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THESIS

. Four and Six Horse Teams On The Farm.

By
E.D.A. True Class of '78.

My object in this paper, is to propose a reduction of expense to the farmer of Michigan, by increasing the number of horses in a team, from two or three, to four or six, and correspondingly reducing the number of men employed in cultivating the soil and hauling loads.

What I shall say on this subject, is based on a growing experience of fifteen years, it being about that length of time, since we began using four horse teams on the farm. Since that time we have gradually passed from the occasional use of a four horse team to the almost constant use of four, five or six horse teams, for plowing, harrowing, rolling, and so forth, and the frequent use of four horses, for hauling loads, especially on the road.

Our first systematic use of four horses, began before the general introduction of the springtooth harrow, when the wheel cultivator was almost universally used in the spring, for working up fall plowing.

Cultivating was such heavy work, that when the ground was at all hard, one of three evils generally followed; either the horses were overworked, the work was poorly done, or the cultivator and man had to stand idle one third of the time, while the horses were resting. This we observed and undertook to remedy, by putting a span of horses on each side of the pole of our cultivator, and found as a result, that doing the work thoroughly, one man, one cultivator and four horses would, cultivate as much as two men, two cultivators, and four horses.

From that time forward we always did our cultivating with four horses.

● 1997年10月1日起，凡在我国境内销售货物的单位和个人，均应按销售额和规定的税率计算应纳税额，并随同货物在销售时一并收取和缴纳。

1. The first group of people who are not in the labor force are those who are not in the labor force because they are not in the labor force.

[illegible]

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

[illegible]

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3. The third step is to develop a plan or strategy to address the problem. This involves breaking down the problem into smaller, manageable tasks and determining the resources needed to complete them.

4. The fourth step is to implement the plan. This involves putting the strategy into action and monitoring progress to ensure that the objectives are being met.

5. Finally, the fifth step is to evaluate the results of the project. This involves assessing the outcomes against the objectives and identifying any areas for improvement or further action.

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After cultivating with four, our next step was coupling two harrows together, and trying four on them.

Two harrows however when coupled together, proved to draw much harder than when separate, consequently though with grave misgivings as to whether we were not overstepping the bounds of prudence, we applied six horses abreast, and with such satisfactory results that six abreast became a regular institution with us, for though two harrows together, drew harder than when separate, the work done was so much more effective that we considered it no waste of energy.

After using two harrows together we soon coupled two rollers together, and also used various combinations of tools as for instance, a roller or a Randall disc with a harrow hitched behind.

A harrow with a roller behind it, a spring tooth with a spike tooth behind it, and occasionally a train of three tools together; Last of all we added a gang plow, which turns two large furrows and requires six horses to draw it, and with which one man plows four acres a day, so that at present nearly all our cultivating operations, are done to a greater or less extent, in a wholesale manner.

We have been advancing along these lines, year after year, because ~~byxxxxxlakxg~~ we believe we receive benefits by so doing.- What are they?

First, and most directly, we save wages and board of one or two men in the most hurrying time of the year, aggregating perhaps there are four months for one man, in the course of the year. This is not a vast saving, but is good as far as it goes, but the benefits do not stop with wages and board, for when we lessen our gang of men, we lessen the cost of supervision.

If I send three men into a field, with two horses each, I know that they are almost certain either intentionally, or unintentionally, to waste each others time, and experience has taught me, that it pays to keep near enough to know what is going on ~~there~~. If I combine the six horses into one team, with one driver, I am practically care free for I find by experience

The following information was obtained from the records of the [redacted] Department of the Interior, Bureau of Land Management, regarding the [redacted] land grant.

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that there is only the slightest danger that he will not work and work faithfully, Responsibility has a good effect on men in any circumstances, and I believe that the responsibility of driving six horses, makes a man work better than when driving two. Again, I may drive the team myself, feeling that I am earning the wages of boss and all hands,.

I have ridden many a week after six horses, feeling that I was doing work worthy of a graduate of M.A. C., when I might otherwise have been plodding wearily after two, feeling myself in more than one sense, on a level with my horses.

We often get considerable help in the hurrying season, by using colts and other horses which for any reason are not fit to do the full work of a horse, and would scarcely be worth driving, if we had to furnish a driver for every two, or even three.

For instance, last spring we made five colts do the work of about three old horses by working them into large teams, when otherwise, they would not have been used. After the corn was planted, they were turned out, and have not been hitched up since, and perhaps will not be till next spring.

We often get the use of our horses by making one man drive six, when they would otherwise be idle for want of a driver, when work not requiring horses, calls off the men.

Horses, will do whatever you set them at, without jealousy or dissatisfaction. If you want to change them from one job to another, or from one team to another, you may do so with impunity, as far as the horses are concerned.

Men are more sensitive, about the way they are handled, and a man who has eight or ten horses, and only two teamsters, can manipulate them much more easily, than the same number of horses with four or five teamsters.

Reducing the number of men out of doors, reduces the work in the house, and in fact, the farmer who can successfully work his horses with half the usual number of teamsters, will gain advantage upon advantage.

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A large factory is not an aggregation of small shops under aone management. Instead of half a dozen small engines with half a dozen engineers , one large one with one engineer, furnishes the power.

Instead of small machines we find large ones, with which the same number of men, do tens or hundreds of times the amount of work. A large farm should not be an aggregation of small ones, but large fields, large tools, large teams and wholesale methods should correspond with broadened opportunities.

