a food mixer design HERMAN HEIDT



THE DESIGN OF A HOUSEHOLD FOOD MIXER

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THESIS BY-----HERMAN HEIDT

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- A HOUSEHOLD FOOD MIXER design has been created and developed for a mass market. A market analysis was conducted to ascertain controlling market factors for design consideration. It indicated that the foodmixer industry is highly competitive and composed of high caliber firms. Successful economics of the industry demands a mass production policy. The estimated national retail mixer sales for the period beginning July, 1947, and ending July, 1948, is 2,000,000 mixers at a retail value of \$60,000,000. A product research was conducted to define the function of a household food mixer and to evaluate competitive mixer design features. It indicated that the motor design, the speed control system, and the gear transmission, are the determining factors in establishing a desired retail selling price. A consumer research evaluated the housewife's wants in a food mixer. These points were tabulated and studied with the findings of the market analysis and the product research to establish the primary design considerations for the solution.
- The DESIGN SOLUTION has been directed toward the 90 percent of the potential market desiring an all-purpose mixer. It consists of a mixing unit with an integral mechanical bowl clip, one large size mixing bowl with cover, a two-blade mixer, and a disc-type whipper. With these four basic parts any kitchen mixing, whipping, or stirring job can be done easily and efficiently. Since a bowl is necessary to hold the ingredients, there are only two parts involved in any operation: the mixing unit and a beater. There is no heavy stand to arrange, clean, or put away. The mechanical bowl clip is designed to offer secure mounting on any metal bowl or pan in the kitchen. Provision for parking the mixer on its heel is featured to make the unit readily accessible and encourage more frequent usage.

A specially designed planetary mixing action, plus pitched beater blades, gives completely automatic mixing and bowl scraping in the featured stainless steel mixing bowl. By providing a copper-plated bottom, and a cover, the bowl is available for any other cooking task as well as mixing. Efficient whipping and stirring is achieved in various depth bowls with the new adjustable length whipper. Rapid identification on the sales floor, or in the kitchen, is realized by the absence of the conventional stand and the protruding, chromium-plated transmission cover. The design is readily applicable to the characteristic sub-contracting production proceedures used in the food mixer industry. The rich color scheme in white, grey, and chromium, gives fresh consumer appeal. The over-all appearance of the design suggests efficient food handling. Its adaptability to new cooking tasks is a long step toward definition as a necessity type item. Therefore, it justifies \$50 of the housewife's operating budget.

PROBLEM

The problem is the design of the basic mixing unit of a household food mixer for mass consumption. A juice extractor and the various other accessories offer separate distinctive problems. They will only be developed in as much as they affect the basic unit.

APPROACH

The investigation began with an extensive market analysis to establish the domestic food mixer market condition. Knowing the market condition, a product research was conducted to establish the function of a mixer; to analyze existing brands; and to evaluate new technical developments in materials and processes. Simultaneously, a compilation of consumer wants in a food mixer was developed through consumer research. At this point, a careful study of research data ascertained distinctive trends in mixer production and marketing. The research findings were applied in numerous design suggestions. These suggestions were carefully evaluated to evolve a best design. This selected design was then developed, and a practical production and marketing policy drafted.

ACKNOWLEDGEMENTS

I wish to acknowledge my indebtedness to the faculty members of the Industrial Design department for their guidance and consultation; and to my fellow graduate associates for their continual help and criticism. I express sincere thanks for the expert advice and willing cooperation received from the numerous members of the food mixer industry, manufacturing managements, and research departments.

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SUBJECTPAGEApproach.7Product and services.7Markets.8Marketing policies and methods.10Competition.11Sales promotion.12Sales performance.13Distribution channels.14Estimated 1947-1948 market condition.15

APPROACH

To effectively analyze the market for household food mixers, the market research was divided into the following categories:

product and services markets marketing policies and methods competition sales promotion sales performance distribution channels

Each of these seven research categories will be discussed seperately in this report and followed by a quick-reference resume of the estimated 1947-1948 market condition.

PRODUCT AND SERVICES

The electrical food mixer for household use was introduced in the early thirties. It was a development of industrial food mixing apparatus and introduced by the manufacturers of industrial equipment. Public acceptance was favorable. However, the function of the food mixer at that time did not justify \$20 of the household operating budget. Therefore, the mixer was promoted as a gift item. To establish a market trend toward a necessity type item, the design was strenghened through the appeal of accessories. These accessories lessened the importance of the numerous menial tasks of the kitchen. The accessories have not yet been favorably accepted in their entirety.

The mixer is manufactured on an assembly line basis. Usually a number of the various parts are obtained from other sources of supply than the manufacturers plant. These items are usually die castings, stampings, rubber cords, governors, and plastic handles made in accordance with the manufacturers specifications.

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The manufacturer offers repair services. Repair stations are located at key distribution centers.

Most existing models have been designed by an industrial designer.

MARKETS

The economics of the food mixer industry demands a mass production policy. This means national distribution to get proper sales volume. All mixers on the market today are distributed nationally, and some are exported in moderate quantity. However, in the following discussion the Southern California area will be used as a sample market area and estimates developed to use as a check point.

The national potential market today as shown by the Electrical Merchandising survey¹ is 40,015,000 consumers. This figure is based upon the total number of electrically wired homes of 31,015,000, and an estimated 9,000,000 families doubling, or living in apartments or hotels, who have access to electrical services. A survey by the Curtiss Publishing Company² shows that only 31.4 percent of this potential market has been reached. The survey also shows that 14.7 percent of the 40,015,000 American families intend to buy food mixers at an average price of \$25 within two years after the time postwar models become available. Of these purchases 10.9 percent will be for replacements and the other 89.1 percent will be new customers. These figures reflect the extent of pent-up demand created by the war and should be used with caution for 1948 volume estimates.

The potential market for the Southern California area is shown by the Electrical Merchandising survey¹ as 630,000 customers.

Since the average life of a food mixer is 8 years,³ it is evident that the

1. See bibliography in appendix

replacement market will be relatively small for some time, and sales effort will be directed to the larger volume of new customers.

As shown by the Scripps-Howard Newspapers 13-city survey,⁴ 34.9 percent of the highest income group owned mixers as compared to 9.9 percent of the low income group. These figures indicate that retail outlets should be most accessible to regions of medium and high income families. Using Southern California as a sample case the best potential markets would be in the following areas:⁵

Pasadena	Santa Monica
San Marino	Long Beach
Beverly Hills	Alhambra
West Los Angeles	Glendale
Hollywood	Burbank

From a study of regional consumer markets by the Office of Business Economics of the Department of Commerce,⁶ 1946, the best improved postwar areas are the Western and Southern states. This improvement is a direct reflection of increased income per-capita since 1939. The significance of the improved mass market condition in the South, is that the area is now a potential market for small electrical appliances such as the food mixer. Electrical power developments, such as the TVA, have further developed the market by supplying power to 50 percent of all families⁷ in that area. A higher population coupled with higher per-capita income of the West makes it the most attractive marketing region in the United States. Further information about "high-selling" areas is available through the Department of Commerce,⁸ Curtiss Publishing Company,² and Scripps-Howard Newspapers.⁴

Consumer demand at home has prevented development of foreign markets. In most foreign countries, markets will be problematical throughout 1947 and 1948, as a result of wartime activities. However, best potentialities are in Canada and South America.

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The market today is again a sellers market. The availability appeal has given away. The pent-up demand created by the war is well worn down.

MARKETING POLICIES AND METHODS



The industry is beginning the second phase of development. The drive to saturate the market comprises large scale advertising and extensive sales campaigns. The market is favorable for newcomers, but any new producer should be equipped to meet the stiff sales promotional campaigns of competitors.

An analysis of marketing policies existing producers use, shows a definite trend toward a more complete line. This is accomplished by introducing a new design as a deluxe model while selling the previous design as a standard model. This policy amortizes tooling and die costs while the design is sold as a deluxe. In this manner, a standard model at a substantially reduced price reaches a large volume of economy buyers.

The "fair trade" policy is used by all mixer manufacturers today. This policy of a fixed retail price is particularly advantageous to food mixer

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distribution. First, it provides an excellent coverage of an area through access to different types of distributors; from hardware to jewelry. Second, it provides more directed advertising for the dealer. A third advantage is an assurance of a fixed profit per sale to the dealer. However, the manufacturer's "fair trade" policy should be flexible enough to accommodate any dealer who cannot accomplish complete sale of an order.

