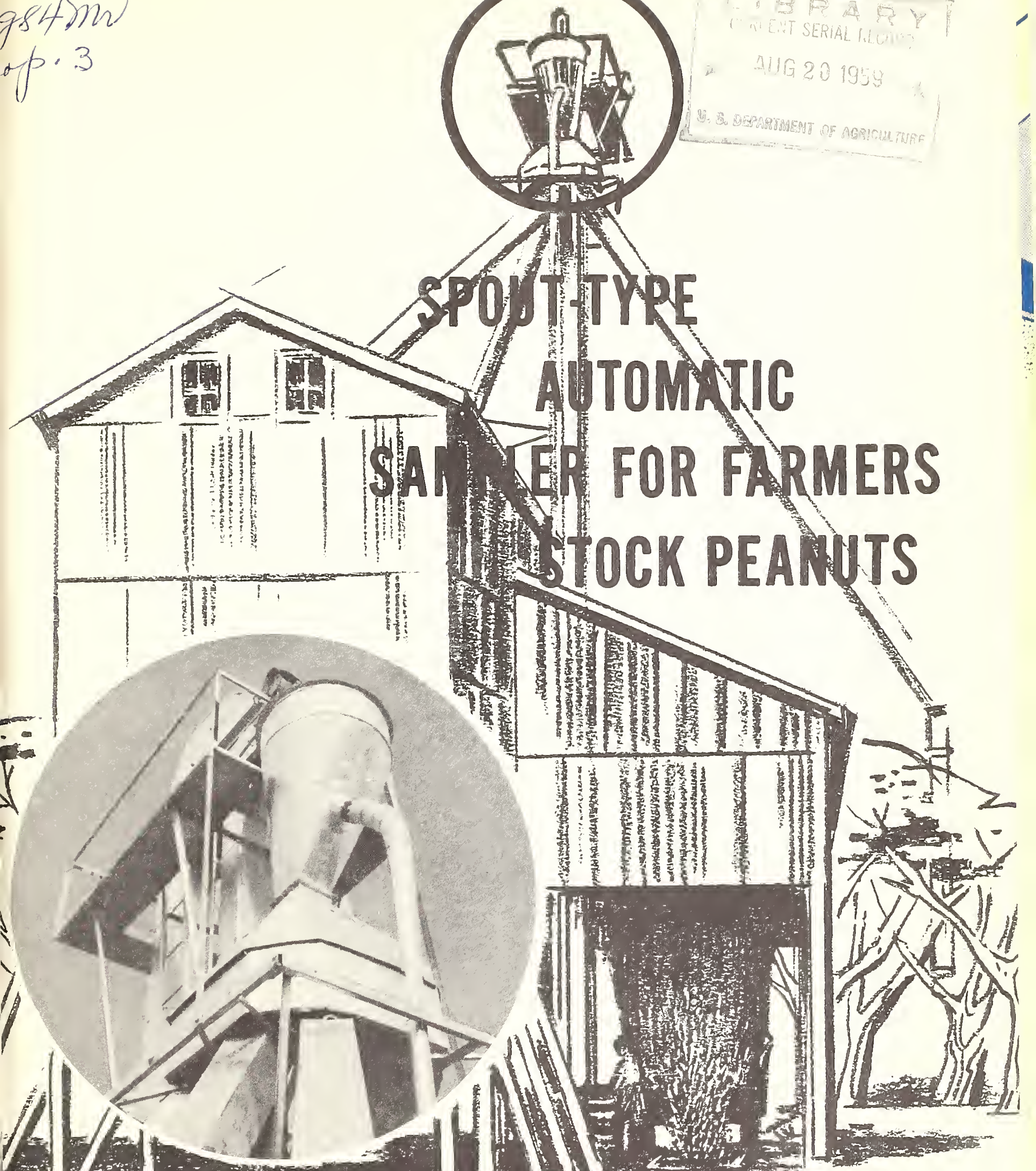
SPOUT-TYPE AUTOMATIC SAMPLER FOR FARMERS STOCK PEANUTS



Marketing Research Report No. 353

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Agricultural Marketing Service
Marketing Research Division

PREFACE

This study is part of a broad program of marketing research designed to maintain quality of farm products, develop and expand markets, improve marketing services, and hold down the costs and increase the efficiency of marketing farm products. This phase of the program is conducted to develop techniques, methods, and devices for the objective measurement of quality factors in agricultural commodities.

The cooperation and assistance of the following persons and firms is gratefully acknowledged:

Mr. Thos. J. Pearsall and Mr. R. M. Adcox of the M. C. Braswell Company, Battleboro, N. C., provided facilities and labor to carry out the tests.

Mr. Bailey Rich and other members of the North Carolina Peanut Inspection Service analyzed the many samples drawn during the tests.

Mr. Malcolm Smith and Mr. Richard Bartlett, Fruit and Vegetable Division, AMS, assisted in conducting the tests and analyzing the data.

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SUMMARY

A spout-type automatic sampler has been designed for farmers stock peanuts handled in bulk. It has been installed and tested under full-scale operating conditions at a peanut-buying point. This sampler has met requirements for reliability and accuracy and has been approved by the Fruit and Vegetable Division, AMS, and the Oils and Peanut Division, CSS, as a means of sampling for official grading. This applies to inspection for both commercial purchases and storage under Government loans. Tests have shown that samples drawn by the spout-type automatic sampler are more accurate and less variable than samples drawn by the scoop-sampling method.