Though it is my object in this Paper to advise the farmer to drive more horses in one team, I would not advocate hitching two or three span of horses together, without carefully considering the safety of the plan, with reference to ones own particular horses.

One man cannot manage two runaway horses, much less half a dozen, and the danger, in case of a general runaway, of course increases with the number of horses involved, therefore, be careful how you take chances by hitching up fractious horses.

Farm horses are however as a rule very docile and if properly fed and managed, may be safely hitched together by the dozen, if required.

If I have to hitch in a horse that I think is inclined to run, I ut him on for an outside horse, and hitch him to the next horses hame by his tie-strap then I put my safest horse on the opposite side of the team, and if the fractious horse starts to run, and I can't hold him, I hold back the safe side of my team, and the result is a circle.

I have never had but one runaway in all my experience with wide teams, and that, I stopped by the above tactics, making a circle, probably not more than three or four rods in diameter, and quickly subduing the runners.

My manner of hitching four horses abreast, is to hitch up two span of horses as if they were to work seperately, drive them side by side, and fasten the two inside horses loosely together, by a strap three or four feet long, passing between the two inside breast strap rings.

If I use a neckyoke, this strap is not needed, as its only use is to keep the two teams from straying apart.

Then I take the four reins in my hands and cross the two inside ones, bringing the right hand rein of each span into my right hand, and the left hand rein of each span into my left hand. Then I start the four, and if necessary let the reins slip in my hands till they all draw evenly, and then without allowing them to slip out of place, I tie a single knot in each pair, just forward of where I wish to take hold in driving, thus converting the two reins in my right hand into one, and the same with those in my left hand, the knots being within reach, so that I can shift them if necessary, and also reach forward of them, as is often convenient in turning.

In hitching six abreast I follow the same plan, hitching up two independent three-horse teams, I place them side by side and tie the inside horses together by their breaststrap rings, unless neckyoked, - cross the reins as before, - start my team to see that the reins are all even, and tie, as before, within reach of the drivers hand.

For five abreast of course I place a two horse team beside a three horse team, cross the reins and tie as before.

The object in fastening the two inside horses together, either by a strap or by a neckyoke, is simply to keep the two teams from straying apart. The reins will generally do this, in fact I used to drive with nothing to hold my horses together, but the guidance of the reins.

This is unsafe however, as the driver is liable to accidentally pull the wrong rein and drive to two teams apart, or a line may become foul and produce the same result, and when the component teams begin to diverge, the driver soon loses all control, and the tangle becomes serious.

Hired men are apt to want to tie the inside horses together by their heads as it relieves them of some trouble in driving, but this I never allow.

The following information was obtained from the records of the [redacted] Department of the Interior, Bureau of Land Management, regarding the [redacted] land grant.

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After the reins are crossed and tied, their direction is changed, enough to cause considerable loosening of some of the cross-reins, and tightening of others. This must be corrected before they will work satisfactorily.

This is explained by figures 1 and 2.

This arrangement of reins is somewhat imperfect, but has the advantage of allowing the teams to be almost instantly changed from two or three abreast, to four or six, and vice versa, without the use of extra straps, which for my own use I consider an essential consideration.

I have no doubt that for use exclusively on four or six horse teams, reins might be contrived, that would be more satisfactory, but the advantage just mentioned is of such paramount importance for my own use, that I have never attempted to make a change.

The imperfection just mentioned in the working of this system of reins will be explained by Figures 3, 4 and 5 more easily than I can explain it otherwise. In these Figures the position of the horses is represented by the position of the bits, a straight pull on B Figure one and loosening of A makes the horses take the position shown in Figure 4, whereas they should take the position indicated in Figure 5, which is done by stepping to the left and making A. & B. take the position A' & B' or by reaching forward of K. on the right hand branch of the rein B., loosening the rein A. This makes the right hand horse act as a pivot for the whole team to revolve upon.

In actual practice after horses become used to working together they will generally turn almost without guidance, one horse standing nearly still sometimes even backing a little, while the rest swing around him. The time and space required for turning not being nearly so great as a novice would naturally suppose.

On my own harness I have adopted a style of rein which I consider superior for any purpose, to that generally in use, but which is especially adapted to

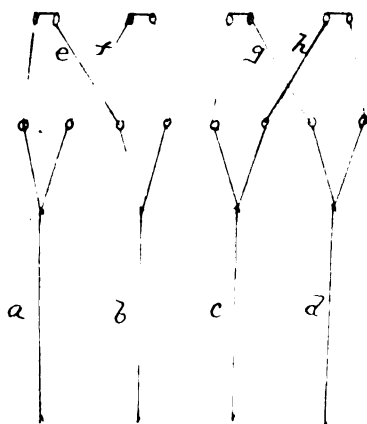


Figure 1.

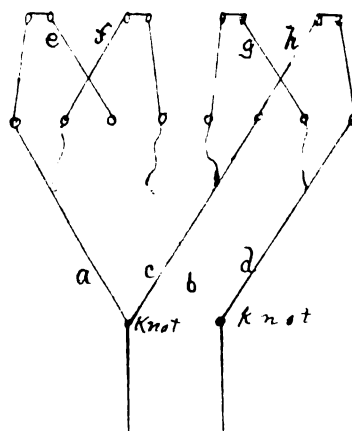


Figure 2.

Figure 1. Represents by means of reins and bits, two span of horses side by side, ready to have reins crossed and tied.

a.b.c.d. Reins.

e.f.g.h. Cross reins.

Figure 2. Represents the same with reigns crossed and tied.

It is evident that the cross-reins f. and g. will be loosened and also that e. and h. tightened.

