the population.

There are single - and double chamber models of vacuum - packaging machines on the market. They are working according to the chamber system with a vacuum of 99,8 percent. The filled bags are put into one chamber of a double chamber machine. Closing the lid starts the automatic packaging cycle. Meanwhile, filled bags are put into the other chamber. At the end of the cycle the lid opens automatically and is placed on to the other chamber. This alternative procedure can be kept up continuously. The automatic packaging cycle is

controlled automatically by electronic device. Each phase of the cycle - evacuation, gas flushing if required, and sealing - can be continuously set by a timing relays. All models feature an impulse sealing system. The chamber volume can be reduced by means of filling plates, which in turn decreases evacuation time.

The output of a double chamber machine is 1200 packages per hour, for bag dimension 160 x 230 mm for example. " Figure XVIII a, b " .

Especially for vacuum - packaging of meat in large cuts there was designed an automatic conveyor - belt machine with intermittently moving belt and electronic control. This unit reduces the packaging time and considerably rationalizes the whole packaging process.

B. ROLL STOCK VACUUM PACKAGING

Roll stock vacuum packaging machines with deep - draw capacity are used for most economic and sales appealing meat - packaging.

All types of heat - sealable flexible films and laminates can be used.

The machines are made of corrosion - resistant light - metal alloys and stainless steel, equipped with vacuum pump and gas flushing, synchronized or infinitely variable infeed and discharge conveyors, photoelectric register mark control for printed upperweb and dating device for printing shelf life limit, price etc. with hot - stamping foil. The control is performed electronically. The packages are produced from two separate stock rolls.

The deep - drawable bottom web is fed into the transport chain via a brake shaft. By intermittent advance movements (gear motor and Maltese Cross drive) the film first passes the forming station where packets are formed thermopneumatically. The loading area, which is next, gives enough space for manual or automatic loading systems. The top film also is advanced through a brake shaft into the sealing station, where the package is heat-sealed. If evacuation or gasflushing is desired, these operations are also performed in the sealing station. After cross- and longitudinal cutting the single packages are discharged from the machine either onto a conveyor or into containers.

The capacity is maximum 20 to 25 cycles per minute.

Length of package : 50 to 290 mm

Width " " : 30 to 400 mm

Height " " : 100 mm maximum

" Figure XIX " .

C. PACKAGING OF SAUSAGE - AND MEAT PRODUCTS UNDER SPECIAL CONSIDERATION OF COOKED HAM

The future will even bring higher requirements to the packaging materials. Under this respect there have been developed new co-extruded multi-layer compounds, which were brought on the market as "shrinkable bags". By its very low oxygen-permeability of less than $5 \text{ cm}^3/\text{m}^2 \cdot 24 \text{ h} \cdot 1 \text{ atm}$ at 20°C after shrinking and a water vapour permeability of less than $1 \text{ g}/\text{m}^2 \cdot 24 \text{ h}$ at 20°C and 85 percent relative humidity and its high mechanic resistance the conservation of oxygen-sensitive sausage- and meat-products has been improved.

The sausage and meat producing industry demands more and more sales promoting packages and by the shrinking procedure there are not only avoided stand-off edges, but there has been also gained an increase of the mechanic chargeability of the material. As known, stand-off edges, stiff welding or sealing ridges are very liable to damages. Shrinkable bag material has been developed as a highly flexible one with great elasticity of extension, to correspond to the elastic deformations of sausages on fall-down and transport charges.

On the portioning procedure the product remains in the bag and is so well protected from graps, which means also, that there are less surface infections. For this reason the shrinkable bag has a broad field of application in the food-industry. For example it suits very well for the maturation of fresh meat as well as for the packaging of meat and sausage products.

For cooked ham is not only expensive and delicious but also very sensible, we should treat this product and its packaging in some short sentences. Only hind-leg ham is worth to be offered as cooked ham. There are three common shapes: the bulb-, the block- and the natural shape. These shapes are not required by the product itself, but from the production procedure. Initial basis is always the deboned ham, which gets its better taste by mild wet salting and short smoking before it is cooked.

The shrinkable bag vacuum packaging procedure is performed as follows:

The ham is filled into the shrinkable bags and evacuated as well as clipped simultaneously by modern vacuum clippers. An output of 10 to 20 packages per minute can be achieved, dependent upon the type of clipping machine. Then the bags are passed through a hot-air or hot-water tunnel continuously for shrinking and afterwards stored in a cold storage room. The storing stability is approximately 3 to 4 weeks. " Figure XX " .

D. SELF - SERVICE SALE OF FRESH MEAT

Today, as much as 30 percent of the fresh meat supplied to the customer is portioned and packed for self - service. The novel keep-fresh-trays of wood pulp are able to protect the high quality of fresh meat and poultry in the best possible way.

The meat is placed on the tray, and an elastic or shrinkable foil is wrapped over it, the basic material of the foils being thin - walled soft PVC. Afterwards the foil is sealed on the bottom of the tray by means of a hot - sealing plate. Passing a hot - air tunnel the shrinkable foil is shrunk and presses itself closely over the wrapped goods in the tray.

During the last years, the packing trade prefers elastic foils for fresh meat packaging, since here, in contrast to shrinking foils, no hot air has to be used. Elastic foil wrapping is done manually as well as mechanically. Modern packing machines are able to wrap 40 and more meat packages per minute in elastic foil. It should have a minimum thickness of 17 my to be resistant against easy damage by splinters of bones.

This packaging system is performed without evacuation, and is only recommendable for short storage of meat, mainly for hygienic purposes in self - service sales.

The following characteristics of the keep - fresh - trays shall be mentioned :

Venting capacity for a direct and unimpeded access of oxygen to the meat, which keeps it attractive in colour.

Quick cold air absorption through the latticed bottom of the trays, allowing the cold air of the freezer to get immediately to the meat.

Good view of the meat's bottom side.

Used trays may be burnt or composted without leaving harmful residues and thus protect the environment.

" Figure XXI " .

IV. PRAXIS OF SPICING : BASICS , INFORMATIONS , TIPS

Since the research engages itself of the spices, there were created new aromes, there were recovered old spices and the spicing itself was done sophisticatedly. We know more than 1,000 herbs, spices and spicing additives. Of course they are not used all, but a spicing specialist may play with more and more success on that large range of spices. Meat is an ideal culture for micro-organisms of every kind. On bombed meat conserves there was found out that those failer - products could be reduced to a too high germ content. There was also noticed that the main source for those failers were the spices. Spices are mostly very dirty and they have germ - numbers between 1 and 11 million germs per gram, and in some single cases there were even found 100 million germs per gram. You can only then understand these high rates of germ- contents, when you take into consideration the hygienic conditions in the country where they come from. Even the conditions for treatment, storage and transport lead to a strong establishment of the surface germs.

Against this high increase of germs the sterilization by ethyleneoxide under vacuum has proved to be very efficient. Probably it might be of interest to know that grinded spices have a good sterilizing effect. And this sterilizing effect has also a certain influence to the germ- contents in sausages. By addition of spices the goods are not spoiled so soon. The strongest effect of sterilizing has the cinnamon, followed by cloves. Further, listed in accordance to their strength of effect there are : majaram, piment, cardamom, coriander, ginger, macis and pepper.

To take for each product the spices that suit best - that's the art of spicing. There it must be compounded from many arome components a new taste creation. It is no spice - master who is only spicing with salt and pepper. To spice a raw sausage, means, that the spices must be combined in a very fine way. For this purpose we must at least have 14 spices. Mostly the main thing to look at for the composition is, to add very small quantities of uncommon spices. " Figure XXII " .

In former times the storage was the main problem for manhood. By conserves it is now possible to store goods without any problems, and these advantages lead to an increased buying interest. Animated by that increased demand the producers enlarged their offers and tried to improve the quality of their products to survive the stronger and stronger competition. An essential fact for the quality improvement of conserves was the prolongation of their durability. Some years ago most of the conserves were semi - conserves and had to be stored cool. But even then their durability was only for short periods. Most of the producers were not able to control the storage conditions at their distributors. That caused great fabrication - risks, many

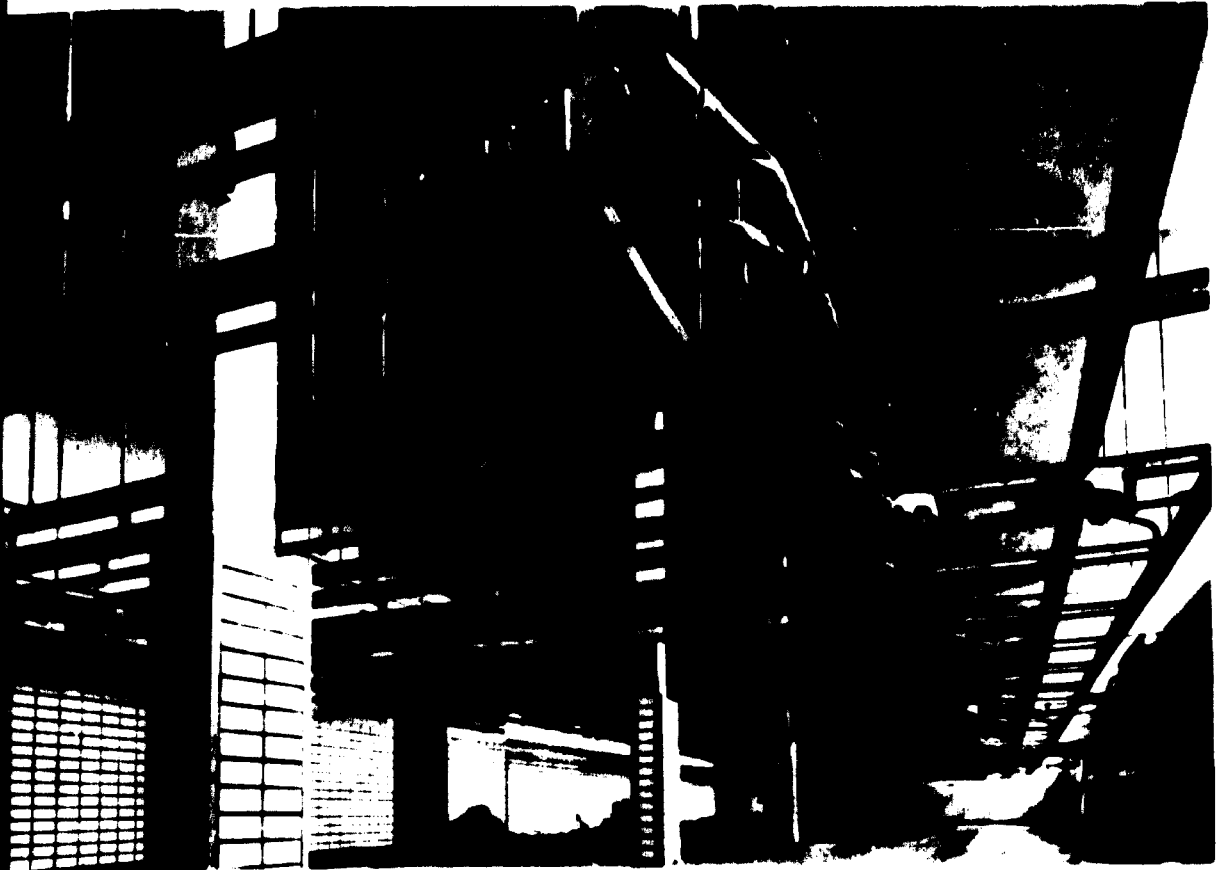
returns and complaints. In the meantime the problem of the durability is solved. There were developed machines with which the conserves could be heated in a smooth way on higher temperatures. The praxis showed, that mostly the heating of conserves effected a damage of their taste - value.

