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# Summer Tillage Implements

By
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Montana Extension Service in Agriculture and Home Economics, J. C. Taylor, Director, Montana State College and the United States Department of Agriculture, Cooperating Acts of Congress May 8 and June 30, 1914.

# SUMMER TILLAGE ILLUSTRATED.

## The Aim Should be —— But Too Often We See

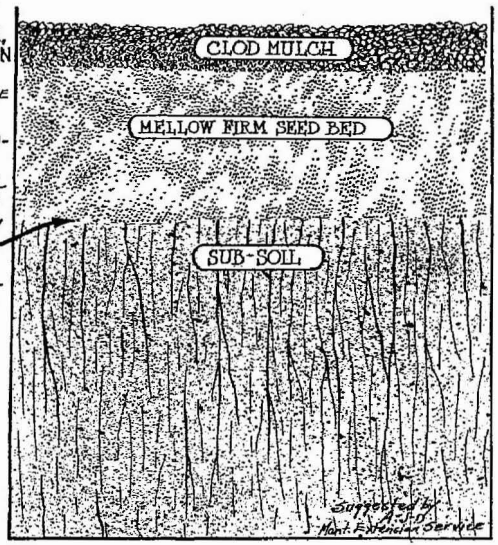
FREEDOM FROM WEEDS.
*NO LOSS OF MOISTURE THRU PLANTS*

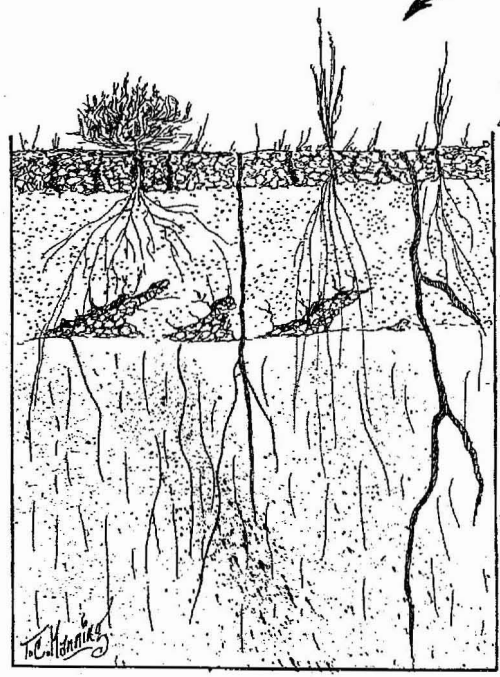
CLODDY, LOOSE, GRANULAR, OPEN SURFACE
*LOSS FROM SURFACE EVAPORATION REDUCED*

SEED BED SUPPLIED WITH MOISTURE & AIR
*MORE PLANT FOOD AVAILABLE THRU BACTERIAL ACTION*

A FIRM CONNECTION BETWEEN PLOWED LAYER AND SUBSOIL

MOISTURE STORED IN SUBSOIL
*GOOD CROP INSURANCE.*




GROWTH OF WEEDS
*ENORMOUS LOSS OF SOIL MOISTURE*

DUST MULCH OR BAKED SURFACE
*HEAVY RAINS LOST BY RUN-OFF.*

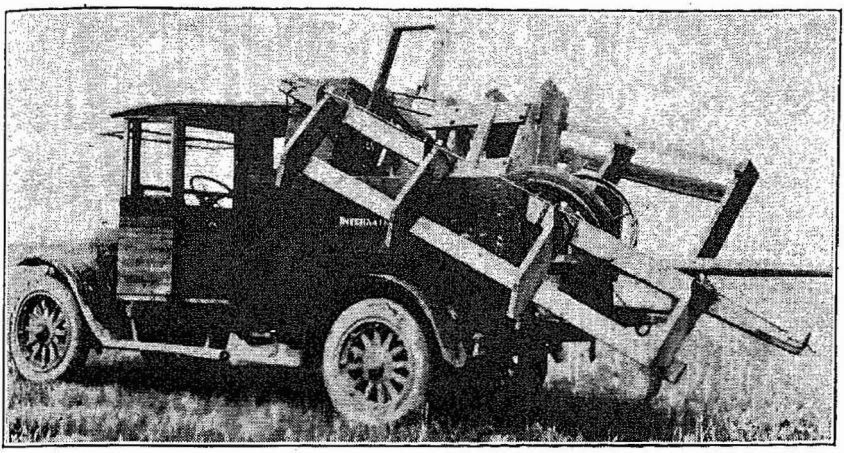
DEEP CRACKS
*LOSS OF MOISTURE THRU EVAPORATION*

LOOSE, OPEN, & DRY SEED BED
*LIMITED BACTERIAL ACTIVITY AND PLANT FOOD*

OPEN SPACES BETWEEN PLOWED LAYER AND SUBSOIL
*INEFFICIENT MOISTURE STORAGE AND LOSS OF WATER.*

VERY LITTLE MOISTURE IN SUBSOIL
*GAMBLING ON SEASONAL RAINFALL-NO INSURANCE*

Fig. 1—A county truck loaded with various types of homemade implements and ready to proceed to a community tillage implement demonstration in Montana. County agents have used this method in bringing the matter of adapted implements effectively to the attention of the farmers in Montana.



# Implements for Summer Tillage

**By A. J. OGAARD**
**Extension Agronomist, Montana State College**

## Introduction

*THIS CIRCULAR presents information about various types of implements which are being used for summer tillage by many dry land farmers of the northwest. It is the hope of the author that this discussion of summer tillage principles and these comments on summer tillage implements may assist Montana dry land farmers materially in working out methods adapted to their own peculiar needs and conditions.*

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One of the fundamental principles which must be taken into consideration in working out a system of farming on most dry land farms of Montana, is that of reserves—the carrying over of moisture, feed and cash from the years of enough or plenty for use in the occasional and inevitable years of lean production. It is because of this necessity of reserves that summer tillage occupies such an important and promising place in Montana dry land agriculture.

The four main objects of good summer tillage are:

1—**Storage of moisture** from one season as a reserve and insurance in the production of crops the following year;

Fig. 2—The "clean and cloddy" soil surface which should be the aim of the Montana summer tiller. A "dust mulch" will generally puddle and cause loss of moisture through run-off. A dusty surface increases the tendency of some soils to blow.

2—**Control of weeds** by clean and timely cultivation;

3—**The accumulation of available plant food** resulting from a combination of moisture, air and heat conditions favorable to bacterial action; (In other words, the putting of more strength and nourishment into the soil water, which is to be taken up by the crops);

4—**Better distribution of labor** during the year, with more land prepared for seeding at the proper time.

Summer tillage should not be considered as a "miracle method," cure-all or general panacea for dry land farming ills. Its value in any particular case will depend a great deal upon the peculiar combination of conditions existing. In some portions of the state the chief aim may be weed control; in another district moisture storage may be the main objective in summer tillage. In some portions of this great semi-arid empire, corn may be regarded safely and within reasonable limitations as a

most efficient substitute for summer tillage; in other regions summer tillage will remain the backbone of profitable and safe production.

*From the standpoint of the State of Montana as a whole, it is unquestionably true that there is room for more and better summer tillage.*

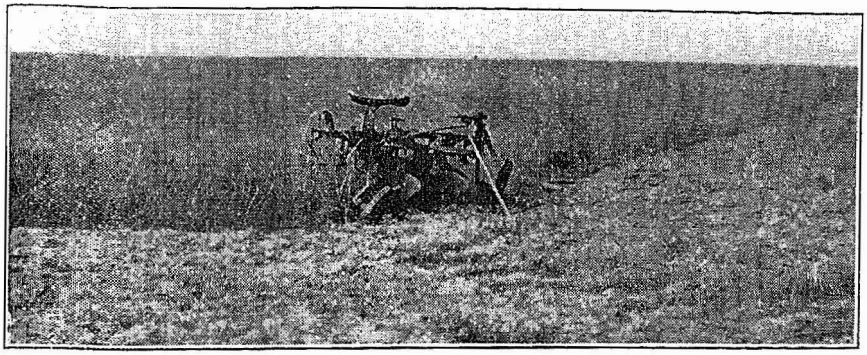


**Fig. 3**—Late "summer plowing" of land that is covered with weed growth should not be confused with proper summer tillage practice. On weedy land the soil has not been in proper condition to absorb moisture during the normal period of heaviest rainfall and weed growth has dissipated most of the moisture stored in the soil. Unsatisfactory yields on such land should not be used as an argument against summer tillage.

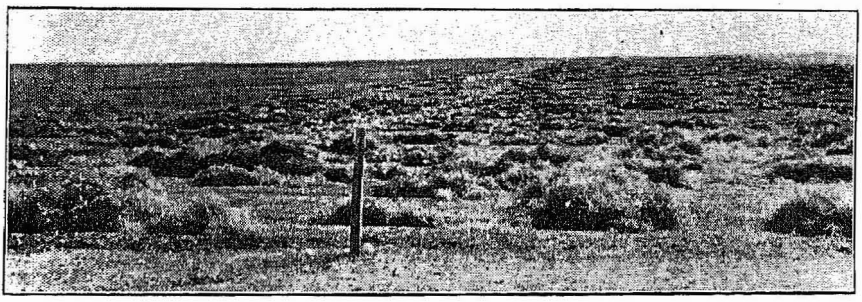


**Fig. 4**—Weedy summer fallow, an all too common result of untimely use of unadapted tillage implements. Weeds are the prime dissipaters of soil moisture under Montana dry land conditions.

From the point of moisture conservation it is important that the rainfall be absorbed into the ground as efficiently as possible. Proper tillage practices should be applied which will tend to place the soil surface in the best condition to prevent or reduce moisture losses through run-off. Early plowing or cultivation, as early in the normal rainy season as possible, may be used to bring about this surface condition. A hard stubble or a dust-mulch surface would generally be inefficient from the standpoint of moisture absorption, especially on the heavier clay soils. A slightly lumpy condition commonly known as a "clod mulch" is much less likely to puddle during heavy or beating rains.

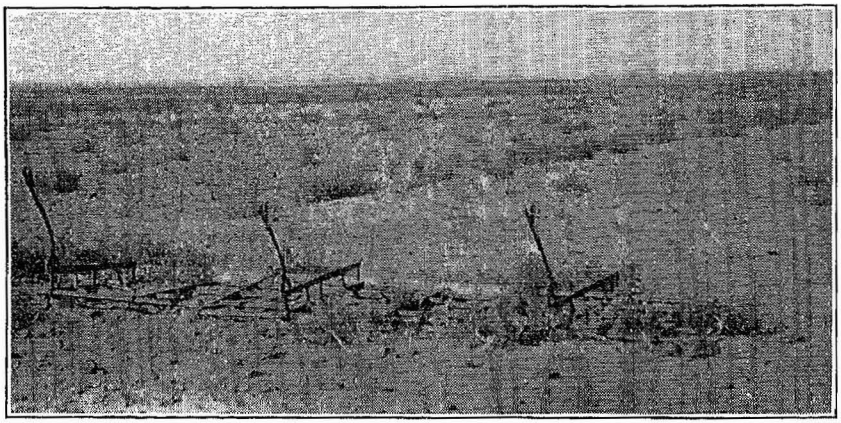


Fig. 5—The spike-tooth harrow is an inefficient and unadapted implement for summer tillage. It tends to unduly pulverize the surface and is not especially designed for the elimination of average weed growth.

After the moisture has been stored in the soil, the chief problem is to prevent losses by direct evaporation and, more especially, through weed growth. Deep checks or cracks in the soil should be closed by cultivation to prevent loss of moisture through circulation of the air or by direct evaporation into it. It is commonly held in the Northern Great Plains area that control of weeds is a function of cultivation more important than the creation and maintenance of a soil mulch, because there is usually a complete absence of an underground water table within any reasonable depth.