The design of the sampler is such that it may be expected to draw representative samples of any commodity which is normally handled by a belt and bucket elevator. Corn and soybeans have been successfully sampled. However, actual sampling tests have been conducted only with peanuts.

SPOUT-TYPE AUTOMATIC SAMPLER FOR FARMERS STOCK PEANUTS

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Agricultural Marketing Service

INTRODUCTION

It is customary to grade farmers stock peanuts at buying points located throughout the production areas. Since it is impracticable to grade the entire contents of loads of peanuts, delivered to the buying points, inspectors must base their grade determinations upon small samples taken from the respective loads. If the small samples are not representative of the entire loads, accurate grades cannot be determined.

BACKGROUND

Bulk handling of farmers stock peanuts is becoming increasingly popular. Most areas have already adopted this practice and it is anticipated that bulk handling will become a universal practice in the future. Under this system, peanuts are usually delivered to the buying points in trucks. The loads vary in size and the quality of the peanuts may vary considerably throughout the loads. It is difficult to obtain a representative sample from a bulk load of peanuts.

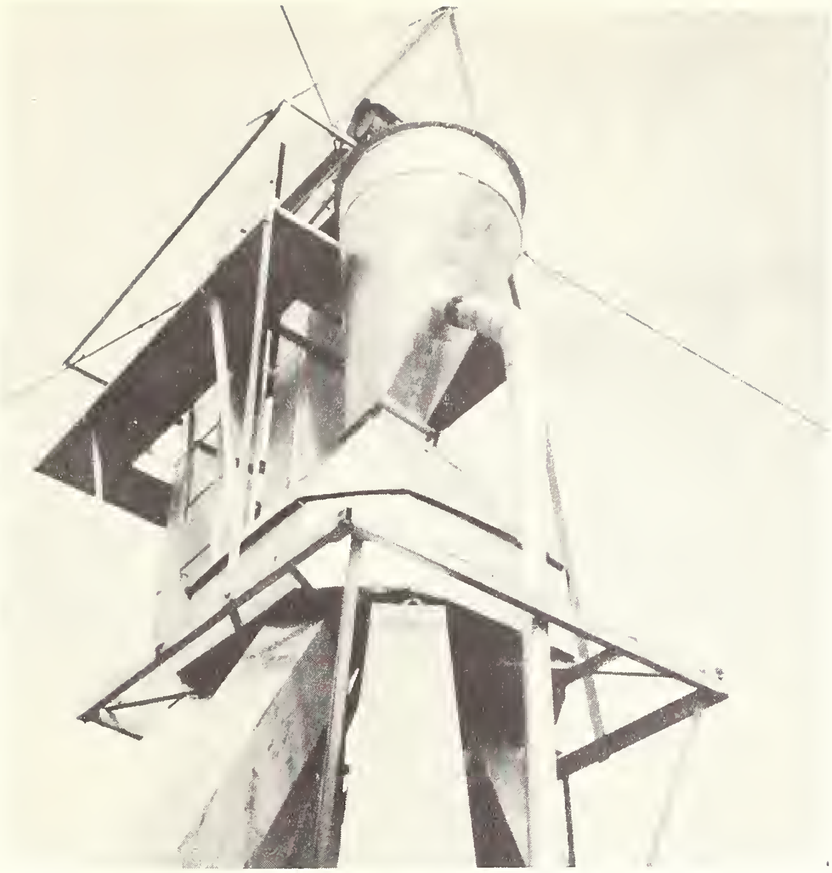
From the theory of sampling it is known that a representative sample of a product is more easily obtained if the product is moved past a given point in a thin stream. Small subsamples can then be taken from this stream at frequent intervals. In the case of farmers stock peanuts, this sampling can be done at some point along the conveying system which transfers peanuts from transporting vehicles to holding bins or storage.

A survey of present and anticipated future construction for bulk peanut-handling facilities was made. This led to the conclusion that the majority of peanut-buying points have already installed or will install belt and bucket-type elevators to elevate their product to holding bins or other storage. These elevators range in capacity up to fifty tons per hour and have discharge spouts up to 12 by 12 inches in cross-section.

DESCRIPTION OF SAMPLER

The spout-type automatic sampler draws samples of peanuts as they flow by gravity through the discharge spout of a belt and bucket elevator. The sampler is usually installed near the elevator head and above the distributor (fig. 1). Flanges are provided at top and bottom for bolting the sampler in place.

This sampler (fig. 2) has only one internal moving part, which consists of a deflector with a rectangular opening at the top. The deflector is attached to a vertical shaft. As this shaft rotates, the open deflector cuts across the entire cross-section of the spout and momentarily diverts the entire stream of peanuts flowing downward through the spout. The diverted peanuts flow to the center of rotation and then downward to the outside of the sampler and into a sample spout leading to the inspectors' sample box where the total sample for the lot or load accumulates. The vertical shaft is rotated by a totally enclosed gear-reduction motor having a vertical output shaft. A simple keyed-shaft coupling joins the two shafts end-to-end.