This tightening and loosening must be corrected or the horses will not drive properly.

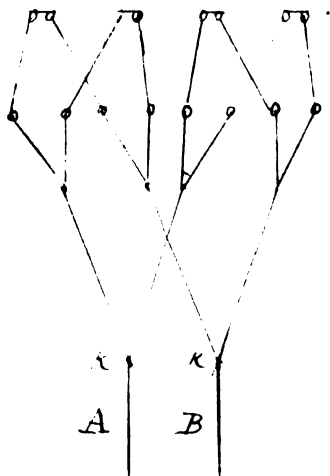


Figure 3.

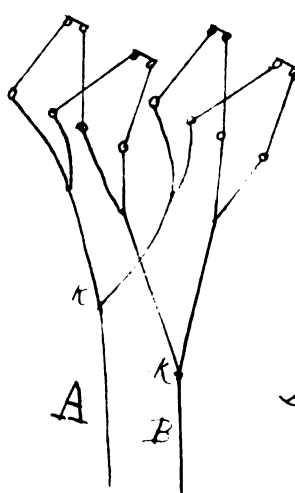


Figure 4.

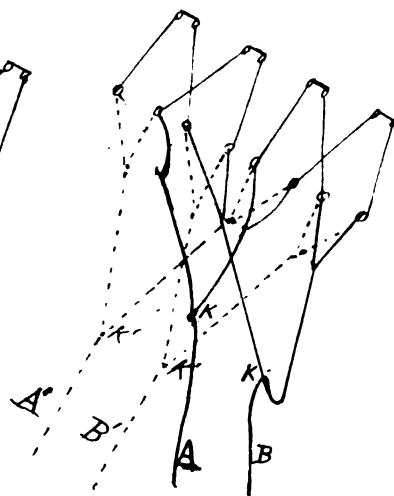


Figure 5.

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

2. Once the problem is identified, the next step is to define the objectives and goals of the project. This helps to clarify what needs to be achieved and provides a clear direction for the work.

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4. The fourth step is to implement the plan. This involves putting the strategy into action and monitoring progress to ensure that the project is on track.

5. The final step is to evaluate the results of the project. This involves assessing the outcomes against the objectives and goals to determine the effectiveness of the intervention.

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains. The number of transformed cells was determined by the number of colonies obtained on the selective medium. The results are the mean of three independent experiments. Error bars represent the standard deviation.

use on wide teams, as it allows of unlimited change in the length of the two forks of the rein in either direction without the need of buckle holes and also allows the long and short branch of the rein to change places without turning the rein over or changing the distance of the fork from the bits.

I can explain the comparative workings of the two reins more easily, by referring to Figure 6 and Figure 7, The ordinary form of rein is shown at Figure 6 and consists of two peices, the stem A.B.C. and the cross rein B.D..sliding on the stem by means of the buckel B. Bd. is supposed to be longer than b.C.



Figure 7.

but in case of driving six abreast B.& C. sometimes has to be made longer than B.d. which makes it necessary to turn the rein over or slide the buckle B. along distance on the stem, making the fork come much farther from the bits than was intended, and making it necessary to have a long row of buckle holes punched in the stem in order to allow of so much shifting.

The rein that I prefer is also composed of two parts as seen in Figure 7

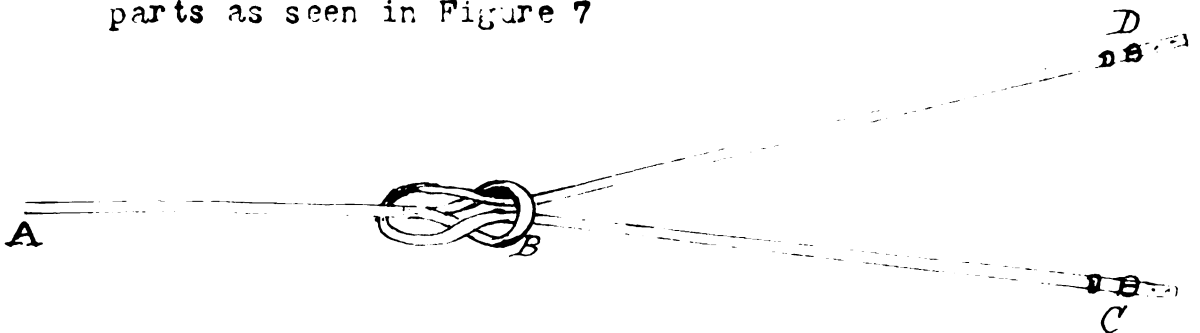


Figure 7.

A.B. stem which is simply a straight strap with the end turned back and sewed down making a loop at B.

C.B.D. the cross rein is a continuous strip 12 feet long with the usual arrangements for fastening it into the bits, and looped upon the stem as represented at B.

When the loops are drawn upon they will not slip but are easily loosened, when the cross-rein may be slipped in either direction as far as desired.

I often use a stem or handpiece of quarter inch rope, looped upon the leather cross-rein, this makes a very light, cheap rein that any one can make in a few minutes, of any length desired.- For driving six the reins need to be uncommonly long and lightness is also consideration. A whip long enough to reach the remotest horse is an essential part of the drivers outfit. This need not be an expensive braided affair but may be cut from a good heavy boot leg or some other piece of firm leather.

Six abreast make a rather loose jointed team and the driver must not expect to hold them as strictly to place as if driving two, and if they get out of the proper course, are not to be brought back suddenly by a sharp pull, but gradually by an easy curve.