The greatest losses of soil moisture undoubtedly are due to the use of moisture by growing vegetation. The average man does not realize the enormous amounts of water pumped out of the soil through plants. Thus the elimination of weeds is all-important in summer tillage, and the time to kill weeds is when they are young and tender. "A stitch in time saves nine" in weed control—the job must be done thoroughly and on time.

In weed control it is important that implements be used which will not allow the weeds to slip by or otherwise escape destruction. Shallow cultivation is recommended generally; deep stirring of the soil causes direct losses of soil moisture without any advantage in weed control, in spite of the fact that the draft of the implement is increased.

It is recognized that summer tillage inevitably brings forward other problems, notably that of soil blowing. As the virgin root fiber and organic matter become depleted as a result of cropping and tillage, soil drifting troubles become more acute.

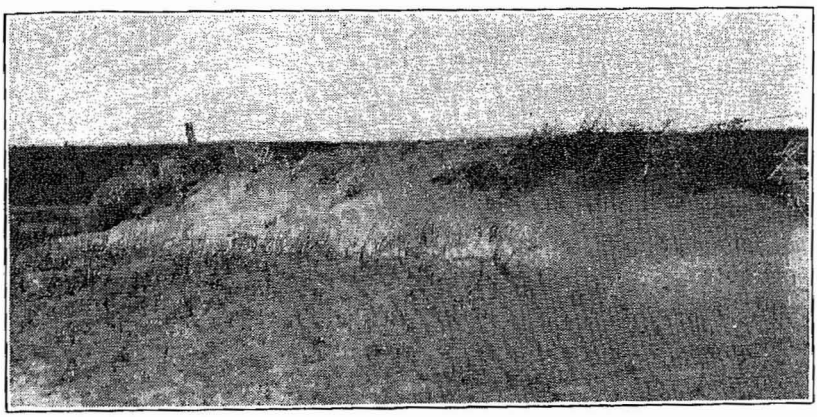


Fig. 6—Soil blowing troubles are reduced by the use of tillage implements which do not pulverize the surface unduly, but rather tend to create and maintain a cloddy surface condition.

Ordinarily it is considered best practice to cover stubble, straw and trash, but on "blow soils" the rubbish and clods should be kept at the surface. If possible, implements should be used which will tend to create and maintain a cloddy, trashy surface and which do not pulverize the surface unnecessarily.

In the days of dry land settlement in Montana, from 1907 to 1917, the settler naturally brought with him the tillage im-

plements and tillage practices that he learned to use in other states. He practiced late plowing, and he brought with him those inefficient summer tillage tools—the spike-tooth harrow and the disk; he gave his land a rest, but it was too often the unattended rest that allowed weeds to take their toll. His spike-tooth harrow and his disk pulverized the soil too much, and

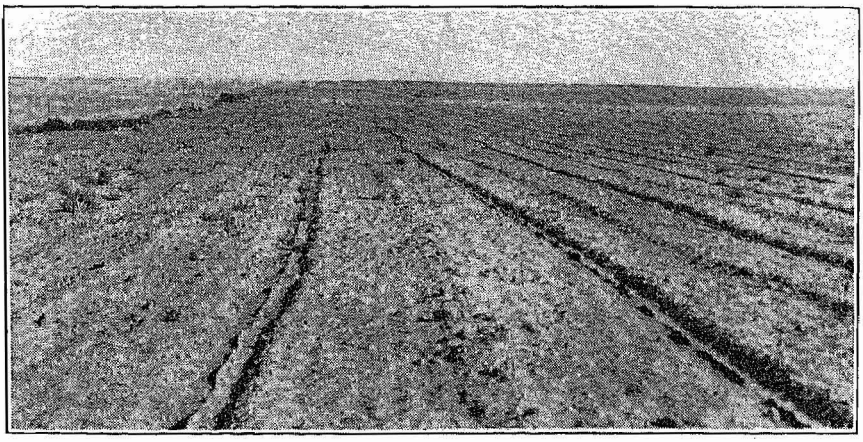


Fig. 7—Summer tilled land cultivated with an ordinary disk is likely to be overworked if weeds are to be kept down. Weedy summer fallow and a finely divided, dusty surface very often result from disking. The spike-tooth harrow and the ordinary disk are poorly adapted implements for the cultivation of summer tilled land after plowing.

had little value in weed eradication. He had not yet learned that the disk, while it has its place in the preparation of land for plowing or subsequent summer tillage, is not particularly adapted for summer cultivation where the clod mulch and weed control are of primary importance.

Experience now has taught the more successful farmers that the ideal summer tillage cultivator or weeder should cut, shear, pull or tear all weeds when its blade is pulled beneath the ground surface, and that this work should be done so as to cause the clods and rubbish to move to the surface and the fine soil to sift into the seed bed below.

Each Montana dry land farmer knows his own soil conditions and must be the best judge as to what particular type or types of weeders seem best suited to his particular farm. A publication of this nature can help him most when it merely

submits facts about various implements which have been used by other farmers under varying conditions. Local adaptations necessarily will have to be made for **there is no one universal best implement for any or all conditions.**

The common sense and judgment of each individual farmer will finally decide for him just what implement or combination of implements will be best suited to his needs.

Fig. 8—An ideal summer tilled surface resulting from the intelligent and timely use of a duckfoot cultivator.

## Duckfoot Cultivator

*The duckfoot cultivator is the outstanding tillage implement for general purposes and for average Montana conditions. It is adapted to most soils, rocky or gravelly conditions, and will be used in Montana more than will any other single type. However, it is not to be expected that it will be the best implement for each and every condition to be met in this state.*

As the need for better implements for summer tillage has become recognized, manufactured types of duckfoot cultivators have been rapidly introduced. Their use has spread especially fast on the glaciated soils of the state where the rocks and

Fig. 9—A duckfoot cultivator in action on "plowless" summer fallow. Note the clods and rubbish on the surface. Attention is called to the homemade spring teeth, sometimes used to level the ridges.

gravel have interfered considerably with the operation of blade and rod weeders. An increasing acreage of "plowless summer tillage" also has brought about a corresponding increase in the number of duckfoot cultivators in use.

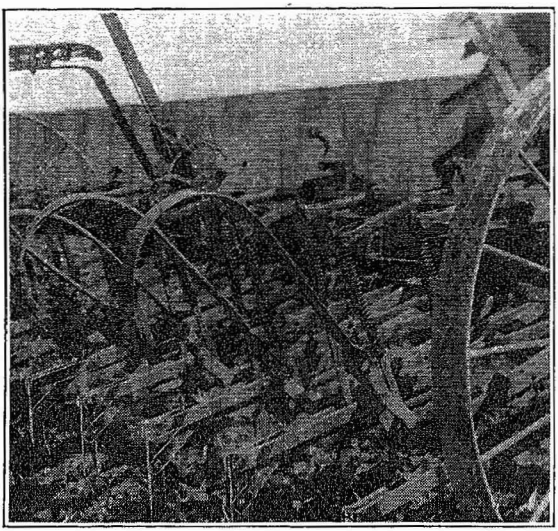


Fig. 10—Close-up view of special homemade spring teeth devised by Peter Peterson of Valley County, for use on a manufactured duckfoot cultivator in leveling ridges during the summer season.

The shovels of the duckfoot cultivator operate under the soil surface and do not pulverize the soil unduly. If the shovels lap sufficiently all the weeds will be cut off and a slightly ridged and cloddy surface will result. The ability of the duckfoot cultivator to avoid clogging, and its ability to work in hard, rocky or gravelly soils, are two outstanding reasons why an increase in its popularity is expected.

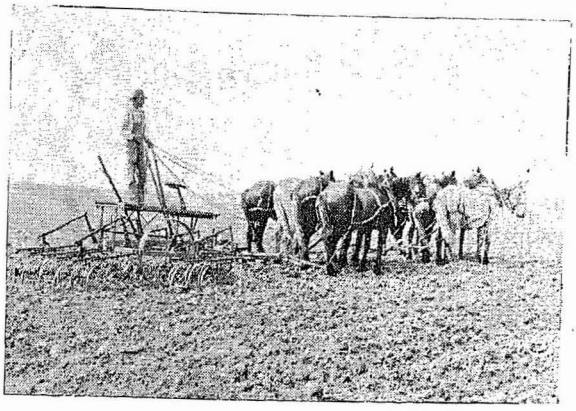


Fig. 11—The flat spring type of duckfoot cultivator in action on a Montana summer tilled field. Note the clean and cloddy surface.

There are several makes of duckfoot cultivators on the market. In making a choice, one must use judgment and consider the machines from various standpoints—such as cost,

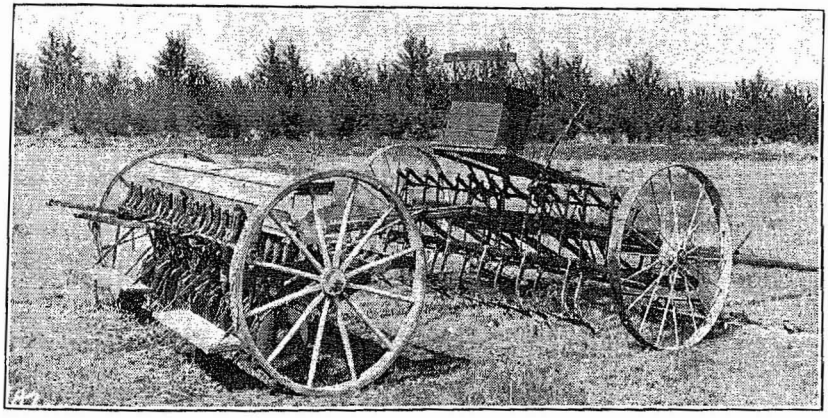


Fig. 12—A duckfoot cultivator and grain drill operated tandem. Shallow cultivation, which kills weed growth just before or at the time of planting, is to be recommended, especially in a cool and backward spring when weeds are favored as compared with the grain crops.

durability, and ability to work in trash, rocks and gravel. The stiff toothed, individual spring release type, and the flat spring type, both are receiving favorable comment, depending on local conditions and upon personal preference. The general tendency seems to be to use shovels which are too narrow, and to run the shovels too deep. The use of wider shovels at a shallow depth results in better weed elimination and prevents unnecessary loosening of the soil. Shovels usually should be set as flat as possible, that undue pulverization of the soil may be avoided. This is a general statement, however, which is not expected to hold good for all soil conditions.

