

# Tractor Plow

# Operation

Plowing is an art, and good plowing is the pride of every farmer. A good job of plowing is apparent even to the casual observer.

A well-adjusted plow will do better work, have lighter draft, give less wear on plow parts, and will make the tractor easier to operate than a poorly set plow. Most plows are received from the factory "knocked down," and must be set up and adjusted before being used. Variations in plowing conditions may make frequent plow adjustments necessary. Most modern tractor plows have all adjustments necessary to set the plow properly. When properly set, a plow should do a good job under usual plowing conditions. If a poor plowing job is done with a tractor plow, it is usually traceable to improper adjustment or extremely unfavorable plowing conditions. In most cases, failure to do first-class plowing results from careless adjustments or lack of knowledge as to how to set the plow.

Because of the many different kinds of mounted plows, this bulletin deals principally with the "pulled" type mold-board tractor plow.

## PLOWS MUST BE KEPT IN GOOD REPAIR

To do a good job it is essential that the plow be maintained properly. Plowshares, jointers and coulters should be kept sharp, and a land polish maintained. Broken or sprung malleableized iron and steel castings should be replaced.

Some of the most common causes of plowing difficulties are dull, worn or improperly sharpened plowshares. Reduced draft, ease of penetration and smooth, even-cut furrows depend upon proper share set. The new share has both "down" or "bottom" suction and "side" or "land" suction. Down suction is produced by pointing the plowshare down slightly. It enables the share to penetrate the soil. Side suction is pro-

duced by pointing the share slightly sideways. It holds the plow to an even, full-width furrow. See fig. 1.

When the plowshare is sharpened, it is important that the original set of the point be maintained or restored. The amount of down suction varies from one-fourth to one-half inch. Side suction ranges up to one-fourth inch. Total suction depends upon plow design and soil conditions.

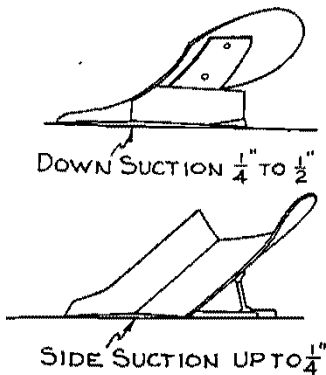


Fig. 1. When plowshares are sharpened, it is necessary that the original set of the point be restored.

The shortage of capable plowsmiths has prompted the plow manufacturers to introduce the trade-in or exchange system. This provides farmers with re-sharpened shares which are capable of doing the same kind of work as new plowshares.

## MATERIALS

Soil conditions in Iowa are such that the hardened soft center plow bottoms are used almost exclusively. Soft center steel bottoms with hardened surfaces will take the high polish necessary for good scouring in sticky or heavy soil. This material has strength sufficient to withstand shocks when striking buried obstructions such as stones, boulders or old stumps.

Bottoms of solid steel cannot be hardened on the surface to the same degree as soft center steels, and are used in soils where scouring is not difficult. They wear more rapidly, and should not be used in sandy or gravelly soils. Solid steel bottoms are somewhat lower in cost than soft center steel bottoms.

Chilled cast iron bottoms are used in very sandy or gravelly soils. They withstand abrasion better than hardened soft centered steel bottoms in soils where scouring is no problem. They have the lowest first cost of any of the common plow bottoms.

## HARD-SURFACING MATERIALS

There have been a number of innovations intended to increase the life of plowshares. One method involves welding a new point and edge of either high carbon, tool or alloy steel onto the share. Another method is the application of a coating or layer of an alloy especially resistant to abrasion along the cutting edge. Any steel can be hard surfaced, but with plowshares solid steel is best for hard surfacing. Soft center steel shares can be hard surfaced by proper heat treatment. Cast iron shares are not suitable for the application of surface hardening materials.

## PLOW BOTTOM ALIGNMENT

Proper alignment of the plow bottoms is necessary to secure good plow adjustment. If the plow bottoms are not in good alignment, uneven ridges, poor trash coverage, increased draft and rapid wear of plowshares will result. Misalignment may be caused by a sprung beam, a sprung or broken frog, or both. Ridging caused by poor alignment of plow bottoms is usually more apparent with plows having three or more bottoms than single or two-bottom plows.

Before adjusting a plow or purchasing a used one, check for sprung beams or frogs. New or factory reconditioned plow points should be installed and all plow bolts tightened before any check is made. To determine if a plow is sprung:

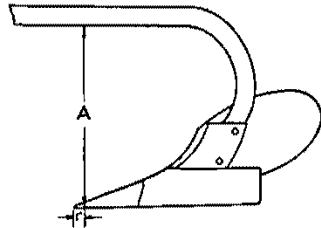


Fig. 2. To check for sprung beams or frogs, measure distance A on all bottoms. There should not be over  $\frac{1}{4}$  inch variation in this measurement with new shares.

Measure from a point 1 inch back from tip of plowshare to underside of the plow beam directly above (fig. 2) on each bottom. There should not be over  $\frac{1}{4}$  inch difference in these measurements.

Plows having two or more bottoms can be checked for alignment by measuring the distance between

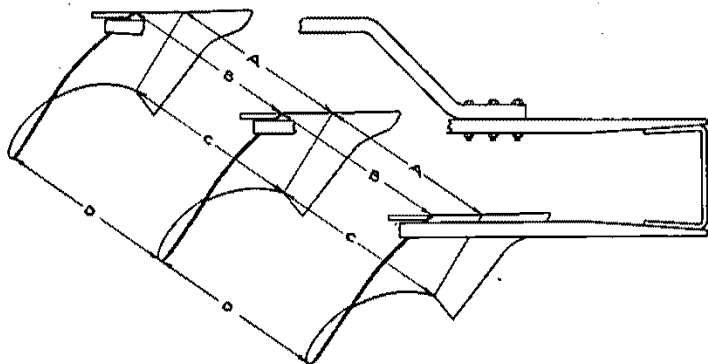


Fig. 3. Alignment of bottoms can be checked by measuring distance between corresponding points on any two bottoms. If alignment is correct, distances A, B, C and D will be equal.

corresponding points on any two bottoms (fig. 3).

All measurements should not vary more than  $\frac{1}{2}$  inch between any two adjacent bottoms.

