A PACKAGING PROBLEM WITH AUTOMOBILE WHEELCOVERS; AND OUTLYING ISSUES AFFECTING THE PROBLEM

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ABSTRACT

A PACKAGING PROBLEM WITH AUTOMOBILE WHEELCOVERS; AND OUTLYING ISSUES AFFECTING THE PROBLEM

by Joseph Charles Dressel

The problem was to analyze the present packaging methods for wheelcovers and to improve them through product analysis and packaging materials research.

The methods used were in the manner of an educated trial-and error search for materials, once having established the package requirements of the product.

The result of the study was a considerable saving both in storage requirements and in cost of materials for packaging; and an increase in packaging production rate.

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By

Joseph Charles Dressel

A THESIS

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To

Marilyn

whose patience and understanding

made this possible.

PREFACE

A packaging problem arose which appeared to present a challenge in consideration of an overall problem. The writer chose this problem because of its dynamic nature.

The scope of this paper is to approach the problem at hand from an unbiased view and to consider possible solutions.

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INTRODUCTION

The problem about which this paper is written is a portion of a research project. This writer has the goal of finding an optimum means for packaging the wheelcovers described herein, with a minimum of cost and a minimum of materials required for the given purpose.

First, one must analyze the product to be packaged and the mode of transport from producer to user. The type of protection required will, to some extent, indicate the type of packaging to be used. However, the specific package is not dictated and therefore the range of packages available must be considered. Since economy is paramount, this must be the final deciding factor as to a package decision. Efficiency of materials handling is also a factor to be considered when one thinks in terms of better methods.

Cutting costs is almost synonymous with virtue in the eyes of industry. This paper, it is hoped, is involved in cost cutting and therefore is helping the writer become prepared to contribute to industry; indeed, it is hoped that this thesis is a first contribution.

CHAPTER I

ANALYSIS OF THE PROBLEM

Background Information

The company for which the work was done is one of seven companies owned by a parent organization. This company is a manufacturer of hubcaps and wheelcovers for the automotive industry. The company operates on a contract basis, subletting some of its contracted work for wheelcover components, such as inserts, die castings, etc. This company's basic production function is stamping and forming of sheetstock.

For the 1964 automotive year, the company received a contract from one of the 'Big Three' automotive producers to produce two specific wheelcovers for the deluxe models of the automotive company's line. The company is not the sole supplier for these wheelcovers.

Upon receipt of this contract, the company immediately designed and built an automated production line with many modern concepts allowing for high production of the new wheelcovers. The investment was in the range of one-half million dollars for this automated line.

Upon inspection of the new production line, the writer noted a complete lack of a facility for packaging the new product. Thusly, the production process had a high degree of automation and potential for high capacity for production, while the packaging facility observed was slow in comparison. Also noted at this time was an acute shortage of storage space for both incoming and outgoing materials.

It is the opinion of this writer that this company's management was not abreast of modern packaging concepts. The packaging portion of the production process suffered because of this. The parent organization had expressed its concern for this problem. The parent company realized that outdated packaging techniques were not capable of matching the output of the newly installed production and assembly line.

The production company itself, however, had a different outlook on packaging than that of the parent organization. From the level of production engineer and downward, there was a noted attitude that packaging was at peak efficiency and therefore only very minor changes would be necessary. This presented a rather severe problem in communication and attention given to the problems at hand.

This writer, as a result of the attitudes shown, felt at once that the most difficult problem would be to 'sell' these people their own problems. Since they were not aware of the problems, it can be seen why little or no attention was given to them. Actually, many of the problems themselves were fairly simple ones, but they had to be brought out before a solution could be executed.

It was easily seen that poor packaging was the rate-determining step in the system. This dictated the investigation and resultant improvement of packaging methods.

Obviously, the author's job was first to bring out these problems and then to improve the existing situation, by the best means available. Immediate problems of waste in packaging material usage were to be the first steps to be considered in improvement of the packaging operation.

Another point of interest was that this company's labor force was of a fairly low caliber. One reason for this was that the work was not steady. A fluctuation in work load was cast from a similar type of work in the auto industry. The type of work, therefore, lent itself to non-steady labor.

Product Analysis

The wheelcovers to be packed were composed of several parts and of several materials (Fig. 13a.) The body was composed of a single piece of stainless steel. The ribbed portion of this body had black and aluminum enamel on its surface.

Also enameled was a center ring of black, just outside the center mounting. This center mounting was a chrome-plated die casting which was screwed onto the stainless steel piece by means of three metal screws and lock washers. An additional part of this center mounting was an insert of polystyrene with the motor company insignia stamped and painted on its back surface.

As a sound damping mechanism, a ring of soft plastic was inserted between the contacting surfaces of the center mounting and the main body of the wheelcover. A steel ring was mounted on the back of the main body and directly under the mounting position for the center die cast piece. This ring served as a reinforcing plate to help support the weight of the die cast mounting.

The significant dimensions of the wheelcovers were as follows:

1. Outside diameter--14-3/64 inches.
2. Diameter of back locking ring (including the locking protrusions)--13-23/32 inches.
3. Diameter of the back locking ring (not including the locking protrusions--13-13/32 inches.
4. Back-to-front thickness--3 inches.
5. Die cast center mounting:
    a. Top outer diameter--2-5/8 inches.
    b. Base diameter--4-5/32 inches.
    c. Angle of incline from vertical--$13^{\circ}47'$.
6. Height from top of die cast mounting to the highest point of the main body--1-1/2 inches.
7. Diameter of the ring which forms the highest point of the main body--9-57/64 inches.
8. Height of that ring--1-19/32 inches.

The writer's next step was to establish the level of protection needed for these wheelcovers. A preliminary step then, was to establish a criterion of damage for the wheelcovers. The following statement summed up the features believed to be significant:

> Damage was to be any mark, scratch, bend or any other visible change to the outer (finished) surface of the wheelcover. This included all parts visible when the wheelcover was on a wheel.
>
> Also to be considered as damage was any bending or other distortion to the back inner locking surface which may hinder installation or removal of the wheelcover, or tend to make the wheelcover too loose to stay on the wheel, once installed.
>
> Also to be considered as damage was any vibratory motion causing a loosening of the retaining screws for the die cast center piece.

A first step in considering protection requirements, once a criterion of damage was established, was to look for parts of the wheelcover that may tend to bend or be distorted rather easily.

When considering the possibility of weight being applied in a front-to-back direction when the wheelcover was lying flat, the first point was that the die cast center piece offered a great deal of strength. This was because the base of the center piece made contact with the surface of whatever backing was to be used. Also the ring which constituted the highest portion of the main body offered considerable strength in the same direction as mentioned above. This strength was the result of a concave structure towards the center and down to the base of the die cast piece, and a short ribbed structure towards the outer diameter of the main body. (Fig. 13a.)

The conclusion was that due to the geometry of the wheelcover and materials used, these wheelcovers offer a great deal of resistance to bending type distortion from a front-to-back direction, that is, vertical stress when the wheelcover was lying flat on a rigid surface.

Resistance to edgewise compression appeared to be somewhat less than top to bottom resistance. However, since the main body was stainless steel, the wheelcovers had a spring type action and returned to their original shape, even after as much as one hundred pounds static stress was applied directly to an edge with the wheelcover standing vertically. Therefore, it was concluded that bending caused by compressive force was not a problem, due to the high structural strength and resiliency of the wheelcovers. Bending distortion was no longer considered a problem and it was concluded that, for all practical purposes, the wheelcovers were self-supporting and that any containers used for packaging need not be of high structural strength. From this conclusion the writer became concerned with having to protect the wheelcovers from surface damage only.

Summing up then, the type of protection required for the wheelcovers was protection from marring, abrasive and shock-type action. In other words, the major concern was to protect the finished surfaces of the wheelcover. Support function of a container was only to be enough support to prevent collapse of the package and a resultant breakdown of internal protective packaging.

Production Analysis

The automated production line referred to earlier was capable of producing 550 wheelcovers per hour. The wheelcovers came off the production line from a circular final assembly table. The handling from this point on was totally manual and was limited to about 200 units per hour. (Reference 5.) This means that the overall operation could run at about 36 per cent efficiency.

The wheelcovers were picked off the final assembly table by hand and packed by hand into corrugated containers. The containers were set up by one individual and a second operator would then proceed with the packing operation. Once filled, the containers would then be sealed and pushed away by the first-mentioned individual. From this point the containers were carried by hand down a narrow flight of stairs and then further carried about forty feet to a loading dock, where they were put on a truck for shipment.

The point to be noticed above was that the containers had to be carried out immediately. The available storage space, used both for unused and for filled containers, was minimal. Were trucks not waiting to be filled, the plant would be shut down in approximately eight hours because of lack of storage space. For this reason, the author considered it necessary to reduce the storage space required by unused containers. This was to be accomplished by cutting down the amount (volume) of corrugated board required for packing the wheelcovers.

Since the writer wanted to cut overall costs, it was manditory that the production rate not be reduced merely for the sake of cutting down on materials. Thus a study of the actual packing process was deemed necessary. Following is a description of the steps involved in filling the various containers and approximate times associated with the procedure.

A. Accessory Kit (4 wheelcovers/container) (Fig. 15b.)

1. The container was set up and taped on the bottom.

2. The container was placed next to the worker on the end of the production line.

3. The container was filled as follows:

   a. The first wheelcover was placed with its back to the container wall.

   b. An insert was placed against the cone facing of the first wheelcover.

   c. The second wheelcover was placed in the container with its frontside resting against the previously placed insert.

   d. A third wheelcover was then placed in the container with its back to the back of the second.

   e. A second insert was placed against the cone facing of the third wheelcover.

f. The fourth wheelcover was then placed in the container with its back against the container wall.

g. The container was pushed away to make room for the next.

h. The filled container was then taped shut.

4. A master carton (3 kits/master carton) (Fig. 17.) was then set up and three kits placed into it and then the master carton was taped shut.

ELAPSED TIME--1 minute, 42 seconds

B. Production Pack (20 wheelcovers/container) (Fig. 16b.).

1. The container was set up and taped on the bottom.

2. The top flaps were taped open for easier filling.

3. The container was set next to the production line.

4. The container was filled as follows: The procedure was the same (order-wise) as that described for the kit, except that there were ten wheelcovers per layer, a layer insert and two layers of wheelcovers totalling 20 per container.

ELAPSED TIME--2 minutes, 26 seconds

The above information will be used later in the paper for comparison of times required for new packing methods derived in the attempt to cut costs without reducing the production rate. (See Table 3.)

CHAPTER II

SEARCH FOR MATERIALS AND EVOLUTION OF NEW METHODS

Preliminary Considerations

The author's objective in this search for materials was to find the best materials for the packaging of wheel-covers. This meant finding the lowest cost package that would still satisfy the product requirements for protection.

An additional requirement was to meet the automobile manufacturer's specification requirements for the package. This requirement needed to be followed in the proposed immediate changes only. The hope was that when more extensive changes would be proposed, that any changes in containers would be approved by the automobile company in question. This, of course, referred to changes towards an automated packaging system, whereas immediate changes were only to be economy measures applied to the present procedure.

The economy measures were to be economies both in cost of materials used and in storage space required by the unused and the filled containers.

The question of complete protection of contents as opposed to acceptance of a certain low percentage of damage was dismissed, since the value of each unit (about ten dollars) would warrant its protection. (Reference 5.) The cost of this protection would be quite low as compared to the cost of the wheelcovers being protected; roughly 0.5 per cent of the cost of the unit. This figure was based on approximate cost of packaging as it was at the present time. It was hoped that this would be reduced somewhat further in the economy move.