The trend in sales policies is to sell the food mixer with a juice extractor as a single unit. This policy encourages sale of accessories since it permits the dealer to work up a deal with as many attachments as he desires.

COMPETITION

Competition is keen in the food mixer market. The economy and "knowhow" required to successfully produce a mixer have limited the field to high caliber firms. A composite directory of manufacturers is included in the appendix.

The percentage of the market held by leading manufacturers has been estimated from brand popularity. The estimates are based on the findings of Scripps-Howard Newspapers,⁴ Curtiss Urban Housing Survey,³ Industrial Design Associates,⁹ and the author. The listing below gives the five most popular brands with estimated percentage of market volume.

BRAND NAME	% OF MARKET
Sunbeam "Mixmaster"	
Hamilton Beach	18
General Electric	12
Dormeyer	11
Hobart "Kitchen Aid"	9

The geographic location of the manufacturer is only important insofar as it expedites build-up through local outlets at the time the manufacturer

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MARKET ANALYSIS

begins business. In this regard the location should be in a greater city market area. These markets can be studied at length from surveys by the Department of Commerce.⁸

SALES PROMOTION

All existing brands are advertised nationally by the manufacturer. The following magazine listing is favored to reach the housewife:

Womans Home Companion	Good Housekeeping
Ladies Home Journal	Farm Journal
Parents' Magazine	The American Home
Saturday Evening Post	Country Gentleman
Colliers'	McCalls'
Better Homes and Gardens	House Beautiful
Woman's Day	

To gain distributors and dealers advertising is through such trade journals as Electrical Merchandising.

Advertising services for the dealer include window and counter displays, newspaper mats, and banners for window, counter, or wall.

Good will established through advertising of a carefully selected brand name has proven very effective. An example is Sunbeam "Mixmaster". The name "Mixmaster" has been developed through good advertising to the extent that 50 percent of housewives refer to a food mixer as a "mixmaster".

There is a decided trend to offer a suggestive book of recipes with proper usage of the particular mixer. This jesture, of doing something in behalf of the housewife without charge, is well received and adds to the sales features desired by the dealer.

Accompanying the book of recipes is the endorsement of a popular name home economist to build prestige. Occasional feature articles by the home economist in the previously mentioned home magazines carry much good will.

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Frequent demonstrations by responsible home economists are sponsored by the manufacturer to extend usage of the unit. This educational activity is expensive, but delivers the best results toward reduction to a necessity type item.

The design features promoted on the sales floor should be directed to a particular income group. From consumer survey, it is evident that the ardent cook, usually of the middle income group, desires a rugged, more powerful design. A definite contrast is the "keep-up-with-the-Jones" housewife who desires the latest in aesthetic quality and attachment in-ovations. She normally buys through a more exclusive dealership.

It is quite evident that the overwhelming majority of buyers are women. Sales promotional efforts should be directed to favor her interests.

SALES PERFORMANCE

Fig. 2 below summarizes the last twelve years of national mixer sales in number and dollar value per year.¹

	NO. SOLD	RETAIL VALUE
1933	350,000	\$ 6,125,000
1934	413,753	7,100,000
1935	447,748	8,449,000
1936	not ava	ilable
1937	n	
1938	11	
1939	400,000	7,000,000
1940	460,000	10,120,000
1941	510,000	11,220,000
1942	306,000	6,732,000
1945	not ava:	ilable
1946	1,500,000	47,265,000

Note: There was no production during the war years 1943 & 1944.

Fig. 2

Despite the rapidly growing acceptance after its introduction, the mixer remained a luxury item. The moderate regressions during 1937 and 1938 are

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a positive reflection of the affect of consumer income. A comparison of mixer sales at retail value,¹ and individual disposable income,¹⁰ shows the mixer sales as an exaggerated effect of disposable income. This correlation affords a good check point in estimating the volume for the coming year.

The average retail price of the mixer has increased steadily from \$17.50 at the time of its introduction, to a present average price of \$32.00. This retail price of \$32.00 is partly the result of mechanical developments such as the speed control, and partly to rise in cost of labor and materials. Retail selling price is at a peak today. Since the average family spends $14\frac{1}{2}$ percent of its income for household operation, the existing price of \$32.00 seems quite favorable.

A large percentage of the market is still the gift market. The seasonal sales peaks during the Christmas holiday season and June are a reflection of these gift sales.¹¹ Gift sales importance indicates the need for higher performing, more functional design.

Interviews with distributors and dealers defined the following design features as the best points of sale:

wide speed control with full power high power new mechanical features simplicity of usage good brand name improved mixing system attractive appearance

DISTRIBUTION CHANNELS

The distribution channel showing the most success for food mixers is from factory, to sales representative, to distributor, to dealer, and

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then to the consumer. This system is costly, but insures the necessary volume, thereby realizing economy. A more direct scheme from factory to dealer is necessary when a manufacturer begins business in a key trading area. However, in this instance, care should be taken to have available the services of distributors when planning market expansion beyond this local area.

Dealer outlets are through hardware stores, appliance, jewelry, electrical, and department stores. The largest volume of sales is through appliance and jewelry stores.

Mail order houses carry their own brand of food mixer. The percentage of the market they sell is low. The apparent reason is that mail order houses cannot offer the good will established by old brands. Furthermore, they experience difficulty in selling below these existing brands.

Food mixers are shipped as second class freight. Shipping rates are per pound. They are packaged in individual cartons, and any size order is packed as needed.

ESTIMATED 1947-1948 MARKET CONDITION

On the basis of the market conditions discussed, the following quick reference points were developed:

Estimated retail sales for the period beginning July, 1947, and ending July, 1948.

MARKET	No. OF SALES	RETAIL VALUE
Los Angeles Area	60,000	\$ 1,800,000
United States	2,000,000	60,000,000

From reports by manufacturers and distributors there are still heavy backlog orders to be filled. The large number of new families created

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during the war years coupled with discontinued production, developed a demand for 6,000,000 mixers.² Postwar production has been slightly under 3,000,000 units.¹ and 8

The Los Angeles market is one of the best in the nation today.⁶ The great increase in population since 1940 is accompanied by a favorable per-capita income.

A mixer designed to retail at \$30 that improves performance and features new applications, will fulfill the demands of 90 percent of the market today.

Material shortages have eased and the labor situation is favorably stabilized. Therefore, production during the 1947-1948 period will function more smoothly than any postwar period.¹²

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PRODUCT RESEARCH

APPROACH

Product research comprised general investigation to determine the function of a food mixer, a study of actual usage, an analysis of existing brands, motor research, and a patent study.

An evaluation of discussions by popular home economists and a study of actual usage conducted by the author, defines the following purpose for a household food mixer:

The fundamental function of a household food mixer is to aid the housewife in those tasks that are physically difficult and time consuming. It must do these tasks well and efficiently. It must be easy to set-up, operate, and clean. It must be available and encourage new usage.