V. HYGIENIC MEASURES

Even in the case of a high degree of mechanization, there is always a risk of bacterial growth : For even the smallest joints and cracks, which are always found on tiled floors and tiled walls, in machines, filling systems and on conveyer belts, have remainders of raw materials and finished products. To avoid the necessary intensive manual cleaning, which also costs a lot of money, high - pressure cleaners of different models as offered by several firms may be used. Built - in tanks for chemicals allow their direct addition to the water jet at the various working processes.

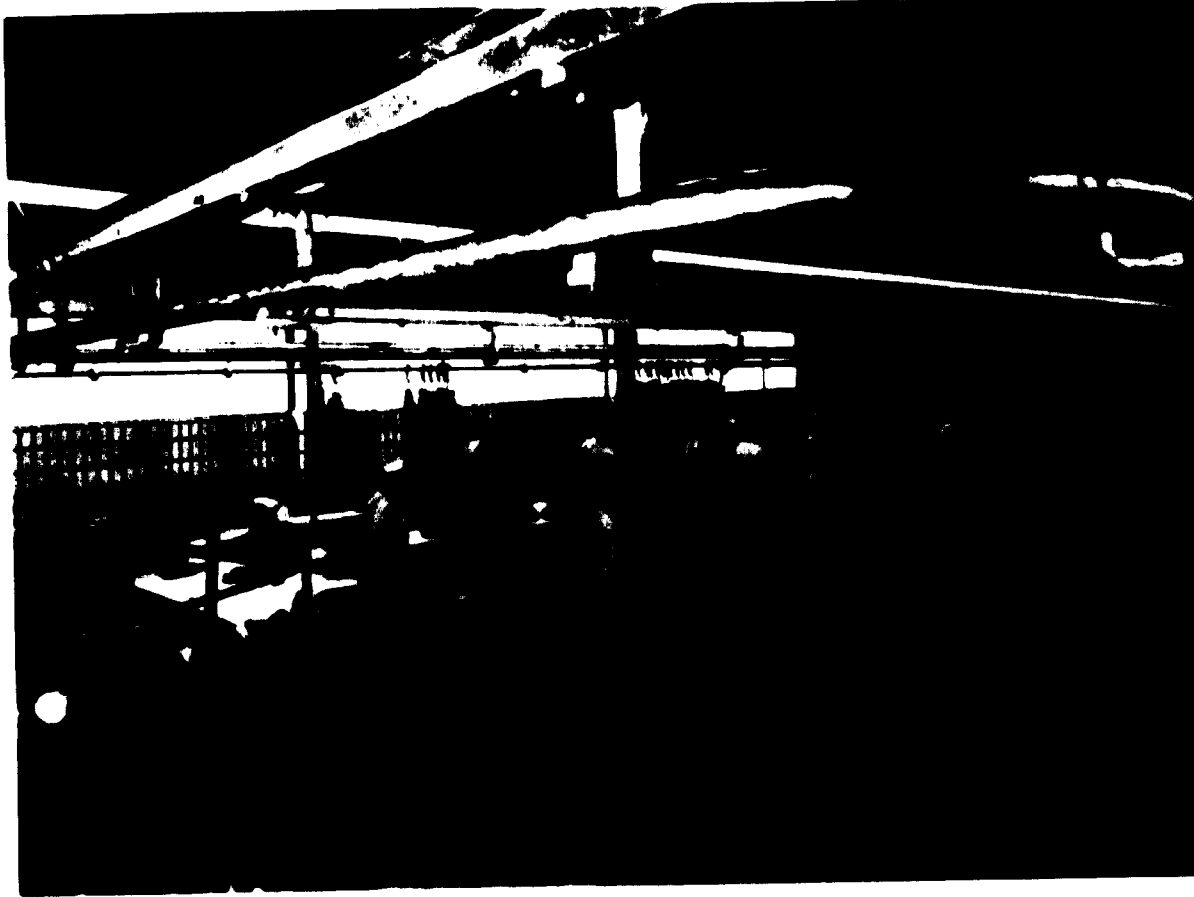
As far as the costs of operation are concerned, the manufacturers of the high - pressure cleaners analyzed them and came to the conclusion that such a machine is amortized after little more than 9 months. A high - pressure cleaner has for example a capacity of 50 bar at a water consumption of 900 litres per hour and a temperature of 290° C.

" Figure XXIII " .



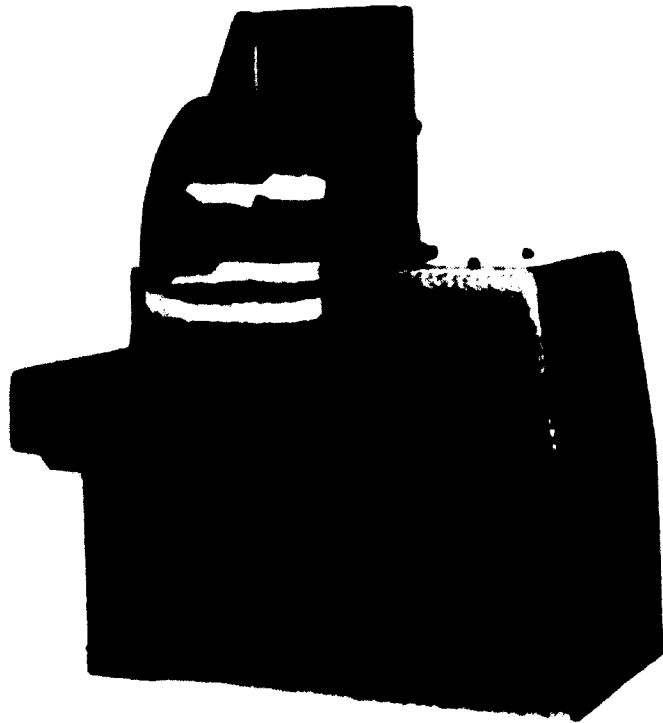
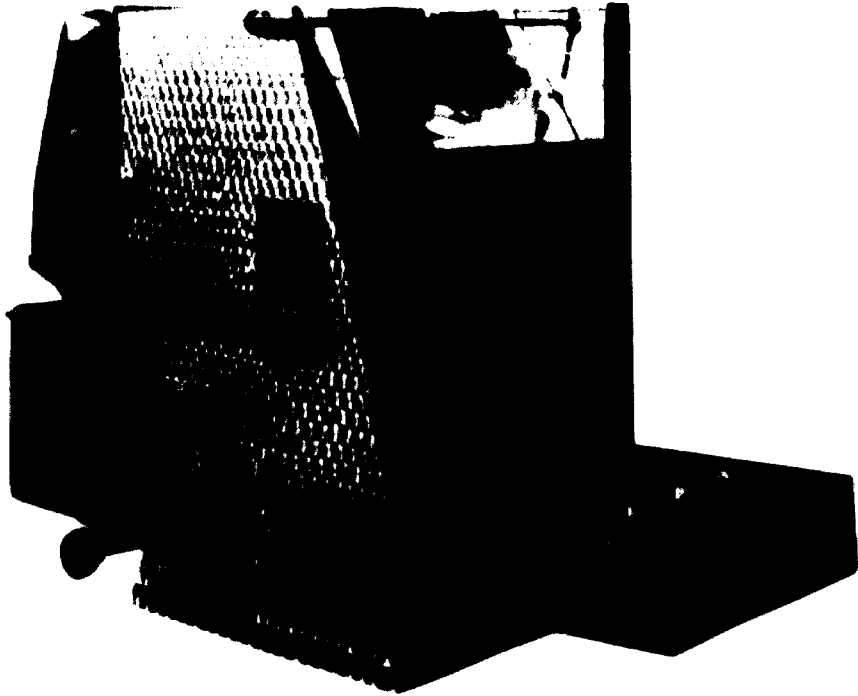
" Figure 1 " Conveyer belts - Slaughtering lines



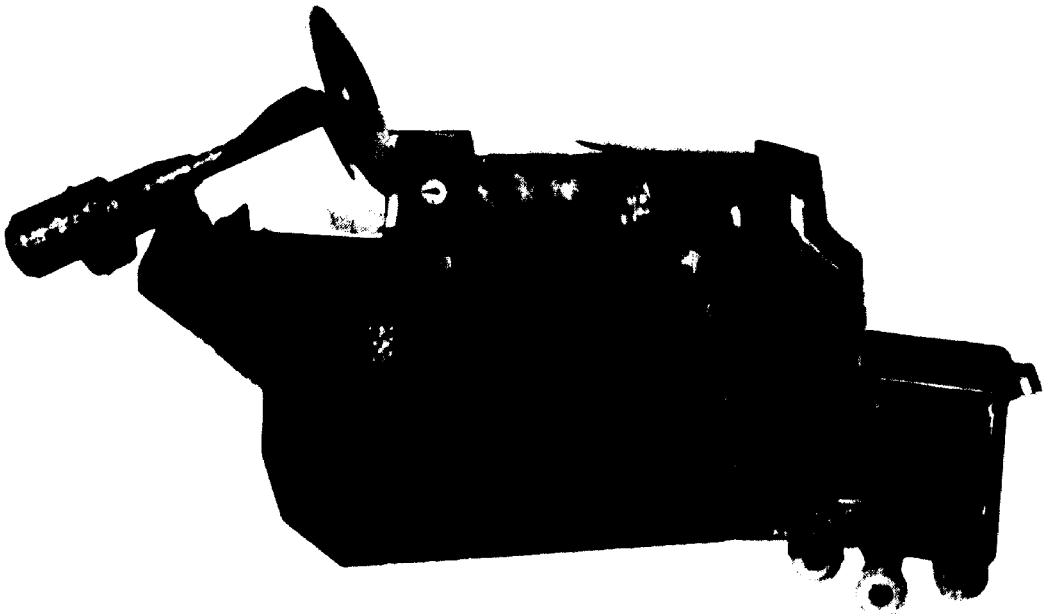
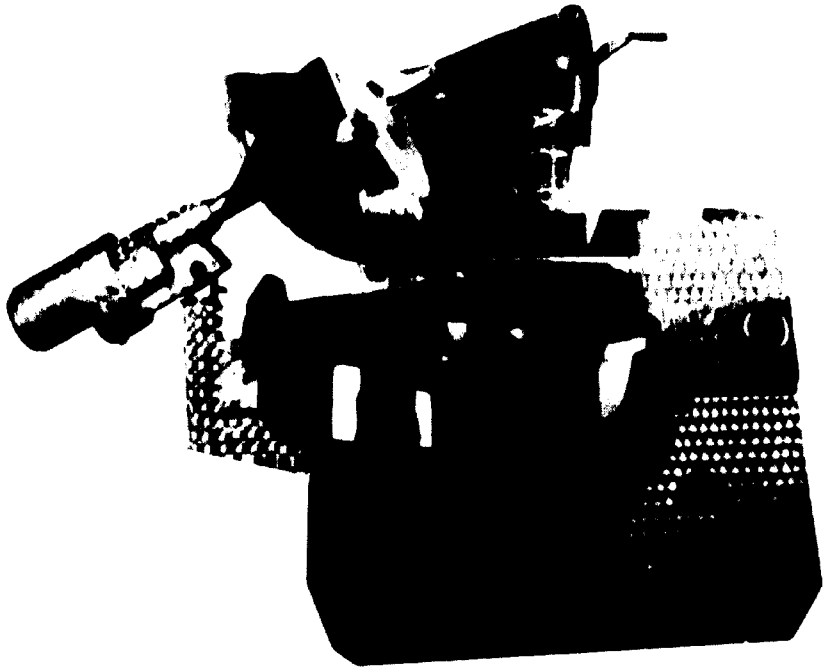


