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PEELING OF TOMATOES FOR CANNING

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Contents

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1.0 Introduction

The tomato canning industry in Ontario is a viable sector of Canadian food processing, however, several aspects of this industry warrant study. The production of high quality, whole canned tomatoes is probably the most economically attractive area, when compared with juice, soup or concentrate production, however, it is also the most labour intensive segment, and produces considerable waste which must be removed.

The peeling and coring operations in producing canned tomatoes need consideration. Most plants are now having difficulty finding adequate labour to operate their conventional peeling and coring lines. Hand operations of peel separation, coring or trimming require a large labour force and place the processor in a strong economic squeeze. Mechanization of the operations also has problems, for example, the greater waste handling problems introduced with chemical peeling.

Canadian standards for the quality of whole canned tomatoes are quite high, with skin allowed in a 20 oz. can being 1/4 sq. in. for Canada Fancy, 1 sq. in. for Canada Choice and up to 1-1/2 sq. in. for Canada Standard (Canada Agricultural Products Standard Act). In the U.S. grade A may have up to 2 sq. in. of peel in any single container up to 2 lb in size (The Almanac, 1973). The small amount of peel which is allowed in Canadian products increases the production difficulties.

The objective of this study was to consider some of the possible alternatives to the conventional lye or steam peeling of tomatoes. With this objective in mind several plants in California were visited and some pertinent literature reviewed.

2.0 Summary of Plants Visited

2.1 Ontario

During the canning season of 1972 three plants operated by Canadian Canners were visited to observe their peeling operations. Mr. Wayne Donders of Canadian Canners guided the author and Dr. W.P. Mohr of the Agriculture Canada Research Station at Smithfield, Ontario, through the plants. Three different peeling systems were seen.

Pyramid Canners - Leamington, Ontario

Pyramid Canners is one of the plants operated by Canadian Canners Ltd. The plant was operating on H-1350 tomatoes flumed from bulk wagons to the line. Production was primarily whole pack and juice.

This plant used Fox[a] lye peelers with a lye concentration of 18 - 19% and an exposure time of 30 sec.

The general layout of the Fox system is seen in Fig. 1 as taken from the manufacturer's literature. The tomatoes are conveyed through the lye tank between two belts. The tomatoes then pass along a "reacting conveyor", over skin slitters and under a water spray before entering the peeling drum. The rotating peeling drum is roughened inside to remove peel. This drum is also equipped with water sprays. Steel rods extending from the end of the drum provide for separation of the tomatoes from the spray water and skins.

From the peeling cylinder, the tomatoes enter a rotating rinse tank where the remaining peels are removed.

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[a] Chisholm-Machinery Sales Ltd., Niagara Falls, Ontario.

A small amount of sorting of the tomatoes entering was performed at this plant, however, only a limited amount was removed and the rest went for peeling.

A wetting agent such as Faspeel or Tergitol was used in the Fox system.

Canadian Canners - Amherstburg

This plant is the smallest of the three Canadian Canners plants visited. Tomatoes are water flumed from bulk wagons to the processing line. The plant packs whole or stewed tomatoes, juice and ketchup. Only about 1/3 of the incoming tomatoes were used for whole and stewed tomatoes, and that 1/3 was selected by hand from the main incoming belt for feeding the peeling line. In this way only the best quality fruit was directed towards the peeling line.

The plant used FMC[b] lye peeling equipment which had been in operation about 20 years, and which still functioned quite efficiently. In the FMC equipment the fruit enters on a stainless steel conveyor which was equipped with many cups. Four to six women orient the tomatoes in a stem-down position in the cups. The tomatoes then pass under a hot caustic spray, through a holding section and into a water rinse. The fruit is then mechanically cored from underneath while the calyx spot and skin are spun off from above. This equipment appeared to work quite well with the sound, whole fruit being used at the plant. Some hand trimming was being used in the plant but not to the extent of that used at Pyramid Canners

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[b]Food Machinery Corp., Canning Machinery Div., P.O. Box 1120, San Jose, California 95108.

