

**Deere & Company's
Early
Tractor Development**

By Theo Brown

1953

F O R E W O R D

The material used in this report was gathered from many sources, and pieced together to form a connected and comprehensive account of the earliest activities of Deere & Co. in tractor design and development. An endeavor has been made to record the thinking that prompted these activities, to record what was done, and also to tell why these various early activities were discontinued.

This report will reveal that many features in tractor design, which today are considered both desirable and novel, were incorporated in these early tractors of Deere & Co. -- as, for example, Sklovsky's one-piece cast iron body; Melvin's integral power-lift plows; Dain's transmission, changing from low to high speed without stopping the tractor; reversing the tractor for certain operations (Melvin's tractor), and the single-row motor cultivator.

In the early days of tractor development, creative thinking went beyond the ability to transform such thinking into practical use. Had today's engineering knowledge and manufacturing technique been available at that time, many of the novel ideas would have proved commercially successful.

On March 14, 1918, Deere & Co. purchased the Waterloo Gasoline Engine Co. This report covers the activities of the company up to that time, and is divided into six sections, of which the first five are devoted to as many distinct projects by Deere & Co. engineers:

1. The Melvin Tractor (1912-14), Page 2.
2. The Dain Tractor (1915-18), Page 9.
3. The Sklovsky Tractor (1915-16), Page 48.
4. The Single-Row Motor Cultivator (1916-17), Page 58.
5. The Two-Row Motor Cultivator (1917-19), Page 78.
6. Directory of Other 1916 Tractors, Page 107.

The Appendix contains information about men mentioned in this report. Acknowledgment is given to the following for their assistance: Nathan Lesser, Walter Silver, Joe Dain, Leonard Neighbour, Fred Kirby, Miss Martha McCormick (Elmer McCormick's sister), and FARM IMPLEMENT NEWS magazine. Much information was gathered from the records of Deere & Co. Board of Directors' meetings, from the files of the Deere & Co. Patent Department, and from the diaries of Theo Brown.

DEERE & COMPANY'S EARLY TRACTOR DEVELOPMENT

By Theo Brown

Chapter 1 --- THE MELVIN TRACTOR

THERE WAS A TIME when the opinion of agricultural leaders differed as to the practicality of gas tractors -- when many farm implement manufacturers wondered whether they should build gas tractors or attempt to ignore them.

For that reason, this record of the early participation of Deere & Co. in the development of gas tractors logically begins with March 5, 1912, for on that day the Deere & Co. Executive Committee passed a resolution which was to influence the Company's entire future. It read:

"RESOLVED: That in view of the inevitable future use by farmers for diverse purposes of gasoline and kerosene tractors, and especially since the trend is to use them in connection with implements, particularly plows, it seems vital to the interests of this Company that serious cognizance should be taken of the situation, and that through its experimental department, the personnel and talent of which shall be increased, if necessary, a movement to produce a tractor plow should be started at once having in view constantly, that the success of the same would be enhanced if not assured, were it possible to divorce the tractor from the plow and to thus make it available for general purposes."

On May 23, 1912, Mr. Mixer reported that Mr. Max Sklovsky had fully investigated the various tractors, with conclusions as follows as to the best tractor in each class:

Heavy tractor class -- Aultman-Taylor

Smaller tractor class -- Avery

Motor plow class -- Hackney

On July 1, 1912, C. H. Melvin was transferred from the Experimental Department of the John Deere Plow Works to the General Company and given the assignment of designing and building an experimental tractor plow.

A room in the Plow Works was provided for Mr. Melvin, and there he built the tractor shown in Figures 1 through 7.

Records show that a total of \$6,000 was expended for this purpose. There are no records to be found that refer to the performance of this outfit in the field, but Joe Dain remembers that the results were disappointing both as to field performance and keeping the tractor from breaking down.

Only one Melvin tractor was built.

Figures 8 and 9 show two drawings incorporating some ideas of Max Sklovsky for a motor plow. One is dated July 15, 1912, and the other August 24, 1912, but such a tractor was not built.

The general layout of Mr. Sklovsky's drawings has a semblance, in some aspects, to Melvin's tractor. Both Melvin and Sklovsky must have been influenced by the design of the Hackney motor plow (Figure 10).

In 1914 it was decided to stop any further development work on the Melvin motor plow. The transition from the heavy, slow moving tractors pulling 12 to 16 plows to a small tractor that could pull 3 plows was well under way.

Some of the first efforts to design a small tractor resulted in mounting the plows under the tractor frame midway between the front and rear tractor wheels. The Hackney motor plow was an early example of such a construction and Melvin followed the idea in his tractor. This type of tractor was not successful.

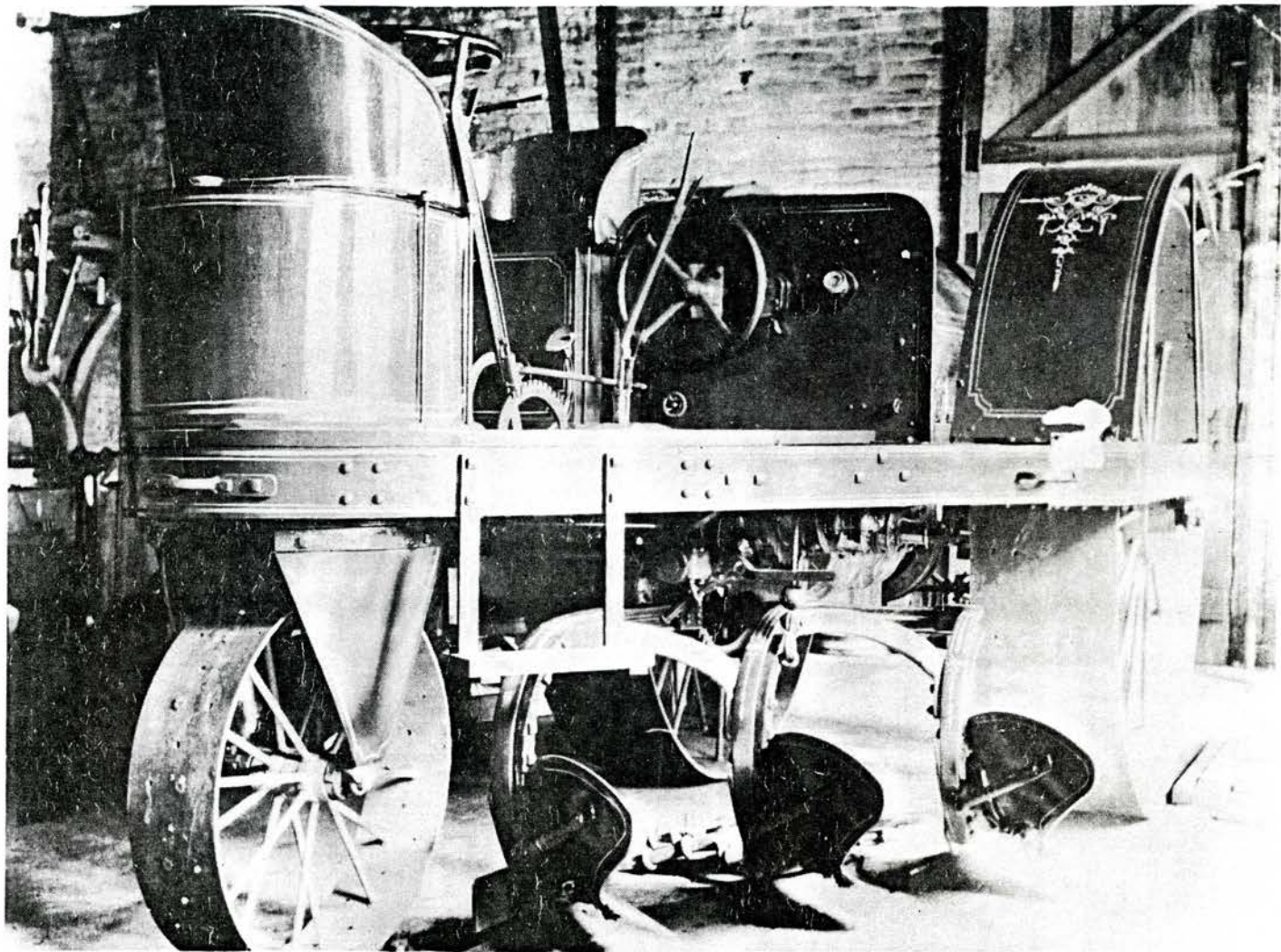


Figure 1

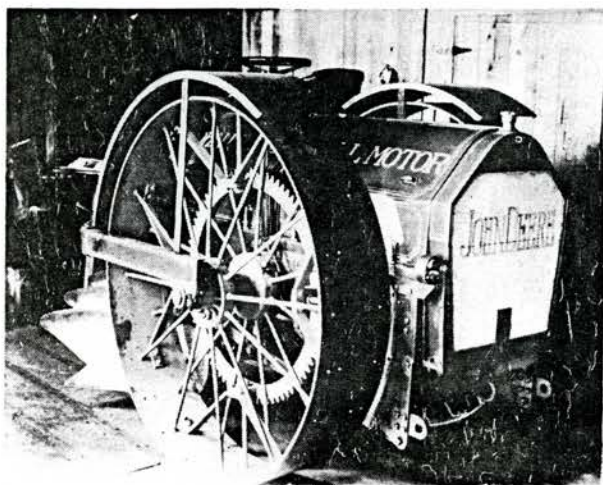


Figure 2

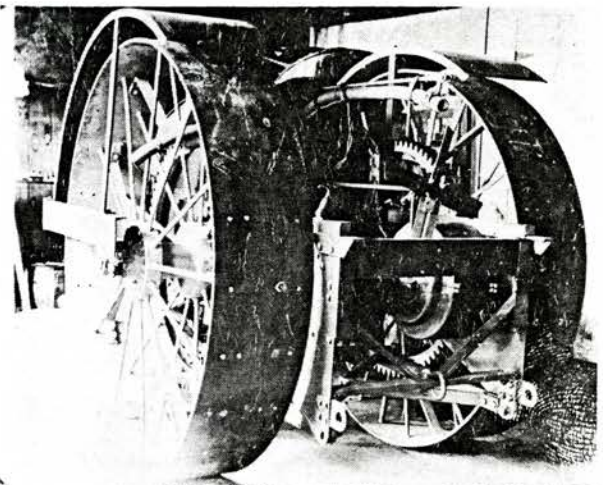


Figure 3

FIGURES 1, 2, and 3 -- C. H. Melvin's tractor, built at a cost of about \$6000. As will be seen by referring to Figure 10, Melvin designed a tractor similar in many respects to the Hackney Motor Plow, on which Leslie A. Hackney had made application for patent letters in 1910. Figure 3 shows Melvin's tractor with hood and radiator removed.

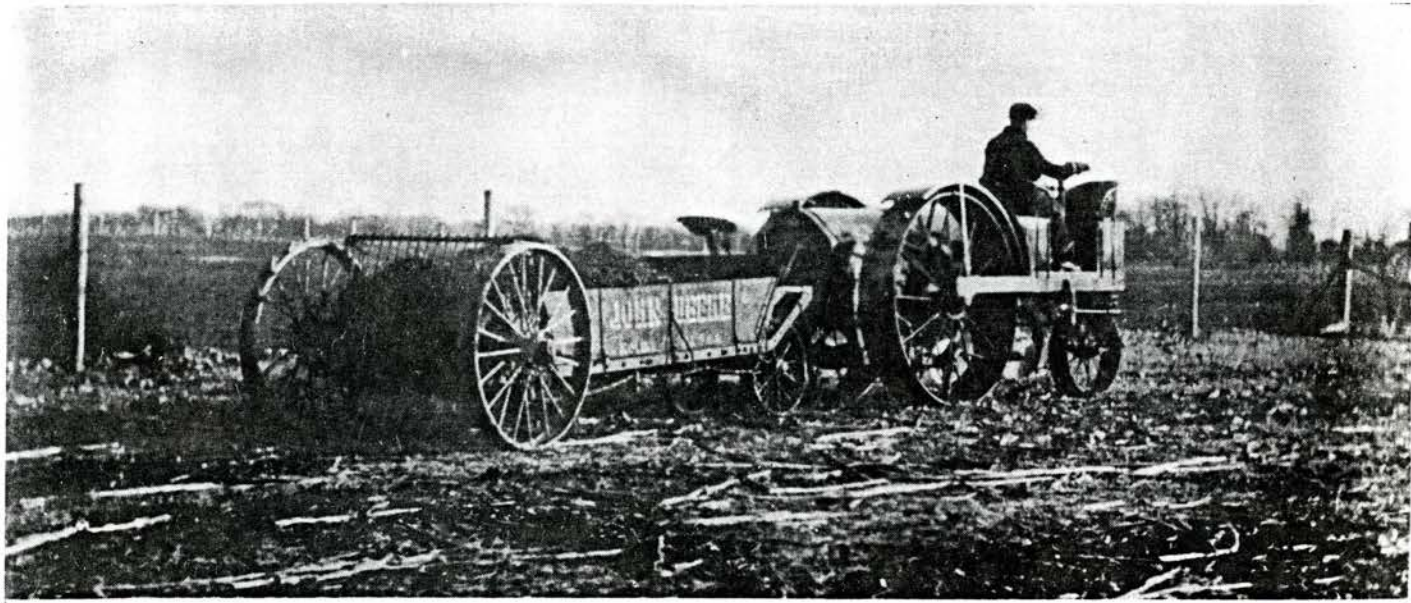


Figure 4

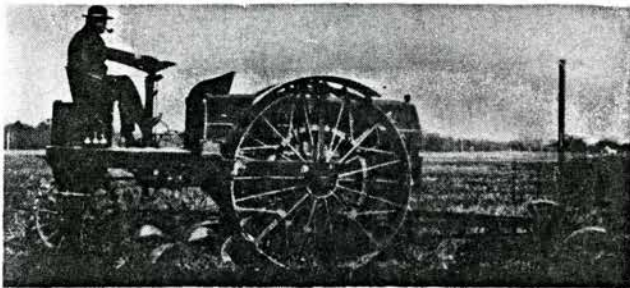


Figure 5

Figure 6

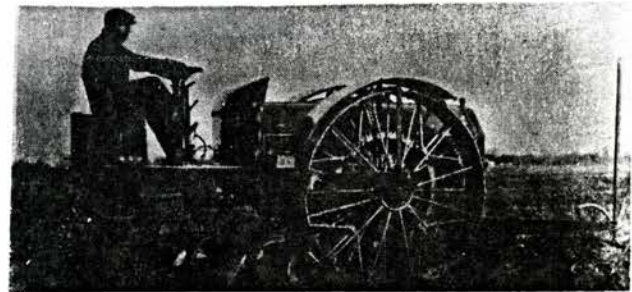
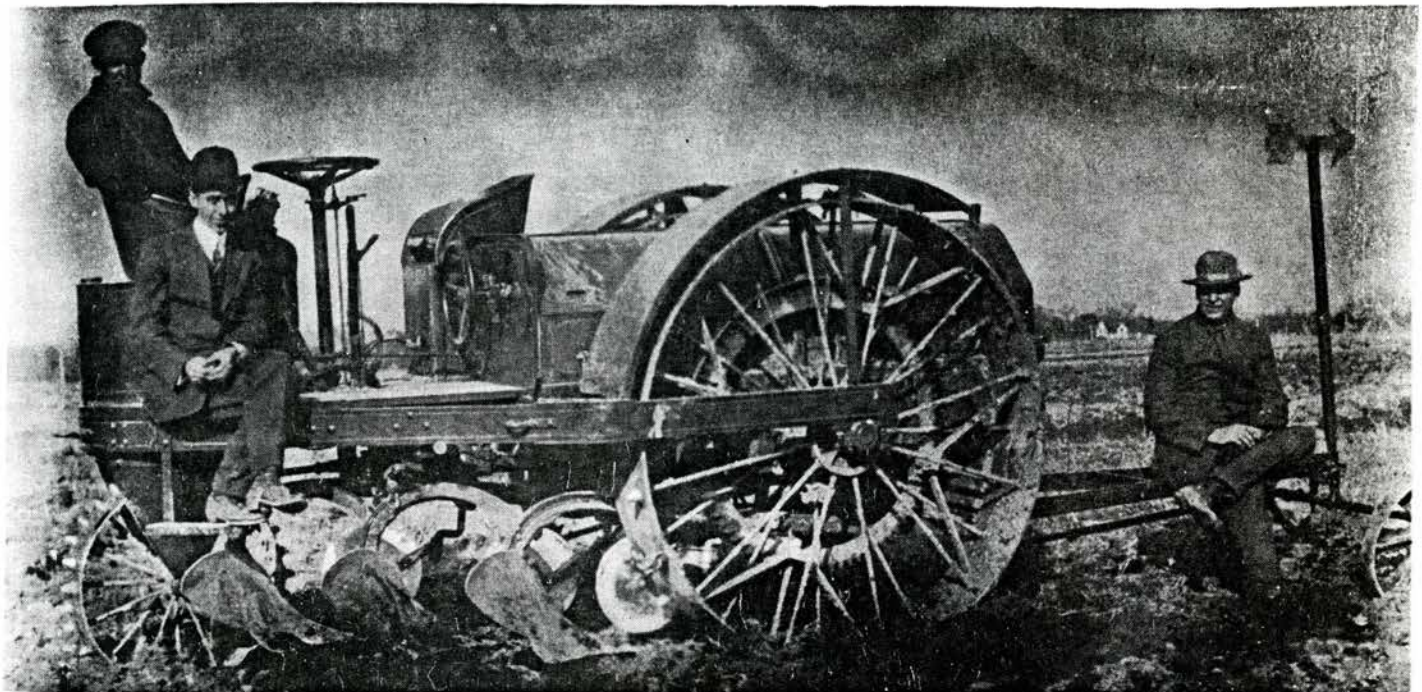
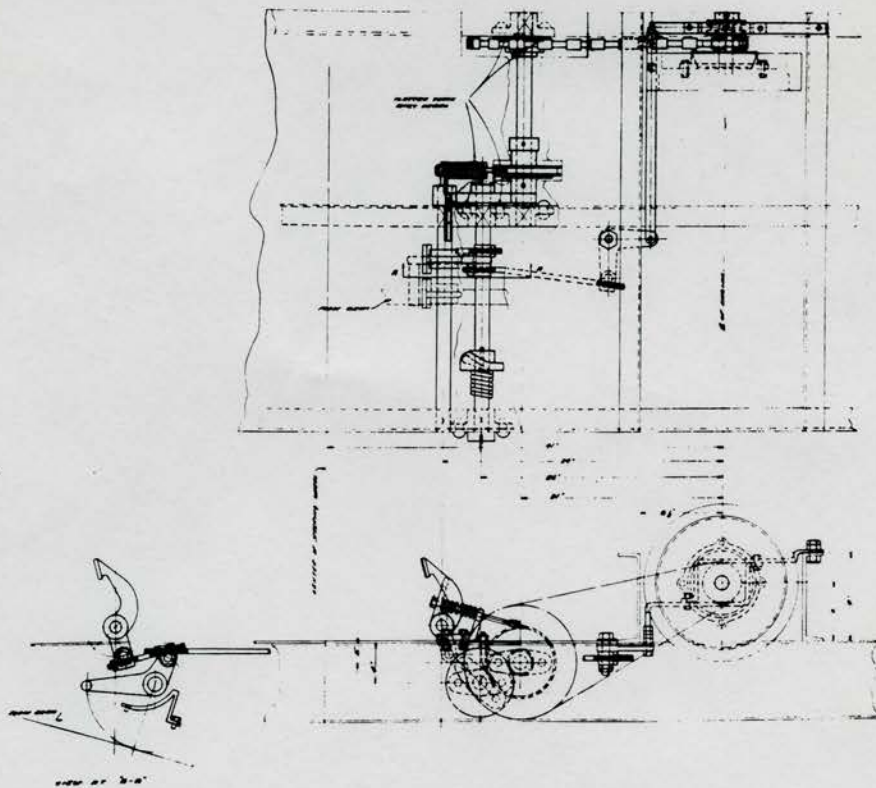