" Figure II " Meat sectioning department - Conveyer tables





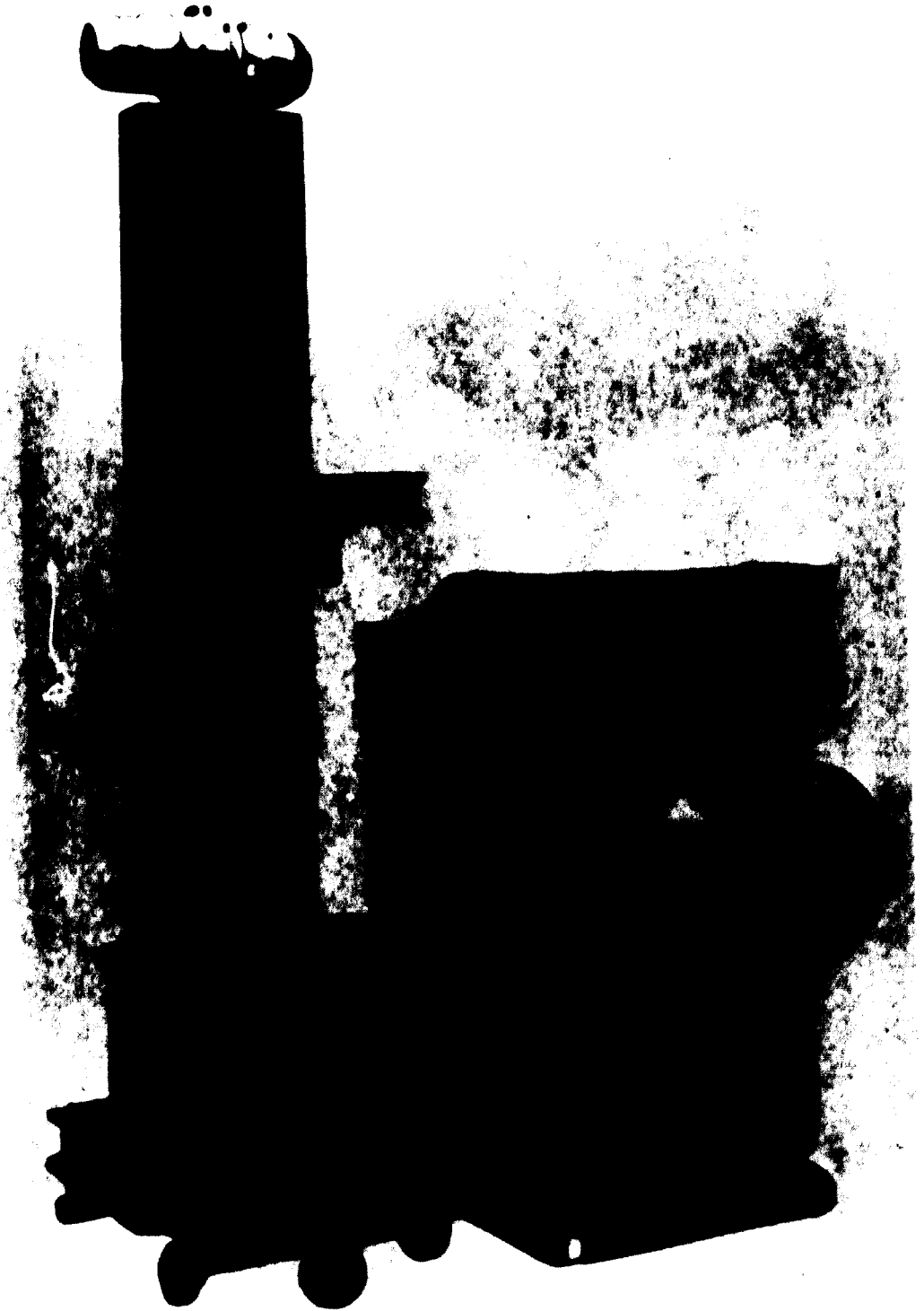
" Figure III " - Press Mat Cutters



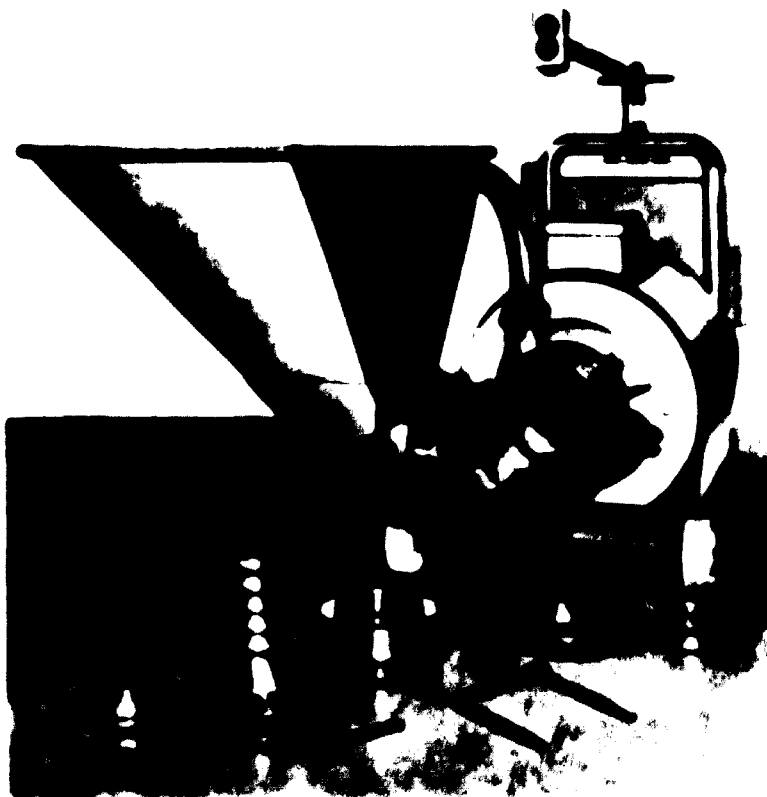
" Figure IV " - Automatic Bowl Cutters 100 and 200 litres respectively



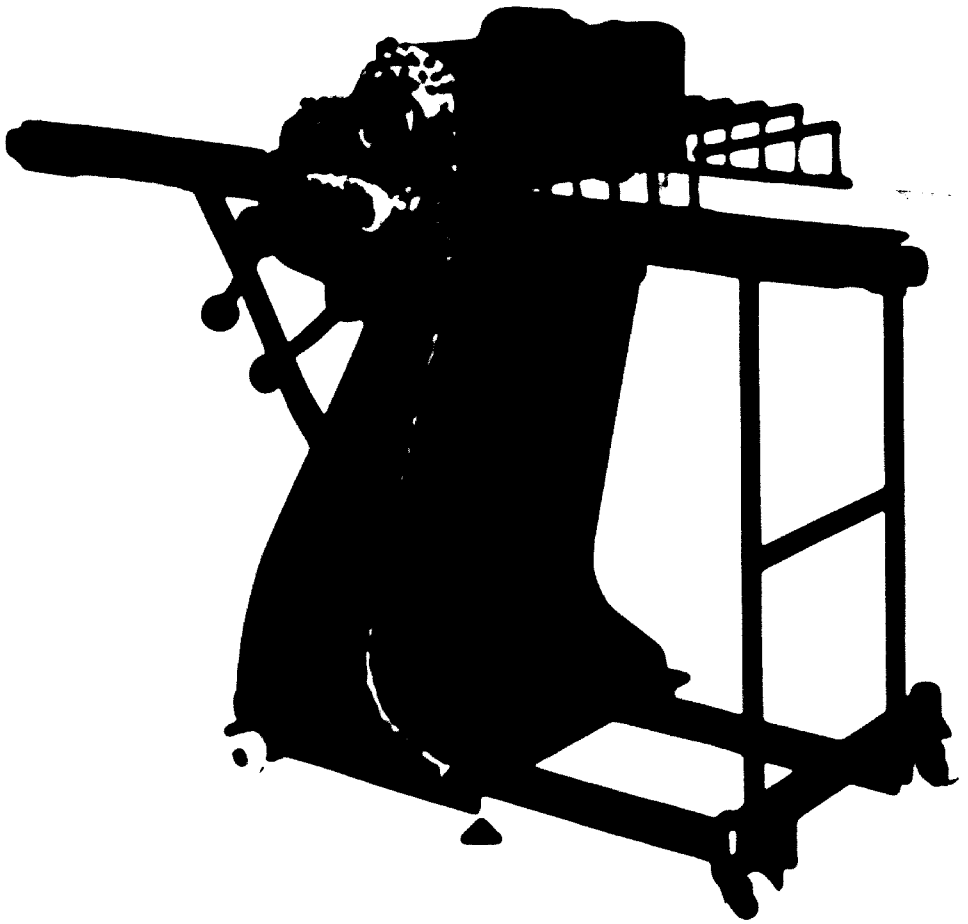
• Figure V • - Automatic Blade Cutter 320 litres with full hydraulic system and sound dampening hood



