A STUDY OF AGRICULTURAL IMPLEMENTS

BY

NORMAN CHARLES WOODIN

THESIS FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

IN THE COLLEGE OF ENGINEERING OF THE UNIVERSITY OF ILLINOIS PRESENTED JUNE, 1904
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A STUDY OF AGRICULTURAL IMPLEMENTS.

INTRODUCTORY.

There are today five distinct classes of agricultural implements. Sometimes six classes are given.

They are as follows:

(1) Implements for clearing the ground, breaking it and otherwise preparing it for the reception of the seed.

(2) Implements for depositing the seed.

(3) Implements for the cultivation of the plant.

(4) Implements for gathering the crops.

(5) Implements for preparing the crops for market.

(6) Miscellaneous implements applied to various farm uses.

The first, second and third classes are manufactured in one factory and form one industry, while the fourth and fifth classes each form separate industries. These are kept separate and very seldom are they seen to intermingle.

It is the first class of business, comprising the first second and third classes of implements to which this thesis is devoted. The history and development of these implements is interesting and covers a long period. They have been slow in developing and today they have not reached that high standard of development, which is so characteristic of the steam engine, gas engine, locomotive etc.
HISTORY.
PLOWS.

The first Agricultural Implements used by prehistoric man, as shown by remains found in the peat bogs of England, France and other countries was a hooked stick (See Fig I Plate I). The age of this plow, if it can so be called, can be gotten at from the fact that it is represented on Egyptian monuments more than 3000 years B.C.

The plows of ancient times seem, however, to have been built only for the purpose of breaking and stirring the soil, the bottom having been invariably a simple wedge, with no power to turn a furrow. It is true plows of ancient times may have been made with one side straight like a modern landside and with the other side extending out to push the loosened soil over and thus leave something like a furrow, but, "in those times no one had grasped the idea of combining two wedges in the same implement, nor had they any ideas of the curves by which this could be affected!" The practical combination of share and moldboard remained to be discovered. Just when this came about no one seems to know. It appears that the first feeble attempt to realize the idea of a moldboard was in France. This French plow was of the form of a twisted wedge, "raising up the earth first and then twisting it to the right. It had two wheels to keep it steady in the furrow, and a coulter of modern form. It is rude compared to our modernimpliments,
but it shows real genius in its author. This is not the first plow which used either wheel or coulter. Plows having a beam and supported by two wheels were used by the Greeks 2000 years ago.

Thus we may infer that there is no real inventor of the plow. We cannot say about the plow as we can say concerning the steam engine, that Watt was its inventor or like the cotton gin that Eli Whittney invented it. The plow seems to have sprung up from natural instinct. Each race and each country had its own form and design of a plow. These different designs are interesting and can be seen by referring to Plate 1.

As late as fifty years ago in this country the common method of plow making was for the farmer to purchase from a jack-of-all-trades, the wagon maker, the wood parts and have it ironed by a blacksmith.

The records of the past fail to show when and where metal points or shares were first used. Several prophetic allusions are made in the Old Testament, "( Isa., 2, 4; Mic 4 3 ) to the time when warriors would, 'beat their swords into plow shares' " and it is known that ancient Egyptians and Assyrians had plows that were pointed and edged with copper and iron, but the time when metal was first used cannot be even guessed.

The Egyptian plow which doubtless was constructed simply of wood, consisted of a plow share, a double handle, and a pole or beam.
The Syrian plow has a single handle and three different shares, for use in different soils.

The Greek Plow. The Greeks in the time of Heriod (850 B.C.) used two kinds of plows. One was made of the limbs of a tree with the branches so diverging as to form the different parts; the other constructed of three sticks so fastened together as to form a plow similar to the preceding one.

The Modern Plow with its moldboard to turn the broken-up soil, it is thought, was invented in the Netherlands in the Seventeenth century, and in the early part of the 18th century many plows were imported from Holland. The most used in America during the colonial period and well on into the last century had a wooden moldboard, sometimes covered with sheet iron, while the share was wrought iron. This was followed with a cast iron plow, which as first manufactured had moldboard so rough as to necessitate scouring by protracted plowing in a gravelly field before it could be used in adhesive soil. An important advance was made by using steel for mold-board and by applying the chilled process to its entire surface, which by this means was made so smooth as to prevent the adhering of the soil.

In America the progress in the development of the plow was slow during the colonial times, owing to the narrow policy of England in discouraging or prohibiting altogether the establishment of factories.
The manner of making a plow a century ago was remarkably crude, judged by modern standards. In the language of Gould: "A winding tree was cut down and a mold-board was hewed from it, with the grain of the timber running as nearly along its shape as it could well be obtained. On to this mold-board, to prevent wearing out too rapidly, were nailed the blades of an old hoe or thin strips of iron. The land-side was of wood, its base and sides shod with thin plates of iron. The share was of iron, with a hardened steel point. The coulter was tolerably well made of iron and steel edged. The beam was usually a straight stick; the handles like the mold-board, split from a crooked trunk of a tree, or oftener cut from its branches, the crooked roots of the white ash being the favorite timber for handles in the northern states. The beam was set at any pitch fancy might dictate, with the handles fastened on almost at right angles with it, thus leaving the plowman little control over his implement, which did its work in a very slow and almost imperfect manner: It must be remembered, however, that in the colonial times the land under cultivation was very largely, "new ground", soil which was not easily penetrated and stirred up. It had neither the stickiness nor the tendency to bake of clay land which has been long under cultivation nor the impenetrable net work of leathery grass roots which made the breaking of the virgin prairie soil so difficult.
In England the first patent granted on a plow was to Joseph Foljambe of Yorkshire in 1720. James Small established the first known plow manufacture at Black Alder Mount, Scotland, in 1763. Roby Ransome of Ipswich England is considered the first to use a share of cast iron and in 1803 he obtained a patent on cast hardening or chilling the share.

In America the first letter patents granted on a plow was in 1797, to Chas. Newbold, a farmer of Burlington, N.J. The plow was of solid cast iron, consisted of a bar, sheath and mold-board. This plow the farmers rejected and would not use it, thinking that the cast iron, "poisoned the land", and stimulated the growth of weeds, so the rude "bull" plow with its wooden mold-board ruled the realm for twenty years more. Jethro Wood in 1819 brought about a new era in the history of the plow, the era of manufacturing, as distinguished from the era of building. By Wood's invention was brought about the interchangeability of parts.

