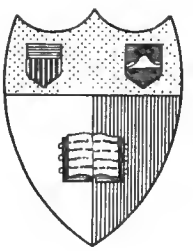
THESIS

POTATO MACHINERY EFFICIENCY AS APPLIED TO PRODUCTION IN STEUBEN COUNTY

Earl Volcart Hardenburg
1915



A MINOR THESIS

ON

POTATO MACHINERY EFFICIENCY

AS APPLIED TO

PRODUCTION IN STEUBEN COUNTY.

Presented to the Faculty of the Graduate School

of

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by

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ACKNOWLEDGMENTS.

The writer here wishes to express hearty appreciation to Doctor Warren for advice on the method employed in this study, to Professor K. C. Livermore for suggesting the problem and to the many potato growers in Steuben County who, by their kind cooperation in furnishing the necessary information, made the study possible.

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"Potato Machinery Efficiency As Applied
To Production in Steuben County"

It is often an open question with the average farmer engaged in diversified farming on a limited acreage whether the purchase of special machinery or even what might be called dual purpose machinery may be considered good economy in his business. Indeed it is a fact long conceded that the average farmer can not own such machinery as a traction engine, gasoline tractor, grain separator or perhaps even a hay press. Rather are these machines to be treated as rolling stock or neighborhood assets than actual farm machinery for the exclusive use of one farm. This is largely true because of the fact that farm economics as now taught tends to show the disadvantages of having an unusually large supply of either labor or machinery on hand which is not steadily employed. The former is certain to be a source of wasted expense and the latter a constant source of depreciation. As some interest rate must always be levied on the capital invested in any business, the interest charge on the undue proportion of unproductive capital as in the above instance must be considered a decided liability to good farm efficiency.

As this paper treats of the economic utility of that class of machinery herein and elsewhere designated as special machinery, it is probably well to define in a general way what is meant by the three classes of machinery that are or may be em-

ployed on a farm, namely, general, dual purpose and special. General farm machinery refers to that class of machines and tools which in this age is considered necessary and is found in more or less regular use on all farms, and for most crops throughout the country. This includes such machines and tools as the wagon, roller, sulky plow, springtooth or spiketooth harrow, scythe and cradle. By dual purpose machinery is meant that class which serves for use in the cultivation of perhaps two or three crops only, including such machines as the grain drill, mowing machine, hay rake, combined harvester, tedder, etc. Special machinery as a class includes only such machines as are intended to suit the needs of a single crop. Such machinery is as a rule of a more expensive construction and of less actual profit to the farmers per dollar invested. In this class will be considered such machines as the corn harvester, ensilage cutter, potato planter, potato sprayer, potato digger, cabbage and cauliflower setter.

In a survey of the potato growing industry of Steuben County, New York, in which 360 farms producing five acres or over of potatoes were visited, it was found that potatoes are there grown not perhaps as the principal crop but as one of the main crops in a quite common rotation of potatoes, or potatoes and corn, oats and hay two years with perhaps a third year stand of hay plowed under before replanting to potatoes. It is natural therefore to find that the area planted to the latter crop varies throughout the county from five to forty acres with the average acreage about 14.7. The minimum acreages of pota-

toes therefore with which the Steuben County farmer can afford to buy and operate either two horse planter, sprayer or digger is not an uncommon question, and one which this problem proposes to analyze.

It must not be concluded however even after the problem has been studied and analyzed on an economic basis and the minimum acreage determined, if possible, that absolute conclusions can be drawn. The element of practicability must also be considered because a very large proportion, 90 per cent of the potato crop of the county is being grown on hillside farms varying in their slope from 1 per cent to 35 per cent with the average about 7.9 per cent. It may be considered quite impractical to operate a potato planter on a slope greater than 15 per cent owing to the difficulty of making straight rows. Fig. I showing a landscape of a portion of the potato section of the northern part of the county is typical of the rolling topography of this region.

A considerable of the hilly acreage in the region is annually sown to oats which must of necessity be cradled owing to the impossibility of operating a harvester safely. A study of the United States Census reports for 1899 and 1909 show Steuben County ranking high in sheep raising, the rank in 1899 being first and that in 1909 being second among the counties of New York State. It is highly probable that much of the pasturage of the hill land so used should never have been broken up for the growing of grain which is unprofitable now both because of the impossibility of employing machinery and because of the impracticability of hauling the needed fertilizer and manure so far and so high.

A study of farms included in the survey revealed the following interesting facts regarding the proportion of the total acreage grown on hill farms which was planted with a machine planter.

Table I. Per Cent Slope Related to Method of Planting. 345 Farms.

Method of planting	Average per cent slope	Total acreage on slope	Per cent of total acreage on slope	Total acreage on level	Per cent of total acreage on level
Machine	7.1%	1139.5	25%	83.5	17%
Hand	7.7	3413.1	75	421.0	83
-----	---	4552.6	90	504.5	10

A study of Table I shows that of the total of 4552.6 acres planted on a slope, representing 90 per cent of the acreage surveyed, only 25 per cent was planted with a machine planter. On the other hand, of the total of 504.5 acres planted on the level, representing 10 per cent of the acreage surveyed, only 17 per cent was planted with a planter. This may be taken as a reasonable indication that topography is at least not the only factor which prohibits the more extensive use of machine planters. It is more to be assumed that the necessity of checkrowing for the sake of cheaper and better weed control is the important limiting factor.

It is generally recognized in farming regions where land is relatively cheap and labor relatively expensive that more tillage machinery and horse labor are employed than in regions where the reverse is true. The former conditions prevail in the potato growing sections of Steuben County in quite striking contrast to those of the potato regions of Eastern Long Island where land is higher and labor, though not cheaper, is usually more available. The common crop rotation being longer and inclusive of more non-tilled crops than that of Long Island, makes the control of weeds more of a problem to the average farmer. It is only reasonable from the above conditions therefore that weed control is facilitated by planting in checks, giving the system commonly known as checkrowing which allows of cross cultivation. Thus it was found that practically no hand hoeing is given the potato crop in Steuben County. Figure II shows a typical checkrowed field of potatoes on a hillside of about

10 per cent slope.

Fig. II.

The economy of checkrowing therefore makes it quite necessary to plant by hand since modern mechanical planters are not capable of dropping seed in checks. The records show that 68 per cent of the farms surveyed practiced planting by the checkrow system.

A review of experimental data relative to the comparative amounts of seed required for and the yields per acre from planting in checkrows and in drills shows that a greater amount of seed is required and a greater yield results from planting in drills. This is reasonable to expect since in this case the hills are placed much closer in the row than would be possible under the checkrow system. The results obtained on 349 farms in Steuben County readily verify the foregoing conclusions as shown in Table II.

Table II. Checkrowing Versus Drills as Method of Planting. 349 Farms.

Method of planting	Number of farms	Percentage of farms	Percentage of total acreage	Average amount of seed per acre	Average yield per acre
Checkrowing	238	68.2%	65%	9.2	129.6
Drills	111	31.8	35	11.9	150.9
Total or average for region	349	100.	100	10.1	136.4

It should be noted from the above data that the increase in yield from planting in drills was considerably more than sufficient to pay for the extra seed required. The practice of checkrowing therefore is not justified on the basis of resulting yield.

This, therefore, will account in part for the large amount of hand planting now practiced in the county outside of its economic aspects. Less difficulty or impracticability is experienced in using machine sprayers and diggers on these same farms owing to their light draft as compared to the machine planter. The types of each of these machines will be considered under the efficiency studies further on in the thesis.

A Study of Types of Planters and Cost of Operation.

Before taking up the details of cost, a preliminary study has been made of the extent of machine planting and prevailing types of planters on 329 farms.

Table III. Machine Versus Hand Planting.

329 Farms.

Method of planting	Number of farms	Per cent of total acreage	Average cost per acre inclusive of fertilizing	Average cost per man hour inclusive of fertilizing	Average cost per horse hour inclusive of fertilizing	Average acreage planted per farm	Average per cent slope of field planted
Machine	67	25.0%	$1.97	$.49	$.39	17.9	7.1%
Hand	262	74.9	2.68	.34	.37	13.7	7.7
Total or average for all	329	100.	---	---	---	14.7	7.9[1]

Table III shows that only 67 farms out of the 329, or about 20 per cent were planted with machine planters. These farms so planted represent about 25 per cent of the total acreage, or an average of 17.9 acres per farm as against an average of 13.7 acres for the farms planted by hand.

There were five makes of planters employed on the 67 farms besides one home-made planter of the one-man or picker type. Table IV shows the different makes and the number and percentage

[1] Average for 345 farms.

of farms using each.

Table IV. Makes of Potato Planters on 67 Farms.

Make of planter	Number of farms using	Per cent of farms using	Type of planter
Robbins	32	47.7%	Platform
Aspinwall	19	28.3	Picker
Iron Age	8	11.9	Platform
Eureka	4	6.0	Picker
Evans	3	4.5	Picker
Home-made	1	1.5	Picker
Total	67	100.	----

Type of Planter	Number of farms using	Per cent of farms using
(2 man) Platform	40	60%
(1 man) Picker	27	40
Total	67	100

It is interesting to note from the summary part of Table IV that, in spite of the greater initial cost of the platform planters as evidenced in the following table, more than half of the machine planters employed in the county are of this type. Another factor which one might suppose would perhaps encourage the use of picker instead of the platform types is that of the extra man required for the operation of the latter. Figure III shows a platform potato planter in operation in Steuben County. For an illustration of the picker type of planter see cut in

the appended list of classified machinery.

Fig. III.

It is doubtless the increased yield thought to accrue from the better stand resulting where a two-man planter is used that is responsible for the predominance of this type. The actual difference in yield between crops planted by each type of planter is shown in Table V. In order to be able to understand the comparative value of the various types of planters enumerated and summarized in Table IV, it is necessary to know the average initial cost, average annual depreciation as measured by the life of each in years and the difference in yield, if any, resulting from the use of each type. Table V gives a summary of these factors.

Table V. Platform Versus Picker Planters.

Type	Average initial cost	Average life in years	Average depreciation	Average yield per acre
Platform	$67.33	15.3	$4.68	161.5
Picker	60.11	13.5	4.70	146.9
Average for 67 farms	64.41	14.5	4.69	156.1

In spite of the difference of about $7.00 in initial cost of the platform over the picker type, the average life of the former being about two years longer than that of the latter gives an average annual depreciation of $4.69, differing for both types by only two cents. It is obvious therefore that the difference of 14.6 bushels yield per acre resulting in favor of the platform planter is approximately clear gain. The difference of 14.6 bushels average yield per acre is enough, figuring potatoes at an average price of 50 cents per bushel to pay for the difference in initial cost of the more expensive type in a single year.

In order to still further test the difference in yield, if any, resulting from these two types of planters, the twenty-five highest yielding farms and the twenty-five lowest yielding farms on which machine planters were used were selected and the proportion of each type of planter used determined for each group. The twenty-five highest yielding machine planted acreages having an average yield of 213.9 bushels per acre showed

that 76 per cent were planted with the platform type. The twenty-five lowest yielding machine planted acreages having an average yield of 107.2 bushels per acre or one-half that of the highest yielding acreages showed that only 44 per cent were planted with the platform type.

Therefore in accordance with popular conception, it is safe to say that this increase in yield is in large part due to the better stand resulting from the employment of the extra man on the two-man planter.