Figure 7

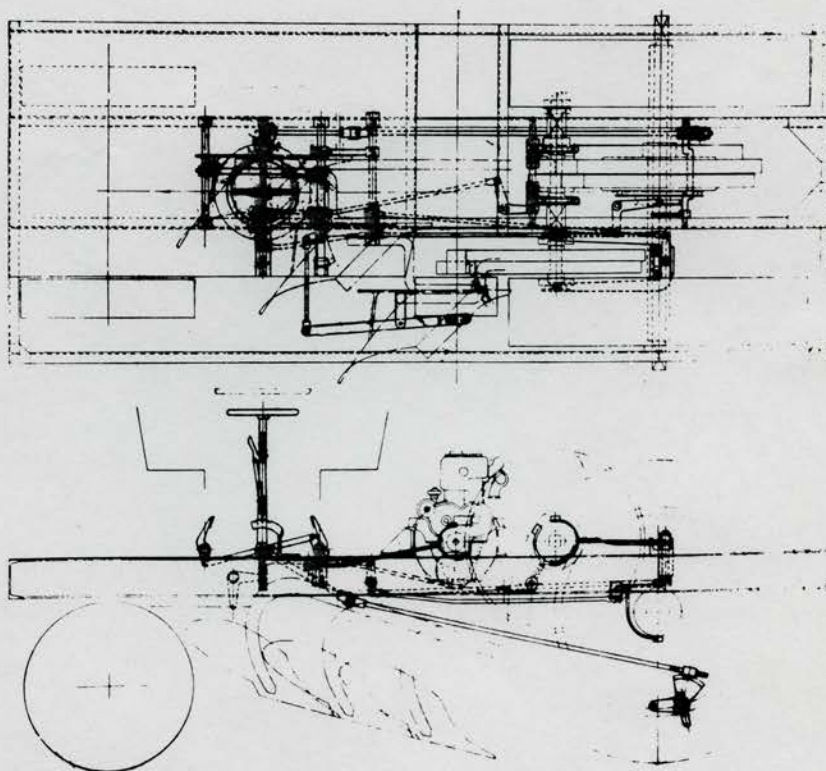


FIGURES 4, 5, 6, and 7 -- Melvin's tractor had two driving seats with centrally located controls, so it could be driven in either direction. For drawbar work, the tractor (see Figure 4) ran in the opposite direction from plowing. All tractor wheels ran on unplowed ground, but a front-mounted guide device had one furrow wheel to assist the operator in maintaining the desired cut.



E-203-22
8-24-1912

ENGINEERING DEP.
OSBORN & CO. ROCHESTER, N.Y.

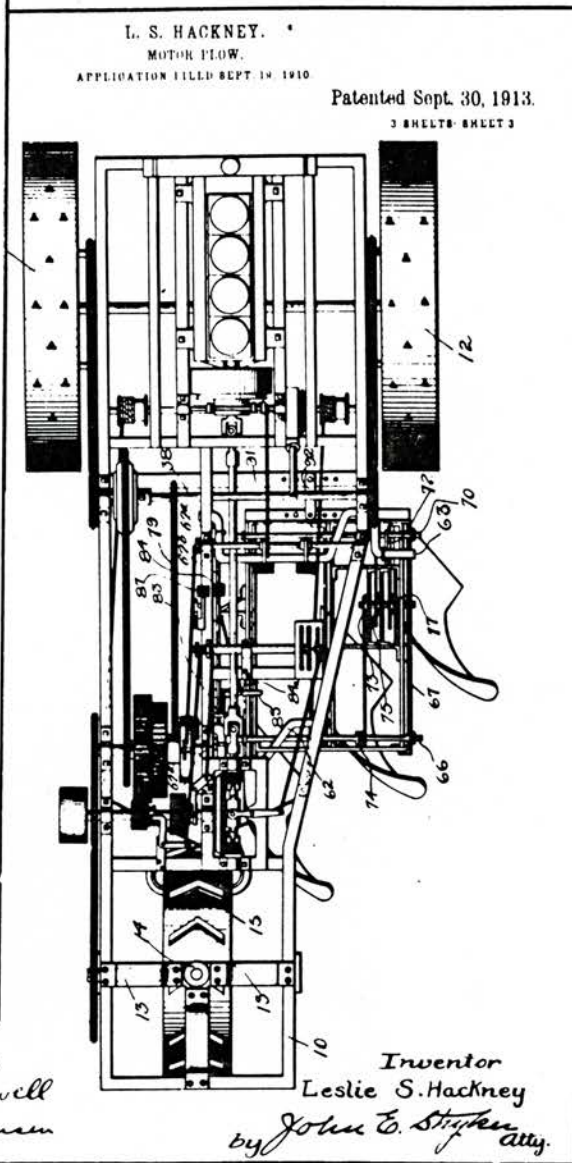
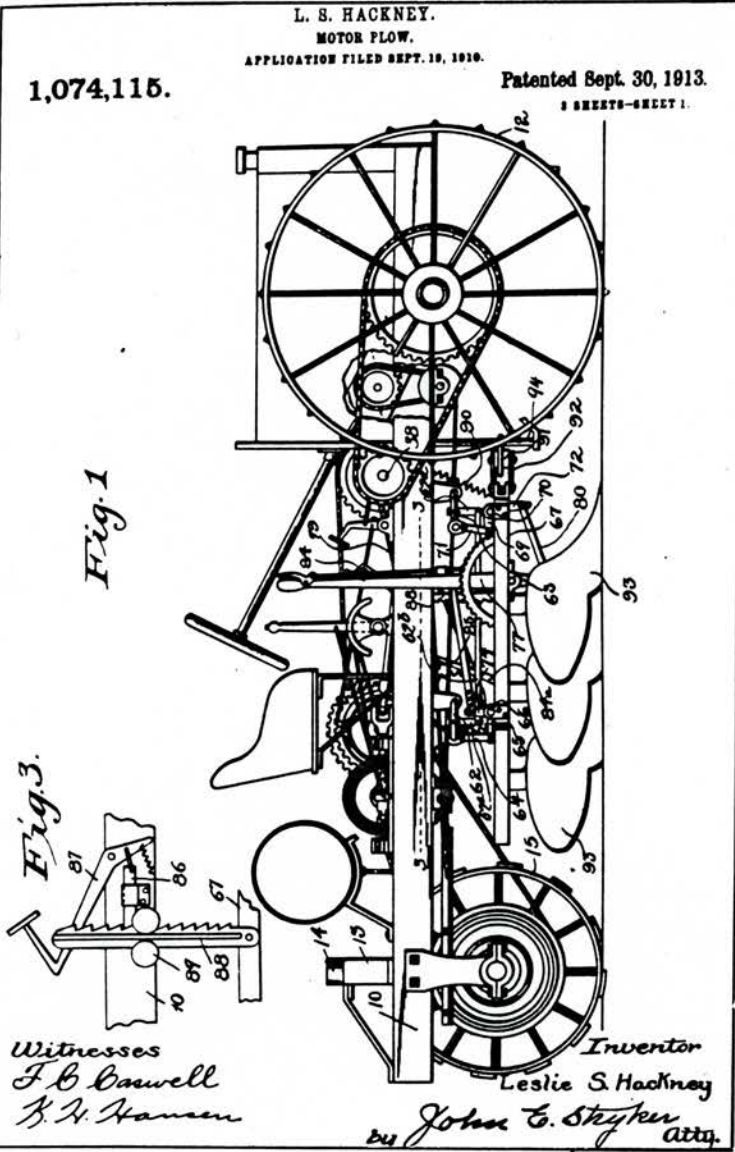


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7-15-1912

ENGINEERING DEP.
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Figure 9

FIGURES 8 and 9 -- Mr. Sklovsky made these motor plow sketches in July and August, 1912. The sketches bear similarity to the design of the Hackney Motor Plow, which Mr. Sklovsky had determined was outstanding in its class when he investigated various tractors earlier that year.



Having described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In a plow of the class described the combination of a main frame, supporting wheels therefor, a plow frame carrying plows beneath said frame and between said wheels, a swinging support on the main frame for the plow frame and means for adjusting said plow frame vertically with respect to said support.
2. In a plow of the class described the combination of a main frame, supporting wheels therefor, a plow frame carrying plows beneath said frame and between said wheels, power driven cranks on the main frame for lowering and raising said plow frame, means extending above the main frame for adjusting the plow frame vertically with respect to said cranks and a draw bar connecting said frame.
3. In a plow of the class described the combination of a main frame, supporting wheels therefor, a plow frame beneath the main frame and between the wheels, plows on said frame, a pair of power driven cranks on the main frame for raising and lowering the plow frame, levers on said frame for adjusting the forward end of said plow frame relative to one crank and

the rear end of said frame relative to the other crank.

4. In a plow of the class described the combination of a main frame, supporting wheels therefor, a plow frame carrying plows beneath the main frame and between the wheels, cranks on the main frame, connecting means between the cranks and plow frame, said cranks being adapted to raise and lower said plow frame, and levers for operating said connecting means whereby said plow frame is adjusted vertically with respect to said cranks.
5. In a plow of the class described the combination of a main frame, supporting wheels therefor, a plow frame carrying plows beneath the main frame and between the wheels, power driven cranks on the main frame, transverse shafts rotatable on the plow frame, arms on said shafts, link-connecting said arms and cranks, a second set

of arms on said shafts, and levers connected with said last mentioned arms for moving the same and rotating said shafts whereby the plow frame is adjusted with respect to said cranks.

6. In a plow of the class described, the combination of a main frame, wheels journaled thereon, a plow frame carrying plows, movable supports on the main frame forming a mounting for the plow frame and levers on said plow frame for tilting the same laterally and longitudinally on said supports.

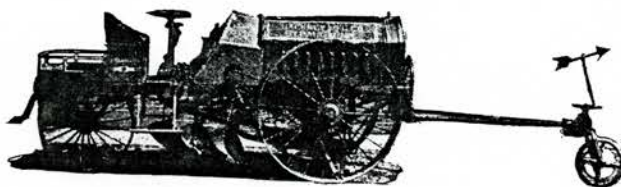
In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

LESLIE S. HACKNEY.

Witnesses:
ASHLEY COFFMAN,
LOUIS JOHNSON.

Figure 10

FIGURE 10 -- Hackney's 1910 Motor Plow. Power-driven cranks raised and lowered the three bottoms. The rear wheel was pivoted to provide a means for steering.



HACKNEY AUTO PLOW 16-30.
 Hackney Mfg. Co., St. Paul, Minn.

Traction Wheels: Three wheels, with two drive members, 60 x 14 in. front.
 No. of Plows Recommended: Three self-contained 14-in.
 Length: 170 in.; Width: 76 in.; Height: 65 in.; Weight: 8,000 lbs.; Price: \$1,650, including plows.
 Turning Radius: 16 ft.
 Motor: Climax; 5 x 6½; vertical, L-head, 4 cylinders, cast in pairs.
 Lubrication: Force feed system.
 Carburetor: Kingston double bowl.
 Ignition System: Dixie high tension magneto.
 Bearings: Hyatt roller and babbitt in transmission and babbitt on drive axle.
 Cooling System: Water circulating, with pump and fan.
 Transmission: Sliding gear, 2¼ to 4½ m.p.h. forward.
 Final Drive: Internal gears enclosed.
 Belt Pulley. 34 x 8; 350 r.p.m.

Figure 10A

FIGURE 10A -- This photograph and description of the Hackney Plow appeared in the third edition (1918) of the Cooperative Tractor Catalog published by Implement & Tractor Trade Journal.

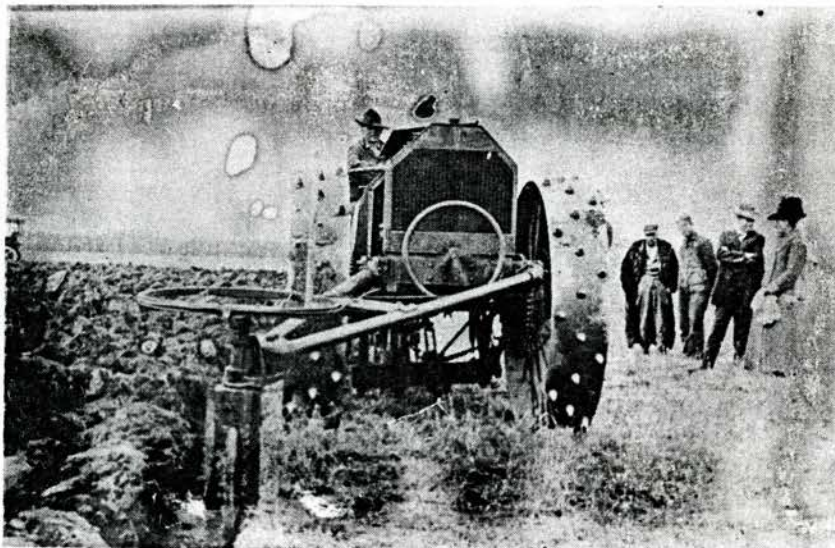


Figure 10B

FIGURE 10B -- This photograph, owned by the University of Illinois, carries the following caption: "A. N. Munson's Hackney tractor with self-steering device used at Fremont plowing contest in 1917."

DEERE & COMPANY'S EARLY TRACTOR DEVELOPMENT

Chapter 2 -- THE DAIN TRACTOR

In 1914 Deere & Co. was skeptical about getting into the tractor business, but realized that further development work should be carried on. This hesitancy of Deere & Co. can best be expressed by quoting from the Company records. These records also give the story of the Dain tractor.

"May 27, 1914. Mr. Dain was asked to report to the Executive Committee whether or not a tractor could be built to sell at about \$700.00 and in the meantime to suspend work of development until his report is made.

"June 9, 1914. Mr. Dain said he was working on a plan which he would submit as soon as completed. It was Mr. Webber's idea that we should decide very soon whether or not a light tractor could be built to sell to the farmer for about \$700.00. Mr. Dain further stated that the tractor he is planning would operate a 3-bottom plow.

"June 24, 1914. ^oResolved, That the preliminary work of designing an efficient small plow tractor be continued under the auspices of Mr. Dain and the Experimental Department. ¹

"September 8, 1914. Mr. Dain reported that \$6,000 had been expended in connection with the work done by Mr. Melvin and further stated he thought he could build a light tractor for experimental purposes for about \$3,000.00. Approved.

Dain Asked to Continue

"February 13, 1915. Mr. Dain has developed a small experimental tractor (Figure 11) and it is questionable whether we should enter into the manufacture of this machine. ^oNow, Therefore, Be It Resolved, That Mr. Dain continue his work with the tractor now built until he considers it perfected, and that it be ascertained at that time the amount we have invested, for the purpose of fixing a basis upon which we would sell the same to a separate company for its development and sale. Also, that Mr. Dain advise the basis upon which his transmission can be used in said tractor. ¹

"March 9, 1915. It was the sentiment of the Board that Mr. Dain should continue his work in connection with the tractor, give it a thorough trial in the field, and continue its development; that the present was not the time for Deere & Co. to decide whether it should go into the tractor business or not; that might seem wise later and it might not; that the wise thing for the company to do was to watch the development of this business, and also watch and develop the tractor, in order that the Company might be ready for any emergency.

"Mr. Dain reported that up to date the amount expended on the present tractor was about \$2,890.00.

"May 1, 1915. The general situation in reference to the new tractors was discussed.

Webber Requests Field Trials

"Mr. Lourie stated that the tractor people are selling plows right on their tractors, and that it is going to interfere with the wheel plow trade. Mr. Webber stated that he had been pretty well satisfied to leave the matter the way it was because the situation in all territories was not alike. What he meant was, that we did not know what we had in that tractor yet, until it had done a lot of work. He stated that Mr. Dain was going to revise the next one he builds, and is going to make some improvements. He thought that the tractor ought to be kept at work to find out the weak places, and that the next one should be sent to the Minneapolis territory where it can plow 300 or 400 acres. Mr. Lourie thought that we should get out at least five tractors and put them in various conditions.

"Mr. Butterworth stated that we had repeatedly told our bankers that we were not in the tractor business and were not going into it. Mr. Lourie stated that the idea had occurred to him, that it might be feasible to have an independent company organized as a selling company, and to let our factory here produce the tractors and the sales company sell them.