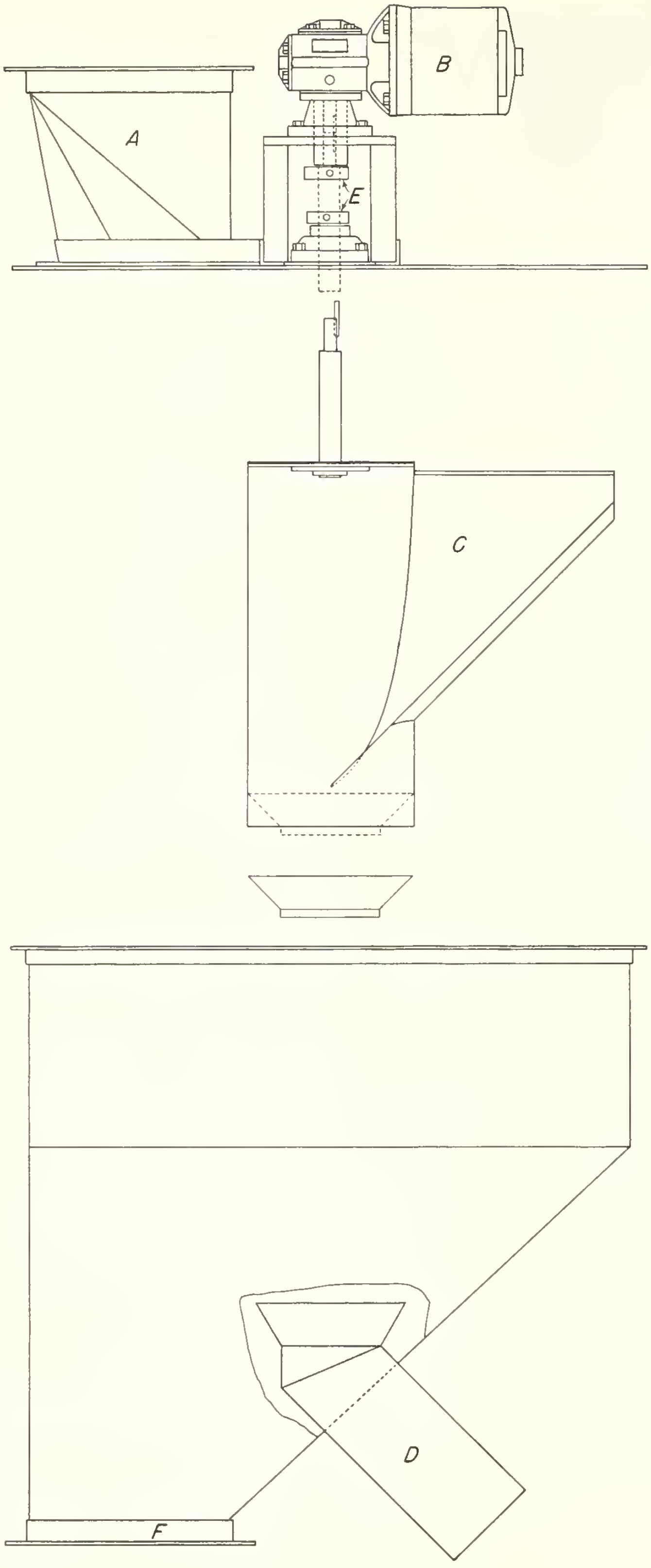


BN-7388
Figure 1.--Spout-type automatic sampler located between discharge point of belt and bucket elevator and distributor.

A commercially available timer is used to energize the electrical circuit to the motor. The desired sampling interval is set on a dial graduated from 0 to 60 seconds. A cam attached to the vertical shaft actuates a micro-switch which breaks the electrical circuit when the shaft has revolved to the "stopped" position. The timer automatically closes the circuit for the next cycle after the desired time interval has elapsed. In the stopped position, the deflector is always on the side of the shaft opposite the spout. Thus, there is no chance of it taking a continuous sample or of its obstructing the flow of peanuts.

The sampler's maximum horizontal dimension is 38 inches and its maximum vertical dimension is 48 inches. The upper and lower flanges are each 12 by 12 inches in size. A one-third horsepower motor provides adequate power.

Detailed information on the design and construction of the spout-type sampler is given in the Appendix of this report.



Peanuts enter sampler through inlet spout (A) at left of motor and speed reducer. (B) At predetermined intervals controlled by a remote timer, the deflector (C), which has a rectangular inlet at the top, rotates one revolution. While rotating one revolution, the rectangular inlet of the deflector passes under the inlet spout. Peanuts falling from the inlet spout enter the rectangular opening and are diverted to the center of rotation. The diverted peanuts then drop into and through the sample spout (D), leading from the deflector to the outside of the sampler, and become part of the total sample collected. Two cams (E) on the vertical shaft of the deflector actuate micro switches, which interrupt power to the electric motor (B) and cause the deflector (C) to stop at the location shown in the figure. Peanuts not diverted to the sample spout fall through the main outlet (F) of the sampler.

Figure 2. --Exploded view showing general construction of the sampler.

BN-8315-4

Figure 3.--Two inspectors independently drawing scoop samples from a load of farmers stock peanuts.

TESTS OF SAMPLER

The spout-type automatic sampler was installed at a peanut-buying point owned by the M. C. Braswell Company at Battleboro, N. C. It was operated during the entire 1958 harvest season to determine its mechanical reliability. No mechanical failures were experienced. This can be attributed mainly to the simplicity of the sampler's design.

Before the development of the automatic sampler, the scoop-type sampler was the official method for sampling bulk peanuts in the Virginia-North Carolina area. Comparative tests of the spout-type sampler and the scoop-type sampler were conducted on 20 loads of farmers stock peanuts of the Virginia or bunch type. The 20 loads averaged 9,239 pounds net weight. Each load was dumped in the conventional manner into the hopper of a belt and bucket elevator.

A scoop-drawn sample of each load was taken independently by each of two licensed inspectors as the load was dumped (fig. 3). The sample drawn by each inspector was identified and analyzed separately.