Two Methods of Measuring Machinery Efficiency.

With the foregoing understanding of those natural conditions to which cultural operations are subject, and which, though exerting their influence, can not be measured in any economic terms, it is possible to calculate the efficiency of special potato machinery as measured in terms of money and labor expended. In doing this, the method of calculating the unit cost of machinery has been that which is used and recommended by the Department of Farm Management of Cornell University.

In the writer's opinion there are two methods which might be employed in arriving at proper conclusions along these lines:

First : When the overhead cost per acre of potato machinery is exceeded by the saving in labor cost per acre of machine labor over hand labor, it may then be considered economy to own and operate a given machine. This necessitates finding the difference in labor cost per acre of hand and machine labor.

Second : Determine the per acre cost of hand and machine

labor. Select and group these records in each case according to a uniform variation in acreage planted. In this way the minimum acreage at which one can afford to own and operate the machine may be determined.

Each of these methods has been used in this study in arriving at conclusions. Each possesses certain value and the essential difference lies in the handling of the data.

The factor used in measuring efficiency in this case consists of a ratio of actual work performed by the power machines against that performed by hand and the ratio of cost of power machine labor per acre against cost of hand labor. In each case, in computing the cost of power machinery, interest is figured on its average value and to this is added the annual depreciation and cost of repairs. Average value is figured by taking the average of values at beginning and end of year 1912. The variation in original cost of various makes of each of these three machines was not considered sufficient to warrant computing an average value of each one separately. The cost of planters, sprayers and diggers, therefore, is figured taking the average of the various brands of each of these.

Cost of Planting.

The data taken on cost of machine planting have been used as outlined on page 13 and summarized in Table VI below.

Table VI. Cost of Machine Planting on 67 Farms.

Per cent of farms of region	Average cost per acre	Labor cost per acre	Machine cost per acre	Average number man hours per acre	Average number horse hours per acre	Average cost per man hour	Average cost per horse hour
20.4%	$1.97	$1.57	$.40	4.04	5.02	$.49	$.39

The average cost per acre of machine planting, $1.97, shown above is considerably lower than the cost of planting by hand as figured further along in this thesis and somewhat under the average cost of planting for the United States. The Crop Reporter of the United States Department of Agriculture for November, 1911, gives $2.39 as the average figure estimated by over 4000 crop correspondents for the Bureau of Statistics. This last figure, however, is naturally higher owing to the fact that it includes all estimates for both hand and machine planting. The actual overhead cost per acre of the planter on these 67 farms forms a relatively small part of the total cost, it being in this case $.40 or about 20 per cent of the total.

Method of Computation.

In figuring the total cost of machine planting as given above, the labor cost of both man and horse and the overhead

cost of the planter were figured separately, the combined totals forming the total cost. Man labor was charged at 20 cents per hour and horse labor at 15 cents, the actual number of hours of each charged being the figure given by the farmer from whom the record was taken.

The items used in computing the overhead machine cost consist of a charge of 5 per cent interest on the average present value of the machine plus a charge for the annual depreciation plus a charge for the cost of repairs for the year 1912. The average present value on which interest was charged was found by taking the value of the machine at the end of the growing season of 1912 and adding to it one-half of the depreciation for that year. This figure,then, really represents the average of the values of the machine at the beginning and at the end of 1912. The annual depreciation was found by dividing the initial cost of each machine by its years of life. Only actual repair costs incurred, if any, for the 1912 crop were added for the third cost item.

Inasmuch as practically all planters are or may be equipped with a fertilizer attachment and hence no added cost from the use of fertilizer, no attention was given to the application of fertilizer in getting at the cost of machine planting. However, in getting the cost of hand planting, wherever fertilizer was used, its cost of application was considered an item in the cost of planting. This seemed justified inasmuch as this same cost would not have been incurred in case a planter had been used and it should therefore be charged against hand

planting.

Likewise the labor cost of marking out potato land was included in the cost of hand planting because all machine planters are equipped with a marker which makes any extra effort or time for marking outside of actual planting unnecessary. Marking is generally done just ahead of planting where potatoes are hand planted, is considered a part of the planting operation and consequently the time used in marking was quite universally included by the grower in his estimate of planting time. Where he did not so include it, the item has been added to the labor cost of planting. Figure IV shows a 4-row type of marker in common use where the crop is hand planted.

Fig. IV.

Owing to the fact that most growers pick up the crop periodically with digging during the day in order that the tubers may not be exposed to the sun too long and in order that they

may be hauled to storage or market as soon as dug, the labor items given for digging by the growers included, and necessarily so, in most instances the labor of picking up. Where this was not true, the labor of picking up has been added to the separate labor of digging either by hand or machine. The cost of digging will therefore be found to be rather high in comparison to average figures.

Aside from the foregoing explanations, the same method of computing machine and labor costs has been used for planting, spraying and digging.

With most farm enterprises there is generally a striking correlation between the cost of that enterprise and extent of acreage. In other words, the cost per acre ordinarily decreases as the acreage increases. A study was made of the influences of size of potato acreage on cost per acre of planting and the result tabulated in Table VII.

Table VII. Relation of Acreage to Labor and Machine Cost of Planting.

Number of farms	Acreage	Cost per acre of machine labor	Overhead machine cost per acre
14	5 - 10	$1.85	$.76
17	11 - 15	1.75	.52
21	16 - 20	1.59	.41
15	21 - 55	1.41	.26
67	17.9	1.57	.40

From Table VII it may be seen that whereas a variation of from five to fifty-five acres makes a difference in machine labor cost of only $.44 per acre, or a reduction to 76 per cent of the original cost, a similar variation of acreage reduces the overhead machine cost to 34 per cent of the original. And for both of these cost factors there is a uniform decrease in unit cost for every increase in acreage.

Contrary to the usual method of sorting records by cause rather than effect, a study has been made of cost and acreage correlation by sorting by cost rather than acreage. Table VIII shows that those farms incurring the highest machine planting cost per acre were those planting the least acreage.

Table VIII. Relation of Cost of Machine Planting and Acreage.

Number of farms	Cost per acre	Average acreage
8	$1. - 1.50	31.2
21	1.51 - 2.00	19.5
27	2.01 - 2.50	16.0
7	2.51 - 3.00	12.7
3	3.01 - 3.50	10.0
1	3.51 - 4.00	5.0
67	$1.97	17.9

The cost of hand planting on 262 Steuben County farms, representing about 75 per cent of the region, has been computed and summarized in Table IX as follows :

Table IX. Cost of Hand Planting on 262 Farms.

Per cent of farms of region	Average cost per acre	Average number man hours per acre	Average number horse hours per acre	Average cost per man hour	Average cost per horse hour
79.6%	$2.68	8.0	7.3	$.34	$.37

It will be noted from the above table that the average number of man hours per acre for hand planting is about double that for machine planting while the average number of horse hours is about forty-five per cent more than for machine planting. This accounts largely for the higher rate of labor cost that is shown in Table X. However, the great reduction in hours per acre for the machine makes the actual labor cost per acre for the latter much less.

Table X. Variation in Man and Horse Labor Cost.

Method of planting	Average number man hours	Average number horse hours	Average cost per man hour	Average cost per horse hour
Machine	4.04	5.02	$.49	$.39
Hand	8.00	7.30	.34	.37
Difference	3.96	2.28	.15	.02

As with machine planting the relation between size of acreage and cost per acre of hand planting has been established and summarized in Table XI.

Table XI. Relation of Size of Acreage to Cost of Hand Planting.

Number of farms	Acreage	Cost per acre	Difference in cost per acre
93	5 - 11	$2.92	---
93	11 - 16	2.72	$.20
47	16 - 21	2.61	.11
29	21 - 55	2.51	.10
262	13.7	2.68	.41

A study of the total differences in cost per acre of machine labor and of hand labor for the total variation in acreage in each case of 5 to 55 acres reveals a striking uniformity. The total difference in cost per acre for hand planting was $.41 while that for machine planting was $.44. The variation between acreage groups in each case was also strikingly uniform.

It was said in the beginning of this study, that wherever the overhead cost of a machine does not exceed the saving in cost of labor from the use of that machine, it may be considered profitable to employ machine instead of hand labor. In Table XII it will be seen in every case regardless of the size of acreage planted that the net difference in cost is in favor of machine labor and that the larger the acreage planted, the greater is this difference in cost saved.

Table XII. Difference in Cost of Machine and Hand Planting.

Number of farms	Average acreage	Per acre cost of hand labor	Per acre cost of machine labor	Difference in labor cost	Overhead machine cost per acre	Difference in favor of machine
H[1] - 93) M - 14)	5 - 11	$2.92	$1.85	$1.07	$.76	$.31
H - 93) M - 17)	11 - 16	2.72	1.75	.97	.52	.45
H - 47) M - 21)	16 - 21	2.61	1.59	1.02	.41	.61
H - 29) M - 15)	21 - 55	2.51	1.41	1.10	.26	.84
H -262) M - 67)	H - 13.7 M - 17.9	2.68	1.57	1.11	.40	.71

In the case of planting, therefore, it may be generally recommended that for all acreages of five or over it is economical to own and operate a machine planter and that best economy is realized from the larger plantings.

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[1] H = Number of farms planted by hand.
M = Number of farms planted by machine.

Sprayers and Spraying on 106 Farms.

Before discussing the actual cost of spraying it is well to note here a few factors such as the type and cost of sprayers used, the extent and kind of spraying done and such other factors as ultimately affect or indirectly influence the cost. Since all machine sprayers operate above ground and their draft while in operation is consequently relatively light, no study was made to determine the influence of slope of land upon the type of sprayer used or the extent of machine spraying done.

There was a very large amount of late blight and rot prevalent on the 1912 crop, in some cases nearly a quarter of the crop being totally destroyed before digging time. It is not surprising to note therefore that only 15 farmers, representing 4.1 per cent of the total farms surveyed, sprayed their potatoes with Bordeaux.

Out of 360 farms, only 106 or less than one-third sprayed the crop with either insecticide or fungicide and of these 106, only 35 employed machine sprayers. Though it might normally be expected that those using such sprayers practice spraying with Bordeaux, actually only 15 farmers or less than one-half of those using power sprayers sprayed for blight with Bordeaux Mixture. None of those spraying with hand implements applied any Bordeaux. Table XIII is a summary of the relative number spraying by hand and machinery with the material used in each case in Steuben County.

Table XIII. Machine Versus Hand Spraying on 106 Farms.

Method and Material	Number of farms	Per cent of farms
Machine (Insecticide only)	20	18.9%
Machine (Bordeaux and Insecticide)	15	14.1
Hand (Insecticide only)	71	67.0
Totals	106	100.

A study of the various makes of sprayers used and the number and percentage of each as classified in the list appended to this thesis is summarized in Table XIV as follows :

Table XIV. Types of Sprayers on 35 Farms.

Sprayer	Number of farms using	Per cent of total used	Vertical barrel type	Horizontal barrel type
Watson	21	60.0%	60	
Iron Age	4	11.4		11.4
Aspinwall	4	11.4		11.4
Ospraymo	2	5.7	5.7	
Le Roy	2	5.7		5.7
Aroostook	1	2.9	2.9	
Hurst	1	2.9		2.9
Total	35	100.	68.6	31.4

The predominance of the vertical barrel type in this case is not an indication of any advantage of this type over the horizontal barrel type because the Watson, Ospraymo and Aroostook

brands are all made by the Field Force Pump Company of Elmira, New York, a city within easy reach of the Steuben County potato fields.