The next step in the development of the plow was the invention of the chilled plow. Credit for making the chilled plow a practical success is due to James Oliver, who began experimenting soon after establishing his plow shop or factory at South Bend, Ind., in 1853, and which is now one of the largest plow manufactures in the country. Two fundamental defects had hitherto stood in the way of a successful chilled mold-board. One the frequency of soft
spots or blow holes in the casting, making it short lived, and
the other was the extreme brittleness of chilled metal, and
the risk of breakage in a mold-board of convenient weight
and thickness. The remedy for the first was finally dis­
covered in using hot water under certain conditions in the
chills, and a way was soon afterwards found for removing
the brittleness. By a peculiar annealing process it was
made possible to toughen the metal without softening
it and so give the strength that would enable it to
endure the hard usage of general purpose work on a million
farms. With this discovery the last barrier in the way of
successful chilled plow was removed. The next obstacle
that presented itself was to get a plow which could pene­
trate the turf of a thousand years' growth and uncover
the inexhaustible soil of the Mississippi valley that lay
shielded beneath the hard matted roots of the prairie
grasses and weeds. The old principles of beam, handles,
mold-board must be made with a long, easy curve and the
share with an edge of the finest steel. With the problem
of breaking overcome, it might have been expected that the
soil would become tractable and obedient to the touch of
its master, but yet another obstacle, was to be surmounted.
The old wooden plows and those of cast iron that were com­
ing in from the east, or of "boiler plate" that were made
by the local blacksmith, would not scour in the light vege-
table mould after it had been stirred up by cultivation during several seasons. Carious remedies were tried without avail until it was discovered that a high grade of steel would clean itself and do satisfactory work. Now comes the same old story, as to who, it was that made this discovery. It would be difficult to determine, but the first steel plow of which there is any record was made in 1833 in Chicago in the woods near where the Illinois Central Station at Twelfth Street now stands. The maker of this plow was John Lane, whose son, the inventor of "soft center" plow steel, was a witness of the incident, yet lives in Chicago.

An old saw, probably, a worn out "cross cut", had been cut and deprived of its teeth, and three lengths of it were used to make the mold-board of the requisite width, another piece forming the share and an "anchor wing of iron" the three cornered shin piece, which can be seen by referring to (Fig. VII Plate II) This worked fairly well and the result was the using up of all the old saws and even new ones. Finely the plow makers bought the steel blanks from the saw manufactures and finely they were able to but special widths of steel from Pillsburg, rolled 12" wide and this gave boom to the infant industry. It was a plow with a mold-board made of old saws that John Deere then a blacksmith, built in 1837, after coming west and he had settled in Grand Detour, Illinois. The success of the first two which he made led him to build a considerable num-
ber and the ready sale inspired him still further in his improvements. The first slab of plow steel ever rolled in the United States was rolled by Wm. Woods at the steel works of Joves and Quigg and shipped to John Deere in Moline Illinois. Mr. Deere, having moved from Grand Detour in 1847 and founded the business which is now flourishing under his name and the plows are known everywhere. Wm. Parlin, another pioneer, has also flourished and his name today is connected with the oldest permanently established factory on earth.

The manufacture of steel plows was revolutionized in 1868, by the invention of "soft center" steel for mold-boards shares and landsides. First a high grade of saw steel was used, then cheaper material was substituted, with result that plows would not scour in all soils. Case-hardened German steel was then tried, but was not satisfactory, chiefly, because of the difficulty in tempering it uniformly. In 1862 an invention was patented that in a measure paved the way for the introduction of "soft center" steel, but did not come into favor. This patent was Wm. Morrison's and consisted of a cast steel plate for the face of a mold-board, share and landside, welded upon and strengthened by a backing plate of soft-iron. The fault of this construction lay in the liability to warp while tempering. The iron and steel would not expand and contract together.

John Lane, referred to above, thereupon conceived the idea of three layer-plate and the middle layer being the
soft-iron. (See Fig. III, Plate II) The importance of this invention can hardly be estimated. It has proved itself worth millions annually to the farmers of the west. Its inventor was contented with a royalty of three cents on a plow.

Thus has been the history and development of the plow; and today our plow factories are making plows by the wholesale. See (Table I, Page 23). In 1900 there were 1,074,999 plows manufactured in United States by 715 factories. The number of factories in the manufacture of agricultural implements is becoming smaller as can be seen by referring to table, page, while the capital is increasing. There are few, if any, branches of manufacturing, in which progressive development and improvement exercise so far-reaching and fundamental effect. For instance the changes in cultivation of corn, the time required to produce one bushel of corn, on an average, declined from 4 hours and 34 min., to 41 min., and the cost of human labor from 35 3/4 cts to 10 1/2 cts.

Comparing our plows with other countries we readily see, we are in advance of others and yet we have room for improvement. What a contrast between our plows and the things so called in Russia, and what a contrast between the respective operators. Like plow, like man. On the one side are brightness, keeness and adaptability; on the other hand coarseness, clumsiness, and stolidity.
SULKY AND GANG PLOWS.

A brief period of thirty years will cover the development of sulky and gang plows. Twenty years of this time were taken up by the old two-wheel sulky, the three-wheel plows, now so popular, having been made practicable for general use in the last ten years. In 1876 the first patent was granted W. L. Casaday, on the famous Casaday sulky, made by the Oliver Chilled Plow Works, which was the first to do away with landside and use a wheel set at an angle against the furrow to support the plow.

For the last forty years inventors have worked on the problem of steam plowing. The favorite way in England has been to draw a gang of plows back and forth across a field by means of a cable driven by an engine at one side of the field. The plan proved a clumsy one and has been abandoned.

In this country the popular plan has been to draw a gang of plows behind a traction engine. Excellent results have been obtained and many outfits of this type are now in use. Since the gas engine has become so generally used and has proven to be a power producer which will be used on many farms and elsewhere, it is the opinion of the writer that the next step in the plow development will be by an automobile plow or a plow driven by gas-engine power.

The last form of plows to be launched forth has been the disk plow which is either in a sulky or gang form. When the ground is dry and so hard that a mold-board plow cannot
enter, a disk plow will cut and pulverize it putting the
farmer in position to do his work on time without waiting
for rain.

HARROWS.

The first harrow used by man was undoubtedly nothing
more than a branch of a tree. The next stage was a wooden
frame with wooden teeth. (See Fig. 1 page 23) This was used
by the ancient Romans who also had a kind of smoothing
harrow. The Japanese have used from time immemorial a disk
harrow. (See Fig. II page 23) This disk form is now being
used on cultivators and plows. A roller with teeth was also
used in Japan.

Harrors may be divided into three classes; spike tooth,
disk and spring tooth harrows. The first two are the old­
est, the spike tooth probably the older. The spring tooth
harrow is an American invention and was patented in 1869 by
David L. Garver of Hart, Mich. The construction of the spik­
ed tooth harrow was so simple, that it was made to order by the
village blacksmith. Aside from the changes in frame and
manner of hitching, the only improvement of which this har
harrow was susceptible was giving the point of the teeth
a backward pitch thus smoothing the surface and crushing
clods. A lever was then invented by an Iowa man for chang­
ing the pitch in an instant, and then the lever made harrows
perfect. The improvement in disk harrows in the United
States were automatic scrapers for cleaning, anti-friction
bearings, solid or cutaway disks, 1, 2, 3, or 4, horse
hitch, and seeder attachment.
GRAIN DRILLS.