Poorly fitting plowshares or trouble with broken moldboards indicates a bent frog. If observed from the side, the plowshare pitches down too much as compared with a share mounted on a frog of proper shape. If the frog is not sprung and the measurements differ too much, the beam is sprung. Sprung beams should be removed from the plow and returned to the factory for straightening.

### PLOW HITCHING

Proper hitching is the least understood adjustment in plow operation, but once the principles are understood, it is not difficult. Hitching involves adjusting the plow tongue and drawbar horizontally and vertically to make the plow follow the tractor.

Correct horizontal or sidewise hitch adjustments will:

1. Make the plow run straight ahead regardless of its position behind the tractor.
2. Prevent the front bottom from cutting and covering.

3. Make the front bottom take a full cut.
4. Prevent ridging in plowed lands.
5. Reduce or equalize side draft between tractor and plow.
6. Reduce plow draft.

Correct vertical or up and down hitch adjustments will:

1. Prevent plow riding on points of shares.
2. Prevent plow riding on heel of landside.
3. Reduce wear on plowshares and wheel bearings.
4. Make even furrow bottoms by eliminating stuttering or bobbing.
5. Make the bottoms scour well.
6. Reduce plow draft.

#### HITCHING PRINCIPLES

All plows will do their best work if pulled straight ahead from their **CENTER OF RESISTANCE**. When the plow is in this position, the **CENTER OF PULL** on the tractor is directly ahead of the center of resistance (fig. 4). When the center of pull is not directly ahead of the center of resistance the hitch points on the tractor and plow drawbars should be placed on a line connecting the **CENTER OF PULL** on the

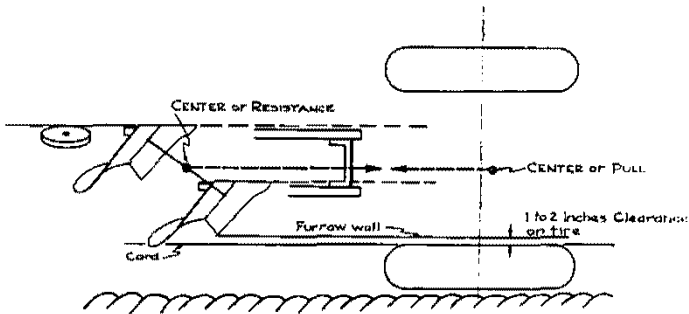


Fig. 4. When a plow is lined up correctly behind the tractor, the edge of the outside share will be 1 to 2 inches inside a cord or string extended back from the inside edge of the tire on the furrow wheel of the tractor.

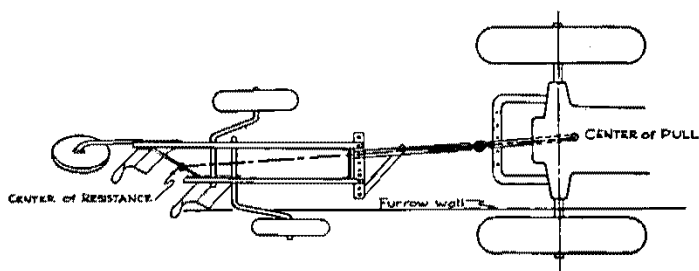


Fig. 5. When the center of pull is not directly ahead of the center of resistance, the plow tongue should be adjusted horizontally so the hitch points on tractor and plow drawbars are on a line connecting the center of resistance and the center of pull.

tractor with the center of resistance on the plow (figs. 5 and 6).

The CENTER OF PULL on any tractor is:

1. Midway between the rear wheels.
2. Two to four inches ahead of the rear axle.
3. About 15 to 36 inches above ground. On tractors having swinging drawbars, the center of pull is at pivoted or front end of the drawbar.

The LINE OF PULL when rear wheels are evenly spaced (fig. 7) extends directly back from the center of pull through the center hole in the tractor drawbar, and is parallel to the furrow.

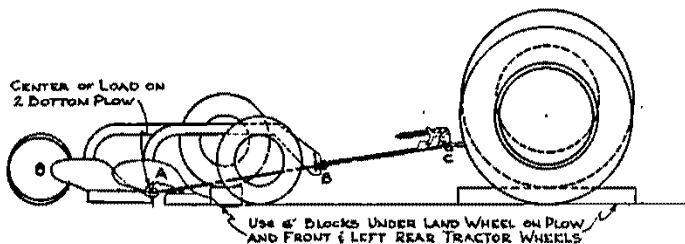


Fig. 6. When the plow and tractor are in plowing position, then the plow tongue is adjusted vertically so that the hitch points are on a line between the hitch point of the tractor drawbar and the center of resistance.

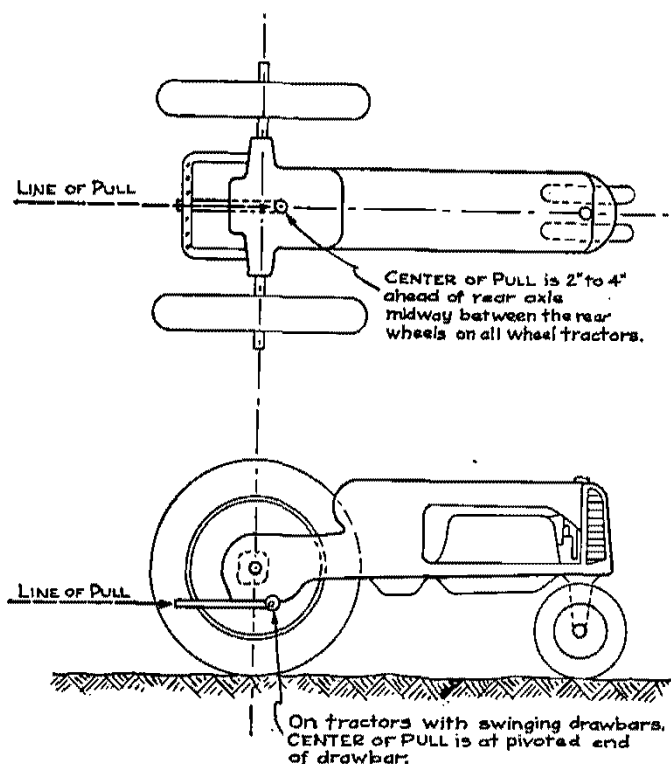


Fig. 7. Location of center of pull and line of pull on a typical cultivating type tractor.

For purposes of plow adjustment the **CENTER OF RESISTANCE** of a one-bottom plow is located one-fourth of the width of the plowshare to the right of the shin or landside and about on the line where the share joins the moldboard. For plows having two or more bottoms, the center of resistance is midway on a line connecting center points of resistance for all bottoms (fig. 8)..

The **LINE OF DRAFT** extends forward from center of resistance of the plow and is parallel to the direction of travel.

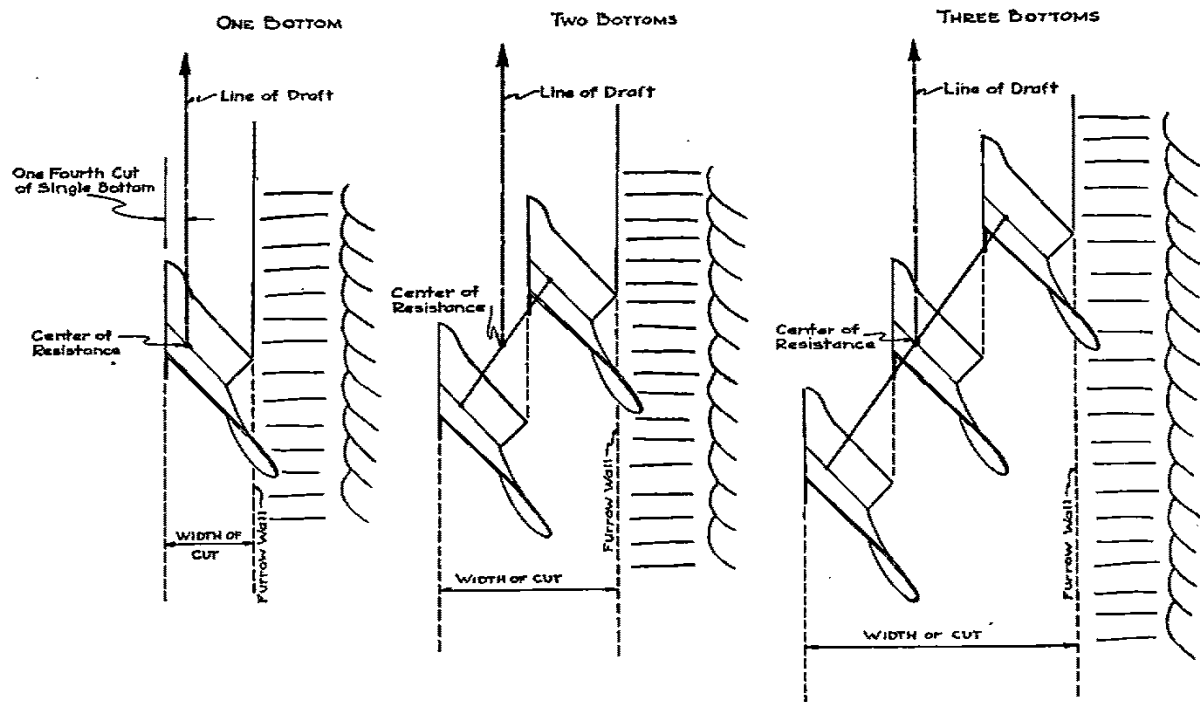


Fig. 8. Diagram showing approximate location of center of resistance on one-, two- and three-bottom plows.



DIRECTIONS FOR HITCHING

Here is the most satisfactory method of setting a plow:

**Step 1. Set the rear wheels of the tractor (if cultivating type).**

- a. For one-bottom or two-bottom plows, set rear wheels to narrowest tread to reduce side draft on tractor and plow. With three or more bottoms this is not necessary.
- b. When the tractor is in a plowing position, the weight on the land wheel is reduced and slippage may result. To improve traction, it is advisable to use extra wheel weights, fluid or a chain on the rear land wheel. Do not set the land wheel out.
- c. When operating on steep slopes, it is advisable to operate the tractor with rear wheels set rather wide apart to reduce danger from overturning.

**Step 2. Place the tractor in plowing position.**

- a. Place tractor on concrete floor or a hard, level piece of ground. Inflate all tires to recommended pressure.
- b. Block up front and rear land tractor wheels which run on the land a distance equal to the depth of plowing. Six inches is the most common depth of plowing in Iowa. (See fig. 9.)
- c. The tractor drawbar is now in the same position with respect to the bottom of the furrow as when plowing. The plane of the furrow bottom is the ground level.

**Step 3. Place plow in plowing position behind tractor.**

- a. Without connecting the hitch, place the plow behind the tractor so that the outside edge of the front bottom will cut a full width furrow. When the plow is in this position, the edge of the share will be from 1 to 2 inches inside a cord or string extended back from the inside edge of tire on the furrow wheel of the tractor (fig. 4.)
- b. Drop plow and block up land wheel equal to depth of plowing. Use same height of blocks as used under tractor wheels.

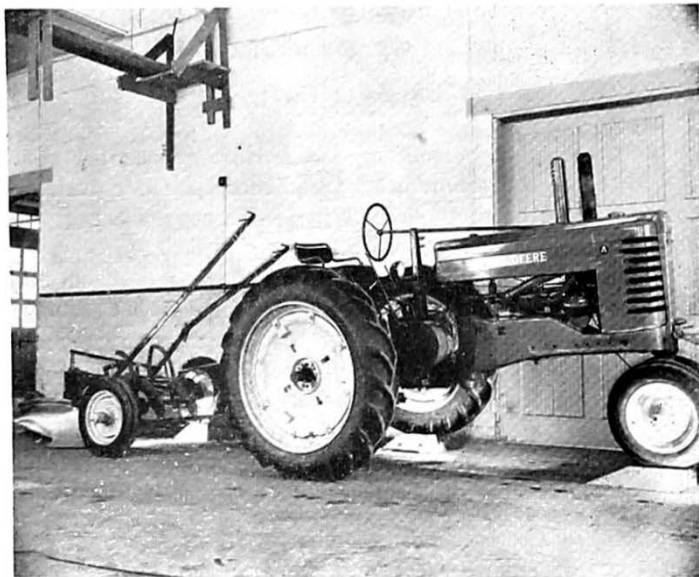


Fig. 9. Illustration showing the tractor and plow blocked up in plowing position as described in Steps 2 and 3. The blocks are 6 inches high.

- c. Level plow beams with depth and leveling levers so that weight of plow is resting on points.

**Step 4. Locate center of resistance on plow (fig. 8).**

- a. The center of resistance on a one-bottom plow is one-fourth the width of cut of plowshare to the right of shin or landside and about on the line where the share and moldboard join.
- b. For plows having two or more bottoms, the center of resistance is midway on a line connecting center points of resistance for all bottoms.
- c. On two- or four-bottom plows, a stake can be driven in soil at position of center of resistance. On single- or three-bottom plows, the position of center of resistance can be marked with a wax pencil on the plow bottom.

**Step 5. Locate center of pull on tractor (fig. 7).**

- a. For purposes of plow adjustment, it can be as-

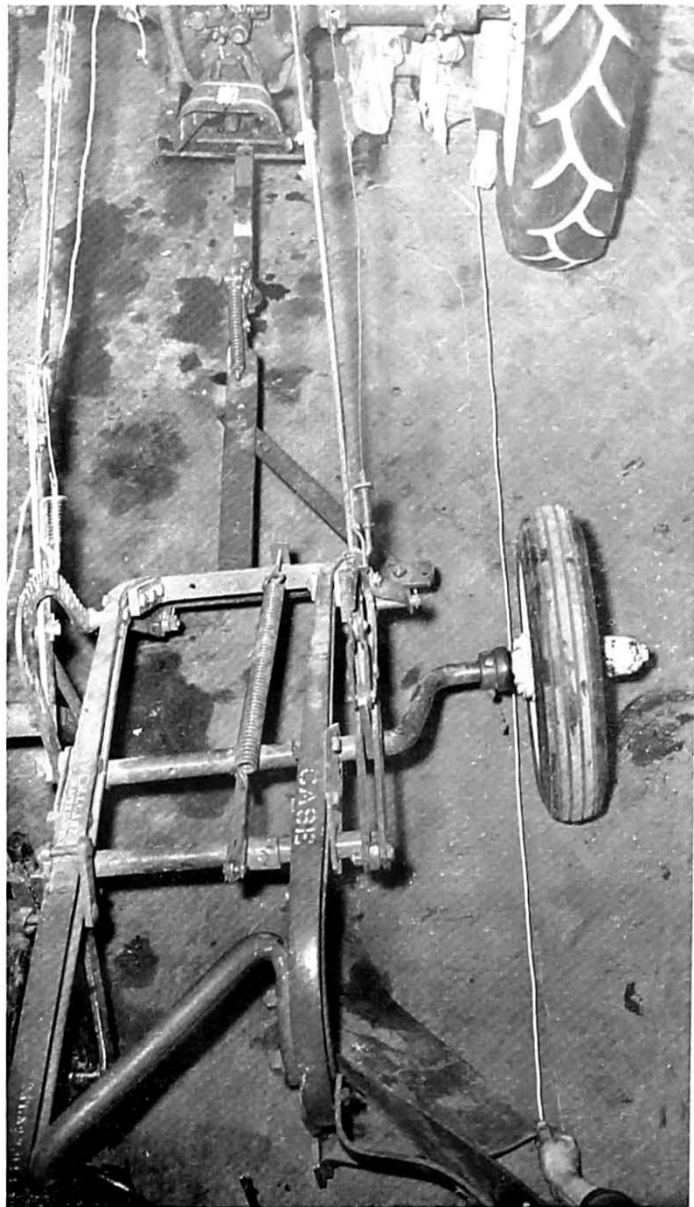


Fig. 10. Lining the plow up behind the tractor as described in Step 3, Part a. The 1- to 2-inch offset provides clearance so the tractor tire will not ride the furrow wall.

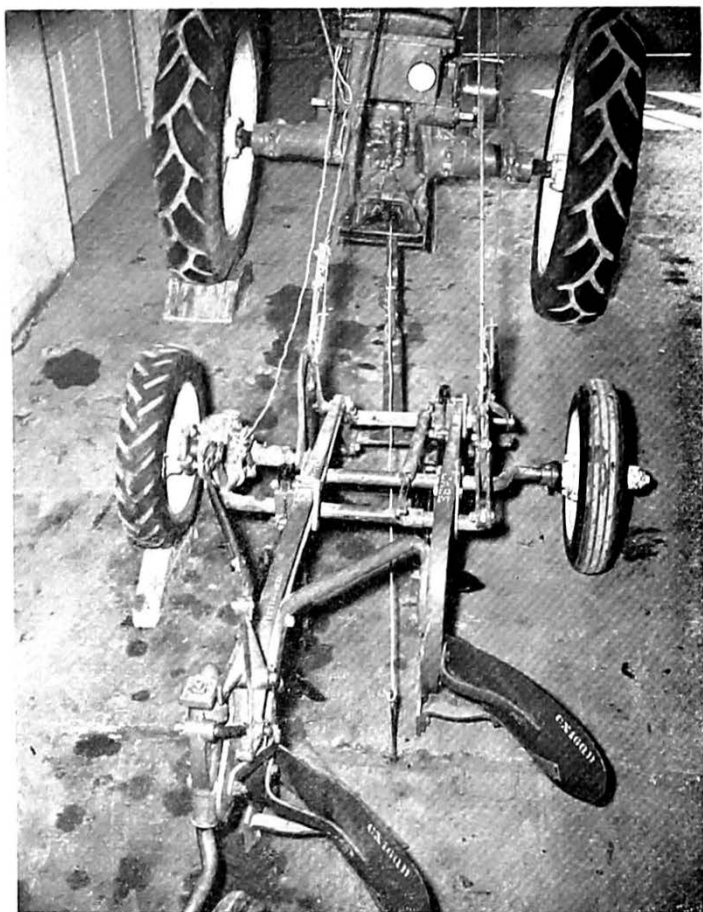


Fig. 11. Cord stretched from center of pull to center of resistance to place swinging drawbar and plow tongue in position to equalize side draft as explained in Step 6.

sumed that the center of pull is at the pivoted end of the swinging drawbar, no matter where the plow is hitched to it.

- b. On tractors without swinging drawbars, such as the Farmall F-20, it can be assumed the center of pull is at a position on the bottom of the differential case and 2 to 4 inches ahead of the axle shaft.

**Step 6. Determine position of hitch on tractor to equalize side draft.**

- a. Stretch a cord from center of pull on tractor to center of resistance on the plow.
- b. If tractor has a swinging drawbar, lock drawbar in a position parallel with cord (figs. 5 and 11).
- c. For tractors without swinging drawbars or where swinging drawbar is not used, hitch the clevis for the plow in hole on tractor drawbar directly under the twine, or in hole nearest to left.

**Step 7. Adjust the plow hitch horizontally.**

- a. Stretching cord in position of Step 6, adjust plow tongue to be parallel and under or in line with the twine which represents line of pull. *Do not be concerned if plow tongue is not parallel to direction of travel. See figs. 5 and 11.*
- b. Set angle brace bar to hold tongue in adjusted position.

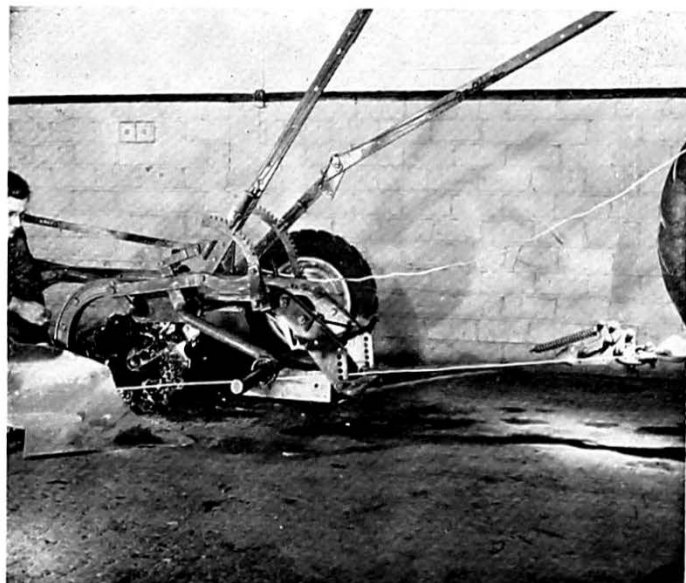


Fig. 12. Adjusting the plow hitch vertically by means of cord stretched between point of hitch on drawbar and center of resistance on plow as described in Step 8.

**Step 8. Adjust the plow hitch vertically.**

- a. The hinge bolt should be in line with twine string stretched between point of hitch on the tractor drawbar and center of resistance on the plow (figs. 6 and 12). If hinge bolt holes are not in line with the string, set in the next lower hole.

**Step 9. Set safety trip.**

- a. Set when plowing to meet field conditions.

**Step 10. Adjust the furrow wheel or rolling landside wheel.**

- a. The furrow wheel should be adjusted to carry weight on rear end of the plow. With plow still in plowing position, adjust rear wheel downward against furrow bottom or floor until rear end of landside or heel is  $\frac{3}{8}$  to  $\frac{1}{2}$  inch off the furrow bottom. There should be enough clearance so that the tips of the fingers can be placed between the heel and furrow bottom (fig. 13). Recheck this clearance when plow is in the ground and working.

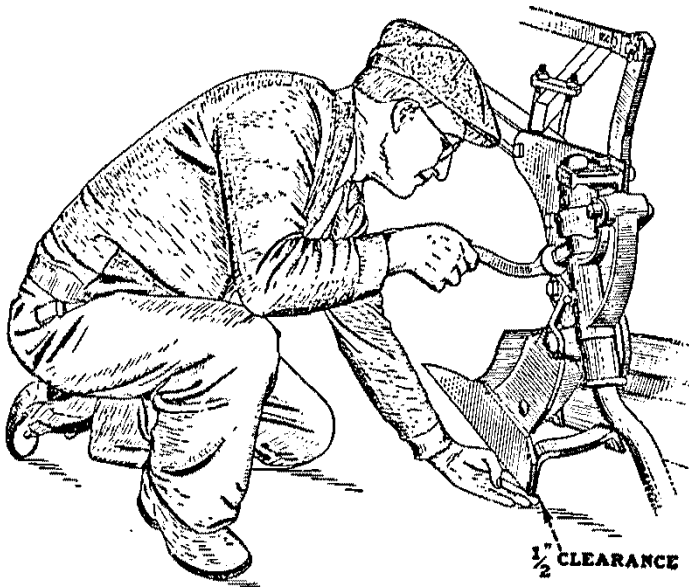


Fig. 13. Adjusting the furrow wheel or rolling landside wheel to provide heel clearance as described in Step 10, Part a.

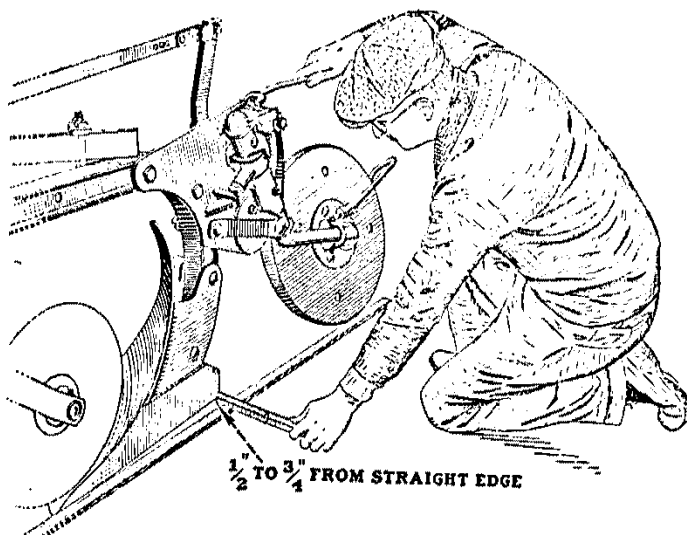


Fig. 14. Adjusting the furrow or rolling landside wheel to eliminate landside pressure.

- b. Set side adjustment on furrow wheel to eliminate landside pressure. With plow in plowing position, adjust rear wheel toward furrow wall until rear end of landside is  $\frac{1}{2}$  to  $\frac{3}{4}$  inch from furrow wall. This adjustment can be made using a straight edge (fig. 14). When the furrow wheel adjustment is properly made the wheel will usually have a slight lead toward the plowed ground. There should be enough clearance so that the forefingers can be placed between the landside and furrow wall when plow is in the ground. Not all three wheel plows have this adjustment.
- c. **IMPORTANT:** If a rubber tire is used on furrow wheel, it must be inflated properly or else tire will deflect and landside and heel of plow will wear. Proper inflation pressures are 40 to 60 pounds, depending upon the size and type of tire.

#### Step 11. Adjust rolling coulters.

- a. The hub of the coulter should be set about over the point of the plow (fig. 15). In hard soil raising

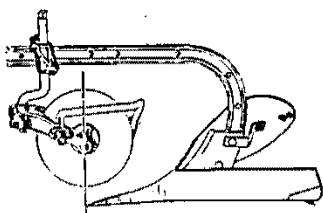


Fig. 15. Set the hub of the coulters over the point of the plowshare.

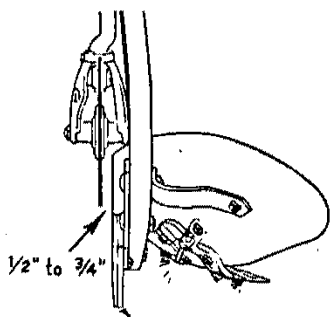


Fig. 16. Properly adjusted coulters are set to cut  $\frac{1}{2}$  to  $\frac{3}{4}$  inch outside the landside.

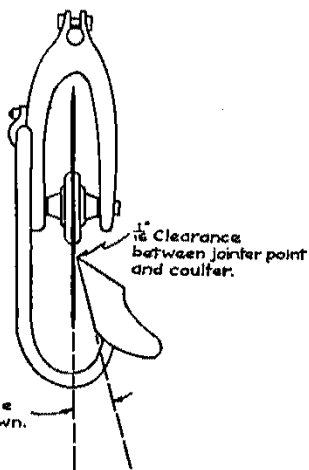
Fig. 17. The space between the coulter and jointer should form a V-shaped area of clearance to prevent clogging. Keep jointers sharpened to a point for best results.

the coulter and setting it to the rear with the hub 3 inches to 4 inches behind the point will let the plow penetrate better.

- b. Coulters should be set  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch to the left of the landside (fig. 16).
- c. Coulters should be set to cut 2 inches shallower than the plow, but never deeper than 4 inches.
- d. Check coulter hub bearing for wear, and set adjustment to prevent play.

#### Step 12. Adjust jointers.

- a. The jointer should be set to cut from 1 to 2 inches deep. The point should be set as near to the coulter as possible. The





space between the coulter and the jointer should form a V-shaped area of clearance (fig. 17) to prevent trash clogging.

- b. An easily remembered expression for setting coulters and jointers in relation to average plow depth becomes 2-4-6; the jointer is set 2 inches deep and coulter 4 inches deep when plowing 6 inches deep.

**Step 13. Adjust control levers.**

- a. Set control lever length adjustments to convenient position for the operator.

**Step 14. Check lifting springs.**

- a. The lifting springs should be set as tightly as possible, without preventing the plow from dropping quickly and penetrating the soil readily when the plow is tripped.

## TRASH-COVERING ATTACHMENTS

In farm practice one of the more important duties of the plow is to cover cornstalks, small grain stubble, and other plant debris left on the surface of the field after the crop has been harvested. While coverage of trash is not a prime requirement for good crop yields, it speeds decomposition of the waste plant materials, makes future cultivation less difficult, and is an aid in corn borer control.

### COULTERS

The coulter is the most common attachment of the mold-board plow. Large sharp rolling coulters, 16 inches to 18 inches in diameter, cut trash best (fig. 18). With large coul-

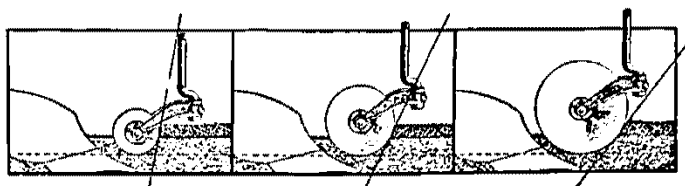


Fig. 18. Large, sharp coulters are the most efficient trash cutters.

ters the angle at which the coultter blade approaches the trash is smaller, and the edge of the blade compresses the loose surface material slightly before the cutting action is

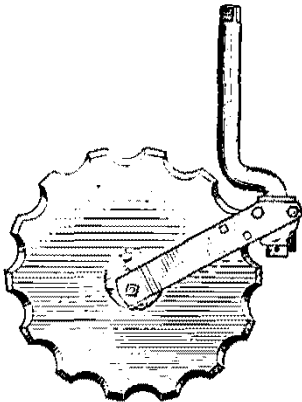


Fig. 19. The notched coultter is effective under very trashy conditions.

completed. Large or unworn coultters provide increased clearance for the coultter yoke and hub. This reduces the tendency to push trash ahead of the coultter blade and cause clogging. Badly worn or small coultters that must be set with the yoke and hub close to the surface of the soil do not shear the trash effectively, and clog frequently when plowing in stalk fields. The notched coultter (fig. 19) is very effective under trashy conditions. The edge of the notch has a more

nearly horizontal approach to the soil surface and readily cuts the trash.

Most plow instruction manuals show the coultter hub set over the point of the plowshare. Coultter blades should be set from  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch to the land side of the plow shin. They should be set to run about two-thirds the depth of cut of share, but never deeper than 4 inches. On mounted or semi-mounted plows, coultters set too deep will prevent proper penetration, since the coultters act as wheels to hold the plow out of the ground. In soil that does not scour well, pressure on the moldboard can be increased by setting the coultter to cut as much as 1 inch to the land side of the shin. In general practice, it is best to set the coultter from  $\frac{1}{2}$  inch to  $\frac{5}{8}$  inch to the landside, and just deep enough to cut the trash and make a good furrow wall.

Most coultters are equipped with adjustable bearings to take up wear which may occur in the hub. Rolling coultters can be made self-sharpening by reversing the coultter blade every other day. Keeping the coultter blade sharp and properly adjusted with respect to the plow will improve coultter

efficiency. Keep bearings well lubricated, and tight enough to prevent play.

#### JOINTERS — CONVENTIONAL TYPES

Jointers, if kept sharp and properly adjusted, are a big aid to clean plowing. There are two types: the fixed or independent (fig. 20) which is clamped to the plow beam and the combination (fig. 21) which is attached to and swings with the coulters yoke. The fixed type of jointer, which is independent of the rolling coulters, can be adjusted to meet a wider range of field conditions and is gaining in favor with farmers. However, before purchasing fixed jointers for a plow now equipped with the combination type, make sure that there is clearance at the proper position on the plow beams to permit mounting the fixed type.

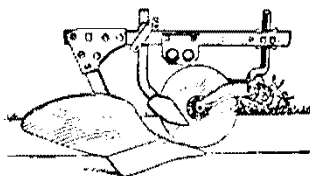


Fig. 20. Fixed or independent types of jointers are less subject to clogging.

By far the greatest problem with jointers is caused by clogging with trash. Jointers are rather critical to field conditions, and may have to be reset every day to obtain good coverage. They wear rapidly and need to be sharpened often to secure good results. It is suggested that two sets of moldboard jointers be kept on hand to permit changing and sharpening each time the plowshares are removed for sharpening. When sharpening jointers, the original point should be built up.

Moldboard jointers should be set to cut about 2 inches deep and about in the position shown in fig. 20. The point should be set close to the coulters (fig. 17). The space between the jointer and the coulters should form a V-shaped opening or clearance to pre-

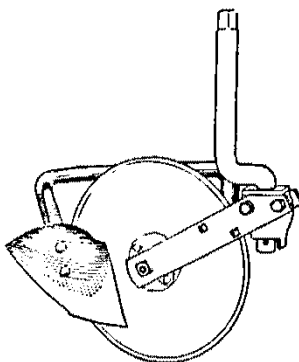


Fig. 21. Combination coulters and jointer.

vent trash clogging. **Setting the angle of clearance (fig. 17) is the real secret of jointer adjustment.** Careful inspection of the jointer shank will invariably reveal an adjustment for setting the jointer point close to the coulter blade. This provides for the clearance necessary to prevent clogging.

#### LEFT-HAND DISK JOINTERS

If difficulty is experienced in making moldboard jointers work, left-hand disk jointers (fig. 22) can be used. Left-hand disk jointers replace both rolling coulters and moldboard jointers. Trash and soil are jointed to the left or onto the unplowed land. For this reason left-hand jointers may work better on plows that have limited clearance. Careful adjustment is necessary if they are to do good work. When properly set they will reduce the draft of the plow by relieving most of the landside pressure, causing the front bottom to cut less than a full furrow slice. If this happens, it will be necessary to reset the hitch.

The left-hand disk jointer is not available commercially. It can be made by altering a disk hiller. Plans and directions for adjusting are available through the Iowa State

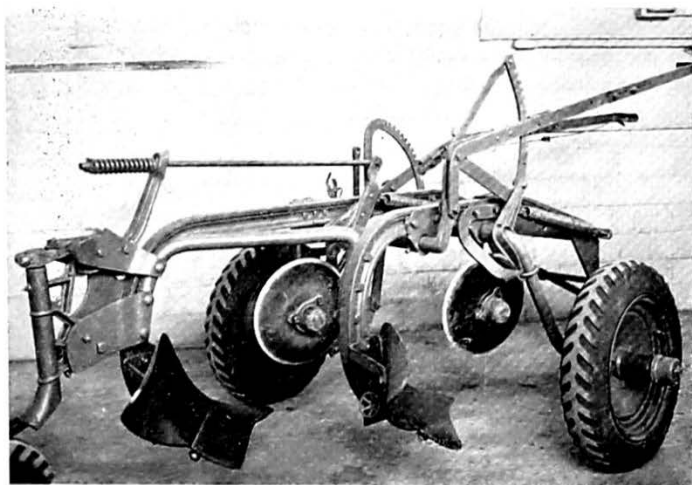


Fig. 22. Left-hand disk jointers can be made from disk hillers.

College by asking for Engineering Plan Sheet No. 2, "Left-Hand Disk Jointers for Plows."

#### TRASH WIRES

Trash-covering wires are an effective aid when plowing under plant debris. Wires can be easily attached, and their adjustment is relatively simple. The long trash wires extend back under the turned furrow slice, holding loose plant debris and trash against the top of the furrow till turned under. One to three wires per bottom can be used.

These wires should be No. 8 or No. 9 gauge, and at least 10 feet in length. The first wire is attached to the coulter shank, threaded down through the coulter yoke (fig. 23) and back beneath the coulter bearing bolt. By placing it under the coulter bearing bolt the first wire is held nearer the soil surface, producing a more effective covering action. Other wires can be attached to the beam, axle or drawbar of the plow considerably ahead of the coulter.

#### MOLDBOARD EXTENSIONS

Moldboard extensions improve trash coverage in heavy

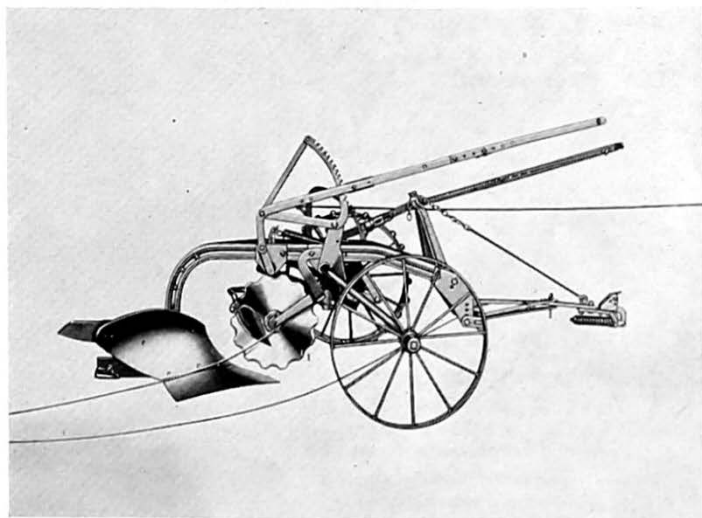


Fig. 23. Trash wires help cover cornstalks, but must be at least 10 feet long and properly attached.

soil, where slow plowing speeds are necessary. They are not necessary in light soil where plowing can be done at normal speeds.