Canadian Canners - Dresden

This was the largest of the Canadian Canners plants visited and was the only plant using steam peeling in place of lye peeling. This plant was packing whole tomatoes, juice, ketchup and soup.

For peeling the skins are loosened using steam and the core and peel manually removed. The Dresden plant used five peeling lines each with about 25 - 30 people doing the coring and skin removal. The manager of the plant felt the system was quite efficient as long as adequate good labour was available. The Dresden plant used West Indian men for operating the night shift lines and local women for the day shifts.

One factor with the steam peel line is that the peels and cores can go to a finisher and be added to other strained products such as ketchup or soup.

2.2 California plants

Two plants were visited in California in August 1972 where a large number of tomato products were being processed. Yields in California are high with an average of near 24 tons per acre. Transport to the plants is commonly in gondola transport trucks each with a 40' long 3' - 4' deep fiberglass bin. The tomatoes processed are mainly of the coreless Roma types although some of the core type are processed as well.

Tilley-Lewis Foods - Stockton, California

The Tilley-Lewis plant was large by comparison with the Ontario plants visited. This plant used a lye peel system with a combination of an abrasive drum, water spray and rubber chutes or tubes to separate the skin from the fruit. After the tomatoes pass through the rotating abrasive drum they drop through vertically hanging rubber tubes which tend to pull any remaining skins off.

More skin is left on the fruit, in general, than is allowed by the Canadian Grading Standards.

Stanislaus Foods Ltd. - Modesto, California

This food processing plant was operating two types of peeling lines for a capacity of nearly 30 tons per hour. The first type was a conventional lye peeling line but equipped with a water spray system for peel removal. Two lines of this type were operating. The second line used a Magnuson system for peel removal following the lye peel. The plant was running this unit with some additional water sprays not recommended by the manufacturer. This line was processing about 15 tons per hour which was higher than the 11 tons per hour suggested by the manufacturer.

The soft fruit Magnascrubber seemed to do quite an effective job of peel removal although this probably could have been improved if the manufacturer's suggestions on throughput and water sprays had been followed. The single Magnascrubber was handling about the same number of tomatoes as two of the water spray peel removal units, and doing a more effective job.

3.0 New Peel Removal Systems

Most peel removal systems in use involve hand removal, water sprays, rubber sleeves, abrasive drums and so on. There are, however, newer systems on the market which appear to be based primarily on the work of Hart (1970) of the U.S.D.A. at Berkely, California.

The system developed by Hart and associates is based on removal of the peel from the fruit using a series of interleaved soft rubber discs which are mounted on driven stainless steel shafts. After lye treatment the fruit is conveyed across the rolls and the rubber discs strip the peel from the fruit. In the original U.S.D.A. system the discs were rapidly rotated. The shafts were mounted parallel and formed a flat bed over which the fruit was conveyed. Their initial pilot plant unit could peel 1 to 2 tons per hour. The developers particularly pointed out the lower water usage and the reduced BOD loading produced per ton of product peeled.

Magnuson Engineers[c] adapted the soft fruit peeling rolls of the U.S.D.A. to fit their dry caustic potato peeling system. The "Magnuscrubber" unit has 16 of the soft fruit rolls located in a rotating cage. The roll cage is surrounded by an outer drum which also rotates.

In operation the tomatoes (or other fruit) are treated with lye to loosen the peel, rinsed and fed to the scrubber. Tomatoes can be fed over a skin slitter to make certain no fruit with complete skin envelopes enter the scrubber. Once in the scrubber the fruit is conveyed over the rotating rolls, and the loosened skin is stripped from the fruit and thrown onto the outer drum. A conveyor/scraper removes the peel residue from the rotating drum for removal as waste, or in some cases further treatment for animal feed.

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[c]Magnuson Engineers Inc., 1010 Timothy Drive, San Jose, California 95133.