The first method of putting seed in the ground by primitive man was to make holes with a stag horn or crooked stick and drop in seed, cover it over afterwards. Broadcast sowing originated in the valley of the Nile, where, after the water had subsided a farmer could sow his seed and drive sheep over the ground or go over it with a brush harrow or plow. The first trace of seeding machine that is found in history is an Assyrian drill used many centuries before Christ, a reproduction of it being found on the Aberdeen "black stone" of the time of Esarhaddon, 680 B. C.

The Chinese have a kind of wheelharrow seeder with hollow teeth which draws furrows and drops the seed and it is claimed that this implement has been used for ages.

The greatest contribution to the early development of grain drills was made by Jethro Full in the eighteenth century. In 1731, in a work which he published, entitled, "Horse-Hoeing Husbandry", he argued that grain and seed should not be sown broad-cast, but should be planted in rows or drills so as to admit of hoeing by horse power with proper implements.

In Dodsley's Annual Register for 1764 in England, a seed plow is mentioned as having been made to go to York. It was mounted on two wheels, to be drawn by one or two horses. It made several furrows at once and would sow any kind of seed and cover at the same time, "all with great expedition and exactness". This was practically the crude
predecessor of modern grain drills. From this time on many inventions were patented, some of them simple and practical, others too complicated for successful use. Early in the 18th century the English had traveled far on the road towards the manufacture of grain drills, such as are now used. The Norfolk drill is favorably mentioned by Loudon. It sowed, "a breadth of nine feet at once", and was quite generally used on light soils and on thin ground.

In a hand-drill harrow used in England, may be seen the predecessor of the one-horse drill, which is still used for covering beans and other seeds. It is a suggestion also of the lister, a modern American implement.

The first patent on a seeding machine in America was granted in 1799, up to 1836 patents were granted to about thirty inventors. The most important inventions that were left to be discovered were in the feed and in adjusting devices that to day distinguish Americal drills.

The manufacture of grain drills began in this country about 1840. The first important patent of which we have any record, was granted in 1835, and reissued in 1838. It was a machine to sow lime and plaster and as reissued showed that it was intended to sow grain, also. In 1837 another patent was granted, covering the application of centrifugal force, to sow lime, plaster and small grain. In 1838 a patent was issued for a grain drill in which a spring arm revolved in a hopper and agitated the grain over the mouths of tubes, through which the grain was distributed.
In 1840 J. Gibbons of Adrian, Mich., patented a drill with a device for regulating the volume of grain. By 1850 many patents were issued. These were of three classes, distinguished by their feeding devices. 1. Cylinder drills as built by several; 2, slide drills, in which the distribution was effected by means of a slide; 3, force feed drills which were just coming into use. Many of the slide drills used had a slide moved by a cam or crank motion to distribute the grain, and also a slide in the bottom of the grain-bot to increase and decrease the quantity, by enlarging or decreasing the size of the opening for the passage of the grain. Others of this class used the slide in the bottom to govern the quantity fed and had a metal agitator or a rotary feed in the box to assist in the passage of the grain, and still others used two continuous flexible rollers to distribute the grain, the quantity being regulated by increasing or decreasing the distance between the rollers.

The first patent on force feed for grain drills was issued Nov., 4, 1851, to N. Foster, G. Jessip, H. L. and C. R. Brown. This invention introduced the name, "force feed." I will not here attempt to describe the drill. These parties manufactured drills at Palmyra, N. Y. In 1854 the Browns moved to Shortsville and established a factory under the name of H. L. & C. P. Brown. This firm is now incorporated as the Empire Drill Co. About twenty-five years ago inventors turned their attention to shoe drills, Brown, of corn planter fame, had introduced the principle
of a shoe so shaped as to cut through or rise over obstructions; and it was but a step to adapt this invention to grain drills, as well as chains or wheels for covering the seed. In later years disk seeders convertible into disk harrows are in popular favor.

CORN PLANTERS AND CHECK-ROWERS.

The practical development of the two horse corn-planters now in general use throughout the west and southwest, dates from 1853. By the burning of the patent records in 1836, all traces have been lost of the man who conceived the idea of the corn planter. There are many patents after this. D. S. Rockwell's patent, 1839, shows a planter with four wheels of equal size and two seed boxes; this was intended to plant two rows. Furrows were opened for each row by a peculiarly shaped shovel, behind which the seed was dropped between two diagonally set blades. The combination of shovel and blades is suggestive of our modern shoe. The rear wheel, set behind the blades, covered the corn and packed the earth as in the modern planter. A motion was obtained from one of the bearing wheels which operated the dropping of the corn.

The aim of these early inventors was evidently to produce an automatic planter, and nothing practical came out of their efforts because the real need of the western farmer was a planter that would place the hills, "in check" so the corn could be plowed both ways. A device for dropping the corn by hand or in some way in control of the operator must be combined with means for opening the furrow.
and covering the corn. This was done by Geo. W. Brown of Galesburg Ill., in 1853 and 58. A shoe for opening the furrow was the addition in 1858. Mr. Brown in his first patent claimed the oscillating horizontal wheels having the slots and holes of various sizes, for the discharge of different kinds and quantities of seeds. Mr. Brown seems to have done a good deal in the development of this machine and was granted quite a number of patents.

The first marker patent was given to E. McCormick, 1855. It was a devise projecting from the end of the axle. F. Goodwin of Astoria, N. Y., patented the first marker that could be changed from one side to the other. The marker as used today was the work of Jarvis Case of La Fayette, Ind. It has a double edge shoe, and is hinged so that it can be turned over to mark on either side, or be raised clear off the ground in turning.

Geo. W. Brown showed the principle of rotary drop. The Deere & Mansur Co of Moline Ill., are credited with the pioneer work in adapting this rotary drop to check-rower. The Moline Plow Co., introduced a few years ago the Principle of gearing the dropping mechanism to the wheel of the planter so as to drop one kernal at a time into valves. The advantage of this device, is that corn can, if desired be planted in hills with check-row attachment, or the check-rower can be taken off and corn drilled in.

The lister is a modified form of corn-planter. It is used where soil is dry and other conditions are favorable
to this method of planting. The distinguished feature of a lister is a small double mold-board plow adapted to opening a furrow (generally with a subsoiler running behind to make a seed-bed) in combination with a covering wheel, seed box and mechanism actuated by the covering wheel for dropping corn. Lately a lister is mounted on two wheels like an old-fashioned sulky plow.

The advantage of planting in this manner is that the seed is covered in the bottom of a furrow, and is better able to withstand the dry weather; and planting can be done without first plowing and harrowing.

The introduction of the lister dates back about fifteen years. Parlin & Orendorff Co., of Canton Ill., were first to build this implement in any quantities, Wm. Parlin giving to the lister a good deal of attention.

THE CHECK-ROWER.