The items which contribute toward the overhead cost of the 35 machine sprayers have been averaged and summarized in Table XV as follows :

Table XV. Overhead Cost Items on 35 Sprayers.

Average initial cost	Average depreciation	Average life	Average cost repairs	Average machine cost per acre
$60.34	$6.02	10	$.69	$.20

It may be noted from Table XV that the average machine cost of sprayers is 20 cents per acre whereas the same cost for planters was found to be 40 cents per acre. (See Table VI.) Figure V shows a 7-row horizontal barrel sprayer in operation on one of the largest fields in Suffolk County. The operation of this type of sprayer is one important means of reducing the cost of machine spraying.

Fig. V.

Cost of Spraying on 106 Farms.

In arriving at the cost of spraying on 106 farms in Steuben County, the records were sorted into classes namely, farms applying insecticide only with machine sprayers, Table XVI; farms applying both insecticide and Bordeaux or Bordeaux alone with machine sprayers, Table XVII; and farms applying insecticide only by hand, Table XVIII.

Table XVI. Summary of the Relation of Acres to Machine Spraying with Insecticide Only.

Acreage	Number of farms	Total acres	Man hours Total	Man hours Per acre	Horse hours Total	Horse hours Per acre	Average value of spraying machinery	Interest on machinery Total	Interest on machinery Per acre	Depreciation Total	Depreciation Per acre
5 - 16	10	131.5	100	.8	195	1.5	$45.45	$22.75	$.17	$49.00	$.37
16 - 26	6	153.	98	.6	197	1.3	33.17	9.97	.07	18.00	.12
26 - 51	4	177.	44	.2	88	.5	56.25	11.25	.06	20.00	.11
	20	461.5	242	.5	480	1.	43.93	43.97	.10	87.00	.19

Table XVII. Summary of the Relation of Acres to Machine Spraying with Bordeaux and Insec

5 - 16	3	180.	160	.9	320	1.8	39.67	5.95	.03	18.00	.10
16 - 26	9	539.5	443	.8	832	1.5	37.83	17.04	.03	71.00	.13
26 - 51	3	326.	329	1.0	543	1.7	30.83	4.63	.01	35.00	.11
	15	1045.5	932	.89	1695	1.62	36.80	27.62	.03	124.00	.12

Table XVIII. Summary of the Relation of Acres to Hand Spraying with Insecticide Only.

5 - 16	46	475.	1224	2.6	---	---	1.87	4.51	.009	52.00	.11
16 - 26	21	349.	848	2.4	---	---	5.00	5.34	.02	30.00	.09
26 - 51	4	33.	42	1.3	---	---	2.25	.47	.01	4.00	.12
	71	857	2114	2.47	---	---	2.82	10.32	.012	86.00	.10

on of Acres to Machine Sp raying with Insecticide Only.

Horse hours Total	Horse hours Per acre	Average value of spraying machinery	Interest on machinery Total	Interest on machinery Per acre	Depreciation Total	Depreciation Per acre	Machine cost Total	Machine cost Per acre	Labor cost Total	Labor cost Per acre	Grand total cost Total	Grand total cost Per acre
95	1.5	$45.45	$22.75	$.17	$49.00	$.37	$73.75	$.56	$49.25	$.37	$123.00	$.94
97	1.3	33.17	9.97	.07	18.00	.12	27.97	.18	49.15	.32	77.12	.50
38	.5	56.25	11.25	.06	20.00	.11	41.25	.23	22.00	.12	63.25	.36
80	1.	43.93	43.97	.10	87.00	.19	142.97	.31	120.40	.28	263.37	.57

ion of Acres to Machine Sp raying with Bordeaux and Insecticide.

20	1.8	39.67	5.95	.03	18.00	.10	23.95	.13	80.00	.44	103.95	.58
32	1.5	37.83	17.04	.03	71.00	.13	97.04	.18	213.40	.40	310.44	.58
43	1.7	30.83	4.63	.01	35.00	.11	42.63	.13	147.25	.45	189.88	.58
95	1.62	36.80	27.62	.03	124.00	.12	163.62	.16	440.65	.42	604.27	.58

ion of Acres to Hand Spra ying with Insecticide Only.

--	---	1.87	4.51	.009	52.00	.11	56.51	.12	244.80	.52	301.31	.63
--	---	5.00	5.34	.02	30.00	.09	40.34	.12	169.60	.49	209.94	.60
--	---	2.25	.47	.01	4.00	.12	4.47	.14	8.40	.25	12.87	.39
--	---	2.82	10.32	.012	86.00	.10	101.32	.12	422.80	.49	524.12	.61

This classification includes all farms practicing spraying in any form since there were none on which Bordeaux was applied by hand labor alone. Each farm and method of spraying has been studied separately with reference to the others and with reference to the influence of size of potato acreage and total acreage upon each of the cost items.

Machine Spraying.

The reasonable assumption that owing to the clogging of nozzles with Bordeaux, spraying in this way should show a higher man and horse hour rate per acre is well substantiated in this study. Whereas the rate on farms spraying with insecticide alone was .5 man and 1 horse hour per acre, the rate in case of farms using Bordeaux was .89 and 1.67 hours respectively.

By studying Tables XVI, XVII and XVIII it is of interest to note that the average acreage sprayed with Bordeaux per farm is over three times greater than that of the farms sprayed with insecticide alone by machine sprayers and nearly six times greater than that of the hand sprayed areas sprayed with insecticide. The acreages as referred to here are 70, 23 and 12 respectively. This is accounted for by the fact that the Bordeaux sprayed farms sprayed from four to five times while the machine sprayed farms applying insecticide only sprayed on the average about twice and the hand sprayed farms about once.

The above variation in average acreage sprayed will account in large part for the cheaper machine cost of spraying on the Bordeaux farms over the insecticide sprayed farms because the

overhead charges are very little affected by acreage sprayed. On the other hand, the labor cost of Bordeaux spraying is considerably above that of the machine insecticide spraying as might be expected and the resulting total cost of spraying per acre by power sprayers therefore shows only one cent less in favor of insecticide machine spraying.

Hand Spraying.

The average acreage sprayed by hand is notably low indicating that farms as treated were sprayed but once. In this case the man hour rate is over two and a half times greater than that for machine Bordeaux spraying, giving an average labor cost per acre of $.49 or $.07 per acre more than for Bordeaux spraying. A higher than expected machine cost per acre may be noted here owing to the high depreciation charged on knapsack and canteen sprayers. In nearly all cases where canteen sprayers are used, their depreciation is charged as 100 per cent since their life is but one year. This makes an average machine cost of hand spraying of $.12 per acre. The difference in total cost of hand spraying is $.61 per acre or only $.03 more than machine Bordeaux spraying.

Summary of Cost of Spraying.

From the last three tables it may be noted that there is very little difference in cost per acre of the three methods and types of spraying. Labor cost is undoubtedly greatest with hand spraying and labor cost of machine spraying is greater where Bordeaux is used than where insecticide is used alone.

But another important economic factor, that of yield of the resulting crop must be considered in reckoning the advisability of using Bordeaux. Table XIX below is a fair indication of the value of Bordeaux Mixture as measured in terms of yield against yields resulting where no spraying was done.

Table XIX. Relation of Spraying to Yield on 359 Farms.

Type of spray	Number of farms	Per cent of farms	Yield per acre
Bordeaux	15	4.2%	166.3
Insecticide only	160	44.5	137.2
None	184	51.3	130.2
For Region	359	100.	136.4

Digging on 308 Farms.

It is generally true in regions growing large acreages of potatoes that most of the crop is dug with some form of mechanical digger. Just how much more profitable this is over hand digging, this study attempts to determine. Table XX shows the prevalence of each practice on 308 farms with the average slope of land, average acreage per farm and average yield per acre under each.

Table XX. Hand Versus Machine Digging on 308 Farms.

Method	Number farms	Per cent of farms	Per cent of acreage	Average per cent slope	Acreage per farm	Yield per acre
Hand	82	27%	23%	8.2%	12.4	139.2
Machine	226	73	77	7.3	15.2	134.7
Total	308	100	100	7.5	14.5	135.7

Less than one-third of the total acreage was dug by hand in 1912. This is to be expected where five or more acres are grown per farm and the slope is not too steep to permit of the use of a machine. It might be reasonable to suppose that the larger acreages would tend to encourage the use of machine diggers. Table XX shows that the average acreage per farm where the crop was hand dug was only 3 acres less than that where the crop was machine dug. Also the table indicates that there is a tendency for more hand digging on the steeper areas, a difference in this case of about one per cent. The slight

difference in yield in favor of the hand dug crop is only enough to account for the cleaner work done by hand over machine digging.

Types of Diggers on 266 Farms.

Owing to the extremely steep hillsides on which a large part of the Steuben County crop is grown, the heavy draft elevator type of digger is not popular on many farms. In its stead, a digger of much lighter weight and simpler construction, known as the "Boss", is used on these farms. It consists essentially of a vertical or slightly tilted reel which operates from the main axis of the drive wheels by a system of cogs and at right angles to the drive wheels kicking the tubers out at the side of the row. Fig. VI shows one of these diggers in operation on level ground. As might be supposed from this figure, the main objection to this reel type of digger is its injury to the tubers while digging.

For reference to the other type, the chain elevator digger less popular in the county see the cuts appended at the end of this thesis. Table XXI gives the various makes of diggers, the number in use and the type of each as used on 266 farms.

Table XXI. Types of Diggers on 266 Farms.

Name of digger	Type	Number of farms	Per cent of farms
Boss	Reel	166	62.4%
Cummings	Shaker	26	9.7
Reuther	Elevator	25	9.3
Hallock	Elevator	18	6.7
Rice	Elevator	12	4.5
Saltsman	Reel	6	2.2
Williams	Reel	5	1.8
Hoy	Elevator	3	1.1
Iron Age	Elevator	3	1.1
Farquhar	Elevator	2	.7
Total	----	266	100.0

From the foregoing table it may be seen that potato diggers are of two general types, namely, reel and elevator. In this study, owing to their similarity of cost, size and construction, those diggers which, like the Cummings, consist mainly of a shaker are classed with the chain or riddle elevator diggers for comparison with the reel types. Table XXII, really a summary of digger types as listed in Table XXI, shows the influence of

slope on the type of digger used.

Table XXII. Types of Digger on 226 Farms Affected by Slope.

Type	Number farms	Per cent of farms	Per cent of acreage	Average per cent slope	Acreage per farm	Yield per acre
Reel	155	69%	68%	7.8%	15.2	128.6
Elevator	71	31	32	6.2	15.4	147.8
Total	226	100	100	7.3	15.2	134.7

Though the difference in slope shown here is not great, the greater slope of those farms dug by the reel type indicates the greater workability of this type for those farms. Of the 155 who used the reel type, only 19 expressed a desire to change to the elevator type. Of the 71 who used the elevator types, only 13 expressed a desire to change to the reel type. Three growers out of the 226 expressed themselves as preferring hand digging to machine.

Overhead Cost Items for Digger Types on 215 Farms.