A prototype using a similar type of roll has been used by Gangi Bros. Packing Co. (Gangi et. al. 1973). This unit is the FMC model SV tomato dry washer. The peel removal unit is 4 ft wide and 10 ft long and slopes 3 degrees in the direction of travel. The tomatoes flow over a series of interleaved soft rubber discs which rotate in the direction of travel. The rubber discs wipe the lye loosened skin from the tomatoes. A series of mist nozzles spray a small quantity of water onto the tomatoes. This unit appears to be very similar to the original unit constructed by the U.S.D.A. (Hart 1970) except for the slope on the unit and the direction of rotation of the discs. In the U.S.D.A. unit the fruit flows in the direction opposite to the rotation of the discs. No extra conveying devices are used to carry or retain the fruit over the peeling rolls. The reduced usage of water when compared with the use of pressure sprays in the peeling is pointed out as a major advantage. The users of this machine claim to have up to 25 tons per hour throughput with at least the same efficiency as their previous high pressure spray system. They feel that the system is easier on the product than the high pressure spray system.

While both the Magnuson and FMC systems are claimed to be effective for either round or coreless type tomatoes, the problem of applying them to the conventional core type tomato used in Ontario still exists. The Canadian Standards call for not more than 1/10 oz. of core material in a 20 oz. can.

4.0 Peel Loosening

4.1 Lye

Systems using lye for skin loosening are very common in the tomato industry and will not be considered in general. One aspect which should be mentioned is that of the "dry lye" peel systems. This type where a short immersion in lye followed by an infra red heating period has proven effective for root crops and also for some soft fruit.

Efficiency in a lye peel operation depends on the control of lye strength, immersion times, peel removal methods and pre sorting of the tomatoes. The presence of cracked and broken fruit results in less efficient use of the lye because of the release of the acidic fruit material into the lye.

Mechanical peel separation is still required as is coring and trimming. Waste loading tend to be high and peel cannot be recycled into the finishers.

4.2 Calcium chloride

Interest has been shown by several workers in the use of hot $CaCl_2$ brine in place of water or steam for scalding tomatoes. In 1948 Childs (cited in Stephens 1973) patented a process for peeling tomatoes in hot $CaCl_2$. Heddins and Burns (1964) compared hot water, NaOH and $CaCl_2$ peeling. The tests used various salt concentrations and temperatures for immersion times of 10, 20 and 30 sec. The water treatment used a boiling water immersion for 90 sec. Heddins found improved color and firmness in the $CaCl_2$ peeled tomatoes. He does not comment on the comparative peel removal between NaOH and $CaCl_2$, but it should be noted that he does not include "iso-peel" lines for above 80% skin removal for $CaCl_2$, whereas he shows "iso-peel" lines for 100% skin removal using NaOH.

Stephens (1967) et. al. found that tomatoes peeled with $CaCl_2$ and packed with juice from tomatoes peeled in $CaCl_2$ exceeded the FDA limits for calcium salts. $CaCl_2$ peeled tomatoes canned with juice from water peeled tomatoes were acceptable for calcium salt levels. Another problem pointed out was the development of a burned sugar smell in the peeling brine which was imported to the tomatoes. This was due to carmelization of dissolved solids from the tomatoes and would be particularly troublesome with field run tomatoes including any split or broken fruit.

Stephens et. al. (1971) compared peeling methods for improving firmness of canned tomatoes. They did not find any significant differences in the drained weight of $CaCl_2$, hot water or nitrogen peeled salad pack tomatoes. When no additional calcium salts were added to the pack, the $CaCl_2$ peeled material was firmer than the water or LN_2 peeled product. Adding calcium salts to the pack increased the firmness of the LN_2 and water peeled product so that for the Chico variety no significant differences were found in firmness.