Mr. M. Robbins of Cincinnati Ohio is credited with the first planter (1857) to drop in check automatically. It was checked by a jointed rod provided with buttons. Mr. Robbins' invention was only a one horse drill and did not receive the name of check-rower.

In 1864 John Thompson & John Ramsey of Aledo I11s., received a patent on a planter using a cord or wire, provided with knots at a suitable distance apart. G. D., J. W., L. L., and M. Haworth in 1875 got up a planter and used a knotted cord for actuating seeding devices and which received the name of check-rower. There has been many improvements in this and
today corn planters with check-rower devices are successfully used. The checking is accomplished by means of a knotted wire catching in a fork-like arm which operates the dropping device. This wire is made by automatic complicated machinery, which makes and forms the knot from straight wire at its proper distance.

Of late an effort has been made to do away with check-rower wire and yet obtain the same results. Large paddle wheels were arranged to operate the check; it was found however, that the machine would be sadly out of check upon going over any length of a field. The scheme turned out a sad failure to the regrets of one large manufactory. The check-rower wire still holds the fort as regards checking corn.

CORN CULTIVATORS.

The development of the "straddle, row" cultivator has been since 1850. The corn-planter and corn-cultivator have been developed together. Horse hoes were the predecessors of the modern sulky cultivators.

The first patent was granted to Geo. Esterley in 1856. Following his patent were others but they were all with a straight axle. The first to arch the axle was N. Whithall, of Indiana, in 1859. His cultivator also had an evener suspended on three points.

James Dundas of Illinois, in 1859, was granted a patent in which the use of two wheels on a cultivator arranged with two gangs with a space between them, a seat for the driver, and means for moving the gange laterally and rais-
ing the plows relatively to the tread of the wheels were
the main features.

The springs on a cultivator came in use by G. Moore's
patent, in 1879. After this patent others occurred using
springs.

For many years following the introduction of cultivaotrs
the popular style was the "long swing", in which the coup­
ing was located forward of the axle, thus permitted
the use of long beams, and giving the gangs a long easy swing.
Cultivators with couplings at the axle, however, were in the
field early and soon grew in favor on account of their
convenience and compactness.

Disks in place of shovels have been introduced by a
number of manufacturers, have meet with favor, and today
they are extensively used.

Within the past few years many styles of "tongueless"
walking cultivators have been put on the market by manufact­
urers and have met with a favorable reception. They have
the advantages of general convenience, light draft,
flexibility in the frame so that the gangs can be held more
steadily and nearer to the corn when it is small, and less
room is required for turning at the side of the field.
For these reasons they are preferred by farmers
who are not averse to walking.

Manufacturing in this line is now largely in the hands
of the steel plow manufacturers, each of whom has patents
covering distinctive devices in couplings, springs, and
other parts.
Oldest Plow, Used by Prehistoric Man

Ancient Egyptian Plow

Ancient Roman Plows

Ancient East India Plow

Hebrides Island Plow

Sicilian Plow

Corsican Plow

Mexican Plow

North Russian Plow
**Plate II.**

**Philippine Island Plow**  
*Fig. I.*

**Japanese Plow**  
*Fig. II.*

**Italian Plow**  
*Fig. III.*

**Central Russia Plow**  
*Fig. IV.*

**Wooden Mold-Board Plow of a Century Ago**  
*Fig. V.*

**First American Cast-Iron Plow 1797**  
*Fig. VI.*

**First Steel Plow - 1833**  
*Fig. VII.*

**John Lane’s Patent 1868 “Soft-Center” Steel**  
*Fig. VIII.*
PLATE III

TABLE I.
Number of Implements Made in United States and Illinois in 1900.

<table>
<thead>
<tr>
<th></th>
<th>Cultivators</th>
<th>Harrows</th>
<th>Plows</th>
<th>Planters, Harvesters &amp; Binders</th>
<th>Hay Rakes</th>
<th>Mowers</th>
</tr>
</thead>
<tbody>
<tr>
<td>U. S.</td>
<td>504,978</td>
<td>477,620</td>
<td>1,074,999</td>
<td>397,640, 26,961</td>
<td>216,345</td>
<td>397,561</td>
</tr>
<tr>
<td>Illinois</td>
<td>182,060</td>
<td>194,375</td>
<td>283,050</td>
<td>91,461, 152,702</td>
<td>108,670</td>
<td>246,804</td>
</tr>
</tbody>
</table>

TABLE II.
Showing Decrease in No. of Establishments with Increase in Capital

<table>
<thead>
<tr>
<th>Year</th>
<th>1900</th>
<th>1890</th>
<th>1880</th>
<th>1870</th>
<th>1860</th>
<th>1850</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Establishments</td>
<td>715</td>
<td>910</td>
<td>1,943</td>
<td>2,076</td>
<td>2,116</td>
<td>1,333</td>
</tr>
<tr>
<td>Capital</td>
<td>157,707,900</td>
<td>145,313,392</td>
<td>62,109,668</td>
<td>34,834,600</td>
<td>13,866,389</td>
<td>3,664,202</td>
</tr>
</tbody>
</table>

Fig. I.

Fig. II.
The technical terms given to the parts of a plow are; (1) body, that part to which all the rest are attached; (2) the sole, i.e., the bottom, to the fore part of which is affixed the share, whose point expands into a fin, the hind part of the sole being called the heel; (3) the beam, to which the team is attached and on the end of which is a clevis, a sort of rack or elongated staple into which the draft-chain is hooked; (4) the coulter, a cutting-iron fixed in the beam in a vertical position before the point of the share for the purpose of cutting the furrow-slice from fast land; and (5) the mold-board, the broad concave part which receives and lays over the furrow-slice cut-off by the coulter and raised by the share.

CLASSIFICATION.

We have today, in general, three classes of plows, namely: walking, sulky, and gang plows. The sulky and gang plows are most always riding plows. The gang plow has two or more shares and throws two or more furrows, while the sulky plow has only one share and throws only one furrow. Plows are made with two fundamental different shapes depending upon the character of the work which they are expected to do. If the chief object of the plow is to cut a clean furrow slice and to turn it over as to completely cover whatever may be upon the surface, as in Fig.1 plateIV, a shape represented by figure
**Plate IV.**

**Fig. I.**
Furrows turned completely over

**Fig. II.**
Lap-furrowed

**Fig. III.**

**Fig. IV.**

**Fig. V.**
Pulverizing with steep mold-board, soil completely turned

**Fig. VI.**
Double-plowing

**Fig. VII.**
Plate IV is used. This is a sod or breaking plow. If on the
other hand the primary object of the plow is to thoroughly
pulverize the soil, making it deep and mellow, as in Fig. V, plate
IV, a form shown in Fig. V/ plate IV, is used. This class of
plow is known as the stubble plow. Then there are shapes of
plows in which the mold-boards are more or less steep ranging
all the way between these two, extremes according to the
nature of the soil and work to be done. These are known as
turf and stubble plows.