### Homemade Duckfoot Cultivators

Many farmers who desire to use a duckfoot cultivator can not afford a manufactured machine. To such men the cheaper and possibly less efficient homemade types make a strong ap-

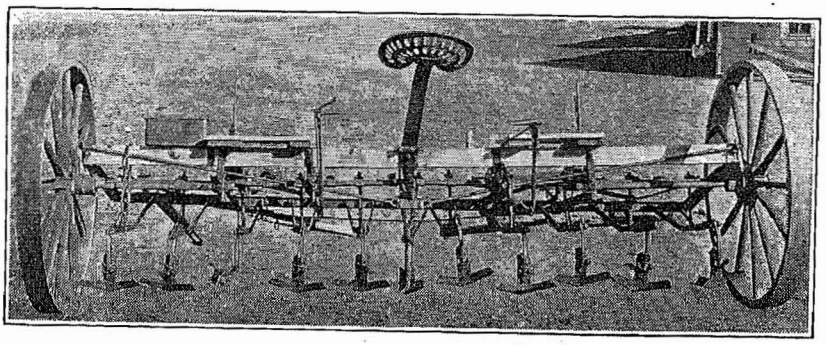


Fig. 13—A homemade duckfoot cultivator constructed at slight cost from a discarded drill.

peal. If an old and discarded drill be available, a homemade duckfoot may be constructed for from $25.00 to $35.00. Two types of construction commonly are used. Figure 13 shows a machine which is representative of a common method of construction. Various means are used to obtain a suitable support for the shovels. The machine shown in Figure 13 is faulty because the shovels are too far apart. Any good blacksmith should be able to construct shovel supports adapted to any

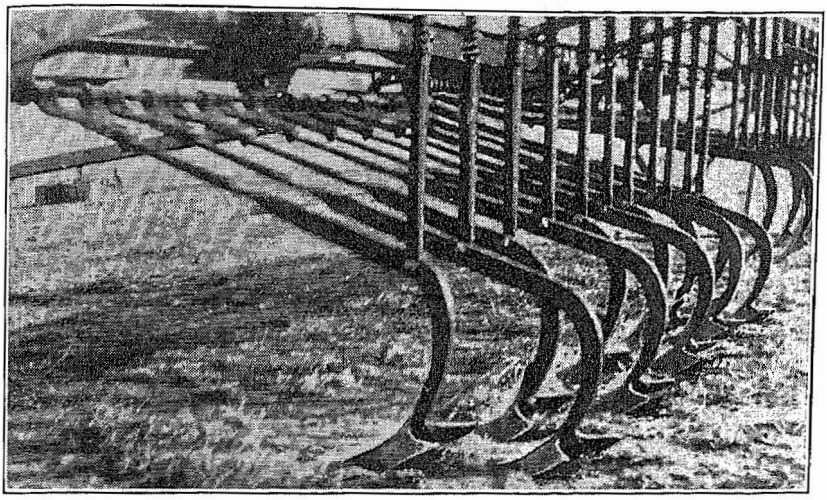


Fig. 14—Detail view showing one method of constructing duckfoot supports, in transforming a discarded drill into a homemade duckfoot cultivator.

particular type of drill. Usually it is necessary to strengthen the coil springs, as more pressure is required for shovels than for drill furrow openers. Shovels may be obtained from dealers handling manufactured types of machines. The flat type of shovel is recommended.

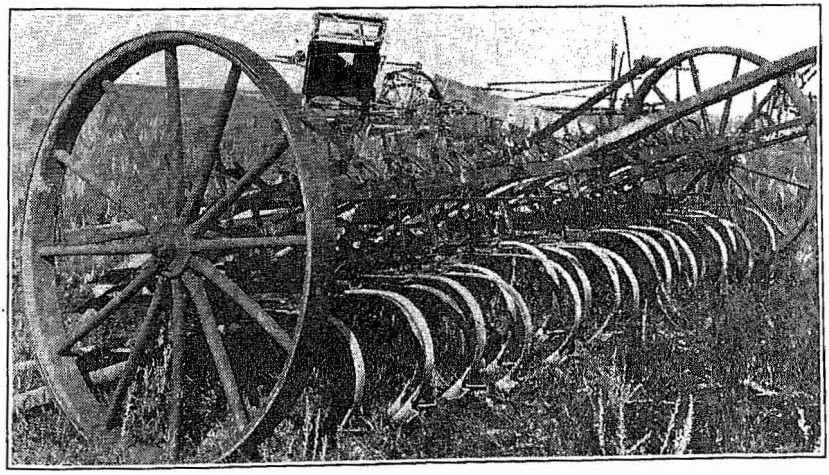


Fig. 15—Homemade duckfoot weeder of the flat spring type, used in Fergus County.

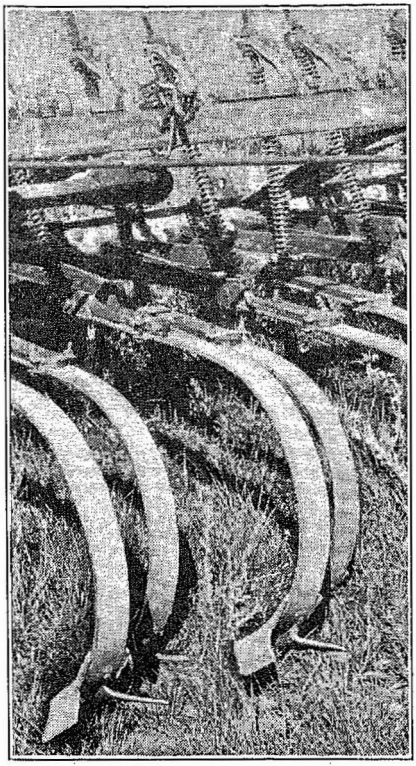


Fig. 16—Close-up view of flat spring duckfoot supports used in the homemade machine shown in Figure 15.

Another type of construction is shown in Figures 15 and 16. This type has been found satisfactory but it is a trifle more expensive than the frist type described. In the second type, the flat spring supports and shovels from a manufactured machine are attached to the old drill. The machine shown in Figure 15, an 11-foot machine, cost about $35.00, not allowing anything for the discarded drill. It will be noted that the shovels are supported by two types of springs, the flat and the coil.

It is not claimed that either of these two types just mentioned is as strong, or capable of doing as good work, as the manufactured type of machine. They are efficient, however, and are far superior to the disk or spike-tooth harrow.

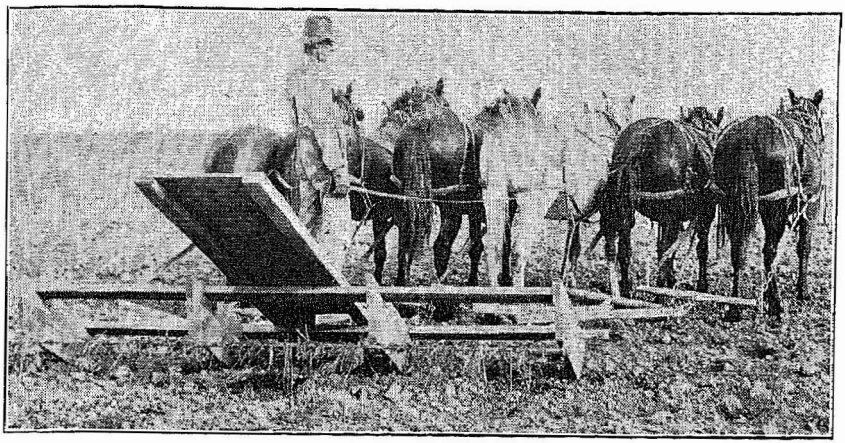


Fig. 17—Rear view of the double rod weeder of the wooden sled-runner type. The front rod is in the ground while the rear rod is ridding itself of accumulated straw and roots.

## Double Rod Weeders

*The double rod weeder primarily is adapted to soils from medium to light, where rocks and gravel are not troublesome, and where the soil is not too hard. The double rod type is preferable to the single rod type, due to ease in keeping the double rods cleaned.*

The experience of farmers in Montana has demonstrated clearly the value of the double rod weeder where the land is suited to its use. This type of weeder leaves the soil surface in better condition than do the knife types of weeders. The rod loosens the surface, sifting the fine dirt into the seed bed and shaking the lumps and rubbish to the surface. One big advantage is that the rod weeder can do efficient work at the right time—when the weeds are not too large and when the soil surface is fairly dry. If the top inch or two of the soil is dry the rod weeder will go through a surprising amount of trash. The single rod weeder operates on the same principle but, in order to clean the rod, the driver must step off the implement. With the double rod weeder this operation is more simple; the driver stands on the rear end of the dump board, bringing the rear

rod into action and allowing the front rod to come above the ground and free itself of trash. When the rear rod clogs, the driver steps forward to force the front rod into the ground and to bring the rear rod free to clean itself. This shift is made gradually and easily.

Three distinct types of double rod weeders are now commonly found in use in Montana: the sled-runner type, the U-iron type, and the wheel-and-axle type.

### Sled-Runner Type of Double Rod Weeder

The sled-runner type of double rod weeder is shown in Figure 18. The rear rod is shown in action in this illustration. In Figure 17 is a weeder of the same type with the front rod working. The runners of this machine are made of 2x12 ma-

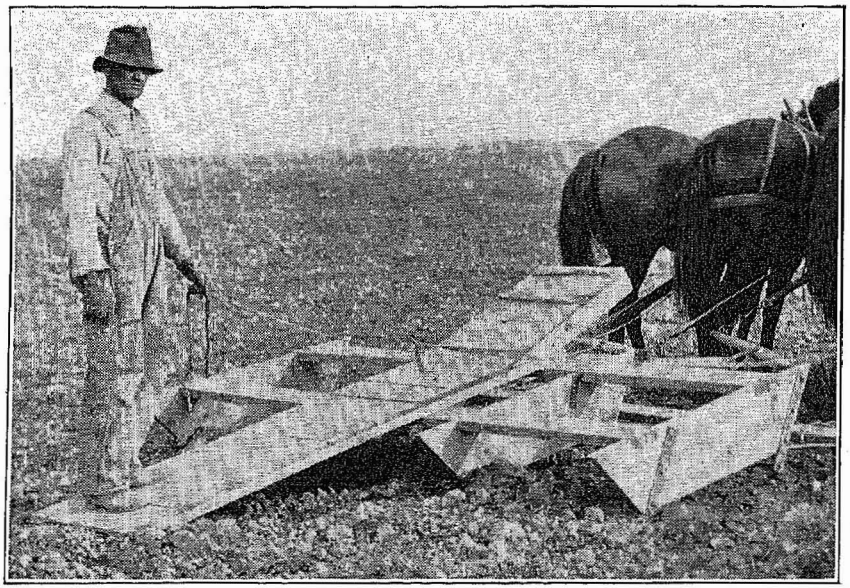


Fig. 18—Double rod weeder of the wooden sled-runner type.

terial, four feet long. The top frame work is made of 2x10 stuff if the weeder is 12 or more feet long, and of 2x6 stuff for smaller sizes. The five-eighths inch tool steel rods are held in place about two inches below the runners by iron bars (plow shares, flattened out, are commonly used). These bars should

be given a backward slant to reduce clogging troubles. (See final discussion of rod weeders for further information regarding materials used for rods.)

The sled-runner double rod weeder, while very commonly in use, is not, in the writer's opinion, as good as other types to be described hereafter. This type costs less but is not as rigid in construction nor as convenient in operation.

### U-Iron Double Rod Weeder

While on a tour of observation in eastern Washington, the writer's attention was called to this type of weeder, which was being used on "plowless" summer fallow. This machine is


Fig. 19—The U-iron double rod weeder used at Waterville, Wash. The operator is standing on the front of the dumpboard, causing the front rod to go into action, while the rear rod is shaking free from trash.

strong, is easily handled, has good clearance and unquestionably is lighter in draft than is the sled-runner type. Several machines have been made and demonstrated by county agents in Montana and are reported as giving satisfaction. It is recommended without reservation for medium to light soils where rocks and gravel are not too prevalent.


Fig. 20—Front view of the U-iron double rod weeder being used on "plowless" summer fallow. Note the cloddy surface full of trash. The operator is standing on the rear of the dumpboard, causing the rear rod to operate while the front rod is cleaning.

Figures 19 and 20 give dimensions of the U-iron double rod weeder. A blacksmith can readily make one of these machines by using the dimensions given in the photograph. It is important that the specifications be followed carefully. Note especially that the upright bar is 18 inches from the **bottom** of the runner to the **top** of the frame. The bumper blocks fastened underneath the front beam are necessary for holding the beam up to the hitch rods, or else the beam would rest near the ground and pulverize the surface soil. Several holes should be drilled in the upright bar in order that the hitch may be adjusted properly. A few trials soon will enable the operator to adjust the hitch so the machine operates as well on one rod as on the other.

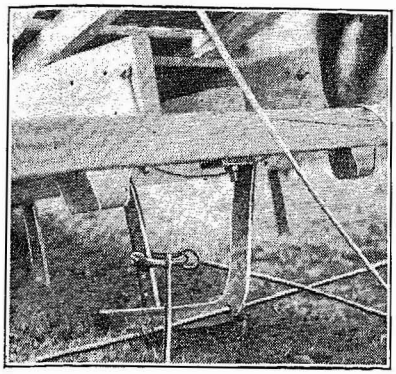


Fig. 21—A close-up view showing the attachment of center hitch rods and the wooden blocks which strike the hitch rods when the U-iron double rod weeder is in the forward position.