PRODUCT STUDY

A number of the most popular brands were investigated for design features, function and appearance. Important features are listed on the following pages.

```
Hamilton Beach
Hamilton Beach Co.
Model E------$30.50
Thumb speed control---finger-tip bowl control---full power at all
speeds---one-piece guarded beaters---easily portable 5 lb. head---
juice strainer---white with black trim.
Beater speeds------270 to 1040 rpm
Motor------1/10 hp
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Dormeyer

Dormeyer Corporation

Model 3000------\$20.95 Model 3200-----\$29.95 Revolving mixing turntable---click-mix arm---3 speeds---oil sealed--portable 5 lb. head---lift-off motor---white with black trim. Beater speeds------325 to 1330 rpm Motor: Model 3000-----1/20 hp Model 3200-----1/12 hp

Kitchen Aid

Kitchen Kit

A. C. Gilbert Co. Model B-27-----\$36.95 Portable-----\$15.00 Electrical governor speed control---16 speeds---speed selector plate---revolving mixing turntable---built-in power outlet for attachments---5 lb. portable head---white with black and chromium trim. Portable-----slender motor, use housing as handle---2 lb. unit--plastic housing---whipping type beater---oil-sealed---white and chromium. Beater speeds-----Model B-27---260 to 1180 rpm Portable-----1/50 rpm Motor: Model B-27-----1/8 hp Portable------1/50 hp Miracle Miracle Electric Company Model 111-----price not released Portable-----\$25.10 Governor type speed control---12 speeds---speed selector plate--low profile --- built - in power unit --- not portable --- swinging beater arm --- power driven turntable --- built -- in power unit for attachments --oil sealed --- white with chromium and black trim---weight 12 lb. oil sealed --- 2 beaters --- thumb switch and speed selector --- white with black. Beater speeds-----Model 111---350 to 1300 rpm Portable ---- not available Motor: Model 111-----1/10 hp Portable-----1/20 hp Westinghouse Westinghouse Electric Corp. Model FM-71-----price not released Governor type speed control---20 speeds---portable 52 lb. head--oil sealed --- revolving bowl turntable --- lift-off motor --- built-in

Beater speeds-----275 to 900 rpm

Motor-----1/8 hp

black trim.

In all units investigated, the universal series type motor was used. The trend is toward the straight series motor with governor speed control in favor of the compensated motor.

power outlet for attachments --- easy to keep clean --- white with

Every manufacturer produces an all-purpose unit with a line of accessories. The small portable unit of 2 to 3 pounds is a postwar development and has not yet been satisfactorily proven. The heavy duty unit has a limited application and a small market.

The all-purpose mixer units have been designed with the same general lines. They consist of a base with mounting post having swivel joints and a mixer holder. A bowl turntable fits on the base. The mixer unit consists of a motor and housing speed control device, reduction gears, and quick detachable beaters. This assembly is completed with a large and small bowl, usually opal glass, and a juice extractor. This combination will hereafter be referred to as "conventional".

The light portable unit usually has no handle. It fits in the hand. It does not have a stand, juicer, or bowls.

The heavy duty type is not portable. Ingredients must be brought to the mixer. It always features a very complete line of heavy duty attachments.

Reduction gearing is through spur gears, spiral, and worm gears. To reduce noise the combination of "metal to fiber to metal" is used. A high reduction is usually obtained through a worm cut on the motor shaft. Materials used in gear trains are steel, bronze, brass, and fiber.

All beaters except the Kitchen Aid planetary system are approximately the same. Smaller blades are used to reduce torque on low power units. The planetary action of the Kitchen Aid unit carries the beater around the bowl in one direction as it rotates it about its own axis, at high speed, in the opposite direction. It eliminates turning of the bowl and assures better quality of mixed ingredients.

Governors are of the centrifugal mechanical type, which make and break electrical contact through breaker points to adjust the speed of rotation. In this system a condenser must be shunted across the contact points to eliminate radio interference.

All units are vented and fan cooled. Cooling is a serious problem. Sleeve type bearings are preferred. They offer a satisfactory answer

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to the oiling problem, are quieter, and cost less.

The standard attachment cord is rubber covered, with a soft rubber plug, and is 6 feet long.

The mixer and stand materials are aluminum, zinc alloy, or steel. Aluminum is gaining favor through light weight and the increasing ease with which it can be finished. Beaters are chromium plated steel or stainless steel. The trend is toward stainless steel. Handles and speed knobs are usually plastic.

The mixer housing and stand are either die cast or stamped. The trend is toward die castings. They cost 8 percent more, but can save 15 percent in assembly costs.

The finish is usually baked enamel. Less expensive units are lacquer finished.

The retail price bracket desired determines the motor design, speed control system, and gear train design. Savings in cost can be made through simplified assembly and less parts. The beaters can be designed to be less expensive, easier to clean and better functionally. The method of inserting and removing can be improved.

MOTOR RESEARCH

The shortage of materials facing small motor manufacturers is rapidly ending. There are no government controls remaining and production is rapidly realizing a competitive basis.

Size and weight are the limiting factors in food mixer motors. The universal series wound motor is the most satisfactory answer. It develops more torque than any other type for a given size and weight.

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It has a much higher starting torque. The cost of production is lower.

To design a smaller, lighter motor unit for a given power rating calls for the use of new electrical materials. Silver wire is the only wire of higher conductivity than copper. Although it has a conductivity 5.7 percent better than copper it is 18 percent heavier. Furthermore, since the iron in the poles of existing motors is near saturation, it would take a new super-magnetic iron to use efficiently the gain available with silver wire. The cost of silver wire is prohibitive. Several small motors have been wound with silver wire for test purposes, but have been found highly uneconomical.¹³ However, as research progresses, super-magnetic iron or silver wire might well become a satisfactory answer to the future power supply for food mixers.

The universal series type motors for mixer use are of two types. The compensated motor and the straight series motor. They will operate on either A.C. or D.C. lines.

Speed control of the compensated unit is obtained by a brush shift. The brushes are shifted against the direction of rotation. The compensated series structure has several advantages. The distributed windings provide better flux distribution than can be secured with the single-coil sailient-pole type. A greater amount of active material can be accommodated in the same diameter and stacking length since the inactive interpolar space of the straight series motor is converted into iron and copper. Better control can be exercised over the degree of compensation, resulting in better starting torques. However, the speed control range is limited.

Simplicity of construction and ease of ventillation through the inter-

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PRODUCT RESEARCH

polar space mark the advantages of the straight series motor.

The high speed of the series motor is a real advantage in that it permits light weight and large power outputs in comparitively small dimensions. They can operate satisfactorily at speeds of 25,000 to 28,000 rpm. However, they are rarely used at these speeds since their output efficiency drops, and it is difficult to supply suitable bearings.

The series motors are seldom used for continuous operation. The duty cycle is determined by the temperature obtained in the driving unit. It should not exceed one hour.

Ventilation is important. Because of the nature of the construction, it is often found that housing temperatures are exceedingly low, yet the motor parts may be on the verge of failure due to high internal coil temperatures.

Under constant load operation, a governor will hold the speed of a series motor to variations of less than plus or minus 1 percent with a plus or minus 10 percent variation in line voltage. A resistor and capacitor are connected in parallel with the contacts to obtain a clean break at the contacts, giving smoother motor operation and longer contact life.

The life of a series motor has been improved to give expected values of 1000 to 2000 hours.

The brush life is reduced somewhat by the addition of a governor, but the slower speeds at which the motor will operate tend to overcome this loss. Brushes need not be accessible for repair from the outside of the mixer housing. They are usually made in this manner to simplify assembly, and cut down overall dimensions.

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Small diameter motors fitting in housings that can be held in the hand are used in small portable mixers such as the Gilbert portable. These are low power units and are not practical for a heavy duty mixing job.

Since 24 volt aircraft motors are available in the desired power range, an investigation was conducted to ascertain the practicability of rewinding these motors for 110 volt power supply and using them in a food mixer. The rewinding practice was found to be uneconomical.