It must be clear from the mechanical action of the plow
that its form should be adapted to the soil. If the soil
has a tendency to be too open and porous, and is naturally
coarse grained, as in the case of sandy soil, it should be
plowed with a steep mold-board. If the soil is generally too
close in texture, is heavy and soggy, it needs the less steep
mold-board.

We may therefore make the following inferences: (1) A sod
Plow or Breaking Plow is constructed so as to reduce the draft
as much as possible by doing the only work needed, i.e., cut
and turn the furrow slice, as in Fig. I, plate IV. This is
accomplished by making the mold-board very long and slanting
so that the furrow slice is bent and twisted as little as
possible; the chief work being to cut it and roll it bottom up.
(2) The Turf and Stubble Plow (with a medium mold-board) does
a work the nature of which is shown in Fig. II, plate IV.
The difference is, that in the former case the plowed land lies
solid, and is difficult to break up, whereas in the latter the
land will break somewhat of itself, while there will remain at the same time beneath the furrows the hollow triangular space shown in Fig.,II plate IV. Hence, when the cultivator, or clodcrusher, is passed over the land, the soil will be more thoroughly broken up.

(3) The Stubble Plow has a steep mold-board. The object is to bend the furrow slice as much as possible before it is turned over, for this is what pulverizes the soil and gives it the loose, fine open texture sought.

This pulverizing action is best explained by F. H. King at the University of Wisconsin. If you open a book, placing the fingers upon the fly leaf in front and the thumbs under the fly leaf in the back and abruptly bend up the corner, it will be seen that every leaf is slipped over its neighbor. What takes place is represented in Fig I, plate V. Had pins been put through the book before attempting to bend the leaves, the bending would have tended to cut the pins into as many pieces as there were leaves, just as seen in figure mentioned. Now the plow has exactly this kind of effect upon the furrow slice; it tends to make it divide into thin layers which slide over one another just as the leaves of the book did, and it is because of this sort of action that a plow pulverizes a soil as no other tool can.

SUCTION AND LAND.

Two very important points in the study of the plow are the suction and land. In a new plow or an old one whose share has just been properly sharpened and pointed, the point of the
Plate V

Showing the Principal of Pulverizing Action of the Plow

Fig. 1

Direct of the Line of Draft for Plows

Fig. 2
share dips down about (3/16") three sixteenth of an inch depending on the plow, from the straight line along the bottom of the land side. This is the right shape to make the plow go into the ground as it should. In an old plow it is nothing unusual to find the share point worn so the bottom of it is on a straight line with the bottom of the land side or even turned up instead of down. When this is the case it is necessary to give a higher hitch to raise the line of draft and hold the plow into the ground. This makes a heavier pull. The plow ought to go into the ground of its own accord, and does when it is new. In a riding plow the straight-point or turned up point, as in an old plow, raises the plow off its wheels instead of putting weight on the wheels. This tendency of the plow, from its shape, to work itself into or out of the ground is called suction. The share should turn into the land about three-sixteenth of an inch to obtain suction in land. This is called the land of the plow.

If this curve is worn off a readjustment at the evener clevis is required and again the plow pulls harder from the fact, force is required to keep the plow in land. It is very necessary that this point of the plow-share should be right as on this depends the economical work of the plow in more ways than one.

By referring to plate VI the way suction and lands are given to the different plows, can be clearly seen. Beams are landed with respect to hitch. Beam land has no connection with
Walking Plow Suck = \( \frac{3}{16} \)" to \( \frac{1}{4} \)"
A-B = Straight Line
Fig. I.

Wheel Plow Suck = \( \frac{1}{2} \)" at Heel of Landside
Fig. II.

Plow Bottom Land
Walking Plows - Land = \( \frac{1}{8} \)" to \( \frac{3}{16} \)"
Riding Plows - Land = \( \frac{1}{8} \)" to \( \frac{3}{16} \)"
Fig. III.
the bottom land.

Beam at position I; (See Plate VI, Fig. III) No land; for 3 and 4 horses.

Beam at position 2; Half land; for 2 and 3 horses.

Beam at position 3; Full land; for 2 horses.

LINE OF DRAFT.

It is very important in the handling of a plow that the "line of draft" be just right and such that a line connecting the center of draft A, (See Plate Y, Fig. II) in the mold-board with the place of attachment of the plow bridle shall also lie in the plane of the traces, as shown in the figure by the line ABD. If for any reason the line of draft becomes a broken one as ACD of 1, 3, 5 or 1, 4, 5, instead of 1, 2, 5, the draft of the plow is made heavier. The greatest care should be exercised to have the length of the traces, or the hitch at the plow bridle such that the plow, "swings free", requiring little or no pressure at the handles to guide it.

TEMPERING.

Tempering is one of the most vital steps in the production of a high grade steel plow. Difficult scouring soils almost always contain a fine jasper grit, ground to powder during the glacial period of the middle west, which cuts hard metals almost like a diamond. The face of the plow must be made extremely hard to resist this cutting action, as well as to afford a basis for a brilliant polish, which alone permits sticky soils to slide freely across the plow, - in other words to "scour".
To obtain this hardening, plow manufacturers have looked to ice making machinery for this purpose and they have installed tempering plants at an expense of thousands of dollars.
Each manufacture has its own particular line of goods and to each is given a name, no two implements having the same name. So thoroughly is this carried out by all manufacturers that it has been possible for the Midland Publishing Co., at St Louis Mo., to get out a book known as the "Blue Book" in which are the names and makers of all implements on the market in the United States.

The following is a classification of Goods for one of the leading Agriculture Firms. Deere & Co., Moline, Illinois.

<table>
<thead>
<tr>
<th>PLOWS.</th>
<th>PLOWS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riding and Wheeled</td>
<td>Riding and Wheeled</td>
</tr>
<tr>
<td>walking.</td>
<td>walking.</td>
</tr>
</tbody>
</table>

Black Land

<table>
<thead>
<tr>
<th>Breakers</th>
<th>Disk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush</td>
<td>Bedding</td>
</tr>
<tr>
<td>Middle</td>
<td>Single</td>
</tr>
<tr>
<td>Marsh</td>
<td>Double</td>
</tr>
<tr>
<td>Prairie</td>
<td>Triple</td>
</tr>
<tr>
<td>Rod</td>
<td>Quadruple</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>Secretary</td>
</tr>
</tbody>
</table>

General Purpose

<table>
<thead>
<tr>
<th>Grading</th>
<th>Gilpin Sulky</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hillside</td>
<td>New Deal</td>
</tr>
<tr>
<td>Listing-Walking and Riding</td>
<td>Single</td>
</tr>
<tr>
<td>Mixed Land</td>
<td>Double</td>
</tr>
<tr>
<td>New Ground</td>
<td>Triple</td>
</tr>
<tr>
<td>Pony</td>
<td>Quadruple</td>
</tr>
<tr>
<td>Potato</td>
<td>Multiple</td>
</tr>
<tr>
<td>New Deere</td>
<td>New Deere</td>
</tr>
<tr>
<td>Single</td>
<td>Single</td>
</tr>
</tbody>
</table>
Road
Root
Subsoil
Texas Ranger
Timber
Vineyard
Wood Standard.