The writer is of the opinion that the double rod type of weeder will increase in popularity as soon as farmers observe that these machines are especially adapted for use in combination with other types, such as the duckfoot weeder. An extract from a letter received from a practical and successful dry farmer of North Central Montana is reproduced below and illustrates the place of the double rod from this standpoint. Many other home-made machines have their greatest utility as a combination tool to be used when conditions favor its use. They often do better work with less expenditure of power than some of the higher priced manufactured machines.

**A Typical Letter from a User of Rod Weeders**

"The rod weeder is one of the best weeders that I have ever used in this section. After plowing for summer fallow I spring-tooth the field crosswise to level it up nicely. After that I use the rod weeder unless a beating rain should pack the surface. Then it may be necessary to loosen the surface with the spring-tooth before the rods can penetrate. I do not use the disk as our land tends to blow. The rods leave the soil in good condition to resist wind. For the past two seasons I have used the "plowless" method of fallow. First, I disk the stubble twice, as early as I can get around to do it. When the weeds begin to show up I duckfoot or use the rod weeder, depending on which will work best under the conditions. A duckfoot and a rod weeder make a fine combination. I use ten horses on a heavy 20-foot machine and six horses on the lighter 18-foot type. I can build one in two days at a cost of about twenty-five dollars. I average about 40 acres a day."

## Wheel-and-Axle Double Rod Weeder

Farmers in the vicinity of Creston, Mont., (near Kalispell) are enthusiastic about the type of double rod weeder shown in Figures 22 and 23. The dimensional photographs show the im-

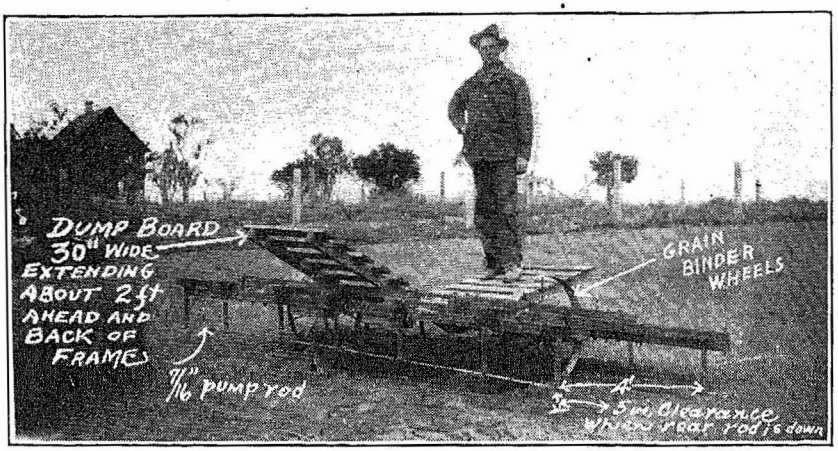



Fig. 22—Wheel-and-axle double rod weeder as finally improved and now used in Flathead County, Montana. One of the best stationary rod weeders for medium to light soils of this state.

plement as improved by Max Wendt of Creston. Mr. Wendt says that he likes this machine better than anything else he has ever tried on his summer tilled land. He finds that it will either cut, pull out or efficiently cover any deep rooted weeds like Chinese lettuce, Canadian thistle or wild bush, as well as volunteer grains and annual weeds.

The special advantage claimed for this type is lightness of draft and ease in dumping and cleaning the rods. In constructing this machine it must be remembered that each of the upright bar supports swings forward freely on the bolt from which it is suspended, but this bolt is so placed in relation to the 2x6 cross beam that the bar can swing back only at a slight angle when the rod goes into action. The length of the upright bar supports is dependent upon the diameter of the wheels. The bars should be just long enough to give one rod a clearance of five inches from the ground when the other rod is on the ground. It will be noted that when either rod is out of the

ground, it is free to swing like a pendulum, which assists in cleaning the rod of attached roots and other trash. This type of weeder should be tested out wherever any of the rod weeders have proven to be adapted.

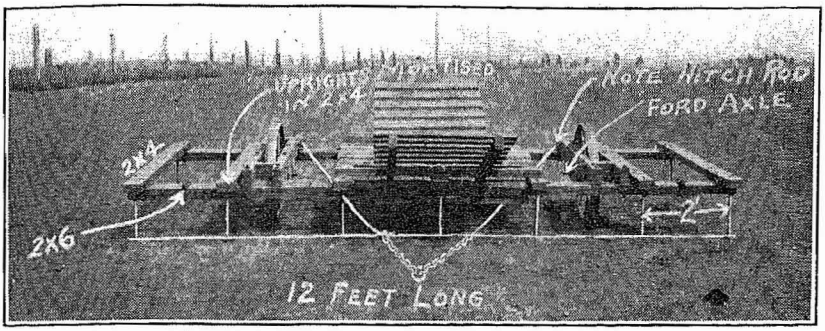



Fig. 23—Front view of the wheel-and-axle double rod weeder.

## General Comments on Double Rod Weeders

The size of the rod depends a great deal upon soil conditions. A small rod unquestionably pulls through the soil more easily than does a heavy rod, but a small rod catches and holds

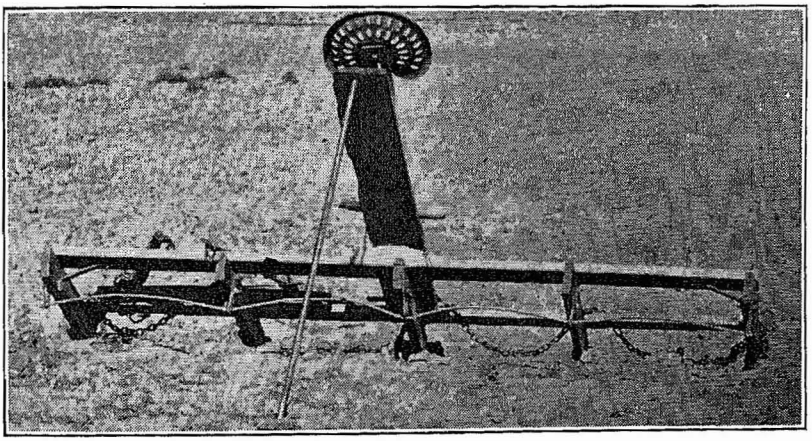


Fig. 24—A single rod weeder showing the rod badly buckled, which is a common trouble experienced if an iron rod is used without proper tightening device of some kind. A tool steel rod is much preferred.

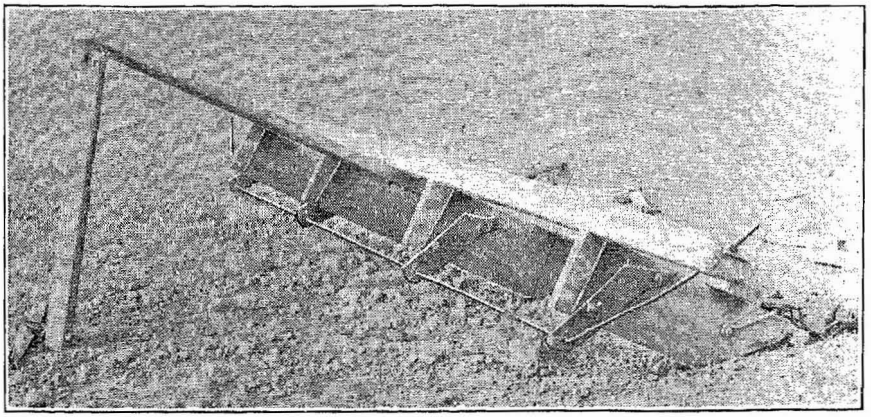


Fig. 25—A single rod weeder employing a special method for keeping the light rods tight and straight, this method consisting of an extension to the cross beam so that the rod may be tightened from the outer end of these beams. It also can be applied to the double rod types.

more trash. The small rod also is likely to buckle out of shape, this being especially true of iron rods. Tool steel is much to be preferred. For average conditions a five-eighths inch tool steel rod is used. Figure 25 shows a single rod weeder where a small pump rod is used but is kept tight and straight by drawing it up through the end of an extension of the rear cross beam. This principle may be applied to double rod weeders also.

Another method of using a pump rod is to fit a section of small gas pipe over the rod between each of the iron supports. By tightening a nut at each end of the rod, a rigid construction is maintained. By means of a notch in the ends of each section of pipe, the pipes are prevented from revolving.

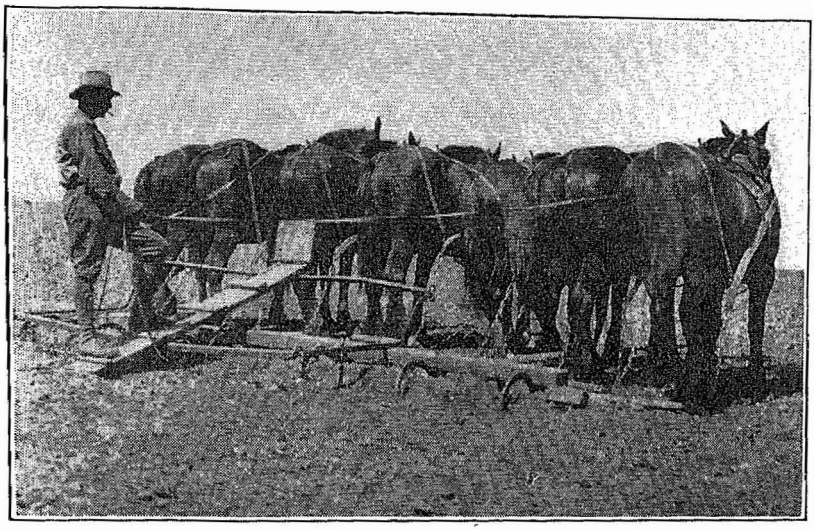


Fig. 26—The improved gooseneck slicker, the same as in Fig. 29 and Fig. 30, but shown here in action. Eight horses are used in pulling this 16-foot machine.

## The Gooseneck Slicker

*The gooseneck slicker unquestionably is the best of the straight blade types of weeders. It will work under most soil conditions but is especially adapted to the heavier soils where the land is not very rocky nor too full of litter or trash. Power of penetration, ease of handling, a comparatively light draft and low cost are the outstanding advantages.*

The gooseneck "slicker" is an improvement over the simple sled knife or slicker type of weeder, which consisted of a wooden sled carrying, at the heel, a broad, flat blade sharpened on one edge. Tendency to clog and difficulty in dumping were disadvantages of this crude weeder. The original gooseneck has been used in dry land sections of the Northwest for a considerable period of time and was standard equipment in the Walla

Fig. 27—The standard gooseneck slicker.

Walla (Wshington) and Pendleton (Oregon) districts until more improved and convenient types were developed. Some of these improvements will be discussed later.

In using the gooseneck slicker, it is best to dump the blade in windrows. These windrows are worked lengthwise after each cultivation of the field has been completed. The main objection to the original type of gooseneck slicker described here was the necessity of dismounting from the tailboard at each windrow. This type of machine is especially well suited as a companion machine for the duckfoot on the heavier soils. Often during the season soil conditions will be such as to make it expedient to use the lighter draft slicker instead of the duckfoot.

An ordinary gooseneck slicker is shown in Figure 27. In operating this type, the driver stands on the tailboard and, when a windrow is reached, he alights to let the machine rock forward on the flat runners. Then the driver pulls the tailboard back into place and again takes his position on the board. This operation is done while the team is in motion.