Stephens et. al. (1973) studied the effects of submergence time in the $CaCl_2$ peeling solution on the degree of peeling and uptake of calcium for four varieties. The degree of peel was in excess of 90% for immersion times of 35 to 40 sec in the boiling 42% $CaCl_2$ solution. They noted that the fruit became more difficult to peel as the season progressed. In three of the varieties when the peel removal reached or exceeded 90% the level of calcium in the pack exceeded the allowable limits.

4.3 Freeze Peeling

Several workers and companies have studied the use of freezing as a means of loosening the skins in tomatoes in place of lye or hot water treatment.

Some of the early work was performed in Italy (Cagnoni, 1955). More recent work has been done in the U.S.

Freeze peeling involves freezing the subcutaneous layer, thawing and then removing the skin. Freezing has been performed using various cooling media including chilled brine, freon and liquid nitrogen. The duration of freezing is quite short. Cagnoni (1955) used a 20 - 30 sec dip in chilled bine at -10°C while Brown (1970) used a 20 sec submergence in liquid nitrogen. Thawing of the frozen subcutaneous tissue loosens the peel. A thaw time of 7 - 10 min was used by Cagnoni, whereas a 30 sec thaw in water at 20 - 30°C was used by Brown.

Freeze peeling appears to offer some very attractive features. As opposed to other methods of skin loosening, no heating is involved which should result in a firmer product. Tomatoes which had been peeled in liquid nitrogen seen in California were of very good color as peeling did not expose the vascular bundles to the same extent as lye peeling. A tangible advantage of using a system based on liquid nitrogen peeling would be the reduced pollutant loading. Lye systems involve quite a large volume of liquid which must be treated and disposed of. Freeze loosened peel could probably be fed back to a finisher and utilized to at least a certain extent, as is done with some steam peeled material.

Experimental pilot freeze peeling of tomatoes has been undertaken in California by Magnuson Engineers, University of California at Davis and the du Pont Company. Initial studies were undertaken by the University of California in 1972, however, no figures have been released on peeling efficiency, losses or costs. During the 1973 processing season a pilot line was operated at the California Canners and Growers plant in San Jose, California.

This system used a du Pont freon freezer, a steam chamber and a Magnuson peel remover. This line operated at between 500 and 1000 lb/hr. As with the University of California work, no figures have been released by the companies involved. Comments from Anderson (1973) and Corby (1973) pointed out some of the difficulties encountered. While peeling was accomplished, it was considered to be only fair. Problems arose with blemished tomatoes, with difficulty in removing peel from blemishes and sun spots. To remove skin from blemishes it was necessary to increase the freezing which in turn increased peeling losses. In general the peel removal was considered too low to be commercially feasible at this stage. Corby (1973) felt that the freeze peeling system was at about the same level of development as brine peeling. The freeze peel pilot line may be operated experimentally again during the 1974 processing season.

Trials conducted in California used the coreless type typical of that region, however, for application in Ontario where core type predominate, an additional coring step would be required. This would of course affect the economics of a freeze peel system as coring and trimming would still be required to reach Canadian grading standards.

A trial system using liquid nitrogen was operated in Italy (Temple, 1973). Their test, using 100 tons of tomatoes, required the utilization of about 0.2 lb. of nitrogen per lb. of tomatoes processed. Operational costs would depend on the quantity of LN_2 used but would probably be between $10 and $16 per ton of tomatoes.

5.0 Summary

Peel removal system based on the USDA soft fruit rolls seem to be quite suitable for use with tomatoes of the coreless type. Problems must be anticipated in the application of these units to core type tomatoes if the Canadian grading standards for the presence of core material are to be met.

Both the Magnuson and FMC peelers are of the USDA type. Operation of the Magnuson at a throughput of about 11 tons per hour shows very good peel removal. FMC machines have not yet been seen in operation.