Each dumped load of peanuts was elevated by the belt and bucket elevator and was sampled automatically by the spout-type sampler located at the discharge point of this elevator (fig. 1). Automatically drawn subsamples of each load were taken at 10-second intervals. All the odd-numbered subsamples were combined into one composite sample and all the even-numbered subsamples made up a second composite sample for each load. The sum weight of the samples taken at 10-second intervals amounted to 0.5 percent of the weight of the peanuts. Each composite sample was identified and analyzed separately.

Approximately equal-size samples were drawn by each of the two sampling methods in order to give each method a fair advantage. To avoid error and to increase the precision of the sample analysis, the entire content of each sample was analyzed for foreign material and loose shelled kernels. The various components of foreign material were weighed separately and so recorded on the data sheets. Empty peanut hulls which are normally included with sticks and hay were also weighed and recorded separately. Results of these comparative sampling tests are given in Tables 1, 2, and 3.

TABLE 1.--Foreign material and loose shelled kernels found in duplicate samples drawn by two sampling methods from the same load of farmers stock peanuts

Load and sample	Scoop-drawn samples						Automatically drawn samples					
	Foreign material					Loose shelled kernels	Foreign material					Loose shelled kernels
	Stones	Dirt	Sticks and hay	Empty hulls	Total		Stones	Dirt	Sticks and hay	Empty hulls	Total	
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Load 1												
Sample 1	0.00	1.23	0.63	0.17	2.03	1.23	0.00	1.06	0.79	0.34	2.19	2.02
Sample 2	.00	1.11	.74	.34	2.19	1.56	.02	.98	.73	.39	2.13	2.18
Load 2												
Sample 1	.00	.33	1.64	.72	2.69	4.87	.12	.28	1.73	.73	2.86	6.33
Sample 2	.02	.19	1.59	.53	2.33	3.74	.10	.30	1.51	.68	2.60	6.85
Load 3												
Sample 1	.00	.17	1.02	.35	1.54	2.03	.00	.38	.76	.48	1.63	3.55
Sample 2	.00	.20	.93	.27	1.40	1.58	.00	.33	1.01	.51	1.84	3.46
Load 4												
Sample 1	.00	.59	1.59	.26	2.44	1.17	.00	.38	1.32	.38	2.08	1.72
Sample 2	.00	.13	1.53	.23	1.89	.76	.00	.29	1.20	.33	1.83	1.68
Load 5												
Sample 1	.00	.08	1.69	.22	2.00	.72	.00	.18	1.39	.41	1.99	1.80
Sample 2	.00	.09	1.55	.21	1.86	.68	.12	.18	1.41	.38	2.10	2.12
Load 6												
Sample 1	.00	.33	1.04	.28	1.65	1.77	.00	.49	.96	.44	1.89	3.73
Sample 2	.00	.21	.84	.28	1.33	1.62	.00	.27	.74	.42	1.42	2.89
Load 7												
Sample 1	.07	2.57	2.29	.40	5.32	2.10	.00	2.98	2.10	.53	5.61	3.62
Sample 2	.19	2.50	1.72	.32	4.74	2.16	.12	3.55	1.78	.62	6.08	4.25
Load 8												
Sample 1	.46	1.52	2.25	.63	4.86	4.00	.36	1.43	2.24	.67	4.71	4.56
Sample 2	.13	.95	1.81	.52	3.41	4.18	.14	1.70	2.05	.71	4.60	4.66
Load 9												
Sample 1	.00	.12	2.81	.70	3.63	2.52	.00	.43	4.35	1.08	5.86	6.72
Sample 2	.00	.32	2.85	.78	3.95	3.10	.06	.63	3.39	1.15	5.23	7.47
Load 10												
Sample 1	.00	.42	2.27	.79	3.48	2.08	.33	.98	2.01	.68	4.00	4.92
Sample 2	.15	.53	2.50	.89	4.08	3.60	.13	1.09	1.77	.81	3.80	5.43
Load 11												
Sample 1	.00	.57	2.13	.88	3.58	3.72	.13	.91	2.34	.91	4.30	8.38
Sample 2	.00	.63	2.00	.68	3.31	6.03	.00	.87	2.22	1.06	4.15	7.03
Load 12												
Sample 1	.11	.24	1.84	.80	2.98	6.22	.00	.48	1.95	.87	3.29	7.40
Sample 2	.00	.18	1.98	.68	2.84	8.48	.00	.52	1.77	.99	3.28	7.85
Load 13												
Sample 1	.00	.46	1.34	1.13	2.93	3.81	.00	.63	1.51	1.34	3.49	4.01
Sample 2	.00	.73	1.07	.64	2.44	2.80	.00	1.07	1.51	1.70	4.29	4.64
Load 14												
Sample 1	1.13	1.61	2.89	.52	6.16	2.18	.84	2.64	2.77	.48	6.73	3.12
Sample 2	.82	1.43	3.73	.34	6.32	1.34	.50	2.75	3.35	.48	7.08	3.20
Load 15												
Sample 1	.00	3.60	2.90	.60	7.10	3.10	.00	2.87	1.72	.68	5.27	3.92
Sample 2	.00	2.33	1.85	.43	4.60	2.41	.00	3.19	2.15	.69	6.04	3.54
Load 16												
Sample 1	.00	1.74	2.01	.44	4.19	2.28	.00	1.96	1.87	.89	4.73	3.57
Sample 2	.00	1.25	1.62	.48	3.35	1.73	.00	1.74	2.64	1.07	5.44	4.91
Load 17												
Sample 1	.00	.94	.58	.31	1.83	1.67	.00	2.26	.67	.50	3.43	3.33
Sample 2	.00	2.17	.75	.41	3.33	2.83	.00	1.96	.58	.54	3.08	2.81
Load 18												
Sample 1	.00	1.09	.78	.31	2.19	2.37	.00	2.41	.77	.55	3.73	3.62
Sample 2	.00	4.21	1.14	.49	5.84	5.84	.00	3.22	.86	.56	4.63	3.98
Load 19												
Sample 1	.00	1.78	.42	.28	2.47	1.16	.00	1.44	.38	.40	2.22	2.05
Sample 2	.00	1.39	.54	.38	2.31	2.72	.00	2.14	.42	.40	2.96	2.30
Load 20												
Sample 1	.00	1.12	.99	.42	2.53	3.75	.00	1.31	.96	.70	2.97	4.63
Sample 2	.00	.65	1.04	.52	2.21	1.59	.00	1.25	1.00	.62	2.88	5.02