"Mr. Webber stated that, with the danger ahead of losing plow trade, as suggested by Mr. Lourie, we ought to be prepared to keep moving. He stated that he was very much impressed with the opinions of Mr. Schutz and Mr. Hornburg on the Dain tractor. They stated that they had never seen a tool or an implement that impressed them so favorably as that machine. They believed it had great qualities and would be a tremendous success if put on the market.

Other Tractors Heavy and Clumsy

"Mr. Webber thought that we could go out and say that Deere & Co. is going to put this engine on the market; that it is an engine that will pull three plows, and two in difficult plowing; and that it is a good engine, or Deere & Co. would not make it. He thought that the bankers had very good reasons to be scared about gas tractors, but that they had in mind the Rumley, the Emerson and the Hart-Parr people. They have made a heavy, clumsy machine and have made a failure, and have not made any money. They think it is something we are going to sell on two or three years' time, while we are talking about something that is entirely different and that will go to the farmer. He thought that the question to be decided in the end was whether this machine or any little engine is going to be an economical thing for the farmer to buy. That we do not know as yet.

"The following resolution was unanimously adopted:

"RESOLVED. That without attempting to at this time define our final policy toward the tractor business further than the resolution passed at the Directors' meeting held February 13, 1915, but with the view of trying out more thoroughly the Dain tractor, Mr. Mixter be requested to cooperate with Mr. Dain in order to hasten the try-out of the present machine and to determine upon the improvements that should be made in it, with the authority to build from three to six of the revised experimental tractors to be thoroughly tried out this Summer and Fall."

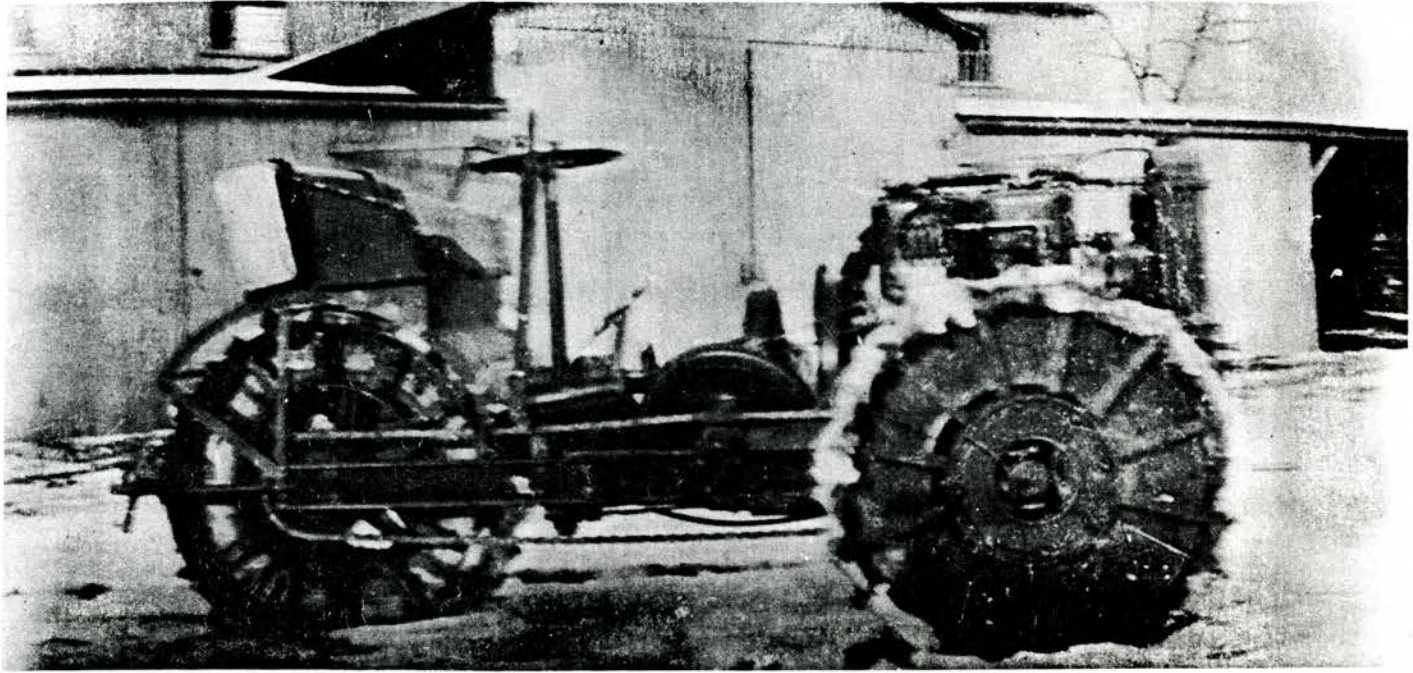


Figure 11

FIGURE 11 -- This photograph, probably made in February, 1915, shows the first experimental tractor built for Deere & Co. by Joseph Dain, Sr., after development of the Melvin motor plow was discontinued. The "all-wheel" drive was an important advantage (over other contemporary tractors) of this and subsequent Dain tractors.

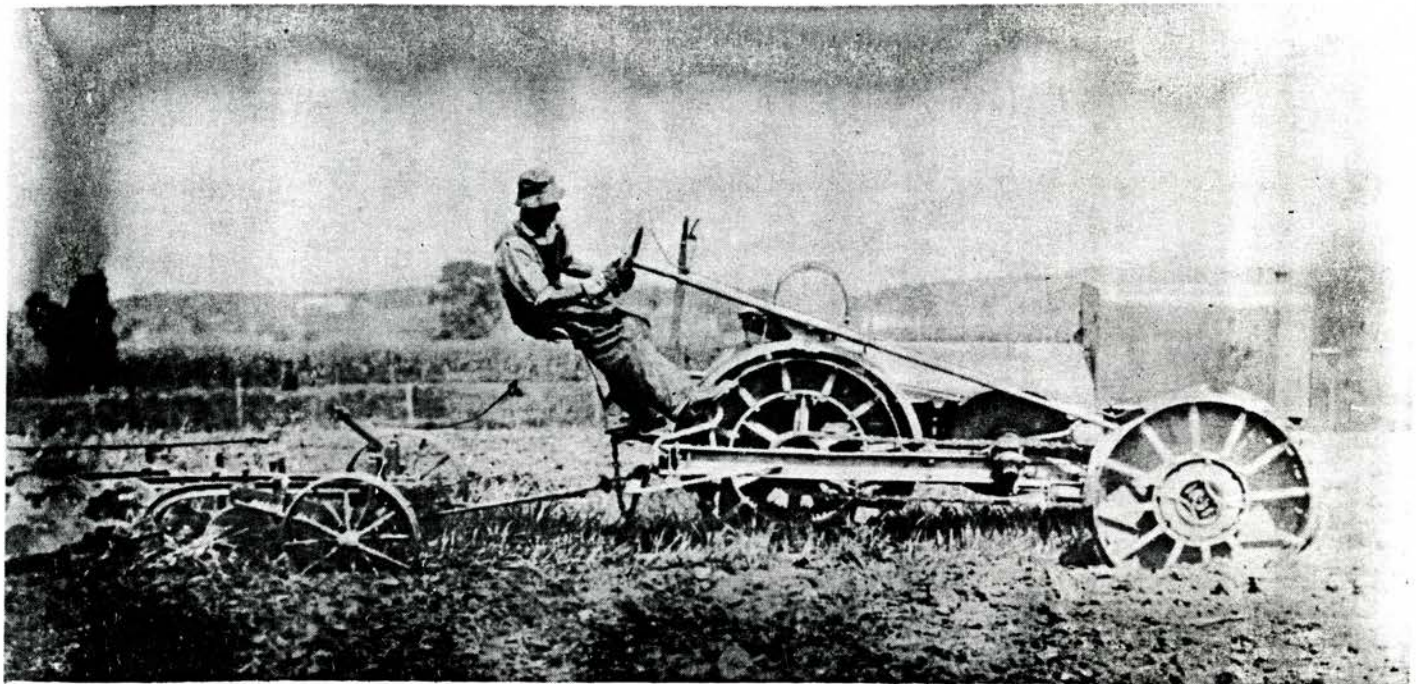


Figure 12

FIGURE 12 -- This shows Mr. Dain's second experimental tractor, which was completed in the fall of 1915, plowing heavy, wet gumbo in the Red River Valley near Winnebago, Minn. The cost for 80 acres of 6-inch plowing (three 14-inch bottoms) was 59 cents an acre, including the operator's time at 30 cents an hour.

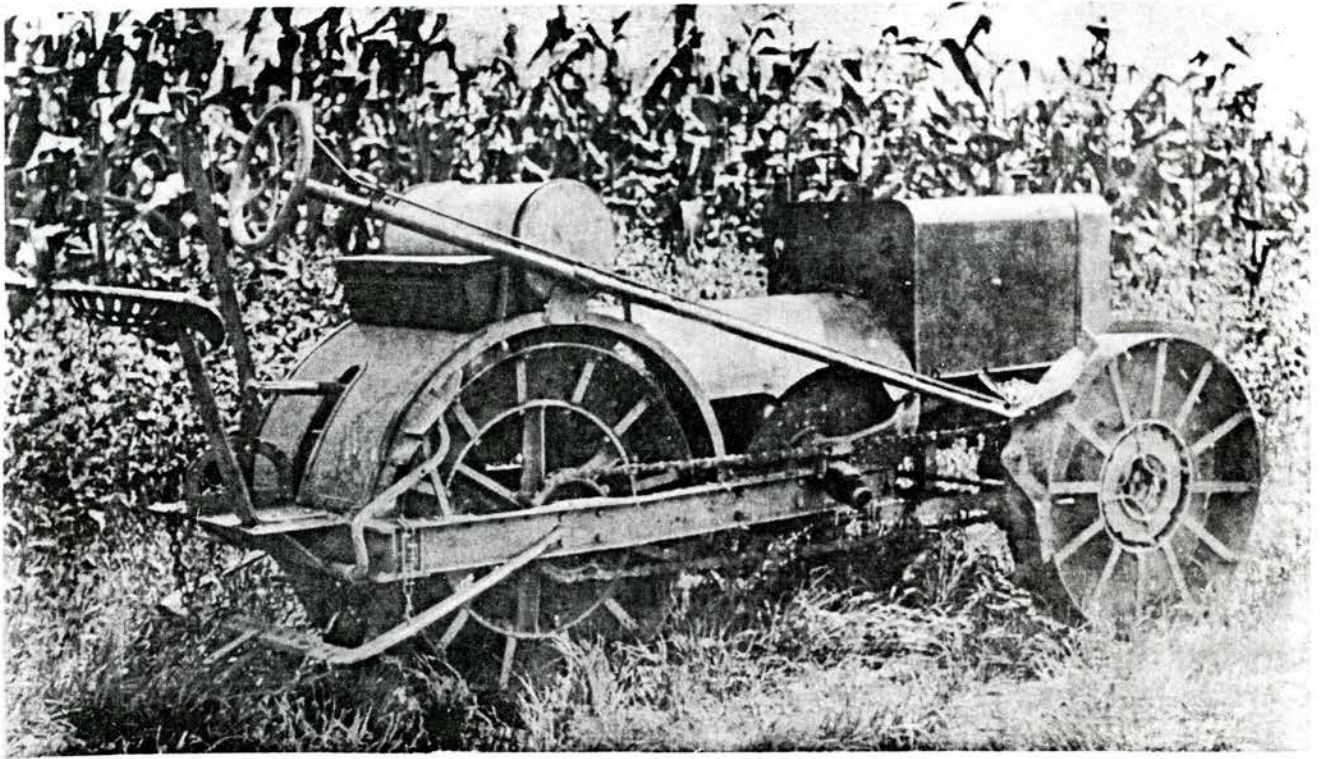


Figure 13

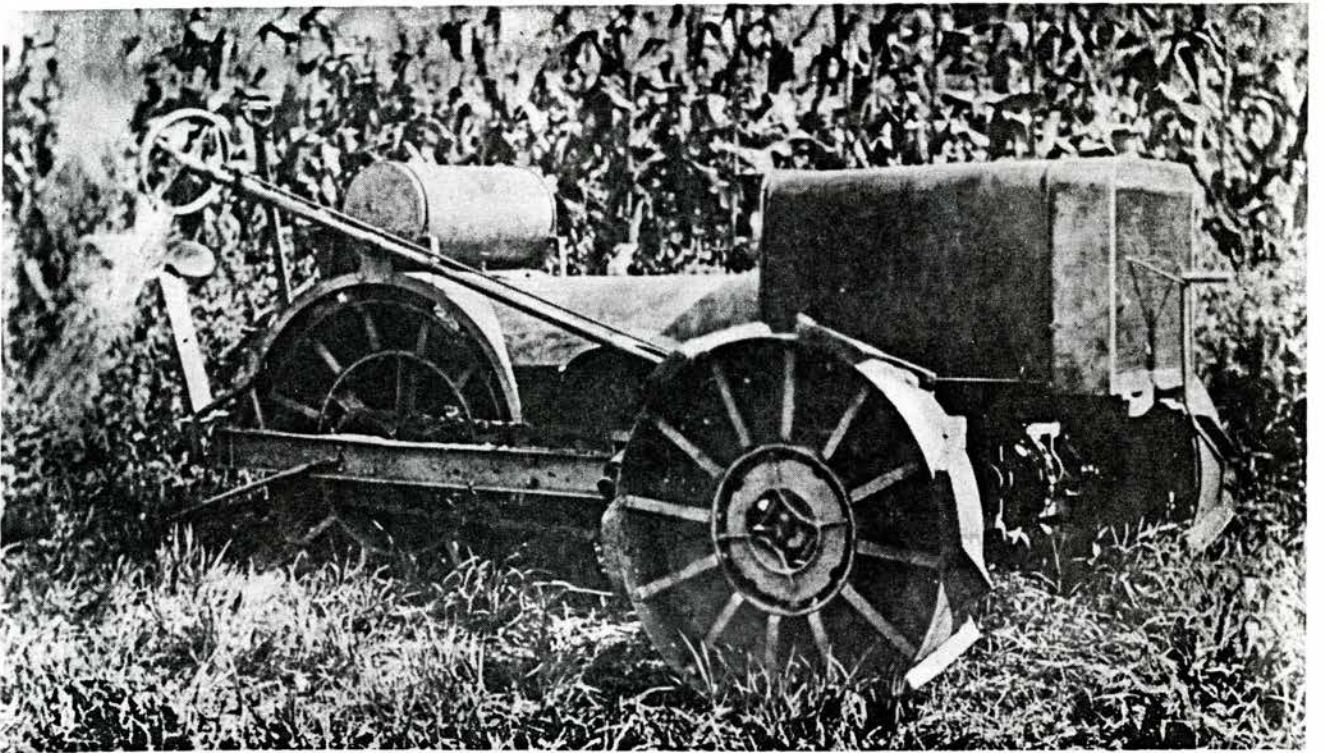


Figure 14

FIGURES 13 and 14 -- Two additional photographs of Mr. Dain's second tractor. His third experimental tractor, completed in December, 1915, was practically identical to the one shown here except for the transmission; a positive gear-driven transmission was used instead of a friction transmission.

Mr. Dain Makes Full Report

"December 16, 1915. Mr. Dain presented the following report on experimental tractors.

"We have, to date, made three machines - two with friction transmissions, and one with a gear transmission that in all other respects follows the same general plan as the friction machines.

"The first tractor, weighing about 3800 pounds, was finished last winter and tested in the shop for strength and power. We obtained in these tests, by means of artificial traction, a steady draw-bar pull of 5000 pounds, on slowest transmission speed. As soon as the weather permitted we put the machine in the field and obtained a draw-bar pull of over 3000 pounds with our natural traction.

"In plowing we first tried the machine in five-year-old clay sod, pulling the three 14" bottoms at two and one-half miles per hour. After plowing all Spring, we pulled two binders in heavy oats at an approximate speed of three miles per hour. This Fall we sent the tractor to Mr. S. H. Velie's farm near Kansas City, where it plowed about 85 acres. The conditions here were about the most difficult we have had as the land is hilly and the soil in the draws a very heavy clay that was harder to plow this Fall than usual owing to the heavy summer rains followed by hot, dry weather.

Minor Mechanical Troubles

"No accurate record has been kept of the amount of work done by this first machine, but it will easily amount to over three hundred acres. We have been very well pleased with its performance, considering that, as it is entirely different from any other tractor, on the market, we did not have anyone's previous experience to guide us. The first chains were too light, causing some breakage, but this has been entirely overcome by putting on a little heavier chain. We broke two front ratchets, which was easily remedied by making them of a little better material. The front wheel drive has proven very satisfactory, and has demonstrated to us that this is a most desirable feature.

The gears in the rear wheels show considerable wear. We had at first considerable trouble with the motor overheating, but since putting on a radiator recommended by Long Mfg. Co. and a larger size fan we have had no further trouble of this character.

Machine No. 2

"This tractor (Figures 12, 13, and 14), weighing about 4000 pounds, was finished this fall, and after plowing about fifteen acres near Moline was sent, at the request of Mr. Webber, to Winnebago, Minn., where it plowed eighty acres at a cost of fifty-nine cents per acre, counting the man's time at thirty cents an hour. The soil here was of heavy black gumbo and was in poor plowing condition owing to the almost continual rain - several days we plowed the neighboring farmers thought it too wet to plow with their horses. We pulled three 14" bottoms 6" deep at two and one-half miles per hour. The farmer plowing on the next field was using five good horses on an 18" sulky - he tried using six horses on a New Deere gang, but the draft was too heavy for them.

Machine No. 3

"This is the geared transmission machine, and has just been finished. It is identical with the other machines, excepting the transmission, and instead of a worm and gear and internal gear drive to the rear wheels has a chain drive - this change necessitated by the transmission we are using, and from the results obtained by the other two machines we believe this type of drive to be satisfactory in every respect.

"Judging from the tests we have made in the shop with this tractor, we believe we are in a position to recommend it for serious consideration and comparison with the friction transmission machine."

"March 14, 1916. Mr. Mixter read to the Board the following telegram from Mr. Dain, in reference to the tractor being tried out in Texas:

"San Antonio, Tex. March 13, 1916

"Deere & Company

"Moline, Ill.