PATENT STUDY

A concise patent study revealed that patent structures of existing mixers are quite complicated. There are many patents relating to slight variations of similar designs. Most patents are granted for speed control systems. However, specific production and assembly designs, and special features such as the Sunbeam beater ejector, are all covered with patents. A patent search is suggested on any apparently new design features.

An appendix listing, references the patent number and type, the owner, and the date of issue for the various patents investigated.

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To ascertain the consumers wants in a food mixer a comprehensive study was made from two excellent national consumer researches, and data gathered by personal interviews. The questions used for personal interviews will be discussed here with comments and adjustments indicated from the other sources. A sample questionnaire can be found in the appendix.

REFERENCE RESEARCH SOURCES

Survey by Industrial Design Associates, Pasadena, California⁷; 66 interviews. A national survey Questionnaires sent to: home economics instructors home service directors universities and colleges magazine home service editors Personal interviews with: home economics instructors home service directors

Survey by Curtiss Publishing Company, Independence Square, Philadelphia 5, Pennsylvania²; 4007 interviews. A national survey Questionnaires sent to: housewife Personal interviews with: housewife

Personal interviews by the author; 25 interviews A survey of the Los Angeles area Interviews with: home economics instructors home service directors housewife

FINDINGS

Brand popularity-----Challenge 1% -Dormeyer 11% -1% -Eskimo General Electric 12% -Hamilton Beach 18% -Kitchen Aid 9% Kitchen Kit 5% -Magic Maid 1% -Mixmaster 30% -Red Seal 1% -Universal 6% -Westinghouse 6% -4% -Montgomery Ward Others mentioned were: Kenmore, Powermaster, Mary Dunbar Handy Mix,

CONSUMER RESEARCH

Miracle Mixer, Knapp-Monarch, and Waring.

These percentage values were derived from response to the question; "What different makes of food mixers have you used?" The name "Mixmaster" was often times quoted while reference was made to another brand.

Weight------



Weight is an important factor, especially when the mixer is used as a portable. The preference is a light portable unit. Some users would like a heavier base.

Portable head-----Yes 90% 10% No

The majority prefers a portable head that can be used conveniently with one hand. It should be light, well balanced, and easy to remove from the stand. The Hamilton Beach release is preferred.

Speed control------

3-speed	38%	
Multiple	62	%

Although the majority of users stated that only three or four speeds were used to advantage, 62 percent preferred the multiple speed control. The existing speed ranges are satisfactory. Sixty-five percent preferred a finger-tip or thumb speed control knob so arranged that it could be operated with the same hand that held the mixer. The control knob should be easy to operate. A separate speed legend plate should be conveniently placed and easy to read. Most users prefer a small indicator with large distinct figures. The dial at the rear of the Mixmaster is inconvenient to use as a portable. The Hamilton Beach lever control is easier to use and read. The speed indicator and shut-off button should be integral.



Eighty-five percent of users stated that kitchen lighting was sufficient.

Mixing, beating, whipping------

Mix adequately 85% Don't mix adequately 15%

The texture of a batter mixed with a food mixer is much smoother and even than that obtained in any other way.

Seventy-six percent preferred two sets of beaters. One set for mixing, beating, and mashing. The other set for stirring, whipping, and drink mixing. The majority of users state the beaters are easily detached. They should be easier to clean. A narrow, long shafted beater is desired for whipping and using in deep pans. A large heavy duty set of beaters is desired for mixing doughy ingredients and mashing potatoes. The Hamilton Beach beaters are difficult to clean. The ridges on Mixmaster beaters are hard to clean. Many users object to the creases in the beater blades.



Proper size 86% Want other sizes 14%

A few users wanted a larger bowl and a smaller bowl, but still preferred only two in the selection. The large size is most often used. They are easy to clean. A large bowl is difficult to handle. Seventy-four percent

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say the bowls are too heavy. Sixty-eight percent prefer pouring spouts on the bowls.

Want rotating bowls 81% Don't want rotating bowls 13% Indifferent 6%

The rotating bowls are desired for better mixing and ease of scraping

while mixing.

Use bowls over stove Don't use bowls over stove Indifferent 3%

The mixer is often used while heating the ingredients. A transfer of bowls should not be necessary.



Stainless steel was favored for light weight, attractive appearance, and scuffing resistance. Glass and ceramic were more commonly associated with food and cleanliness, but objections were breakage and weight. The light weight of aluminum met with favor, but was not accepted well when associated with food mixing. Comments on bowl design were to keep the bottom smooth, have a small bottom to keep from spreading contents too thin, and provide a handle for ease of handling. Higher sides, curved in sides, or covers, were mentioned to overcome spatter. Some would like to use the bowls as serving dishes.

Mixer usage-----

Add ingredients while in operation 100% Don't add ingredients while in operation 0%

Ingredients are always added while in operation when mixing cake or cooky batter. Thirty-seven percent say it is difficult to add ingredients while

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the mixer is in operation, especially when using the small bowl.



More users would use the mixer several times daily if the unit could do smaller jobs more easily. The ardent cook would use her mixer much oftener if a good illustrated instruction and suggestion book accompanied the unit.

Mixer on counter Mixer in cupboard Indifferent

The mixer should invite tendency to keep it on the counter. It is used much oftener when kept out. The trend in the modern home is to have the mixer built-in; often times on a swinging door.

Seventy-five percent of all mixer owners use the juicer. Of these 41 percent use it daily. The juicer should be more stable. The strainer should be easier to clean. Many objected to the high working level of the juicer. Only 15 percent used accessories.

The accessories available are:

food chopper	pea sheller	coffee grinder
vegetable slicer	ice chipper	meat grinder
oil dropper	can opener	dough kneading hook
colander and sieve	knife sharpener	wire whipper
ice cream freezer	silver buffer	pastry knife

The resistance to accessory usage is their complexity and cleaning problem. Most housewives say the price is too high.

Color 8-----

cream	20%	
cream & pastel green	9%	
chromium	- 2%	
polished metal	9%	
neutral		
white	1/5	1.001
day 14 Jay and	1.1	42/0
don't know	4%	
	- 31 -	

CONSUMER RESEARCH

White with a trim of another color was preferred by 42 percent. It blends better with other kitchen equipment and metal finishes. Suggestions of trim in a contrasting color, and chromium, received favorable comment. Cream would have a distracting appearance in the presence of the polished metal and white of other kitchen utensils.

Motors------



In general the user of a brand having 1/12 hp or over felt there was sufficient power. Users of brands having less than 1/12 hp strongly advocated more power. The majority preferred a self-oiling unit. A minority objected to overheating.

Design comments-----

Forty-five percent of users preferred the appearance of the Mixmaster, and 27 percent preferred the Kitchen Aid. The comments were that these brands were more graceful, simple appearing, compact, and suggestive of heavy duty mixing. The color schemes of white with black trim are pleasing and blend well with the general kitchen atmosphere. The trend is to more graceful lines, emphasizing a low silhouette.

Functionally the Kitchen Aid planetary mixing system was desired. Both Kitchen Aid and Mixmaster carry a complete line of accessories.

General design features mentioned:

adjustable height splash preventing provisions to coil cord transparent bowl covers easier bowl location rubber bowl scraper prevent mixtures from climbing beater shafts automatic shut-off when head is tilted back.

CONSUMER RESEARCH

The usage of the mixer could be improved by simplifying outside contact parts. This would make operation easier and relieve the cleaning problem.

All mixers operate excessively noisy. A quiet operating unit would be enthusiastically accepted. Radio interference should be eliminated.

In general, the comment was that the price is too high when the money has to come from the housewife's operating budget.

SUMMARY

An analysis of the consumer research indicates that the following design features are essential for favorable sales room appeal:

all-purpose unit attractive appearance compact design color----white with contrasting trim multiple speeds at full power finger-tip speed control---clear legend light weight---well balanced good mixing and whipping easy to clean motor---sufficient power---1/10 hp or more quiet operation---no radio interference concise, illustrated instruction and suggestion book retail for \$30

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APPROACH