The guiding of six abreast reminds me of the steering of a large boat, the man at the wheel never stops turning it, first a little to the right and then a little to the left, so with six abreast, the driver must be constantly touching this rein then that, nipping in the bud each incipient curve, not making and straightening great ones.

The easiest way to drive six, if walking, is to tie the reins together and put them around the body, The force required to straighten so many reins, will very materially lessen the labor of walking: while if holding the reins simply in the hand the strain on the hands and arms is very tiresome.

I always feel however that a six horse driver deserves to ride and when using a tool without a seat as for instance, a harrow, I generally couple on a little cart made for the purpose, which adds much to the comfort of the driver and not very much to the draught of the team.

The first of these is the fact that the
 government has been unable to raise
 the necessary funds to carry out
 its policy. This is due to a
 combination of factors, including
 the high cost of the program and
 the low level of public support.
 The second factor is the lack of
 coordination between the various
 agencies involved in the program.
 This has led to a duplication of
 efforts and a waste of resources.
 The third factor is the lack of
 information and communication
 between the government and the
 public. This has resulted in a
 lack of understanding of the
 program and its goals.

When unhitching four and especially six horses the driver will necessarily be out of reach of several horses most of the time and they are apt to take advantage of this and begin to stray away causing much trouble. Do not allow one to start till all are ready to go and if necessary have a light strap or rope ready and pass it through a bit ring of each horse snapping or tying it to the two outside ones, this will prevent all trouble and when all are unhitched it can be unsnapped at the ends and pulled out. This plan will prevent much trouble and if the horses are inclined to be frisky perhaps ~~weal~~ danger.

My plan and constant aim when working horses is, whatever tool I am using, to have power enough to keep it going constantly, I do not intend to have the team stop much more than I do a threshing machine. From the time they start till time to turn out, it is a steady jog,- not fast, unless the footing is firm and the work light but constant. When a team has to rest every few minutes the time thus consumed, soon amounts to an alarmingly great part of the day, and resting will very likely be carried to excess if the drivers inclination leans that way, and if not the horses will be in danger of being overworked.

What would you think of a teamster who on the road constantly loaded his horses so that they had to rest every mile? You would say he was a fool and not fit to drive a horse. How much better is a farmer who does the same thing in his field?

Horses worked so hard that they have to be rested frequently are much more likely to have sore sholders, than when worked moderately and continually, and of all the jobs that fall to the lot of a teamster, I think nursing a sore shouldered horse is about the most discourageing and of all the abuses carried on by respectable people, I count working a horse with the collar pressing into a raw sore about the worst.

A four or six horse evener, with whiffletrees attached., is a heavy thing at the best, and should be made as light as possible. The easiest way to reduce the weight, and keep the strength, is to reduce the length, and consequently the other diminsions, of the

whiffletrees. For most work I prefer whiffletrees two and one half feet long to those three and ~~xxxx~~ feet long, and they only require to be about two thirds as heavy.

When using this length of whiffletrees the long eveners for six horses should be eight and one half feet long and four horses, six feet long; These lengths allow for three inches of timber at each end beyond the pin holes, and also a little distance between the ends of the whiffletrees.

When an eveners is made it should have several holes bored at each end, also several in the middle, to allow plenty of latitude for giving light horses the advantage, and also in case of a six horse eveners, to allow of its being used for five horses.

A three horse eveners when composed of a long arm and a short armed, should always, if possible be attached to the main eveners with the long arm out as in this position, it is much less likely to foul against the main eveners than when the long arm is turned in.

Every eveners whether for two, three, four or six horses should have a centre clevis and ring, by which to attach it to whatever is to be hauled, and every Implement, to which horses are to be attached, whether it be a wagon, plow, harrow or roller, should have a hook to which the eveners may be instantly attached, without taking off the centre clevis and ring.

If wagons and cultivators have hammer straps and pins and other tools have attachments requiring a centre clevis and ring, the pins will be changed about and often missing and so will the clevises and rings. This I know by experience, but the universal rule of a hook on every rool and a clevis and ring on every eveners has ended this trouble.

Do not use a staple instead of a clevis and ring, in the centre of an eveners, as it offers the greatest opportunity for a lazy horse to take advantage of a free one, a thing which should be guarded against in any team, but especially when driving more than the usual number of horses.

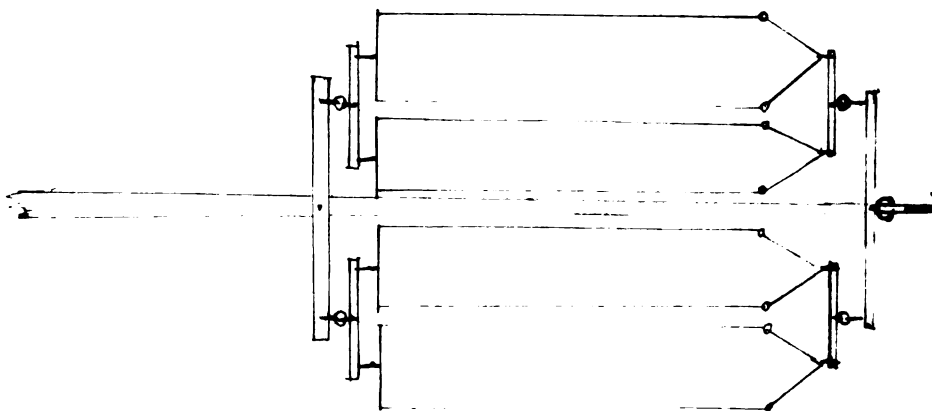


Figure 8.