TABLE 2.--Average amounts of foreign material and loose shelled kernels found in samples drawn by the automatic-sampling method and by the scoop-sampling method from 20 loads of farmers stock peanuts

Grading factors	Percentage foreign material found in--	
	Scoop-drawn samples	Automatically drawn samples
	Percent	*Percent*
Stones	0.08	0.07
Dirt	1.04	1.34
Sticks and hay	1.62	1.62
Empty hulls	.49	.68
Total foreign material	3.23	3.71
Loose shelled kernels	2.79	4.21

TABLE 3.--Coefficient of variability for foreign material and loose shelled kernels found in samples drawn by the automatic-sampling method and by the scoop-sampling method[1]

Grading factors	Scoop-drawn samples	Automatically drawn samples
	Percent	*Percent*
Stones[2]	125	143
Dirt	69	17
Sticks and hay	17	16
Empty hulls	20	12
All foreign material	28	9
Loose shelled kernels	33	7

[1] The coefficient of variability is computed by dividing the standard deviation by the average amounts of foreign material found in the sample (see table 2), multiplied by 100.

[2] Amounts of stones found in the samples were insignificant (table 2) and their variability in this case is meaningless.

RESULTS OF TESTS

Tables 1 and 2 show there were differences in the amount of foreign material and loose shelled kernels found in samples drawn by the two sampling methods.

The amounts of stones found in the samples were insignificant for either method of sampling and may be disregarded except for one important aspect. The automatic sampler found stones in the samples from nine loads while the scoop found stones in the samples from only six loads of the same series of 20 loads. Also, the scoop had the first opportunity to find any of the few stones which were present in the loads. The failure of the scoop to find stones later found present by the automatic sampler is an important observation.

Dirt within a load of peanuts has a definite tendency to sift to the bottom of the load. When this occurs it is very difficult to obtain an accurate sample of the dirt with the scoop because most of the dirt within a load concentrates on the bottom in a layer and is usually dumped with the second half of the load. Under these conditions it is necessary for the inspector to anticipate where the dirt is located. This explains why scoop-drawn samples often indicate an abnormally high or low percentage of dirt. In these tests, the automatic sampler found a little more dirt than was found by the scoop.

The average percentage of sticks and hay found by each sampling method was the same. This can be expected, as sticks and hay are normally well distributed throughout peanuts and, therefore, are more easily sampled.

Empty hulls behave in the same manner as sticks and hay and also are easily sampled with accuracy. The automatically drawn samples contained 0.19 percent more empty hulls than the scoop samples. This excess is probably due to mechanical damage produced in handling the peanuts. Hulls represent about 25 percent of a peanut by weight and the kernels the remaining 75 percent. An increase of 0.19 percent in empty hulls may, therefore, be expected to produce an increase of about 0.57 percent in loose shelled kernels.

Total foreign material consisted of stones, dirt, sticks and hay, and empty hulls. These items have been totaled in tables 1 and 2.

Loose-shelled kernels behave like dirt and are difficult to sample accurately with the scoop. The samples drawn by the automatic sampler averaged 1.42 percent more loose-shelled kernels than the samples drawn by the other method. The increase of 0.19 percent in empty hulls would explain an increase of 0.57 percent in the amount of loose-shelled kernels; the other 0.85 percent was probably the result of better sampling. In these tests the mechanical damage to the peanuts was somewhat greater than normal because the peanuts had been dried shortly before sampling and the hulls were very brittle.