"Have followed tractor closely for two weeks. Conditions extremely hard and rough. Absolutely no weakness in construction. Gears, chains, universals, in fact all parts in good condition. Tractor has travelled near five hundred miles under extreme load. Change speed gear a wonder. I recommend to the Board that we build ten machines at once.

"Joseph Dain."

"Mr. Mixter stated that what little difficulty they have had with the tractor was due to poor material; that he thought Mr. Dain felt that there were some details yet that could be worked out to get the tractor on a manufacturing basis; that this tractor in Texas is the first one of that type that has been tried out - the first gear transmission. The friction transmission has been essentially dropped. He also stated that we could probably manufacture tractors in existing factory capacity of an expenditure for new machinery, patterns, tools, jigs, etc. from \$25,000 to \$50,000.

Board Approves Further Development

"The following resolutions were passed:

"WHEREAS, Mr. Joseph Dain has developed several small tractors which have been experimentally tried out, the latest machine proving successful in Texas for a sufficient time to demonstrate its practicability from a general standpoint, and

"WHEREAS, It is desirable that this machine should now be reconstructed to meet such minor questions as have developed in Texas, and to make it suitable for economical manufacturing and then turned over to a manufacturing organization,

"RESOLVED, That Mr. Dain be requested to reconstruct said tractor with such modifications as may be deemed wise by him and his associates, preparatory to economical manufacturing;

"FURTHER, That the Marseilles Plant (now the John Deere Spreader Works) be directed to take up this tractor work with the object of getting it on a manufacturing basis as a possible part of their regular line;

"FURTHER, That about ten machines be built by the Marseilles Company, at the earliest practical date;

"FURTHER, That both Mr. Dain and the Marseilles Company be directed to vigorously continue tractor development work.

McVicker Designs Engine

"June 13, 1916. Mr. Dain reported that the Marseilles Company had started to manufacture five machines, and that one was being built here at Moline, which would complete six of the ten tractors authorized at the last meeting of the Board. One of the tractors had been shipped to Minot, N.D., and was doing very satisfactory work. A new motor is being developed as rapidly as possible, Mr. Dain stated, with the assistance of Mr. McVicker of Minneapolis. The difficulty experienced with the motors on the market is the inaccessibility of all the parts. This feature is being overcome in the motor which Mr. McVicker is working on at the present time.

"On July 13, 1916, Mr. Mixer reported that: 'McVicker design of engine should be complete about July 17 and in view of preliminary work already done one engine should be complete about August 17.

"We can count on four to six machines of the Dain type with Waukesha engines for shipment in August, providing design of rear axle and transmission is decided on within ten days. We can count on a modest tryout of one or two engines of the McVicker design this fall.

"Original cost figures on this machine were \$736 (1.25 steel) - \$761 (2.25 steel). These figures are based on paying \$200 for the motor. The writer has been over the detailed labor figures on the latest estimates of cost and believes that the machine as today designed with the motor figured at \$200 can be built for \$600 (1.25 steel) cost of manufacture.

"This means, judged in the light of other goods of our manufacture, that the farmer should pay \$1,200 for the machine. This is somewhat higher than has been considered admissible for a three-plow tractor. It is the writer's belief, however, that an all-wheel drive will ultimately be the tractor the farmer will pay for."

Extensive Field Tests

"September 12, 1916. Mr. Webber stated that three of the Dain tractors were in the Minneapolis territory. One was at Minot, and had been there since spring. It had done quite a lot of breaking, pulling two 14' plows in hard ground, and had performed very well. One was at Huron, S.D., and had been used for running a threshing machine, but was now plowing. One had also been sent to Fargo, but had just arrived.

"Two of the best Minneapolis men have been detailed to visit these machines several times between now and freezing-up time, and Mr. Webber and Mr. Velie expect to go with them, if possible, and to keep close track of their work.

The 1916 Minneapolis Report

"Mr. Dain read a report from the Minneapolis house on the operation of the tractors in their territory, as follows:

"November 13, 1916

"Deere & Webber
"Minneapolis, Minn.

"Gentlemen:

"Mr. Molstad and the writer after having visited Dain tractors at Aberdeen, Fargo, and Minot each three times, have the following to submit:

"We are firmly of the opinion, providing the clutch collar and bevel pinion sleeve trouble can be eliminated, and not taking into consideration the power plant or the question of belt power, that we have in the Dain very much the best tractor on the market, principally for the following reasons:

Best on the Market

"1st. Because of its all-wheel drive, minimum weight, and maximum traction.

"The all-wheel drive makes its light weight possible and gives the maximum traction, the advantages of which are that the tractor will go thru more difficult conditions without miring down than any other tractor, and in the event it does mire down, by uncoupling the plows, it will always pull itself out, which other tractors cannot do.

"Because of its light weight it packs the ground less than other makes - which packing is generally conceded to be a serious objection.

"2nd. Four chains being used to drive the wheels divides the strain on the sprockets and chains, making the chain drive, in our judgment, two or three times more durable than gears, and much easier for the farmer to replace and adjust.

"Another big advantage of this feature is that there is no noise. The noise made by the gears and the exhaust, on many tractors, especially after they have been used for some little time, is almost unbearable.

"3rd. Because of being able to change speed without clashing the gears.

"4th. Being able to change speed without stopping saves time, trouble and gasoline, and prevents loss of momentum.

"5th. Because of its fool-proof simplicity and accessibility.

The Question of Power

"Question of Power: We are firmly of the opinion that no one will ever build a tractor that will prove satisfactory for plowing without having a power surplus of 33-1/3% or 50% over and above the amount required to do the work. In other words, in building a tractor to pull 3 bottoms in stubble or two in breaking, the engine should have power enough to pull from 4 to 4-1/2 bottoms under average conditions. This would mean that the tractor would have to be marketed so as to insure the user not pulling more than 3 bottoms in stubble or 2 in breaking - by making him sign an agreement to that effect, the agreement stating that in case of its being violated it would invalidate the Warranty.

"As further precaution would recommend that a cast plate be put on the tractor somewhere stating that the tractor is guaranteed to pull only 3 bottoms in stubble or 2 in breaking.

"A tractor, like a man or horse, can not work to its limit continuously and last.

"The greater the number of cylinders that are used in the motor the less the amount of surplus power required, because the more cylinders there are, the more the motor is like a steam engine.

Gray . . . Waterloo . . . Heider Tractors

"At Aberdeen we saw a \$2,150 6-plow Gray tractor, and its owner. It was pulling one of our No. 2, 4-bottom Pony Engine Plows. We asked the man why he was not pulling 6 bottoms. He stated that he wore out one tractor in a short time by pulling all he could with it, and he made up his mind that the only way a tractor would stand up was for it to have enough power so it would 'play' with the plows, so to speak.

"We also saw a Waterloo and a Heider tractor at work. Neither of them had plowed 500 acres.

"The Heider had plowed about 400 acres and it was in very bad shape. The noise it made was terrific. Everything about it seemed to be loose. It was about ready for the scrap heap.

Service Problem

"Mr. Harrington, of the Fargo Implement Co., has sold 17 Waterloo tractors - 10 this year and 7 last. He stated that if he had 17 more out it would keep him and all of his men busy doing nothing other than look after the tractors; and he has about concluded not to sell any more of them on account of the general effect it would have on his business - regardless of the precaution he takes when selling them.

"He stated that if a customer has trouble and they all seem to have an undue amount, he will blame the Fargo Implement Co. just the same, and when the farmer is ready to buy a gang plow the probabilities are he will go to their competitor and get it.

"On the other hand, Harrington said, if he had not sold these tractors he probably would have sold only 4 or 5 of our Pony Plows instead of the 17 that he sold this year.

Good Tractor Needed

"This goes to show that our dealers need a tractor badly but that they must have a good one.

"We must not only have plenty of power, as indicated above, but must have an extra strong, heavy, well-built motor, with very liberal bearings.

"We do not believe that the Waterloo tractor, except under very favorable conditions, can pull more than one 16-inch sulky plow and stand up.

"As to the number of bottoms the Dain tractor should pull we have recommended, and the factory has been working along these lines we believe, pulling 3 14-inch bottoms under favorable conditions, and 2 in breaking; we are wrong in this! Our tractor should be strong enough and have power enough to pull 3 bottoms in stubble, under almost any condition, as the majority of farmers when purchasing a 3-plow tractor expect to be able to do better and deeper plowing than they could with horses. In fact, a good many tractors are sold at times when plowing conditions are unusually hard for horses.

Three-Bottom Power

"Purchasers are not going to be satisfied, and the sales will not be repeaters, unless the Dain will pull 3 bottoms in stubble generally.

"Further, under most all sod breaking conditions in our territory it is just as hard or harder to pull 2 14-inch bottoms as it is to pull 3 14-inch stubble bottoms under hard plowing conditions.

"Comparing the work of the three tractors referred to herein, the Aberdeen tractor is the only one that proved satisfactory to the user - although they had some carburetor, magneto and fan belt, and other minor troubles. The motor in this tractor, so far as we know, had no connecting rod trouble. The user of this tractor and a neighbor of his were so well pleased with it that they will buy Dain tractors as soon as they are put on the market. Although this tractor has the smallest motor of the three, viz. 4-1/4 x 5-3/4, it was working under very favorable plowing conditions.

"The work done by the Minot and Fargo tractors, particularly the Fargo tractor, was, we would say, nearly twice as severe - so severe that considerable motor trouble was experienced. Although there was no connecting rod trouble with the Fargo motor, they plowed only about 200 acres.

"0 An extra heavy, strong motor throughout is just as essential as is the surplus horsepower it seems to us.

"0 Salability of the Dain Tractor. There is no question in our minds that the Dain tractor will easily outsell all others on account of its having so many big plainly apparent features of merit, such as the all-wheel drive, etc., enumerated in the forepart of this letter.

Quality Should Come First

"0 We think the matter of price should be forgotten for the present. Go ahead and build the tractor - first class all the way through, using extra good magnetos, carburetors, etc., as well as making it extra good in other details, and when that is done if the price must of necessity be \$1,500, to market them profitably, let's sell them for that. We, of course, could not sell as many at \$1,500 as at \$1,200, but the factory probably could not make them, to begin with, any faster than they would sell at a good, fair, round price - and above all we are favorable to marketing them at a price that will net the dealer a good profit, so he will push their sale and can afford to look after them.

"0 Further, with reference to the price: we know that the Dain as Deere & Co. will probably build it, will figure stronger per pound than does the Bull or Waterloo. We cannot see why the Dain tractor should run into a cost that will make it necessary to sell it for a price as high as \$1,500. It weighs only about 4000 pounds. The Bull and Waterloo each weigh about 5000 pounds, the former selling for \$685, the latter for \$750. The Gray tractor (4-plow) which is an expensive, well-built machine, in fact a good deal better than the Dain, weighing 6000 pounds, 50% more than the Dain, sells for \$1,650 cash.

Tractors and Plows

"In considering the matter of price we must remember the more tractors we sell the more tractor plows we will sell.

"Yours very truly,

"Geo. P. Schutz" (Signed)

"September 12, 1917. Mr. Webber stated that the tractor situation was changing in this respect - the demand is for a tractor that will pull three plows - and he believed it will be one that will pull two, three, or five. He thought ~~we could sell the~~ Dain tractor for \$1,500. He said that the Dain tractor was all right; that it was a 3-plow outfit, and that we would probably have to eventually make a bigger one.

"Mr. Webber reviewed in detail the performance of the Dain tractors in the Minneapolis territory, which were very satisfactory.

"RESOLVED, That Mr. Dain be authorized to continue his negotiations with the thought in mind of buying not over 100 of the Dain tractors outside with the view of continuing the development of the tractor line, the purchase to be made on a fixed price basis."

Mr. Dain's Untimely Death

On October 31, 1917, Mr. Joseph Dain died in Minneapolis following a trip to Huron, S. Dak., to investigate the performance of the Dain tractors. George Schutz accompanied Mr. Dain on this trip to South Dakota, and under date of November 7, 1917, reported as follows:

"November 19, 1917. The subject of Dain tractors was considered and the report of November 7th, 1917, signed by Mr. G. P. Schutz and approved by Messrs. C. D. Velie, C. C. Webber, and F. R. Todd in reference to these tractors, was read and spread upon the minutes.

Subject: Huron, S.D., Dain Tractor Report

The undersigned, with Mr. Jos. Dain, Sr., spent two days, October 24th and 25th, at Huron, S.D., investigating the performance of 3 Dain tractors.

Mr. Velie's signature appears on this report, he concurring in what is stated herein, having visited at Huron to see these tractors in operation a few days prior to the above dates.

F.R. Brumwell Tractor

The first tractor we visited was on the farm of our agent, F. R. Brumwell. This tractor had plowed 110 acres; had harvested 260 acres, and had drawn 5 wagon loads of stone at a trip on two different occasions to Huron, about 12 miles distant.

We saw this tractor pull one of our No. 5 NA214 3-furrow Pony tractor plows, plowing 6 to 7 inches deep, several times around the field. To test the tractor we set the plows several times to run 8 to 10 inches deep, and it handled the load fine, with no engine knock or undue slippage of traction wheels.

Plowing conditions: somewhat harder than normal. Soil: heavy black loam; subsoil being quite hard below 6 inches. This tractor had been operated by two different hired men of average ability.

Mr. Brumwell is very enthusiastic over the Dain tractor. He believes it to be much better than any other he has seen.

He had a few suggestions to make for refinement of some of the details, which among other suggestions, will be found further on in this report.

In 1916 we loaned Mr. Brumwell a Dain tractor, equipped with a Waukesha motor, which tractor was returned to the factory last winter, overhauled and equipped with a new motor. The 1916 machine gave such good satisfaction that he has bought 3 tractors equipped with the new motor, one for his own use, and two which he has sold, being the three tractors referred to herein.

"J. J. Hoffer Tractor

"This man had plowed 70 acres 8-1/2 to 9-1/2 inches deep with his tractor, pulling one of our No. 5 NA214 3-furrow Pony tractor plows. This was 2 to 3 inches deeper than the ground had ever been plowed before.

"Plowing conditions: difficult; heavy black loam soil, quite dry.

"We followed the outfit around the field several times, at one end going through quite a strip of sod, on high speed and without changing the depth, the engine handling the load splendidly.

"This farmer was very enthusiastic. Said it was the best tractor in his community; that his neighbors liked it; that one of them owning a Case, purchased last year, said the Dain was a much better tractor than his.

"Frank Lyon Tractor

"This tractor purchased only recently, and therefore he had plowed only a few acres with it. We were not able to see it in operation, a bolt having gotten into the transmission gears and broken two cogs out of the high speed gear.

"Mr. Lyon, however, was highly pleased with this tractor, he feeling that the breakage was nothing for which the machine was to blame.

"1917 Minot Tractor

"In addition to the 3 Dain tractors, with the new motor, sold at Huron, Deere & Webber Company's agents at Minot sold one, which has plowed some 200 acres with one of our 14-inch 3-furrow Pony tractor plows, 100 acres of which plowing was done with this plow as a 2-furrow with breaker bottoms.

"Mr. Schutz visited this tractor after the farmer was through using it, and examined it carefully. He found it in first-class condition. While he did not see

the owner, the Minot Implement Company stated that he was very much pleased with the tractor, having experienced no trouble with it whatever.

"Other Tractors Visited

"We saw two small 4-cylinder single drive wheel Case tractors, the users of which both told of having been stuck at times due to lack of traction power. These Case tractors are very complicated and inaccessible. We also noticed that the large main wheel driving gears were badly worn.

"We saw two made by the Avery Company. One was a 2-plow tractor, with a 2-cylinder opposed engine equipped with two carburetors, one for kerosene, one for gasoline. This tractor is extremely inaccessible, and so narrow it would tip over very easily.

"The other was a 2-row motor cultivator, which the owner said was worthless, owing mainly to the engine being no good and having insufficient power. He used it but a short time, finishing up his cultivating with horses.

"We also saw a Bates Steel Mule tractor and interviewed the owner. It was not in operation at the time. He had experienced a lot of trouble with it. This tractor does not look practical to us.

"For want of time we were not able to visit many other makes, but we were impressed by the few we did see with the fact that many tractors lacking in important essentials are being marketed.

First Engines Too Light

"The 3 Dain tractors equipped with Waukesha motors, loaned to customers in the Minneapolis territory last year, to be tried out, one each at Fargo, Minot, and Huron, which plowed 300 to 400 acres each, proved entirely satisfactory

in all essentials, except that the engines were too light for tractor work and lacked power.

Some trouble also was experienced with the thrust collar for flywheel clutch, and bevel pinion drive shaft bearings giving out.

We have had none of these troubles whatever with the 4 1917 Dain tractors put out this year, viz; the one at Minot and the 3 at Huron, the engines having stood up and given perfect satisfaction; no difficulty of any kind having been experienced with the clutch thrust and bevel pinion shaft bearings, which were redesigned and equipped with ball and roller bearings.

The 1917 engine is a splendid one, having much more power, but no more than needed, extra strength so it will stand up, and is made very accessible. So, by using heavier chains, which have already been tried, and heavier driving sprockets, to measure up with the stronger motor, we feel sure it will take the Dain tractor out of the experimental stage.

CONCLUSIONS

We believe we have in the Dain tractor one that will create a sensation and prove to be a big seller, for the following reasons:

1. The 3-wheel drive. Will go through more difficult conditions without miring down than any other tractor, and in the event it does mire down, by uncoupling the plows it will always pull itself out, which other tractors cannot do.

2. Maximum traction with minimum weight. Because of its light weight, which is evenly distributed on all traction wheels, it packs the ground less than other makes, which packing is generally conceded to be a serious objection.

3. Transmission running in oil, insuring perfect lubrication at all times.

4. Change of speed made without clashing of gears.

"5. Being able to change the speed without stopping the tractor saves time, trouble and gasoline, and prevents loss of momentum.

No "Unbearable Noise"

"6. Four chains being used to drive the tractor divides the strain on the sprockets and chains, making the chain drive in our judgement two or three times more durable than gears, and much easier for the farmer to replace and adjust. The four chain drive precludes the possibility of a tie-up through breakage of any one of the chains or sprockets. The chain is noiseless. The noise made by the gears and the exhaust on tractors generally, especially after they have been used for some little time, is almost unbearable.