In attaching four horses to a pole a four horse neckyoke is a very good thing, but ~~is~~ not practically necessary. Figure 8 shows a pole with four horse whiffletreest and neckyoke, connected by traces and breaststraps, where it is evident that if one horse goes ahead, another must fall back correspondingly, and the tension on breast straps and neckyoke remain constantly the same.

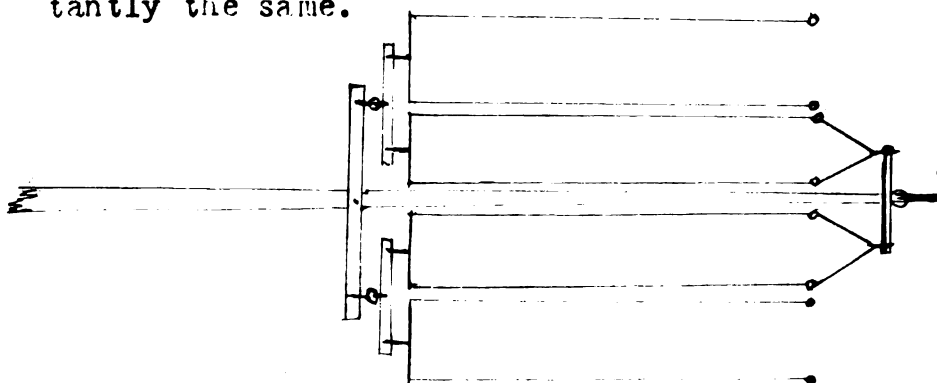


Figure 9.

Figure 9 shows pole with four horse whiffletrees and two horse neckyoke, where it is evident that if the two middle horses advance and the outside ones fall

The following is a list of the names of the persons who have been appointed to the various positions in the Department of the Interior, under the act of March 3, 1879, entitled "An Act to provide for the better management of the public lands, and for other purposes."

back the tendency is to slip the neckyoke off the end of the tongue. On the contrary if the outside horses advance and the middle horses fall back, the traces and breast straps of the inside horses being practically continuous straps, become taught, and the tendency is for the outside horses to draw the entire load, the inside horses simply supporting the pole, by means of the tightened traces and breast straps.

To avoid these troubles the end of the tongue should project well beyond the neckyoke ring, to prevent its slipping off, and the breast straps should be long and rather loose, which will counteract the other difficulty.

For driving six abreast on a pole a four horse neck yoke is necessary as the two difficulties just mentioned are increased to such an extent as to be serious practical difficulties, when only two horses support the pole. Figure 10 shows a four horse neck yoke.



Figure 10.

A and b are ordinary two horse neckyokes, C four horse neckyoke, which is twice the length of a two horse neckyoke and made of a good piece of ash or rock elm board one and one half inches thick, by four or five inches wide in the centre and tapering at the ends to about two inches. D.d.hooks by which c is attached to a & b, E.E.light clevises by which the ring is fastened to c.

This neckyoke is very easily made and can be instantly attached and detached by means of the hook d.d.

With reference to implements, suitable for whole-sale farming in Michigan, volumes might well be written.

It is not my aim however to go beyond a point where I believe my suggestions might be of immediate practical value, to a large number of Michigan farmers.

The plow is the great foundation implement, and though improved by thousands of inventors, and brought to great perfection in some respects seems to be the hardest of all tools, to increase in width by multiplication; There are gang plows however, that work well under favorable circumstances and would be very valuable tools on many farms, except for the difficulty attaching and driving the horses.

In speaking of gangs, I refer only to those composed of two plows.

Makers of gangs generally claim that they can be operated successfully by three horses, and that if four are required they can be driven successfully abreast without driving a horse on the plowed ground.

I have tried a number of gangs, but they all draw so hard that to work them with three horses, is not even to be thought of, It is possible to work them with four horses, if the ground is in nice condition and the furrow not too large, but this brings the hitch so far to one side of the plow as to be objectionable, and even with the shortest whiffletrees, crowds the furrow horse very badly. I am satisfied that one might partially relieve this troubles by lengthening the traces, say from three to six feet, by introducing some tace chains, and I should certainly try this if I wanted to use four horses on a gang. I think a better plan would be to hitch five abreast, putting one horse on the plowed ground and giving him the advantage to compensate for the hard traveling. This would give powereenough, to turn two furrows pretty well, and also bring the hitch in the same place, as if using three horses which I consider the only proper hitch for a two furrow plow.

Whoever can manage to run a gang, successfully will find it a great help in pushing work along, especially fall plowing, when apple picking and corn

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters. The text suggests that organizations should implement robust systems to track every detail, from small expenses to major investments.

2. The second section addresses the challenges of data management in a rapidly changing environment. It notes that as the volume of data increases, the complexity of managing it also grows. The author argues that organizations must invest in advanced technologies and skilled personnel to effectively handle this information. This includes not only storage but also the ability to analyze and interpret the data for strategic decision-making.

3. The third part of the document focuses on the role of leadership in fostering a culture of innovation and risk-taking. It states that leaders must encourage their teams to think creatively and explore new possibilities, even if it means taking calculated risks. The text provides examples of successful companies that have thrived by embracing change and innovation, highlighting the importance of a supportive and flexible organizational structure.