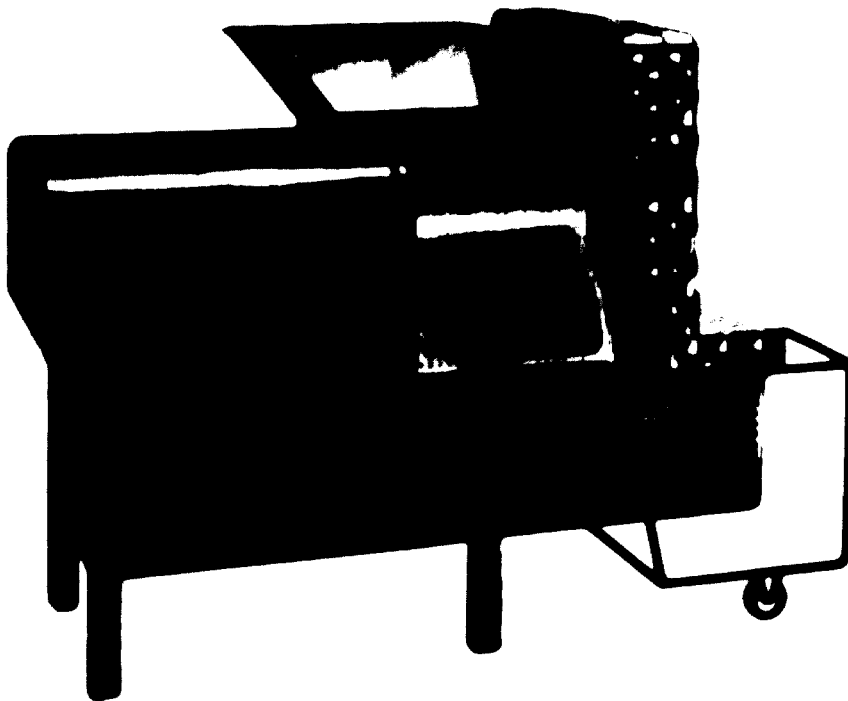
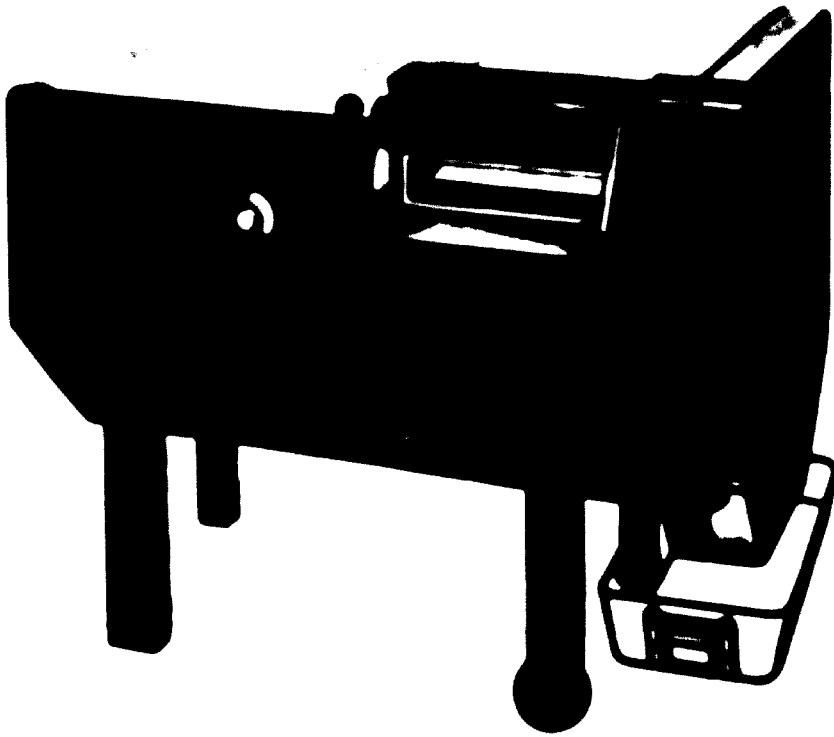
" Figure VI " - Mast Aftener with landing device