Figure 28 is an end view drawing, showing the details of the construction of the gooseneck supports and flat runner. Full size drawings, the same as this cut, may be obtained from any county agent in the state or from the office of Extension Agronomy, Bozeman.

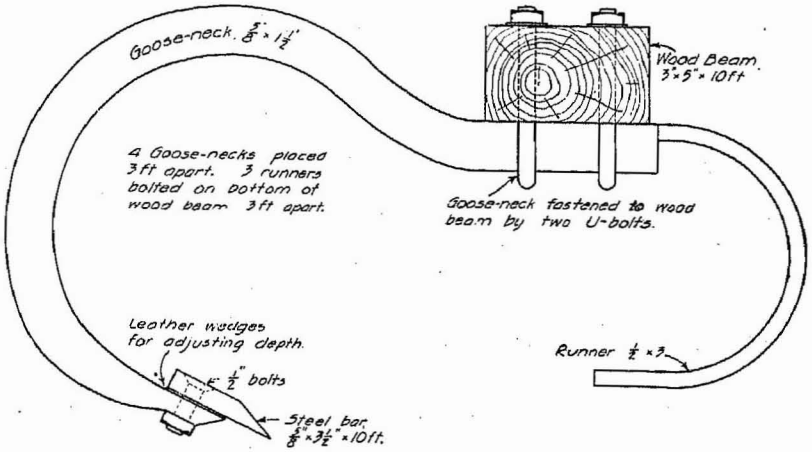



Fig. 28—Detail end view of the gooseneck slicker. Full size drawings may be obtained from any county agent or from the Extension Service at Bozeman, Mont.

## Improved Slickers

Local manufacturers in the Walla Walla and Pendleton districts have recently developed improved types of gooseneck slickers, many of which are covered by patents. From the

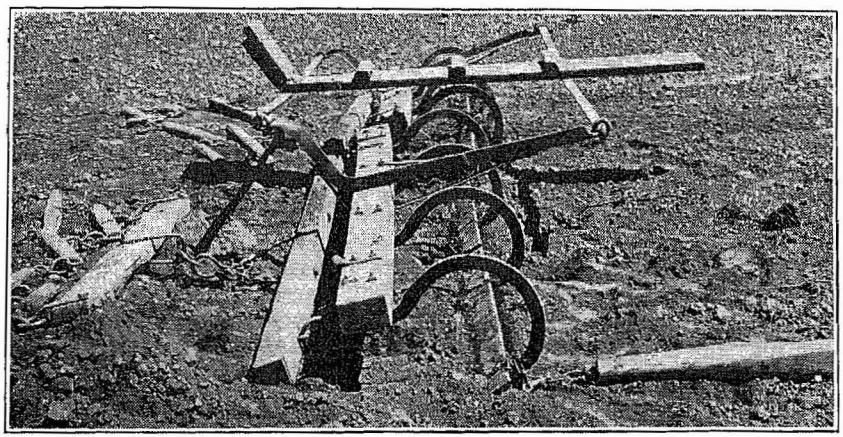


Fig. 29—Side view of the improved sectional gooseneck slicker manufactured at Walla Walla, Wash. This is a decided improvement over the standard gooseneck slicker with its inconvenient tailboard. The substitution of the angle iron frame supporting the dumpboard makes it possible for the operator to dump this machine while it is in motion by merely stepping forward and then backward on the dumpboard.

standpoint of average Montana conditions, two sectional types are of especial interest. Figure 29 shows one of these types in operation. The tailboard has been removed from the ordinary slicker and a dump board has been placed on a raised framework of angle iron. This enables the operator to dump the machine merely by stepping forward and it also permits the operation of a wider machine. Figures 29 and 30 are side and rear views of this machine with more detail shown. Note the wooden marker shown in Figure 29.

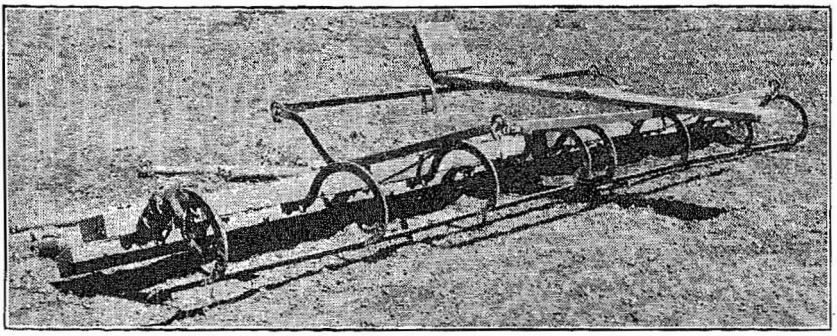


Fig. 30—Rear view of the improved gooseneck slicker.

Another improved slicker developed at Walla Walla is shown in Figure 31. The illustration is self explanatory. Two slickers have been combined. The tailboard is supported from a raised beam connecting the middle of each section. This gives the operator increased leverage. It is claimed that this

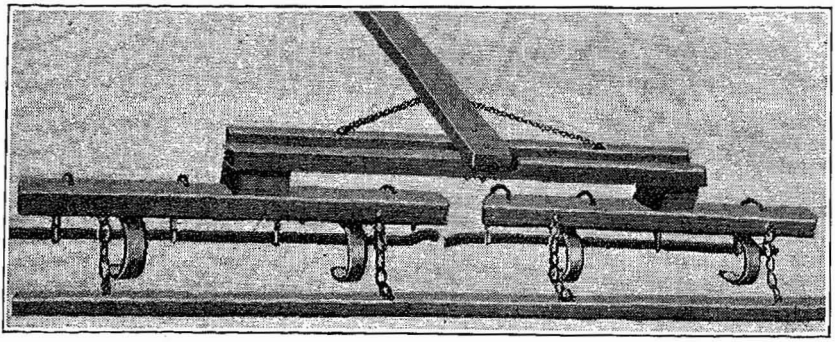


Fig. 31—An improved sectional gooseneck slicker manufactured and used in the Walla Walla district of eastern Washington.

type may be moved from one field to another without injury to the blade because, by simply getting off the tailboard, the blade lifts up and the machine proceeds forward on the runners and with the blade out of action. It will be noted that sectional slickers require the slight bending of the blades at the junction point to permit the required overlapping.

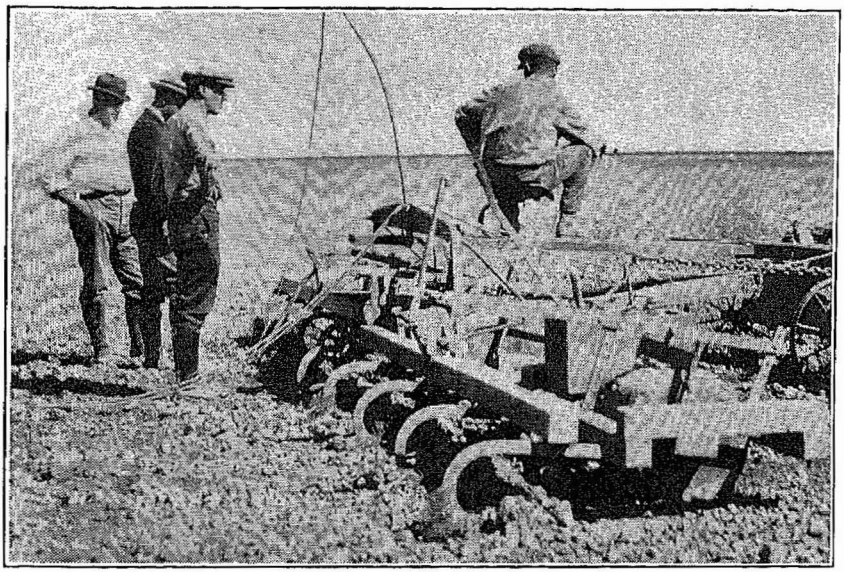


Fig. 32—A wide gooseneck slicker operating on wooden rollers and used on level fields of the Pendleton district of eastern Oregon where the soil is especially free from rocks and where the stubble left by the combine is burned off.

For level and large areas such as are found in the Pendleton district, various types of wide slickers, operated on wheels or rollers, often are used. No doubt some areas in Montana might profitably utilize some of these machines which enable one man to cover considerably more land in a day. Figures 32 and 33 show these types. County agents will assist interested farmers in obtaining more detailed plans.

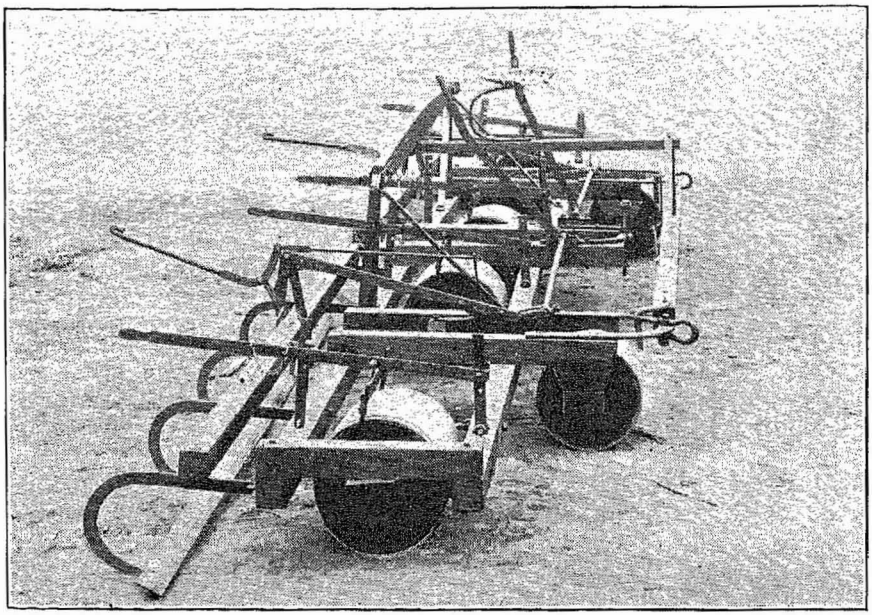
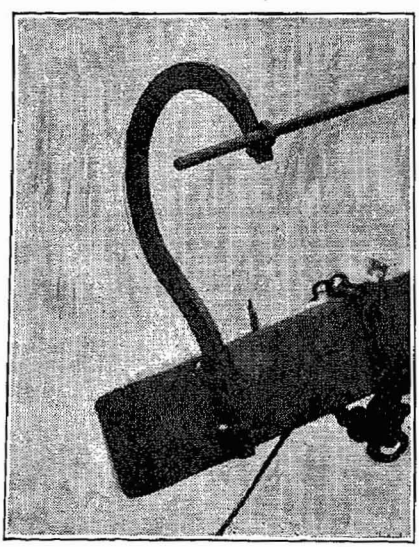


Fig. 33—A wide gooseneck slicker manufactured in Washington and used successfully in the Walla Walla district where conditions are especially favorable for the use of the various modifications of the standard slicker type of machine. Lightness of draft and acreage capacity per man are the main advantages of this special type.



## A Rod Weeder from a Slicker

A gooseneck slicker may be converted into a rod weeder by merely removing the blade and attaching a five-eighths inch rod by means of eye-bolts. Figure 34 shows the change on one of the gooseneck supports.

Fig. 34—A single gooseneck support of a slicker showing the method employed in transforming a blade weeder into a single rod weeder. An eye-bolt is substituted for the countersunk bolt used on the blade.

# Miscellaneous Types

The three general types stressed in this circular, namely the duckfoot, double rod and gooseneck slicker weeders, appear to be the outstanding types for the varying conditions encountered on Montana dry land farms. Tastes vary in tillage implements and it is to be expected that many farmers will prefer other types. For the benefit of such farmers, as well as for the information of all farmers in general, pictures and short descriptions of a number of other weeders are presented hereafter.

Figures 35 to 61 follow on succeeding pages in numerical order.