Exterior Packaging

The question of what type of outer container to be used was considered. Corrugated board was the first and most obvious material to be considered, since it was fairly inexpensive and easy to use.

The second outer package material to consider was the possibility of using an overwrap material such as kraft paper of fairly heavy caliper. However, the use of this material is quite difficult without the proper machinery. Since new machinery was not in the immediate plan of events, the possible use of an overwrap was discarded (for the time being). The overwrap concept will be discussed later in the paper when discussing future possibilities for automation.

Because corrugated board was so readily available and comparatively low in cost and easy to use, this material was the one which the writer chose to use as an outer container material.

The containers used by the company at that time were of C-flute corrugated board. An immediate objective was to consider the possibility of using B-flute corrugated board which would be approximately 20 per cent thinner than the C-flute board in use at that time. (Reference 1.) If this change was feasible, this would mean that a 20 per cent reduction in storage space required for unused containers could be affected.

The most important factor in considering this change was a possible loss of protection because of use of less rigid corrugated board. Cost was not significant in considering this change, since the costs of C-flute board and B-flute board per square foot of board used were identical. (Reference 6.)

Containers of B-flute corrugated board were constructed, duplicating the inside dimensions of the C-flute containers which were in use at the time. (Fig. 16d.) It was believed at that time that, due to the self-supporting nature of the wheelcovers with regard to crushing, the B-flute board would be sufficient in stacking strength to warrant its use in all containers concerned. This thought was born out by the tests which were performed in the School of Packaging laboratory.

The tests performed were comparative in nature. Boxes were identical except for differences in flute sizes. Each test performed on a new type container was also performed on the comparable container being used at the time. Thus, within the reproducability of the test equipment (sometimes questionable), a direct comparison of the proposed containers and the ones which were in present use, was made.

The primary test performed was on a vibrating table. The force exerted by the table was approximately that force required to oppose the force of gravity, i.e., 1 g. This represents considerably more force than would be encountered in normal shipment and handling of the containers. Therefore, containers holding up under these conditions would almost surely hold up under normal shipping conditions.

After 60 minutes of shaking no damage to the wheelcovers was found in any of the B or C-flute boxes of style of containers in use at the start.

Since the wheelcovers inside the containers would lend to the support of the package, stacking strength of the corrugated board was not considered to be a problem.

The question of vulnerability of the containers to sidewall crushing was considered, since B-flute board is somewhat more easily bent than C-flute corrugated board. The B-flute containers were more easily caved in than the C-flute containers when merely shoved-in by hand. However, this was not considered to be disadvantageous because there still was no damage to the wheelcovers.

The only container for which appearance was important was the accessory kit in which wheelcovers are sold at retail. Since three of these kits were to be contained in a single master carton (Fig. 17) they would not be directly vulnerable to caving in, and it was found that the master carton provided ample protection to the three kit containers inside.

Therefore, in all aspects of importance, the B-flute corrugated containers were highly acceptable containers for use in packaging the wheelcovers. Again, the conversion from C-flute to B-flute corrugated board was for the purpose of reducing storage space required for unused containers. The author, therefore, recommended this change as a means of conserving space in the plant.

Interior Packaging

'Centered' Packing

An attempt was to be made to cut down on material usage through changes in packaging design and methods.

At the time that the wheelcovers were being packed in their centered back-to-back and face-to-face manner, the thickness of a four-unit container was four times the thickness of a single wheelcover plus the thickness of the two inserts used. (Fig. 15b.)

The wheelcovers were non-stackable in the sense that the back of one would not nest over the face of another. This was because the outside diameter of the die cast cone face was the same as the inside diameter of the disc hole found on the back side. (Fig. 13a.) Thus nesting in the above manner was not possible.

A first attempt at material reduction was to try to reduce the size of the inserts used as separators in the packing operation. At that time the inserts were squares measuring 14-1/8 inches on a side, which were precisely the inside dimensions of the container (kit). The cost of these squares was $19.85/1,000 or very close to two cents per insert. (Reference 5.)

A reduction in materials was envisioned by cutting circles which would be of slightly larger diameter than the outer diameter of the die cast piece on the wheelcover. Some means of fixing these circles onto the cone was needed. A piece of pressure sensitive tape was placed over the top of the disc and down the sides of the cone. (Fig. 13b.) However, due to the disc's larger diameter, the tape had a tendency to peel off the side of the cone.

The next affixing mechanism considered was a double-backed pressure-sensitive ring on the circle of corrugated padding. This unit would be placed directly onto the cone surface. It was realized that the tape might not stick to the cone because the upper cone surface had a slight bevel towards the center, and, as a result, the only effective sticking surface would be a very narrow ring of the cone. The rigidity of the corrugated pad would also have contributed to this problem.

The circular corrugated pad had a disadvantage when the container was being loaded using these pads. In the four unit kit, when the last wheelcover was being placed there was a strong tendency for the pad to catch on the die cast cone of the opposing wheelcover. Correction of this would have resulted in considerable time loss in the packing operation.

At the time this problem was being considered there was a fairly new cushioning product on the market. This product consisted of a skived sheet of expanded polystyrene which was available in several thicknesses ranging from one-sixteenth to three-fourths inches. This product appeared to have properties that could be useful in packaging the wheelcovers under discussion.

The writer, upon meeting with the producer of this sheet cushioning material, was able to get prices and estimates of cost of production of the desired circles of cushion with a pressure sensitive backing on these circles. The price was quoted in two parts: first was a price of just the circles of cushion and second was a price including the installation of the pressure sensitive backing. (Reference 7.) From these two figures, one could get a fairly accurate estimate of the cost of the backing.

Thus, a price comparison of this material (cushion) and the corrugated circle could be made. The result was that the polystyrene sheet cushion was very close to the estimated cost of the corrugated circles, both with a ring of double-backed pressure sensitive tape attached. This price was only slightly lower than the two cents being paid for the inserts in use at that time.

Essentially the same difficulty in packing was encountered with the new cushion circle as was encountered with the corrugated circle. Added to this was the fact that, due to the relative flexibility of the cushion, these new pads tended to fold over when 'hooked' by an opposing wheelcover and in this manner surfaces were exposed to damage through metal-to-metal contact.

When submitted to only light vibrational forces on the vibrator, the new cushioning material was rather easily destroyed, for its intended purpose. The bevel on the upper surface of the die-cast cone acted as a cutting edge and literally cut a complete ring through the pad. This, of course, exposed the opposing edges of the die-cast to direct contact. This material was therefore discounted as a useful protective padding between wheelcovers.

The idea of a circular pad being placed on the cone facing of the wheelcovers presented an added problem in production efficiency. There would be a motion involved in packing that would most probably slow production significantly. Since it would be essential that the circular pads completely cover the surface to be protected, these pads would, of necessity, have to be applied with care and this could only be done by taking additional time in the packing operation. The above methods would undoubtedly increase labor costs, more than off-setting material saving, and were therefore not desirable as new methods of packaging. For the above listed disadvantages, the ring-on-cone idea was discarded in the hope of finding a more satisfactory means of cutting cost.

'Off-Centered' Packing

It was found that if two wheelcovers were placed face-to-face and about three inches off-center they could be nested to the extent of the total thickness of two nested wheelcovers being about two inches less than the thickness of two non-nested wheelcovers. A considerable reduction in total thickness of container required could be effected by use of this nesting characteristic.

The obvious problem was that of designing an interior packaging method that could take advantage of the nesting of wheelcovers.

The first interior packaging material considered was a padding which was a combination of wool, cellulose, and cotton fibres bound together forming a blanket-like pad. The material was low in price and could compete with corrugated board, if suited for the job. (Reference 4.)

These pads were cut into twelve-inch squares and placed between two face-to-face wheelcovers. With only a small amount of friction induced by hand, the pads were cut through and therefore rejected.

Pads of the skived polystyrene sheeting were also considered but it was found that they were flexible only through large radius bends. When submitted to the bending that would be required in the nesting of wheelcovers, these pads immediately broke in two, rendering them useless as a protective material.

The next insert tried was a piece of corrugated board with two holes cut into it such that the die cast portions of the wheelcovers would rest in these holes, and in this manner the opposing cones would be held apart. However, several problems immediately arose. First, the wheelcovers were not restricted in movement, as was anticipated, and the die castings easily made contact with the stainless steel portion of the opposite wheelcover. Secondly, the cut holes were so close together that with only slight rotation of the wheelcovers, opposing die cast cones made contact with each other. This method was, at that point, discarded as unsuccessful. However the idea of using corrugated board for separating the wheelcovers was not discarded.

The second attempt more or less evolved from the type of failure occurring in the previous attempt. Rather than cut a complete circle out of the insert, a sunburst arrangement was cut into the insert, with the thought that the sunburst rays would protect the cones when rotation occurred.

An additional idea was to try a single piece of board properly scored so as to wrap around the first pair of wheelcovers and reach far enough to service a second pair. Thus a single piece would serve four wheelcovers rather than two, as was originally planned. (Fig. 13c left.) The wrapping around of this single insert, it was found, had the added advantage of restricting the rotation noted in earlier attempts. (Fig. 14a,b.)

When placed on the vibrator, it was found that the sunburst did not provide the desired protection. The writer noted that the only part of the sunburst being taxed was the peak of a single ray lying immediately between two die cast surfaces. This peak was easily crushed and in many cases was sheared completely off, and considerable damage to the wheelcovers occurred. (Fig. 14c.)

The idea of a single 'wrap-around' insert was a good one, since it represented a significant reduction in internal packaging materials. However, improvements on this type of interior packaging were needed.

The next thought was to try a trap-door arrangement in which a double hinged trap-door would replace the sunburst. (Fig. 13c middle.) After testing, this was recognized as a definite improvement over the sunburst. The wheelcovers were, in effect, separated by a complete pad of corrugated board as opposed to separation by a single ray in the sunburst. The wheelcovers withstood considerable shaking (80 minutes at about 1 g.) on the vibrator table and showed no signs of damage; indeed very little crushing of corrugations occurred.

With this new insert in mind, the author proceeded to design the complete line of containers needed for the various uses. Comparative changes in dimensions and board usage were calculated and drawings of all containers and container parts were made. (Figs. 1 through 12.)

At this point the writer visited a producer of corrugated board and was able to obtain price estimates on the new containers and inserts. (Reference 6.) These figures were to be used in comparison with costs incurred by the old methods in use at the time. There was a significant reduction in materials cost, even though a die cutting charge was added to the cost of the inserts.

It was later found that a new and much simpler insert served better than any of the previous types attempted. This was a piece of corrugated board requiring less material than all others tried and which also eliminated the die cut pattern required in the trap-door insert.

The new insert had six simple score lines running vertically and served to protect the wheelcovers as well as or better than previous attempts, including the method in active use at the time. The new insert was scored such that rotation, as found in earlier cases, was essentially eliminated and positive separation of all finished surfaces was evident. This pad could not be rotated, shifted or moved in any way so as to lessen the protection offered. (Fig. 13c right and Fig. 14d.)

In addition to the above features offered by the latest insert, a non-test corrugated board was used and this had two added advantages over the preceding types. The first and most obvious advantage was that non-test board is cheaper than any other type of corrugated board. Secondly, the non-test board was much more flexible than test boards in the sense that it would bend along scorelines much more easily than its stiffer counterparts. This speeds up the packing procedure considerably.

Regarding ease of loading, it was found that with a minimal amount of practice, wheelcovers could be packed into any given container as fast as or faster than any previous method, including the method in use at the production line. Table 3 lists the comparison of packing times required for the old and new methods, the old referring to the method which was in use at the time. Table 1 is a comparison of the old containers and the new containers by dimensions, board area and material and volume savings. Table 2 is a cost comparison between old and new containers. (Also see Figures 15a,b, 16a,b,c,d, and 17)

At the users plant the wheelcovers would be easily removed from their containers for use, since there were no locking devices or any tricks to removal.