As in figuring the overhead cost of planters and sprayers, the same cost for diggers was obtained by figuring interest at 5 per cent on the average value and including the cost of repairs and depreciation. Table XXIII is a summary of these items.

Table XXIII. Digger Costs on 215 Farms.

Type	Number farms	Average initial cost[1]	Average depreciation	Average life[1]	Average cost of repairs
Elevator	71	$73.31	$9.92	8.6	$2.38
Reel	144	53.77	5.26	11.3	1.52

The reel type of digger is much cheaper in most ways than the elevator which requires a new chain nearly every year and on the whole does not last as long. The reel type costs a third less than the elevator type, annually depreciates about half as much, has an average life three years longer and costs a dollar less for repairs each year. These things combined with its lighter draft would tend to increase its popularity more rapidly were it not for the bruising which results in many cases to the crop when being dug.

Cost of Harvesting on 308 Farms.

In collecting the data on time required in digging operations it was difficult for the growers to give the actual hours spent in digging separate from time spent in picking up and hauling the crop either to storage or market. This is due to the fact that all three of these operations are conducted at the same time, that is, at various times during the same day at harvest time. Therefore the study here made is on the total and acre cost of harvesting rather than on digging alone.

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[1] In arriving at these items, 19 of the reel diggers and 11 of the elevator diggers used and included in the average were second-hand machines. Therefore the figures for these items are slightly lower than normal.

Although cost of digging would not ordinarily be influenced by yield, the cost of harvesting might be to a slight extent. Nevertheless, in dealing with a large number of farms as is done here, any influence of variation in yield on the cost of harvesting by hand or with either type of digger would be negligible.

Therefore the main point to be borne in mind in interpreting these data is that the labor cost items in all cases include the cost of picking up and hauling to market.

Interest		Depreciation		Machine cost		Labor cost		Grand total cost	
Total	Per acre	Total	Per acre	Total	Per acre	Total	Per acre	Total	Per acre
Digging to Cost.				308 Farms.					
						$15332.20	$15.04		
$165.76	$.15	$704.00	$.64	$1038.76	$.95	15086.00	13.81	$16124.76	$14.76
245.57	.10	816.00	.35	1372.67	.58	31747.00	13.49	33119.77	14.07
of Harvesting.									
By Hand.				82 Farms.					
						4349.15	14.95		
						6494.20	14.49		
						3469.65	16.29		
						1019.20	15.21		
Elevator Diggers.				71 Farms.					
44.05	.25	170.00	.95	248.05	1.39	2818.25	15.74	3066.30	17.13
52.19	.15	245.00	.71	343.19	.99	4588.05	13.24	4931.24	14.23
38.67	.15	176.00	.69	267.67	1.05	3271.15	12.83	3538.82	13.88
30.85	.10	113.00	.36	179.85	.58	4408.55	14.13	4588.40	14.71
Reel Diggers.				155 Farms.					
68.30	.16	215.00	.52	337.30	.81	6031.90	14.53	6369.20	15.35
73.55	.11	246.00	.38	425.55	.66	8524.10	13.25	8949.65	13.91
59.75	.09	198.00	.29	367.75	.55	9035.90	13.44	9403.75	13.98
43.97	.07	157.00	.25	242.07	.39	8155.10	13.10	8397.17	13.49

COST OF HARVESTING ON 308 FARMS

	Number of farms	Total acres	Man hours Total	Man hours Per acre	Horse hours Total	Horse hours Per acre	Average value of machinery
			Table XXIV. Relation of Method of				
Method							
By hand	82	1019.1	50777	49.8	34512	33.9	
Elevator digger	71	1092.5	44807	41.	40772	37.3	$46.63
Reel digger	155	2353.5	98653	41.9	80110	34.	51.65
			Relation of Acres per Farm to Cost				
			Table XXV.				
Acres per farm							
4 - 11	33	291.	14836	51.	9213	31.7	
11 - 16	35	448.1	21566	48.1	14540	32.4	
16 - 21	12	213.	11322	53.2	8035	37.7	
21 - 55	2	67.	3053	45.6	2724	40.7	
				Table XXVI.			With
4 - 11	20	179.	8045	44.9	8003	44.7	$43.95
11 - 16	26	346.5	14049	40.5	11855	34.2	40.10
16 - 21	14	255.	9653	37.9	8937	35.	55.21
21 - 55	11	312.	13060	41.9	11977	38.4	56.05
				Table XXVII.			With
4 - 11	48	415.	18725	45.1	15246	36.7	$28.43
11 - 16	49	643.5	26254	40.8	21822	33.9	29.98
16 - 21	37	672.5	28239	42.	22588	33.6	32.27
21 - 55	21	622.5	25435	40.9	20454	32.9	41.83

Digging Method Related to Cost.

The cost of harvesting when the crop was dug by hand was found to be $15.04 per acre, when dug by the elevator digger $14.76 per acre and when dug by the reel digger $14.07 per acre. The differences here are slight but show in favor of machine digging. There is a saving of about $1.00 per acre by the use of a reel type of digger as compared to hand digging. There is an average difference of $.32 per acre in labor cost in favor of the reel digger over the elevator type. The greater machine cost of the latter makes up the difference in total acre cost of $.97 in favor of the reel digger. The saving in labor cost of harvesting with a reel digger rather than by hand is $1.55 per acre. This is an appreciable total saving for the grower who is handling a large acreage each year. There is an average saving of 9 man hours per acre where the crop is harvested with the use of a digger rather than by hand. The horse hour rate is practically the same.

Size of Acreage Related to Cost.

Briefly, size of acreage shows very little influence upon the horse or man labor cost either when the crop is harvested by hand or by machine. There is, however, a tendency for the cost to decrease as the acreage increases. This is more true when harvesting is done by machine diggers than when it is done by hand. This may be reasonable to expect, since an acre of potatoes is more than the average man can dig in a day while machine diggers usually dig from 4 to 6 acres in a single 10

hour day.

On the contrary, machine cost per acre is uniformly decreased as acreage increases.

The above conclusions are based upon the summary data given in Tables XXIV, XXV, XXVI and XXVII.

Potato Machinery Rented.

The practice of renting potato machinery is very small, probably due to the fact that most growers owning their own machinery desire to use it during the period when it might be rented.

All of the potato machinery rented among over 330 farms consisted of 12 reel diggers and 8 planters. Renting of a machine is usually done for a lump sum rather than on an acre basis. The average rental of reel diggers was found to be $.60 per acre while the average acre rental for planters was $.31.

Special Potato Machinery.

In order to make available a source of information which shall include the names and addresses of manufacturers of special potato machinery with the special features and price, if quoted, of each machine, the following classified list has been compiled and appended.

In order to facilitate the selection of each type of the various classes of machines, the classes have been grouped roughly according to their structural mechanism.

No attempt has been made by the writer to emphasize or to recommend any particular type or manufacture because doubtless each possesses some feature or features which commend its use to certain localities or certain economic conditions, or certain conditions of soil and topography.

The list, though not complete, is thought to include all of the larger manufacturers of special potato machinery east of the Rocky Mountains.

Following the list is appended a series of cuts which may serve to illustrate in a general way the structure of the various types of each class as grouped in the list.

PLANTER TYPES.

TWO-MAN, PLATFORM TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Wabers Mfg. Co.	Racine, Wis.	Milwaukee	Semi-automatic cup delivery	---
McWhorter Mfg. Company	Riverton, N. J.	New McWhorter	Regulation of depth easy and sure. Fertilizer attach.	---
Bateman Mfg. Company	Grenloch, N. J.	Iron Age #1	Fertilizer attach. ahead of dropper which mixes it with soil.	$78
Bateman Mfg. Company	Grenloch, N. J.	Iron Age #2	Same as #1, without fertilizer distributer.	$68
Wm. Fetzer & Company	Springfield, Ill.	Fetzer	Small roller as a front wheel to the frame support. Seed feeds from cups to planter hose.	---
Stevens Mfg. Company	Decatur, Ill.	Stevens	Cog driven elevator planter, marker attachment.	---
Hirsch Brothers	Milwaukee. Wis.	Spalding	Feed over chute to planter spout.	$40

PLANTER TYPES.

TWO-MAN, PLATFORM TYPES.

Name of Firm	Address	Name of Machine	Particular Merit	Price
A. J. Platt	Sterling, Ill.	Keystone	Accuracy, very simple construction.	---
Champion Potato Machinery Co.	Hammond, Ind.	O. K. Champion Dial #25	100 per cent accuracy.	---

PLANTER TYPES.

ONE-MAN, PICKER TYPE, AUTOMATIC.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Aspinwall Mfg. Company	Jackson, Mich.	Aspinwall No. 3	Fertilizer attach.	---
Aspinwall Mfg. Company	Jackson, Mich.	Double Row	Fertilizer attach.	---
American Potato Machinery Co.	Hammond, Ind.	Automatic	Fertilizer attach. Seed elevated in cups in full view of operator.	---
Pugh Mfg. Co.	Topeka, Kans.	Pugh Planter	Double disk furrow opener or shoe furrow opener.	---
Haywood Fire & Equipment Co.	Indianapolis, Ind.	Invincible	None in particular.	---
Springer Bros. Mfg. Company	Edwardsville, Ill.	Springer, one & two planters	Construction like corn planters.	---
Eureka Mower Company	Utica, N.Y.	Eureka	Automatic dropper and accurate.	---
American Seeding Mach. Company	Springfield, Ohio.	Evans	Automatic, great accuracy.	---
Bernhardt Mfg. Co.	Edwardsville, Ill.	King	Simplest automatic planter.	---

PLANTER TYPES.

ONE-MAN, CUP DELIVERY TYPE, SEMIAUTOMATIC.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Champion Potato Machinery Co.	Hammond, Ind.	O. K. Champion Automatic #22	Simple, does not bruise or stick the seed.	---
Schofield & Company	Freeport, Ill.	Schofield's Jr. Combined planter and digger	A cheap combination, where one can not afford 2 machines.	---

ONE-MAN, HOPPER FEED TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
American Potato Machinery Co.	Hammond, Ind.	National Automatic seed cutting potato planter	Hopper holds 1 bu. and cuts and plants all from same hopper.	---

PLANTER TYPES.

HAND JAB, TUBULAR TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Wabers Mfg. Company	Racine, Wis.	"Invincible"	Double Leaf spring all steel, adjustable handle.	$1.25 FOB
Wabers Mfg. Company	Racine, Wis.	Wabers Potato Planter	Solid tube planter instead of slatted as with the Invincible.	$1.25 FOB
Prairie Mfg. Company	Indianapolis, Ind.	Invincible	None in particular.	$1.50
Potato Implement Co.	Traverse City, Mich.	Eureka Tubular	Potatoes fill 20" tube.	---
Potato Implement Co.	Traverse City, Mich.	Peerless Tubular		---
Potato Implement Co.	Traverse City, Mich.	Acme Wire Tubular	Tube of wire screen.	---
Potato Implement Co.	Traverse City, Mich.	Acme Tubular	Tube solid like Eureka.	---
Sheffield Mfg. Company	Burr Oak, Mich.	Sheffield	Strong and light.	---

HAND JAB, SINGLE PIECE TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Potato Implement Co.	Traverse City, Mich.	Acme	Wooden broom handle. Piece dropped in for each hill.	---
Potato Implement Co.	Traverse City, Mich.	Pingree	Wooden broom handle. Piece	---

SPRAYER TYPES.