HARROWS.

Ajax, Steel Lever
Deere King
Deere, Wood, Lever
Deere, Smoothing

Universal, Steel Lever.

CULTIVATORS

Walking, Riding, Combined.

Combined Riding and Walking

Hammock
New Elk
New Elk Pivotal
Royal

Riding.

Deere
Deere Pivotal
Disk Listed Corn
New Elk, Jr.

Surface
Two Row
World.

Walking.

Faun, Jr. Tongueless

New Deere

Five Tooth,
Seven and nine
New Deere
Adjustable Arch

Listed Corn
New Deere
Balance Tongue.
WALKING PLOWS.

It is necessary to take a great deal of pains in the manufacture of the walking plow. Perhaps there is no other implement made that requires as much care. Each plow must be made so that repairs can be ordered for the plow and the repairs must fit. This has brought about the well known fact, that this kind of machinery must be manufactured instead of built. Thus perfect duplication of the parts is required. Walking plows generally are made with either wood or steel beams thus making a difference of price to the farmer.

General Purpose Plow.

The general purpose plow is made in 12 inch, 13 inch, 14 inch, 16 inch and 18 inch sizes, meaning the width of furrow which it will turn. The shape of mold-board is such as to turn the trash under completely.

Turf and Stubble Plow.

In form, the shares are more sloping and the mold-boards have greatly increased length and easier turn than with the stubble plows. The landside is so much longer as to give the plow perfect steadiness in heavy work.

Stubble Plows: By the term "Stubble as used, is meant, in a plow a quality particularly adapting it for work in old ground of the lighter or loamy character usual to lands in the West and Northwest, and where, in many localities, nothing but the most improved forms, of the finest finish, can be made to scour. Farmers for the most part understand the importance of selecting a Plow with a shape or turn of mold-board suitable for the work to be done and the soil of their farms; and it is
often the case that unjust condemnation of plows occurs in their hands, because of improper selection of shapes having been made. A farmer who has much sod or hard or heavy land to turn does not want these plows. One who has light soil and little meadow should use a stubble plow. This kind of plow is made in 12, 13, 14, 16, and 18 inch sizes.
RIDING OR WHEEL PLOWS.

Riding plows have lessened the labor of the farm considerably, both to the farmer and to his horses. Where the farmer walked miles up and down his field, he now sits on an easy spring seat and rides, controlling the plow by means of levers which are in easy reach and easily handled.

A riding plow is a three wheel plow, having two small furrow wheels and one large land wheel. The front furrow wheel runs in the furrow of the previous cut and the hind furrow wheel runs in the new furrow. The draft of a riding plow is largely determined by two things: the set of the wheels and the pitch of the bottom of the plow. The wheels should be so set as to hold the landside away from the land while the pitch of the bottom should be such that the heel of the landside does not drag on the bottom of the furrow. Wheels are very important parts of any implement and particularly of sulky or gang plows where they are obliged to withstand heavy stresses. The wheels are fitted with removable bearings or boxes and the furrow wheels are fitted with dust-proof, oil-retaining screw caps. As the furrow wheels work close to the dusty furrow, and run on an angle spindle, it is very important that the dust be kept out of the box and that the oil should be retained, otherwise the boxes will cut out rapidly. The rear wheel is generally governed by a rod, by which it is connected to the front furrow wheel, the movement of which in turning is immediately effected by the pole. Through this connection the rear wheel is made to turn in an opposite or reverse way from that of the front wheel, and the
plow, while being driven straight ahead, turned on a corner or backed up, is always perfectly controlled by the tongue through this means.

Flexibility of the bottom, in connection with the frame, is a feature which must be well taken care of. This is accomplished in many ways and gives the bottom and beam, in operation, the free and easy movement of the walking plow, and also permits the land wheel to pass over obstructions without affecting, in the least, the movement of the bottom in the soil.

The frame is generally made of wrought iron with malleable castings.

There are two ways of hitching a riding plow and are known as "Beam Hitch" and "Frame Hitch." Both ways are used but it is recognized that the "Beam Hitch" is the only correct way to hitch. The frame is properly for carrying the plow and not to pull it by.

It is a very common thing now for one to hear of "high-lift" plows. By this is meant, that the plow is lifted high above the ground so as to be easily transported by clearing obstructions.

In all riding plows a locking device is used whereby the plow can be held in the ground or out of the ground, or at the desired depth. This locking device must be so designed that it can be readily or easily released by the operator.

DRAFT OF RIDING PLOWS.

The draft of different plows have been determined by dynamometer tests at the University of Illinois. The following tables show the results of such tests.
TABLE 1.
Width, 14 inches, turf moldboard.

<table>
<thead>
<tr>
<th>Depth inches</th>
<th>Sq. In. across furrows</th>
<th>Pounds draft</th>
<th>Pounds draft per sq. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>56</td>
<td>241</td>
<td>4.314</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>298 1/3</td>
<td>4.26</td>
</tr>
<tr>
<td>6</td>
<td>84</td>
<td>353</td>
<td>4.202</td>
</tr>
<tr>
<td>7</td>
<td>98</td>
<td>406</td>
<td>4.149</td>
</tr>
<tr>
<td>8</td>
<td>112</td>
<td>430</td>
<td>3.914</td>
</tr>
</tbody>
</table>

TABLE 2.
Width, 14 inches, stubble moldboard.

<table>
<thead>
<tr>
<th>Depth inches</th>
<th>Sq. In. across</th>
<th>Pounds draft</th>
<th>Pounds draft per sq. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>56</td>
<td>275</td>
<td>4.91</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>310 2/3</td>
<td>4.437</td>
</tr>
<tr>
<td>6</td>
<td>84</td>
<td>360</td>
<td>4.26</td>
</tr>
<tr>
<td>7</td>
<td>98</td>
<td>410</td>
<td>4.183</td>
</tr>
<tr>
<td>8</td>
<td>112</td>
<td>450</td>
<td>4.017</td>
</tr>
</tbody>
</table>

TABLE 3.
Width 16 inches, turf moldboard.

<table>
<thead>
<tr>
<th>Depth inches</th>
<th>Sq. In. across</th>
<th>Pounds draft</th>
<th>Pounds draft per sq. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>64</td>
<td>298</td>
<td>4.656</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>360</td>
<td>4.50</td>
</tr>
<tr>
<td>6</td>
<td>96</td>
<td>416</td>
<td>4.33 1/3</td>
</tr>
</tbody>
</table>

TABLE 4.
Width 16 inches, turf and stubble moldboard.