TABLE 1

COMPARISON OF OLD AND NEW CONTAINERS
(Dimensions, Board Area, Material and Volume Saved)

Unit	Board Area	Container Dimensions	Material Reduction	Pre-Use Storage Saved	Filled Volume Reduction
I. Accessory Kit					
Old: Container	1424 in^2	$12\frac{1}{8}x14\frac{3}{8}x14\frac{3}{8}$			
Inserts (2)	399 in		311 in^2		
New: Container	1242 in	$9\frac{1}{2}x17x14$	17.1%	33.7%*	463 in^3
Insert (1)	270 in				14.4%
II. Master Carton					
Old: Three Kits	5469 in^2				
Master Carton	3064 in	$37x14\frac{1}{2}x14\frac{7}{8}$	986 in^2		
New: Three Kits	4536 in		11.6%	29.3%*	621 in^3
Master Carton	3011 in	$29x17\frac{1}{2}x14\frac{1}{2}$			7.7%
III. Production Pack					
Old: Container	3913 in^2	$30\frac{1}{2}x14\frac{1}{4}x28\frac{1}{2}$			
Layer Insert	450 in				
Ten Inserts	2000 in		97 in^2		
New: Container	4174 in	$17x27\frac{1}{4}x28\frac{3}{4}$	1.4%**	21.1%*	932 in^3 Increase *
Layer Insert	472 in				& 7% Increase**
Six Inserts	1620 in				

*Includes material savings plus thickness changes in converting from C-flute to B-flute containers.

**Notice that the number of units per carton is increased from 20 to 24. Therefore 20% more units are packed in the above new container.

TABLE 2

COST COMPARISON BETWEEN OLD AND NEW CONTAINERS

Container	Old	New
I. Accessory Kit	$202.50/1000 Includes Setup, Printing & Liners	$191.20/1000 Includes Setup, Printing & Liners
II. Master Carton	$317.55/1000 Includes Setup	$302.55/1000 Includes Setup
III. Production Pack	$605.55/1000 Includes Setup & Liners (20 Units)	$671.55/1000 Includes Setup & Liners (24 Units)

Cost Changes:

I. Accessory Kit	5.6% cost Reduction
II. Master Carton	4.8% cost Reduction
III. Production Pack	8.9% cost Increase for 20% increase in units packed. (Represents an approximate 10% Reduction in cost)

TABLE 3

COMPARISON OF PACKING TIMES REQUIRED FOR OLD AND NEW METHODS

A. Accessory Kit (4 units/container) and (3 Kits/Master Carton)

Time required for complete packing through sealing of the Master Carton (12 units total)

Old Method . . . . . . 1 minute 42 seconds*
New Method . . . . . . 1 minute 40 seconds*

B. Production Pack

Time required through sealing of the container

Old Method (20 units) 2 minutes 26 seconds*
New Method (24 units) 1 minute 54 seconds*

32 seconds saved or 20% time reduction to pack 20% more units.

This represents a 50% Increase in production rate for the Production Pack.

*Based upon ten trials by the author.

CHAPTER III

SUGGESTED PACKAGING PROCEDURE FOR THE NEW METHOD

The following is a suggested procedure for packing the wheelcovers by the new method. It is fully realized that individual differences may be cause for slight variation in the procedure. However, the general order listed below seemed to the author to be the most efficient means.

A. Accessory Kit (4 wheelcovers/container)

1. Set up container and tape the bottom.

2. Place container in appropriate position (height and distance) at the end of the assembly line. (A slight downward slope is desirable)

3. Have inserts stacked close to the end of the assembly line within easy reach of the packer.

4. Fill the container as follows:

    a. Place the first wheelcover with its back to the container wall and one edge in contact with the container sidewall. (Left or right according to individual ease)

    b. Hold an insert on one end with the inner score line towards the body.

    c. With the other hand fold the insert and end the action by pinching along the second set of score lines with one hand.

    d. Holding the insert in a folded position, place it into the container such that the second score line from the edge is in line with the centermost edge of the cone of the first wheelcover. Let go of the insert allowing it to spring open.

e. Place a second wheelcover in the container with its face towards the first wheelcover and off-center such that the wheelcover edge touches the container sidewall opposite the first wheelcover.

f. Place a third wheelcover with its back to the back of the second and centered with the second.

g. Bring the wrap-around insert into contact with the finished side of the third wheelcover.

h. Place the fourth wheelcover into the container facing the third and centered with the first.

i. Some forcing is necessary at this point in order to push the insert into its proper place. However, pushing on the fourth wheelcover should insure proper placement.

j. Push the filled container away to make room for the next.

k. Tape the filled container shut.

5. Three accessory kits are placed in a set up master carton and the master carton taped shut for shipment. (12 wheelcovers/master carton.)

B. Production Pack (24 wheelcovers/container). The procedure here is essentially the same as that used for the accessory kit with the following exceptions:

1. In addition to container setup and taping on the bottom, the packer should tape the top flaps open for easier loading.

2. Three groups of four wheelcovers are packed in each of two layers with a corrugated insert between layers. (24 units/container.)

3. The container is taped shut ready for shipment.

CHAPTER IV

SUGGESTIONS FOR FURTHER WORK

A long range goal for this manufacturer of wheel-covers, as regards its packaging system, was to bring the packing rate up to the rated capacity of the production and assembly lines. The suggestions by the author have been ones of an economic nature, with the immediate intent of cutting packaging costs without lowering the packing rate. The new method suggested should also increase production. However, this increase would not bring the rate up to the desired level.

Therefore, if one were to continue work on this project, his goal would be to somehow increase packaging capacity to the level of the production capacity. It is the authors intent here to suggest possible roads to this goal.

There appear to be three routes towards increasing packaging capacity. The first would be to increase, by numbers, the present manual system. Second would be to install machinery to perform the actions presently performed manually. Third would be to completely redesign the packaging system from scratch. These three modes of action will be discussed separately.

The first method would probably be the easiest to perform, that is, the fastest means to increased packaging capacity. This would consist of splitting the packaging line into two or three lines. This would enable the packaging crew to handle two or three times as many wheelcovers coming off the line.

However, this would also entail the use of two to three times as much labor and for that reason would not be a good means of permanently increasing packing rates. Nevertheless, this would be an immediate means of increasing production if the need should arise. This would only be recommended as an emergency procedure, however, since it does involve a relatively great increase in packaging labor costs.

The second manner by which packaging capacity could be increased would be to automate the present system, maintaining present containers and internal packaging. This could be accomplished by designing machinery that would duplicate or modify present manual steps from taking the wheelcovers off the final assembly table to sealing the packed container and pushing it out the door.

It is believed that this scheme would be very costly since it would involve a considerable amount of machinery design and construction. Also, if this method were adopted, the resulting machinery would be quite restricted and specialized. Due to the changing nature of the product from year to year, machinery of this type would become obsolete in a very short time. The conclusions here are that this would be an extremely expensive and non-versatile method of increasing production in the packaging line.

The third suggested method would be, in the writer's opinion, the method with the most possibilities as to flexibility in choice. The first point to be made here is that a complete revision of the packaging system would cost no more, and possibly less, than the above mentioned choice.

There is, at this time, no machinery for packaging in the plant. Therefore, there would be no equipment to sell or possibly write off as a loss. Complete freedom of design would be another advantage, with the only restriction being the floor space available for equipment. (And this is no real problem.)

Overwrap machines available on the market have proven themselves to be quite versatile machinery. This opens the possibility of designing an interior packaging system which would serve all the support functions needed for the wheelcovers, and then putting on an overwrap of kraft paper. This could, conceivably, lead to an extremely low cost package with greatly increased production rate. These two savings could easily justify the cost of machinery.

The factor of the most importance here would be to consider machinery that could be converted rather easily and with minimal cost for year-to-year style changes.

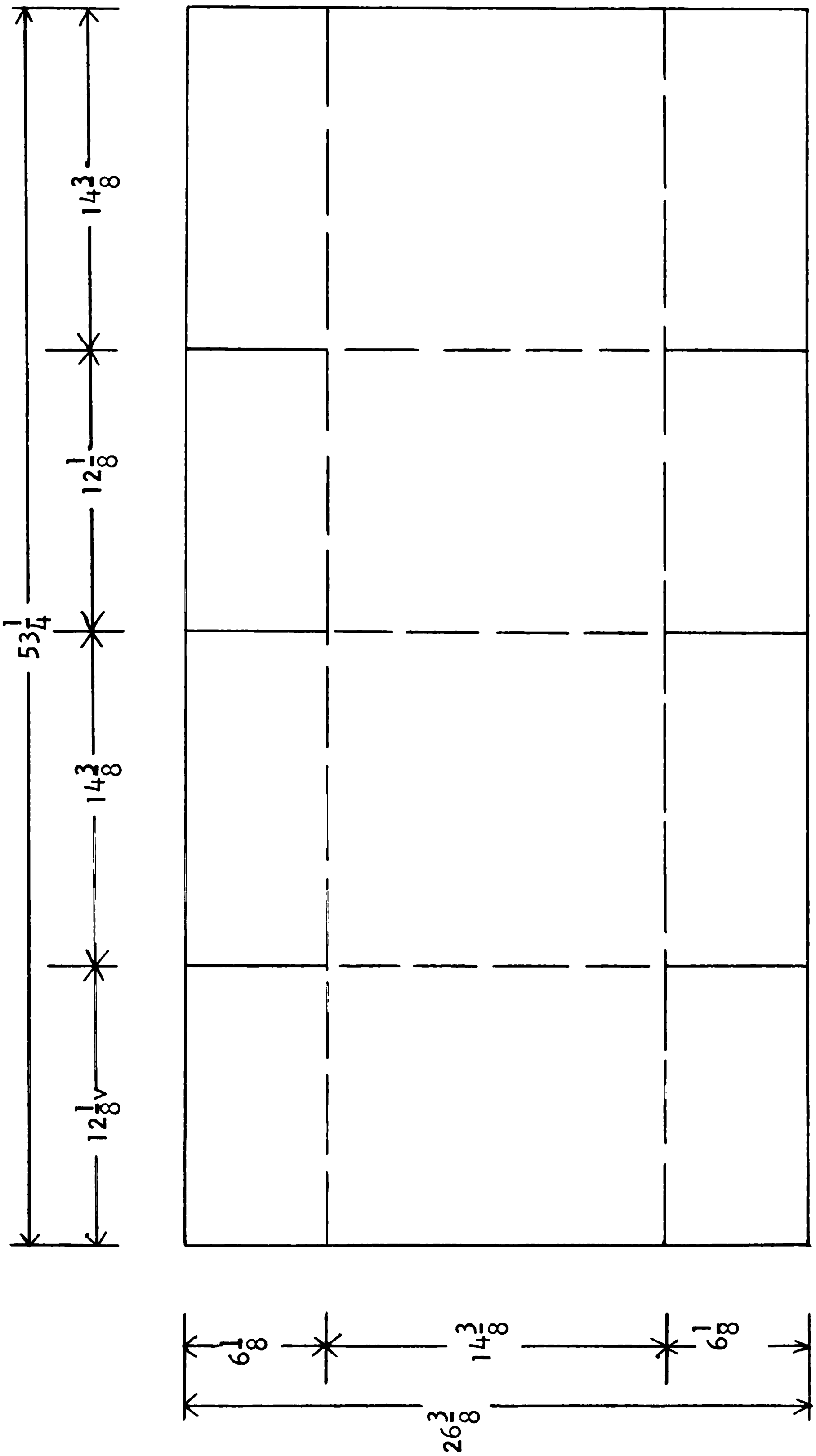


Fig. 1.--Present Four-Unit Kit

Scale: 1cm.= 3in.