The fundamental approach used in developing this food mixer design has been to improve the performance of existing applications, and to create new functional applications, in such manner as to enhance the aesthetic qualities and economic values of the unit.

Through improved performance and new functional applications, a food mixer design can induce an enthusiastic consumer acceptance. It provides excellent service for the heavy, difficult tasks. At the same time, it offers an efficient solution to the numerous menial tasks common to the kitchen, and to cooking and serving. With this approach a design can be developed that offers the appeal of a necessity type item. It can sufficiently ease the buying conscience of the housewife to justify \$30 of her already thin budget.

The dealer will welcome an aesthetically balanced design offering advanced economic gain through the fresh sales appeal of new practical applications.

Greater economic values can be achieved for the manufacturer through sound, practical usage of materials and industrial fabrication processes.

To efficiently apply this design approach, six basic design themes were established. Numerous creative suggestions of each theme were developed and discussed with experts. All design suggestions were then evaluated with the aid of qualified consultants to determine the most appealing design for manufacturer, consumer, and dealer. The six basic design types used were:

conventional portable flexible shaft drive folding unit mixer on the bowl combination

The accompanying evaluation of each type includes several illustrations of the most promising design suggestions using that idea. CONVENTIONAL-----

DESCRIPTION

The conventional mixers are an all purpose heavy duty type with a portable head. They consist of a base with a mounting post having a swivel joint and a mixer holder. A bowl turntable fits on the base. The mixer units consist of a motor and housing with speed control device, reduction gears, and quick detachable beaters. This assembly is completed with a large and small bowl, plus a juice extractor. See Fig. 3.

ADVANTAGES

consumer accepted graceful appearance flexibility in design proven economy established service reputation known production methods

DISADVANTAGES

unstable with juicer large size limited new applications necessitates transfer of bowl or ingredients complex structure difficult to accomplish outstanding sales appeal



PORTABLE-----

DESCRIPTION

The portable units are designed to be held in the hand without the use of a handle. They consist of a motor and housing with speed control device, reduction gears and quick detachable beaters. This assembly is accompanied with either a wall or cupboard bracket, or a wire holding clip. See Fig. 4.

ADVANTAGES

compactness simplicity light weight easy to use good balance use any bowl facilitates shipping problem easier to clean

DISADVANTAGES

limited application---light duty only technical problem with dimensions limited power supply must always be held while in use---when used with a wire clip will induce storage in a drawer, thereby lessening usage no juicer no accessories



Portable Type Design

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FLEXIBLE SHAFT DRIVE------

DESCRIPTION

The flexible shaft drive arrangement transfers the motor torque to the beater shafts by means of a flexible shaft. It consists of a motor and housing with speed control and power take-off. The length of shaft transfers the power to a handle containing the reduction gears and quick detachable beaters. The juice extractor is built-in. See Fig. 5.

ADVANTAGES

light portable head compact unit attractive appearance stability built-in juicer built-in power take-off use any bowl facilitates shipping problem slow speed, high torque motor usage

DISADVANTAGES

shaft only relatively flexible
high cost of shaft
maintenance problem of shaft---especially end couplings
excessive power loss through shaft under sharp shaft bends
head must be held for best operation while mixing
oiling problem---at shaft couplings
necessitates bowl transfer
complex structure

DESIGN



Fig. 5 Flexible Shaft Design FOLDING UNIT-----

DESCRIPTION

The folding unit is a development of the conventional type. The mixer unit consists of a motor and housing containing a speed control device, reduction gears, and quick detachable beaters. The base has provisions for a bowl turntable. The conventional post is replaced with a folding mechanism to provide a small compact unit when closed. See Fig. 6.

ADVANTAGES

small, compact unit for storage attractive unit for cabinet top facilitates shipping problem fresh sales appeal

DISADVANTAGES

expensive production difficulties in folding mechanism unstable with juicer limited access complex structure complicated operation accessory problem wearing problem of the folding mechanism

Fig. 6

Folding Unit

1. he . Here

MIXER ON THE BOWL-----

DESCRIPTION

The mixer on the bowl type combines the mixer and bowl. The conventional stand and turntable are eliminated. The mixer is supported by the bowl. The mixer consists of a motor and housing containing a speed control device, reduction gears, and quick detachable beaters. The means of support is either from the mixer, from the bowl, or from a separate part. See Fig. 7.

ADVANTAGES

self-support without a stand possibility of using any bowl anywhere compact unit facilitates shipping problems excellent portability low cost of manufacture more readily adaptable to new uses simplified usage and maintenance easier to clean fresh sales appeal simplified structure

DISADVANTAGES

separate juicing arrangement requires sturdy mixer to bowl support noise problem attachment problem---need separate supports for accessories



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COMB INAT ION ----

DESCRIPTION

In the combination type the base unit contains the motor, speed control device, reduction gearing, and a power take-off. It features a built-in combination grinder-shredder. Power is transmitted through a drive shaft to the handle holding quick detachable beaters. See Fig. 8.

ADVANTAGES

compact unit stable, well balanced all-purpose provisions attractive appearance use any bowl will induce more usage of grinder-shredder slow speed, high torque motor usage

DISADVANTAGES

not portable high cost of manufacture maintenance problem shaft oiling problem complex structure necessitates bowl transfer



SELECTION OF DESIGN

After careful consideration, the "mixer on the bowl" idea was selected for development.

A design of this type would inherently improve performance. The reduced number of contact parts means less pieces to handle, arrange, and dismount for a given operation. The cleaning problem is greatly simplified with less parts.

The flexibility of the design readily suggests new functional applications. By means of a clip or bracket the mixer unit could be used on any bowl. Such flexibility means a simple transfer of a clean mixer, as contrasted to the transfer of ingredients to make a bowl available.

The cost of the eliminated base, mounting post, and bowl turntable, can partly be directed to a more efficient mixing and whipping arrangement. Stainless steel bowls can be economically featured. The increased sales appeal of these new design features for the same retail selling price as that of the conventional mixing unit, would be enthusiastically accepted.

Through proper design application the inherent disadvantages of this arrangement can be effectively diminished.

DESIGN OF BOWL MOUNTING

From an analysis of the advantages and disadvantages of the "mixer on the bowl" idea, it is evident that the degree of success the design can achieve hinges upon the flexibility of the joint between mixer and bowl. This joint was studied in the following systems:

- as a cover for the bowl
 a separate bracket
 a spring bracket on the mixer
 a mixer support bonded to the bowl
 a metal support band around a glass bowl
 a free riding clip
 a mechanical clip
- 1. By supporting the mixer with a bowl cover a firm rigid support is possible. The cover serves to prevent splash of ingredients. Through usage of a vertical set-up, an attractive, low assembly is possible. Excellent balance is inherent. A planetary system could easily be adapted to keep the bowl scraped in operation. A full-view glass bowl can be featured to advantage. Juicing can be directly into the bowl. However, the limitations of the cover reduces efficiency of existing usages, and makes new applications quite difficult. The cover would fit only one size bowl. Access to the bowl is bad while ingredients are being mixed. The handling and cleaning problem of the cover is as troublesome as the conventional stand. Production of the unit would be the same as the conventional type. The cover could be drawn from sheet stock.
- 2. A separate bracket support would greatly improve bowl access over that of the cover idea. It provides an attractive and low appearance. A fullvision glass bowl can be featured. The bracket would be a firm support

and give excellent balance. It could be flexible enough to fit several different bowl sizes. However, its complex design would be difficult to keep clean. It needs to be removed before removal of bowl ingredients. A separate juicing arrangement is necessary. The bracket could be fabricated from sheet stock. Stainless steel would be preferred.

- 3. A spring bracket on the mixer would feature excellent flexibility. Any type bowl with a bead at the brim could be used with the mixer unit. A well balanced, attractive unit is possible. However, a firm, rigid support is difficult; particularly on small bowls. The spring shape necessary is quite awkward to handle and clean. It would be especially unwieldy when used as a portable unit. If the spring and mixer were made detachable, the disadvantages of an additional part in usage are again existant. The spring band might be fabricated from stainless steel. A separate juicing arrangement is necessary.