<table>
<thead>
<tr>
<th>Depth inches</th>
<th>Sq. In. across</th>
<th>Pounds draft</th>
<th>Pounds draft per sq. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>64</td>
<td>300</td>
<td>4.687</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>370</td>
<td>4.625</td>
</tr>
<tr>
<td>6</td>
<td>96</td>
<td>435</td>
<td>4.531</td>
</tr>
<tr>
<td>7</td>
<td>112</td>
<td>463 1/3</td>
<td>4.136</td>
</tr>
<tr>
<td>8</td>
<td>128</td>
<td>515</td>
<td>4.023</td>
</tr>
</tbody>
</table>

TABLE 5.
Width, 16 inches, stubble moldboard.

<table>
<thead>
<tr>
<th>Depth inches</th>
<th>Sq. In. across</th>
<th>Pounds draft</th>
<th>Pounds draft per sq. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>64</td>
<td>340</td>
<td>5.312</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>420</td>
<td>5.25</td>
</tr>
<tr>
<td>6</td>
<td>96</td>
<td>500</td>
<td>5.208</td>
</tr>
<tr>
<td>7</td>
<td>112</td>
<td>553 1/3</td>
<td>4.94</td>
</tr>
<tr>
<td>8</td>
<td>128</td>
<td>591 2/3</td>
<td>4.62</td>
</tr>
</tbody>
</table>

TABLE 6.
Same depth, but different widths of mold board. Stubble mold board, depth 5 inches.

<table>
<thead>
<tr>
<th>Depth inches</th>
<th>Sq. In. across</th>
<th>Pounds draft</th>
<th>Pounds draft per sq. In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>70</td>
<td>310 2/3</td>
<td>4.437</td>
</tr>
<tr>
<td>16</td>
<td>80</td>
<td>420</td>
<td>5.25</td>
</tr>
<tr>
<td>18</td>
<td>90</td>
<td>480</td>
<td>5.33 1/3</td>
</tr>
</tbody>
</table>
Table 1 shows that while the total draft increases of course with the depth, the draft per square inch of furrow decreased.

Table 2 shows that the draft with stubble moldboard is a little greater than with the turf moldboard.

Table 6 shows that the draft per square inch is greater with the 16 inch plow than with the 14 inch plow. Considering the plowing alone, the 14 inch plow does more economical work than the 16 inch plow, and the latter more economical work than the 18 inch plow. The narrower the plow (within these limits at least) the more economical work it does.
DISC PLOWS.

The disc plow has been in use in Texas and the south for a number of years and has outstripped the mold-board plow in that section because it is difficult for a mold-board plow to handle that soil. A disc plow well made and properly proportioned is peculiarly adapted to plowing in dry hard stubble, or where it is impossible for a mold-board to scour. It is properly an old ground plow and not adapted for sod.

A disc plow should run from six to eight inches deep and give dirt enough for the discs to cover trash and level the ground well. Such a depth will turn a furrow 8 to 12 inches wide with one disc, 16 to 24 inches with two discs, 24 to 30 inches with three discs, 32 to 40 inches with four discs, depending on the adjustment of the plow.

The discs are generally 24 inches in diameter. The wheels on a disc plow are made of cast iron and weigh about 60 pounds each. The tires of the wheels are V shape, which experience has demonstrated to be the best for disc plows.

A disc plow is something like a disc harrow as regards to scouring and therefore needs a good scraper to clear the disc.

One noticeable feature of a disc plow is its weight. Great weight is not necessary to keep a disc plow in the ground; the discs have sufficient suction for this purpose, if set at the proper angle, and require only a strong and simple frame to support them.
The hardest feature of a disc plow to contend with is the disc bearing. The disc revolves in its bearing with a heavy pressure thus requiring the bearings to be well designed and lubricated. It must be absolutely dust proof and perfectly chilled. Some manufacturers use ball bearings in their disc plows.

It is claimed that a disc plow requires one fourth less draft than a mold-board plow doing the same work, that it pulverizes the soil better than a mold-board plow and that the ground never gets too hard to plow with it. One good feature about a disc plow is that it is practically unbreakable, and, that rocks and stones will not affect it, except that they may blunt the edge of the disc a little.
To study and obtain the different curves of mold-boards of
plows, I have designed and built a machine which will trace the
curves of each mold-board upon paper. Referring to a photograph
of the machine page 44, the operation of the machine can be seen.
The board on which the paper is tacked is fastened to a cast
iron frame connecting two upright pieces each running in parallel
universal slots cut in the bed of the machine. These upright
pieces move together and are actuated by a hand wheel in the front
and a threaded rod which runs across the top of the base. The
parallel rod seen in the photograph and which holds the pencil
is raised and lowered by means of threaded rods which receives
their motion from a hand wheel on top as the picture shows. A
spring gives the bar the horizontal motion and holds the point
of the bar continually against the mold-board as the bar is rais-
ed for one particular meridian. If another meridian curve is de-
sired, the tracer is moved one inch forward. At the end of this
thesis are shown curves obtained from an 18 inch stubble plow.
Plow Profile Machine.
HARROWS.

Spike Tooth.

Harrors are either spike tooth drag harrows or disc harrows. The spike tooth harrows are of many sizes and styles. The teeth may be square pointed, drag pointed or round pointed. The bars which hold the teeth are of many kinds such as the "U" harrow made of steel, oblong or round wooden bars, or gas pipe bars.

The "U" bar is unquestionable the best form in which material can be used to give the required strength without too much weight. With the lever harrow, in addition, the "U" bar affords certain conveniences in construction not possessed by any other style of tooth bar. Thus the tooth can be secured by a clamp which holds it firmly in place, at the same time making it easy to loosen for the purpose of letting the tooth down as the lower end wears away or to turn it around as the front becomes dull or rounding. The loosening or tightening of the clamp is done by means of a thread and nut. Other advantages might be mentioned.

Harrors are made in sections and each section has a certain number of teeth and bars (generally four or five bars). Different number of teeth, sections and bars are used, depending on the width of cut, as follows:

- 2 sections 50 teeth, cuts 8 feet
- 2 sections 60 teeth, cuts 10 feet
- 3 sections 75 teeth, cuts 12 feet
- 3 sections 90 teeth, cuts 15 feet
- 4 sections 100 teeth, cuts 16 feet
- 4 sections 120 teeth, cuts 20 feet
The teeth are so placed in a section as to have no two teeth in the same line in respect to line of draft.

Each agricultural implement firm makes what is known as a "Boss" harrow, see plate VII Fig. I, which explains itself.

At first the farmer walked behind the harrow but now there is made a riding attachment for the drag harrows, see (plate VII Fig. II.)

The need of such a device as illustrated in the figure need not be urged to any one who has had actual experience of following for an entire day an ordinary spike tooth harrow.

DISC HARROWS.

Disc harrows are made in two sections and contain either 8, 10, 12, 14, 16, 18, or 20 discs of either 16, 18 or 20 inch and cut 4 1/2, 5 1/2, 6 1/2, 7 1/2, 8 1/2, 9 1/2 feet depending on the number of discs.