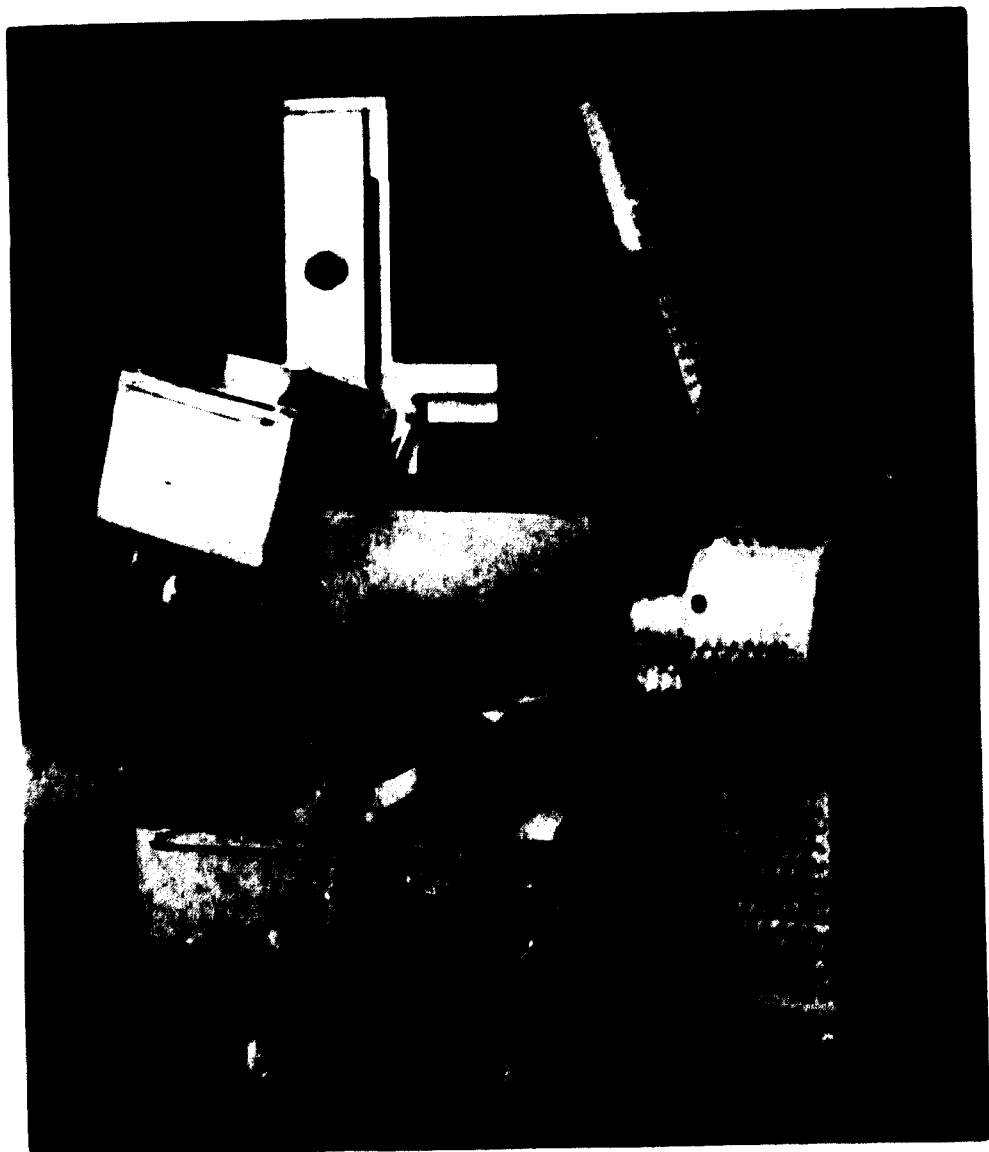
• Figure VII • - Emulsiya



**"Figure VII" - Automatic Desanding Machine
with Infeed and outfeed conveyors**



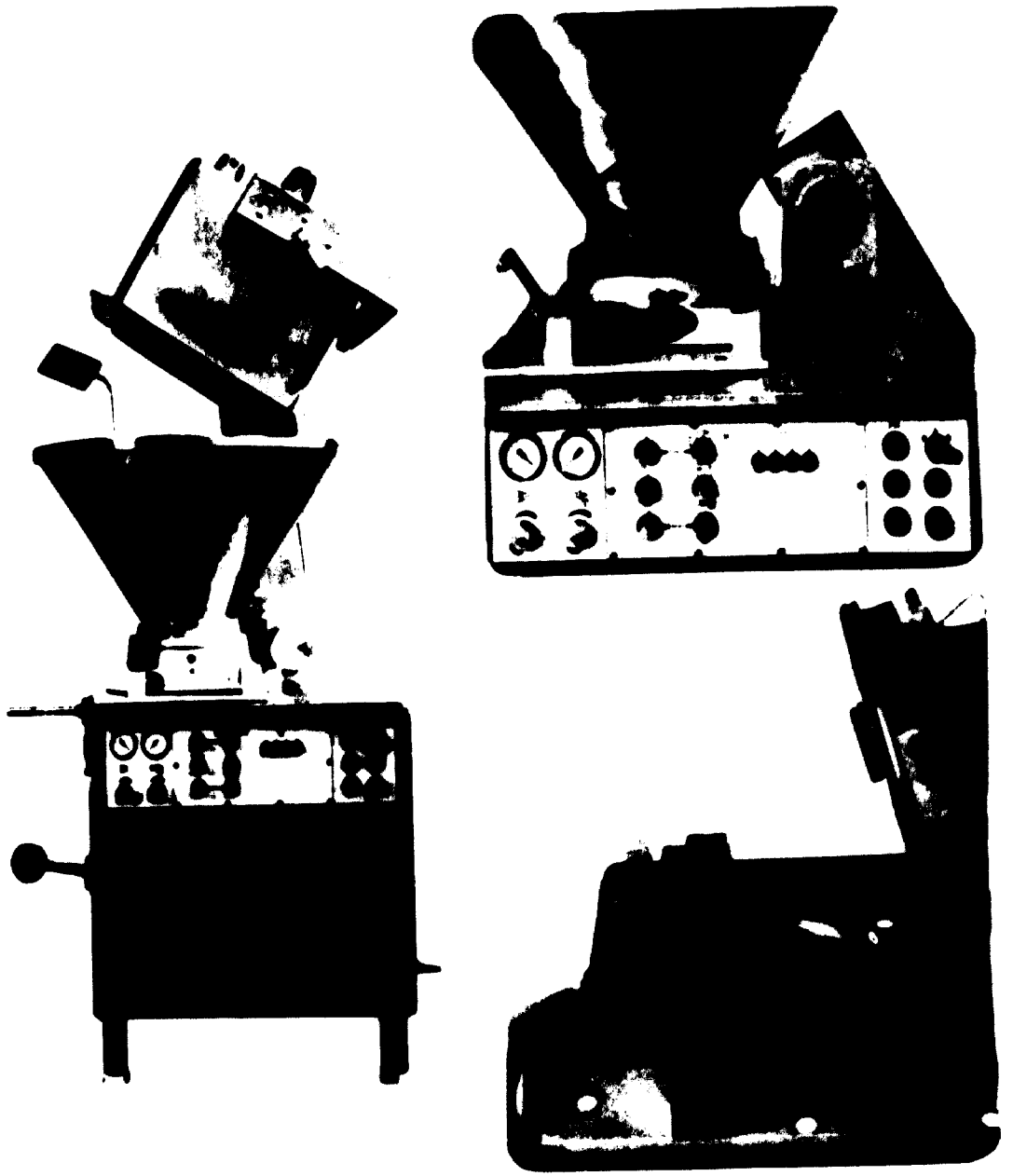
• Figure 81 • • All Purpose Cotton



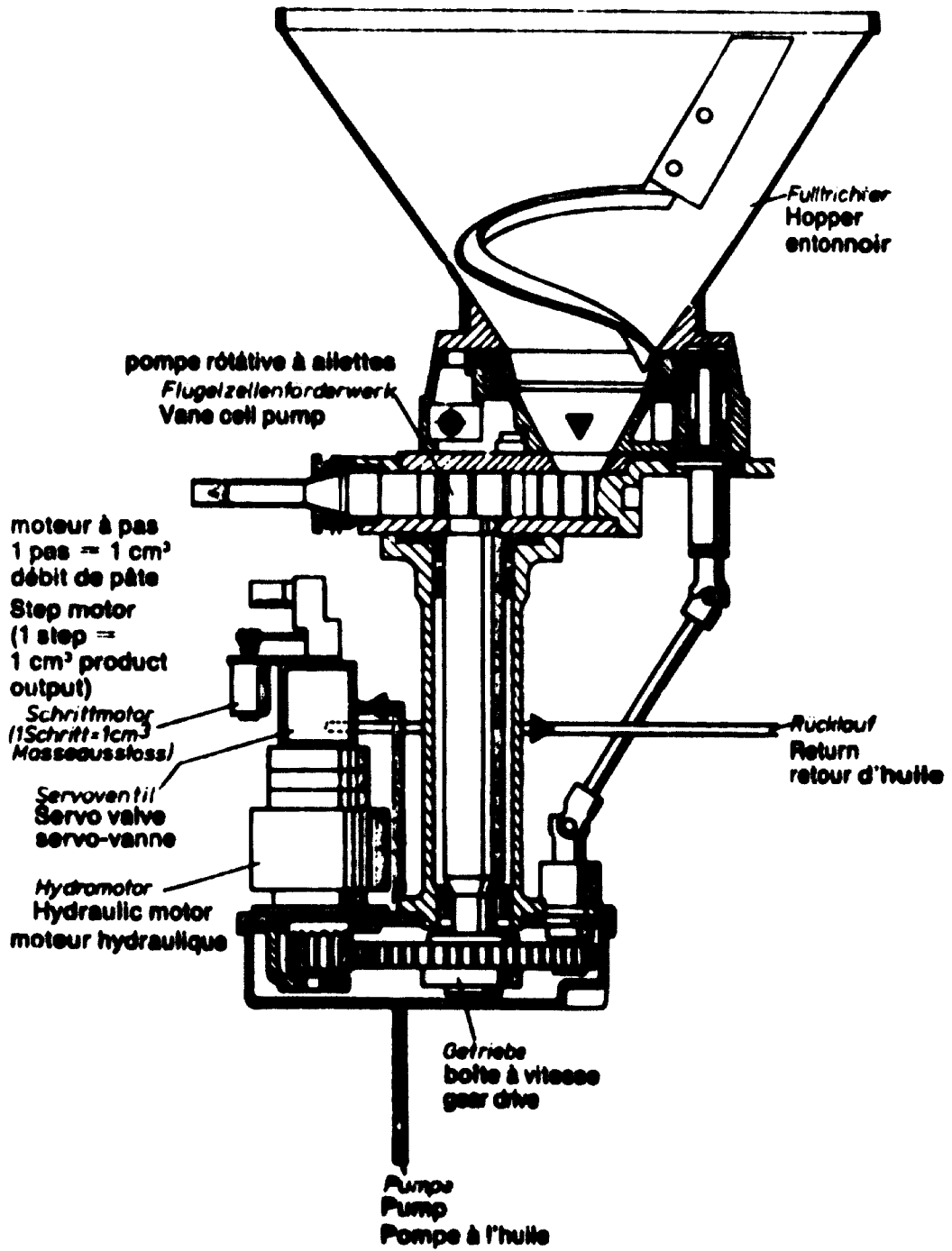
• Figure X • - Vacuum Mixer 400 Hves



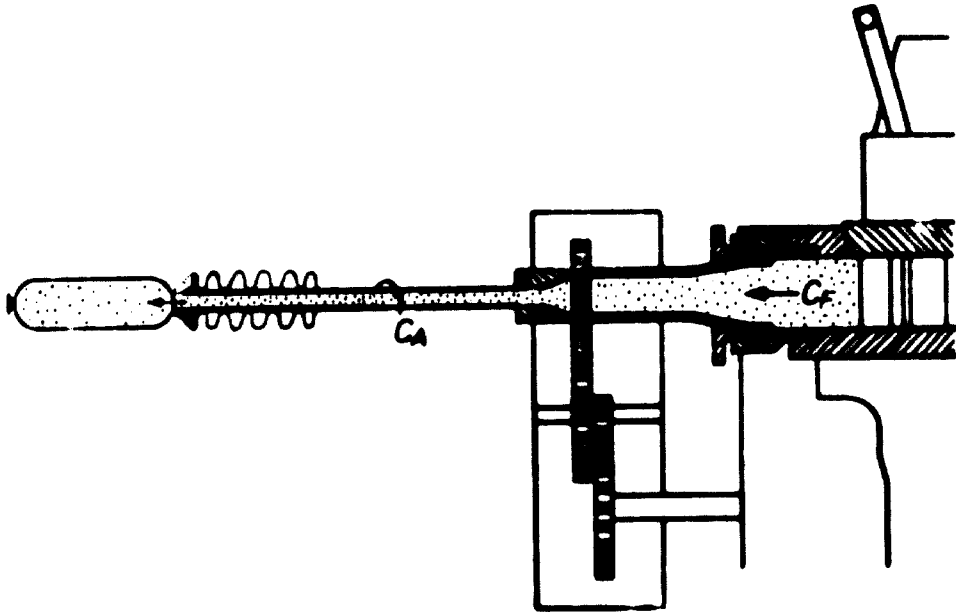
• Figure XI • - Continuous Vacuum Filling Machine



" Figure XI b " - Continuous Vacuum Filling Machine
Vane cell pump



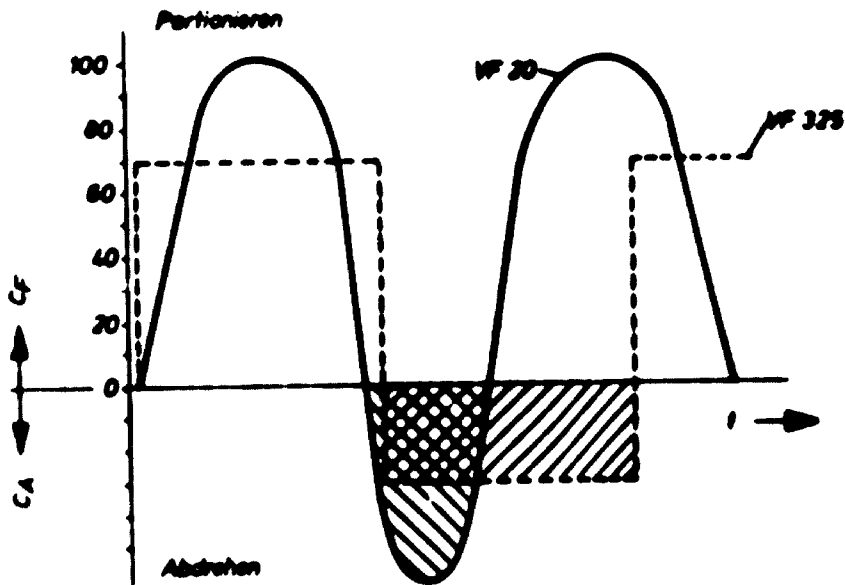
" Figure XI e " - Continuous Vacuum Filling Machine
Section



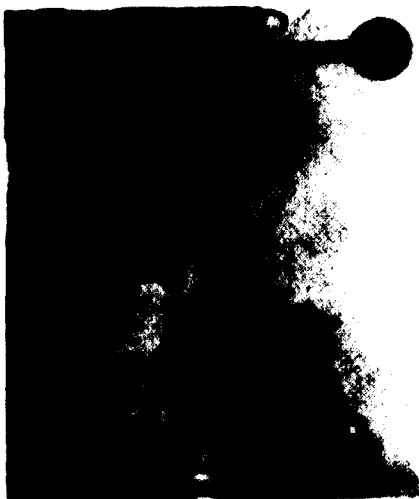
Portionier- und Abdreher-
fahren der neuen Vakuum-Füller

processus de portionner et torsionner
des nouveaux pousseurs à vide

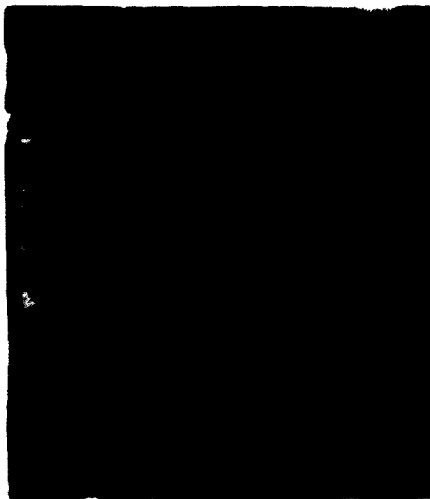
Portioning and linking
method of the new vacuum
fillers