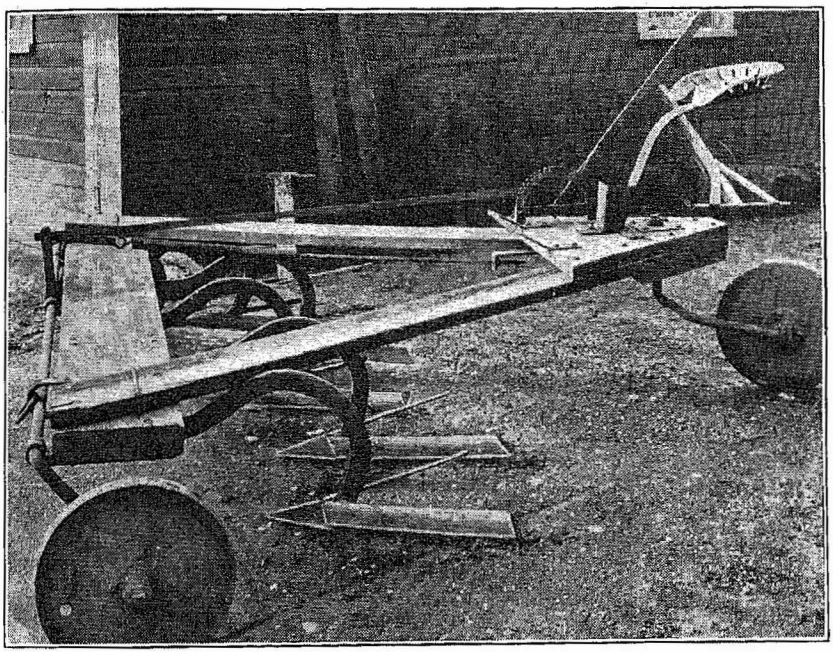


Fig. 35—The Mitchell weeder, manufactured at Conrad, Mont. The large duckfoot type blades are attached to the gooseneck supports, which are raised and lowered by a lever operated from the seat.

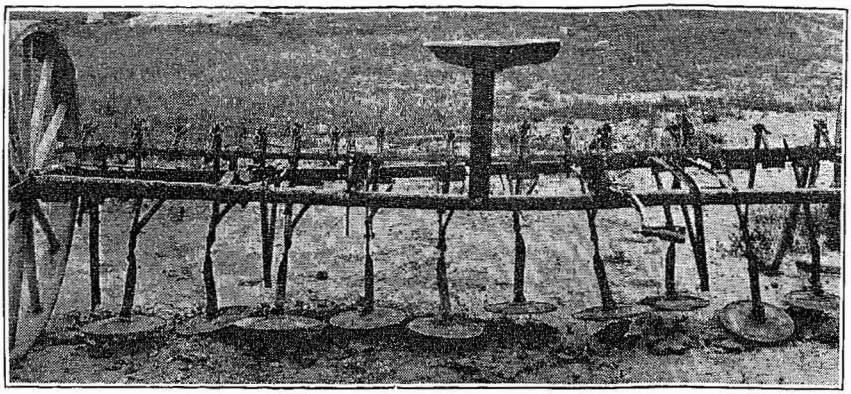


Fig. 36—An ingenious but unsuccessful attempt at substituting disks for duckfoot shovels on a homemade weeder.

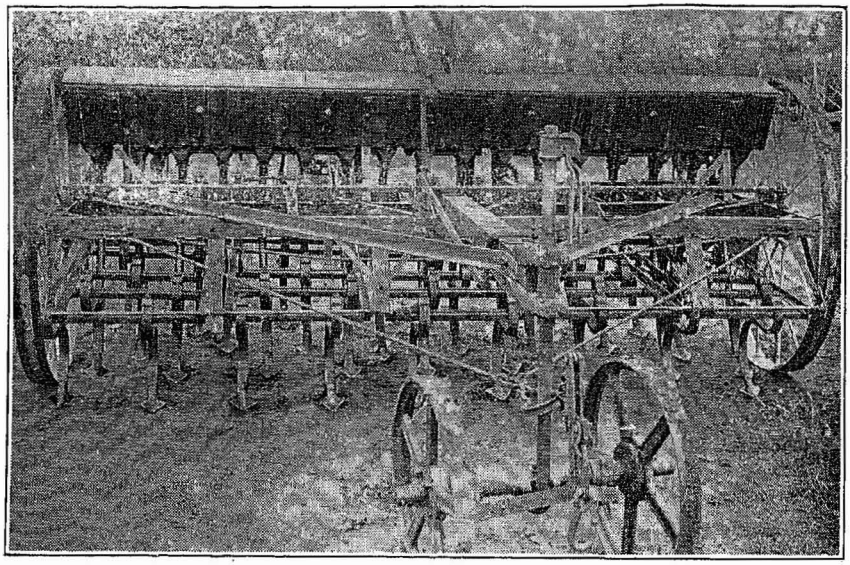


Fig. 37—A combination drill and cultivator which makes it possible to give the land the final clean-up as well as to plant the seed with one machine in one operation.

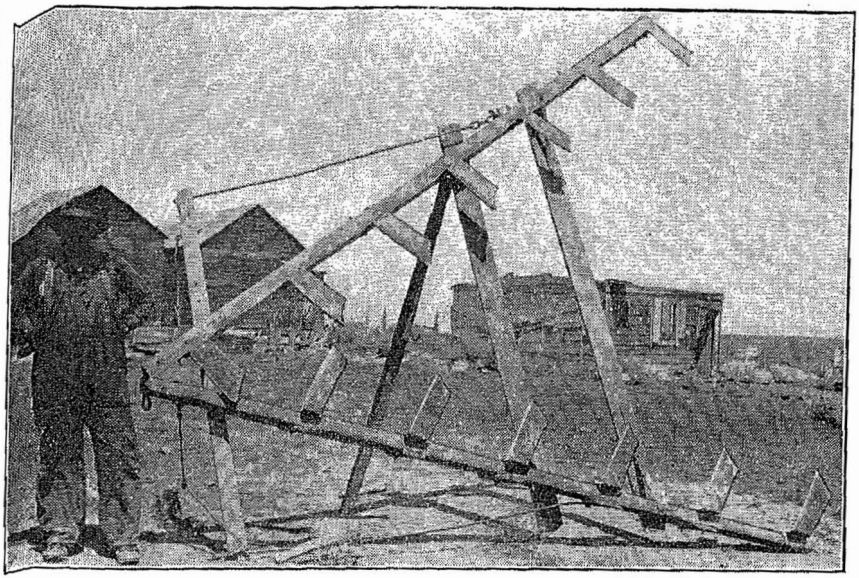


Fig. 38—A plow share and knife weeder of unique construction. Experience has shown that the knives should be set at a more acute angle and should overlap to a greater extent. The type of hitch used tends to steady the machine.

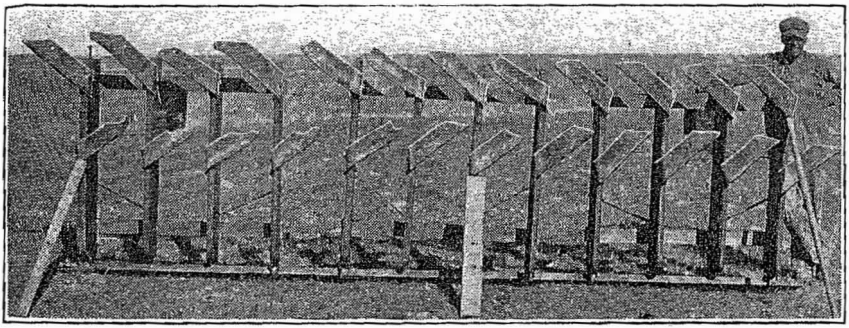


Fig. 39—A plow share weeder which has given a good account of itself on fairly heavy soils. This machine is similar to the manufactured Jones or Clack weeders.

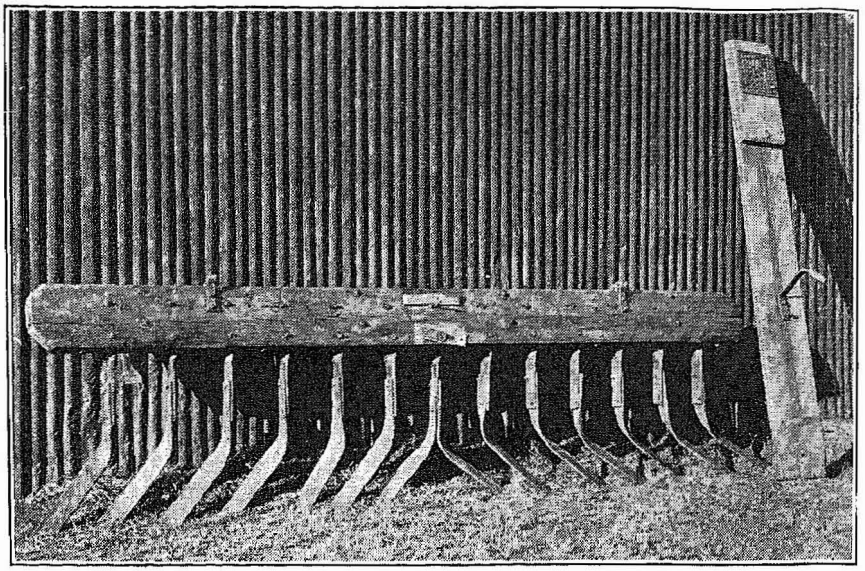


Fig. 40—The cyclone weeder. This is a manufactured machine which has been found to be quite efficient. It has a tendency to pulverize the soil slightly more than would be advisable under some conditions.

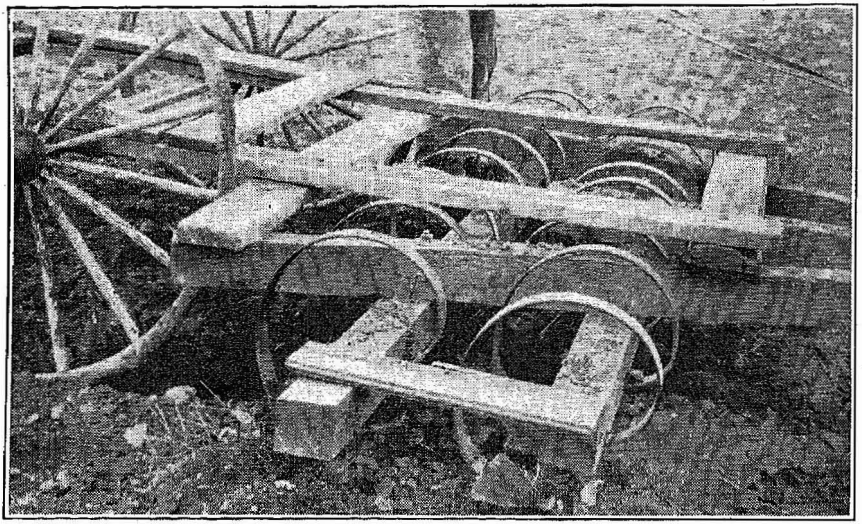


Fig. 41—A homemade spring-tooth weeder of rather unusual construction.

Fig. 42—The manufactured Jones or Clack type of weeder. This machine is quite popular, due to its fairly low cost, its efficiency in eliminating average weed growth and its comparative freedom from clogging troubles.