"7. Motor: more durable, being heavier, for its bore and stroke, than any other tractor motor. Valves so made and timed as to limit supply of gasoline, making it fool-proof, so operator cannot overload engine with gasoline and tear motor to pieces.

Simple and Accessible

"8. Because of its fool-proof simplicity and accessibility throughout. No other tractor on the market begins to approach the Dain in this respect. No other tractor on the market has the motor so made that the pistons and connecting rods can be removed without tearing motor down.

"The pump and magneto are separate from the camshaft and can be removed without taking the motor down.

"The cylinder head can be removed to take out carbon and grind valves without tearing engine down.

"The transmission is easily gotten at, with plenty of room to work, by simply removing transmission cover.

"Finally, we firmly believe the machine, generally, is perfected to a point where it can be successfully manufactured commercially, and we strongly recommend that you proceed with the construction of at least 100 as soon as possible.

"Yours very truly,

"Approved:

"Geo. P. Schutz

"C. D. Velie

"C. C. Webber

"F. R. Todd

Board Orders 100 Dain Tractors

"The following action was taken (by the Deere & Co. Executive Committee Nov. 19, 1917):

"RESOLVED, That Mr. Clausen be requested to proceed with the manufacture of 100 tractors of the Dain type, using for that purpose such members of the organization as are available and such outside assistance as it is advisable to obtain, provided, however, that the personnel of the organization called into this branch of the business shall be decided upon after conference with the Executive Committee and that the Executive Committee and the Conference Committee as well be fully advised and conferred with from time to time during the progress of the work, and

"FURTHER, It is the opinion of those present that the services of Joseph Dain, Jr., who has had wide experience in the development of the tractor in connection with the work of his father, should be made use of to the fullest extent and in as important a capacity as his experience and abilities permit.

"December 11, 1917. Construction has been provided for 100 tractors, and motors have been contracted for. Mr. Clausen stated that he expected fifty of these tractors would be completed by June 1st, 1918."

Deere Buys Waterloo Company

On March 14, 1918 Deere & Company bought the Waterloo Gasoline Engine Co., makers of the Waterloo Boy tractor.

"July 16, 1918. Mr. Morgan discussed at some length the tractor situation and stated that, in his opinion, we should not discard the Dain machine permanently. This tractor, in Mr. Morgan's opinion, has many good features and at a later date it might be advisable for us to continue the manufacture of this machine."

One hundred Dain tractors were built at the Tenth Street factory in East Moline, the same factory in which the first John Deere binders were built. Elmer McCormick was in charge of building the 100 tractors. He had been closely associated with Mr. Dain in working on the design of the tractor and engine almost from the start.

These tractors were built in 1919, and all were sent to the Huron, S. Dak., territory. There are no records to be found that give any information relative to the performance or disposition of these last tractors. The illustrations, drawings, and description of the Dain tractor shown on the following pages were prepared as an aid to sell the tractors.

After this lot of tractors was built, there was no further development of the Dain tractor. It may be presumed that the following reasons contributed to the decision to stop further activities:

Why Dain Tractor Was Discontinued

1. In 1918 most of the full line implement companies were building tractors, particularly International Harvester Company and Case. It was felt that it was imperative to get into the tractor business at as early a moment as possible in order for Deere & Co. to hold onto their plow business. A tractor and plow were usually sold by the same dealer.
2. That the Dain tractor, while a good tractor, was high-priced and also that it would require considerable time to tool up for manufacture.
3. That Mr. Joseph Dain, Sr., who was responsible for the Dain tractor, had died.
4. That Deere & Co. had purchased the Waterloo Gasoline Engine Co. and thus had a factory, a

tractor, and an organization that was functioning, and so was in the tractor business at one quick stroke.

In concluding this chapter on the Dain tractor, it should be emphasized that in his thinking about tractors Mr. Dain was ahead of his time, for he insisted that tractors must be made better in every way, and that price was not the main objective. Many features of the Dain tractor were better than those of most tractors of that period.

DAIN TRACTOR

SPECIFICATIONS

Rating -- Draw bar, 12 h.p.; belt, 24 h.p.

Speeds -- Two forward and two reverse. All speeds direct. No intermediate gear used. High, 2-5/8 m.p.h.; low, 2 m.p.h. Reverse speeds same as forward.

Weight -- 4,600 pounds.

Length -- Wheel base, 6 feet 2-3/4 inches; over-all, 12 feet 6 inches.

Height -- 4 feet 9 inches.

Width -- 6 feet 4 inches.

Wheels -- All traction. Rear, 40 inches in diameter, 20 inches face; front, 36 inches in diameter, 8 inches face.

Steering gear -- Worm and sector.

Transmission -- Exclusive design. No gears to shift in changing speeds. Change can be made from low to high or vice versa while under full load without stopping the machine.

Crank shaft -- 3 bearings, 2-1/2 inches in diameter. Drop forged from open hearth steel and double heat-treated.

Bearings -- Connecting rod, 2-1/2 inches diameter by 2-7/8 inches long.
Front main, 2-1/2 inches diameter by 3-7/8 inches long.
Center main, 2-1/2 inches diameter by 3 inches long.
Rear main, 2-1/2 inches diameter by 4-7/8 inches long.
All bearings bronze back with special Babbit metal lining.

Lubrication -- Force feed from mechanical oiler, supplemented by a splash system.

Governor -- John Deere design, built in.

Cooling -- Water circulated by positively driven centrifugal pump of extra large capacity.

Fan -- 19 inches in diameter. Positive gear drive.

Carburetor -- 1-1/4 inches Model M-2 Stromberg.

Air cleaner -- Bennett.

Ignition -- K W high tension magneto with starter coupling.

Pulley -- Steel, split hub, 30 inches in diameter with 8 inch face. Belt speed, 2,190 feet per minute.

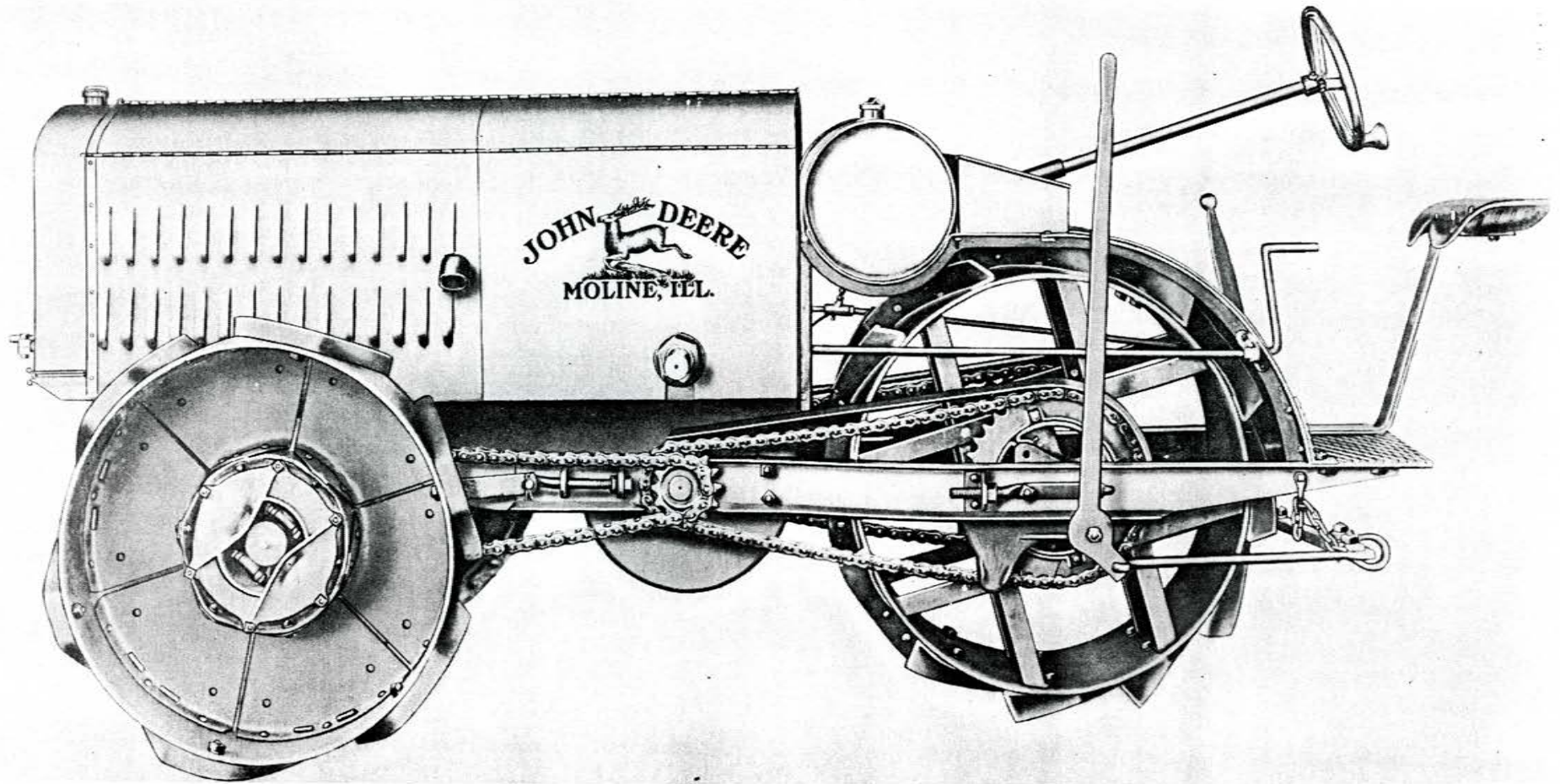


Figure 15

FIGURE 15 -- One hundred of these Dain tractors were built in the Tenth Street factory in East Moline in 1919, under direction of Elmer McCormick, who had been closely associated with Mr. Dain in working on the design of both tractor and engine.

The final Dain tractor had two 8x36-inch front wheels and one 20x40-inch rear wheel, all three chain-driven, the front wheels being used for steering. Among the claimed advantages were: (1) Reduction of weight possible by using all weight for tractive purposes; (2) equal distribution of this lighter weight (4,600 pounds) to prevent packing the soil; (3) ability to work on softer ground than other round-wheel tractors, and (4) the front wheels being pullers, it was possible to steer the tractor under adverse conditions.

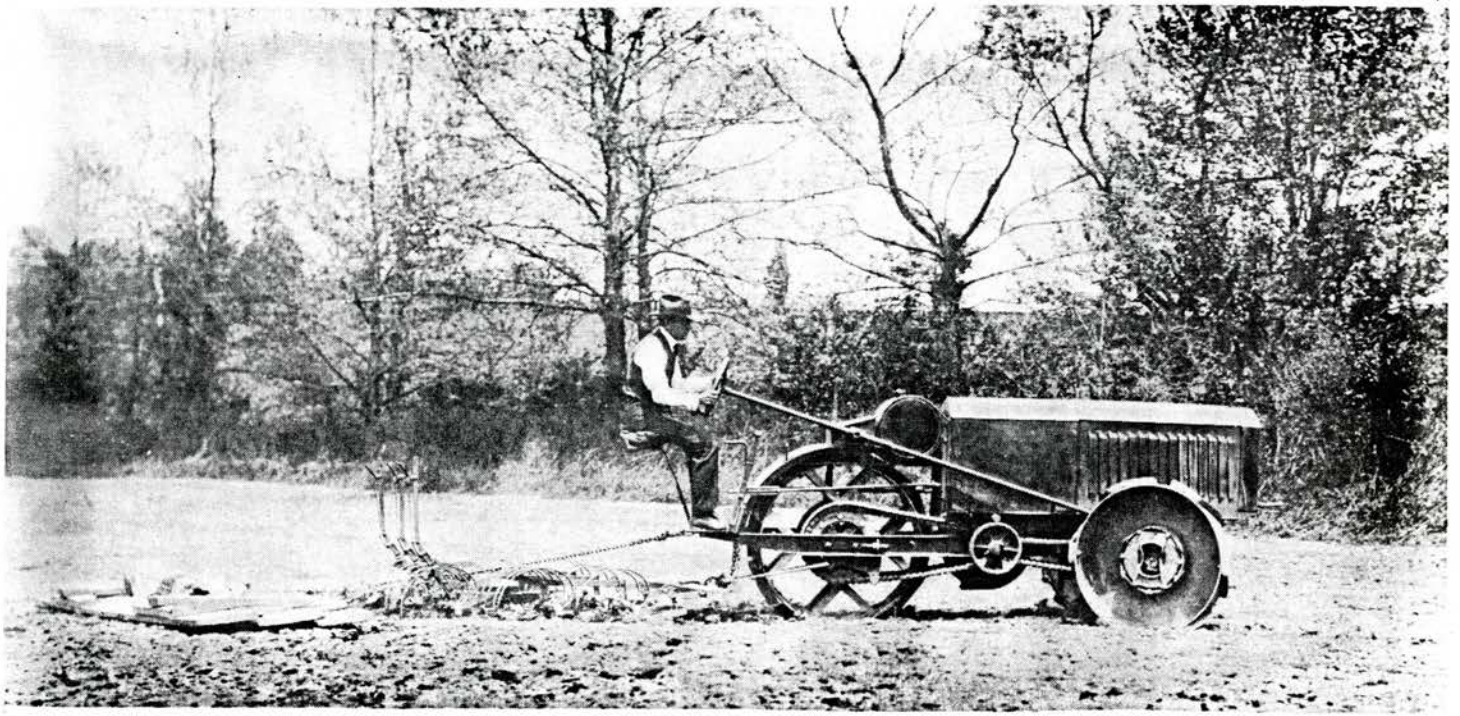


Figure 16

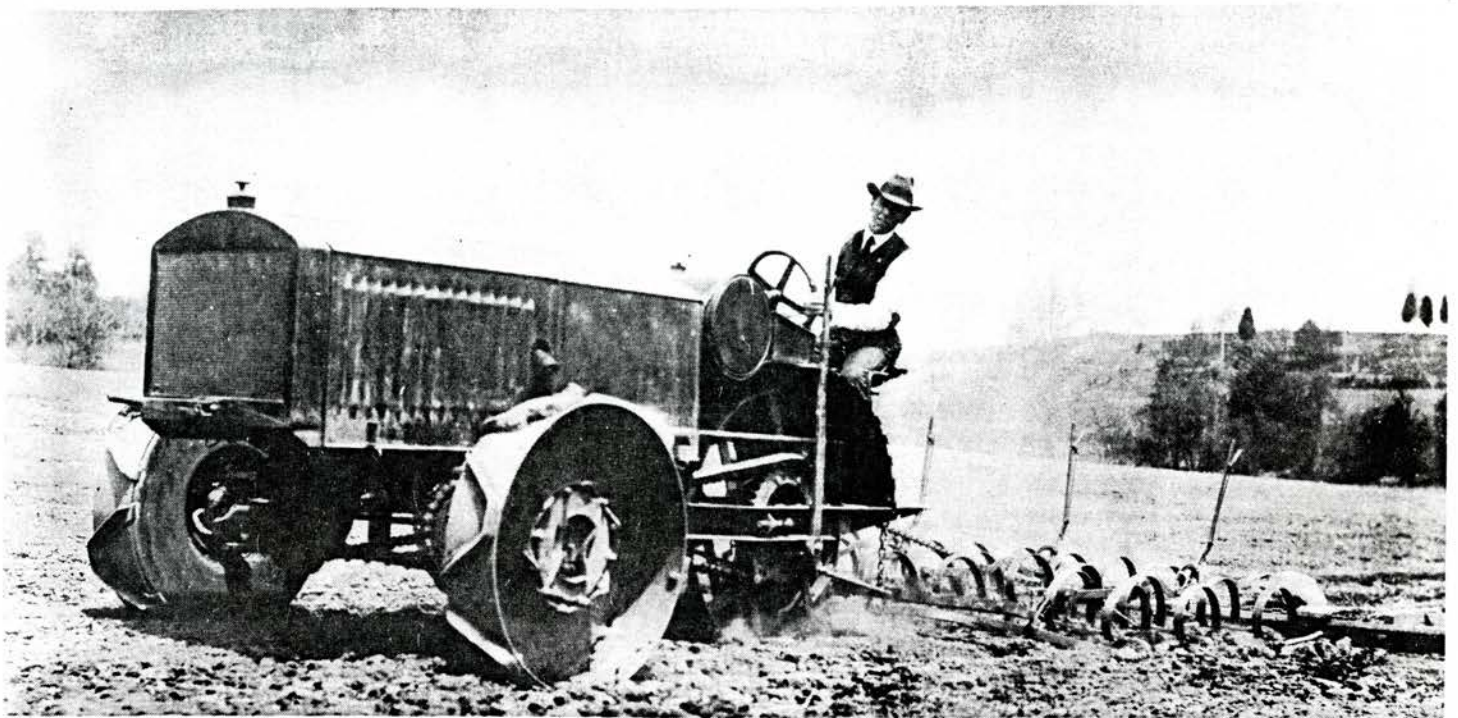


Figure 17

FIGURES 16 and 17 -- These photographs show one of the 100 Dain tractors made in 1919, all of which were sent to the Huron, S. Dak., territory. There are no records as to their performance or final disposition.