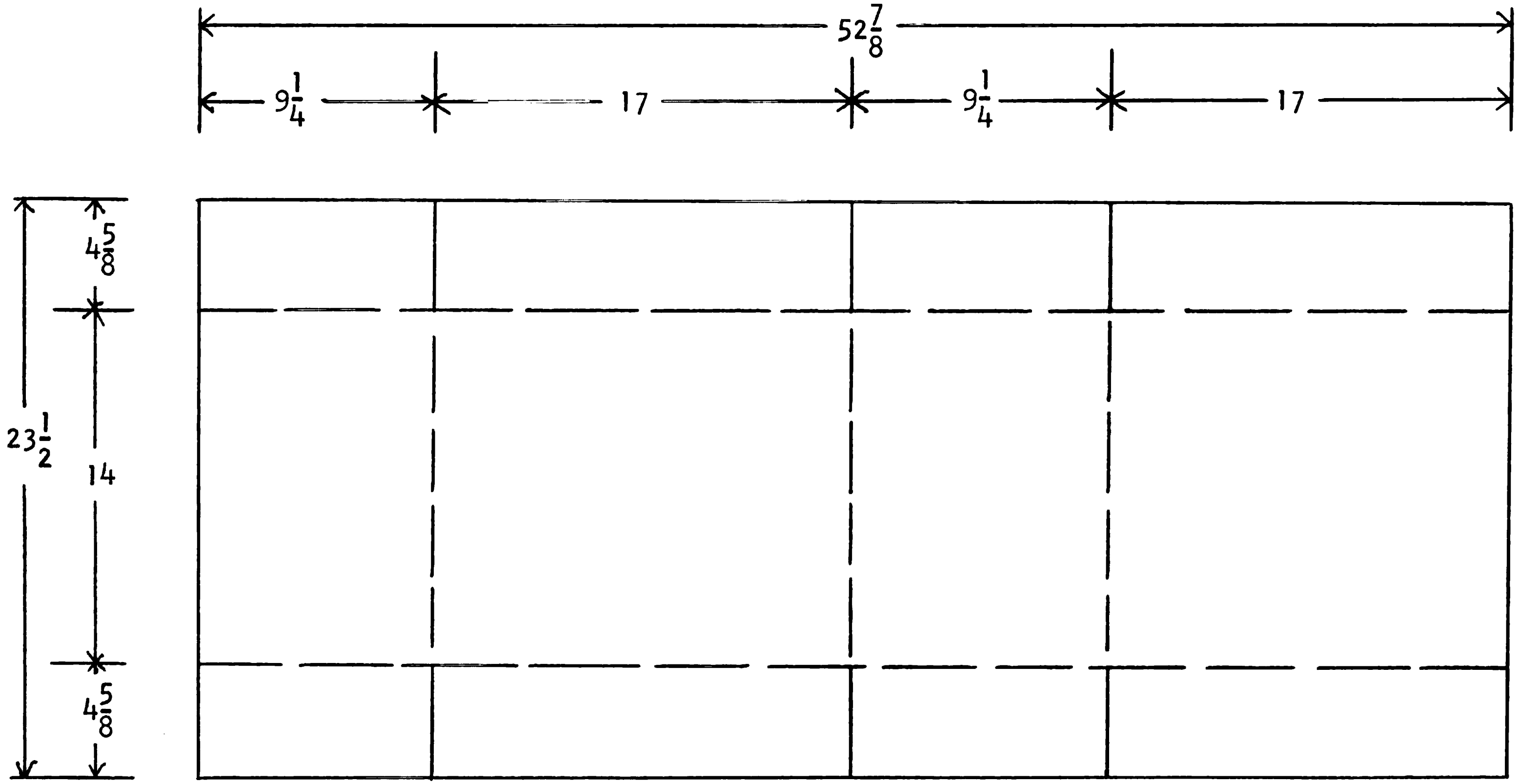


Fig. 2.--Proposed Four-Unit Kit

Scale: 1cm.= 3in.

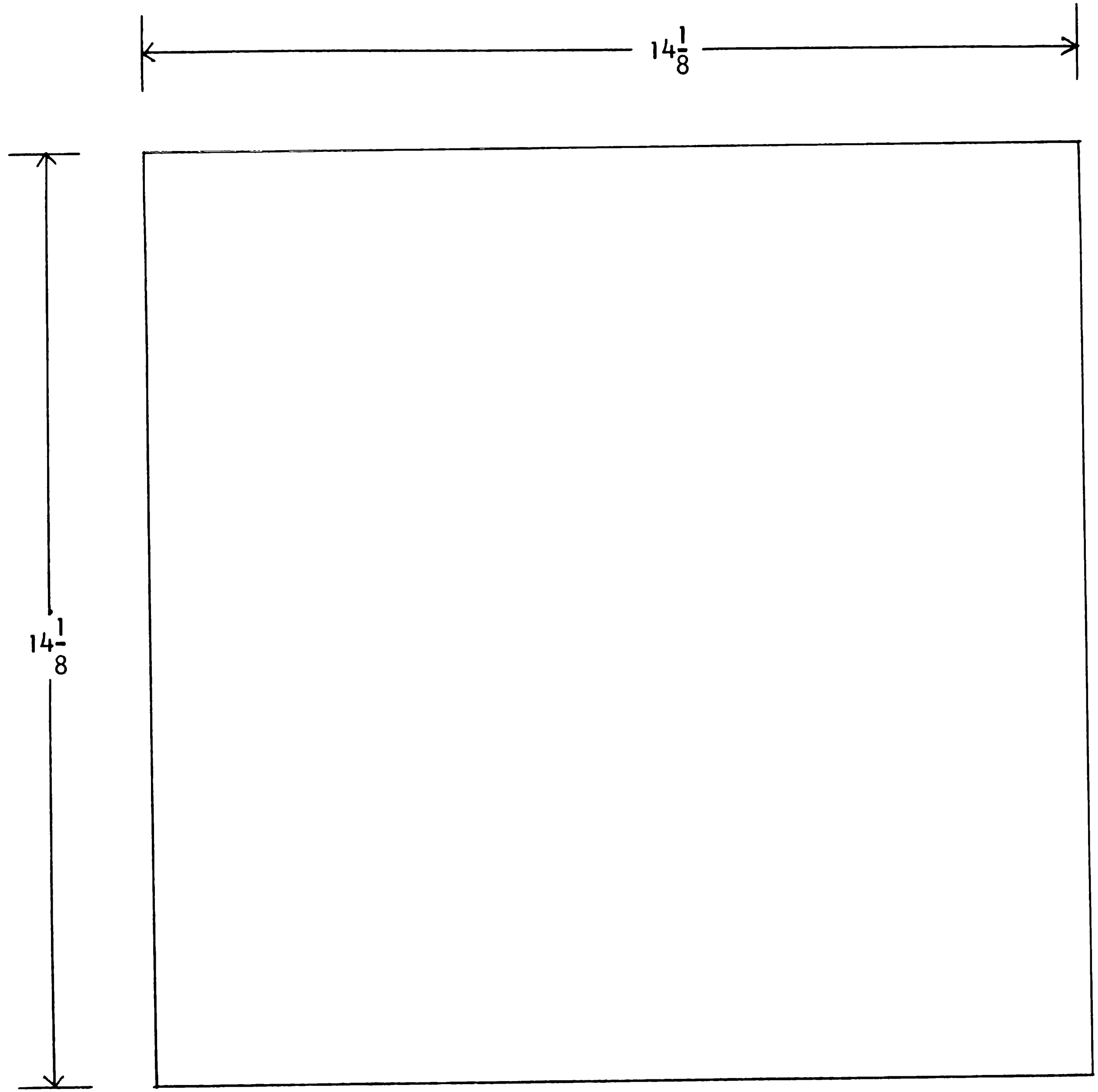


Fig. 3.--Present General Purpose Insert

Scale: 1cm.= 1in.

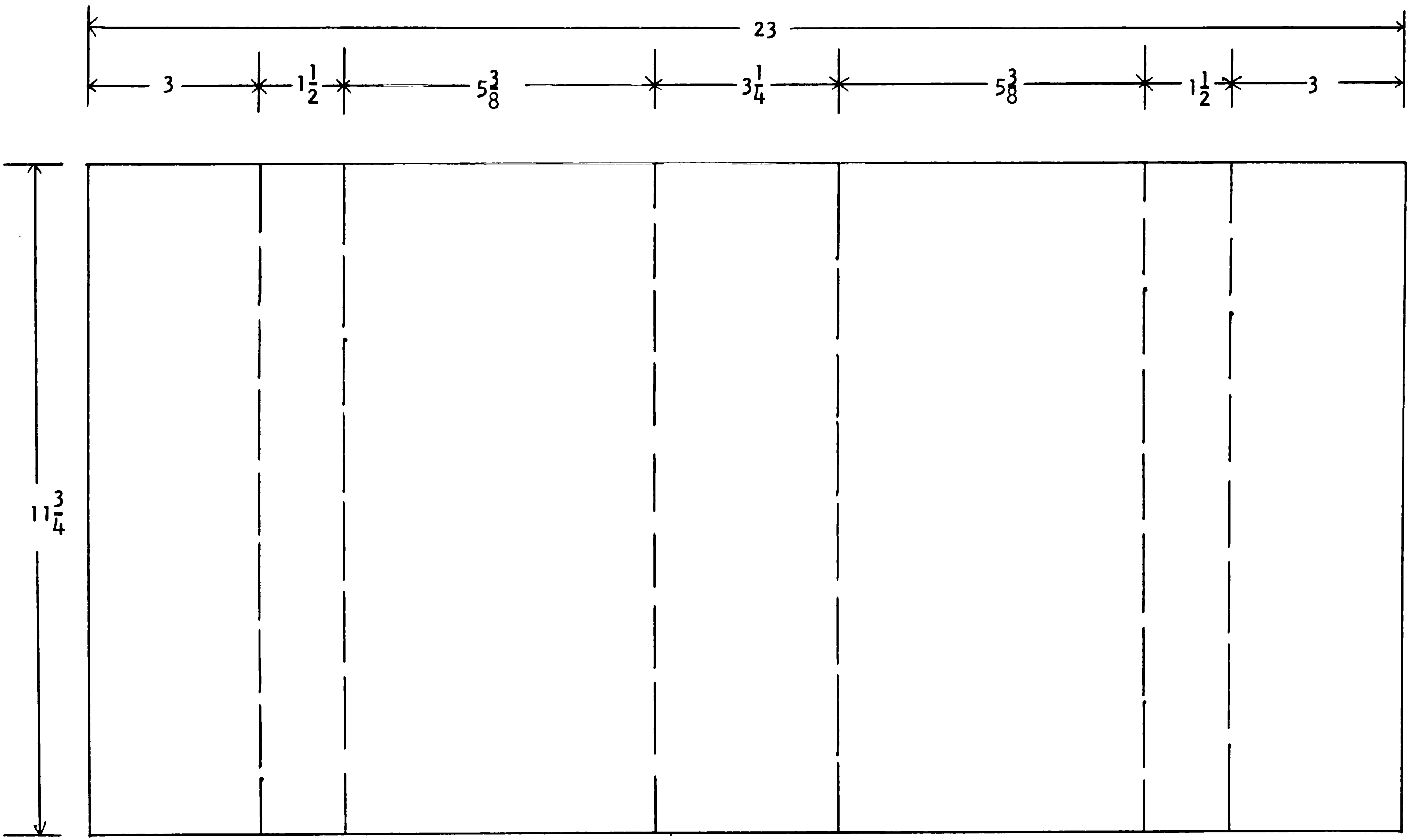


Fig. 4.--Proposed General Purpose Insert

Scale: 1cm.= 1in.