• Figure XI d • Continuous Vacuum Filling Machine
Portioning and linking device



• Figure XII a •



• Figure XII b •



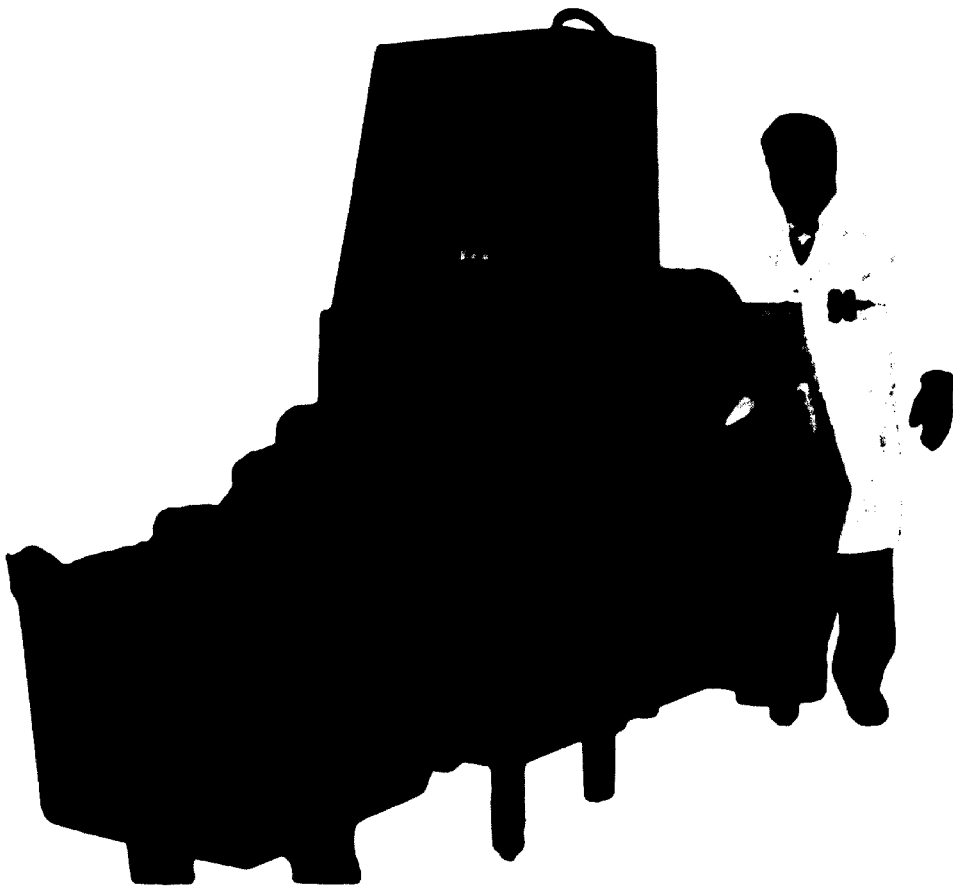
• Figure XII c •

Clipping Machine



" Figure XIII " - Combined Smoking and Cooking Units





• Figure XIV • - Automatic Field Injector



• Figure XV • - Vacuum Mulling Units for lign - production

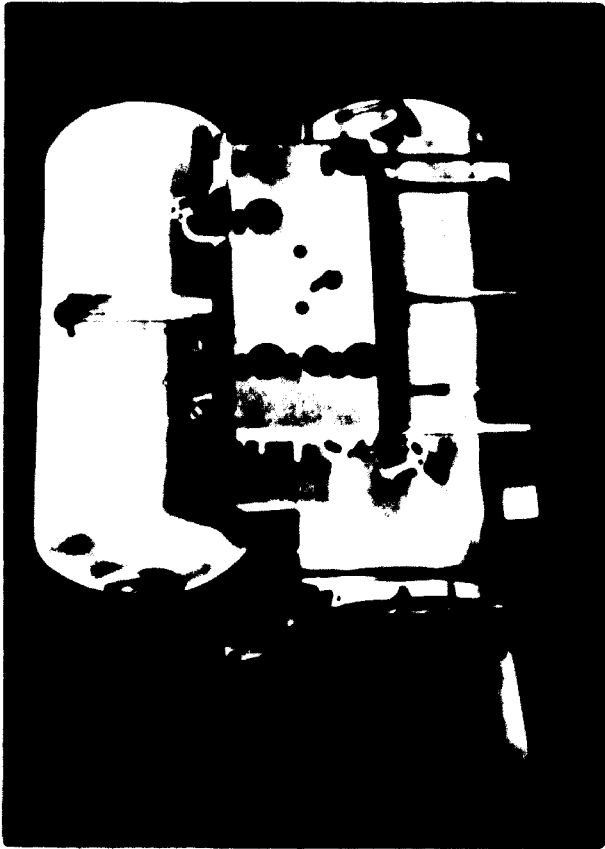
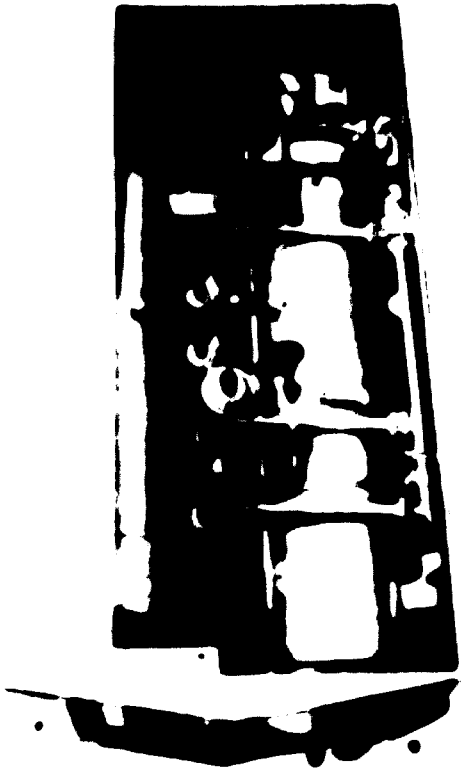
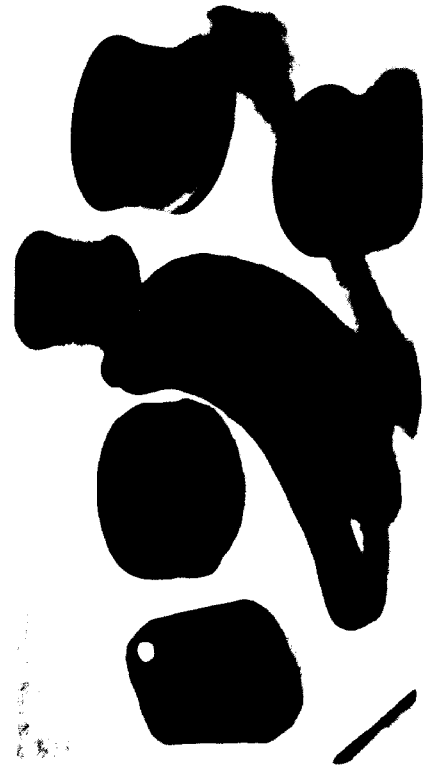
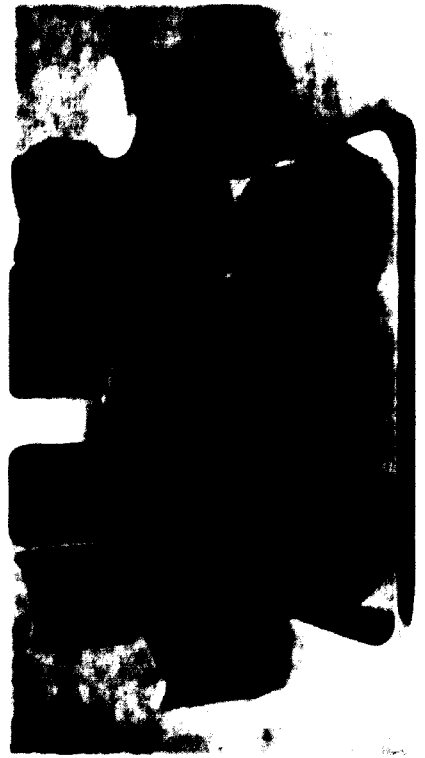