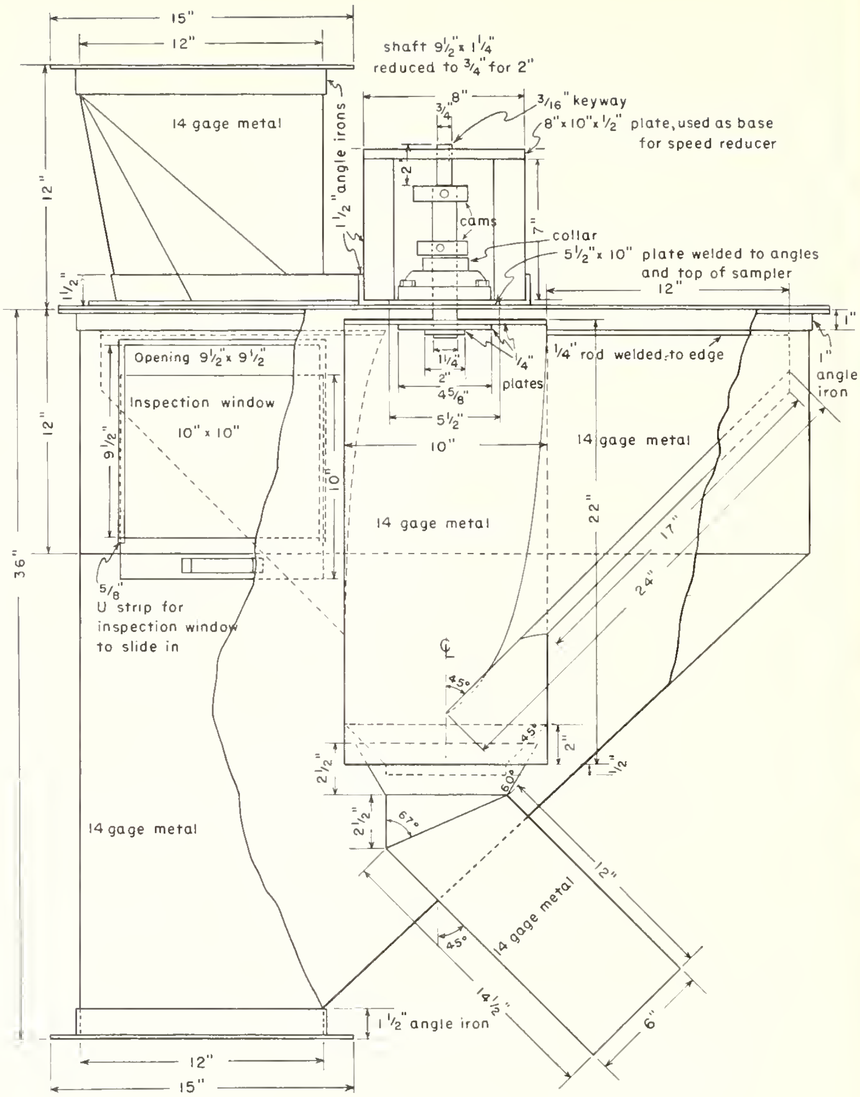
Table 3 shows that, with the exception of stones, the coefficient of variability, that is, the measure of precision in this study[1] for the automatically drawn samples was considerably less than for the scoop-drawn samples. For total foreign material it was less than one-third as great and for loose shelled kernels it was less than one-fourth as great. This means that two automatically drawn samples from the same load were in better agreement with each other than two samples drawn by scoop.

The variability of a sampling method is of great importance to anyone interested in the quality of a particular load of peanuts. Table 2 shows the averages for foreign material and loose shelled kernels were greater for automatically drawn samples than for scoop-drawn samples. However, an inspection of the original data in table 1, from which these averages were calculated, shows several instances where samples drawn by the scoop method have a higher foreign material and loose shelled kernel content than samples from the same loads drawn automatically.

[1] The lower the number, the more precise the method is.

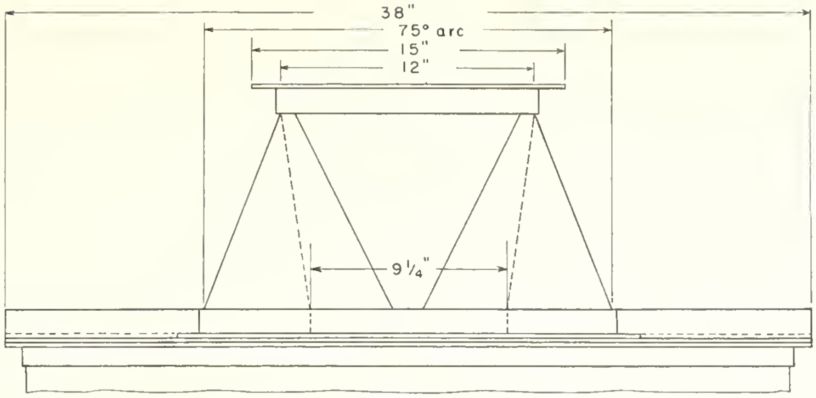
The performance of the sampler was observed through an inspection door while it was in operation. The design of the deflector allows it to cut cleanly through the product being sampled, with a minimum of splatter and without interrupting its flow.

All controlled tests of the sampler were conducted with peanuts. However, other agricultural products such as corn and soybeans were also sampled. The mechanical performance with these products was good and the samples obtained appeared to be representative. It is believed that any product normally handled with a belt and bucket elevator can be accurately sampled with the spout-type sampler.