4. The final section discusses the importance of continuous learning and development for all employees. It suggests that organizations should provide opportunities for training, workshops, and conferences to keep their workforce up-to-date with the latest industry trends and technologies. The author concludes by emphasizing that a commitment to learning is a key factor in long-term success and growth.

harvest call off the men and leave the horses idle. On my own gang I drive three horses abreast on the pole and three abreast for leaders, this makes an elegant and powerful team, but as it requires the addition of an elevated seat on the plow for the driver, and the use of a whip about twenty five feet long, it is of little use to recommend it to any but a professional four horse teamster.

On the whole gang plows work, ~~xxxxxx~~ as far as I have observed is not first class, but I think it averages as well as the work done by hired men with walking plows.

I strike out and finish up my own lands with the gang and think I do so as well as can be done with any sulky plow.

To ~~any~~ one interested in gangs, I would say don't buy till you try and reserve the right to be your own judge whether or not the plow is a success. W

With reference to harrows for four or six abreast I can simply give my own manner of combining two in one.

Harrows as we buy them are usually composed of two leaves hinged together and hooked to a coupling evenner. To combine two in one simply place them side by side remove the short coupling evenners and substitute one long enough for both harrows, with four hooks instead of two.

This makes a tool too wide to run steadily when the hitch ~~is~~ only in one place in the middle of the long coupling evenner, and requires a crotch iron or chain as shown in Figure 11.

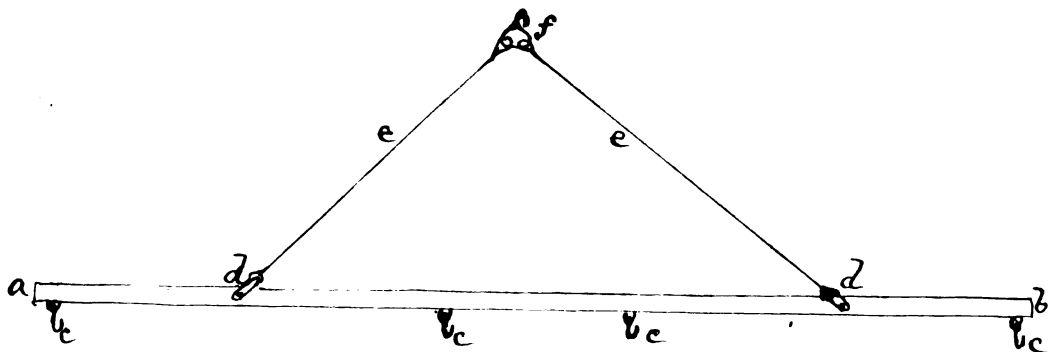


Figure 11.

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a.b. Long coupling evener.

c.c.c.c.c Hooks by which harrows are attached.

d.d.Clevises.

e.e. Iron rods with loops in each end by which they are attached to d.d. and also to the hook f.

I have often thought of making a harrow with each section independent of the others, except for being hitched to the same long evener in front. This would allow much greater freedom in raising - a great advantage., and also the sections might be coupled together in odd numbers allowing one to use three or five sections together, instead of confining him to the use of four.

The coupling for two rollers consists of a wooden stretcher between the ends of the two tongues to keep them always at the proper distance, and a short chain say 18 inches or 2 feet long, hooked to the adjacent ends of the ~~just~~ rollers just tight enough to prevent one roller from getting ahead of the other.

The teams are attached as if the rollers were to be used separately then driven side by side the stretcher fastened between the tongues and the chain hooked

The seat is the most difficult part of the outfit as the driver naturally wants to sit directly behind the middle of his team, which would be over the ends of the two rollers where there is no suitable place to attach the seat. A plank extending between the seats of the two rollers or some other support in the middle of each roller, furnishes a seat on which the driver can take any position he desires, and also brings all the weight at the proper points. This plank seat must needs slide endwise at one support or the other as these two supports must evidently change their distance from each other, with the tipping of the rollers and also as one roller advances or recedes with reference to the other as it must continually do.

The exact arrangement that I use would ^{be less} be here, as my rollers were made with special reference to being used together.

Figure 12 will give a suggestion that will I think be practicably applicable on most of the rollers in use.

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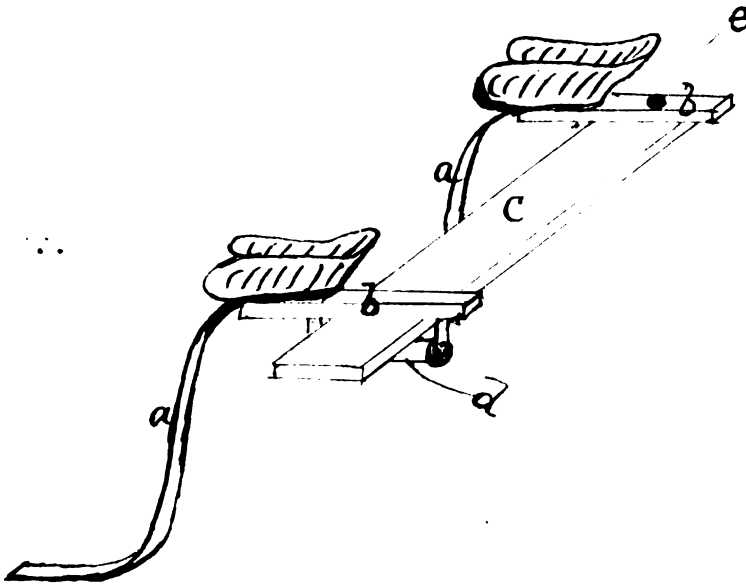


Figure 12.

- a.a. Roller seat standards.**
- b.b. Pieces of scantling bolted to standards and projecting backwards from under seats.**
- c. Plank seat extending between the two standards.**
- d. Roller on which one end of the plank slides.**
- e. Bolt on which the other end of the plank turns.**

ii

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This arrangement of rollers leaves a narrow strip of unrolled ground, between the two rollers which may be disregared or rolled like the rest by the means of a small roller attached to one of the others.

A very pleasant way of cultivating is to hitch one tool behind another as a harrow behind a roller. This is a favorite plan because it is so easy to make the hitch with a couple of short chains and some hooks on the roller frame.

I also use a roller behind a harrow which I consider really a better combination in most cases for several reasons, 1st.- It leaves the ground rolled which is often a benefit. 2nd.- It makes a better footing for the horses when going over it the next time. 3rd.- It is perfectly killing to lumps great or small, as moist ground is stirred by the harrow, and pressed by the roller with only the lapse of a second or so, and has no chance to become hardened by the sun or wind.

It requires however that the tongue be removed from the roller and a short one substituted, and also a somewhat complicated attachment applied to the harrow to receive the end of the short tongue, allowing it lateral motion in turning and also vertical motion in passing over inequalities in the surface of the ground.

See Figure 13.

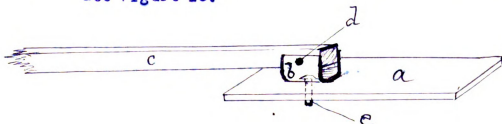


Figure 13.

A. Foundation of wood or iron of any shape convenient for fastening to the harrow.

b. U shaped piece of iron or wood to which the roller tongue c. is attached by means of the pin d.

e. Bolt by means of which b. turns on a.

In hitching four or six horses to a tool having a pole it is necessary to guard against putting too much weight on the necks of the horses.

I have in mind my own disc harrow on which the place for the whiffletrees was originally above the tongue, but which I have changed to a point a considerable distance below.

Figure 14 gives approximately accurate measurements taken from this tool which will serve to illustrate this point.

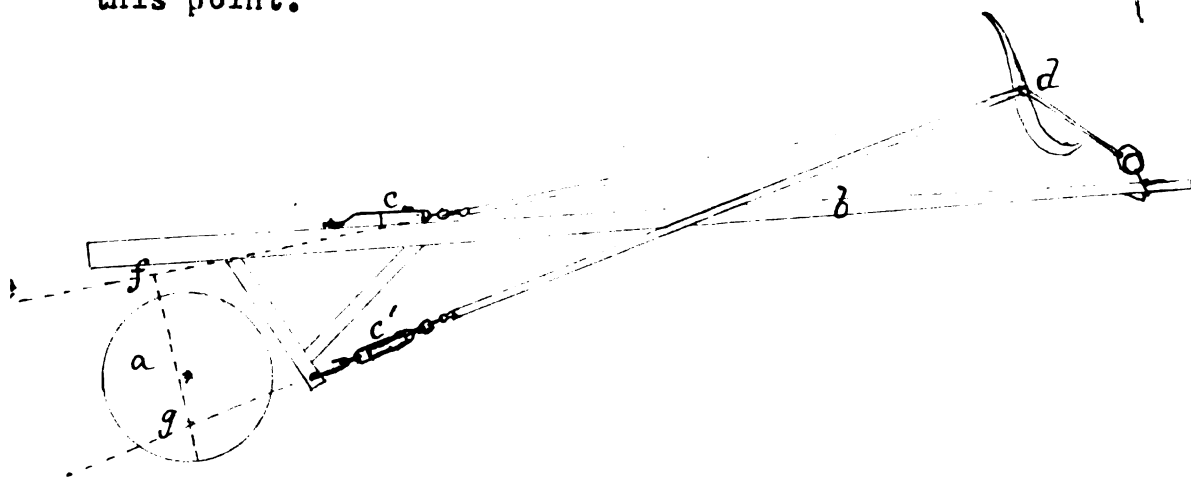


Figure 14.

- a Disc.
- b. Pole.
- c. Whiffletrees in original position.
- c' Whiffletrees in new position.
- e.c.d. Trace in original position.
- c'.d. Trace in new position.
- d. Point of attachment to hames both of trace and breast straps.
- e.c. Trace produced.

Now with the whiffletrees c. in the original position, f.g. at right angles to e.c.d. would represent the short arm of a lever with the horses attached at f., the fulcrum at g. and g.d. the long arm bearing on the necks of the horses at d.

Then the short arm f.g. which is 1 1-2 feet :g.d.

which is 13 1-2 feet :: 1 : 9

From which we see that when the whiffletrees are placed at c. 1-9 of the entire draught of the horses comes on the neck of the team.

This harrow originally intended for two horses, when set to its full capacity furnishes abundance of work for four.

Now let us hitch on four horses with the two middle horses carrying with tongues an a set of four horse whiffletrees weighing 50 pounds at c. add to this 1-9 of the entire draught of the four and we will have a weight on the neckyoke sufficient to soon lay the team up with sore necks, - Moral- Put the whiffletrees at c.

To the average farmer, four horses appears to be a ponderous and unwieldy team, when in truth it is not a hard team to drive, and can be handled with ease in a good large garden, and I believe that many a farmer who has driven horses all his life, would as readily undertake to run the Erie Rail Road, as to hitch up and drive six, still they can be handled to advantage in any medium sized field, that is not full of objections and after one has become used to such teams, the feeling on going to work with two is that of throwing away ones time and probably not less so than in case of a man used to driving two or three horses on going to work with only one.