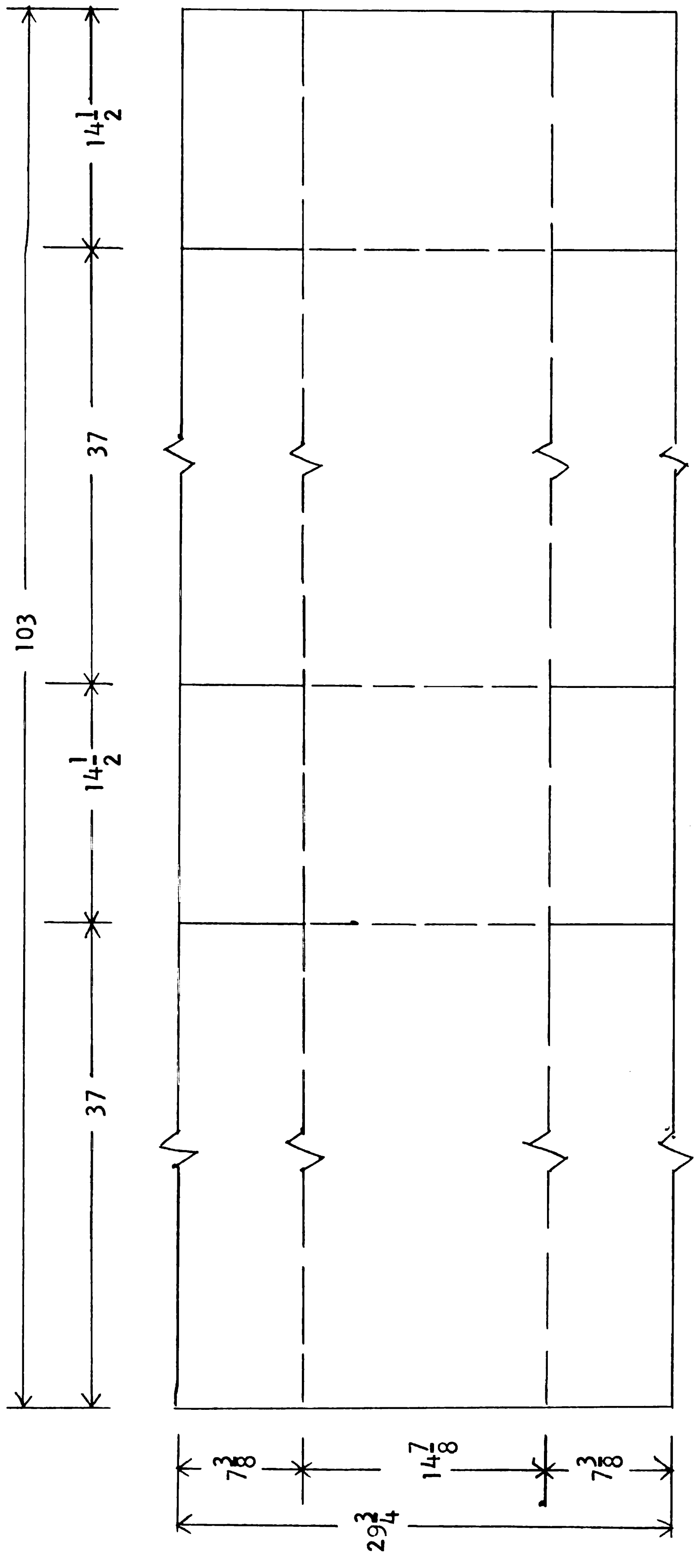


Fig. 5--Present Master Carton

Scale: 1cm.= 4in.

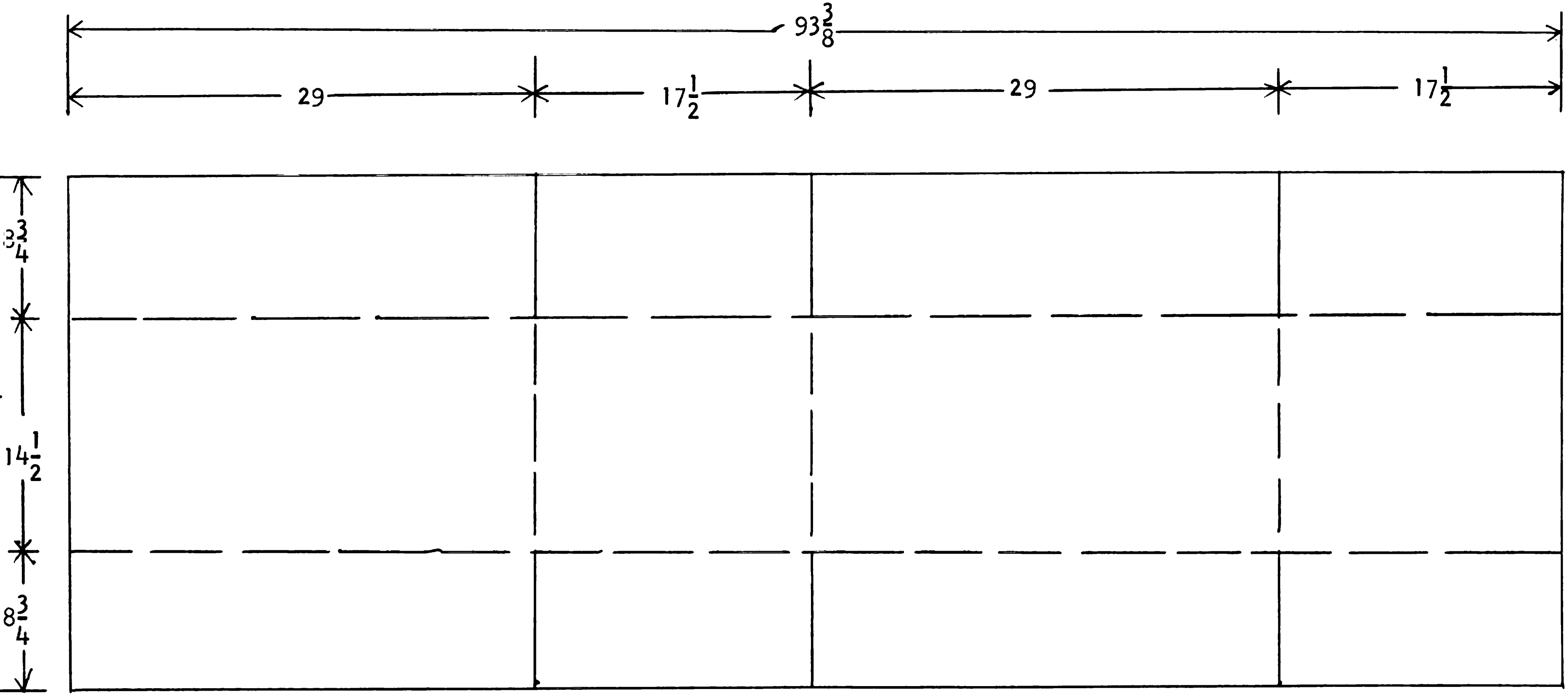


Fig. 6.--Proposed Master Carton

Scale: 1cm.= 4in.

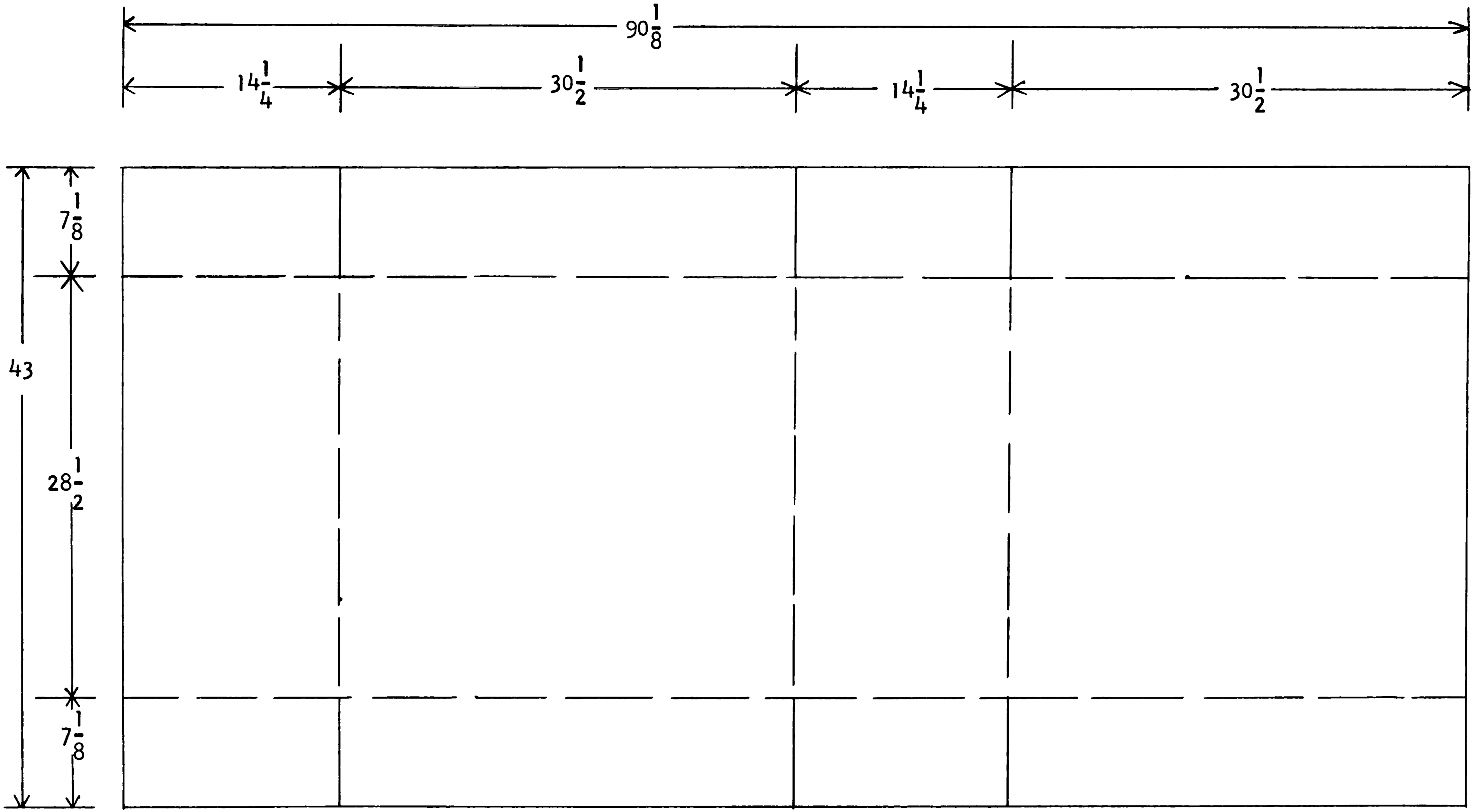
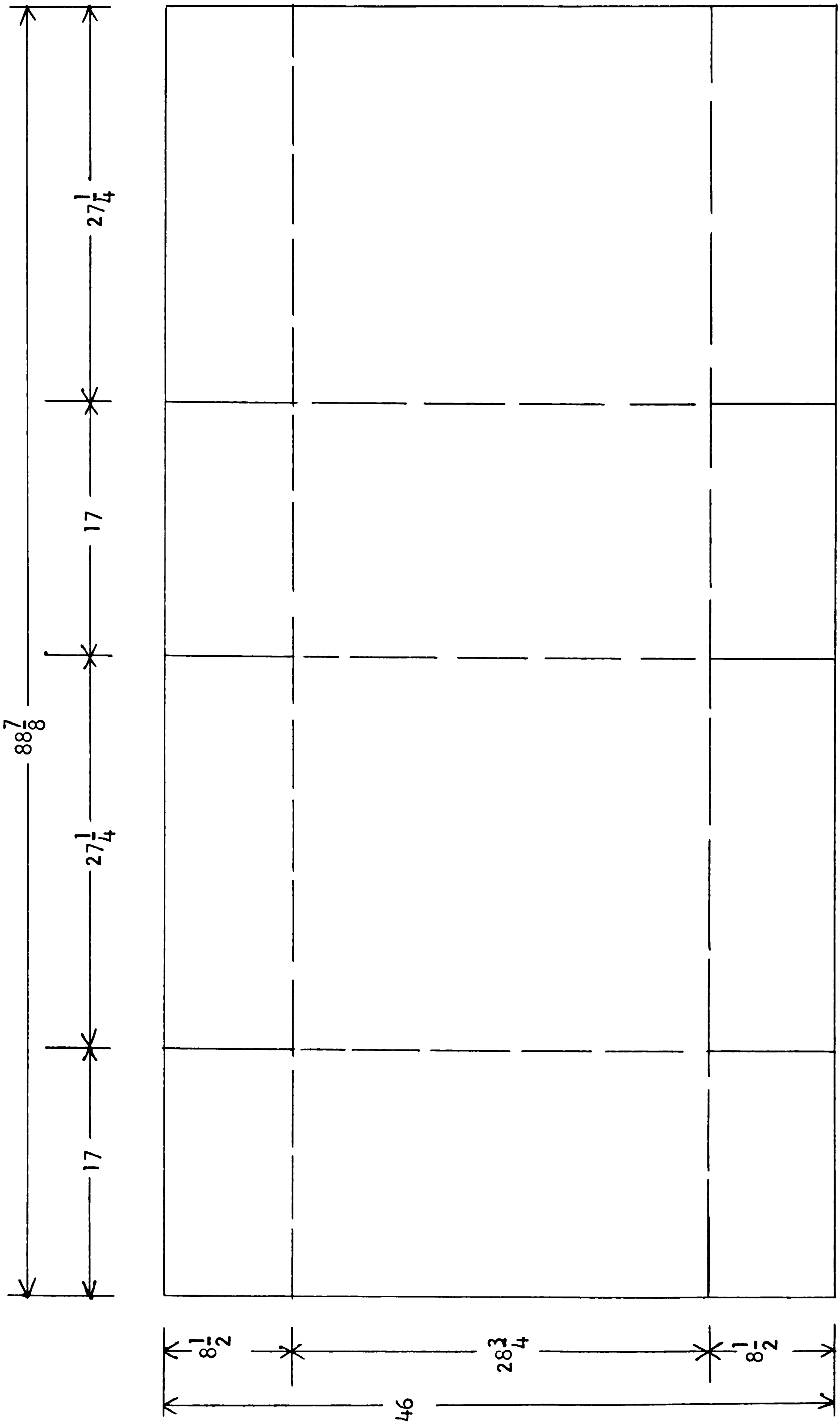