CHAIN DRIVE, HORIZONTAL BARREL TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Thos. Peppler	Hightstown, N. J.	Perfection 6-row	Flexible pipe extension operated from driver's seat to pass obstacles.	$75 complete
Brandt Mfg. Company	Minneapolis, Minn.	Simplex Sprayer	Cam driven, strong, all parts under control of drivers, 4 or 6 row.	$70
Aspinwall Mfg. Co.	Jackson, Mich.	Aspinwall	Pump at right angle, distributes power required in suction, pressure is equivalent to purely rotary motion. Barrel above axle-less weight on horse.	---
Bateman Mfg. Co.	Grenloch, N. J.	No. 105DS Iron Age,	Six row, 100 gal. traction sprayer. Galvanized barrel container, ahead of driver, nozzles behind.	$105
Bateman Mfg. Co.	Grenloch, N. J.	No. 105 D Iron Age	Same as #105DS except for 4 rows.	$97
Champion Potato Machinery Co.	Hammond, Ind.	O.K. Champion	4 row, simple and pump efficiency.	---
McKenzie Bros. Mfg. Co.	LaCrosse, Wis.	Egan 5 row	Barrel mounted on steel frame chain drive traction.	---

SPRAYER TYPES.

CHAIN DRIVE, HORIZONTAL BARREL TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Pugh Mfg. Company	Topeka, Kans.	Pugh Sprayer	Cog drive, barrel container, air tank behind.	Not given
McKenzie Bros. Mfg. Company	LaCrosse, Wis.	Little Giant 4 row	Barrel mounted on steel frame chain drive traction.	---
McKenzie Mfg. Company	LaCrosse, Wis.	P & O Sprayer	Horizontal barrel with traction pump.	---

SPRAYER TYPES.

CHAIN DRIVE, VERTICAL BARREL TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Hurst Mfg. Company	Canton, Ohio	Outfit #5	Sprays 4 rows, half barrel container, chain drive.	$68
Field Force Pump Company	Elmira, N. Y.	Wooster Potato & Orchard sprayer	Automatic brush to keep nozzles clean.	$58.50
Field Force Pump Company	Elmira, N. Y.	Watson "Ospraymo"	High pressure, chain drive, 4 row sprayer.	$75
Field Force Pump Company	Elmira, N. Y.	Watson "Ospraymo Special"	Chain drive, high pressure, 12 nozzle.	$89
Field Force Pump Company	Elmira, N. Y.	Aroostook	Six row-high pressure mechanical agitator with automatic brush to keep strainers clean.	$85

SPRAYER TYPES.

HAND PUMPED BARREL TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Brandt Mfg. Company	Minneapolis, Minn.	"Eureka" high pressure	Compressed air tank over barrel suspended from axle.	$40
Hurst Mfg. Company	Canton, Ohio	Hurst 20 Gal. H. P.	Light, mounted on steel wheelbarrow frame, 3" tires, sprays from adjustable steel spray arms.	$28
Field Force Pump Company	Elmira, N. Y.	Empire King	4 row sprayer hand pump pressure.	$32
Bateman Mfg. Co.	Grenloch, N. J.	Iron Age #190 D.	Double action pump, hand power barrel sprayer, mounted on truck, sprays 4 rows.	$30
F. E. Myers & Brothers	Ashland, Ohio	Myers 3 row	Side shot spray with flexible nozzles, 2 for each row. Side delivery nozzles.	$18 without barrel.

SPRAYER TYPES.

COMPRESSED AIR KNAPSACK TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
F. E. Myers & Brothers	Ashland, Ohio	Fountain Spray Pump. knapsack	Galvanized iron round corners and operated by rubber bulb attached to hose.	1 bulb $5 2 bulbs $7
Ripley Hardware Company	Grafton, Ill.	No. 15, 5 gal. Comp. Air	None in particular.	$5
Brandt Mfg. Company	Minneapolis,Minn.	"Perfection" Knapsack	Extra strong tank of double seams.	Steel $5 Brass $7.50
Hurst Mfg. Company	Canton, Ohio	Hurst Compressed Air, No. 10	Used for all fungicides, whitewashing, etc.,carried under arm.	$5
Prairie Mfg. Company	Indianapolis, Ind.	Double cylinder	Will throw stream 30' high and charged in one-half minute.	$4.50 $6
Field Force Pump Co.	Elmira, N. Y.	The Good News compressed air knapsack	Galvanized steel tank.	$5.50 to $8
Bateman Mfg. Co.	Grenloch, N. J.	#199 Compressed air knapsack	Strong, durable, with spring nose-cock.	$5 to $6.50
Potato Implement Co.	Traverse City,Mich.	Hill's Improved knapsack Sprinkler	Capacity 5 gals. Galvanized steel tank.	---

SPRAYER TYPES.

CANTEEN HAND TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
F. E. Myers & Brothers	Ashland, Ohio	Faultless sprayer Plunger	Great force to spray, air chamber securely fastened to tank.	Brass $16 per doz. Tin $7 per doz.
Potato Implement Co.	Traverse City, Mich.	Canteen sprayer	Hand compressed air pull rod type.	---

DIGGER TYPES.

CHAIN ELEVATOR TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Wabers Mfg. Company	Racine, Wis.	The "Best"	Cog driven, chain elevator digger easy to operate.	$90
American Potato Machinery Co.	Hammond, Ind.	New American Elevator Digger.	Chain elevator easy to operate from seat. Special gravel shields. Vine separator. 4 H. digger.	---
A.B. Farquhar Company	York, Pa.	Farquhar Elevator	Special gravel shield. Made with heavy and light chains, chain elevator.	$100
Pugh Mfg. Company	Topeka, Kans.	Pugh	Main carrying chain shaft has reversible brass box compression grease cups, chain elevator.	---
Akron Cultivator Co.	Akron, Ohio	Hist	Front wheels may be raised off ground so as to turn around on the main wheels. Chain drive elevator digger.	---
Hoover Mfg. Company	Avery, Ohio	#300 "Hoover"	Agitating rear rack and vine separator.	---
Hoover Mfg. Company	Avery, Ohio.	#301 "Hoover"	Same as #300 except a riddle elevator.	---

DIGGER TYPES.

CHAIN ELEVATOR TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Bateman Mfg. Company	Grenloch, N. J.	#155 Iron Age	Cog drive, chain elevator.	$85
Bateman Mfg. Company	Grenloch, N. J.	#156 Iron Age	Same as #155 except narrower elevator.	$73
Bateman Mfg. Company	Grenloch, N. J.	#157 Iron Age	Cam drive shaker to agitate dirt from tubers. Lighter draft than most 2 horse diggers.	$85
Champion Potato Machinery Co.	Hammond, Ind.	O. K. Champion	Light draft.	---
McKenzie Bros. Mfg. Company	La Crosse, Wis.	Badger	Digs on slope as well as level, on strong land, as well as sand.	$90
Reuther Mfg. Company	East Aurora, N. Y.	Reuther	No scattering, elevator out of gear when point is out of ground.	---
Gowanda Agr. Works	Gowanda, N. Y.	Gowanda Hamburg	Light draft, simple constuction, chain drive, elevator digger.	$80
Gowanda Agr. Works	Gowanda, N. Y.	Knox Patent	Cog drive,wide shovel raising whole hill into shaker.	$75
Aspinwall Mfg. Co.	Jackson, Mich.	Aspinwall	Chain specially designed for wear.	---

DIGGER TYPES.

DISC ROLLER ELEVATOR TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Bateman Mfg. Company	Grenloch, N. J.	#160 Iron Age	Same as #157 except roller bearings to elevate tubers.	$118

SPIDER, ROTARY FORK TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Stevens Mfg. Company	Decatur, Ill.	Stevens	Little soil carried, tubers dug and elevated by a rotary fork.	---

DIGGER TYPES.

SHOVEL PLOW SHAKER TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
S. L. Allen Company	Philadelphia, Pa.	Improved Planet, Jr. White Potato digger	Series of plow shares which slice up furrows, push aside tops and weeds, carry tubers to surface.	$18
A. B. Farquhar Company	York, Pa.	Gilt Edge	Wings on shovel point.	$45
A.B.Farquhar Company	York, Pa.	Success, Jr.	Wings on shovel point.	$12
H.J.Doughten	Moorestown, N. J.	King of the Potato Field	Low priced, simplicity, consists of shovel point and two lateral riders of bars to deposit tubers in double row.	---
Rock Island Plow Co.	Rock Island, Ill.	#3 Ratteer	Peculiar shaking device back of shovel point, simple and cheap.	---
B. F. Avery & Sons	Louisville, Ky.	Avery's No.E	Plow digger with steel half fingers rollers coulter and disc for clearing away vines.	---
B. F. Avery & Sons	Louisville, Ky.	Avery's Shaker #10	Shaker bars behind plow and adjustable gauge wheels.	---

DIGGER TYPES.

SHOVEL PLOW SHAKER TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
G. W. Jessup	Moorestown, N. J.	Grange	Turns wide 14" space, light, not adapted to hill digging.	$55
Racine-Sattley Company	Springfield, Ill.	"Rustler"	Shovel plow shaker style.	---
Vulcan Plow Company	Evansville, Ind.	Vulcan	Simple, shovel plow, bar attach applicable to small acreage where expensive digger is not advantageous.	$10
Shunk Plow Company	Bucyrus, Ohio	Shunk	Cheap and best only for small growers.	$8
Moline Plow Company	Moline, Ill.	Moline	Cheap, for small grower.	---
Parlin & Orendorff	Canton, Ill.	P. & O.	Cheap, shovel plow shaker, small areas.	---
Eureka Mower Company	Utica, N. Y.	Eureka	Designed for small acreage.	---
Geo. W. Jessup	Moorestown, N. J.	Eastern Shore	Brings 95% to surface.	---

ROTARY REEL TYPE.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Allen Foundry Company	Corning, N. Y.	Boss	Light draft.	$60

MISCELLANEOUS POTATO MACHINERY.

SEED CUTTERS.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Pugh Mfg. Company	Topeka, Kans.	"Gem" cutter	For large potatoes 2-1/2" or over.	---
American Potato Machinery Co.	Hammond, Ind.	"American" Potato Cutter	Simple construction, set blades across basket, stick potato on blades and force blade through potato with mallet.	---
Pugh Mfg. Company	Topeka, Kans.	Junior Gem Cutter	Cuts large, medium and small halves, thirds and quarters all in one stroke.	---
Springer Bros. Mfg. Co.	Edwardsville, Ill.	Springer Cutter	None in particular.	---
Eureka Mower Company	Utica, N. Y.	Eureka Potato Cutter	Operated by foot lever.	---
Champion Potato Machinery Co.	Hammond, Ind.	O.K.Champion Seed Potato Cutter	Operated by foot lever.	---

MISCELLANEOUS POTATO MACHINERY.

POTATO HOES OR HILLERS.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Syracuse Chilled Plow Company	Syracuse, N. Y.	Syracuse Potato Hoe	Adjustable discs for covering or ridging potato rows.	---
S. A. Loose & Son	Hamburg, Pa.	Corn & Potato Hiller	Can hill from 4" to 9" high.	---

DUSTERS.