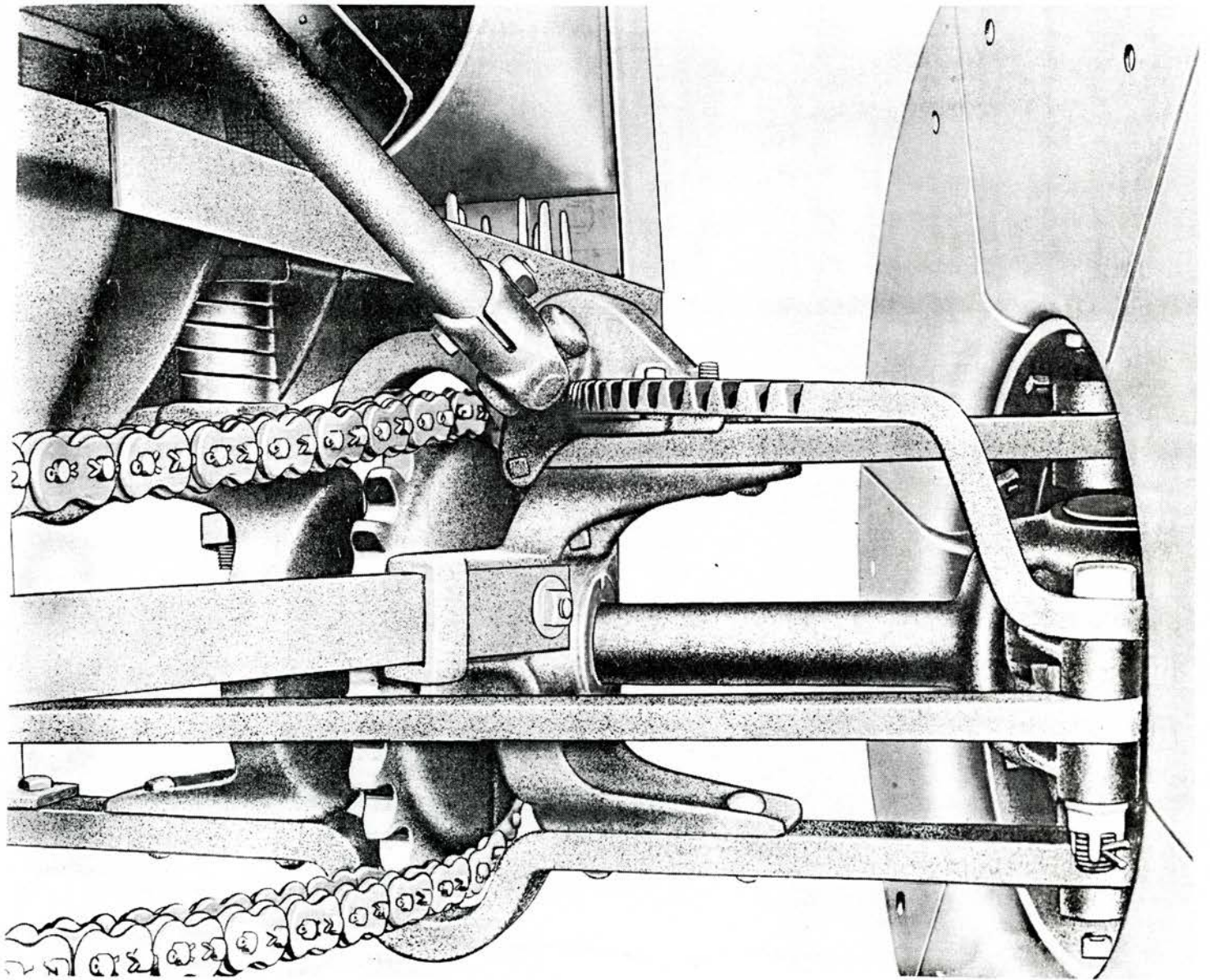


Figure 18

FIGURE 18 -- "No differential being used, each wheel has its own direct power connection, so any wheel having traction will take all the power of the motor," said a contemporary writer concerning the Dain tractor. "A simple ratchet device eliminates the necessity for a differential." This photograph also shows the worm and sector steering method. Details of the "ratchet device" are shown in Figure 24.

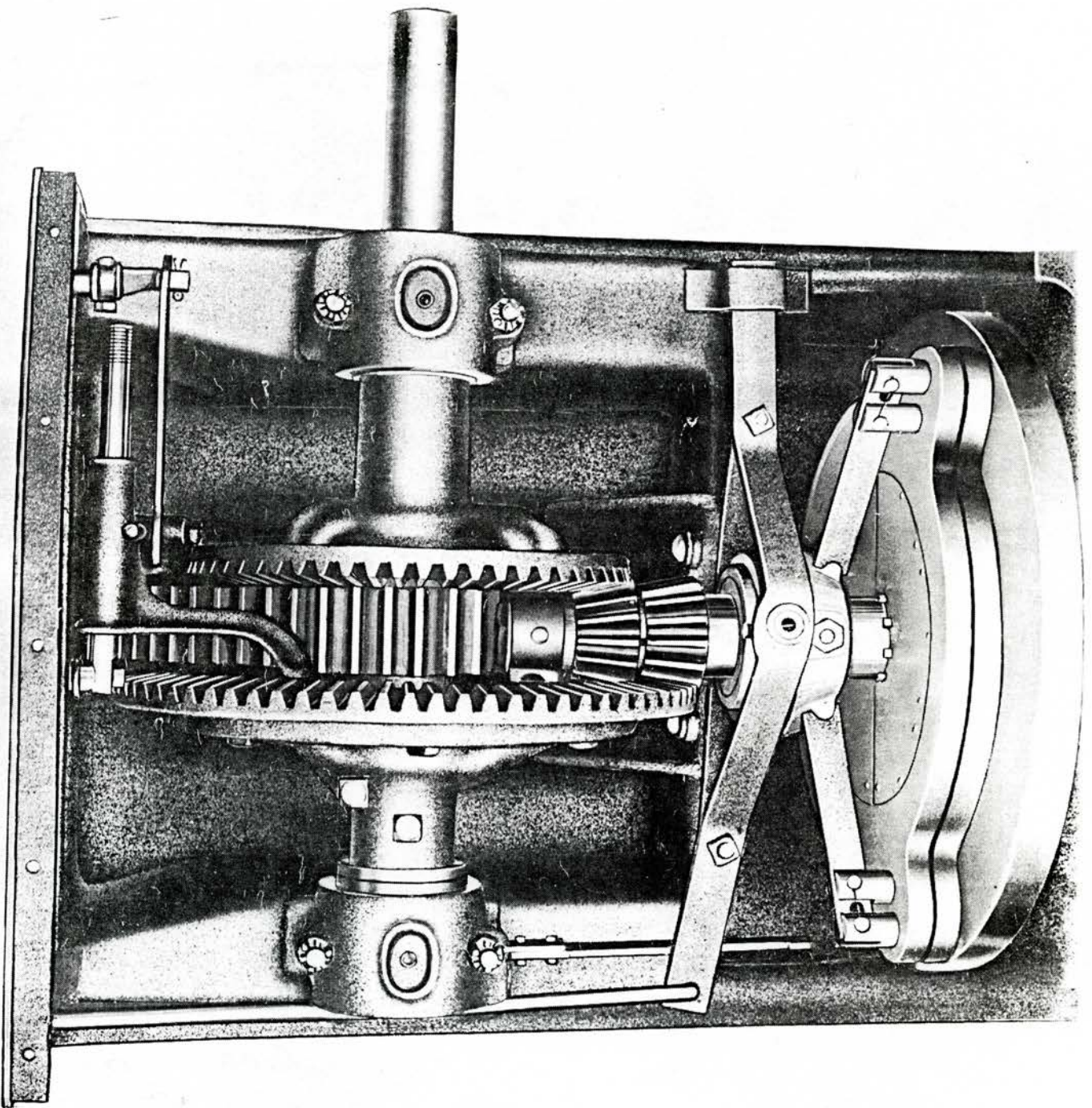


Figure 19

FIGURE 19 -- "An advantage of this transmission is the ability to change from low to high speed, or vice versa, without stopping the tractor," said the 1919 description. "The changing of speeds is accomplished without the shifting of gears, or the use of a clutch pedal, a hand lever being all the operator uses."

The Dain tractor had high forward and reverse speed of $2\frac{5}{8}$ mph., and low forward and reverse speed of 2 mph.

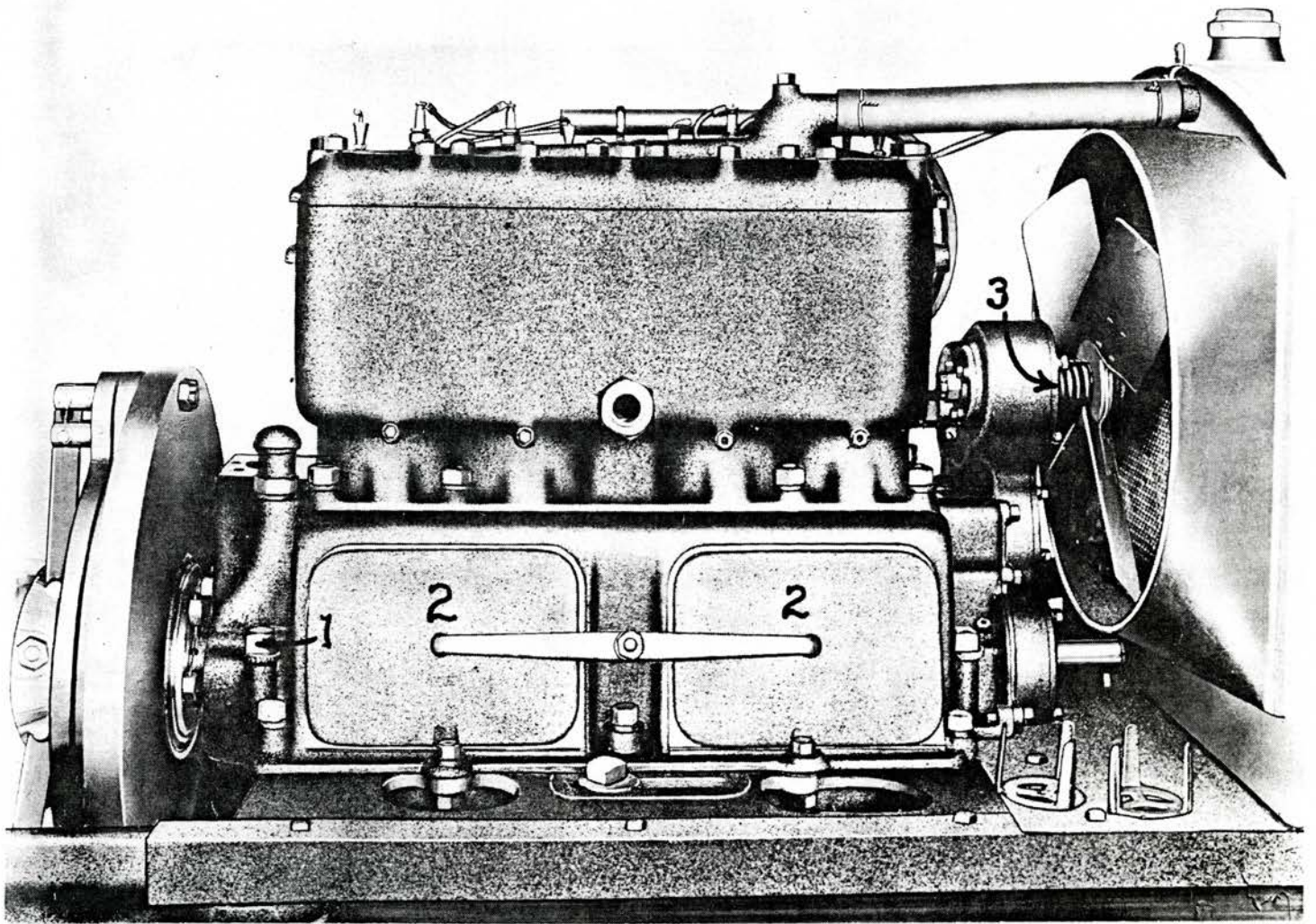


Figure 20

FIGURE 20 -- "Right-hand side view of Dain tractor engine. 1. Rear bearing bolt, showing accessibility for adjusting bearing. 2. Hand hole plates. 3. Spring in fan drive to absorb shocks of starting and stopping; fan is gear-driven."

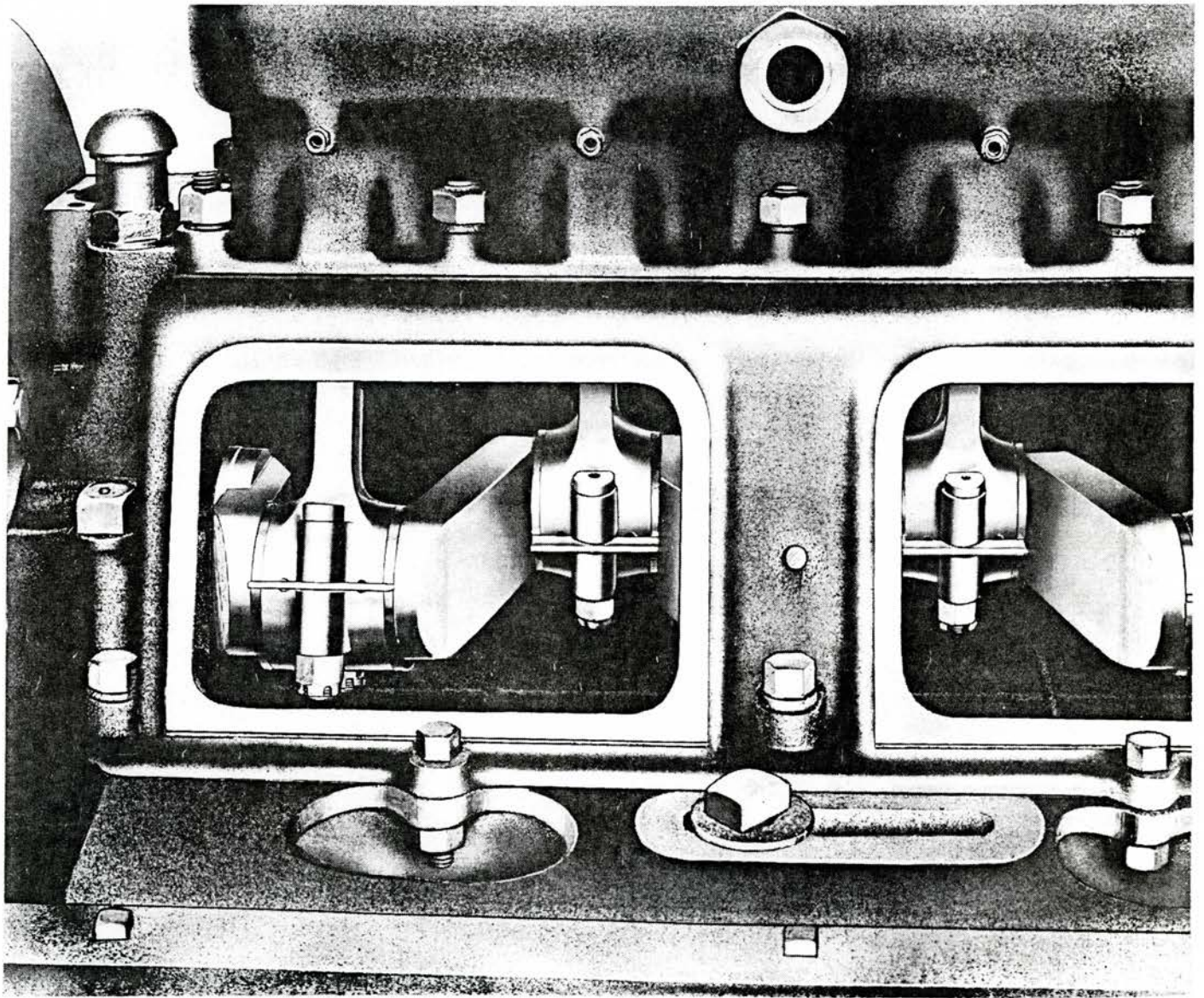


Figure 21

FIGURE 21 -- "Right-hand side view with hand hole plates removed." All bearings, including connecting rod and main, were of 2-1/2-inch diameter.

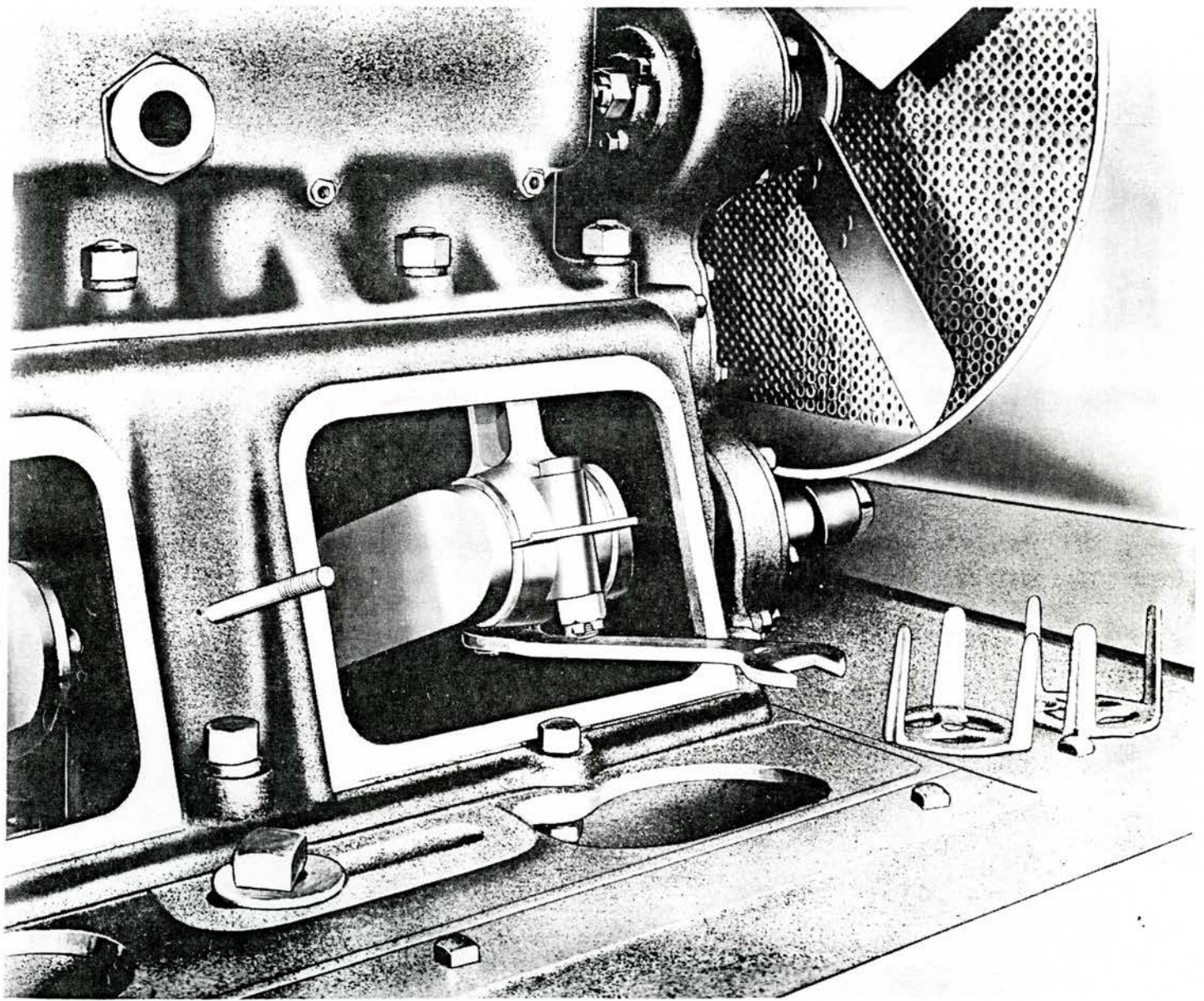


Figure 22

FIGURE 22 -- "Right side of motor with hand hole plates removed, showing accessibility of connecting rod bearings for adjustment or replacement." The motor had a combined force and splash lubrication system, and a "positively-driven centrifugal" water pump of "extra large capacity."