While both hot $CaCl_2$ and freezing methods have shown considerable promise in the laboratory for peeling tomatoes, neither have yet made a successful transition to industrial use. Problems with the hot $CaCl_2$ brine peel seem to be in peel loosening efficiency and on carmelization of solubles from the tomatoes in the hot brine. Pilot trials on freeze peeling of tomatoes in California have not proven to be industrially feasible. While freeze peeling is certainly a possible method with some certain merits, it is not yet practical. The advantages of lower waste loading, and the fact that peels and trimmings can be cycled through a finisher for addition to other strained products may become more important in the near future. The problems arising from difficulty of removing peel from sun spots and blemishes might be partly overcome by better sorting of material entering the line.

6.0 Recommendations

While freeze peeling systems have not yet proven feasible, contact with Mr. John Corby of du Pont in Wilmington, Delaware should be maintained. If further work is done by this company in their demonstration system during the processing season of 1974, it would be very useful to see the system in operation and to obtain at least summaries of their appraisal of the economics of the system.

The use of calcium chloride peeling does not seem to offer to great a hope. The very high temperatures with their carmelization problems and the lower efficiency of peel removal compared with lye combined with the variability and levels of calcium pickup create difficulties which preclude any recommendation for further studies on this method in Canada. The literature should be kept up to date in this area to ascertain if any new findings suggest reconsideration of this method.

Problems of peeling tomatoes in the small and intermediate sized canneries have been raised with Dr. W. Mohr at Smithfield. In his area most of the canneries are of a relatively limited capacity and are having labour shortages. The establishment of a small pilot line to demonstrate peeling systems at Smithfield could be very useful to the canners in that area. If a small pilot line were established at Smithfield, there would be a good opportunity to study the problems of peel removal applying the USDA type soft fruit rolls to the Ontario core type tomatoes. A pilot facility at Smithfield would facilitate studies which would be useful to the Ontario tomato processing industry in general. Areas which could be considered for research in the facility would include:

1. usefulness of USDA type soft fruit rolls to peel removal from core type tomatoes, particularly to ascertain if labour reductions could be achieved.
2. application of freeze peeling to core type tomatoes, particularly for ease of peeling and efficiency of peel removal.

7.0 References

1. Anderson, R. 1973. Personal communication. Magnuson Engineers Inc., San Jose, California.
2. Brown, H.D. and C. Murnane. 1944. The explosion vs. usual method of peeling vegetables and fruit. Proc. Am. Soc. Hort. Sci. 44, 190 - 192.
3. Brown, H.E., F.I. Meredith, G. Saldana and T.S. Stephens. 1970. Freeze peeling of improved quality of tomatoes. J. Food Sci. 35, 485 - 488.
4. Cagnoni, D. 1955. Il freddo e l'industria dei pelati di pomodoro. La Ricerca Scientifica 25 (3), 519 - 520.
5. Cagnoni, D. 1955. Sbucciatura neccanica del pomodora a mezzo del freddo. La Ricerca Scientifica 25 (5), 1115 - 1120.
6. Calcagno, F., E. Garcia and K. Robe. 1968. Increases peeling tonnage 50%; reduces floor space to 1/3. Food Processing, Dec. pp 38 - 39.
7. Canada Agricultural Products Standards Act. Processed Fruit and Vegetable Regulations.
8. Corby, J. Personal communication. du Pont Co., Wilmington, Delaware.
9. Gangi, A.R., A.G. Gangi and K. Robe. 1973. Dry washer lowers water use from 250 - 300 gpm to 8 gpm. Food Processing, April, pp 40.
10. Hart, M.R., R.P. Graham, C.C. Huxsoll and G.S. Williams. 1970. An experimental dry caustic peeler for cling peaches and other fruits. J. Food Sci. 35, 839 - 841.
11. Heddins, G.C. and E.E. Burns. 1965. Chemical peeling of tomatoes. B-1046 Texas A&M University, Agricultural Experiment Station.
12. Herman, D.L. and J. Russo. 1967. Reduces hand-trimming of tomatoes two-thirds. Food Processing and Marketing, January, pp 80 - 81

13. Juven, B., Z. Samish and A. Ludin. 1969. Investigation into the peeling of tomatoes for canning. Israel J. Technol. 7 (3), 247 - 250.