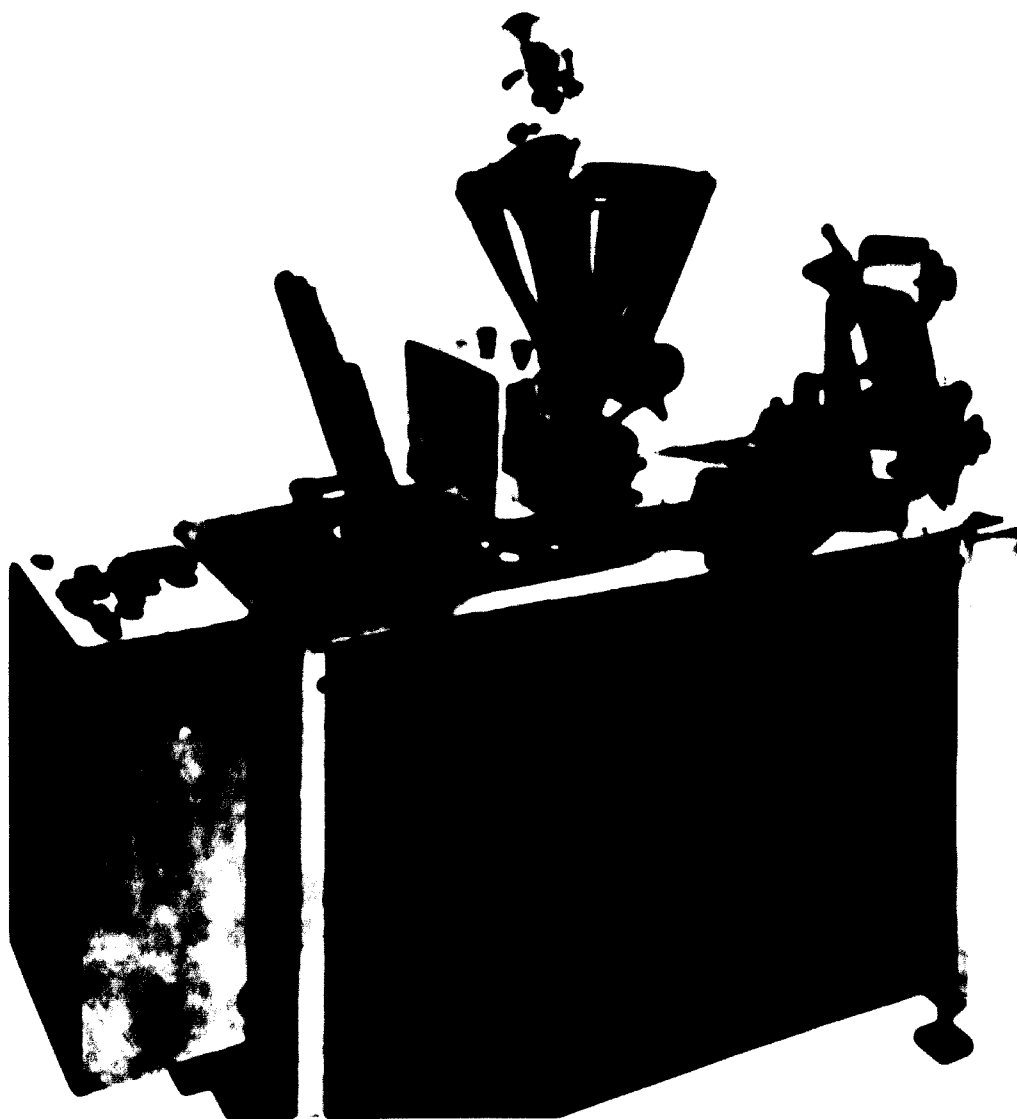
Figure 207





• Figure 2VI 6 • - Escapes - Automobile



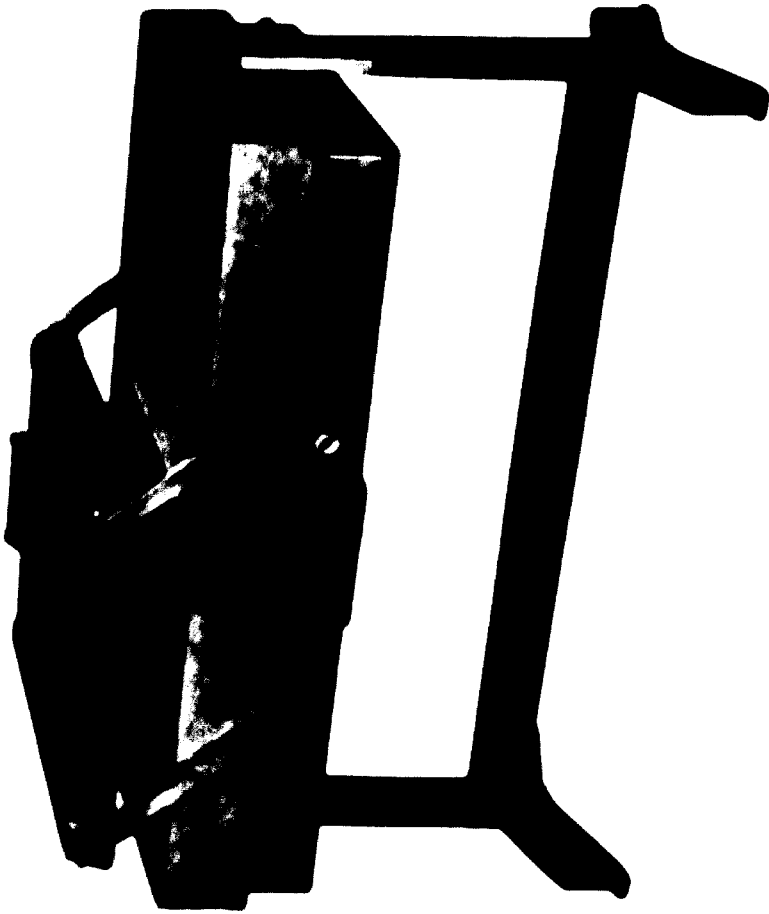


• Figure 1274 • • Automatic Filling and Cap - Sealing Machine

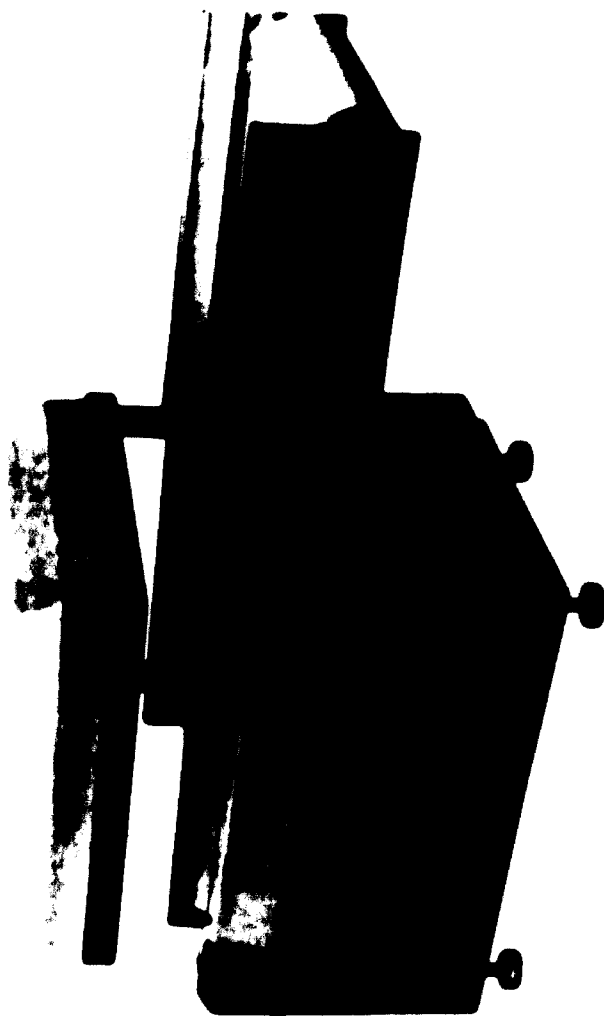


" Figure XIV b "

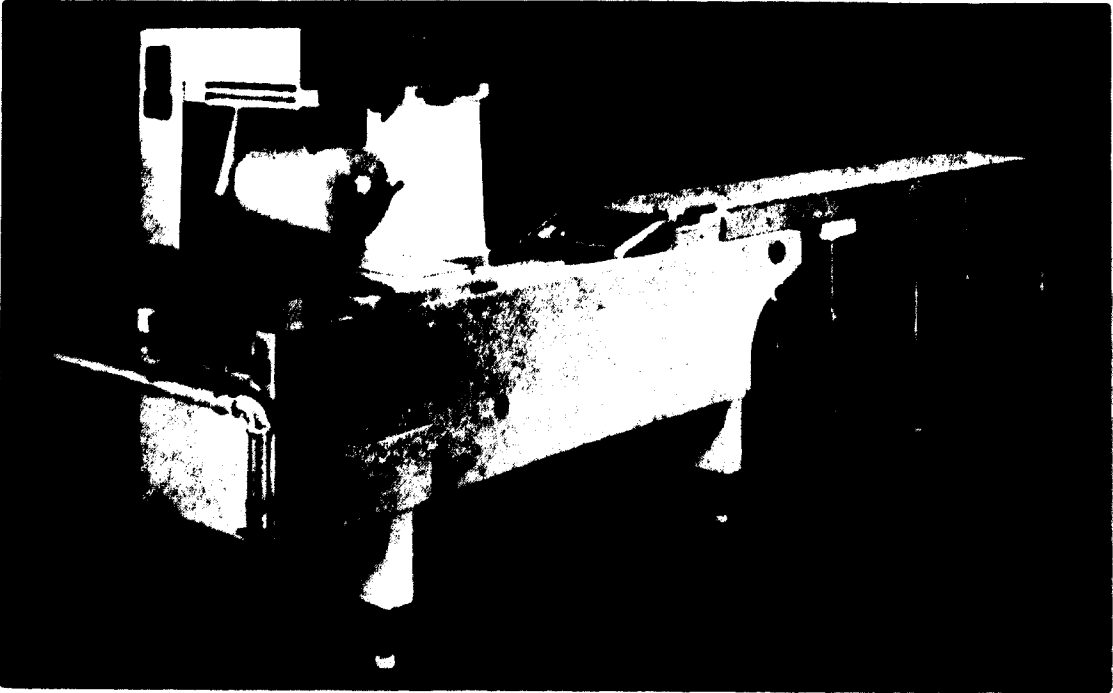
Most products, jam, honey, soup, butter, soft cheese, tomato- pulp etc.
packed in plastic boxes



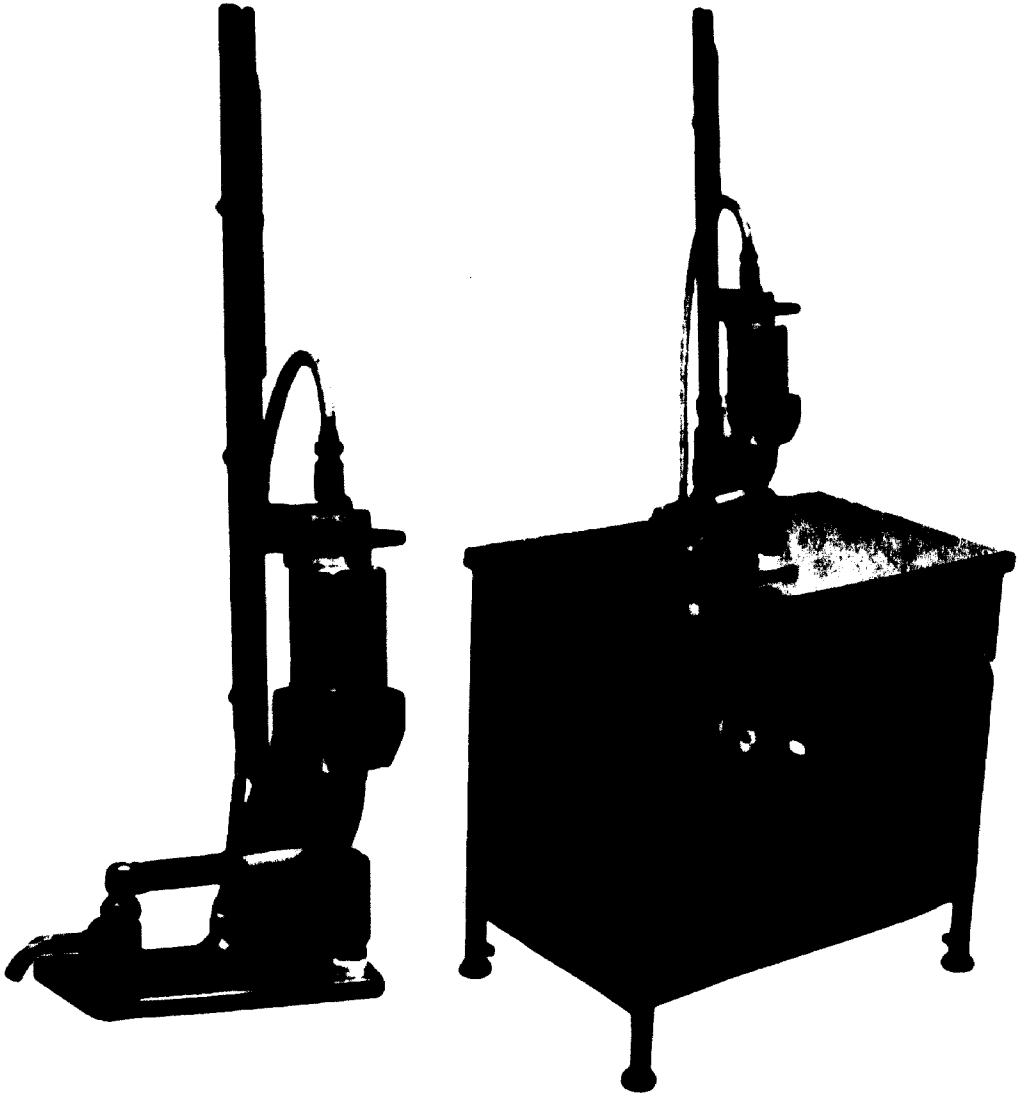
• Figure 20000 e • - Vacuum Packaging - Double Chamber Machine



• Figure 20111 b • Vacuum Packaging - Conveyor Belt Machine



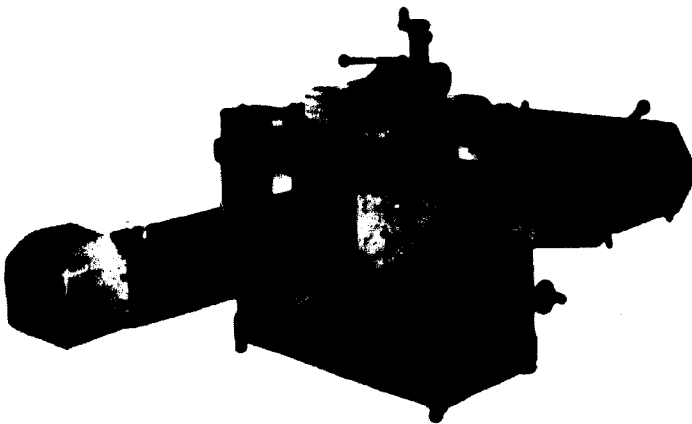
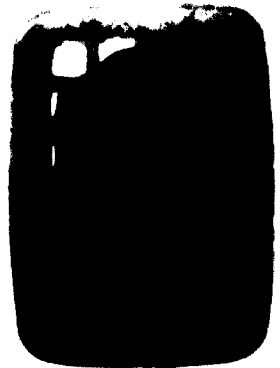
" Figure XDX " - Roll Stock Vacuum Packaging

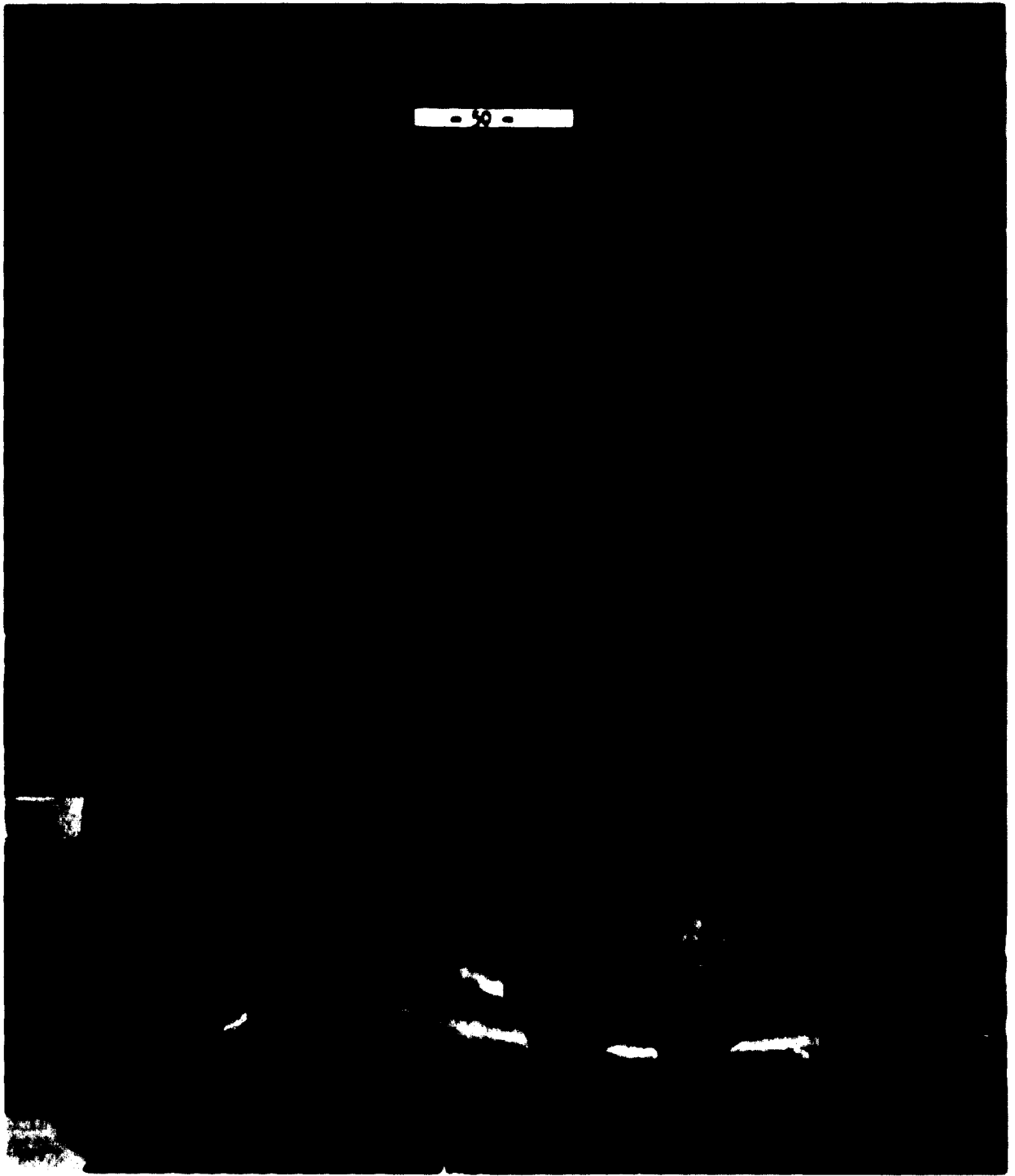


" Figure XX " - Vacuum Clipper

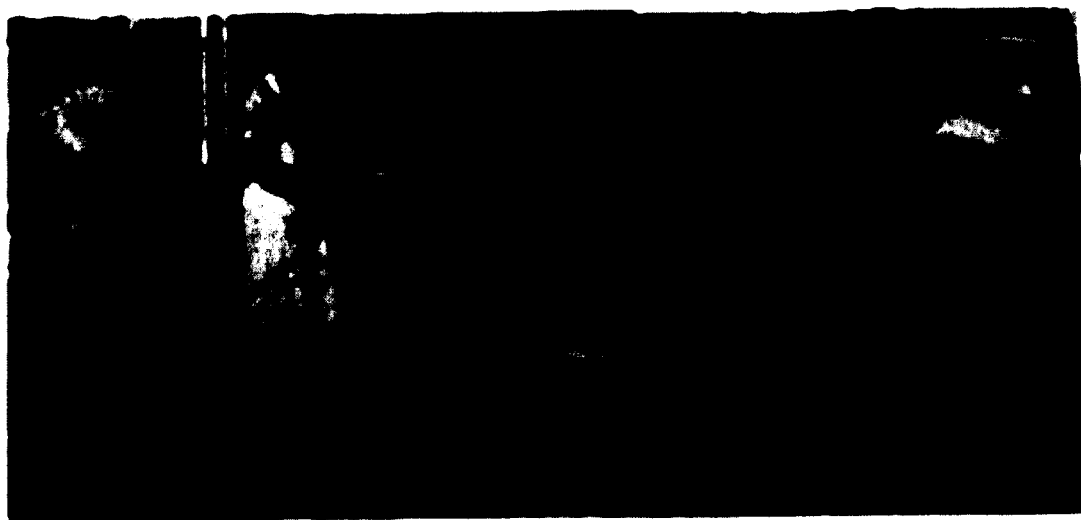


• Figure XXI • - Feedliner Trays



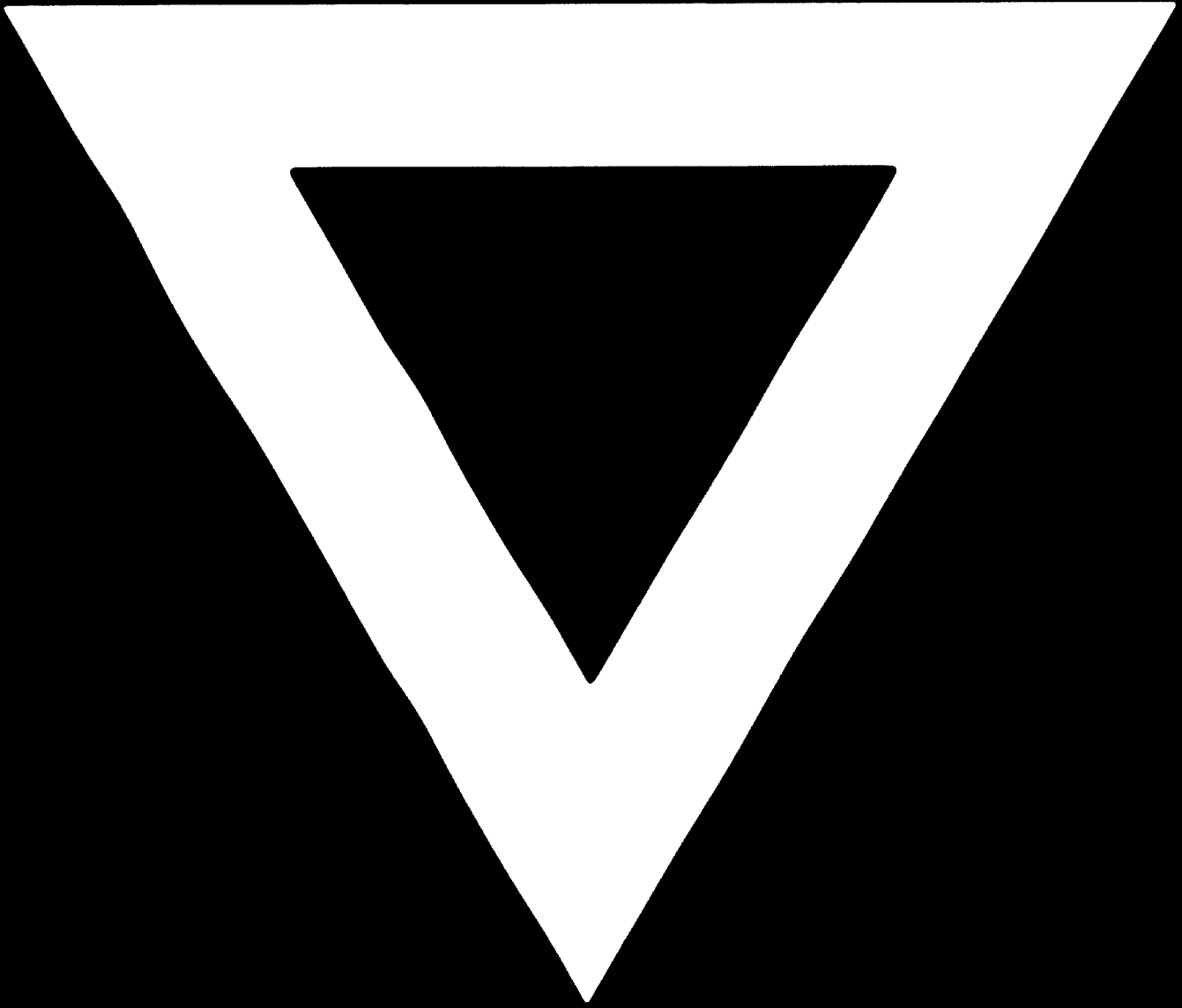


" Figure XXII " - Spring



• Figure 10000 • High Pressure Cleaner





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