Name of Firm	Address	Name of Machine	Particular Merit	Price
McWhorter Mfg. Company	Riverton, N. J.	2 and 4 Row Paris Green dusters	Light, simple. Paris Green and Lime 1 to 25, feed through 4 openings.	---
Potato Implement Co.	Traverse City,Mich.	Acme Plaster sifter	Cylinder swings on handle to shake out plaster of Paris Green.	---
Potato Implement Co.	Traverse City,Mich.	Acme Double Powder Gun	Double blast leather bellows.	---

MISCELLANEOUS POTATO MACHINERY.

COMBINED DIGGERS AND PICKERS.

Name of Firm	Address	Name of Machine	Particular Merit	Price
Hoover Mfg. Company	Avery, Ohio	#302 Combined Digger and Picker	Digs and deposits tubers in crates or in wind rows crosswise of field.	---

POTATO SORTERS OR GRADERS.

Name of Firm	Address	Name of Machine	Particular Merit	Price
American Potato Machinery Co.	Hammond, Ind.	Potato Grader and Sorter	Operated by means of a swinging arrangement.	---
Pugh Mfg. Company	Topeka, Kans.	"Idaho" Sorter	A shaker sorter simple and durable.	---
Pugh Mfg. Company	Topeka, Kans.	Pugh Potato Sorter	Endless flexible screen.	---
F. Boggs	Atlanta, N. Y.	Sorter and Grader	Inclined shaker.	$44 $56
Champion Potato Machinery Co.	Hammond, Ind.	O.K.Champion potato sorter	Operated by fly wheel.	---

SPECIAL POTATO MACHINERY.

Planter Types.

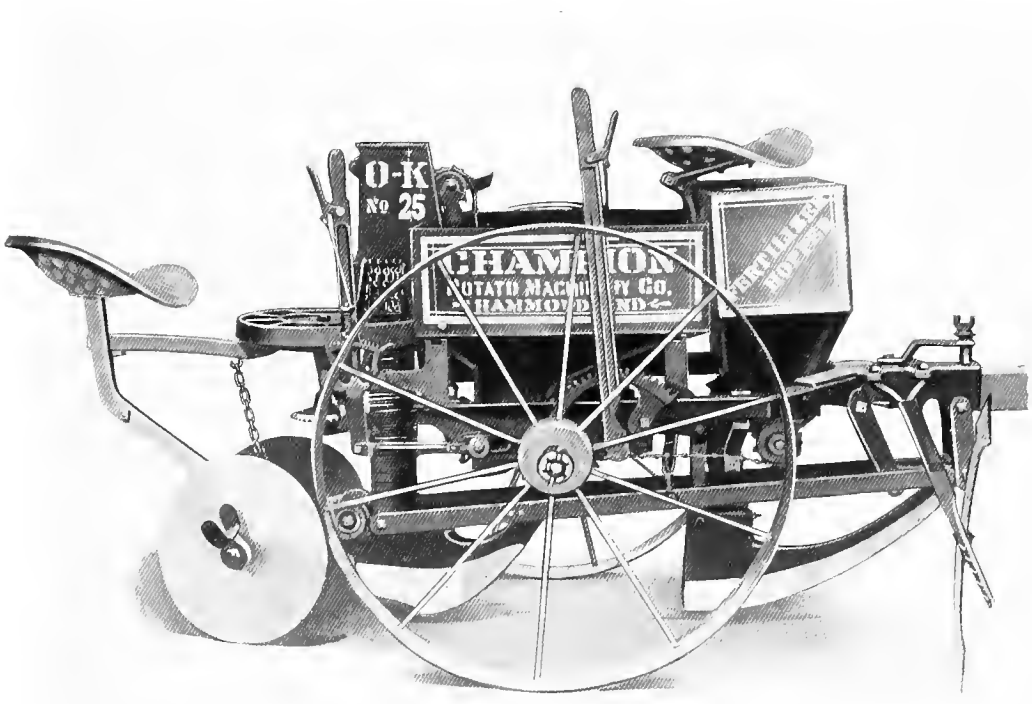
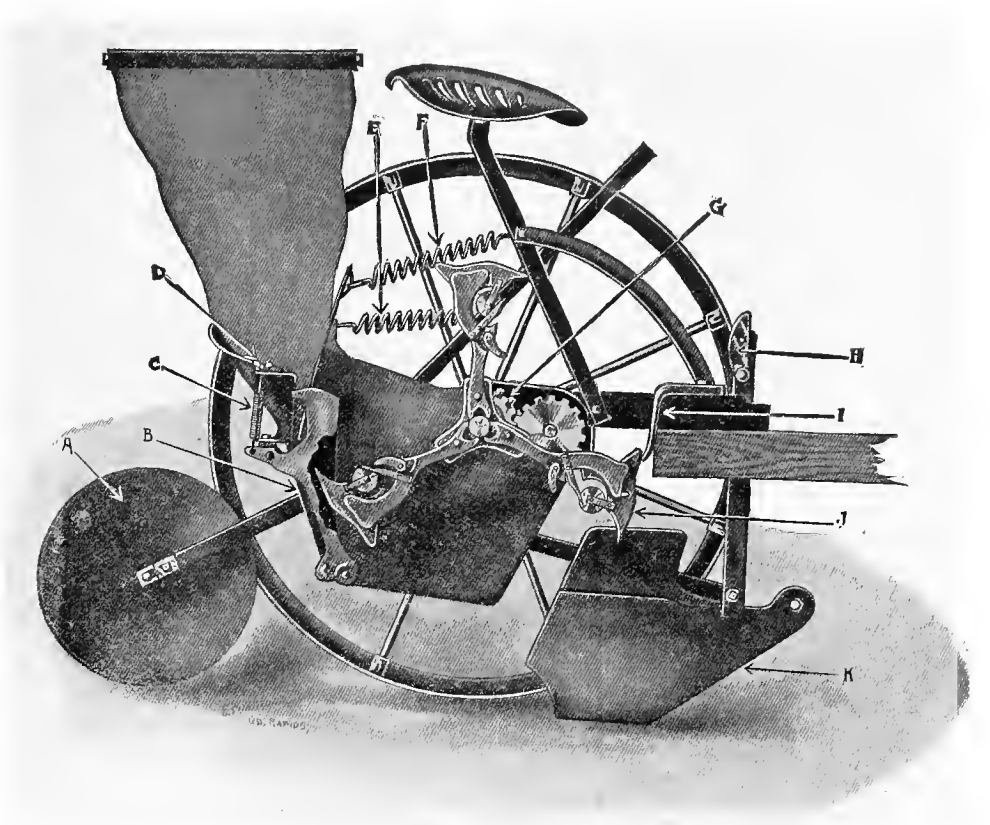


Fig. VII.

The 2-man Platform Type.

Planter Types (Continued)



Sectional View of Aspinwall Planter No. 3

A—Coverer
B—Concave
C—Concave Tension Spring
D—Concave Spring Adjusting Nut
E—Coverer Spring
F—Agitator Spring
G—Gears
H—Lifting Handle
I—Tripper
J—Picker
K—Furrow Opener

Fig. VIII.

The 1-man Picker Type.

Planter Types (Continued)

Fig. IX.

The 1-man Cup Delivery Type.

Planter Types (Continued)

Fig. X.

The 1-man Hopper Feed Type.

Planter Types (Continued)

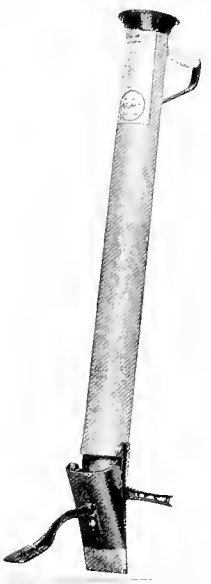


Fig. XI.

The Tubular Hand Type.

Fig. XII.

The Single Piece Hand Type.

Sprayer Types.

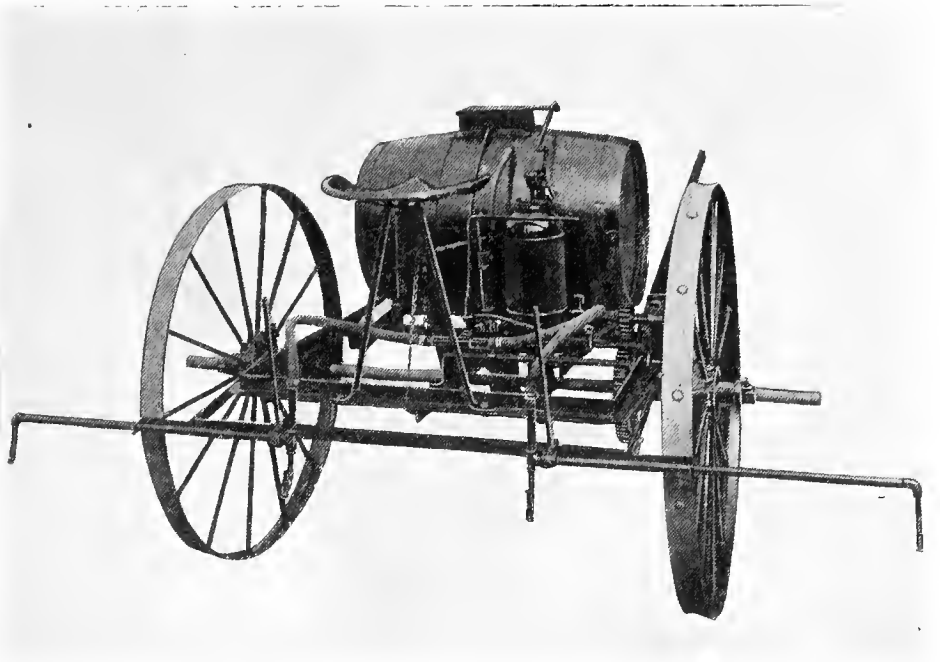
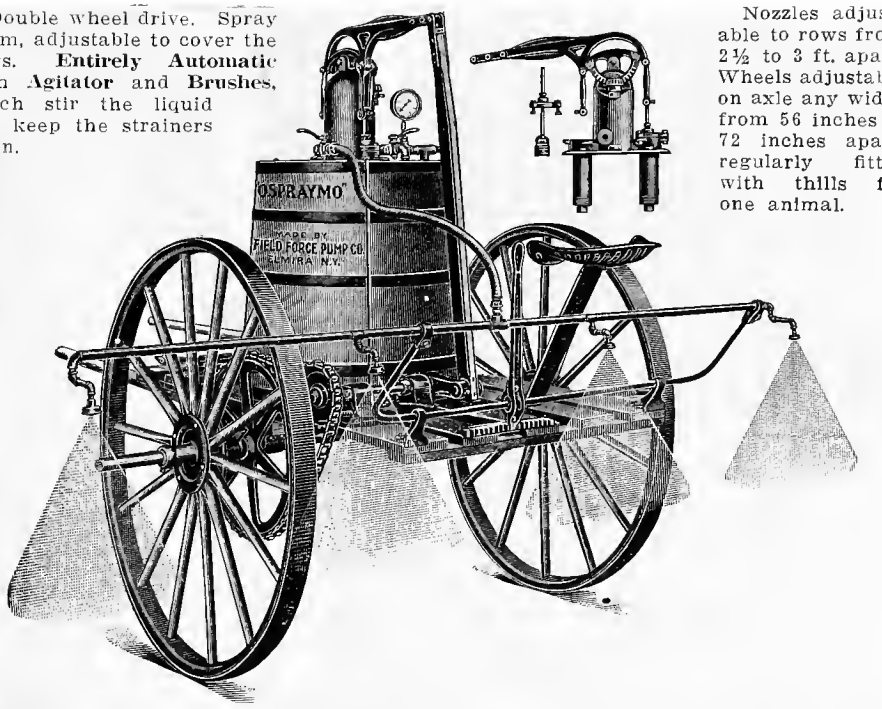


Fig. XIII.