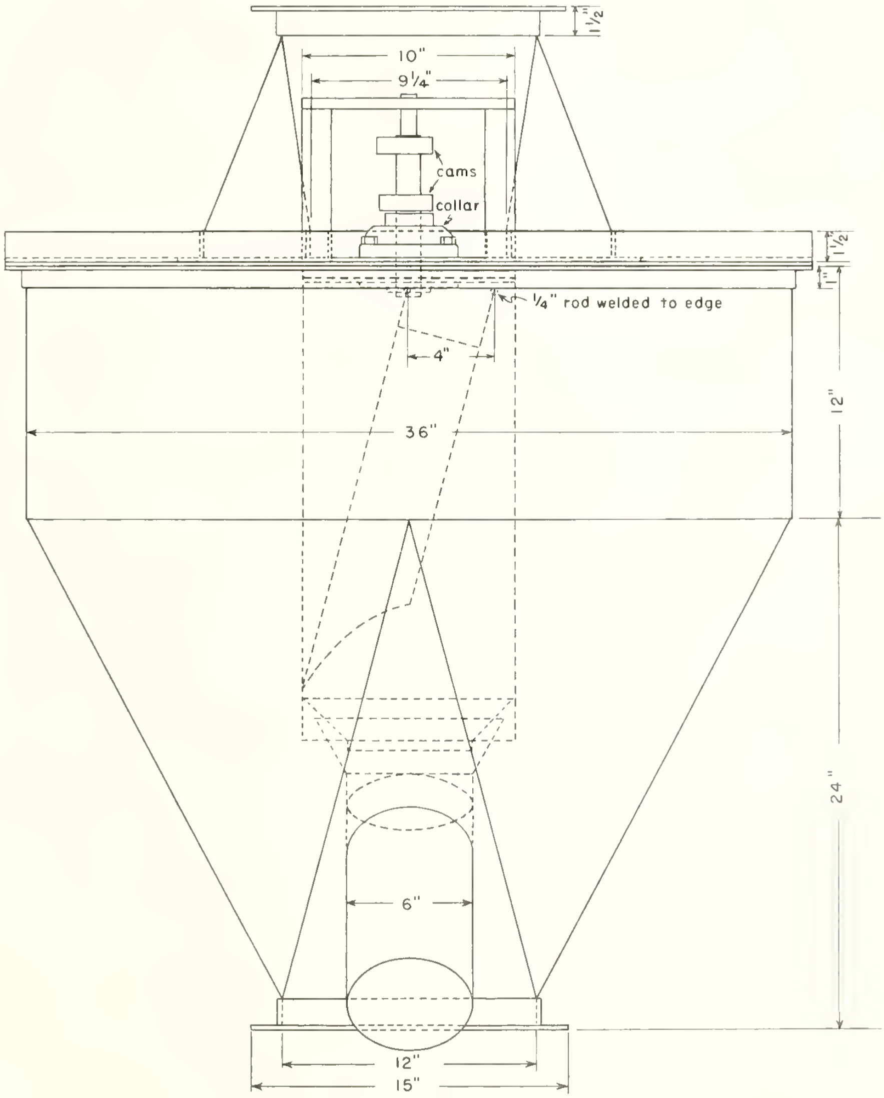


SIDE VIEW

Figure 4

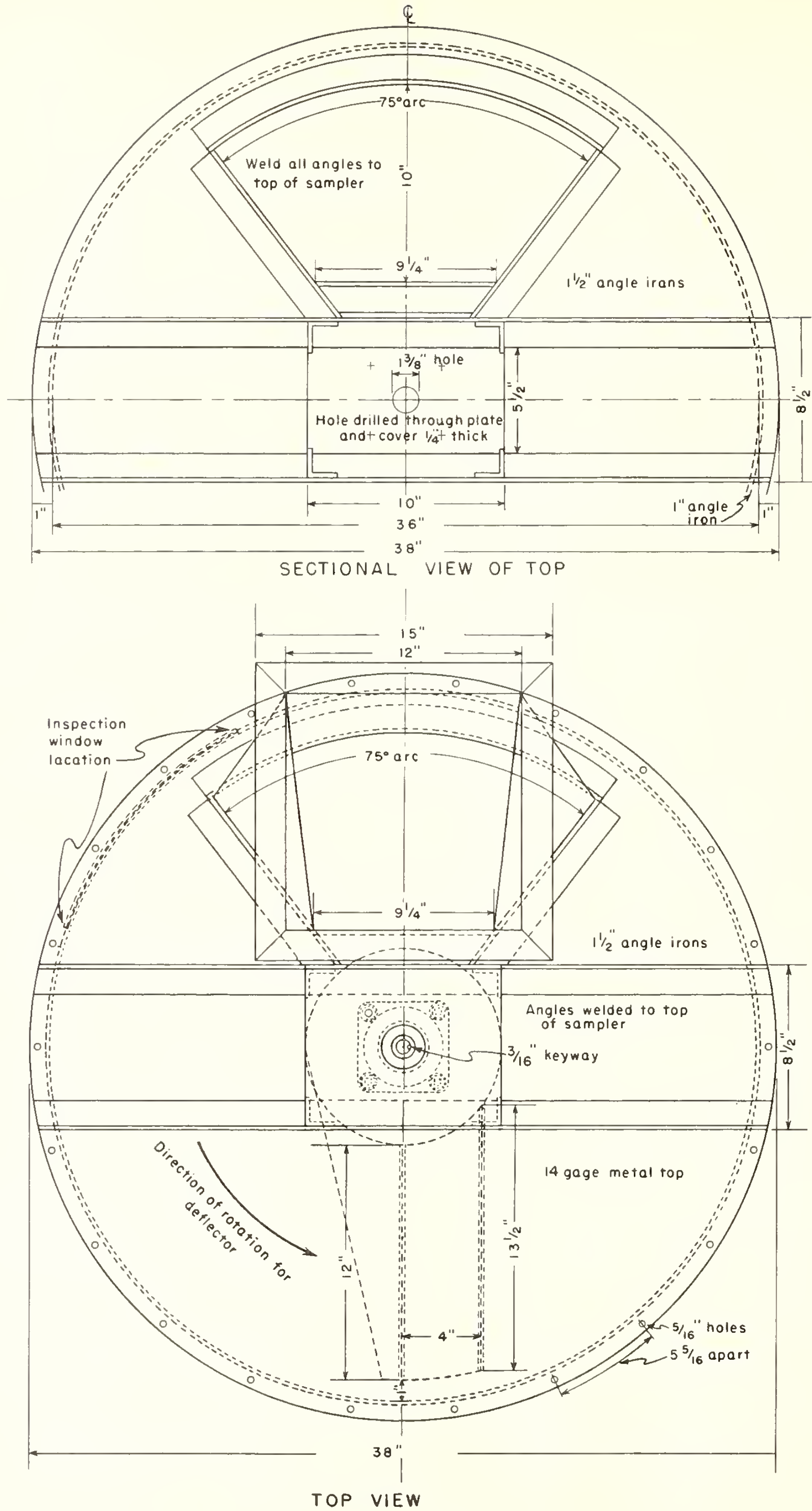


SECTIONAL VIEW BACK OF SPOUT



FRONT VIEW

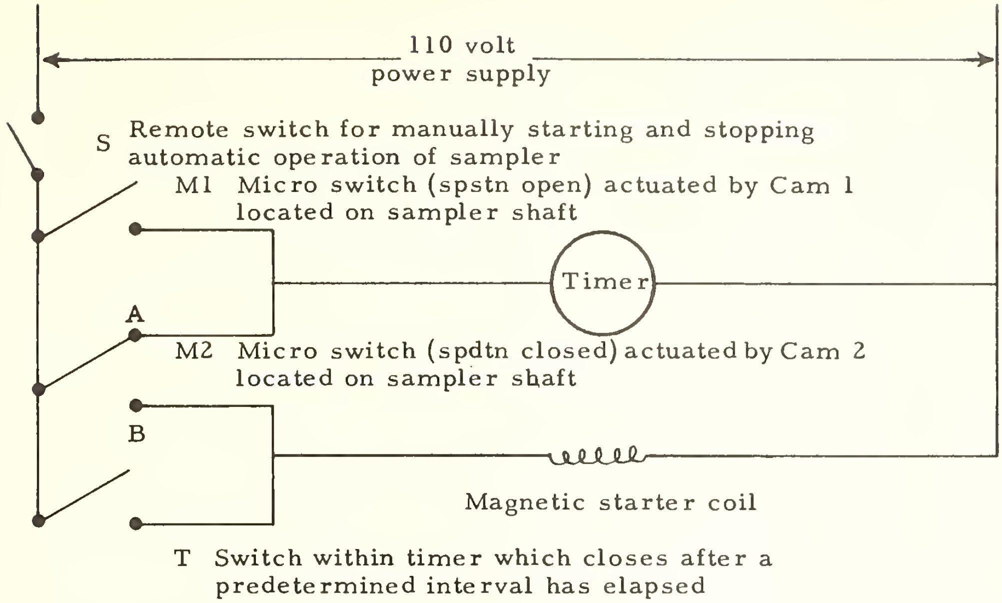
Figure 5



75°arc
Weld all angles to top of sampler
10"
9 1/4"
1 1/2" angle irons
1 3/8" hole
5 1/2"
8 1/2"
Hole drilled through plate and cover 1/4" thick
10"
1"
36"
1" angle iron
1"
38"
SECTIONAL VIEW OF TOP
15"
12"
Inspection window location
75° arc
9 1/4"
1 1/2" angle irons
Angles welded to top of sampler
3/16" keyway
8 1/2"
Direction of rotation for deflector
14 gage metal top
13 1/2"
12"
4"
5/16" holes
5 5/16 apart
38"
TOP VIEW

Figure 6

CONTROL CIRCUIT FOR AUTOMATIC SAMPLER



OPERATING SEQUENCE FOR CONTROL CIRCUIT OF AUTOMATIC SAMPLER

1. Close switch S to begin automatic operation of sampler. This starts small motor within timer.
2. After a predetermined elapse of time (depending upon dial setting of timer) switch T closes and the starter coil becomes energized. This starts motor which rotates sampler shaft and its two cams. As the shaft rotates these cams actuate Micro switches M1 and M2.
3. Micro switch M1 is closed by Cam 1.
4. Micro switch M2 is reversed from position A to Position B by Cam 2.
5. Micro switch M1 is opened by Cam 1. This stops motor within timer, causes timer to reset to zero elapsed time, and also opens switch T which is inside of timer.