- 4. A mixer support bonded to the bowl suggests a good firm joint. A simple snap clip offers smooth removal for portable usage. The support arm could be formed as a handle to facilitate handling of the bowl. The cleaning problem is simplified. The necessary extended position of the support from the bowl would be cumbersome in storage. The mixer is limited to usage of the particular bowl. A juice extractor over the mixer would be badly balanced. A vertical arrangement emptying into the bowl defines limited usage, and means extra cleaning of the bowl. To provide sufficient strength and safety, the support should be metal. Stainless steel spot welded to a drawn stainless bowl might be suggested.

5. To satisfactorily use a glass bowl with an integral mixer support, a metal

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band around the bowl is necessary.¹⁴ This type support is not as rigid as the bonded type. It would again make the bowl necessary with each function of the mixer, except when used as a portable. The sanitation problem under the band is objectionable. The juicer needs to be a vertical type driven from the front of the mixer. A stainless steel band is suggested for sufficient strength and resistance to scuffing.

- 6. The free riding clip offers excellent advantage through simplicity and low cost. It greatly improves performance through ease of handling. Fewer parts means less handling and simplified cleaning. The function of the unit is limited to a specially designed bowl with a bead large enough to give satisfactory support. Since the weight of the mixer is used to hold it in place, a tendency to jump might become objectionable. This problem would become increasingly noticeable as heavier refrigerator batters were mixed. The psychological affect of a juicer over the mixer might be bad from the standpoint of strength. A front end juicer would have the tendency to roll the unit back on the bowl and overturn. A separate juicing unit is needed. The bowl should be drawn from stainless steel.
- 7. A mixer to bowl joint through a mechanical clip offers a firm rigid support with sufficient flexibility to accommodate various sizes and types of bowls. A snap-action lock offers the ease of mounting desired. It insures adequate strength. Having the joint and means of support conveniently arranged as an integral part of the mixer housing, a compact, conveniently handled design is obtainable. Thus, efficiency of usage is improved, and the cleaning problem is simplified. Since the arrangement is flexible enough to use a wide variety of metal bowls, new applications

can readily be achieved. Therefore, the cost of a mechanical clip is justified by increased performance and assurance of safe, satisfied service. A separate juicing arrangement is necessary.

A careful weighing of the design features obtainable from the various joining systems, shows that most sales appeal can be realized with a mechanical clip. This system will be developed and used in the solution.

SOLUTION

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SOLUTION

A careful review of the design research, the market condition, production methods available, and consumer wants, directed the design solution shown in Fig. 9.

The solution has been pointed toward the 90 percent of the potential market desiring an all purpose mixer. The design policy has been to offer more sales appeal at the retail price of a deluxe mixer. This estimated retail price for 1947-1948 is \$30. The unit is to be distributed as a deluxe model until the initial production volume has been exhausted. Consumer sampling should be conducted continuously during this interval. The production schedule should be planned to make the changes detected by consumer sampling when the initial volume has been produced. These changes, and perhaps a substitution of a color finish on the speed knob and planetary cover plate, would determine a standard model which could then be produced in extensive volume for the economy market.

Analysis of the west coast market, sub-contracting rates, tool and die life, and production techniques, defines the best manufacturing economy for a Los Angeles manufacturer at an initial production plan of 25,000 units. This volume could be comfortably distributed in the west coast area at a retail price of \$30.^a

The initial production plan for an established food mixer manufacturer should be adjusted to conform with his production techniques and sales performance record.

The most profitable distribution channel will be from the plant to a distributor; to the dealer, then to the consumer. This policy assures the

a. The \$30 retail selling price has been approximated from comparison with existing brands.

SOLUTION

necessary market coverage.

To realize the fullest degree of success from the new developments of the design, a simple, easily remembered and pronounced trade name would be indispensable. The unmistakeable association of the term "bolmixer" has excellent potentialities. If preceeded by a one or two syllable manufacturers name the trade name would effectively identify the design.

A complimentary book of recipes and instructions is to be given with each sale. The instructions shall be well illustrated and suggestive of numerous new applications. The endorsement by a popular home economist is essential. To conform with the deluxe quality established by the mixer design, the pages of the book shall be plastic laminated.

The developed design offers the maximum in appearance, safety, sanitation, and efficiency. It consists of a mixing unit with an integral mechanical bowl clip, one large size mixing bowl, and two quick detachable beaters. A separate juicing arrangement is to be included.

Aesthetically, the design emphasizes balance and sturdiness. Its simple, graceful lines are easy to clean. The comfortable, sturdy handle provides excellent balance. Its rich sanitary color scheme in white, grey, and chromium, identifies quality and prestige. Increased sales appeal is realized through these high performance features:

new quick "snap-on" bowl clip
every metal bowl or pan is a mixing bowl
24 tested speeds at full power
finger-tip speed control
clear speed legend---for every job
light weight 4 lb. portable head
perfectly balanced
comfortable, full-grip handle
planetary mixing action
high speed whipping action
automatic bowl scraping
new two-blade stainless steel mixing beater

- O new adjustable disc-type stainless steel whipping beater --fits any bowl depth
- full 1/8 hp motor
 sanitary oil-sealed unit
- stainless steel mixing bowl
 quiet operation
 no radio interference
 retail selling price---\$30.

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ENGINEERING

MOTOR----

As the problem definition stated, a standard brand motor was selected. An investigation of availability, performance, and cost of 25 brands of series wound motors defined a modified type V Bodine Electric motor as best suited to the design requirements. Consultation with Bodine Electric representatives revealed that their VCF-12 type frame could be modified to develop 1/8 hp at an operating full load speed of 10,000 rpm, on a 60 cycle, 115 volt line. It has an input of 140 watts. The motor is fan cooled and requires good venting. Expected life under intermittent operating conditions is from 1000 to 2000 hours. The weight of the motor elements is 1-1/2 pounds. Best economy is available in lots of 25,000 or more units.

MATERIALS AND PROCESSES------

The mixer housing has been designed in five parts to facilitate assembly line procedure. The engineering drawing, M-1 shown in Fig. 11, and the cut-away view of the mixer assembly in Fig. 10, will be referenced to identify the parts and clearify assembly procedure. An aluminum alloy has been used wherever possible to reduce weight.

The rear mixer housing (1), Fig. 11, is a die casting from Alcoa alloy number 43. A 3-piece die is used. It is the basic structural member. The clip frame is an integral part of the housing. One motor shaft journal, and the stator mounting provisions are cast in. It provides mounting facilities for the clip cover and gear train housing.

The front housing (2), Fig. 11, is a die casting from Alcoa alloy number 43. A 2-piece die is used. It provides mounting for the handle, speed control system, and gear train housing. The handle and speed control system can be assembled in this section on a sub-assembly line.

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ENGINEERING

The gear train housing is a die casting from a 3-piece die. Alcoa alloy number 43 is used. It is an internal part supporting the entire gear transmission and providing the second journal for the motor shaft. It mounts directly on the rear housing. A sub-assembly line can mount the complete gear transmission.

The planetary cover plate (3), Fig. 11, is stamped from 30 gage SAE 1010 mild steel sheet. Steel was selected since the part is to be chromium plated. It serves as a service access plate and a transmission grease retainer. It snaps into position on the gear train housing.

The fifth part is a cover for the mechanical clip, (4) of Fig. 11. It is stamped of an 18 percent aluminum, 8 percent nickel, stainless steel. The underside is slotted to provide an air outlet. It serves as a spring to aid in mounting the mixer. The abrasion resistance of stainless steel is desirable to restrict the unsightly appearance of scuffing resulting when the mixer is parked on its heel. The clip mechanism can be mounted in the cover on a sub-assembly line.