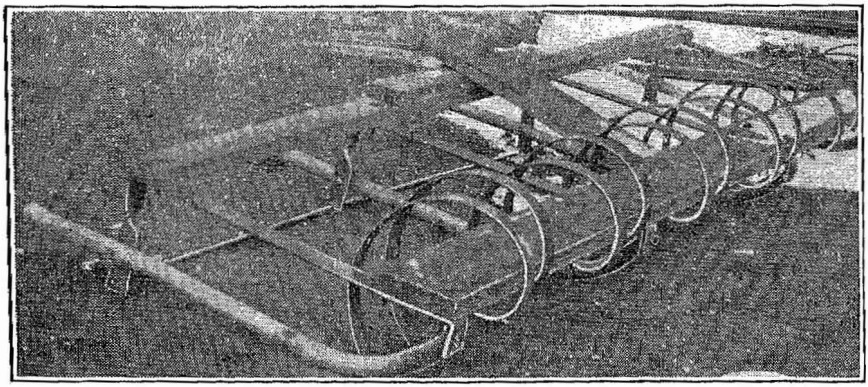


Fig. 43—Combination single rod and spring-tooth weeder. The spring teeth supported from the front beam loosen the surface and give the rod a much better opportunity of penetrating the soil evenly, with disastrous results to weeds.

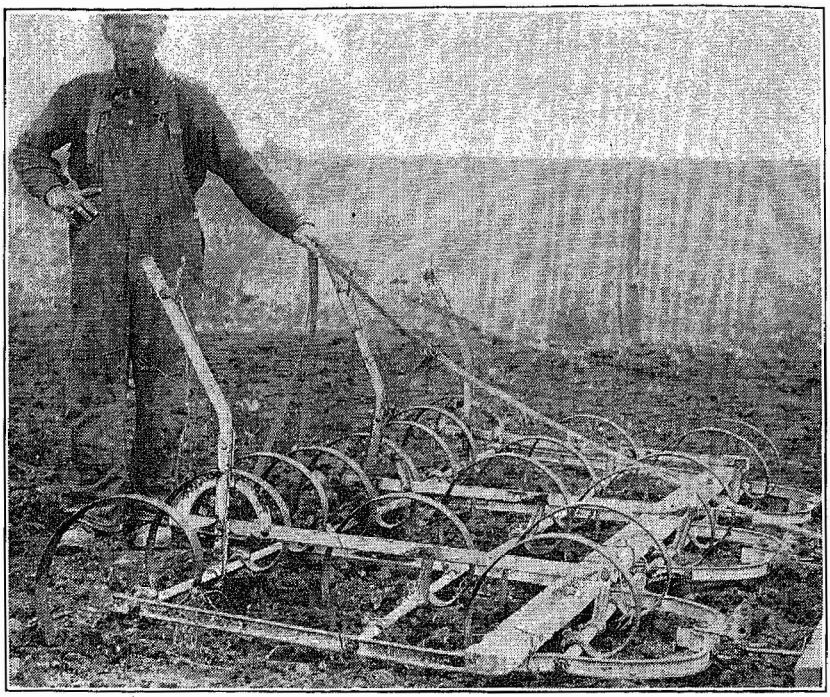


Fig. 44—The spring-tooth harrow is especially adapted for Montana dry land farms. It does not tend to produce the undesirable dust mulch but rather lifts the clods and rubbish to the surface, giving the desirable clod mulch condition.

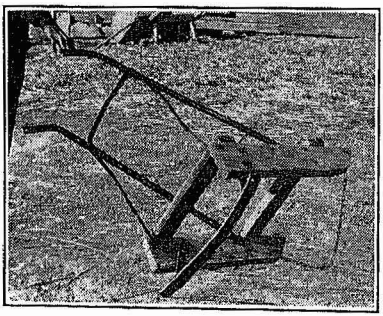


Fig. 45—A small sled-knife weeder especially designed to replace the backache-producing hoe, in caring for the home garden.

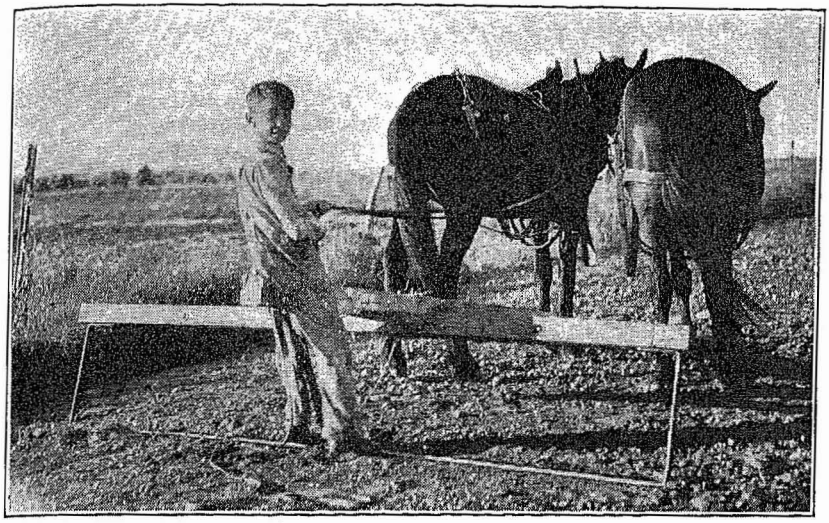


Fig. 46—The "dry land safety razor." This simple weeder can be constructed at little expense from wagon tire iron. The bar is not sharpened but operates more like that of a rod weeder. This simple machine has given a good account of itself on land adapted to the stationary rod weeder. The machine can be made from seven to eight feet in width, with a clearance of about two feet.

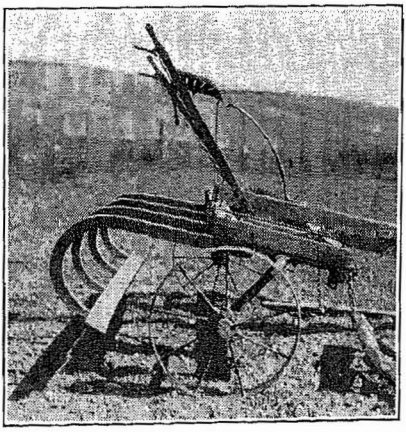


Fig. 47—A "slicker" of the wheel type used in some parts of Washington. No doubt this machine is easier to ride than is the improved gooseneck slicker, but it cannot be dumped as conveniently while the machine is in motion.

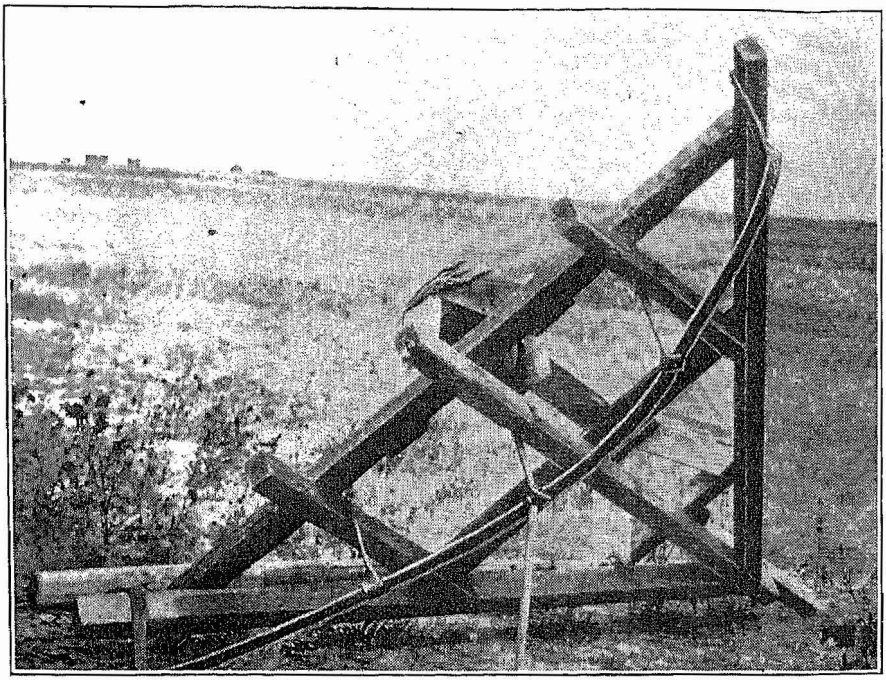


Fig. 48—A knife weeder employing a knife of semi-circular design with the idea of eliminating clogging trouble.

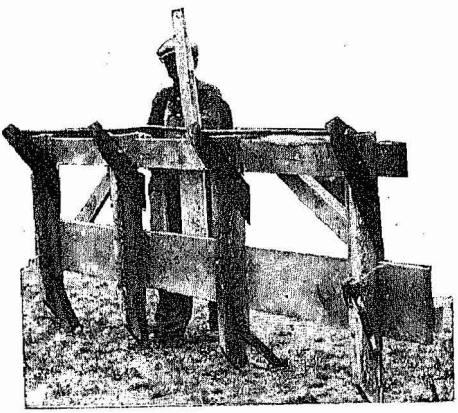


Fig. 49—A simple, single rod weeder of the sled type. Single rod weeders are not as conveniently cleaned as are the machines equipped with double rods.

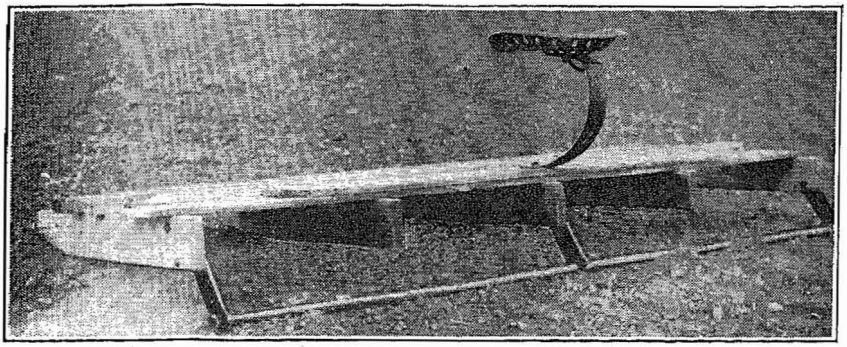


Fig. 50—Single rod weeder of the wooden sled-runner type.

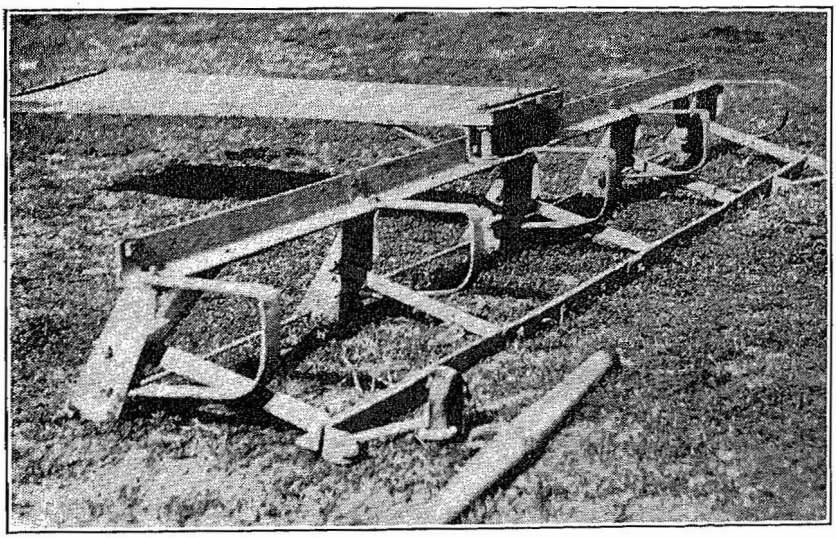


Fig. 51—A single rod weeder of iron construction, made from a hay rake frame, by M. J. Austin of Rudyard, Hill County. Note the rigid construction and the flexible hitch. One of the best weeders of the single rod type.