6. Cam 2 on rotating sampler shaft allows Micro switch M2 to reverse from position B to position A. This deenergizes the starter coil and stops motor and rotation of sampler shaft. Motor within timer is again started and at end of "set" interval the entire cycle repeats until switch S is manually opened.

SAMPLER COMPONENTS WHICH ARE COMMERCIALLY AVAILABLE

1. Electric timer (Cramer)[2]
   Model 412E-60S
   Motor 115V 60 cycle
   Clutch 115V 60 cycle
   W. D. 1123
   Contact rating 15 amps.

2. Micro switches (Minneapolis-Honeywell)
   Model BZE-2RN2 with sealed roller-arm actuators

3. Worm gear speed reducer (Boston Reductor)
   Model VF115C
   Ratio 30 to 1
   Use with NEMA Frame 56C motor and 1725 rpm input

4. Electric brake motor (General Electric)
   Model 5K42FG29 with NEMA Frame 56C
   208/220 volt, 3 phase
   1/3 HP
   1725 rpm
   Factory equipped with Stearns electric brake size H52

5. Magnetic starter
   3 phase with 115V coil

6. Bearing, flange type, self-aligning, Sealmaster Unit No. MSF-20.

[2] Use of manufacturers' names is for purpose of identification only and does not constitute endorsement or preference by the Department of Agriculture.

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