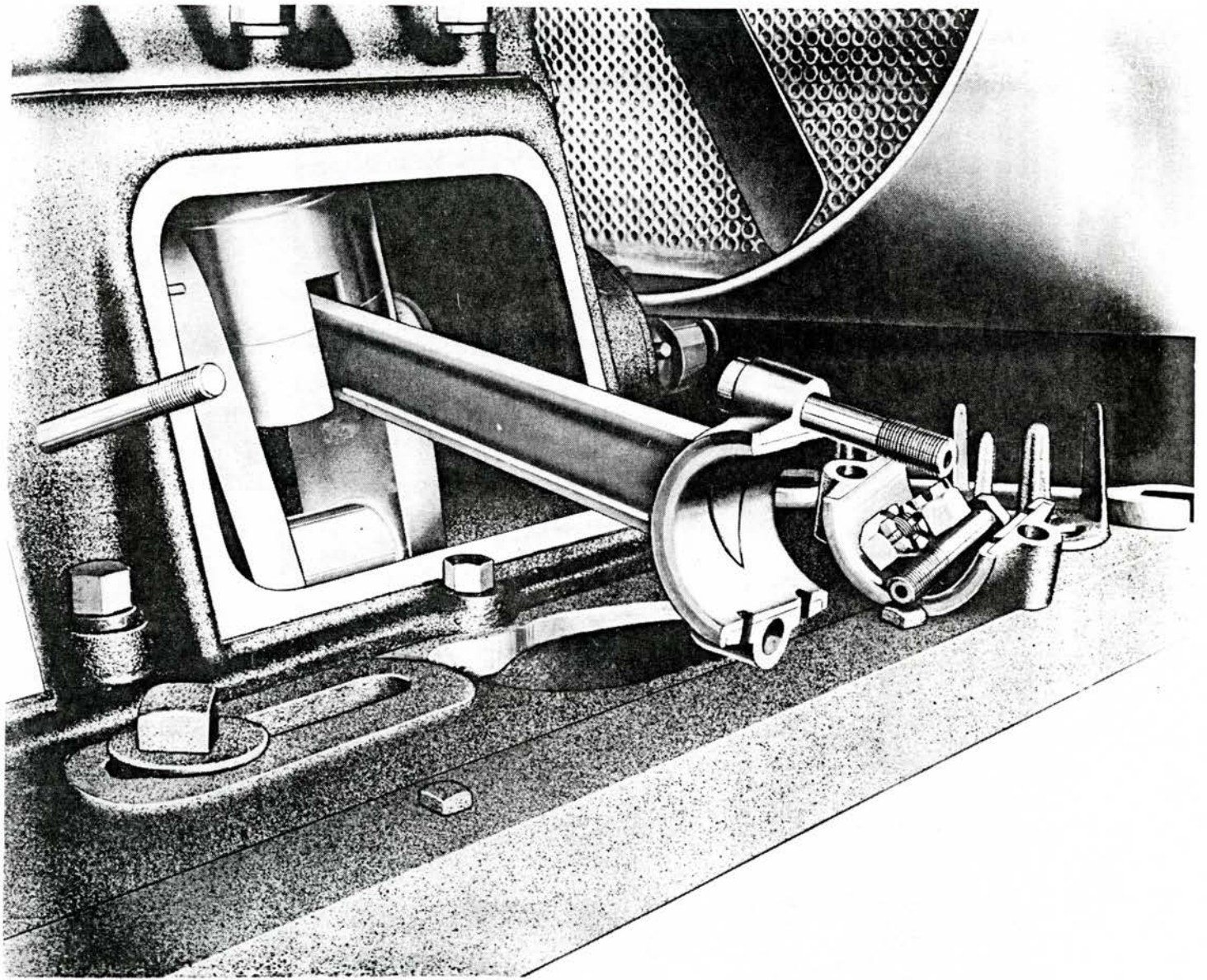


Figure 23

FIGURE 23 -- "Right-hand side showing how the pistons are removed from the cylinders through the hand hole plates." One complaint concerning most early tractor engines was the inaccessibility of parts and the consequent difficulty of service and repair.

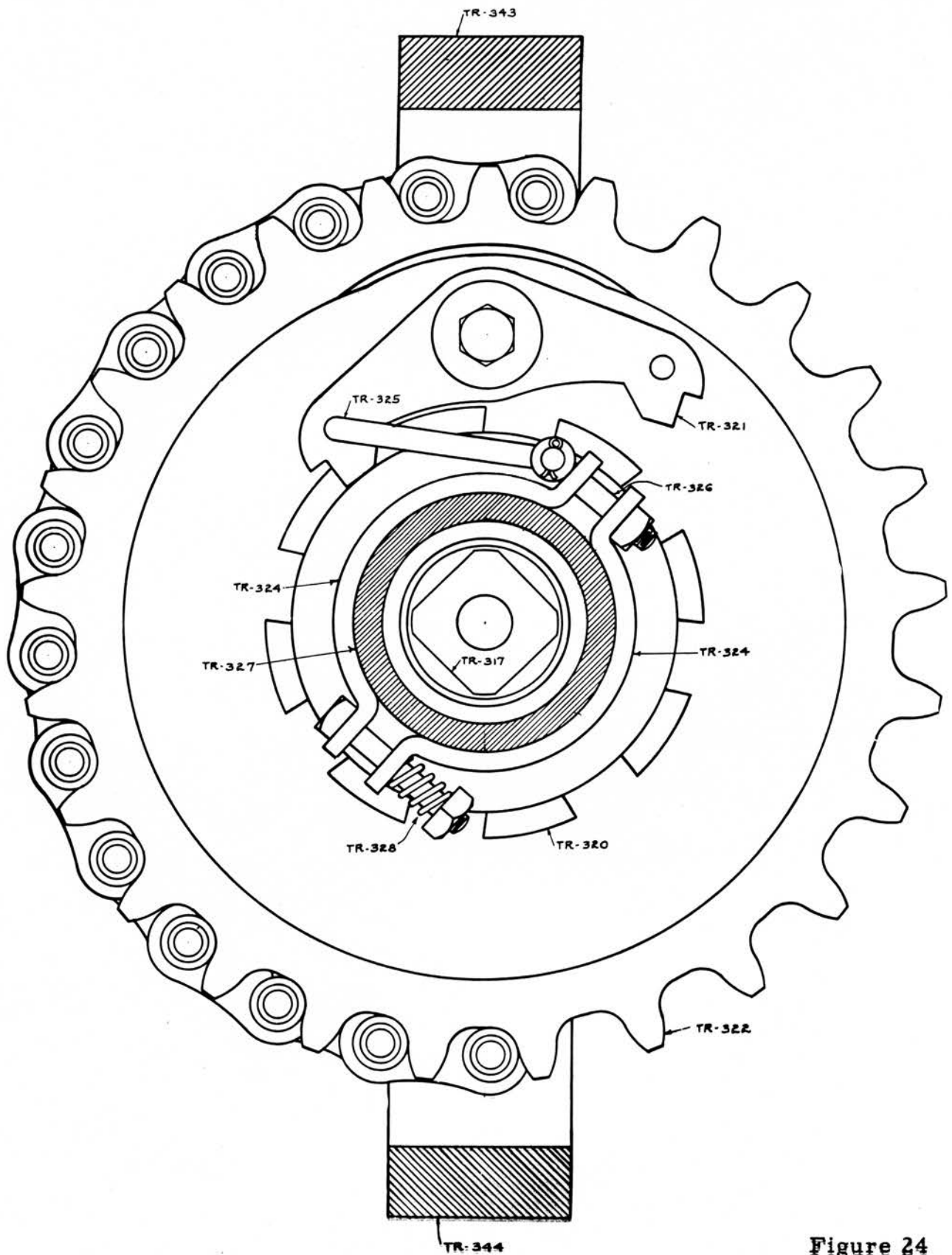


Figure 24

FIGURE 24 -- "A very simple ratchet device eliminates the necessity for a differential." This drawing details the construction of the chain-driven wheel shown in Figure 18.

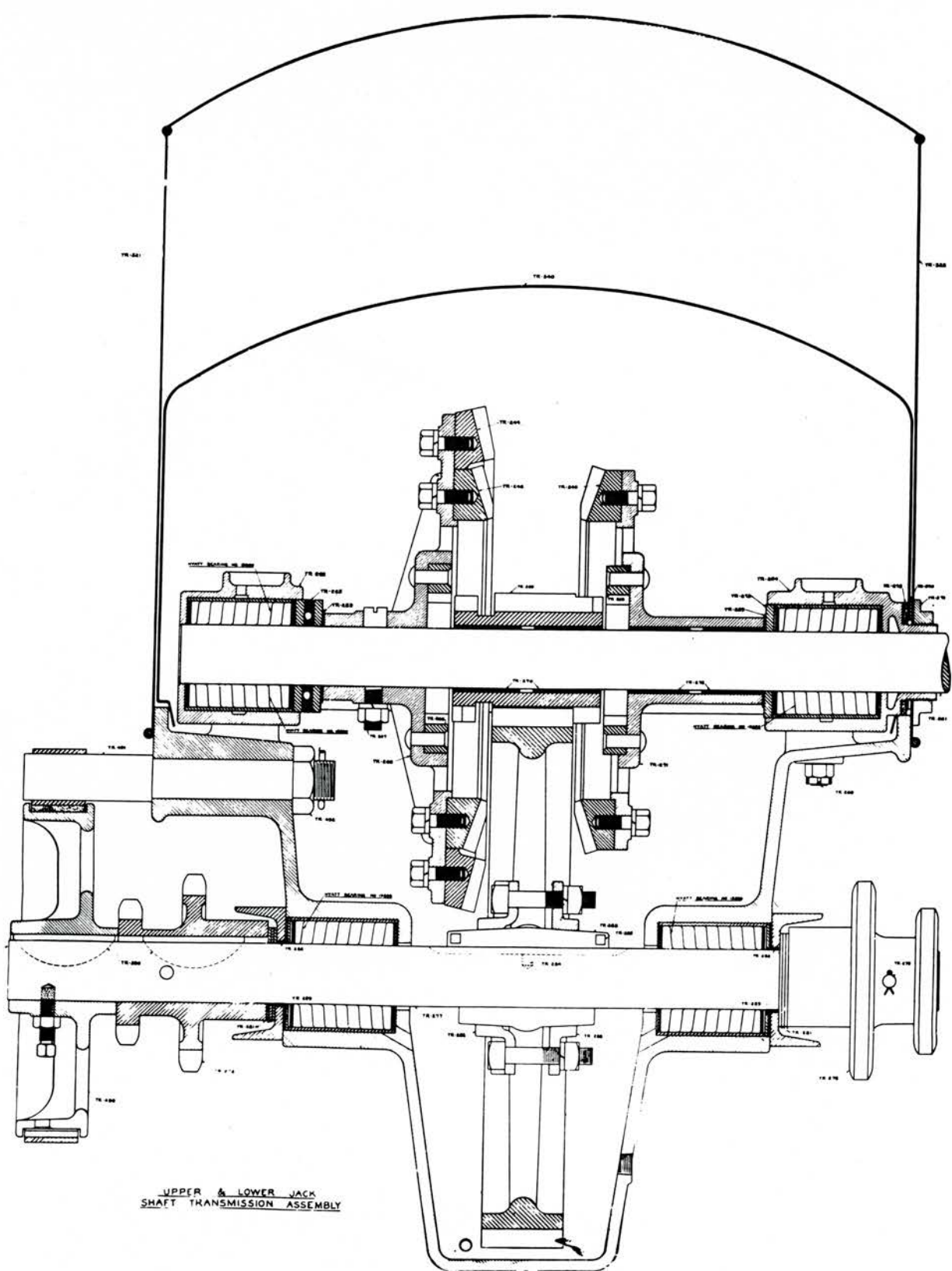


Figure 25

FIGURE 25 -- "Upper and lower jack shaft transmission assembly." Hyatt bearings were used.

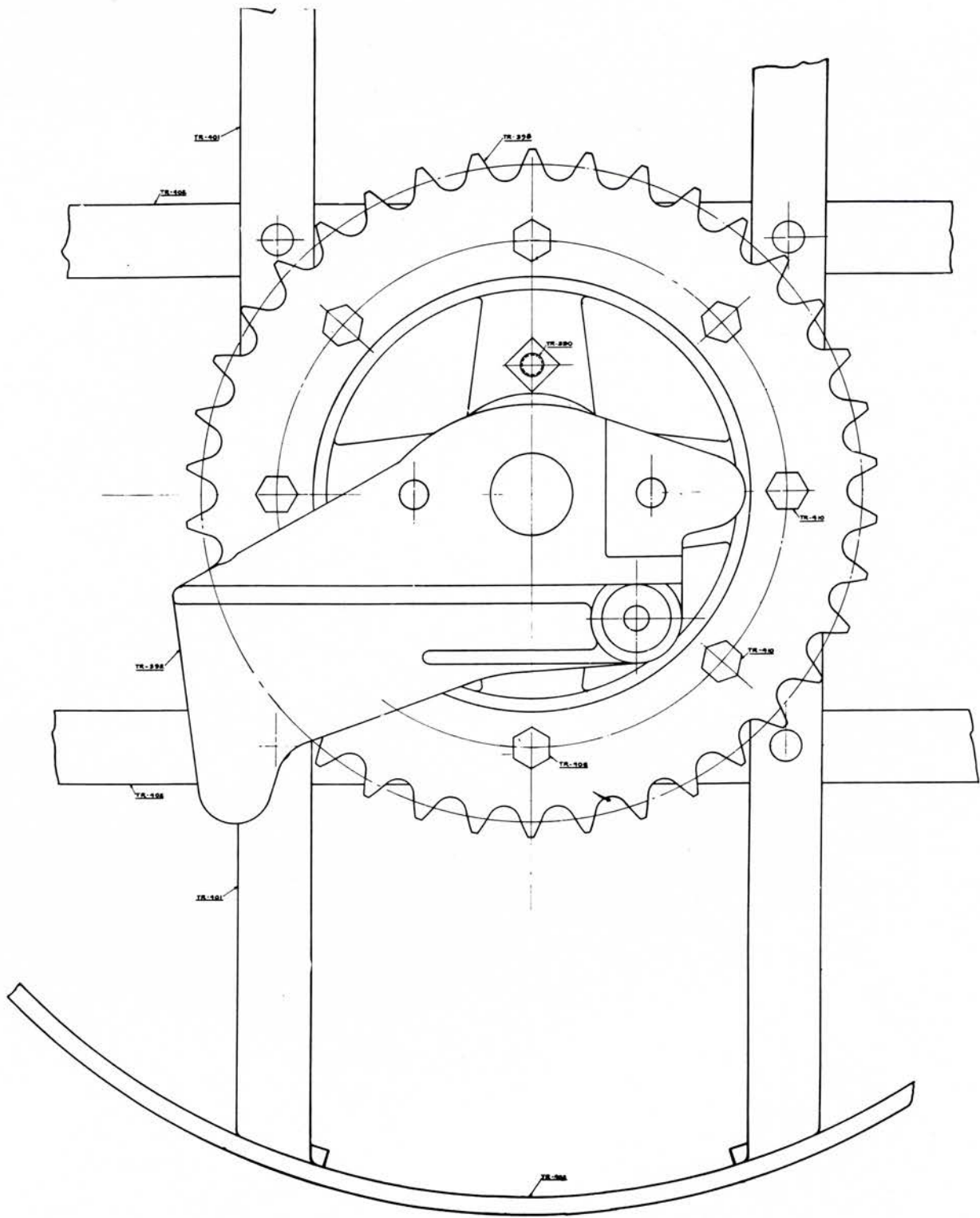
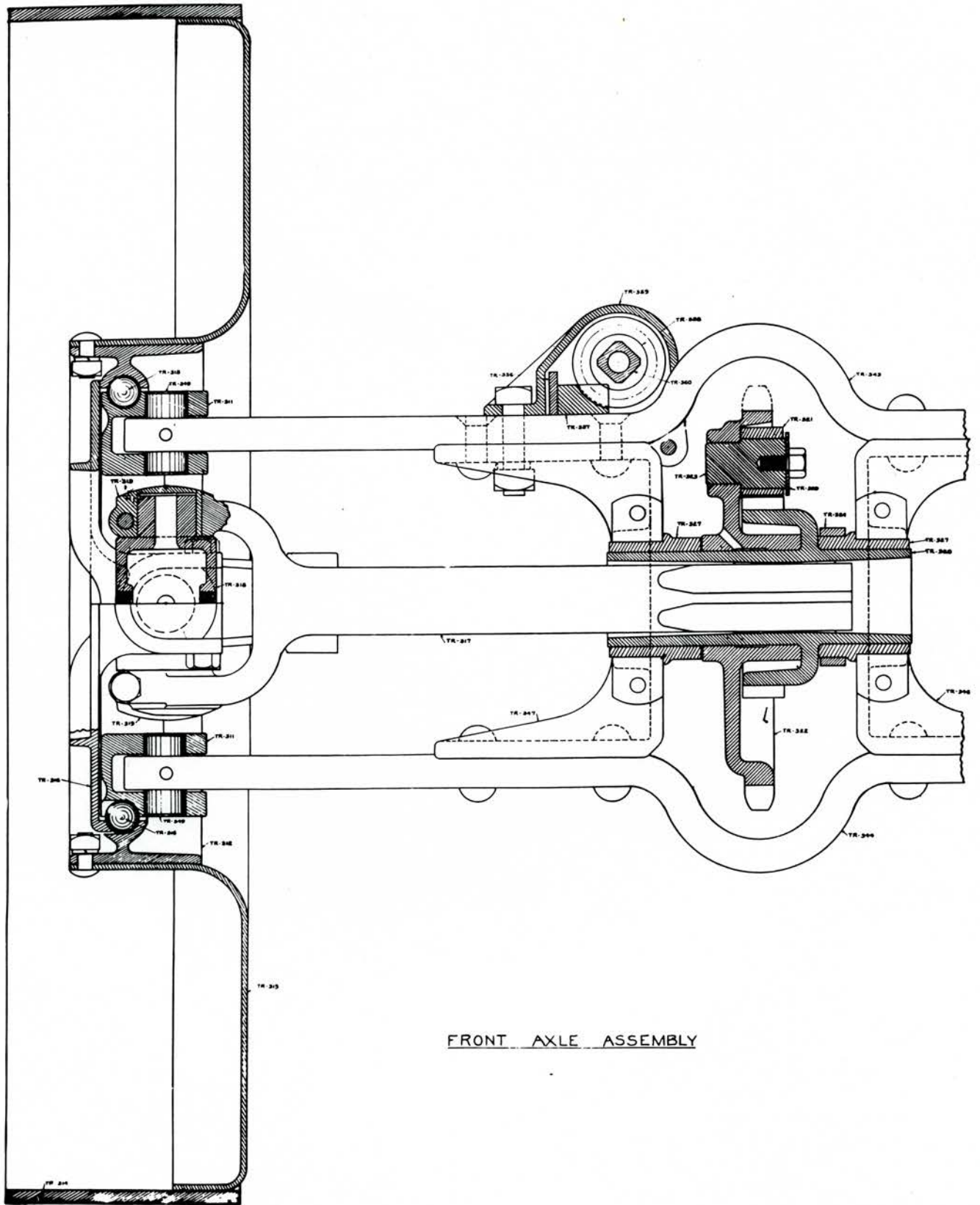


Figure 26

FIGURE 26 -- Details of rear wheel construction. The rear wheel had a double drive chain, and was 40 inches in diameter by 20 inches wide.