Fig. 7.--Present Production Pack

Scale: 1cm.= 4in.



Scale: 1cm.= 4in.

Fig. 8.--Proposed Production Pack

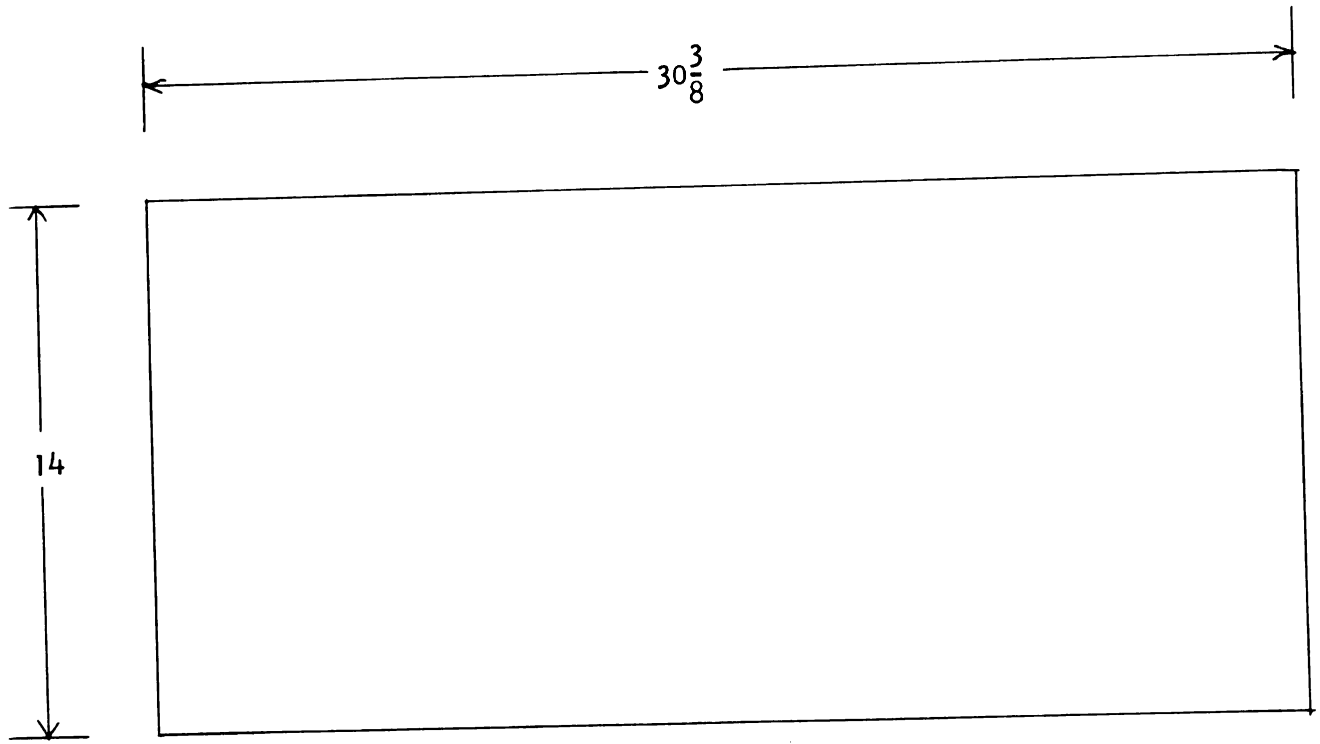


Fig. 9.--Present Layer Insert

Scale: 1cm.= 2in.

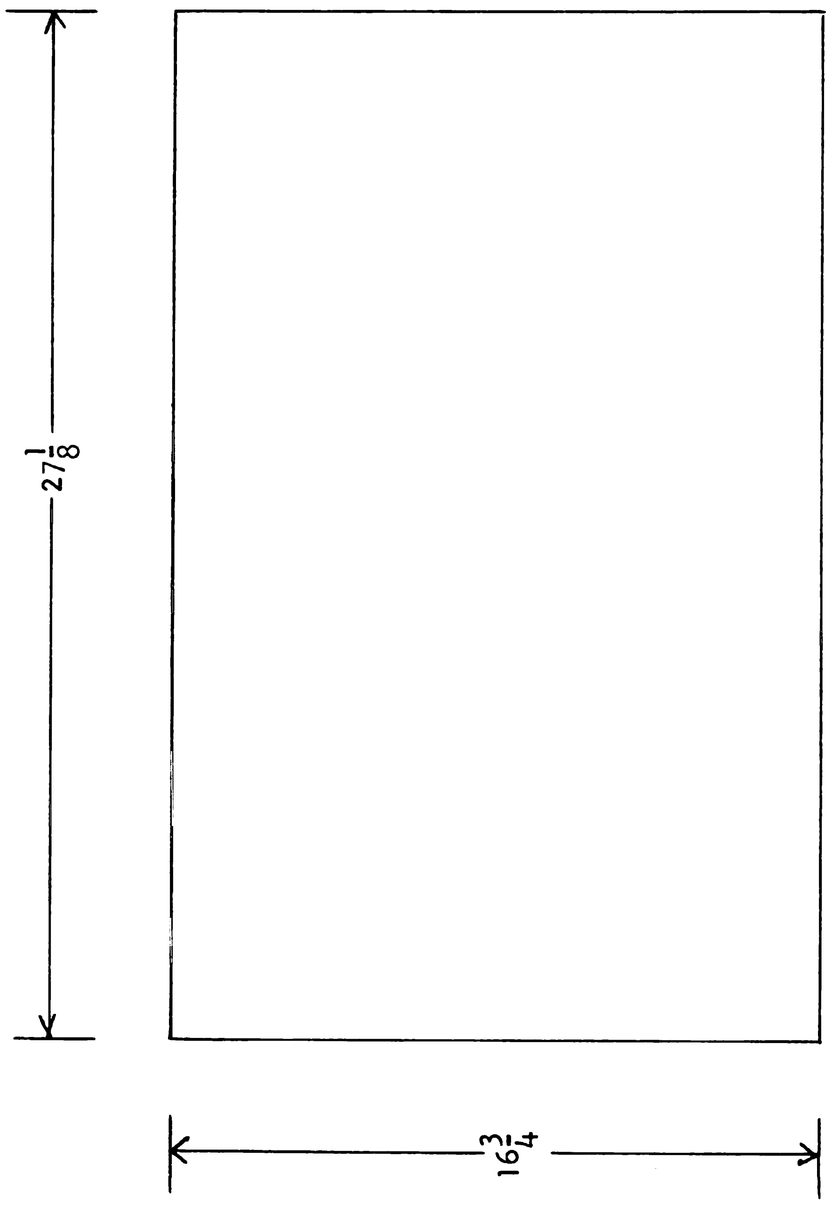


Fig. 10.--Proposed Layer Insert

Scale: 1cm.= 2in.