The supports for the speed control, the condenser, and the mechanical clip, that are not cast in the housings, are stamped from 24SO aluminum alloy and 18-8 stainless steel. They are spot welded in position during sub-assembly. The clip cams are die cast from Zamac number 6 zinc alloy. The clip push-buttons are compression molded of urea formaldehyde.

The handle is compression molded of urea formaldehyde. A 3-piece mold is used. Urea offers the desired physical properties plus the desired color properties. The rear of the handle base is hollowed to provide an air intake.

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ENGINEERING

Since the speed control knob is to be chromium plated, it is die cast from Zamac number 6 zinc alloy. A 2-piece mold is used. An access slot is provided to fasten the knob to its shaft.

The mixing beater and whipping beater are shown in engineering drawing M-2, Fig. 12. An 18-8 stainless steel is used for mixer blade and whipper disc. Its excellent scuffing resistance is desired. One continuous piece of stainless steel is formed to proper contour and crimped to the hub to form the 2-bladed mixer. The hub and shaft are cut from SAE 1010 mild steel bar stock. They are ribbed at the joint and held by a force fit. Both pieces are chromium plated. The whipper disk is stamped of an 18-8 stainless steel and crimped to the shaft. The shaft has four cut keyways for adjustable length. It is chromium plated SAE 1010 mild steel.

The mixing bowl is drawn from an 18-8 stainless steel. See drawing B-1 of Fig. 15. A second set of dies is used to form the brim contour and bead. The bowl is polished to a high gloss. The bottom is copper plated to provide good, even heat conduction for usage over the stove. Stainless steel was selected for its excellent wearing properties, and strong consumer association with deluxe sanitary kitchen ware. The bowl handles are grey urea formaldehyde. They are compression molded with a 2-piece die. The handle support brackets are stamped from stainless steel and spot welded to the bowl. The bowl cover is drawn from an 18-8 stainless steel. The cover knob is grey urea formaldehyde.

The gear train members are die cast from SAE 68 aluminum bronze. Bronze was selected for its ease of fabrication, plus favorable strength, and wearing qualities. The transmission is packed with a low melting point grease. The lower transmission housing (see Fig. 14) is die cast of Alcoa

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alloy number 43.

Bronze oilite bearings are used throughout for satisfactory oil-sealed service and quiet operational qualities.

The 6-foot attachment cord is grey, vinyl plastic coated. It is supplied with a soft rubber plug and a stiff, plastic coated mounting sleeve to prevent fouling at the mixer.

Unless the manufacturer is producing additional products to keep expensive die casting machines and drawing presses busy, he will realize better economy through a sub-contracting policy. Furthermore, sub-contracts with various outside firms provide economical applications of a wide variety of materials and processes. This policy is particularly advantageous for a manufacturing volume of 25,000 mixing units. It has been applied in this design solution to gain fullest advantage of material properties.

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FINISH SPECIFICATIONS------
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To practically achieve the desired color scheme the following finishes are specified:

Front and rear housing-----refrigerator white, Melmac 560-8 Planetary cover------chromium plate Bowl clip housing------polished stainless steel Handle------grey urea formaldehyde (reference Plochere Color Guide--No. 1291-Bbg 6-c) Speed knob------chromium plate Clip push-buttons-----grey urea formaldehyde (Plochere No. 1291) Mixer-----stainless steel

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ENGINEER ING

GEAR TRANSMISSION-----

An exploded view of the gear transmission is shown in Fig. 14. The transmission functions through 8 meshing gears to give a combined rotating, planetary mixing action, and a high speed rotational whipping action. The planetary system achieves the best mixing qualities realized from a mechanical mixing unit.

The worm on the motor shaft (1), drives the worm gear (2), at a speed reduction of 20 to 1.

$$R = \frac{No. \text{ teeth on gear}}{No. \text{ threads on worm}} = \frac{20}{1} = 20$$

Thus, the smooth, quiet operation of the worm reduces the high speed of the motor shaft sufficiently for satisfactory, quiet operation of the remaining spur gears. The planetary driver (2), then transmits the power to the planetary (3), at a speed reduction of 5 to 1.

$$R = \frac{No. \text{ teeth on planetary}}{No. \text{ teeth on driver}} = \frac{50}{10} = 5$$

The combined reduction of 100 to 1 plus a maximum motor speed reduction through the governor of 8 to 1, achieves a minimum planetary speed of 12-1/2 rpm and a maximum of 100 rpm. The planetary serves as one journal

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for the mixer sleeve (6) and is secured to the housing (7) which provides the second journal. The mixer sleeve rotates as an idler on the stationary track (5) at a speed increase of 5 to 1.

$$R = \frac{No. \text{ teeth on track}}{No. \text{ teeth on idler}} = \frac{50}{10} = 5$$

Therefore, the rotational limits of the mixer sleeve are a minimum of 62-1/2 rpm and a maximum of 500 rpm. The stationary track is secured to the transmission housing to provide proper bearing area for the rotating planetary and housing. See Fig. 10. The beater sleeve journals are part of the transmission housing. The sleeve (4) is driven by the external gear of the planetary (3) at an increased speed of 12 to 1.

$$R = \frac{No. \text{ teeth on planetary}}{No. \text{ teeth on sleeve}} = \frac{84}{7} = 12$$

Thus, the realized speed of the beater sleeve is from a minimum of 150 rpm to a maximum of 1200 rpm. Using gear teeth with a circular pitch of .125" the outside diameter of the planetary is 3-1/4", and the mixer revolves about a 2-1/2" diameter pattern. This large planetary pattern permits full automatic scraping of an 8" diameter mixing bowl with a 5-1/2 " beater. The 5-1/2" mixer can be efficiently operated in tacky cooky batter with the 1/8 hp motor.

The distinctive form of the gear train cover plate immediately identifies this special mixing and beating action.

SPEED CONTROL--------

One of the highest performing sales features of a food mixer is a wide speed selection with full motor power at any setting. This speed range is necessary for efficient application of the mixer to the numerous tasks of the kitchen.
The electrical governor design shown schematically in Fig. 15, has been developed for this design. It features an 8 to 1 speed ratio. This means a usable motor speed range from 1250 rpm to 10,000 rpm. The speed control knob (1) can be easily turned with the thumb, or thumb and forefinger. The first position moves the lever (2) far enough to actuate the on-off snap switch (3). Further motion moves the lever (2) along the brush-plate (4). The corrugations (5) in the brush-plate serve as a speed change signal for the operator. The revolving motion of lever (2) is transferred to linear motion at the breaker point (7) by the oscillating link (6). Therefore, a calibrated clockwise motion of the control knob positions the breaker points (7) and (8). The speed responsive device (10) short circuits the system when it actuates the spring loaded pivoting support (9) holding the breaker point (8). Increased efficiency and longer life are realized through point contact of the governor and the pivoting support. The condensor (14) and resistor (15) are shunted across the breaker points (7) and (8) to overcome objectionable arcing. This increases the life of the points and eliminates radio interference.

Directions for speed settings are conveniently located on the rear motor housing.

Adding the wide speed control available from the electrical governor to that of the gear transmission, gives an extra wide speed range to fit virtually every speed demanded in the kitchen.

Planetary12	to	100	rpm
Mixer62	to	500	rpm
Whipper150) t(b 120	0 rpm



· ENGINEERING

BOWL CLIP----

Fig. 16 shows an exploded schematic view of the bowl clip. As the frame (1) is lowered upon the bowl (13), the loader (2) is rotated from position A to position B by the bowl rim. The resulting motion of the loader pulls the housing (3) toward the bowl. Simultaneously the cams (5) and (6) are forced against the action of spring (4). Further motion of the loader brings the loading springs (14) and (15) in contact with the bowl (13). A moderate pressure of 10 to 15 pounds by the operator, will force the loading springs to the final position behind the two outside frame members. In this locked position the inside compression member of the frame and the housing bearing points (14) and (15) form a triangular clamp to support the mixer. Ample frame clearance is available to receive bowls from 5" diameter to 10" diameter. The compression loading springs (14) and (15) insure secure locking on any bowl size. To remove the mixer, push-buttons (7) and (8) are easily operated to free the cams. Thus freed, the cover assumes its natural open position, and the mixer is automatically pushed free of the bowl. The cams (5) and (6) are held in position by clips (11) and (12). The push-buttons (7) and (8) are fastened to the cams with screws (9) and (10).

Proper positioning of the bowl clip located the mixer center of gravity 2-3/4" toward the bowl center, when measured from the point of support. Therefore, stability and balance are assured on any accommodated bowl.