14. Mohr, W.P. Personal communication. Agriculture Canada, Smithfield, Ontario.

15. Saldana, G., F.S. Stephens, H.E. Brown and F.P. Griffiths. 1971. A comparison of peeling methods to improve firmness in canned seasoned salad pack tomatoes. J. Rio Grande Hort. Soc. 25, 72 - 78.

16. Stephens, T.S., G. Saldana, F.P. Griffiths and H.E. Brown. 1970. Refrigerated storage properties of liquid-nitrogen peeled fresh tomatoes. J. Rio Grande Valley Hort. Soc. 24, 134 - 138.

17. Stephens, T.S., G. Saldana and F.P. Griffiths. 1973. Effects of different submergence times in hot calcium chloride on peeling efficiency of tomatoes. J. Food Sci. 38, 512 - 515.

18. Stephens, T.S., G. Saldana and F.P. Griffiths. 1967. Peeling tomatoes by submerging in a hot solution of calcium chloride. J. Rio Grande Hort. Sco. 21, 114 - 124.

19. Temple, G. 1973. Personal communication. Formerly with Canadian Liquid Air.

20. The Almanac of the Canning, Freezing and Preserving Industries. 1973. Edward E. Judge & Sons Inc., Westminster, Md. 21157, p. 349.

21. Willard, M.J. 1971. Infrared peeling. Food Tech. 25, 125 - 127.

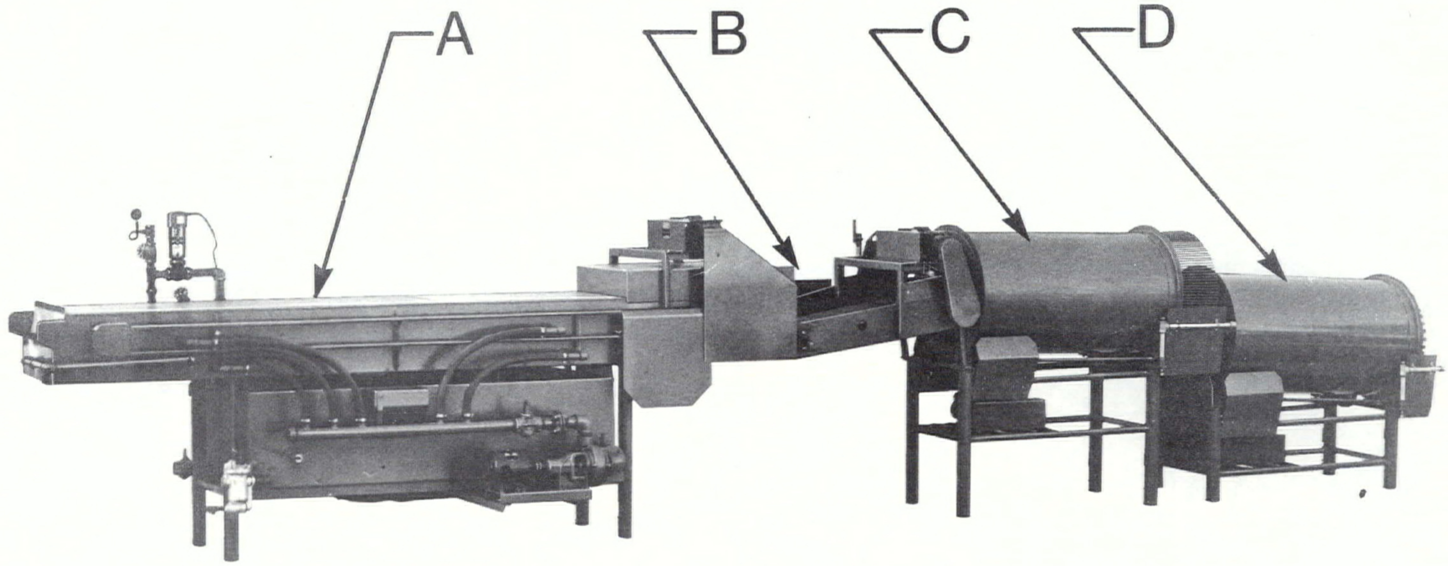

Figure 1. Fox lye peeling system. A. Caustic bath; B. "Reaction" conveyor; C. Peeling cylinder; D. Rinse cylinder.