The Chain Drive Horizontal Barrel Type.

Sprayer Types (Continued)

Double wheel drive. Spray boom, adjustable to cover the rows. **Entirely Automatic** with **Agitator** and **Brushes**, which stir the liquid and keep the strainers clean.



Nozzles adjustable to rows from 2½ to 3 ft. apart. Wheels adjustable on axle any width from 56 inches to 72 inches apart, regularly fitted with thills for one animal.

Fig. 600

Fig. XIV.

The Chain Drive Vertical Barrel Type.

Sprayer Types (Continued)

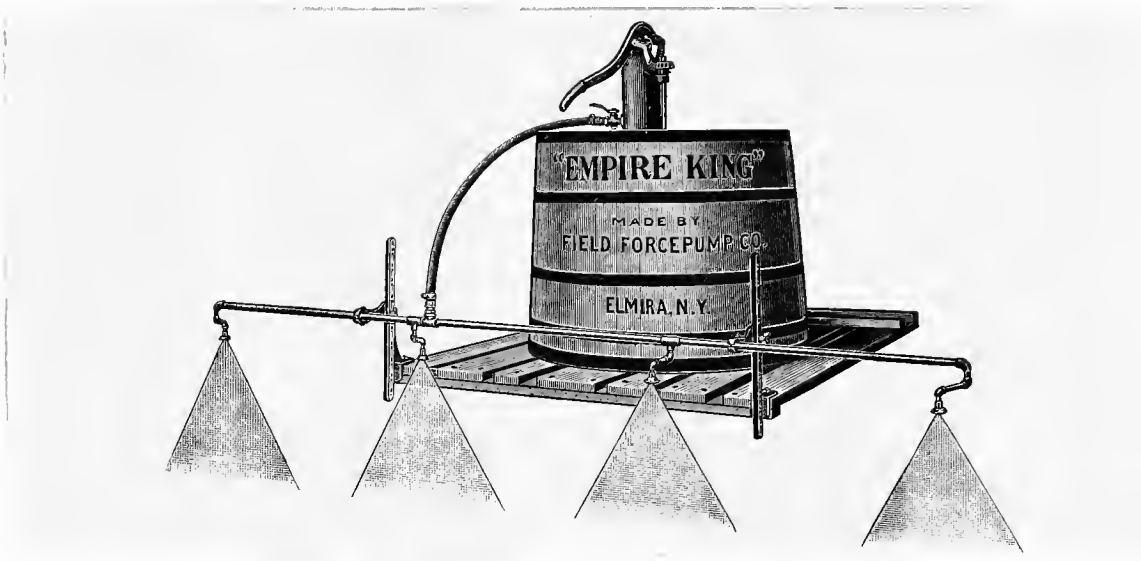


Fig. XV.

The Hand Pump Barrel Type.

Sprayer Types (Continued)

Fig. XVI.

The Knapsack Compressed Air Type.

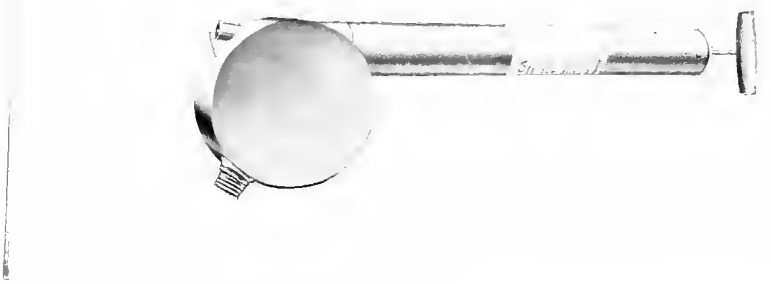


Fig. XVII.

The Plunger Pump Canteen Type.

Digger Types.

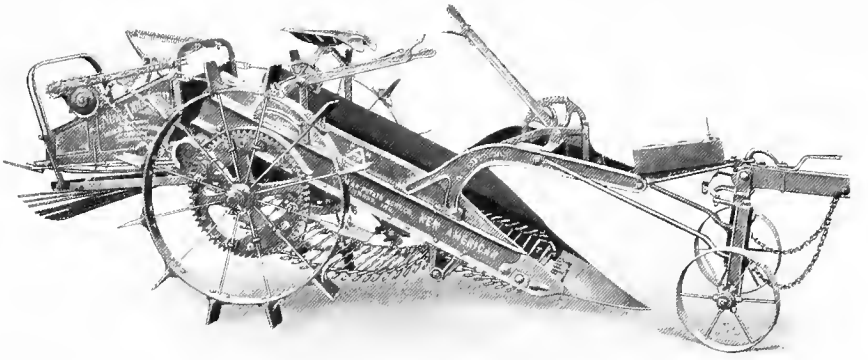


Fig. XVIII.

Chain Elevator Type.

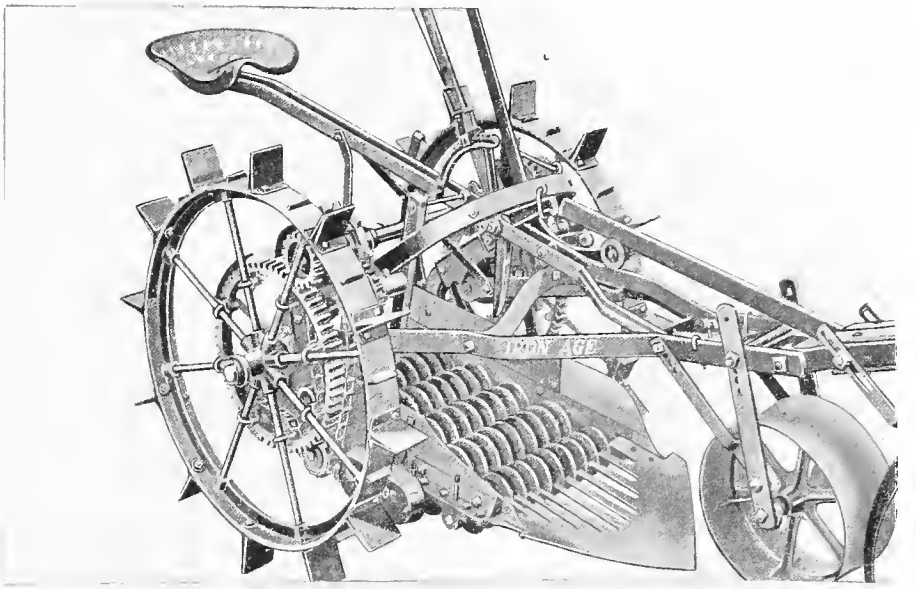


Fig. XIX.

Disc Roller Elevator Type.

Digger Types(Continued)

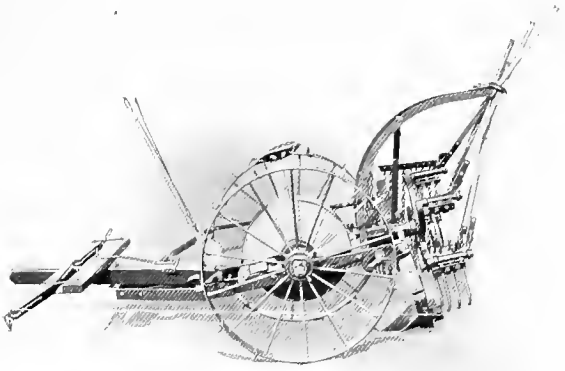


Fig. XX.

Rotary Fork Type.

Fig. XXI.

Rotary Reel Type.

Digger Types (Continued)

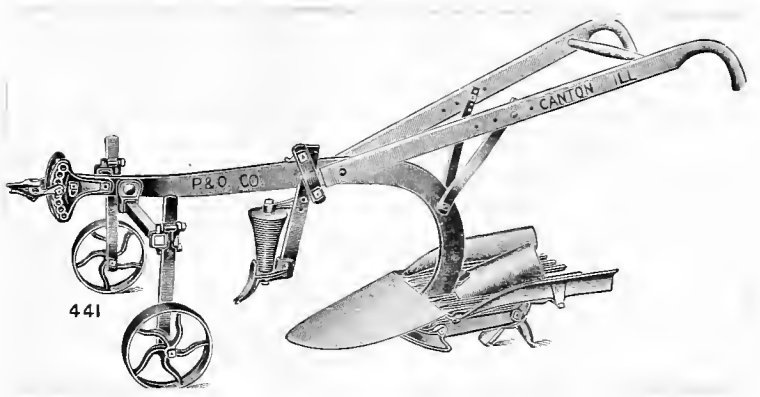
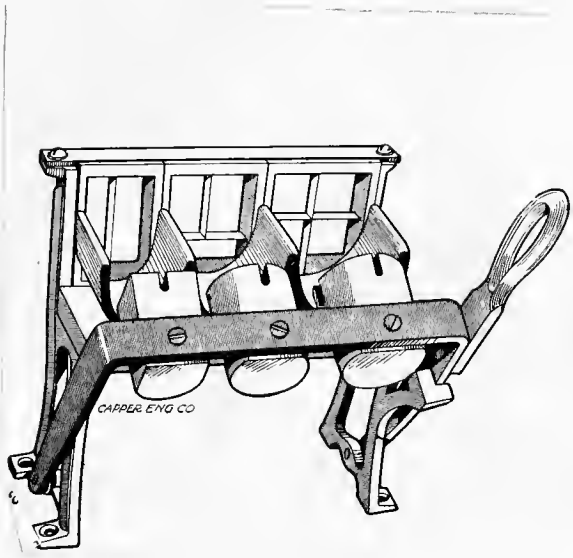


Fig. XXII.

The Shovel-Plow Shaker Type.

MISCELLANEOUS POTATO MACHINERY.

Seed Cutters.



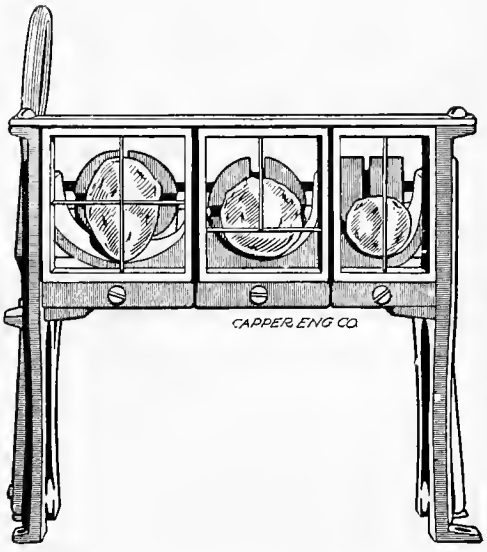
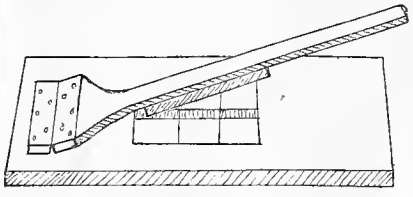


Fig. XXIII.