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<u<image> Image: Construction of the second secon</u<image>	
8 Push-Button	(2) Support
(9) Screw	(13) Bowl
(10) Screw	(14) Loading Spring
(I) Support	(15) Loading Spring
MECHANIĆA	L BOWL CLIP
5-5-47	

JUICING

As the problem definition in the introduction of page 5 stated, the design of the juicer and other accessories are separate distinctive design problems. However, efficient provisions for their usage has been considered throughout the mixer development.

Since a juicer is to be included with each sale of the mixer, careful analysis of its design followed. The conventional juice extractor fits over the handle of the mixer and is driven from a power take-off at the top side of the mixer housing. This scheme limits the size of the juice bowl, and is quite unstable. It positions the juicer at a level which is too high for comfortable juicing at a work bench.

In a suggested design to accompany the developed mixer solution the mixer could conveniently clip to the underside of the frame, and the beater sleeve serve as the power take-off for the juicer. A large size juice bowl would control spatter and collect the juice. It could serve as a container for storage. The low frame permissible would bring the juicing level to a desirable working height. It would transfer pressure vertically down, providing a very stable unit. The contour of the frame can be similar to that of the mixing bowl. In this manner the mixing bowl will fit into the upturned frame, accomplishing a compact unit for shipping.

ACCESSORIES

The juicer frame will furnish excellent provisions for more efficient and simplified accessories. The beater sleeve will function as the power take-off in each instance.

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OPERATION

MIXING

The planetary mixing action eliminates bowl rotation and bowl scraping. It assures far superior results. The mixer blades are set at a 45° pitch for better mixing. Their contour is similar to that of the 3-1/2 qt. mixing bowl. In this manner automatic bowl scraping is effectively realized. The one simple beater is convenient to handle. Simply insert the shaft in the mixer sleeve and push. A key in the sleeve snaps into the shaft keyway to lock the beater in position. To eject the beater, a slight thumb pressure against the bottom of the mixer frees the shaft. The mixer's open design with 2 blades is very easy to clean and requires little storage space. It is an excellent safety factor for the housewife's fingers in using and cleaning. See Fig. 20.

WHIPPING

Best whipping and stirring results are obtained with the perforated disctype whipper. The wide speed range from 150 rpm to 1200 rpm includes every cooking task. Four shaft settings supply a convenient 2-1/4" adjustment in length. The off-center position of the beater sleeve on the mixing unit creates circulation of the mixture in the bowl, thereby assuring superior whipping and stirring. The simple, plain beater surfaces are safe to use and easy to clean.

RESUME

A resume of the principle design features calls to attention improved performance of mixing with a specially designed bowl and planetary mixing arrangement. A positive bowl clip offering easy transfer of the mixing unit to any metal bowl. An adjustable beater that makes any bowl an

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efficient mixing bowl. A speed range for every purpose. A summation of these design features demonstrates an increased performance and a welcomed encouragement for many new and small kitchen applications otherwise considered impractical with a food mixer. They tend to define the unit as a necessity type item, thereby offering sufficient sales appeal to justify \$30 of the housewife's operating budget.

Fig. 17 through 20 illustrate some of the design features.



Fig. 17 LOADING ON THE BOWL



Fig. 18 PARKING FOR ACCESSIBILITY



Fig. 19 PORTABLE USAGE



Fig. 20 BEATER EJECTION

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	9.	Industrial Design Associates, Pasadena, California
	10.	Survey of Current Business, December 1945
	11.	Facts for Industry, Bureau of The Census, Department of Commerce, Washington D. C.
	12.	The Kiplinger Washington Letter, February 8, 1947
	13.	Machine Design, September, 1941, "Selecting Small Built-In Motors"
	14.	Corning Glass Works, Corning, New York
READE	RS GU	JIDE AND INDUSTRIAL ARTS REFERENCES
(Consu	Mmers Research Bulletin "Household Electric Mixers" 18:5-8 September '46
(Consu	mers Union 1939 Buying Guide C U Reports October '32
1	"Your	Home Tomorrow" J. D. Ratcliff Wh. C. 70:34 July 43

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"Around the Clock With the Mixer" Miss C. J. Foster il Parents' Magazine 12:50 + 0 '41 "It Sure Beats Everything" 0 41 26:122-3 American Home "Marketing Strategy for General Mills' First Home Appliance" W. Mac Donough il Sales Management 57:37-9 N 20 '46 "Be a Good Mixer" Francis Armin Better Homes and Gardens 18:32-3 + S '39 "From Trim-tab Motor to Hand Mixer" il Modern Plastics 23:100--1 My 146 "Replacement Market for Household Appliances, tab." Public Utilities 37:185 Ja 31 46 "Most From Your Mixer" Womans Home Companion 64:77 Ja '37 "Electric Utilities....Rural Market" Bans W P 64 N 23 '46

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Los Angeles Chamber of Commerce Los Angeles Examiner Los Angeles Times Industrial Design Associates General Electric Co. Thermadore Electric Co. Erla Corporation Westinghouse Electric Co. Bodine Electric Co. Logan Electric Co. Dormeyer Corp. Hobart Mfg. Co. Hamilton Beach Co. Chicago Flexible Shaft Co. National Electrical Wholesalers Assoc. Chamber of Commerce of the U.S. Curtiss Publishing Co. Department of Commerce Southern California Edison Co. Electrical Merchandising Scripps-Howard Newspapers

Bersted Mfg. Co., Fostoria, Ohio. "Eskimo Kitchen Mechanic" Dominion Electrical Mfg. Co., Inc., Mansfield, Ohio Dormeyer Corp., 4300 N. Kilpatrick Ave., Chicago 31, Ill. "Dormeyer" General Electric Co., 1285 Boston Ave., Bridgeport 2, Conn. "General Electric" Gilbert Co., A. C., Erector Square, New Haven 6, Conn. "Gilbert", "Whirlbeater" Hamilton Beach Co., Div., Scovill Mfg. Co., Racine, Wis. "Hamilton Beach" Hobart Mfg. Co., Kitchen Aid Division, Troy, Ohio. "Kitchen Aid" "K-M" Knapp-Monarch Co., Bent & Potomac Sts., St. Louis 16, Mo. Landers, Frary & Clark, 47 Center St., New Britain, Conn. "Universal" Merryway Co., Poughkeepsie, N. Y. "Merryway" Miracle Electric Co., 36 S. State St., Chicago 3, Ill. "Miracle" Monitor Equipment Corp., 650 West 249th St., Reverdale-on-Hudson, New York, 63, N. Y. Quincy Electronic Co., Quincy, Mich. Racine Universal Motor Co., 1637 Gould St., Racine Wis. "Whip-it" Reynolds Electric Co., 2629 W. Congress St., Chicago 12, Ill. "Reco" (12 and 22 qt.) Sunbeam Corp., 5600 W. Roosevelt Rd., Chicago 50, Ill. "Sunbeam Mixmaster" Tutt Co., 4107 Willys Parkway, Box 54, Toledo, Ohio "Tutt" Vidrio Products, Corp., 134 West 54th St., Chicago, Ill. "Electro-Mix" Westinghouse Electric Corp., 653 Page Blvd., Springfield 2, Mass. "Westinghouse"

NUMBER	SUBJECT	OWNER	DATE ISSUED
2,293,959	Beater Ejector for Mixers	Sunbeam	Aug. 1942
2,274,480	Motor for Food Mixers	11	Feb. 1942
2,213,191	Food Handling Apparatus	Kitchen Aid	Sept. 1940
2,185,156	Food Handling Apparatus	ห	Dec. 1939
2,185,155	Food Handling Apparatus	11	Dec. 1939
2,182,083	Mixer Motor Unit	Sunbeam	Dec. 1939
2,165,858	Electric Motor	H	July 1939
2,144,734	Motor & Speed Control Device	88	Jan. 1939
2,144,733	Motor Control Mechanism	n	Jan. 1939
2,099,050	Speed Control Mechanism	H	Nov. 1937
2,070,768	Mixer	11	Feb. 1937
2,019,771	Juice Strainer	13	Nov. 1935
2,013,887	Mixer	11	Sept. 1935
2,002,333	Portable Household Mixer	11	May 1935
1,975,949	Kitchen Utensil	11	Oct. 1934
1,972,735	Ice Chipper Plate	Kitchen Aid	Sept. 1934
1,926,910	Household Mixer	Sunbeam	Sept. 1933
1,864,209	Food Handling Apparatus	Kitchen Aid	June 1932
1,759,760	Juice Extractor & Mixer	Sunbeam	May 1930

This sample questionnaire was used for interviewing. What different makes of food mixers have you used? Mixmaster Hamilton Beach General Electric Knapp-Monarch Westinghouse Universal Kitchen Aid Challenge Eskimo Red Seal Miracle Dormeyer Magic Maid Kitchen Kit Waring Other Are Mixers too heavy? Yes____ No Comments: Should the beater units detach to be used as a portable? Yes No Comments: What kind of speed control do you prefer? Thumb Finger-tip Hand Other Is it worth while to have a light on the mixer? Yes____ No Comments:

Do the mixers you are acquainted with mix adequately? Yes______ No_____ Comments:

Are they easy to clean? Yes No Comments: Do you like the bowls to rotate on the stand? Yes_____ No Comments: What material would be ideal for the bowls? Aluminum Stainless Glass Pyrex Plastic Ceramic Other Would you like to use the bowls on the stove or in the oven? Yes____ No Comments: Do you use the full range of speeds? Yes No Comments: Do you want attachments with your mixer? Yes No_____ Comments: How many times a week would a housewife use her mixer? Daily Weekly Several times daily Comments: Would the average housewife like to keep her mixer on the work counter? Yes

No Comments:

Would you like the mixer to operate from a wall or cupboard bracket? Yes No Comments: What color or colors would you suggest? White White with black Chromium_____ Oream Neutral shades_____ Other Do you think there is a market for a food mixer which could be used as a liquifier? Yes_____ No Comments: Should the bowls have transparent covers? Yes No Comments: Would you like an automatic bowl scraper while in use? Yes No Comments: Are present mixer motors powerful enough? Yes____ No Comments: Do they overheat? Yes No Comments: Should the mixer be oil-sealed? Yes____ No Comments: General comments on design and usage: