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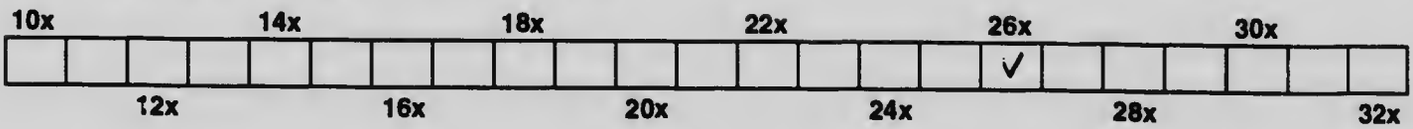

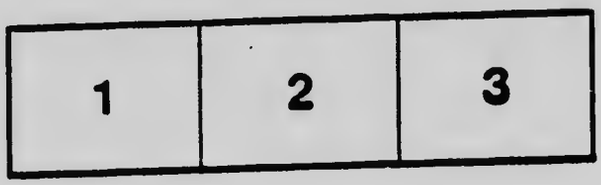

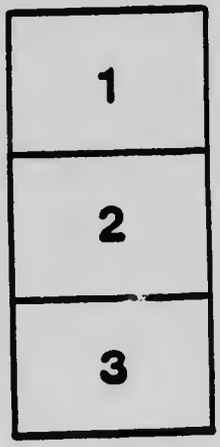

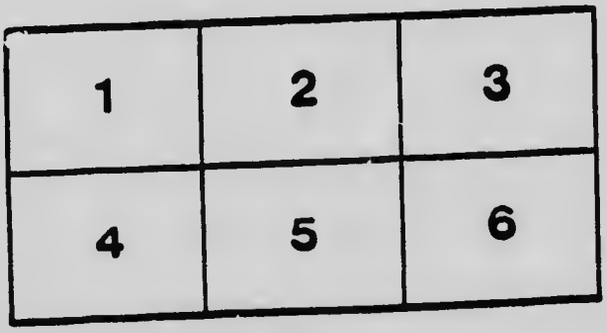

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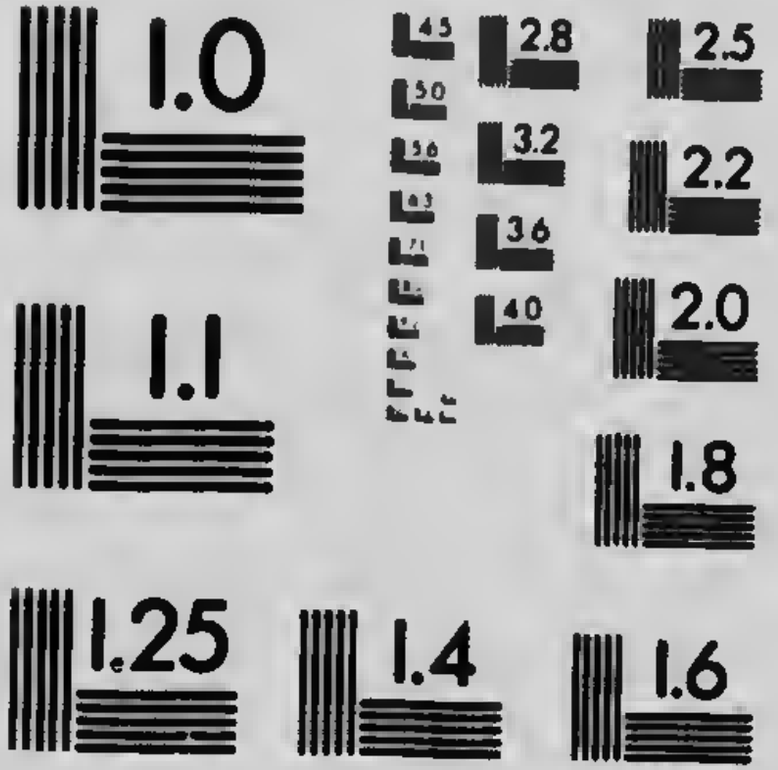

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PLOWS AND PLOWING

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Saskatoon

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By Prof. J. Macgregor Smith
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"Why plow; how to plow; when to plow; are three questions of vital interest to the tillers of the soil. During the past two hundred years plows and plowing have been discussed by a thousand brainy farmers, who knew the art from actual experience between the plow handles, and by 10,000 others, whose only experience was watching a sturdy farmer turn the soil while they rested under a shade tree."

The above quotation hits the nail on the head. Like the former, "having been there," the writer realizes that there are many difficulties connected with this, our most important tillage operation. Do you realize that a plow is harder to run right than a binder? Do you realize that plowing takes more power than any other tillage operation? Do you realize that many settlers in Western Canada are plowing under entirely different conditions from that they were used to "down East" or "in our country," as they so often say.

While the subject has been discussed until it is almost threadbare and shiny yet by getting together and discussing some points, connected with the operation of the implement rather than the work it does, in a systematic manner, we may be able to help each other.

Whether you agree with the foregoing remarks or not matters little, one thing you have to admit is that there is far too much very poor plowing being done in Western Canada. Now, since the amount of time required for a good man and a poor job in this case are practically the same let us decide to have none but the best. It is only good business.

The Pulverising Action of a Plow

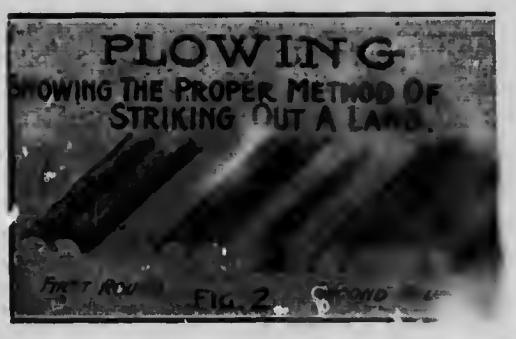
We break with a long sloping moldboard. Why? Because we simply want to turn the furrow upside down so that the sod will rot. We plow stubble land with a quick turn or steep moldboard. Why? Because we want to get the land into a good physical condition, in other words, we want to pulverize the soil. (See Fig. 1). Take a book and hold one corner between your finger and thumb, then by allowing the leaves to slide over one another you can readily see what happens to the furrow slice as it passes up over the moldboard of a stubble plow. There is a shearing action. Imagine a pin in the position 3-3 and notice how it has been sheared into many parts as it reaches the position 1-1. The steeper the moldboard, the more work is done, and, therefore, the more power is required. When the soil is very wet, as it often is in the Spring, or very dry as it often is in the Fall, we do not get this finely pulverized condition. There is an ideal condition and in summerfallowing we usually get good results as the soil is neither too wet or too dry. Perhaps you never realized that a plow had a pulverizing action on the soil at all. We want an even top so that the least possible surface will be exposed to the drying influence of the sun and wind. When the land is ridged it will dry out quicker, because more surface is exposed. Harrow

as you plow. It will mean dollars in your pocket. We do not want high crowns and deep dead furrows as we had in Ontario, or, perhaps, Scotland, because we have no surface water to get rid of.

The Strike Out

A fad, you say. Oh, no. You say you have no time. Then I say you are a poor business man. It only means one round more and you get all the weeds and we need to get them and get them young. As one

passes along a road in the middle of winter, on every side there are long rows, very often crooked as a dog's hind leg, of weeds, indicating that the man had simply driven into the field, and let the plow rip any old way. The result--half a day has to be spent finishing up ends. You know what I mean. (See Fig. 2). Suppose you wish to plow 5 inches deep, then after setting up your stakes you proceed to throw out two furrows about 3 inches deep. "Haw" around and throw out other two furrows. You then have what looks like a shallow finish. Now "Gee" round and throw back the furrows and keep on gathering up the land, gradually increasing the depth. By the time you have reached the



third round you should be down to the desired dep[illegible] the weeds are cut and you have a level crown. The illustrat[illegible] make the point clear.

Unmatched Furrows

Sometimes called "paired furrows," "uneven fu[illegible]w backs." In other words a shallow furrow and a deeper furrow in pa[illegible] By con-

sidering some of the causes of this very common fault we will now proceed to discuss some practical difficulties which experts have to deal with every day. We will take them in the following order:

1. Front plow cutting too wide.
2. Plows not cutting the same depth.
3. Colters not properly set.
4. Bail support moved.
5. Sprung beams.
6. Hitch not right—side draft.

Front Plow Cutting Too Wide

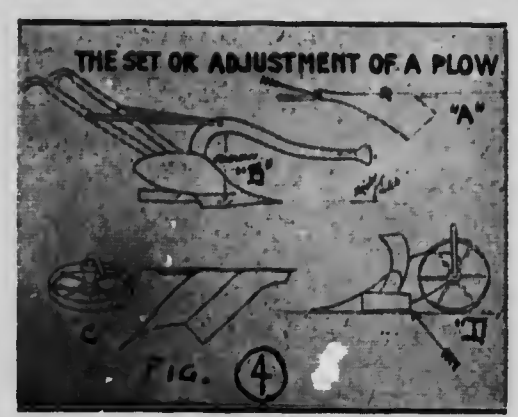
In this enlightened age would you believe that a man would be content to sit on a bag of hay for 10 hours a day and see his 14-inch two-furrow gang plow cut 38 inches? The writer saw it. The man

had not time to visit a "Better Farming Train," which was visiting his town and was actually at the time within a stone's throw. He knew it all. The weeds were four feet high, the moisture had been all evaporated and "cut and cover" would have been a better name for the operation than plowing. (See Fig. 3.)

Wear at the points XX will allow some play between the front vertical axle and the sleeve casting which supports it. The result is the front plow tends to take more "land." The trouble in the above extreme case was that the bolts holding this casting to the frame were both loose. A monkey wrench fixed the plow in two minutes. The plow was all right; was the man behind it? Lay a straight edge along the landslide and measure 14 inches over as shown, some advocate 13½ inches, this will depend on the set of the implement at work. The set of the colter and the hitch will be dealt with in their proper place.

Plows Not Cutting the Same Depth

The farmer should very carefully measure the "suction" of the plow when new. It has suction under the landslide and also on the side, to give penetration and "land." A straight edge and a rule are all that are required to get this information. Then scratch the measurements down on the shop door, or in a note book or in your head. The manufacturer gives his particular plow a definite "set" and this "set" must be maintained, if the best result... desir... You will know if the village blacksmith has given the share more or less if you have the figures; some think that an eighth of an inch more or less "suck" makes no difference; it does, and usually too much is given, and it may take 50 per cent. more power to pull the plow. The team have the heavy end to bear, if the plow was an old walking plow you would very soon find out something was wrong and have it fixed. Do not be too hasty in condemning the plow. You or the blacksmith may be to blame. The suction can be altered on some plows at the point marked "s" by raising the frame o... rear axles. (See Fig. 5). The two cuts on the right hand side sh... suction is adjusted in engine plows. However, this should be a l... ort. A walking plow is given "bearing" at the wing of the share, more in moist soil than in hard, dry soil. This is



required to hold the plow level and prevent it "wringing" over. A gang plow share does not require any because the bottom is held up by the bails (the U-shaped bars on which the beams swing). Turn the plow up and lay a straight edge from the heel of the landslide to the wing of the share. Figure 6 "A" shows "suction" on bottom of landslide. Figure 4 "A" shows suction to the land. Figure 6 "B" shows a share suitable for moist, soft soil. Figure 6 "C" shows a share in form for hard, dry soil or a gang plow. You can readily see that, if by mistake a shipper sends you one of each kind when you order a new set for your plow that one furrow will be deeper than the other and the source of trouble has puzzled even the best plowmen; perhaps you may have had this experience. In a gang plow the friction on the bottom of the landslide is eliminated as far as possible by carrying it on well-oiled bearings. There should be about one-half inch at the point marked "D," figure 4. The rear furrow wheel is also set outside the lean of the landslide as shown at "C" in the same figure. This holds the landslide

away from the furrow wall to some extent and a small adjustment at this point will give more pressure to the moldboard and the plow will often scour better. Figure 7 shows two set screws for making this adjustment, while some plows have two slotted holes, so that the wheel can be moved one way or the other. See that there are spring washers at every bolt, or else have a hot rivetted frame wherever it is possible. A loose frame will cause no end of trouble.

Keep the Plow Frame as Level as Possible

Figure 5 shows a bail support — a small iron clip found in different places in different makes of plows. If it gets moved even an inch ahead or back it will do what? It will allow one plow to go too deep or prevent one going in deep enough. Experts have travelled 40 miles from a railroad just to move this little piece of metal one inch. These things are simple, if you know they are the cause of the trouble, but puzzle the best, if their purpose is not understood. We will now pass on to the colters.

Colters Not Properly Set

A colter reduces the total draft of a plow from 11 to 20 per cent. The importance of the proper set of this attachment cannot be overestimated. It must be set just right to obtain the best results.

1. Usually the bearing of a colter is set between a point directly over the point of the share and another point about three inches behind it.

2. For plowing down trash or manure set as to give the plow plenty of "clearance" (see figure 4 "B").

3. For stony ground it is advisable to set it well ahead and down so that in the event of a plow striking a stone, the tendency will be to raise the plow out of the ground and thus save the point of the share.

4. For stubble plowing the colter should be set about one-half inch outside the line of the landslide, and down low enough to cut about one-third of the depth of the furrow slice.

5. In sod run the colter closer to the shin and also down almost to the bottom of the furrow.

6. Sometimes by setting the colter a little "wide" the scouring of the plow is improved.

7. When a badly worn bearing causes the colter to wobble get it fixed, because it will increase the draft besides doing inferior work. Take as good care of your colter as you do of your shares.

Bail Support Moved

This trouble was dealt with under the heading "Plows not cutting same depth." Again let me call your attention to this very small but very important part of your plow.

Sprung Beam

Many wrong adjustments on a plow are attributed to a "sprung beam." If you had measured the distance the beams were from the share and the distance they were apart when you purchased the plow you would be in a better position to judge this point correctly. Beams are sprung often in stony ground. It is very questionable whether they can be fixed locally or not. It will depend on the quality of the steel and the skill of the blacksmith. My advice is buy a new beam.

Hitch Not Right

Now we have come to the last source of trouble and probably the cause of more plow trouble than all the rest put together. Therefore, we will be justified in going into some of the factors underlying the draft of plows. They must be thoroughly understood, if we are to hitch intelligently to a plow. From the questions asked and the interest shown it may be safely said that farmers are at least interested and anxious to hear the subject discussed. After this point the battle is won. When you hear of a new idea you do not pass your opinion upon it right away, but if you find that it may be of value you most likely adopt the new plan.

When hitching four horses to a wagon would you consider it good practice to put three on one side of the tongue and one on the other? You hitch to the centre of your stoneboat. Why? For the simple reason that it pulls straight. Why do you not hitch to the centre of your plow? If you plow tandem or four abreast with one horse on the plowing, one in the furrow and two on the unplowed ground you do hitch to the centre, but if you put one in the furrow and three on the land you do not. If you have a good farm and can get on a good half mile furrow let me show you why you should plow tandem. Take a board and bore a hole in the centre and when you attach a string and pull it along you will notice it pulls straight. Bore another at an angle. The centre line is the loadline or centre of draft line and is fixed for the board and the stoneboat. But you say what has this to do with the plow? Where is this centre line in the plow?

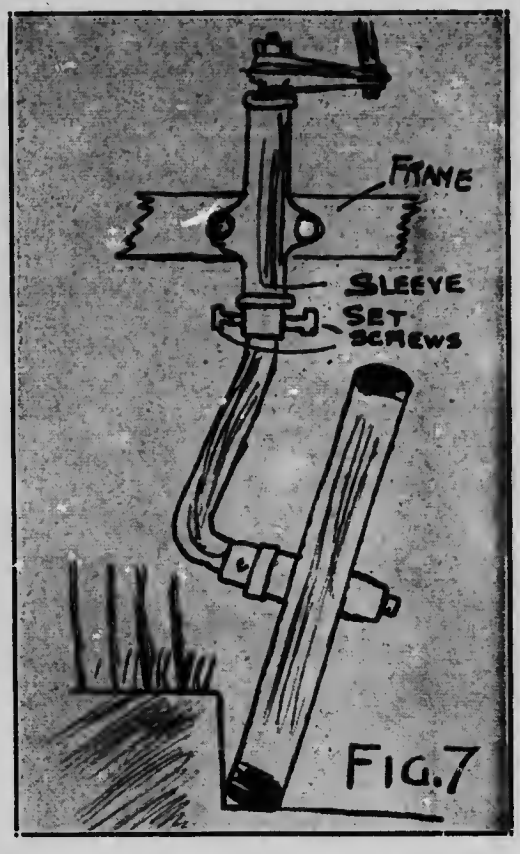
It is about two inches inside the landslide of the plow bottom (see figure 4A). You will see the loadline for each plow bottom marked as well as the centre of draft line for the plow, 19 inches from the furrow wall. Why is the load line not in the centre of each furrow? Because it takes 50 per cent. of the total draft of the implement to cut the furrow slice, and therefore the load line is nearer the landslide. You cannot hitch four abreast (and further reference to four abreast means three on the land and one in the furrow) and hitch at a point 19 inches from the furrow wall. You have to hitch further to the land and the result is the plow pulls at any angle. To overcome this twisting effect you give your front furrow wheel "lead" away from the land. Is that not so? It takes power to hold the plow straight. If you do not think it does try putting wheels at an angle on a wagon similar to a disc harrow and then you will agree with this line of thought. With patent eveners "to remove side-draft" go easy and make sure they do so before you buy. They will hold the plow straight, I grant you but they do so at the expense of power. In other words, the team holds the plow straight. Under the most ideal conditions the centre of a four abreast hitch will be about 27 inches from the furrow and with the centre of the plow fixed and immovable at a point 19 inches from the furrow wall you can now see that there must be a tendency to twist the plow towards the plowed ground or what is known only too well as "sidedraft."

It wears out wheel boxings and horseflesh to an alarming extent. The solution is plow tandem and then the centre of draft for your team and the centre of the plow will be in the same straight line and everything will run well. Some say that it takes so much more power, because the team is farther away from the work. The lead team is not far enough away to make any material difference, and the power that would be consumed in overcoming sidedraft is eliminated altogether. This clinches the argument for the man who wants the best way.

We have not taken up many points in connection with the subject that might have been dealt with, but perhaps we have interested some reader.

What Are You Going to Do About It?

One good plowman in a community will do more good work towards improving the plowing in that district than a thousand articles. Get busy and arrange to have a real live plowing match next June. The Department of Agriculture or the Agricultural College ought to help you. Put the arrangements in the hands of energetic men and help them



to get entries. Have some classes for the boys and young men and you will be surprised how hard it will be to drive them away from the farm. The quality of the plowing will improve each succeeding year to the benefit of all concerned.

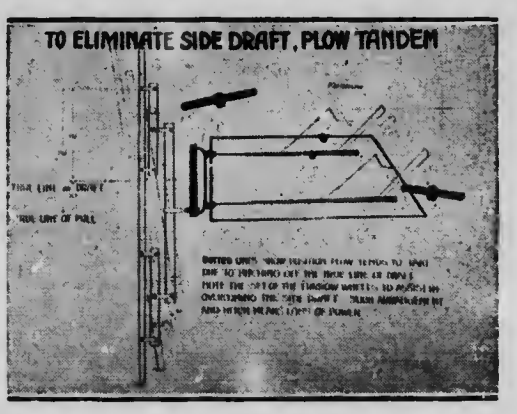
We will deal in more detail with the following:—

1. Factors influencing the draft of plows
2. The method of testing the draft.

Do you know the power required to pull your plow or, for that matter, any other farm implement? In manufacturing plants careful records are kept of the cost of operating their power machinery. This

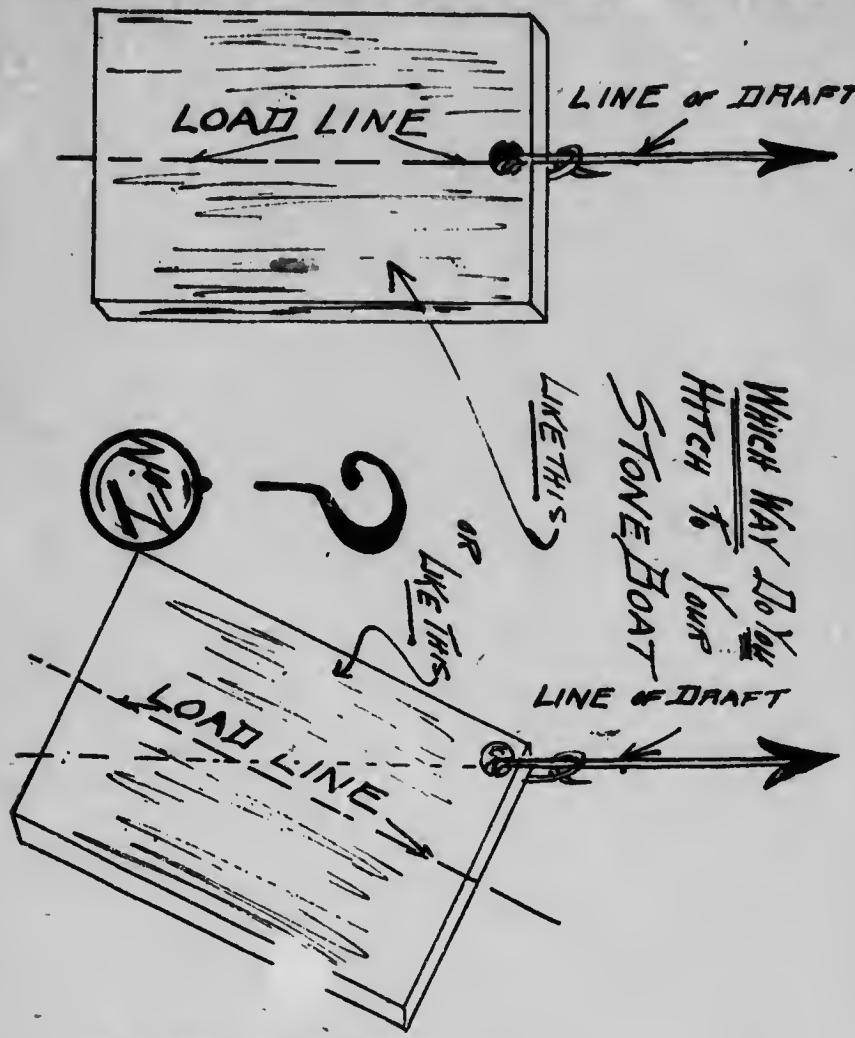
cost is watched very closely so that all the work is performed in the most economical manner, thus keeping the cost of production down. Why should farmers not follow their example? If it pays a manufacturer, it will pay the farmer. I will endeavor to convince you that the question of draft is very important, and that as means of proving this beyond all

doubt I advocate that every municipality should purchase a dynamometer. This is an instrument for testing the draft of any implement; it is simply a strong spring balance. The farmers in the district could then rent this testing device for a nominal cost of perhaps 25c. a day and thus prove to their satisfaction some important points. Every pound saved in draft is a pound earned for some other use, and this year particularly all reasonable care in this question of power is the duty of every true citizen.



You think this sounds rather far-fetched and splendid in theory. We have no time for that sort of thing and don't care. Listen! If it takes 1,000 pounds to pull a two-furrow gang plow cutting 28 inches and plowing 8 inches deep in summerfallow, and only 600 pounds to pull 6 sections of drag harrows covering a strip of ground 24 feet wide, does it sound

reasonable to you as a practical man to make a four-horse team do the work in each case? The plowing is a 6-horse job and the harrowing a 4-horse job. Now it is some trouble to switch your whippletrees and harness around but it may pay you to do so occasionally. Give your teams a fair average day's work and not an overload one day and an underload the next. The harrowing offers poorer footing, of course, but we will discuss some of the factors influencing the draft of plows.



(a) Shape of the moldboard.
(b) Condition of the plow.
(c) Sharpness of shares.
(d) Scouring qualities of plow and soil.
(e) Various adjustments.

(f) Colters and their effort on draft.
(g) Size of furrow.
(h) Line of draft.

The stubble moldboard having a sharp, quick turn, pulverizes the soil to a greater extent than the breaker bottom. It does more work and therefore takes more power. The steeper the moldboard, the more power will it require.

Condition of the Plow

A plow frame with loose bolts and worn wheel boxings cannot be expected to do good work. Your wife does not let her sewing machine get all loosened up. She oils it and takes care of it; that is why it lasts a lifetime. Manufacturers are endeavoring to eliminate this trouble by specifying spring washers on every bolt and in many cases hot rivetted frames are replacing those held together by common bolts and nuts, which will work loose.

Sharpness of Shares

The power absorbed in severing the furrow slice demands that shares be not only sharp but properly sharpened. Sanborn reports a difference of only 6.7 per cent. in favor of an old point resharpened over a dull point on the same plow, but an advantage of 36 per cent. in favor of a new point over the old point resharpened. At all events farmers should not waste on dull shares. Great care should be taken when sharpening shares to return them with the same "set" The same amount of suction both downwards and towards the land.

Scouring Qualities of the Plow and Soil

There are many different shaped moldboards for different soils. Right here let me say that unless a moldboard plow will not scour, a disc plow should not be considered. There are districts where the heavy gumbo soil demands disc plows. "Prevention is better than cure"—when you put your plows away next fall smear them well with thick oil and they will scour easier when started off the following spring. Care must be taken to see that shares are not warped. If they are, a good joint, is not made between the share and the moldboard thus causing trouble. When purchasing a plow pass the finger tips up the moldboards in the direction that the furrow slice will pass, and you readily detect rough places.

Various Adjustments

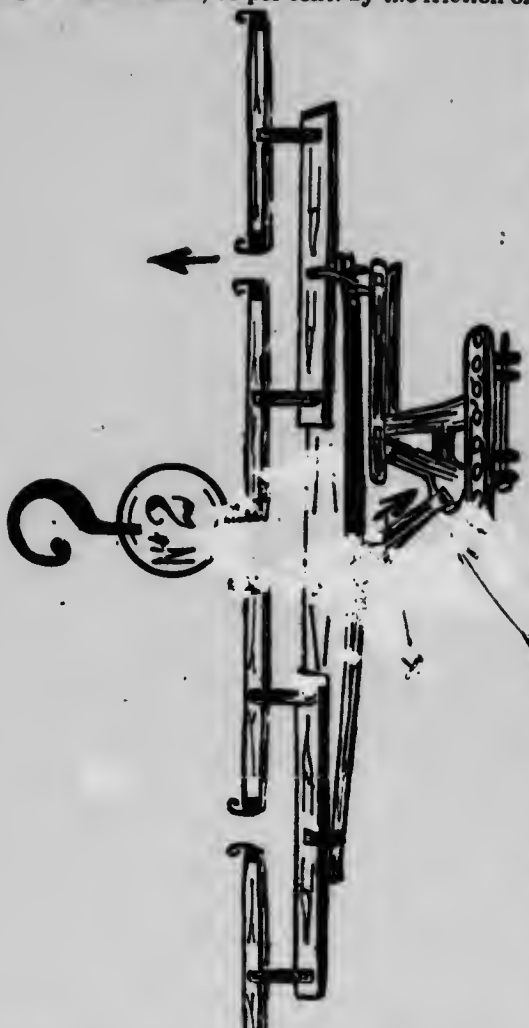
The adjustment of the hitch will be dealt with later. The rear furrow wheel must be set outside the landside of the plow, that is towards the unplowed ground, so that the landside will be relieved of some friction. It takes power to overcome friction. Sliding friction requires more power than rolling friction. When plowing four abreast, that is, one in the furrow and three on the land (any further reference to four abreasts is intended to indicate this method of hitching) the front furrow wheel must be given "lead" to the "land." (See figure 3.) The dotted lines show the position the plow tends to take. When plowing tandem it is sometimes necessary to give a little "lead" away from the land. This was covered fully in the first issue on this subject.

Colters and Their Effect on Draft

Experiments have shown that a colter reduces the draft from 11 to 25 per cent. on the draft. The proper set of this attachment has also been covered.

Size of Furrow

If you refer to figure (4) you will see that the draft of the plow can be classified under three main heads. According to Sanborn, "the plow shows the lightest draft when set to cut the widest furrow." This is probably accounted for by the remarkable results of an experiment at the Utica trials, which showed that 55 per cent. of the draft was used in cutting the furrow slice, 35 per cent. by the friction of the implement and



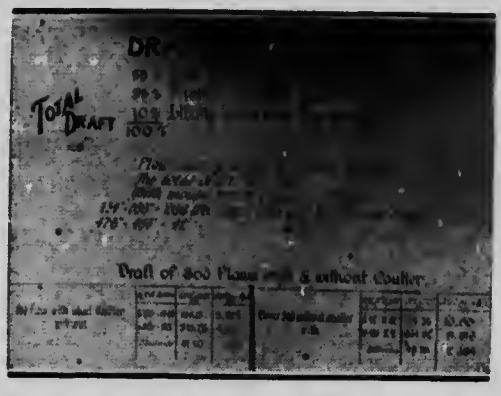
only 10 per cent. was required to lift and turn the furrow. The average draft of a number of plows running in the empty furrow was 168 pounds. The total draft was 476 pounds, and the draft with the moldboard removed was 434 pounds. The difference between 168 and 434 pounds, was taken to be the draft required for cutting the furrow slice. He

states later that 42 per cent. of the draft is used by the share and the landslide, and another writer put the moldboard friction at only 2 per cent. This, however, seems low. These figures will not hold for all conditions, but even an approximate idea of the division of the draft explains many frequently misunderstood facts.

When the depth of plowing is doubled the draft is increased about 75 per cent., and not twice as much, as might be expected.

Line of Draft

We now come to the chief point which our farmer friend wished to have discussed. Refer to the Figure (A) and you will see a diagram representing a wheel and a roadbed. If a spring balance is attached as indicated we find that the easiest line of draft is a line parallel to the roadbed. This ideal condition is practically never found in any of our farm implements. It is found on the railroads where the couplings between the cars are all pulling in a line parallel to the rails. Now, if we move our line of draft to the position AC we are exerting an upward pull as well as a horizontal pull. When the position AD is reached, we are lifting the load entirely. It will be much harder to lift the load than to



pull over a smooth roadbed on well-oiled bearings. On the other hand, if we pull through the line AE we are exerting a downward as well as a horizontal pull which will add materially to the total draft of the implement So much for some of the underlying principles. Figure B shows the effect of the line of the tugs on the load it can pull. When the tugs are horizontal we will assume that it can exert a pull of 1,120 pounds, and when the tugs are at an angle of 22 degrees it can exert a pull of 1,250 pounds. The reason being that the downward pull helps to give the horse a better foothold, or, in other words, more traction. If you doubt this consider what would be the result if the point of hitch X was raised up—would it not tend to raise the horse off its front legs? I think so.

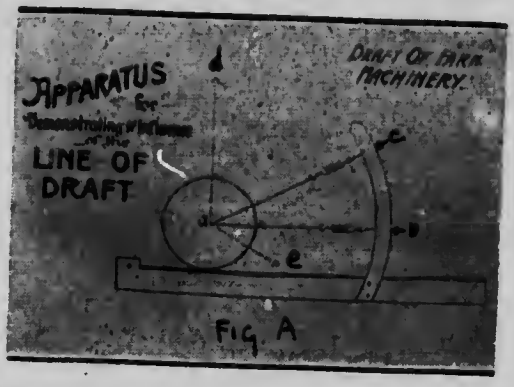
Do not be misled by the above figures. On a steady load like a plow when the tugs are never slack a horse will exert a steady pull of from one-tenth to one-eighth of its weight. This seems very little. How much does it take to pull your gang plow? I cannot tell you exactly, it will depend on the soil, the depth and the adjustment of the plow amongst other things. But it will be between 800 and 1,000 pounds. This seems very little, and I am sure is far below what you

would have estimated. Had I asked you, you might have said 2,000 or 5,000 pounds. This pull is measured on a scale that has a capacity of 2,000 pounds. It is called a Dynamometer. If you would care to weigh yourself you would find that your weight would correspond with that registered on your scales in the granary. The cut showing this instrument may interest some of the readers of this article. It should be an educational feature of every plowing match held in Western Canada, because it helps to solve many difficulties and decide many discussions. Farmers are interested.

The Winnipeg Motor Contest results show that an average pull of 700 pounds are required to pull a 14-in. plow 4 in. deep in breaking. The following results from a test at Saskatoon shows how different kinds of sod varied:

Western Rye	358 pounds
Brome	405 "
Alfalfa	700 "
Mixed Hay	425 "

These tests were not repeated, but they show that there is considerable difference. The walking plow used was cutting a furrow 13 inches by 4 inches.



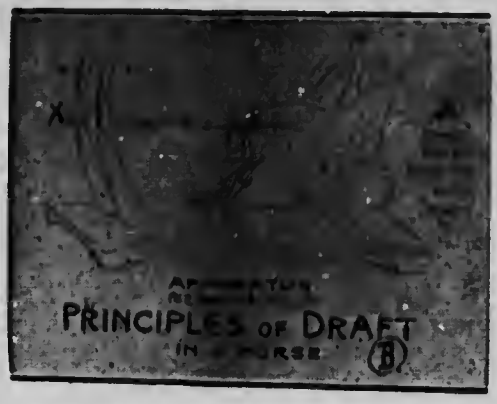
The reason why plowing tandem is desirable is that the centre of the hitch can be in the same line as the centre of the plow. This centre line in a gang plow is 19 in. from the furrow wall as we saw in the last article on this subject. If you hitch away to the left hand corner of your plow, as you must when you plow four abreast, your plow tends to take up the position as shown in figure 3.

Refer to figure 1 and you will see what happens when you hitch to one side of your stoneboat—it pulls at an angle. That's right, and so does your plow. With a three-horse outfit the position of the hitch is decided by the distance from the furrow wall to the centre of the large doubletree, but bear in mind that the centre of the plow is still 19 in. from the land side.

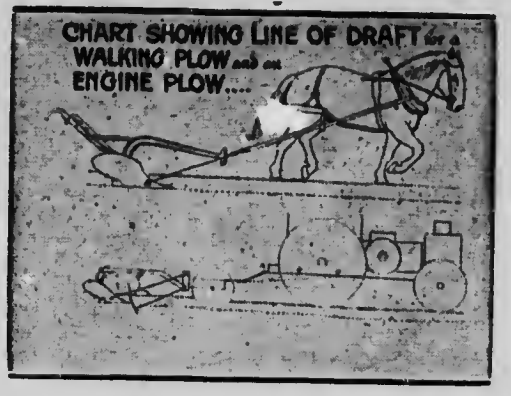
Eveners Which Remove Side-Draft

I hear someone say that there are eveners on the market that will allow you to use four horses abreast and remove the sidedraft. I have never seen them yet, and no one selling such a device has ever convinced me that they do remove sidedraft, because they don't. Well, the plow

pulls straight. If you hitched to one side of your stoneboat and put a brace across to one corner, it would pull straight. What would hold it straight? Why, the brace, of course, I have no quarrel to pick with anyone selling such eveners, if they can, let them go to it. But you as a practical man can prove to yourself that they do not remove sidedraft. Take a few pieces of lath and make a model. When you pull in the direc-



tion of the arrow on the right, there is a pressure in the direction of the arrow on the left. With four abreast you give your front furrow wheel lead to the land in an endeavor to hold your plow straight, and the rear furrow wheel lead away from the land for the same reason. It takes power to hold a plow straight. Your argument about the horses being closer to their work breaks down when you think of the power wasted in

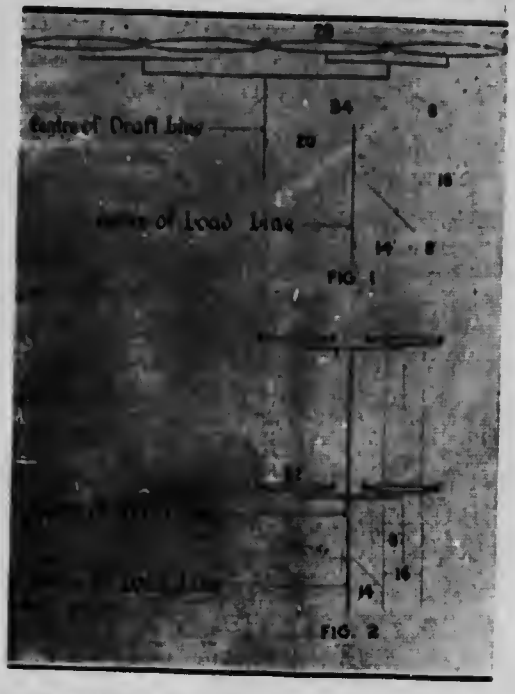


holding the plow straight. Actual trials have shown that in the distance the lead team is away from the plow, the weight of the hitch is about all that is added to the draft. A few pounds. The plow pulls straight, the team has an easier day, especially in the hot weather. Weigh yourself on a spring balance, go to the barn and weigh yourself at the end of a 30-foot rope and you weigh—your first weight plus the weight of the rope. When a man tells you that a team cannot pull a bag of wheat

at the end of a100-foot rope, ask him if he ever tried it. It is a common argument. I know that it is easier to hold a cow at the end of a long rope. But remember that the distance a lead team is away from the plow should never deter you from plowing tandem.

There Is a Real Advantage

By referring to figure 5 the position that a gang plow tends to take when four horses are hitched abreast. There is a decided twisting action tending to swing the plow towards the plowed ground. To overcome this you will notice that the front furrow wheel has to give "lead" to the "land" and the rear furrow wheel "lead" away from the "land." It takes power to overcome this twisting action. Would a wagon pull harder if it had wheels like a disc harrow? I think so, and so do you.



With a sulky plow, you will notice in the figure, the great advantage gained by plowing tandem, it is because the centre of draft line for the team and the plow come in the same straight line.

The line of draft in a vertical direction is also important. Figure 5 shows the ideal line of draft in a walking plow straight from the plow bottom to the hames. You will also notice on this chart an outline of an engine. A short hitch very often tends to raise the tractor off its front wheels, or it may lift the plow in front. In the event of the plow being a self lift it will decrease the grip of the wheel with the lifting mechanism and it will not do the work it is intended to do.

The following may be of interest: The pull on tugs has a tendency to lift the plow out of the ground and some other force must overcome this lifting tendency or the plow will not stay in the ground. If there is not

enough suction to overcome this lifting action of the hitch, you must increase the suction. Tests made at one of the Experiment Stations show that hitching a 9½-foot chain between the end of the plow beam and the evener made a saving of 6 per cent. in the draft of the implement (a 14in. walking plow) while a 13½-foot chain made a saving of 8 per cent. in the pull of the plow. You see when you increase the length of the hitch, you decrease the lifting action, and, therefore, reduce the power by the amount necessary to overcome this lifting action (See figure 5.)

With a short beam plow the tendency to lift the plow out of the ground is greater. The suction has to be increased. Two forces, one lifting out, the other pulling it in, take power, therefore the experiment just referred to is interesting.

The draft of plows varies in different soils in approximately the order of the following:

Sandy soil, 2 to 3 pounds per square inch of cross-section.
Sandy loam, 5 pounds per square inch of cross-section.
Prairie sod, 15 pounds per square inch of cross-section.
Gumbo, 20 pounds per square inch of cross-section.

Example: If you have a furrow 14 in. wide and 5 in. deep You multiply 14x5 equals 70 square inches and if it takes 700 pounds to pull the plow there will be 10 pounds of drawbar pull required for every square inch of cross-sectional area.

The subject is one of vital interest to the farmer who is a good business man that it is hard to know where to end a discussion such as the foregoing, and so to err on the safe side, I will draw it to a close, and hope I have left enough material with you to interest you more in this important subject.