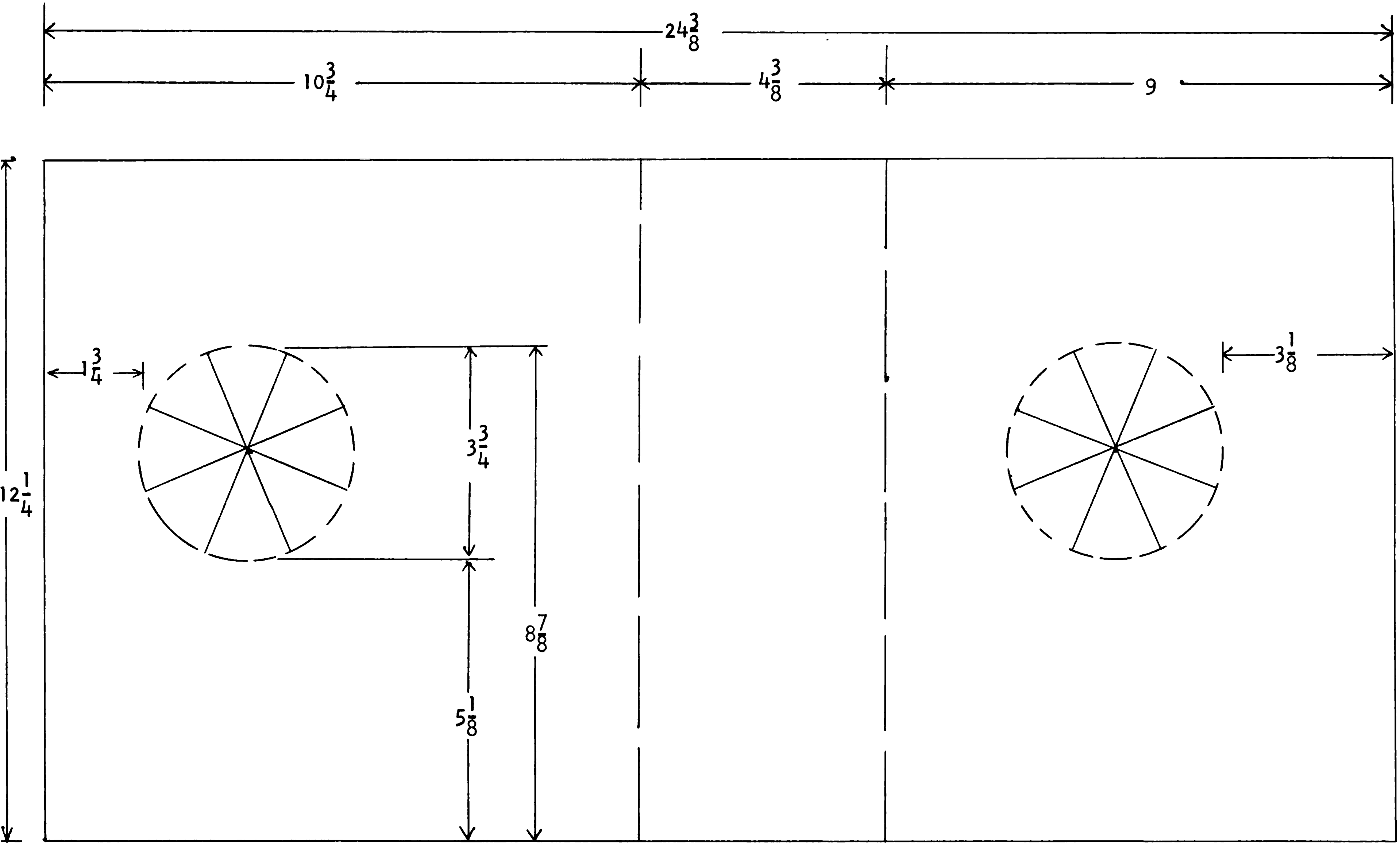


Fig. 11.--Discarded Sunburst Insert

Scale: 1cm.= 1in.

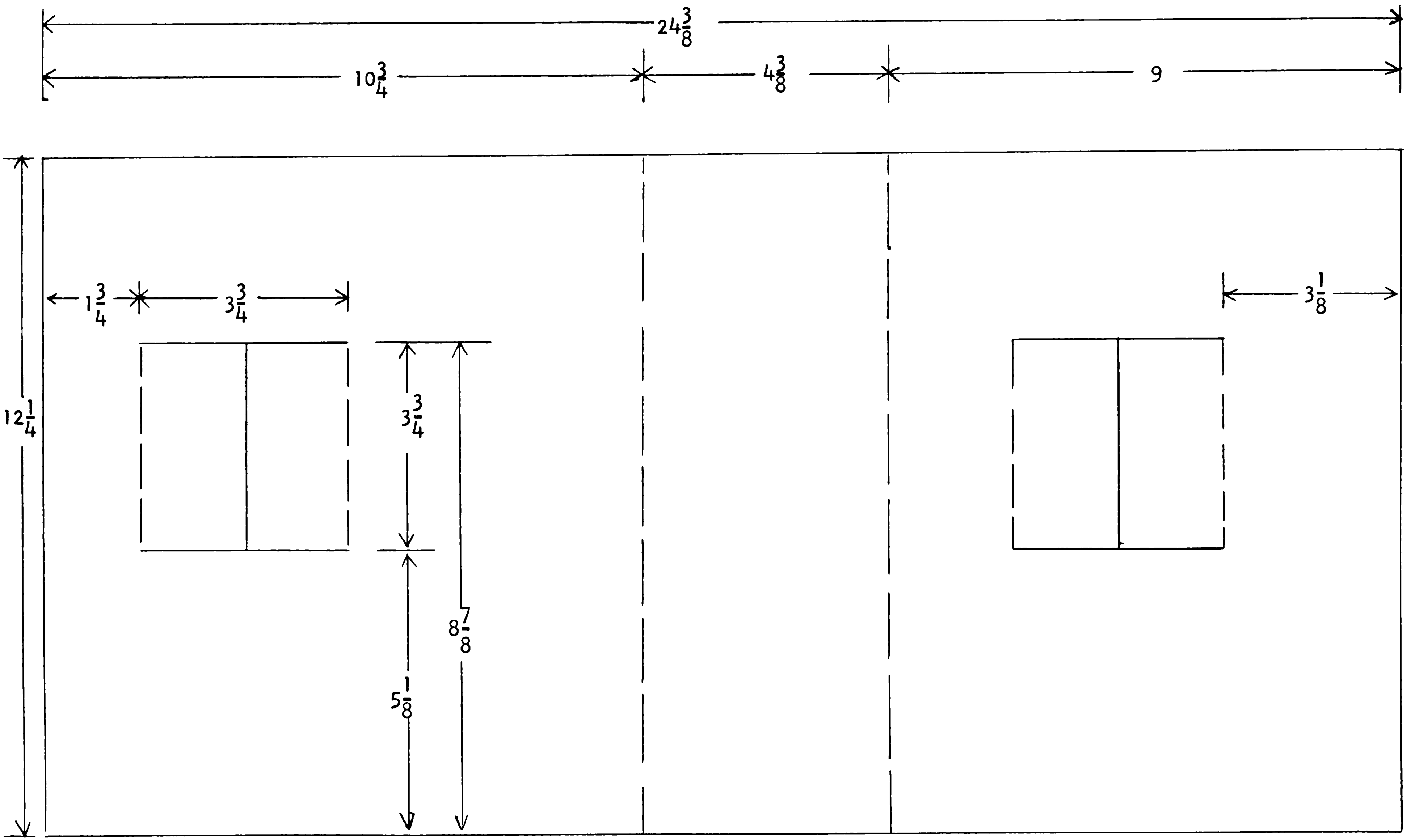


Fig. 12.--Discarded Trap-Door Insert

Scale: 1cm.= 1in.

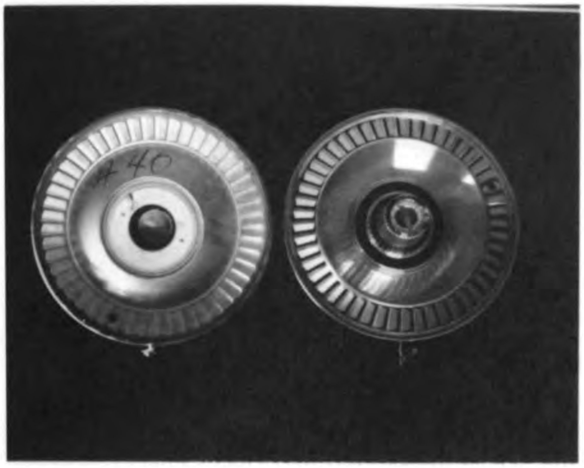
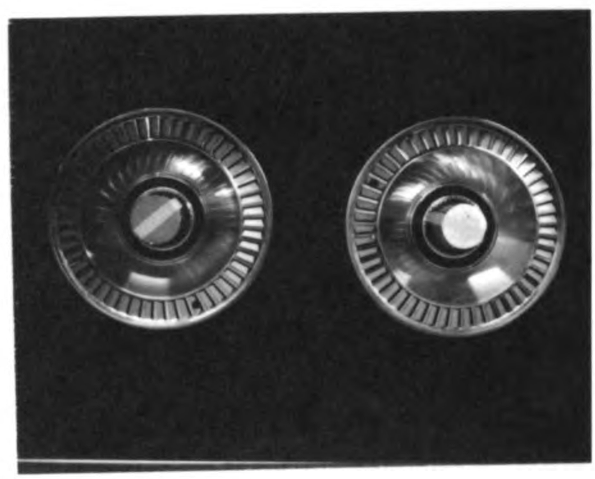


Fig. 13 a.

Fig. 13 b.



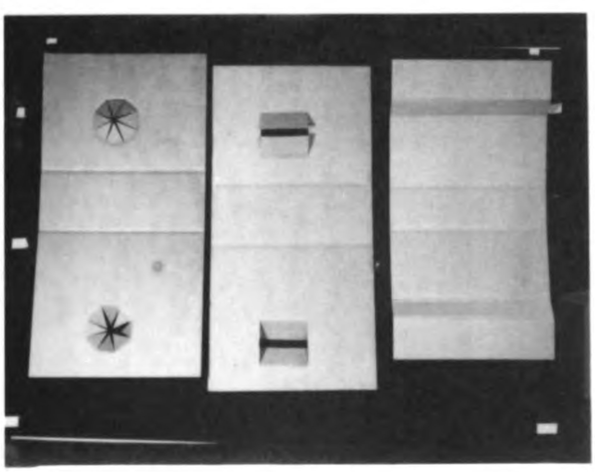


Fig. 13 c.

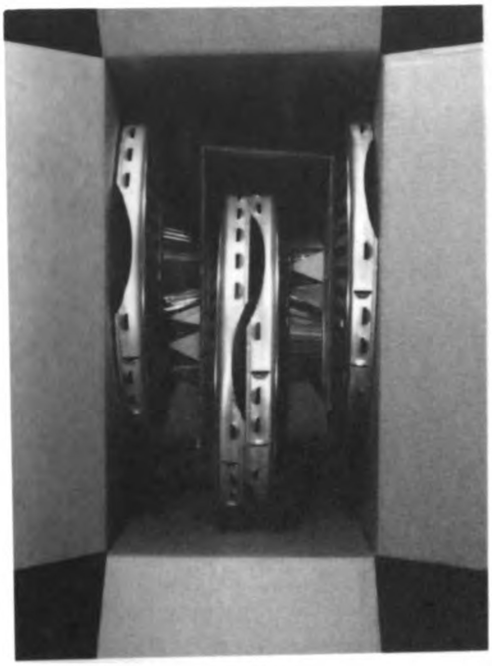


Fig. 14 a.

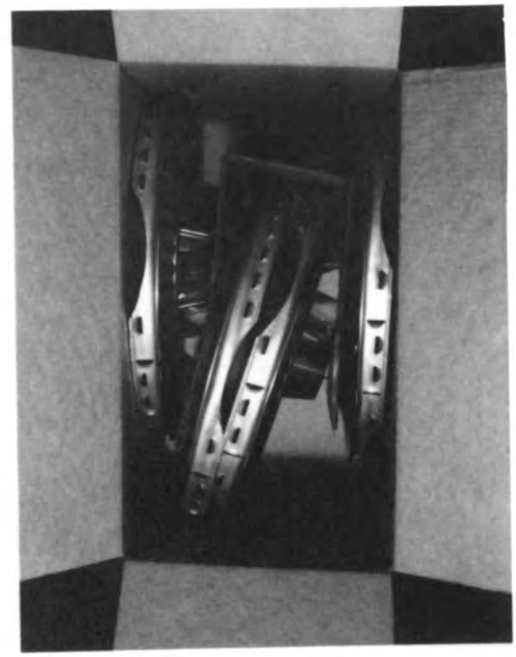


Fig. 14 b.

