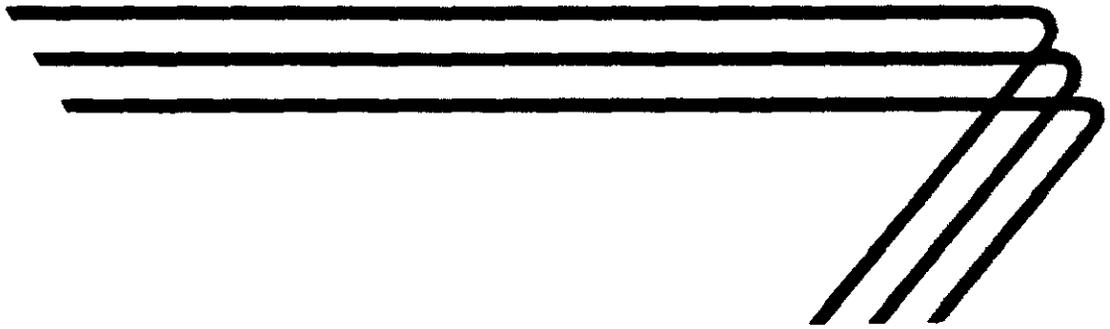


PLANT REQUIREMENTS TO SET UP AND OPERATE A SEAFOOD PROCESSING PLANT



**DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
COMMUNICATIONS RESOURCES DIVISION**

Washington 25, D. C.



FOREWORD

This brochure is one of a series of reports resulting from overseas technical inquiries on factory or commercial establishments, operation, management, and engineering. The report is designed to provide only a general picture of the factors that must be considered in establishing and operating a factory of this type. In most cases, plans for actual installations will require expert engineering and financial advice in order to meet specific local conditions.

Mention of the name of any firm, product, or process in this report is not to be considered a recommendation or an endorsement by the Agency for International Development, but merely a citation that is typical in its field.

This report was prepared by Fehmerling Associates, Consultants to Food and Allied Industries, Bridgeton, New Jersey, in April 1962 for the technical aids program through the facilities of the Office of Technical Services, U. S. Department of Commerce.

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For further information and assistance, contact should be made with the local Productivity Center, Industrial Institute, Servicio, or United States Agency for International Development.

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INTRODUCTION

The purpose of this report is to present methods and information for processing fish, langosta and shrimp in various forms, preserved by freezing.

Preserving of certain species of fish by brining and drying is also briefly discussed.

GENERAL ASSUMPTIONS

To determine the feasibility of the plant, and/or to assure successful operation, certain assumptions are made. These are:

1. The plant is located dockside in order that a large percentage of the raw seafood can be processed directly from the fishing or shrimp boats.
2. Adequate transportation facilities are available.
3. Adequate electric power and potable water are available at the plant site.
4. Water mentioned in the processing procedures in this report, unless otherwise specified, is potable and at ambient temperature.
5. All of the equipment in the plant is so constructed that the prepared seafood is in contact with only stainless steel, monel, or rubber surfaces. The machines are easily dismantled for cleaning and sanitizing.
6. Fish, langosta and shrimp are delivered to the plant as caught (not cleaned or headed), properly iced and in good condition.

7. Species of fish available are suitable for the intended usage.
8. The plant operates eight hours a day, five days a week, fifty weeks a year.
9. Costs of materials, supplies, labor and services are based on current costs in the United States.
10. The following items cannot be estimated realistically:
 - A. Land value.
 - B. Distribution and selling costs.
 - C. Transportation costs.
 - D. Administrative costs.
 - E. Taxes.

General estimates are made of these items; adjustments of these and all other estimates contained in this report, to conform to local conditions, should be made.

ITEMS CONSIDERED FOR PRODUCTION

A. Frozen Fish

1. Blocked Fillets.
2. Breaded Raw Sticks and Portions.
3. Fried, Breaded Sticks and Portions, Heat and Serve.
4. Boil in Bag Prepared Portions with Sauce.

B. Frozen Shrimp

1. Sized, Raw, Unpeeled.
2. Sized, Deveined, Breaded and Cooked, Heat and Serve.
3. Sized, Peeled, Deveined and Breaded, Raw.
4. Unsized and Pieces in Sauce, Boil in Bag.

C. Frozen Langosta

1. Packaged Tails, Unpeeled, Raw.

Obviously the cost figures on all of the various products mentioned in this report cannot be shown.

Therefore, all of the costs shown in this report are based on one product packed in a single package size. The product used for this purpose is frozen shrimp, sized, deveined, breaded and cooked, heat and serve (B. 2).

It is estimated that this product will comprise 15.7% of the total annual production of the plant.

PRODUCTION CAPACITY

As stated above, the production capacity of the plant is based on a single product. The annual production of 12 ounce packages of sized, deveined, breaded and cooked shrimp, heat and serve is 112,500 dozens.

PRODUCTION UNIT

The production unit is one dozen 12 ounce packages of shrimp.

GENERAL PROCESSING OPERATIONS

I. Receiving

The seafood is received at the unloading platform and is shoveled or placed by hand in nesting type baskets of heavy gauge wire. The filled baskets are raised to a platform by a winch, deposited on scales and weighed. Next the baskets of seafood are placed on a wheeled dolly and rolled into the cold storage room. Fish and shrimp are usually bought by weight and langosta by weight or count. Each basket is tagged to note the weight of contents.

II. Washing

The seafood is deposited into a hopper of a flight elevator where sprays of water soak and loosen slime and surface contamination as the product tumbles as it is elevated. Next it drops onto a chute which leads to a rod reel washer where

water under high pressure (100 pounds per square inch, or greater) sprays on the seafood as it tumbles about. This action removes slime and surface borne bacteria. The water collects beneath the equipment in a floor drain and discharges into the bay or a sewage disposal unit.

PROCESSING PROCEDURES FOR SPECIFIC PRODUCTS,
PRESERVED BY FREEZING

A. Frozen Fish

1. Blocked Fillets:

- (a) Washed fish are discharged from the washer on chutes which deliver them to the preparation conveyor. The chutes are so arranged that the fish are divided equally to both sides of the conveyor and travel on the inside twelve inches of the eighteen inch side belts.
- (b) The worker removes a fish from the belt, places it on his projection station of the table, removes the head and entrails which are deposited on the outside six inches of the conveyor.
- (c) Fillets, with skin and scales, are removed so that no bones remain in the fillet. The ribs remain attached to the backbone and are deposited on the outside six inches of the conveyor.
- (d) Fillets are placed, skin down, on the flat surface of the work table and the skin on the tail is hooked on a projecting spike. The worker then slides a knife blade along parallel to the work surface between the skin and the fillet.
- (e) The skinless, boneless fillet is placed on the center sanitary belt and the skins on the outside six inch conveyor. While other methods of filleting are employed, the one described here is most common and is very efficient when performed by experienced personnel. At the completion of the filleting operation, the work area is flooded and the fillet and the knives are rinsed by water sprays which are operated by the foot.

- (f) The fillets discharge onto the washing and drying conveyor where sprays of water remove any contamination which may have been encountered. High velocity air filtered through glass wool or other filtering material blows excess water from the fish.
- (g) The dried fish fillets discharge onto a packing conveyor. The first section of the conveyor is for inspection of the fillets for skin, bones and other extraneous material.
- (h) Workers place fish in cartons alternating thick and thin ends of the fillets to fill the boxes to proper weight as determined by scales. Covers are placed on the packages. The packages are normally slightly rounded on top so that compression in the plate freezer will produce a solid rectangular block with no air spaces between the fillets and square corners.
- (i) The filled packages discharge at the end of the conveyor and are placed in trays. The trays are placed between plates of the plate freezer and when filled, hydraulic pressure is applied and the cabinet is closed. Refrigerant is released through the plates until the packages are solidly frozen. Temperature normally achieved is -40° Fahrenheit.
- (j) The frozen packages are removed from the trays, placed on a belt of the wrapping machine and wrapped with impervious material.
- (k) The wrapped packages are placed in fiberboard cartons and stored immediately in a freezer warehouse at a temperature of about -10° Fahrenheit.

2. Breaded Raw Sticks and Portions:

- (a) Frozen blocked fillets are removed from packages, solidly frozen.
- (b) With band saws properly adjusted, the slabs are sawed into uniform size.
- (c) Slabs are further sawed to portion or stick size. The most popular size of stick is $5/8 \times 5/8 \times 3 \ 3/4$ inch. Portions are usually three and one-half ounces and are $5/8 \times 3 \times 3 \ 1/2$ inches.

- (d) Sawed sticks or portions drop onto a battering machine belt where workers arrange them in single layers, avoiding contact between sticks or portions, so that five sides can be covered with batter on the first belt.
- (e) Completely battered units drop onto a breading machine belt where workers again arrange them as for battering.
- (f) Completely battered and breaded units discharge onto a belt leading into a continuous belt freezer where they are frozen at a temperature of -40° Fahrenheit and then discharge onto a packing conveyor.
- (g) Frozen units are packed into cartons, usually by count. Cartons are closed and proceed to wrapping machine where they are wrapped and sealed.
- (h) Sealed packages are packed in fiberboard cartons and stored promptly in the freezer warehouse.

3. Fried, Breaded Sticks and Portions, Heat and Serve:

All of the steps described above through 2. (e) apply to these products.

- (a) Battered and breaded units slide into fryer where they are fried until almost completely cooked. Time and temperature of the frying depend upon size of the unit and type of product. Normal temperatures vary from 325° Fahrenheit to 365° Fahrenheit and times from two and one half to five minutes. Portions are usually not completely cooked because subsequent oven heating to serve would overcook the product.
- (b) Cooked units discharge onto the cooling tunnel belt where they are cooled to ambient temperature.
- (c) Cooled portions discharge onto the packaging conveyor where they are packed into cartons and the lids closed.
- (d) The closed cartons discharge onto the wrapping machine belt where they are wrapped and sealed.

- (e) The wrapped packages are placed in metal trays in the freezer storage where fans blow cold air over the packages until units are completely frozen, the temperature maintained at -30° Fahrenheit.
- (f) The solidly frozen packages are packed in fiber-board cases and placed in freezer storage at -10° Fahrenheit.

4. Boil in Bag Prepared Portions With Sauce:

During the sawing operations, stainless steel pans are placed beneath the saws to collect the saw dust and the fish slabs. This material is removed frequently while still frozen and placed in large polyethylene bags which are tied shut and placed in the freezer storage until sufficient volume is collected to make utilization feasible.

- (a) Stock is prepared from the saw dust and slabs by placing weighed portion in equal amount of water in steam jacketed kettle. The mixture is agitated and brought to incipient boil and held for 30 minutes at this temperature.
- (b) The resultant liquid is drained from the kettle through a cloth to remove pieces of fish. The liquid is caught in stainless steel buckets and placed in a second kettle. The pieces of fish are discarded.
- (c) The sauce is made from stock using the following formula or a variation thereof:

Fish Stock.....	12 gallons
Salt.....	2 pounds
Mono Sodium Glutamate.....	1/2 pound
Wheat Flour.....	2 pounds
Bland Corn Starch.....	1 1/2 pounds
Spices - Pepper, Onion Powder, Curry Powder, etc. Total.....	4 ounces

Starch and flour are made into a slurry with 3 gallons of stock and added to the batch with agitation. The remainder of the ingredients are placed in the kettle and the resultant sauce is heated to a boil with agitation.

- (d) When the sauce begins to thicken the heating is stopped and the batch cooled by running cold water through the jacket of the kettle. When ambient temperature is reached, the sauce is transferred to the hopper of the piston filler by either a pump or ladle.
- (e) Heavy walled polyethylene bags, which may be covered outside with aluminum foil, are partially filled with sauce and the desired number of frozen, breaded and cooked portions of fish are placed in the bag.
- (f) The bags are heat sealed and placed in cartons.
- (g) The cartons are placed on trays in racks and into the freezer storage with fans blowing cold air over the packages. The temperature is maintained at -30° Fahrenheit until the product is completely frozen.
- (h) When solidly frozen, the packages are placed in fiberboard cartons and into the freezer storage at -10° Fahrenheit.

B. Frozen Shrimp

1. Sized, Raw, Unpeeled:

- (a) Washed shrimp discharge from rod reel washer, drop onto the conveyor elevator and are elevated to the sizer where they are sized into various ranges. Sizes are expressed as numbers of shrimp tails per pound. Accepted market sizes vary from 10 - 12 (very large) to 40 - 51 (very small).
- (b) The size yielding the largest quantity is usually processed directly by transferring by basket, from hopper on sizer, to the preparation conveyor and then fed out as the belt moves. The other sizes are collected in baskets appropriately marked and returned to cold storage until the sizing is completed and then each size is processed separately.

- (c) The sized shrimp are headed, the tails placed on the center sanitary belt, and the heads on the outer six inches of the conveyor.
- (d) The shrimp discharge from the sanitary belt onto the washing and drying conveyor where surface contamination is removed and the tails are blown dry.
- (e) The dry tails discharge onto a packing conveyor where they are filled into packages, weighed and the packages closed.
- (f) The closed packages discharge onto a conveyor, to a wrapping machine where they are wrapped and sealed.
- (g) The packages are placed on trays in racks and into the freezing storage room where fans circulate cold air over them until they are solidly frozen.
- (h) The frozen packages are placed in fiberboard cartons and into freezing storage at a temperature of -10° Fahrenheit.

2. Sized, Deveined, Breaded and Cooked, Heat and Serve:

- (a) Sized, washed and dried tails discharge from the washing and drying conveyor (step 1. (d)) onto another conveyor which transports the shrimp between peeling and deveining machines. This conveyor is equipped with cross bars, which can be installed by the machine operator, to wipe the shrimp from the belt to a table top of the peeling and deveining machines. Ordinarily, the operator will allow twenty to twenty-five pounds of shrimp to accumulate on the table before removing the cross bar so that the shrimp can pass on to the next operator.
- (b) Machine operators place the shrimp into position in slots in the table top as they open. The slots then close and the machine automatically removes the veins from the tails and peels the shrimp.

- (c) The peeled, deveined and washed shrimp discharge from the bottom of the machine onto a conveyor which discharges the shrimp onto a battering machine. The operations from this point are identical to those described in A. 2, Steps (d) and (e) and A. 3, Steps (a) through (f). The shells and waste material discharge onto a waste conveyor located at the side of the machine.

3. Sized, Peeled, Deveined and Breaded, Raw:

- (a) Sized, washed and dried tails follow, identically, the procedure described in B. 2, Steps (a) and (b) and A. 2, Steps (d) through (h). Some operators prefer to freeze the shrimp before battering and breading. The choice of procedure will depend upon plant facilities and speed of operations.

4. Unsized and Pieces in Sauce, Boil in Bag:

During the peeling and deveining operations, shrimp are occasionally broken. These pieces and the very small shrimp are usually block frozen. If they have no market in this form, they are sawed into thin slabs approximately 1/4 inch thick. This produces odd shaped pieces when thawed which are excellent for use as boil in bag shrimp in sauce.

- (a) The sawed slabs are recut into convenient sizes and placed in heavy polyethylene bags which may be covered outside with aluminum foil.
- (b) The sauce as described under A. 4, (c) is filled into the bag with the piston filler and the bags are heat sealed. The operations from this point are the same as described in A. 4, Steps (f), (g) and (h).

C. Frozen Langosta

The langosta, also known as spiny lobster, rock lobster, crayfish, possesses very little edible flesh in the body and only the tail is used commercially.

1. Packaged Tails, Unpeeled:

- (a) Washed langosta are discharged from the rod reel washer onto the preparation conveyor where the tail is severed from the body. The tail is placed on the center sanitary belt and the waste material on the outer six inches of the conveyor.
- (b) The tail passes through the washing and drying operations and from there to the packing conveyor.
- (c) The tails are packed into cartons by count and weight, the packages closed.
- (d) Closed packages are deposited on the wrapping machine conveyor to be wrapped and sealed.
- (e) The wrapped packages are placed on trays in racks and into the freezer tunnel where fans circulate cold air around the packages until they are completely frozen. The temperature is maintained at -30° Fahrenheit.
- (f) Frozen packages are packed in fiberboard cartons and returned to the freezer storage at -10° Fahrenheit.

Where labor costs are not prohibitive, some operators cook the bodies of the langosta in much the same manner as shrimp and recover from one to four ounces of meat from the body. This meat is of about the same value as low quality crab meat and finds a market in the manufacture of a product similar to crab cakes.

PRESERVING FISH BY BRINING AND DRYING

Certain of the oily species of fish, such as herring and mackerel, are more suitably processed by salting or brining than by other means, the terms being synonymous when the brine is left on the fish. The operations, up to the actual preservation of the product, are very similar to preparation for freezing.

A. Brining

1. Mackerel:

- (a) Washed.
- (b) Headed and eviscerated.
- (c) Split down the dorsal side leaving the fillets attached by the ventral flesh.
- (d) Washed and drained.
- (e) Placed in a single layer, flesh side up, in a keg or barrel and sprinkled with a good grade of fine granulated salt. This operation is repeated until the barrel is filled with fish. Salt is added at the rate of one pound of salt to three pounds of fish.
- (f) When the container is filled, the head is placed on the barrel and it is coopered tight and left upright for 36 - 48 hours until the salt is dissolved by moisture drawn from the fish.
- (g) Barrels are then laid on their sides with the bung up. The bung is removed and the barrel filled with a saturated salt solution (approximately 25%).
- (h) The bung is replaced and the product is ready for storage or market.

2. Herring:

- (a) Washed.
- (b) Fish are eviscerated and may or may not be headed. They may be filleted or left intact with entrails removed.

- (c) The brining proceeds in the same manner as described for brining mackerel.

B. Drying

Almost all species of fish can be dried successfully. The oily types have a very short shelf life due to rancidity development induced by oxidation of the fat. However, they can be smoked dry, during which operation the fat is partially cooked from the fish. This affords a somewhat longer storage life.

B.-1. Sun Drying

- (a) Washed.
- (b) Eviscerated and washed.
- (c) The head and the body of the fish are split down the dorsal side and left connected by the ventral flesh.
- (d) The fish are spread on racks and exposed to sun drying during the daylight hours and covered during periods of darkness or rain.
- (e) Depending on the size of the fish, the humidity and air temperature, from one and three-fourths to two and one-half pounds of fresh fish can be dried per square foot of drying rack. Approximately 48 hours of direct sunlight are necessary to complete the drying.
- (f) The dried fish are packed in wood or cardboard containers. In most cases, the containers are lined with waxed paper. Bundling into burlap bags or covers, as is practiced in some instances, is not recommended because of the possibility of contamination during storage or shipping.

B.-2. Forced Air Drying

The fish are prepared for forced air drying identically as for sun drying.

- (a) The prepared fish are placed on racks, usually of wood construction, although stainless steel screening is preferable.

- (b) The racks are placed in cabinets, the temperature is elevated to 110° Fahrenheit and air is forced at the rate of approximately thirty feet per minute through the fish.
- (c) After three hours, the temperature is gradually raised to 140° Fahrenheit and the heating continues at this temperature until the moisture content of the fish is below 10%.
- (d) The dried fish are removed from the cabinets and cooled to ambient temperature, then packed in boxes or cartons.

Fish are often dried by combining sun drying and forced air drying in areas of wide temperature and humidity variations. The procedure normally followed:

First the fish are placed in the sun to remove as much moisture as possible within a reasonable time limit. Then the remainder of the moisture is removed by forced air drying. Sun drying is, obviously, considerably less expensive than forced air drying in most cases and should be utilized to the fullest extent possible.

Shrimp can be dried very similarly to fish following heading and washing. Ordinarily only the small size shrimp are dried. At the completion of the drying, the shrimp are placed in a rod cage, the rods placed close enough together to hold the shrimp in the cage, and tumbled to loosen the shells. They are then hand picked and inspected to separate the dried shrimp from the shells which fall through the rods. They are then packed in boxes or cans with waxed paper liners and are ready for sale.

QUALITY CONTROL

Practically all of the countries which consume prepared seafood products have laws governing the quality. The most stringent of the laws are those referring to presence of extraneous and foreign material, and, viable, enteritic type microorganisms, as well as the total numbers of viable microorganisms present in the product.

Methods of Examining Fish Products

Determination of the presence of foreign or extraneous material by macroscopic means involves examining weighed units for pieces of bone, skin, scales, fins, shell, intestinal material, etc. Quantities

of these materials are recorded by count or weight, depending upon the standards employed.

Microbiological examination is performed by preparing suitable dilutions of weighed samples under sterile conditions and plating the dilutions on differential media. Plates are incubated for a minimum of 48 hours at 98° Fahrenheit. Counts of colonies are made and multiplication by the dilution factor indicates the number of viable microorganisms per unit of product. The counts are expressed, ordinarily, as numbers per gram of product.

Weights of packages and the quality of workmanship in preparation and packaging are determined by selecting and examining representative samples drawn at random during the processing operations from the various packing lines.

The quality and particle size distribution of breeding materials are determined by examination. A good breeding operation depends upon the mix containing the proper proportion of various particle sizes to cover the product completely.

Quality Control Equipment

General

1. Triple beam gram balance with range from .1 to 500 grams.
2. Pound and ounce scales with range from 1/2 ounce to 25 pounds.
3. Standard testing screens and shaking device.
4. White enameled trays.
5. Scalpels, forceps and dissecting needles.

Bacteriological

1. Dilution bottles and stoppers.
2. Test tubes and test tube racks.
3. Petri dishes and holders.
4. Bacteriological pipettes and sterilizing cans.

5. Autoclave.
6. Sterilizing oven.
7. Incubator.
8. Ruled colony counter.
9. Nutrient agar.
10. Eosin methylene blue agar.
11. Refrigerator.

DIRECT MATERIALS

<u>Item</u>	<u>Number Required</u>	<u>Unit Cost</u>	<u>Annual Cost</u>	
			<u>Estimated</u>	<u>Actual</u>
Shrimp, unsized with heads	960 tons	\$ 300.00	\$288,000.00	_____
Batter mix	68 100# bags	14.00	952.00	_____
Breeding mix	135 100# bags	11.00	1,485.00	_____
Cartons	2,700 cases/500	6.50	17,550.00	_____
Waxed paper overwrap	540 rolls/2,500	22.50	12,150.00	_____
Hydrogenated fat	167,850 pounds	.30	50,355.00	_____
Shipping cases	56,250 each	.11	<u>6,287.50</u>	_____
Total			\$376,779.50	_____

SUPPLIES

<u>Item</u>	<u>Annual Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
Lubricating materials	\$1,200.00	_____
Cleaning and sanitizing chemicals	1,200.00	_____
Rubber gloves and aprons	1,200.00	_____
Maintenance and spare parts	1,200.00	_____
Office supplies	<u>200.00</u>	_____
Total	\$5,000.00	_____

PLANT LAYOUT

A suggested plant layout, in block form, for processing of the frozen products mentioned in this report is shown on the last page of this manual.

PLANT SITE

A plant site of approximately one acre, adjacent to a pier over water of sufficient depth to handle fishing boats at all tides, will be required.

The estimated land cost of this plant site, improved is \$16,000.00

Prorated for one product* 2,500.00

BUILDING AND PIER

A single story building of varying wall heights, constructed of cinder block walls and reinforced concrete floors, is required.

* All prorating is based on burdening this product with 15.7% of all costs not direct.

The freezing storage and refrigerated storage must be insulated on six sides. The processing areas must be completely screened and the walls of impervious material. The pilings and deck must be constructed of concrete.

The estimated cost of the building, complete is \$112,000.00

Prorated for one product* 17,500.00

POWER

The prorated connected load requirements amount to 175 horsepower. The annual cost of power is estimated at \$2,600.00.

WATER

The prorated annual cost of potable water for all purposes, not including water for cooling condenser of the refrigeration system, which is considered under recirculation by electrical power and pump, is estimated at \$1,200.00.

FUEL

The prorated annual cost of fuel for frying the product, heating the building and heating water for sanitation purposes, is estimated at \$2,600.00.

* All prorating is based on burdening this product with 15.7% of all costs not direct.

* * * * *

PRODUCTION EQUIPMENT

The following equipment will be required to produce the frozen food items described in this report.

<u>Description</u>	Cost	
	<u>Estimated</u>	<u>Actual</u>
<u>Platform scales</u> - Scales are mounted in a pit, the platform flush with floor level. Weights are recorded from a beam or dial reading. More elaborate variations are available with self recording equipment in which weights are stamped on cards.	\$ 1,160.00	_____
<u>Flight elevator</u> - Elevator is constructed of perforated, flexible metal belt with metal flights. Pipes equipped with spray nozzles are mounted above the elevator. The elevator is powered by an electric motor.	870.00	_____
<u>Rod reel washer</u> - Rods are fastened inside of supporting rings with one half inch of space between the rods. Rings rest in supporting wheels which are powered by an electric motor to revolve washer around its long axis. A pipe equipped with spray nozzles extends through the center of the washer its full length.	1,300.00	_____
<u>Preparation conveyor</u> - This conveyor is constructed with two side belts, eighteen inches in width. The belts are cannery type rubber and are separated by a center belt of white sanitary rubber. This belt runs between sides approximately three inches high, the sides are of heavy gauge stainless steel. The side belts are subjected to sprays of water on the return side to prevent buildup of solids and microorganisms. The return side of the rubber sanitary belt is first sprayed with water and scrubbed by counter revolving nylon brushes and water sprays. The belt then dips into a stainless steel tank where it is sanitized in a solution containing 15 parts per million of residual chlorine. The side belts have metal dividers placed six inches from the outer edge, constructed of flat iron, and suspended over the belt. The inside twelve inches convey whole fish, langosta or shrimp and the outer six inches convey waste material. Extensions eighteen inches long and		

<u>Description</u>	<u>Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
twelve inches wide project from the outer side of the conveyor with an eighteen inch allowance between each extension to form the work station.	\$13,800.00	_____
<u>Washing and drying conveyor</u> - This conveyor is approximately twenty-four inches wide and constructed with a stainless steel, perforated belt. The conveyor is hooded throughout. The first nine foot section is equipped with water sprays above and below to thoroughly wash product. Product passes from this section into another section approximately nine feet long where fans blow high velocity air over product and through the belt to dry the product.	5,600.00	_____
<u>Packaging conveyor</u> - This conveyor consists of a rubber belt approximately twenty-four inches wide. The top carries material for packaging with return side subjected to sprays of water, counter revolving nylon brushes, dips into sanitizing solution containing 15 parts per million residual chlorine and squeeze bar of rubber to dry belt. This continuously sanitizes the belt and prevents buildup of bacteria. Another conveyor approximately twelve inches wide is mounted above the center of this conveyor. Top belt of this conveyor is about sixteen inches above main conveyor and moves in the same direction as main conveyor belt. This belt carries filled packages to freezing trays. Return side, which is approximately eight inches above main belt, transports empty cartons to the packers.	9,500.00	_____
<u>Battering machine</u> - This machine consists of flexible stainless steel belt approximately twenty-four inches wide on which product is placed in single layer. The belt carries the product under a trough overflowing with liquid batter material which covers the exposed surface of the product. Excess batter drops through belt and is caught in a stainless steel tank beneath from which it is pumped again to upper trough for reuse. The product battered on one side drops off end of first		

<u>Description</u>	<u>Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
belt onto a second belt identical to the first. Distance of drop is adjusted by height of belts so that product falls with unbattered side exposed. A second trough of overflowing batter mix repeats the process and completes the coating of the product.	\$ 5,000.00	_____
<u>Breading machine</u> - This machine is a duplicate of the battering machine except that the dry breading material drops on the battered product. The batter causes the breading material to adhere to the portions of seafood. Excess breading material is elevated to overhead hopper by a screw conveyor from collection pan beneath belt. Portions of seafood are turned over in the same manner as for battering and breaded on both sides.	6,000.00	_____
<u>Plate freezer</u> - This freezer is constructed so that the insulated cabinet has large doors on opposite sides. A series of hollow plates about 4 feet X 6 feet and two inches deep are connected to headers by flexible pipes through which refrigerant is piped. Refrigerant may be ammonia gas or refrigerated brine. Packages of weighed seafood are placed on plates in metal trays. Breaker strips of wood, the exact height of the narrowest dimension of the package, are placed between alternate rows of packages. When all of the trays are loaded between the plates, the plates are compressed together by hydraulic pressure, doors are closed and refrigerant circulated. Very rapid heat transfer is obtained in this manner and freezing is accomplished quickly. When product is completely frozen, the hydraulic pressure is released, plates separate and the packages are removed. 3 @ \$ 7,450.00	22,350.00	_____
<u>Continuous belt freezer</u> - This freezer is constructed with heavily insulated walls. Small ports are located on each end, one for entrance of product through a chute and on the other end for discharge of the frozen units on a chute. Through the center of the insulated cabinet runs a perforated flexible metal belt on which material to be frozen is conveyed. High velocity air blows over refrigerated coils and on to product on belt.		

<u>Description</u>	Cost	
	<u>Estimated</u>	<u>Actual</u>
This removes heat rapidly from small units. A freezer approximately sixty feet long, properly equipped, will freeze units one half inch in thickness in less than thirty minutes.	\$72,000.00	_____
<u>Cross elevator conveyor</u> - Constructed with rubber belt with metal flights, built on incline.	1,250.00	_____
<u>Sizer</u> - Constructed of rollers so placed lengthwise in machine that space between them gradually becomes greater. As shrimp drop on to the slowly revolving rollers, they are gradually moved forward by gravity until they all fall through the rollers. They are caught below on cross belts and deposited in appropriate size bins.	2,450.00	_____
<u>Wrapping machine</u> - Rolls of waxed paper, polyethylene or cellophane feed from side as package enters on conveyor from end. Machine cuts wrapping material into proper size for package, wraps the package and heat seals the material to itself where it overlaps.	8,850.00	_____
<u>Batter mixer</u> - This machine consists of a bowl and agitator which revolve to stir ingredients. Weighed portions of dry batter mix are placed in bowl with measured amount of water and mixed until batter is of smooth consistency.	750.00	_____
<u>Steam jacketed kettles</u> - The kettle is constructed of stainless steel. Open kettle is equipped with a jacket through which steam passes to heat water in the kettle. There are valve openings in the bottom of the kettle for draining. 2 @ \$ 1,300.00	2,600.00	_____
<u>Lift system</u> - This system is comprised of an I Beam suspended horizontally over kettles on which an electric hoist is mounted on wheels.	850.00	_____

<u>Description</u>	<u>Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
<u>Band saws</u> - The saws are of stainless steel construction and resemble those used in wood working except for type of blade and ease of dismantling for cleaning. Table is movable so that product is fed easily to blade against a guide that regulates size of slice. 4 @ \$ 1,712.00	\$ 6,848.00	_____
<u>Fryer</u> - The tank is constructed of stainless steel in which edible oils or hydrogenated fat is heated by electric heaters or gas fired heating tubes, thermostatically controlled to maintain proper temperatures. The machine is equipped with a hood and stack to exhaust odors and smoke. The product is carried through the heated fat by a stainless steel link mesh belt with flights. The belt is powered with a variable speed electric motor to permit adjustment in frying time for various products. The frying machines are located in a separate, fireproof room where space permits. Danger to personnel and inflammable material is thus reduced.	36,000.00	_____
<u>Cooling tunnel</u> - The fried product passes on a stainless steel link mesh belt under the hooded section of the conveyor where high velocity air, produced by fans, is directed over and through the units to cool them to ambient temperatures.	8,400.00	_____
<u>Steam jacketed kettles</u> - These kettles are of approximately 25 gallon capacity and equipped with automatic agitators. 2 @ \$ 1,600.00	3,200.00	_____
<u>Semi-automatic piston filler</u> - This machine is of stainless steel. It consists of a hopper with an agitator mounted over a piston and operated by a cam wheel. When the piston is withdrawn, it fills a chamber with an exact amount of material from the hopper. When the piston is pushed into the chamber, all of the material in the chamber is ejected from an orifice equipped with a spout. The volume can be varied and closely controlled.	1,600.00	_____

<u>Description</u>	Cost	
	<u>Estimated</u>	<u>Actual</u>
<u>Heat sealer</u> - The machine has jaws electrically heated and covered with "Teflon", a material that does not become sticky when heated and to which plastic materials will not adhere when heated. The jaws are pressed together by the action of a foot lever.	\$ 320.00	_____
<u>Cooling tank</u> - This tank is slightly larger in diameter and depth than the large steam jacketed kettles described above. It is of stainless steel construction, and equipped with an inlet for water and a bottom drain for water removal.	725.00	_____
<u>Shrimp peeler and deveiner</u> - Shrimp are placed in slots by hand. The revolving wheel slits the shrimp down the dorsal side and removes the vein. The rubbing action of a second wheel removes the shell and legs from the shrimp. 4 @ \$ 4,500.00	18,000.00	_____
<u>Compressors and equipment for operating freezing storage</u> - The equipment furnishes compression and evaporation capacity for maintaining 500,000 pounds of material at -20° Fahrenheit.	65,000.00	_____
<u>Steam generator</u> - 50 horsepower, fully automatic steam generator to furnish heat for all of the operations, with condensate return system.	5,900.00	_____
<u>Laboratory equipment</u>	<u>4,600.00</u>	_____
Total cost of equipment	\$304,923.00	_____
Prorated for one product	\$ 47,873.00	_____

OTHER EQUIPMENT AND MAINTENANCE TOOLS

<u>Description</u>	<u>Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
Dump truck	\$ 5,600.00	_____
Metal baskets, 200	3,000.00	_____
Tools, welder, shop equipment	<u>7,000.00</u>	_____
Total	\$15,600.00	_____
Prorated for one product	\$ 2,450.00	_____

OFFICE FURNITURE AND FIXTURES

<u>Item</u>	<u>Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
Desks, tables and chairs	\$ 1,600.00	_____
Safe and filing cabinet	1,300.00	_____
Typewriter	450.00	_____
Adding machines	<u>400.00</u>	_____
Total	\$ 3,750.00	_____
Prorated for one product	\$ 590.00	_____

DIRECT LABOR

<u>Occupation</u>	<u>Number Required</u>	<u>Hourly Rate</u>	<u>Annual Cost</u>	
			<u>Estimated</u>	<u>Actual</u>
Cold storage receiving	1	\$ 1.50	\$ 3,000.00	_____
Dumping	1	1.25	2,500.00	_____
Operator, sizer and washer	1	1.75	3,500.00	_____
Heading	8	1.25	20,000.00	_____
Peeling and deveining	4	1.50	12,000.00	_____
Battering	6	1.25	15,000.00	_____
Breading	2	1.25	5,000.00	_____
Operator, breading and battering machine	1	1.75	3,500.00	_____
Operator, cooker	1	1.75	3,500.00	_____
Operator, cooler and packing conveyor	1	1.75	3,500.00	_____
Packers	8	1.25	20,000.00	_____
Operator, wrapping machine	1	1.75	3,500.00	_____
Tray loaders	2	1.25	5,000.00	_____
Operator, lift truck (use 1/3 of time in transporting trays to freezer and other supplies to lines)	1/3	1.75	1,165.00	_____
Freezer loading, unloading and case packing	3	1.50	9,000.00	_____
Case sealer and stacker	1	1.25	2,500.00	_____
Case stacker, frozen storage	1	1.50	3,000.00	_____
Operator, freezers	1	1.75	<u>3,500.00</u>	_____
Total			\$119,165.00	_____

INDIRECT LABOR

<u>Occupation</u>	<u>Number Required</u>	<u>Annual Cost</u>	
		<u>Estimated</u>	<u>Actual</u>
General manager	1	\$15,000.00	_____
Production manager	1	10,000.00	_____
Sales manager	1	12,000.00	_____
Quality control manager	1	8,000.00	_____
Quality control staff	2	8,000.00	_____
Office manager	1	6,000.00	_____
Clerks	2	7,000.00	_____
Typist	1	3,000.00	_____
Maintenance chief	1	6,000.00	_____
Maintenance and sanitation helpers	3	7,000.00	_____
Stationary engineers	<u>2</u>	<u>12,000.00</u>	_____
Total	16	\$94,000.00	_____
Prorated for one product		\$14,800.00	_____

DEPRECIATION

<u>Description</u>	<u>Estimated Cost</u>	<u>Years Life</u>	<u>Annual Cost</u>	
			<u>Estimated</u>	<u>Actual</u>
Building and pier	\$17,500.00	20	\$ 875.00	_____
Production equipment	47,873.00	10	4,873.00	_____
Other equipment and tools	2,450.00	10	245.00	_____
Furniture and fixtures	590.00	10	<u>59.00</u>	_____
Total			\$6,052.00	_____

MANUFACTURING OVERHEAD

<u>Item</u>	<u>Annual Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
Depreciation	\$ 6,052.00	_____
Indirect labor	14,800.00	_____
Power	2,600.00	_____
Water	1,200.00	_____
Fuel	2,600.00	_____
Supplies	<u>5,000.00</u>	_____
Total	\$32,252.00	_____

MANUFACTURING COSTS

<u>Item</u>	<u>Annual Cost</u>	
	<u>Estimated</u>	<u>Actual</u>
Direct materials	\$376,779.50	_____
Direct labor	119,165.00	_____
Manufacturing overhead	<u>32,252.00</u>	_____
Total	\$528,196.50	_____

FIXED ASSETS

<u>Item</u>	Cost	
	<u>Estimated</u>	<u>Actual</u>
Land, prorated	\$ 2,500.00	_____
Building and pier, prorated	17,500.00	_____
Production equipment, prorated	47,873.00	_____
Other equipment and tools	2,450.00	_____
Furniture and fixtures	<u>590.00</u>	_____
Total	\$70,913.00	_____

WORKING CAPITAL

<u>Item</u>		Cost	
		<u>Estimated</u>	<u>Actual</u>
Direct materials	30 days	\$31,398.00	_____
Direct labor	30 days	9,930.00	_____
Manufacturing overhead	30 days	2,688.00	_____
Reserve for sales collection	30 days	<u>54,844.00</u>	_____
Total		\$98,860.00	_____

CAPITAL REQUIREMENTS

<u>Item</u>	Cost	
	<u>Estimated</u>	<u>Actual</u>
Fixed assets	\$ 70,913.00	_____
Working capital	<u>98,860.00</u>	_____
Total	\$169,773.00	_____

SALES REVENUE

The annual production capacity of this plant of frozen, sized, deveined, breaded and cooked shrimp, heat and serve is 112,500 dozen packages. As explained above, this figure represents approximately 15.7% of the total estimated plant capacity for various frozen seafood products.

The current average sales price of this product is \$5.85 per dozen packages.

Based on these figures the annual sales revenue would be \$658,125.00.

RECAPITULATION OF COSTS, SALES AND PROFITS

<u>Item</u>	<u>Estimated Cost</u>	<u>Actual Cost</u>
Direct materials	\$376,779.50	_____
Direct labor	119,165.00	_____
Manufacturing overhead	<u>32,252.00</u>	_____
Total manufacturing cost		_____
	\$528,196.50	_____
Interest on loans	\$ 15,000.00	_____
Insurance	2,000.00	_____
Legal fees	3,500.00	_____
Auditing	3,500.00	_____
Unforeseen expense	<u>15,000.00</u>	_____
Total administrative cost		_____
	\$39,000.00	_____
Sales commission, 4%	26,325.00	_____
Label allowance, discounts	5,500.00	_____
Profit before taxes	<u>59,103.50</u>	_____
Total annual gross sales		_____
	\$658,125.00	_____

BUDGET CONTROL

A requisition form designed to provide accurate records of procurement with the least amount of time and effort is shown on page 32.

This form has an account number for each type of the various expenditures which the manager will review in detail, monthly or oftener, in order to control his expenses. Some items, such as power and water, are usually under contract and are easily checked by reference to monthly bills. For simplification, items marked with an asterisk in the list below are omitted from the purchase requisition. Variations in the labor costs are easily reviewed by examination of payroll vouchers. This simplified type of control thus provided makes certain that the manager can control expenses promptly.

Payment of all expenditures in connection with budget control should be made by uniform vouchers. Each voucher should carry an account number.

At the end of each month the manager will receive a statement of all expenditures broken down by budget accounts. If the expenditures exceed the budgeted monthly allowances of any of the accounts, the bookkeeper will furnish the manager with a break-down of all expenditures relative to the budgeted accounts exceeded. All these supporting data can be secured by reference to the purchase requisitions and the check vouchers. This reference will enable the manager to determine what caused the over-expenditure and take corrective action.

If at any time during each month it becomes apparent that expenditures will exceed any of the budget accounts, the bookkeeper will bring this to the attention of the manager for his information and action.

BUDGET CONTROL ACCOUNTS

<u>Account Number</u>	<u>Monthly Expense</u>	<u>Monthly Budget</u>	<u>Annual Budget</u>	<u>Actual</u>
10 Administrative	\$ _____	\$ 2,000.00	\$ 24,000.00	_____
20 Sales	_____	2,652.00	31,825.00	_____
30 Direct materials	_____	31,398.00	376,779.50	_____
40 Supplies	_____	416.00	5,000.00	_____
51 Power*	_____	216.00	2,600.00	_____
52 Water*	_____	100.00	1,200.00	_____
53 Fuel	_____	216.00	2,600.00	_____
60 Unforeseen expense (Reserve account)	_____	1,250.00	15,000.00	_____
71 Direct labor*	_____	9,930.00	119,165.00	_____
72 Indirect labor*	_____	1,175.00	14,100.00	_____
80 Depreciation (Reserve account)	_____	504.00	6,052.00	_____

ECONOMICS

It is recommended that a copy of "Food Processing Feasibility Study" (Code Number ID-14) be obtained and studied. This manual describes in detail the methods of gathering information and procedures to be followed to determine the feasibility of establishing a seafood processing plant.

Specific data which may require technical aid in assembling follows:

- (a) Amount of electricity or fuel required to freeze and maintain seafood in a frozen condition, using selected types of freezing units.
- (b) Labor requirements for various operations. Equipment manufacturers can provide reasonably accurate approximations of numbers of workers and skills necessary to operate their machines to produce a given volume of produce per hour.
- (c) Selection of packaging materials and wrapping films for a particular product.
- (d) Estimated consumption of edible oils or fats for frying operations. This would include life expectancy of fat or oil under given conditions of usage before it must be discarded.

Manufacturers of industrial equipment and supplies employ engineers familiar with the use, design and installation of their specialized products. These manufacturers are usually willing to give prospective customers the benefit of technical advice by those engineers in determining the suitability of their equipment and supplies in any proposed project.

The manufacturers of equipment and supplies also know, and can recommend, professional engineers and consultants in private practice, who are willing and able to provide appropriate services.

PLANT AND OPERATIONAL REQUIREMENTS

Operating a seafood processing plant can be a hazardous undertaking from the standpoints of sanitation, safety and techniques unless certain requirements are clearly understood and enforced.

A. Sanitation

1. The plant must be so constructed as to meet all governmental requirements and accepted industry standards relative to sanitation. These requirements include: proper drains and waste disposal units; adequate light and ventilation; all doors and windows properly screened against insects, rodents, etc.; proper and adequate storage space; rest room and wash room facilities for personnel.
2. Equipment must be so located and of the type that provides ample room and ease of operation of all pieces, and, sufficient free work space for cleaning and sanitizing must be provided.
3. Thoroughly trained cleaning and sanitizing crews, aside from the production staff, supplied with proper, efficient apparatus and material, must be considered an integral part of the plant operations.

B. Safety

There is always danger of accident and injury in any industrial plant. Because of this, the management should inform the employees of the potential dangers and instruct them in safety precautions.

1. All machines and equipment with moving parts should be equipped with shields and safety devices. These appliances should be in working condition and the operators should use them.
2. First aid supplies should be readily available in the plant. The plant manager, foremen and a number of employees should be competent to administer first aid service.
3. Periodic inspections and instructions on safety first should be a part of the production program.
4. Fire drills should be conducted periodically and each employ should be trained as to his responsibility in case of fire.

C. Training

Manufacturing a product of inferior quality during the training period could create sales resistance that might be difficult to overcome later. To avoid such possibilities, the quality of the finished product should be maintained at all times, including the training period.

In some areas skilled workers and operators may be available locally. In other areas all personnel may have to be trained.

If skilled operators are not available, adequate training would be assured by using one or more of the following methods:

1. A contract may be negotiated with the engineering firm which designs the plant to train personnel on a training basis or by agreement to operate the plant for a definite period of time until the personnel is capable of producing acceptable quality products.
2. Key personnel may be placed in the same type of industry in a foreign country for training while the plant is being constructed and equipment installed.
3. Qualified services of private consultants in the field could be obtained to train personnel for key positions.
4. If none of the above methods is possible, it may be necessary to employ either permanently or temporarily, experienced key personnel from another country.

MANUFACTURERS OF SEAFOOD PROCESSING
EQUIPMENT AND SUPPLIES

These companies manufacture fish stick slicers.

H. G. Weber and Company, Incorporated
Kiel, Wisconsin

A. K. Robbins and Company, Incorporated
Baltimore, Maryland

Rimbach Manufacturing Company, Incorporated
Gardenia, California

Nassau Distributing Company, Incorporated
New York 19, New York

This company manufactures band saws.

Biro Manufacturing Company
Marblehead, Ohio

This company manufactures block cartons.

Rock City Box Sales Company
Jacksonville, Florida

These companies manufacture peelers, deveiners and graders.

Ray Skrmetha
New Orleans 25, Louisiana

Gregor Jonsson Associates
Highland Park, Illinois

The Peelers Company
New Orleans, Louisiana

Sort Rite Company
Harlingen, Texas

GENERAL EQUIPMENT AND SUPPLIES

This company manufactures retail packages.

Continental Can Company, Eastern Division
Boxboard and Folding Cartons Division
New York, New York

These companies manufacture refrigeration and cooling tunnels.

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin

The Frick Company
Waynesboro, Pennsylvania

York Refrigeration Company
York, Pennsylvania

These companies manufacture continuous freezers, breaders and battering machines.

J. W. Greer Company
Wilmington, Massachusetts

Sam Stein Associates
Sandusky, Ohio

This company manufactures wrapping machines.

Hayssen Manufacturing Company
Sheboygan, Wisconsin

This company manufactures mixers.

Hobart Manufacturing Company
Troy, Ohio

This company manufactures package formers.

Kliklok Corporation
New York, New York

This company manufactures plate freezers.

Americ Corporation
Cliffside Park, New Jersey

This company manufactures fryers.

Macbeth Engineering Corporation
Harrisburg, Pennsylvania

This company manufactures freezing blowers.

Niagara Blower Company
New York 17, New York

This company manufactures automatic ice makers.

Pappas Industries
Houston, Texas

This company manufactures breading and batter mixers.

D. C. A. Food Industries, Incorporated
New York 18, New York

This company manufactures carbon dioxide safety systems for fryers.

American - La France Foamite Company
Elmira, New York

Other manufacturers may be found by referring to listings, such as Thomas' Register of American Manufacturers.

BIBLIOGRAPHY

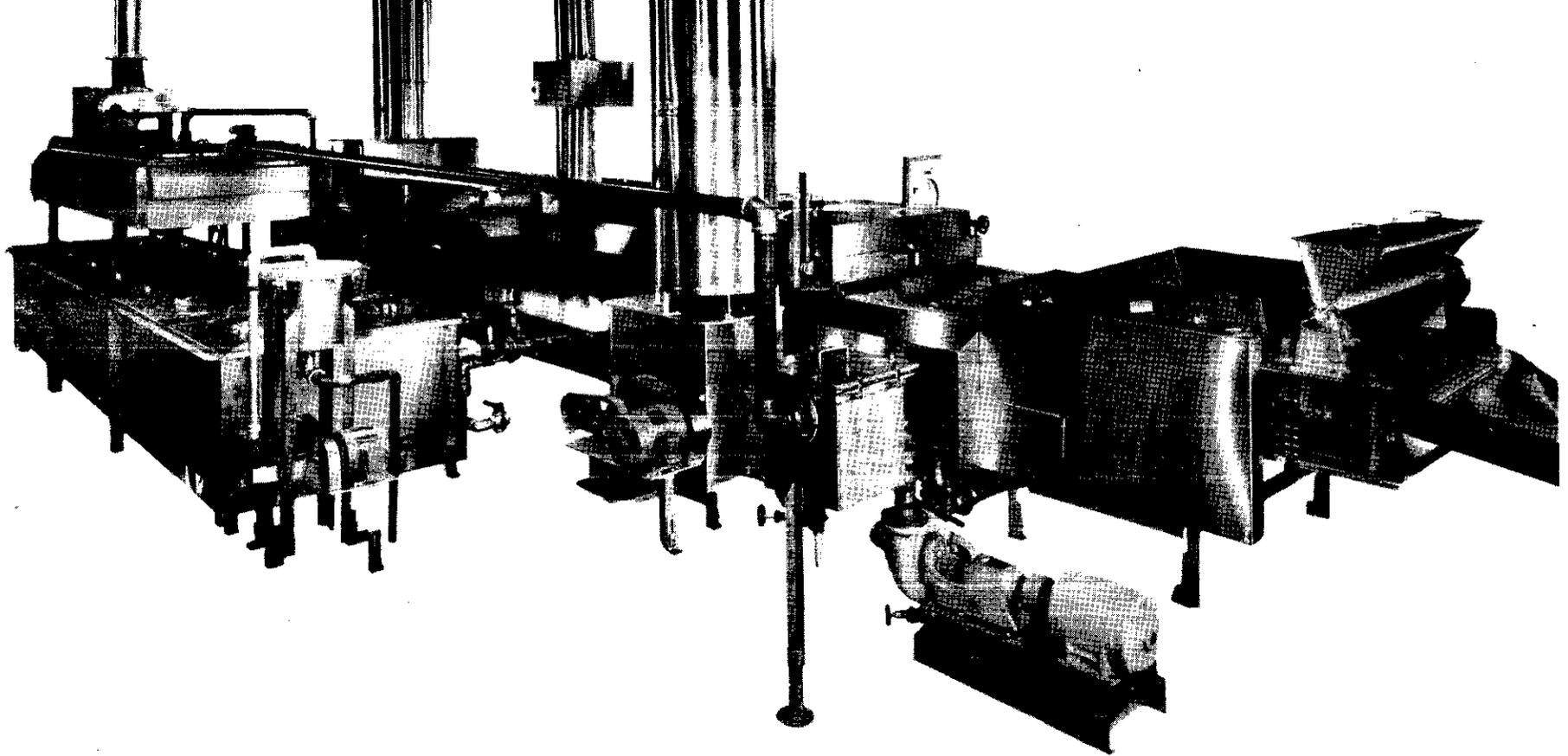
1. Marine Products of Commerce
Tressler, D. K. and Lemon, J. McW. 1955, 800 pp. \$20.00
Reinhold Publishing Corporation
430 Park Avenue, New York 22, New York
2. The Freezing Preservation of Foods Volume 1, 3rd. Edition
Tressler, D. K. and Evers, C. F. 1957, 1214 pp. \$18.00
The Avi Publishing Company, Incorporated
7 Taylor Place, Westport, Connecticut

The publications listed below can be obtained from the United States Fish and Wildlife Service, Washington 25, D. C.

3. Refrigeration of Fish - Part Two. Handling Fresh Fish
Fishery Leaflet 428, 1956, 84 pp.
4. Refrigeration of Fish - Part Four. Preparation, Freezing and Cold Storage of Fish, Shellfish and Precooked Fishery Products
Fishery Leaflet 430, 1956, 124 pp.
5. Federal Specifications for Fishery Products
Separate No. 411, 1955
6. Available Publications on Fisheries
Fishery Leaflet 9
7. Bibliography of the Preservation of Fishery Products by Freezing
Fishery Leaflet 265

The publication listed below can be obtained from the Publications and Technical Services Branch, Agency for International Development, Washington 25, D. C. and Missions.

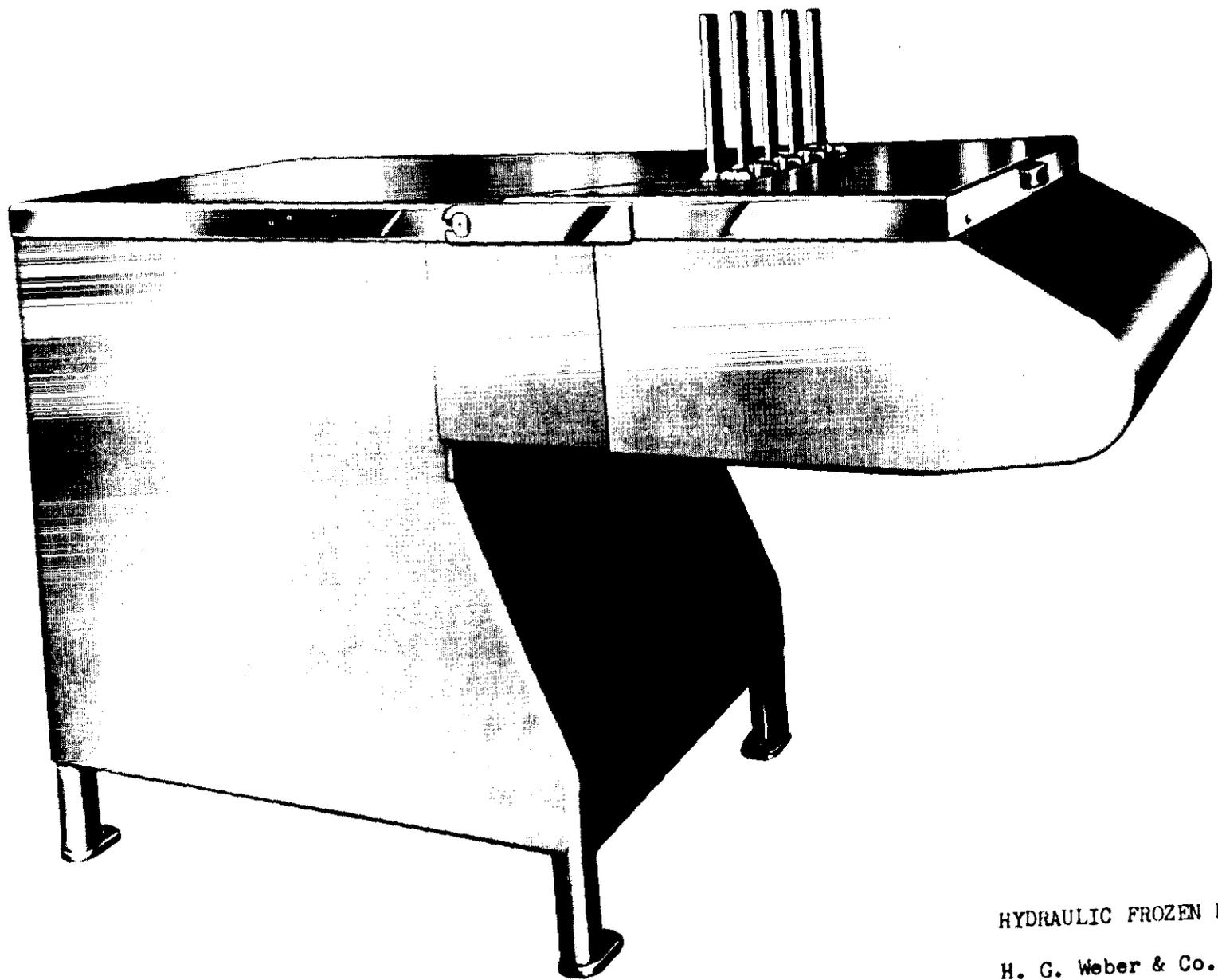
8. Food Processing Feasibility Study
Code No. ID-14



MACBETH POTATO CHIP FRYING MACHINE, SHOWING
COOKING OIL STORAGE TANK, AND MACBETH
AUXILIARY HEAT GENERATOR MOUNTED OVER
COOKING OIL STORAGE TANK.

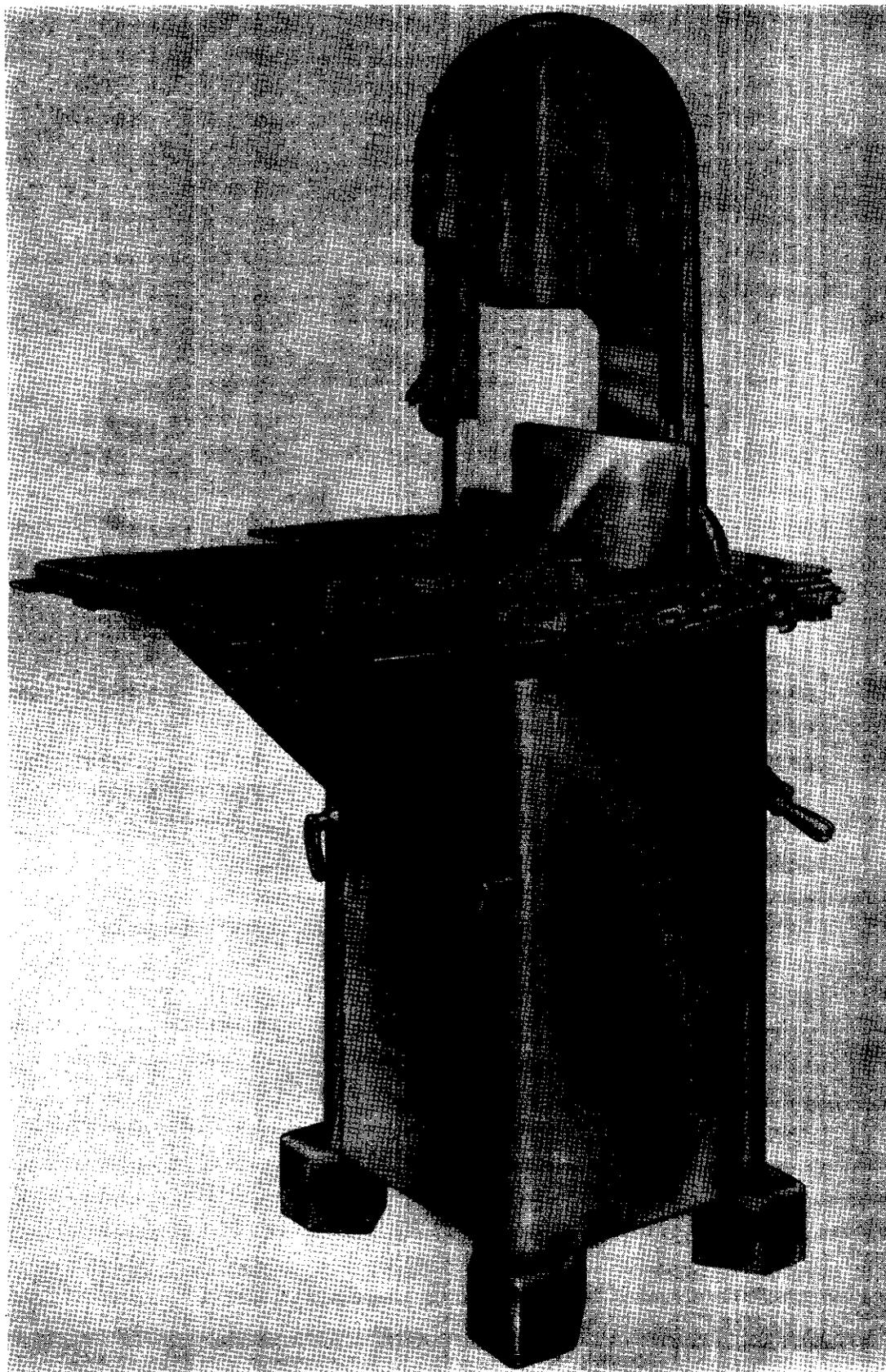
MacBeth Engineering Corp., Harrisburg, Pa.

THIS MACHINE IS USED FOR FRYING SEAFOOD



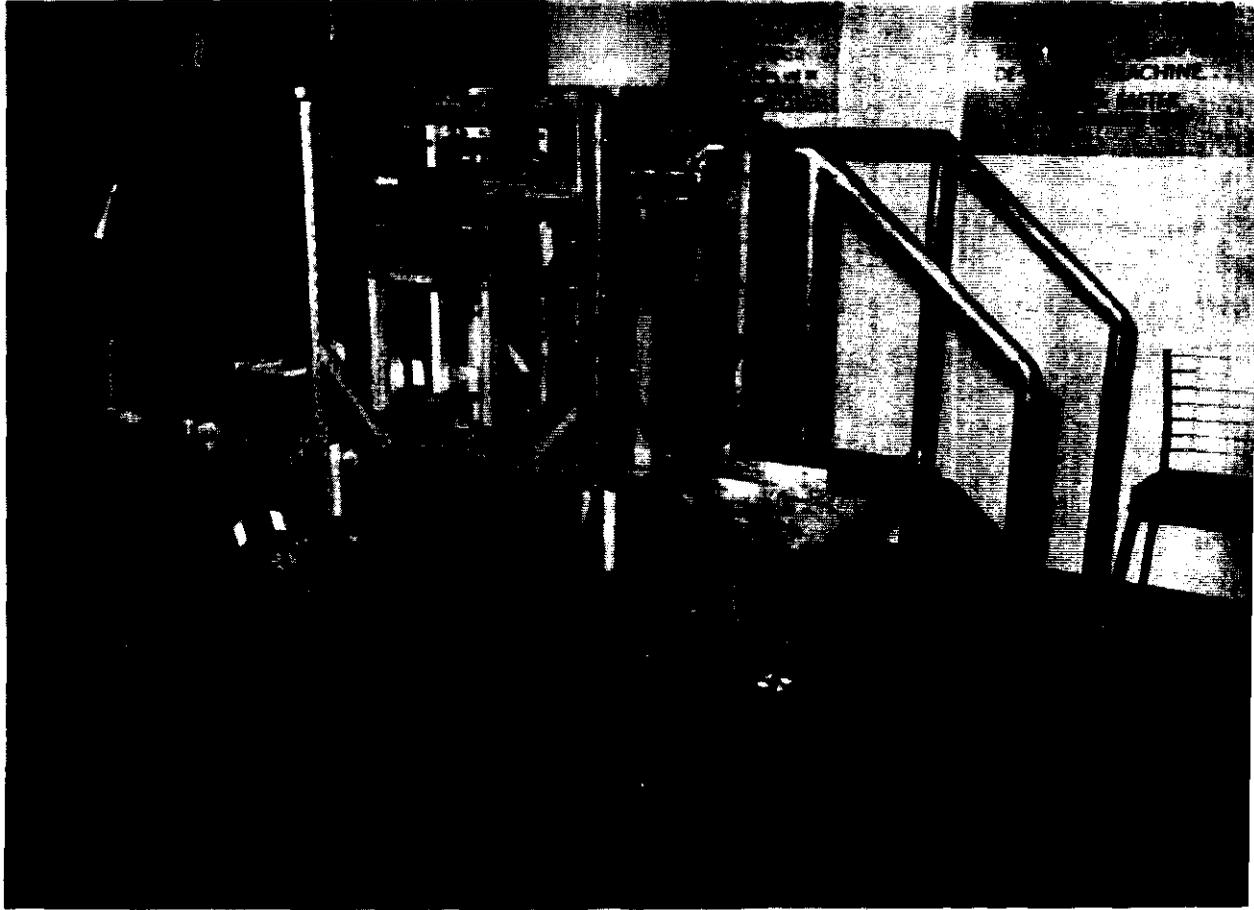
HYDRAULIC FROZEN FOOD SLICER

H. G. Weber & Co.
Kiel, Wisconsin



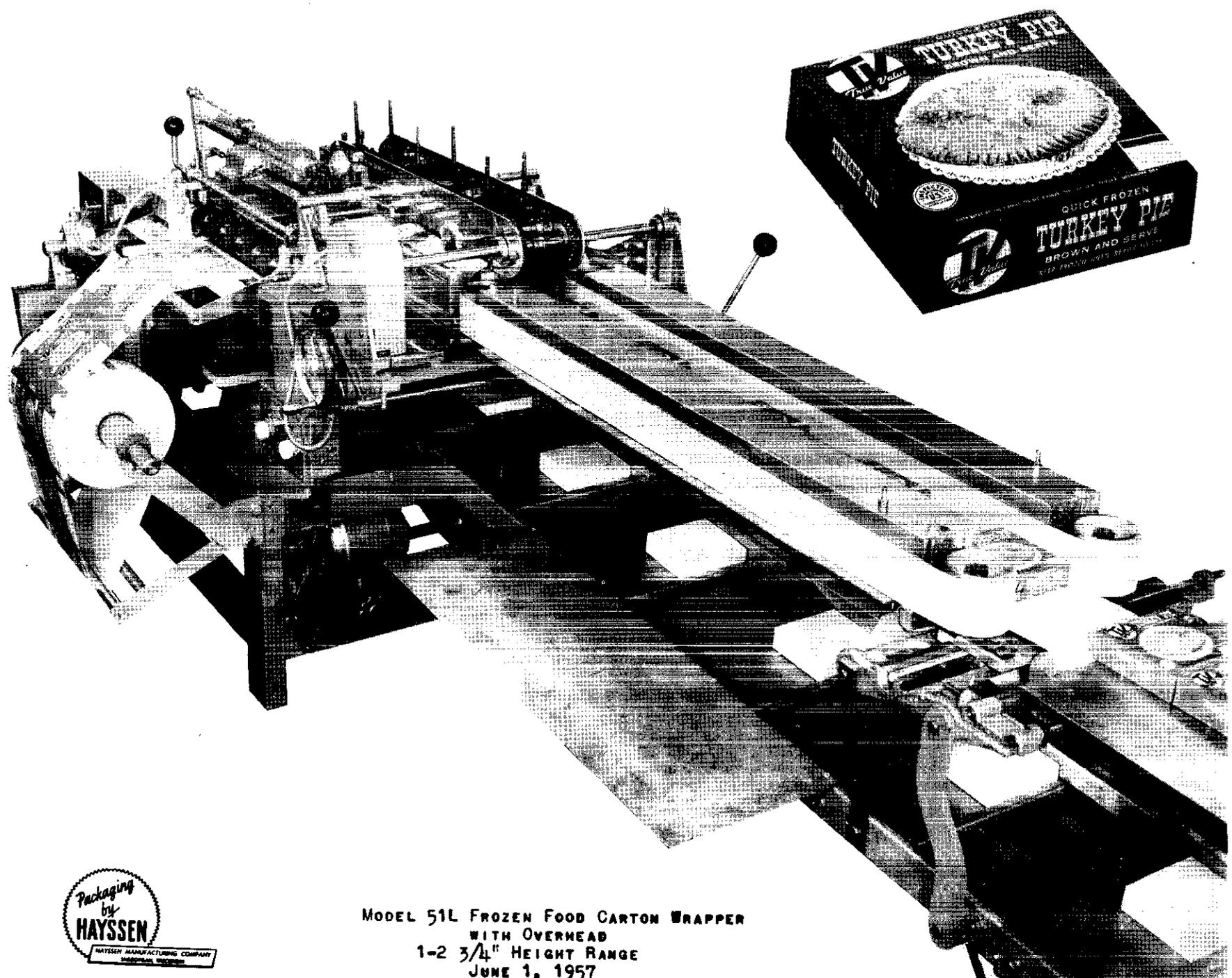
BAND SAW

The Biro Manufacturing Company,
Marblehead, Ohio



Shrimp Deveiner and Peeler

Gregor Jonsson Associates
Highland Park, Illinois



MODEL 51L FROZEN FOOD CARTON WRAPPER
WITH OVERHEAD
1-2 3/4" HEIGHT RANGE
JUNE 1, 1957

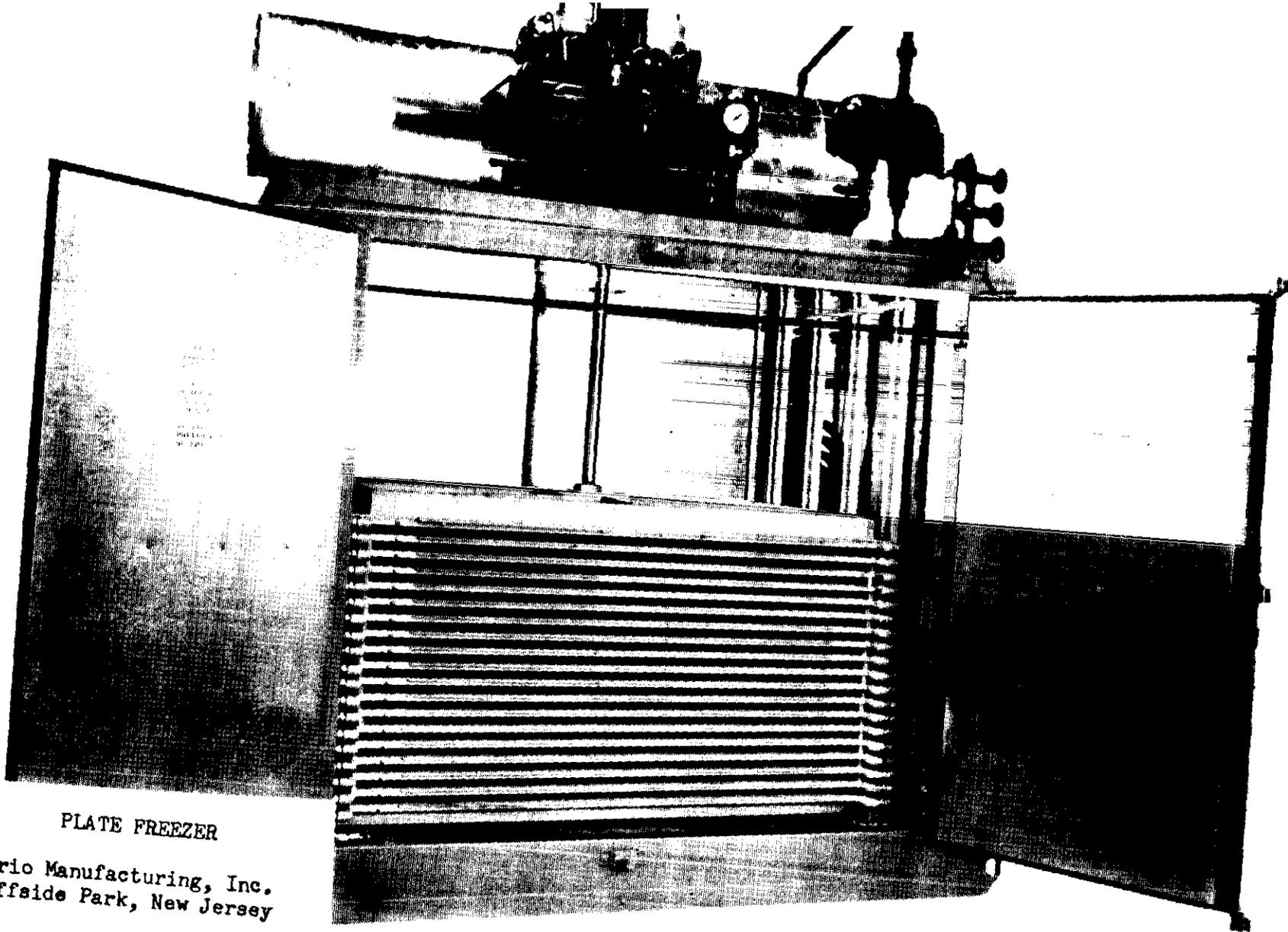


PLATE FREEZER

Americo Manufacturing, Inc.
Cliffside Park, New Jersey

SUGGESTED LAYOUT FOR PROCESSING FROZEN SEAFOOD