A disc harrow is made very strong and heavy. Each disc is separated by a "thimble", which is "turned off" on the ends and which insures the true revolving of the disc. As to the assembling of these parts see, plate VII Fig. VII, notice the square axle.

The discs are of uniform thickness, tempered (case hardened) face, and well sharpened. Every disc is polished on the concave surface, which materially aids it in scouring in difficult soils. The bearings are generally protected from dirt in some way and have chilled wearing surfaces; sometimes they are no more than hard wood bearings. Each disc is provided with a scraper to clean it and free it of soil which may cling to it, especially in
4-Horse. 150 Dagger Teeth. Cuts 26 Feet.
With Pulley Equalizer.
Combination Equalizer
Furnished if Required.

3-HORSE.
102 Dagger Teeth.
Cuts 18 Feet.

2-HORSE.
78 Dagger Teeth.
Cuts 14 Feet.

Bars are Riveted both sides of Teeth.

FIG.I.

FIG.II.

FIG.III.
wet ground.

There must be great flexibility to the sections in reference to each other so as to allow one section to easily ride over any ordinary obstruction. The frame of the disc harrow is of steel and so made that a seeder may be attached.

To get the best service out of a disc harrow, it should be kept sharpened. At present there is no successful disc sharpener on the market and the farmer runs a disc dull till he can spare the time to have it taken apart and sharpened by a blacksmith.
CORN PLANTER OR CHECK-ROWER.

Of the many inventions which have rendered the present age so remarkable, there is none that more deserves to achieve a lasting distinction than the corn planter, which has, in so marked a degree lightened the labor of the farmer, and reduced the cost of production.

The primary requisites in a planter are: (1) uniformity in number of grains dropped in good condition per hill, and (2) if it be a "hill drop", the regularity and evenness of rows in opposite directions. Convenience in operating, durability of working parts, non-liability to get out of order, lightness of draft, and ease in handling for operator and team, are other important items to be considered.

Planting of corn is done one of three ways, viz: as a straight "hill drop", as a straight "drill drop", or the corn may be drilled into the heel of the runner and "checked out", as done by so many of the popular planters of the day. Generally, all three of these ways can be accomplished in one planter by minor changes.

The first or "hill drop" can be readily seen or explained by referring to Fig I, plate VII. Holes in the plate hold the required number of grains of corn for a hill; these are dropped at one time and forced out by a plunger. The plunger is down in the figure and corn is forced by the valve. Fig. II. plate shows the plunger up so corn can pass below it and be ready for the next drop. Observe that the valve is held by a spring.
There are many other ways of accomplishing this same result.

The second way by "drill drop" is as shown in Fig , plate , in which the valve is fastened back with a cotter so that grains of corn fall to the ground singly from the drill plates. In this case no wire is needed.

A planter is an odd shaped contrivance. It might be said to look like a sled with wheels, which is more or less true. see Fig IV, page 52. A planter consists of a frame upon which is fastened two runners by means of which corn is driven into the ground. Directly behind these runners are two wheels which furnish the power by which the corn is dropped into the heel of the runner. The dropping is accomplished by means of round plates revolving and containing holes which allow the required number of grains of corn to enter and drop. The corn is held in a corn box directly above revolving plate.

The wheels are made principally of three different kinds; generally there are two wheels running together as in Fig III, page 52. These serve the purpose as shown in the same figure or there is a single wheel as in Figs I to II, page 52.

What is meant by a check-rower? To get the hills to come in check that is in a line no matter on what side of the field you stand or in other words so the corn may be cultivated in cross-wise, a wire is strung across the field to make the rows thus come in check with the others and obtain this result. This wire contains knots as in Fig V, page 52, which are made equal distances apart and therefore checks the hills.
It is this knot that catches in the checker arm of the planter and actuates in the runner the plunger, which drives the corn out. The check-rower wire is made with knots two certain distances apart but by certain devices on the planter corn can be planted 3 feet, 3 feet 2 inches, or 3 feet 4 inches apart as desired. Each firm has its own way of accomplishing this end.

Planters are made generally so that they are capable of planting rows different distances apart as 3 feet, 3 feet 2 inches, 3 feet 4 inches and 3 feet.
CULTIVATORS.

Cultivators are of two classes, namely: Tongueless and tongue cultivators. Each may be either riding or walking. Cultivators are made generally for cultivating one row at a time but of late there has come into the market two-row cultivators. They are now practically a success and will greatly decrease the time in going over a field. The questions regarding a two row cultivator are generally: "Can the work be done well?" and "Can the tool be handled easily?" These seem to be answered in the affirmative by experience. In using a two-row cultivator it is best to cultivate the two rows together in the same pairs in which they were planted.

There are many designs on the market of cultivators and yet there is a noted similarity. All cultivators use an arched axle where wheels are used. This is to allow cultivation of the plant after it has grown to some height.

The cultivation is accomplished generally by little plow like shovels, highly polished and tempered and sharpened or these may be replaced by discs. Disc cultivators are becoming quite common and are proving in favor.

Shovel rigs, as they are called, are the beams which hold the shovels and are of many styles. They hold from two to five shovels. The beams of these shovel rigs are made of both wood and steel.

In the design of a cultivator one noticeable feature is brought out. This feature is that cultivators can not be made with rigid shovels. If they were made rigid and a shovel struck
a snag, rock, tree or stump, something would have to give or more likely break. To overcome this difficulty many designs have been patented. The best and most successful is that called the spring trip, see page 65, Figs IV-V. The purpose of the spring trip, is to dispense with the vexation experienced in using the old-fashioned wooden break pin, where frequent breaking of the pin, occurs; and to make possible the cultivation of ground somewhat encumbered with roots and stumps without the serious loss of time incurred in restoring shovels and sleeves after encountering obstacles.

A good spring trip must be so simple that its adjustments are easily understood and made. It must be so well made so that frequent action of the working parts will not seriously wear or disarrange them. Two styles of these trips can be seen by referring to page 65, Figs I*II.

Another feature of the cultivator is the well-known balance frame feature. By this arrangement the shovel rigs are perfect balanced in any position which they are placed with respect to the pressure on the horse collar. Many springs are used to accomplish this result.

The spring tooth cultivator is a well known form of cultivator, in which a large piece of bent spring steel holds the shovel and allows the shovel to spring over an obstacle.

Still another form of cultivator is that known as the "Gopher" or "Surface" cultivator. This cultivator is used principally in Illinois, Indiana and Iowa. These contain, in-
stead of the shovels, long blades which run at an angle and just skin the top of the ground. In all cultivators the rigs must be so pivoted that they may be readily swung from side to side either by the hands in walking cultivators or by the hands or feet in riding cultivators so as to easily and quickly dodge a plant which may be out of line.

Fig. I.

Fig. II.

Gopher Blades.
MERIDIAN CURVES
FROM
10 IN. STUBBLE FLOW