I have spoken of driving large teams in cultivating the soil and I believe that four horses ought to be a very common team for hauling loads on the road, a large part of the farm produce of Michigan, is hauled from three to five miles, to market, and much of it farther, and all by teams of two horses, each driven by a man who with a little practice, might just as well drive four and haul nearly or quite, twice as much.

Farmers frequently pass my door hauling loads with two overworked horses, when I know they have horses lying idle at home that might just as well help to haul much larger loads and still have the work easy for all.

What is the reason of this, - Our roads are straight- our bridges are good- We can hardly think

[illegible]

that our men and boys, are not as capable as in other countries, and in other parts of our own country, where four horse teams are common, both on the farm and on the road.

I can see nothing in it but a habit, A wasteful , shiftless habit, in which the whole community has indulged, till a four horse team in the hands of a farmer is considered a dangerous monstrosity, only to be used in case of absolute necessity, and then with two drivers and a footman.

Such a state of things, is an indoustrious and energetic community, where we boast of our quickness, to adopt and carry out every new plan, for making aor saving money and where every man is a teamster is a paradox of folly beyond my comprehension.

I can only compare it to the state of things that missionaries say exists in barbarous countries, where the people cultivate the ground with crooked sticks, and though freely furnished with improved implements, throw them away and return to therewold methods.

What is the matter of the farmer? The trouble is that he lacks education in the principles of mechanical and engineering,- The principles that govern that application of power to work.

The horse is the farmers engine, and he will never have any thing but a two or three horse power, until the agricultural implements manufacturer, moved by his own selfish interest, gets up one for him, unless he makes an effort in this direction himself.

Professor Barrows, Dr. Beal, and Dr. Kedzie, can answer his entomological, botanical, and chemical questions better than he can hope to do himself. But mechanical questions arise almost daily that if solved at all must be solved immediately and by the farmer, himself, and without slighting the others, these are the questions that he ought first of all, to prepare himself to solve if he hopes to advance.

Education cures the barbarian of plowing with a crooked stick, and the right kind of education, will cure the Michigan farmer of wasting his time in large smooth fields, and on straight turnpikes, with the

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same team that his grandfather used, when he had only a little patch of stumpy clearing, no bridges and no roads.

1. The first step is to identify the problem or question that needs to be addressed. This involves understanding the context and the specific requirements of the task.

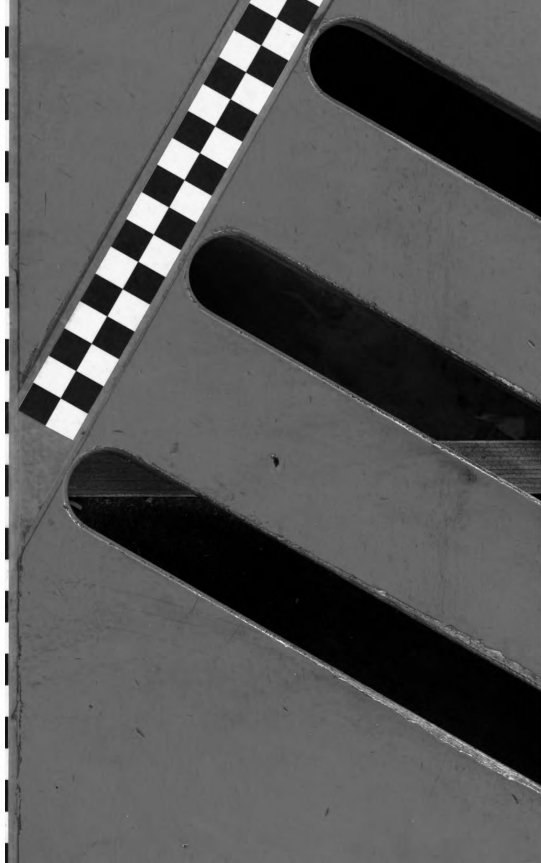
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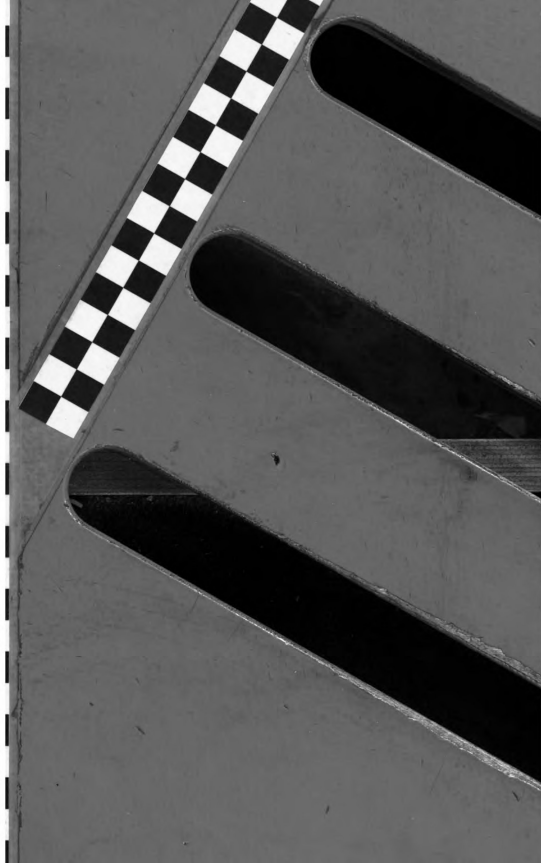
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