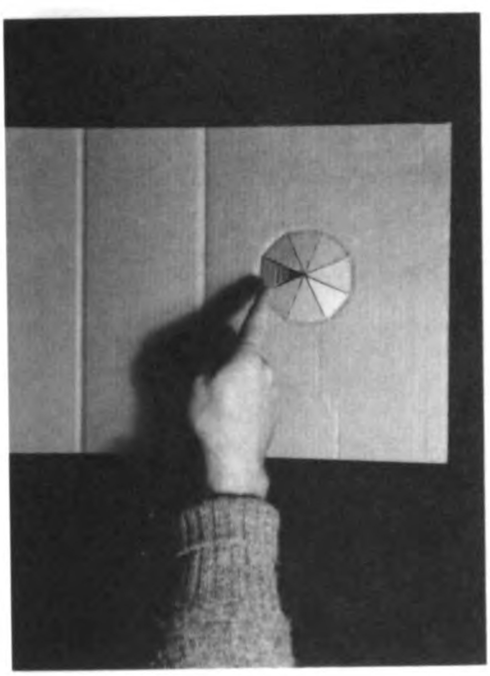


Fig. 14c.

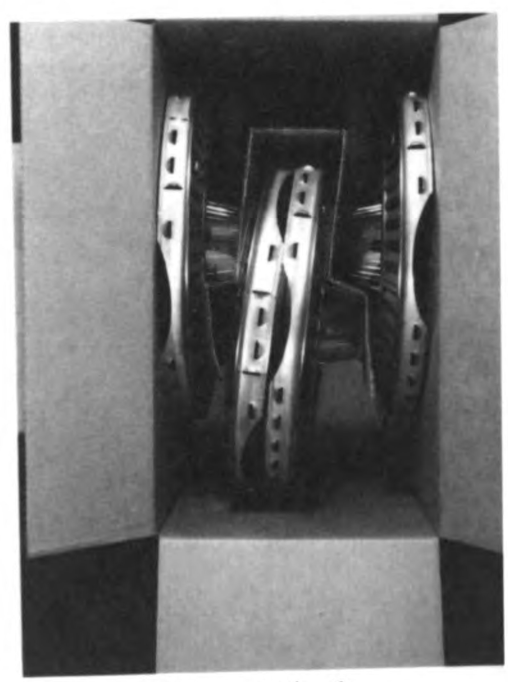


Fig. 14d.

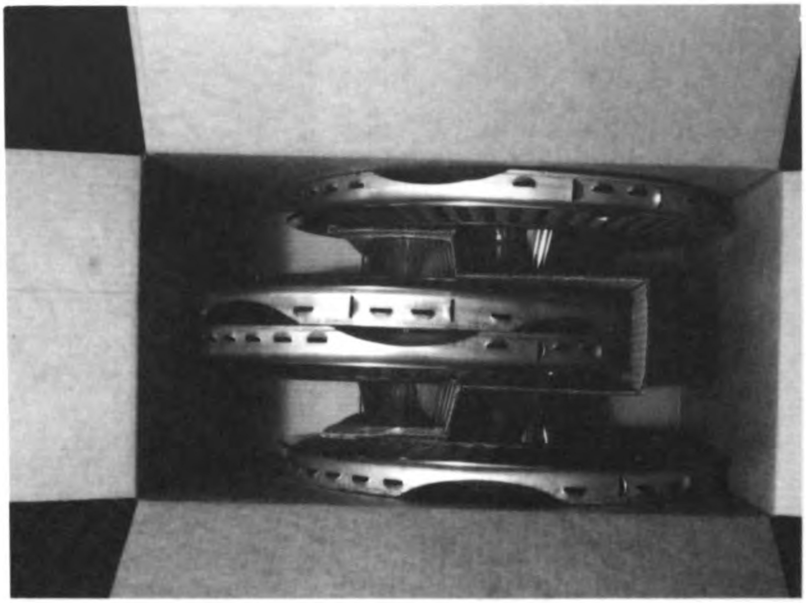


Fig. 15 a.

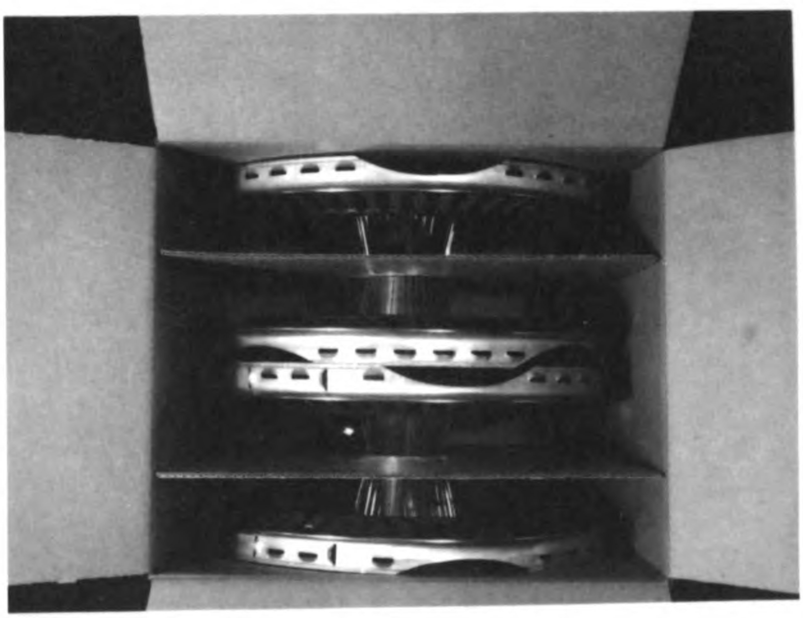


Fig. 15 b.

Fig. 16a.

Fig. 16b.

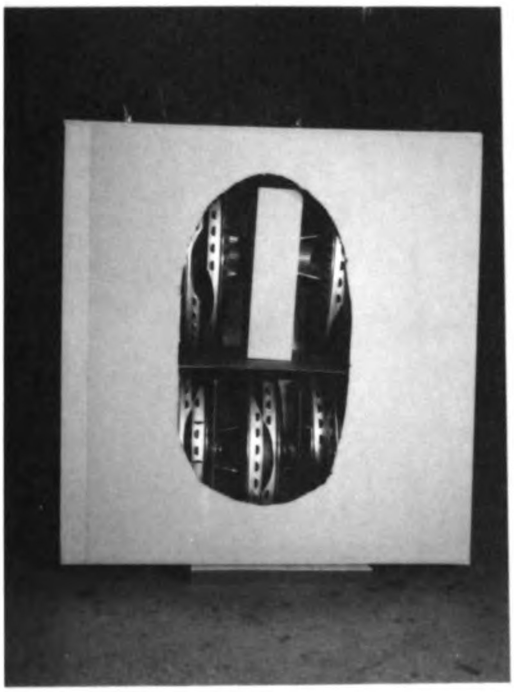


Fig. 16c.

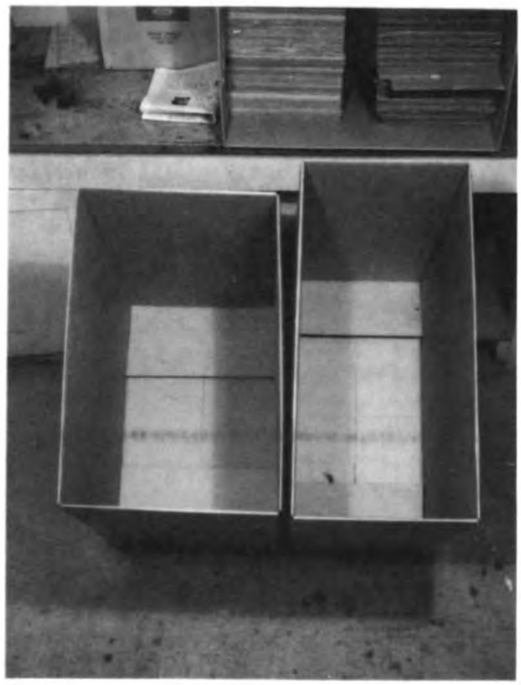


Fig. 16d.

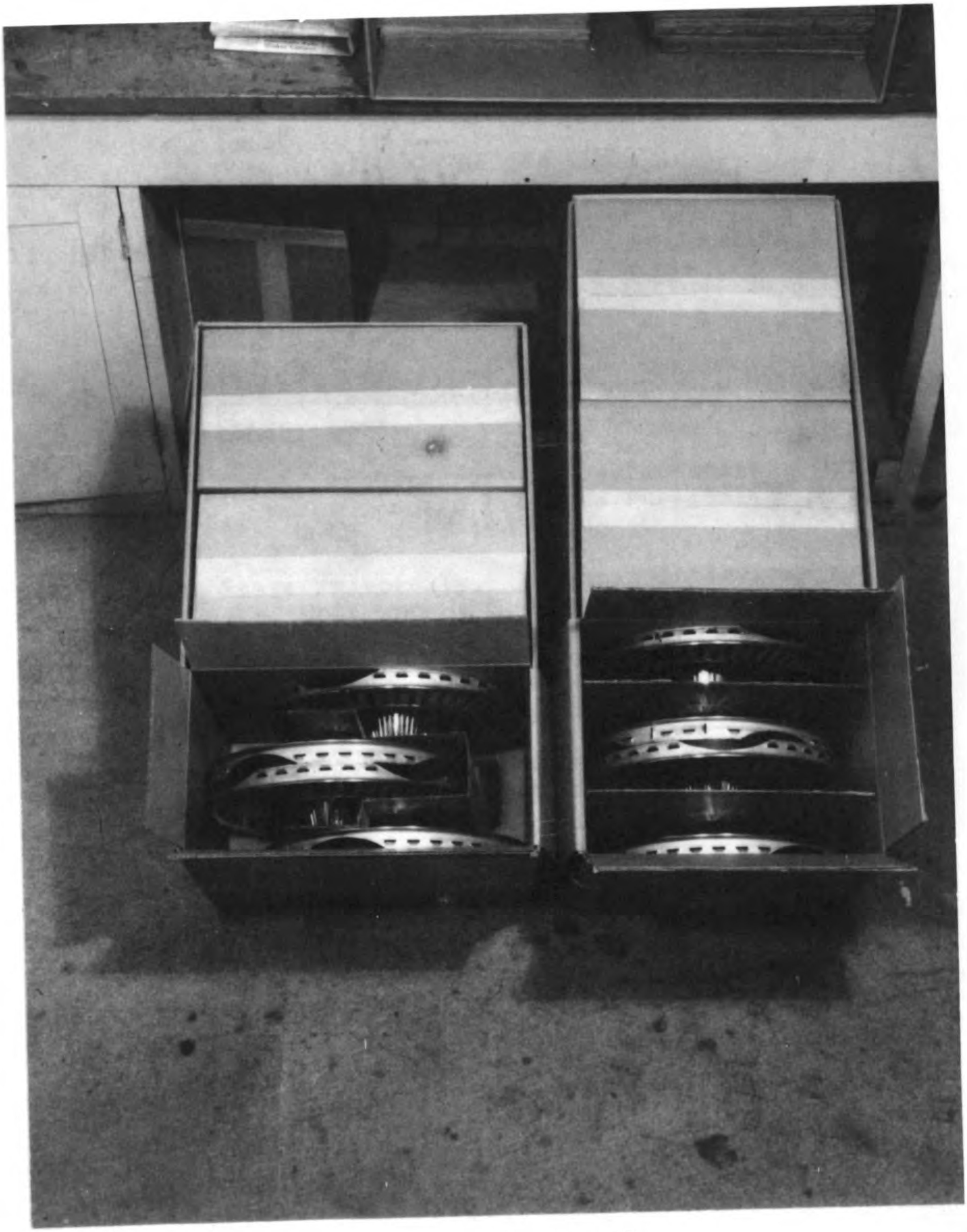


Fig. 17.

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