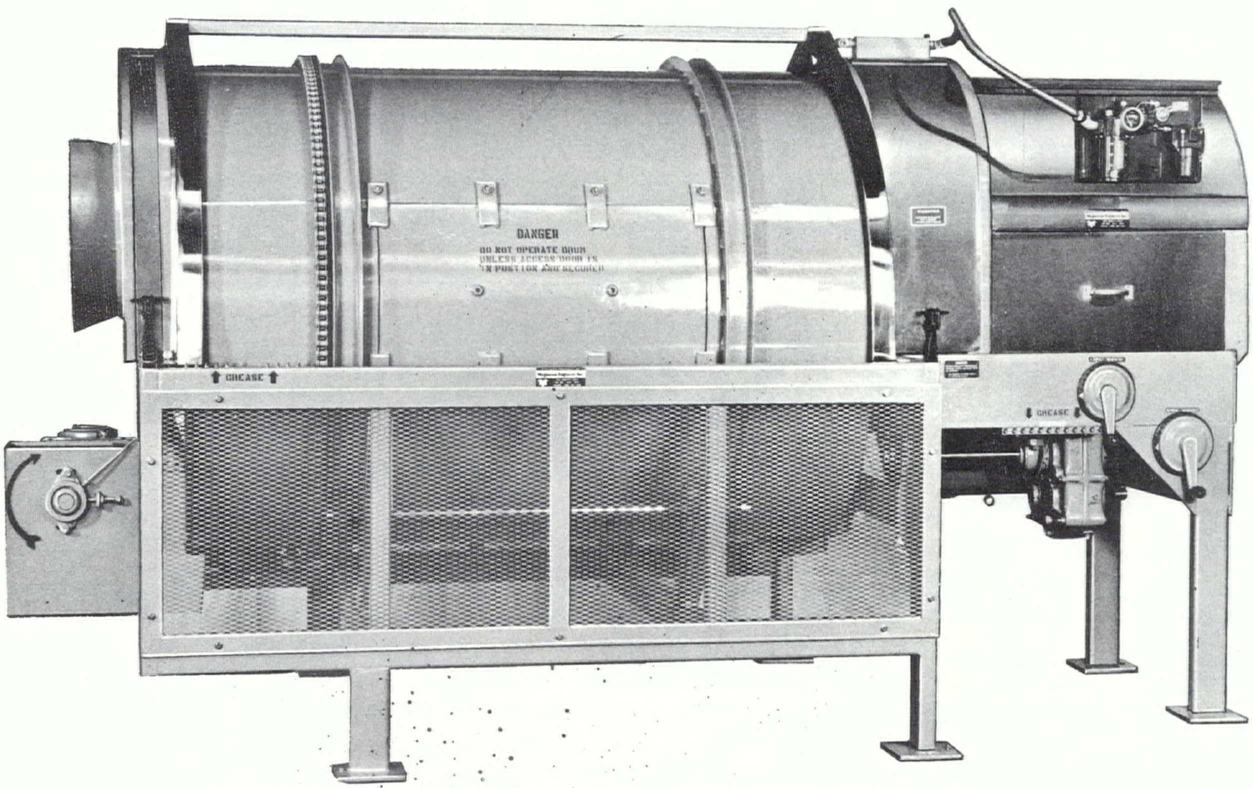

Figure 2. Magnuson peel removal unit.