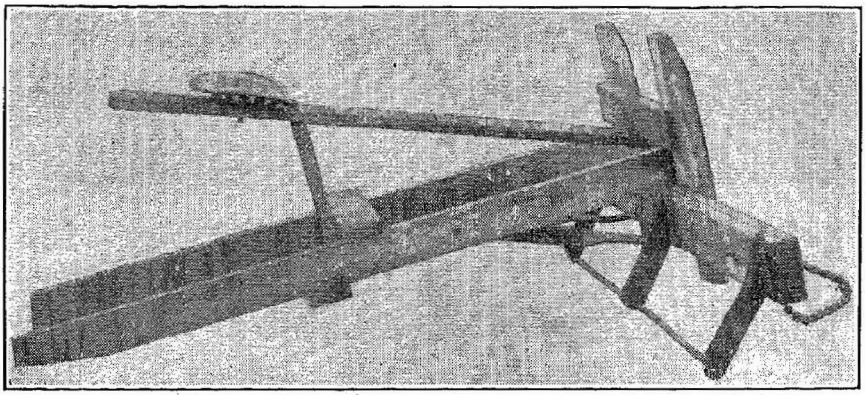


Fig. 52—Single rod weeder used on the Noble Foundation Farms in Canada. The vertical runners are used in transporting the machine from field to field.

Fig. 53—Single rod weeder used at the Lind Branch Station, Washington.

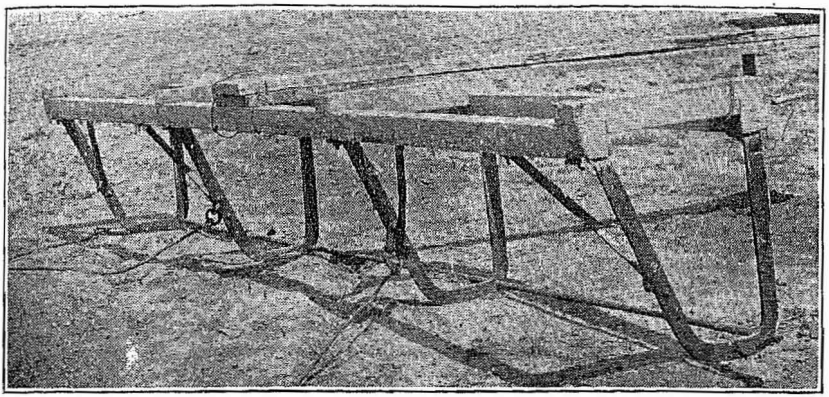


Fig. 54—The V-type single rod weeder used in some sections of Washington. The special advantages claimed for this type are lightness of draft, ease of hitch adjustment, clearance and excellent leverage. This is a very satisfactory machine of the single rod type.

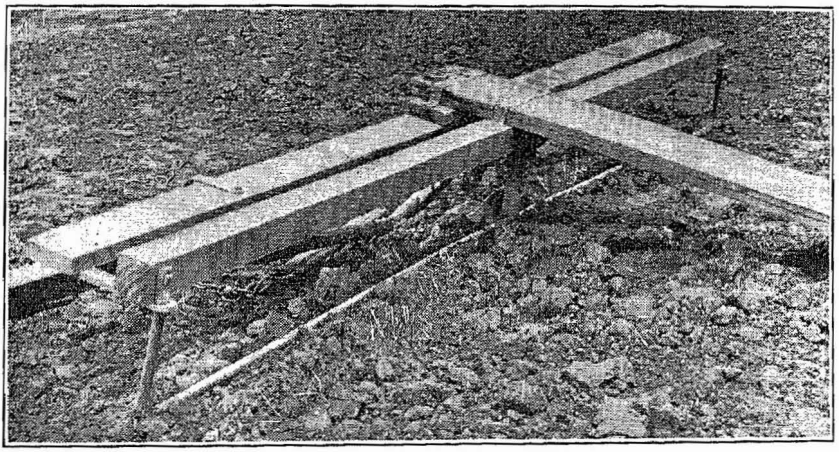


Fig. 55—A simple but effective single rod weeder used on very light soils in certain districts of eastern Washington.

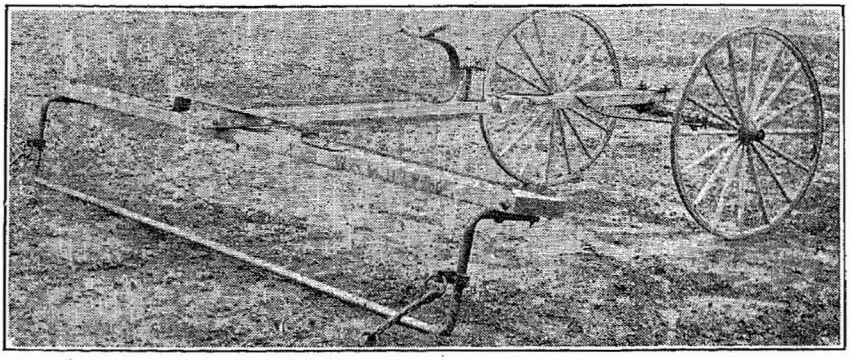


Fig. 56—A single rod weeder used on certain loose "blow" soils where plowing is done with mold boards removed. The heavy one and one-half inch rod is strong enough to permit working at the depth of the furrow slice. A rod of large diameter does not tend to catch and hold trash to the same extent as rods of smaller diameter. Plowing by the above mentioned "sharing" method and subsequent cultivation with this type of weeder have proven to be effective in reducing soil drifting in certain areas of eastern Washington.

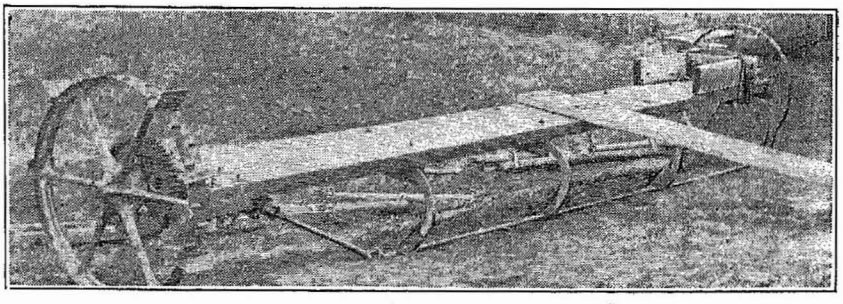


Fig. 57—Homemade type of rotary weeder used in some parts of Washington. These machines are not adapted to average Montana conditions. The rotary rod will work in wetter and more trashy land than will the stationary rod weeder, but it requires more power for operation.

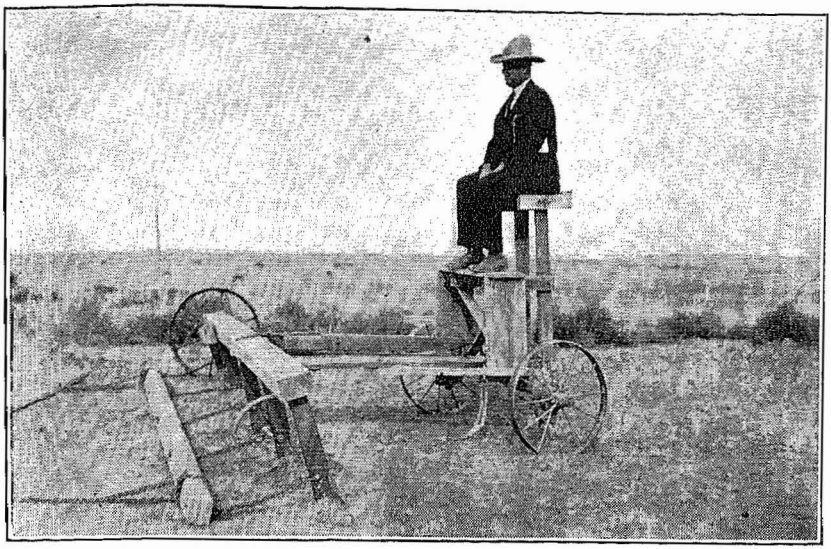


Fig. 58—A unique type of homemade rotary rod weeder which presents some features which might be applied to weeders of the stationary rod type.

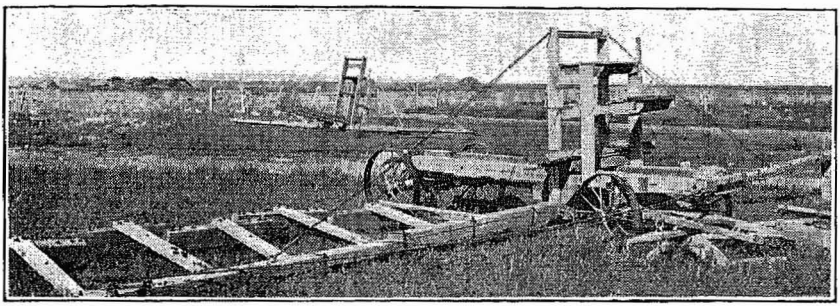


Fig. 59—A special sectional rod weeder used effectively in giving summer fallow a shallow cultivation to eliminate small weed growth just before planting. The small sectional weeders are attached to the aeroplane hitch, which is further explained in Montana Extension Service Bulletin No. 70, "Big Teams in Montana," by M. L. Wilson. This particular machine enables one driver to cover a swath 24 feet wide.

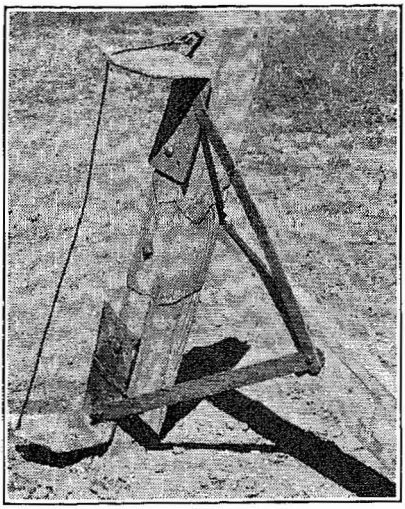


Fig. 60—Close-up view of one section of the special aeroplane hitch weeder shown in Figure 59.

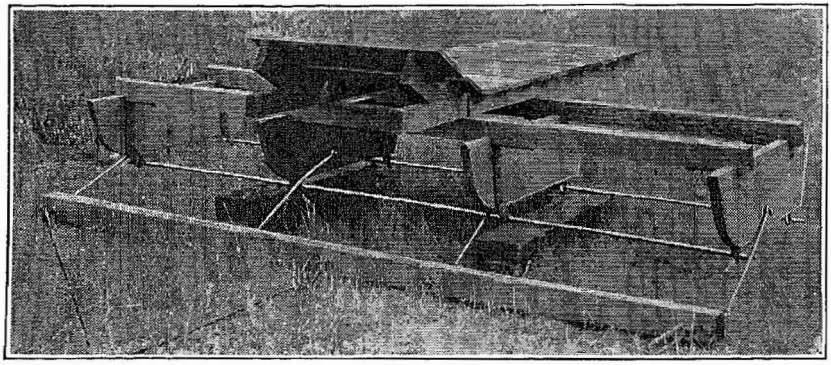


Fig. 61—A double rod weeder resting on two wooden beam runners attached to a regular hitch. This illustrates a common and convenient method of transporting a number of rod and blade weeders from field to field.

## Acknowledgments

The writer claims no originality in the material presented in this circular, which in reality contains a condensed discussion of facts gleaned from studies and observations made on dry land farms of the Northwest. Practical farmers have directly and indirectly contributed to the evidence that is "boiled down" in these pages.

Special acknowledgment is due to M. L. Wilson, agricultural economist of the Montana State College Extension Service, for contributions of information and photographs which he obtained in conducting his "Farm Success Survey" in our dry land regions. Mr. Wilson's work is more fully reported in his Bulletin No. 66 of the Extension Service, and called "Dry Farming in North Central Montana."

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# USE

# Summer Tillage Implements

Which Create a Clod Mulch and Eliminate Weeds Economically and Efficiently Under Your Conditions Due Consideration Being Given to Initial Cost, Upkeep and Draft

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## Ask Your County Agent