Triple-cut Hand Type.

POTATO CUTTER.

Here is a handy device for cutting seed potatoes. It is made of a plank 2 ft. long, 7 in. wide, with a hole 5x8 in.



POTATO CUTTER.

in the center. Knives cross each other at right angles in this opening. The cutter is placed over a potato crate, box or barrel, the potatoes laid upon the knives one at a time, and the handle brought down. — Elmer Hartman.

Fig. XXIV.

Hinge Plank Type.

Fig. XXV.

Foot Pedal Type.

MISCELLANEOUS POTATO MACHINERY (Continued)

Hoes or Hillers.

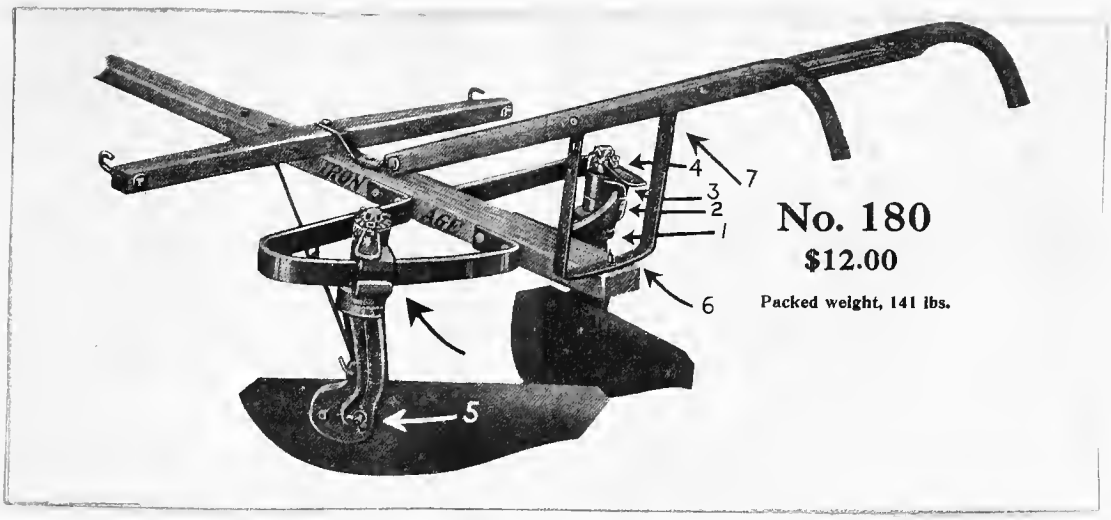


Fig. XXVI.
Low Ridge Type.

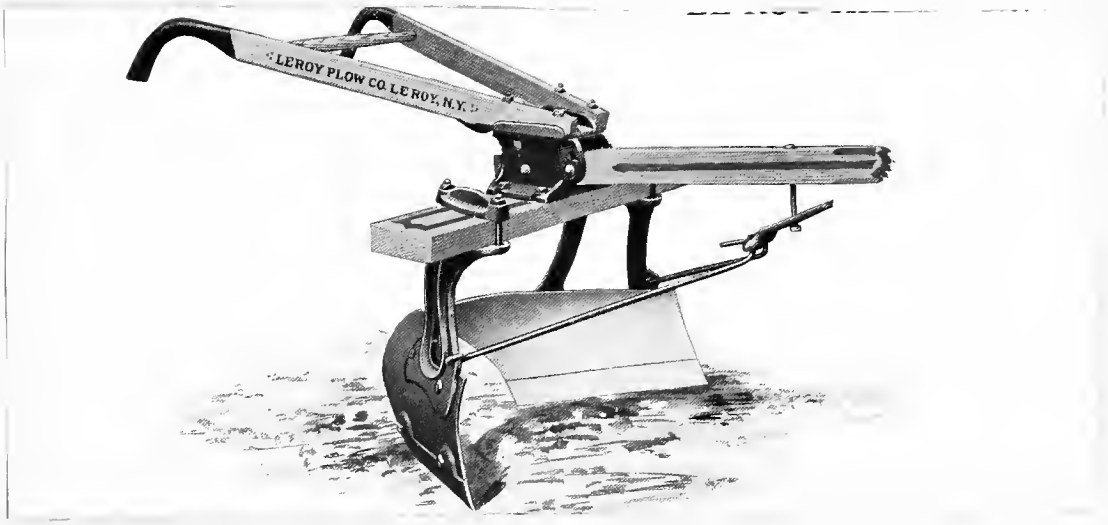
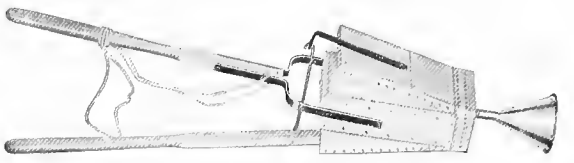


Fig. XXVII.

High Ridge Type.

MISCELLANEOUS POTATO MACHINERY (Continued)

Dusters.



No. 314

Fig. XXVIII.

Bivalve Bellows Type.

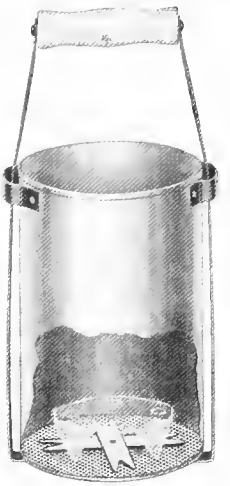


Fig. XXIX.
Shaker Bucket Type.

MISCELLANEOUS POTATO MACHINERY (Continued)

Combined Diggers and Pickers.

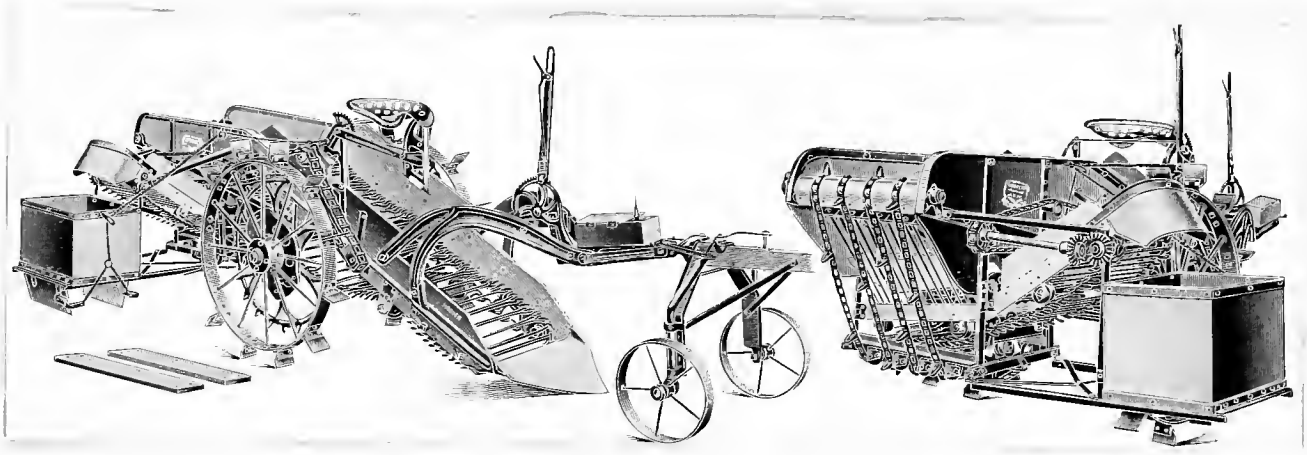


Fig. XXX.

MISCELLANEOUS POTATO MACHINERY (Continued)

Sorters and Graders.

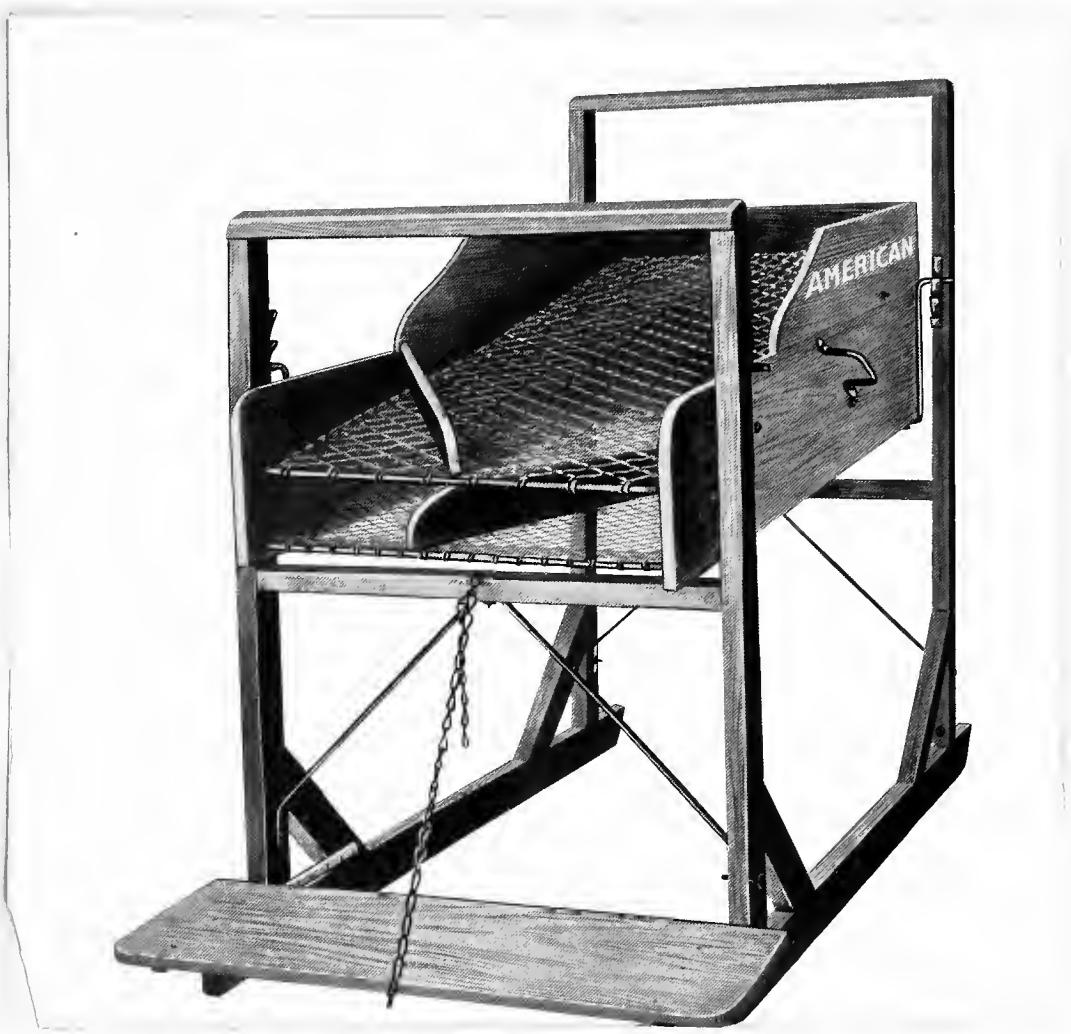


Fig. XXXI.

Screen Shaker Type.

CONSERVATION
REVIEW: 4-30-91
No further action