### SLAT MOLDBOARDS

Farmers who must plow in soil where difficulties with scouring are experienced should try slat moldboards. The slats provide less moldboard surface, which helps prevent the soil from sticking. This type of moldboard works well in the loose, "high lime" or alkali soils which do not hold together sufficiently for turning a clean furrow slice. They can be used to plow heavy gumbo, clay or black waxy soils that fail to slip on the surface of solid moldboard bottoms.

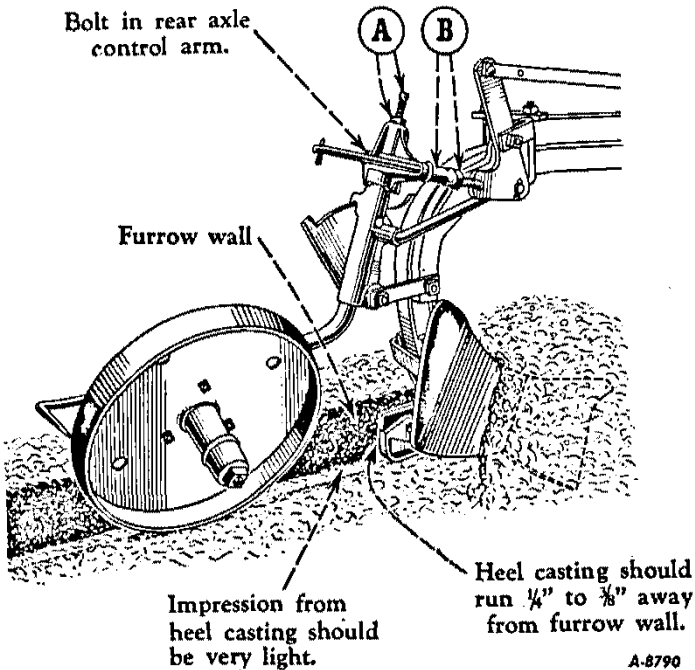


Fig. 24. Directions for adjusting tail wheels vary. On this popular plow, adjust heel clearance at A and landside clearance with nut B.

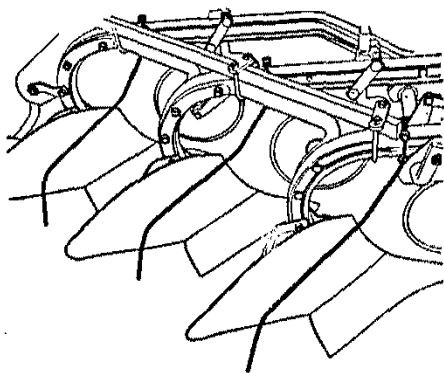


Fig. 25. Weed hooks aid in plowing under tall growing green materials.

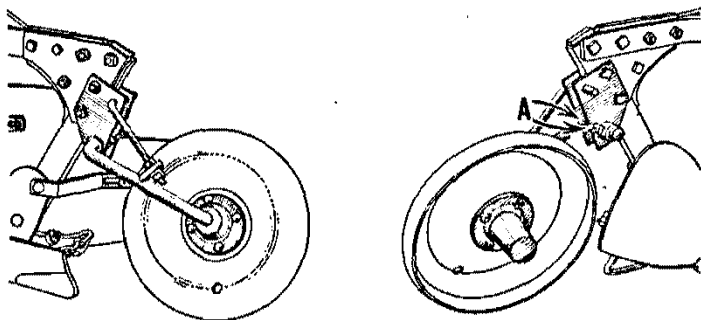


Fig. 26. Modern tractor plows equipped with rolling landside wheels have adjustments for setting both heel and landside clearance.

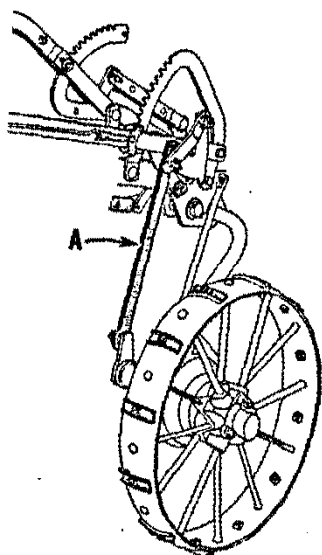


Fig. 27 (Left). Lift bar adjustments provide a wider range of depths of cut.

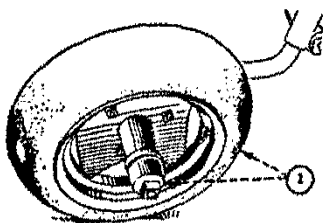


Fig. 28. (Above). Tires on furrow wheels or rolling land-side wheels should be kept properly inflated. Inflation pressures vary from 40 to 60 pounds per square inch, depending upon the size and type.

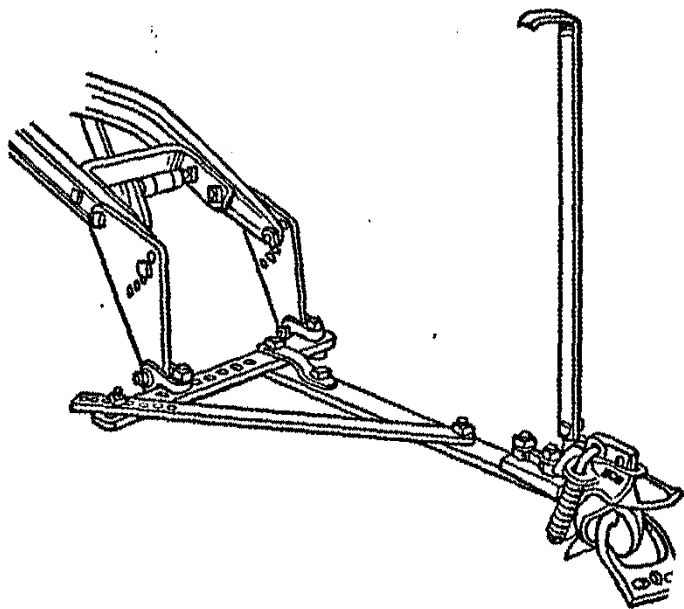


Fig. 29. Typical plow tongue and safety hitch.