FRONT AXLE ASSEMBLY

Figure 27

FIGURE 27 -- Front axle assembly. The front wheels were 36 inches in diameter by 8 inches wide. A universal joint in the wheel hub permitted steering the driven front wheels.

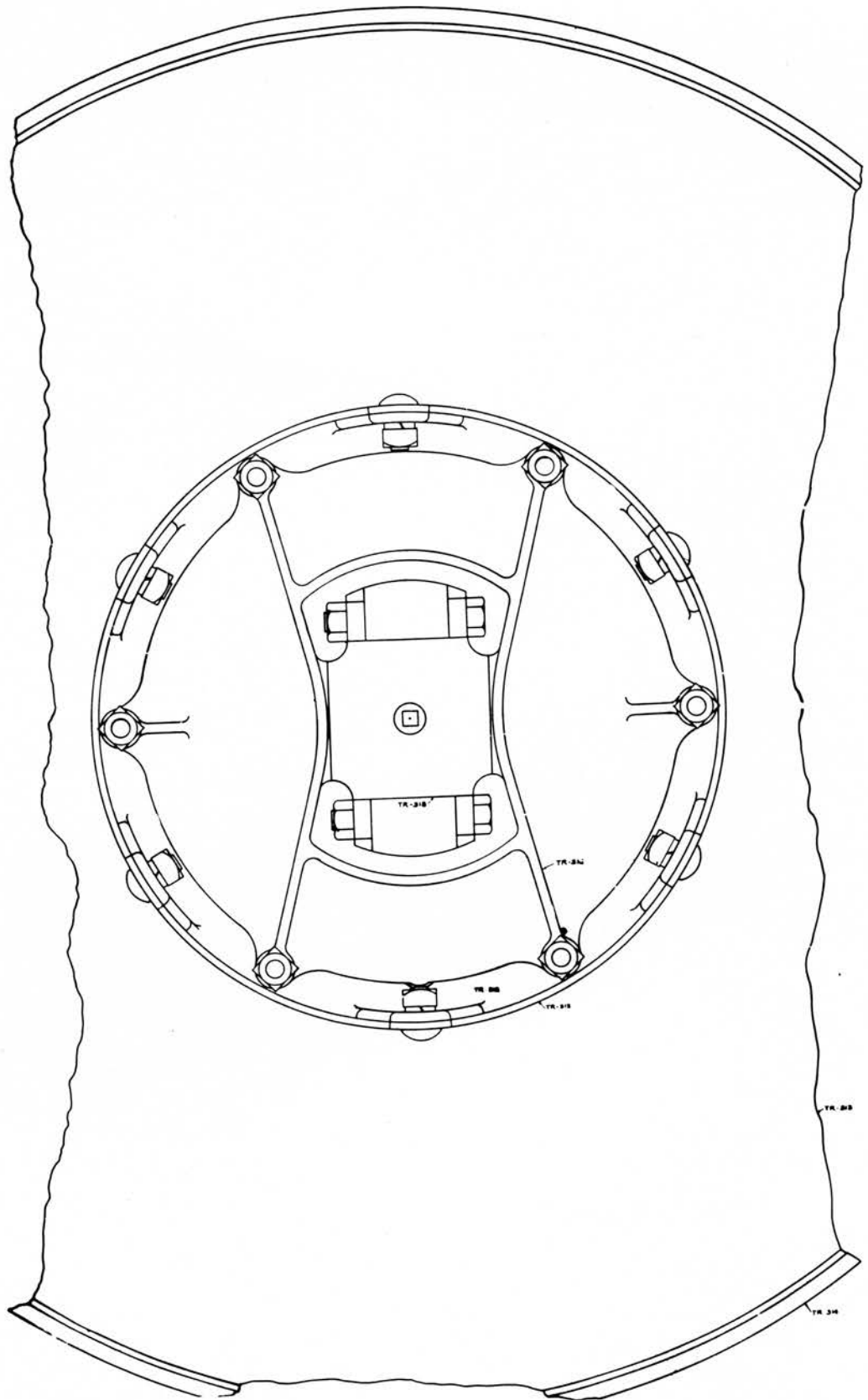


Figure 28

FIGURE 28 -- Additional detail of front wheel assembly of the Dain tractor.

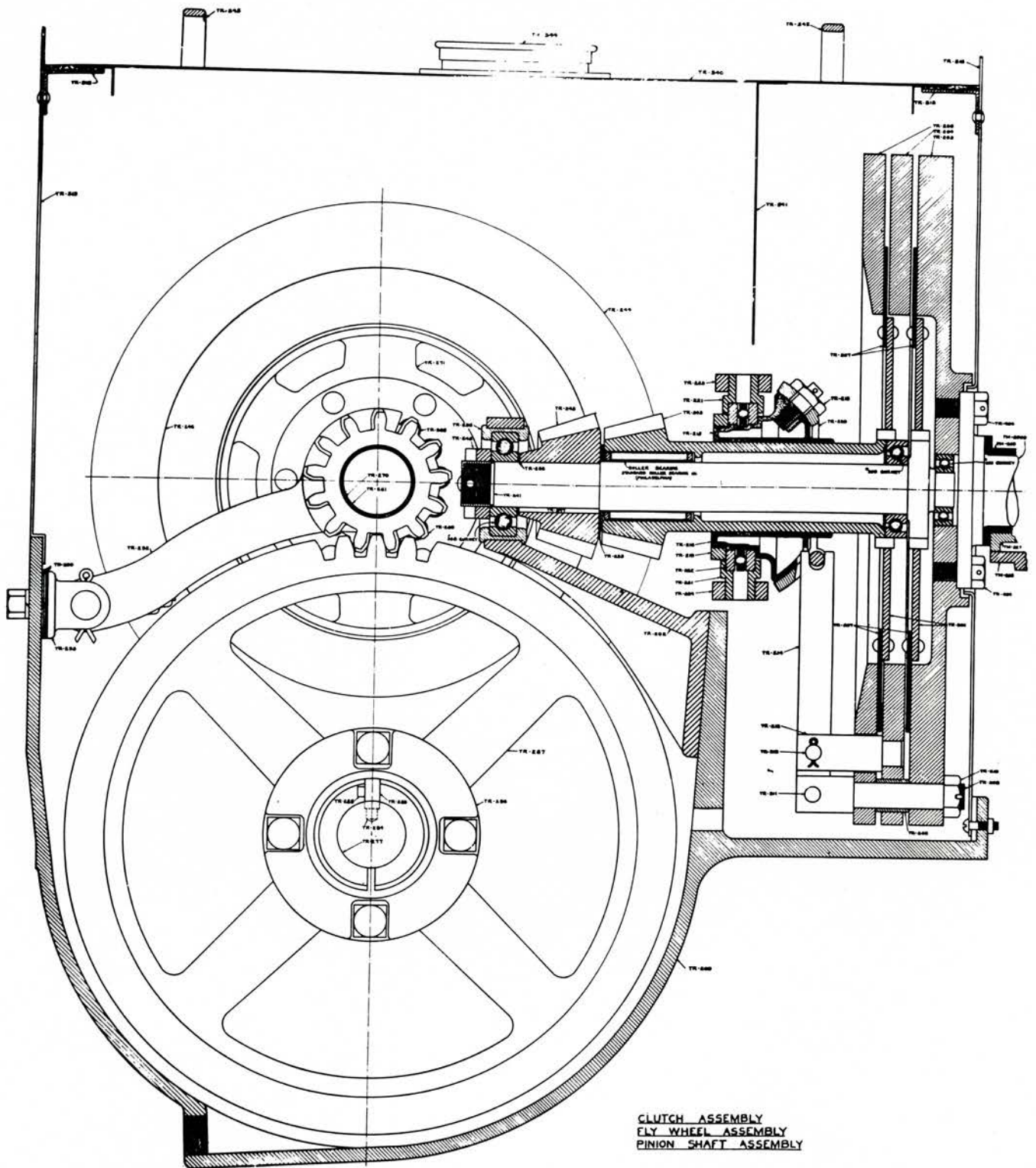


Figure 29
 FIGURE 29 -- Details of clutch, fly-wheel, and pinion shaft assembly of the Dain tractor.

Chapter 3 -- THE SKLOVSKY TRACTOR

In the spring, summer and fall of 1915, there are numerous entries in Theo Brown's diary in reference to a small tractor being designed under the supervision of Max Sklovsky, head of the Deere & Co. Engineering Department. At this same time Joseph Dain was developing a tractor of his own design with power to handle a three-bottom plow. George Mixter was the one who directed Sklovsky to undertake the design of a two-plow tractor, as there was a feeling that there was a field for a two-plow tractor in addition to a three-plow tractor.

E. R. Wiggins, George Pearce, and Nathan Lesser, all in the Deere & Co. Engineering Department, worked out the design of a small tractor under Max Sklovsky's supervision.

One-Piece Cast-Iron Body

A special feature in the design of this tractor was making the whole body, including engine pan, in a single casting. This is without doubt the first tractor to be designed as a solid unit.

Another feature was to so design this unit that there were no recessed surfaces involving costly machining. This contributed to a simple, strong construction.

Mr. Sklovsky's first design, called A-2, is shown in Figures 31 and 32. It was a three-wheel tractor, all wheels being power driven. There was no differential and the front axle was pivoted in the center like a wagon axle.

The A-2 tractor was built at the Marseilles plant (now the John Deere Spreader Works). A Northway four-cylinder engine was used. This tractor was first tried out in the field on November 20, 1915. Items in Theo Brown's diary of 1915 tell of being in the field with this tractor and plow until the ground froze December 15. The outfit did pretty well, except that steering the tractor was almost impossible, since the tractor operator had to overcome the torque of the engine. This was due to having the power-driven front wheels mounted on a wagon-type axle and with no differential.

The tractor performance, other than steering, was satisfactory enough to warrant rebuilding and incorporating a pivot-axle, automobile-type of steer. This revised tractor, known as Model B-2 (Figures 37 and 38) was built at the Marseilles plant and put to field work. On July 13, 1916, George Mixter reported to the Board of Directors as follows:

"Two-Plow Tractor

"One machine with a cast iron frame completely enclosing all working parts has been built. This has a four-cylinder Northway engine and in general layout of driving all the wheels is a small edition of the Dain machine. Has been working continuous for about eight weeks, having plowed about seventy acres, pulled a drag for test purposes and recently has been cutting hay. Seems to contain one or two good elements for a small machine. Probably could be built with a suitable engine so as to be decidedly acceptable to the farmer.

"Cost figures, however, of \$521 (2.25 steel) which figure is based on paying \$140 for the engine, remains a commercial question. It is probable that on a manufacturing basis with proper development of the engine and a reasonable normal price for steel that the cost of manufacture would be just over \$400, certainly not in excess of \$450, which latter figure would mean \$900 to the farmer.

"Nothing further has been done perfecting this particular type of small tractor because of the question in the writer's mind of the commercial practicability of a high-grade four-cylinder machine for two-plow work. Four-cylinder motors of this small size, running at speeds of 1000 R.P.M. apparently are not considered practical for burning kerosene, which is apparently a necessity.

"One-Cylinder Engine

"Some work has been done on the design of a two-plow tractor with a single cylinder engine, all-wheel drive, cast iron frame. There seems to be sufficient possibility in this design to carry it somewhat further. Low cost, easy accessibility, certainty of burning kerosene being some of the desirable features.

"It is probably true that the inclination of the farmer is to buy a tractor that is as much like an automobile as possible. On the other hand, offering an all-wheel drive machine might overcome this point of view.

"Our efforts on this class tractor have thus far aimed at a durable and satisfactory machine at manufacturing cost of not over \$300, i. e., \$600 to the farmer."

War Stops Development

The Model B-2 tractor was built, and performed quite satisfactorily in the field. However, further development of this tractor was halted because of the more urgent war work demands on the small Engineering Department of Deere & Co., and was never revived.

Max Sklovsky endeavored to build a tractor using farm implement construction as far as possible, so that the cost to the farmer would be low.

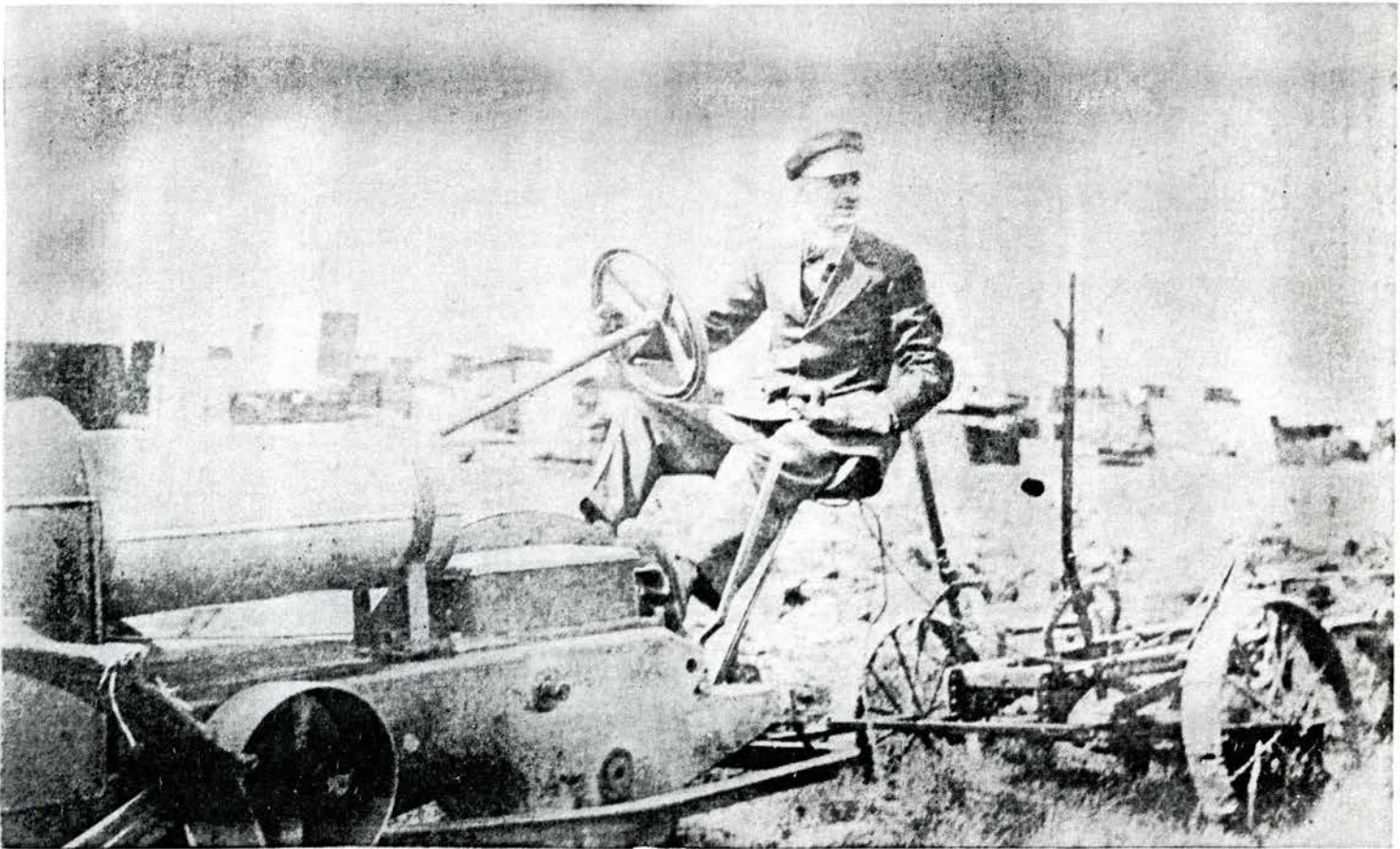
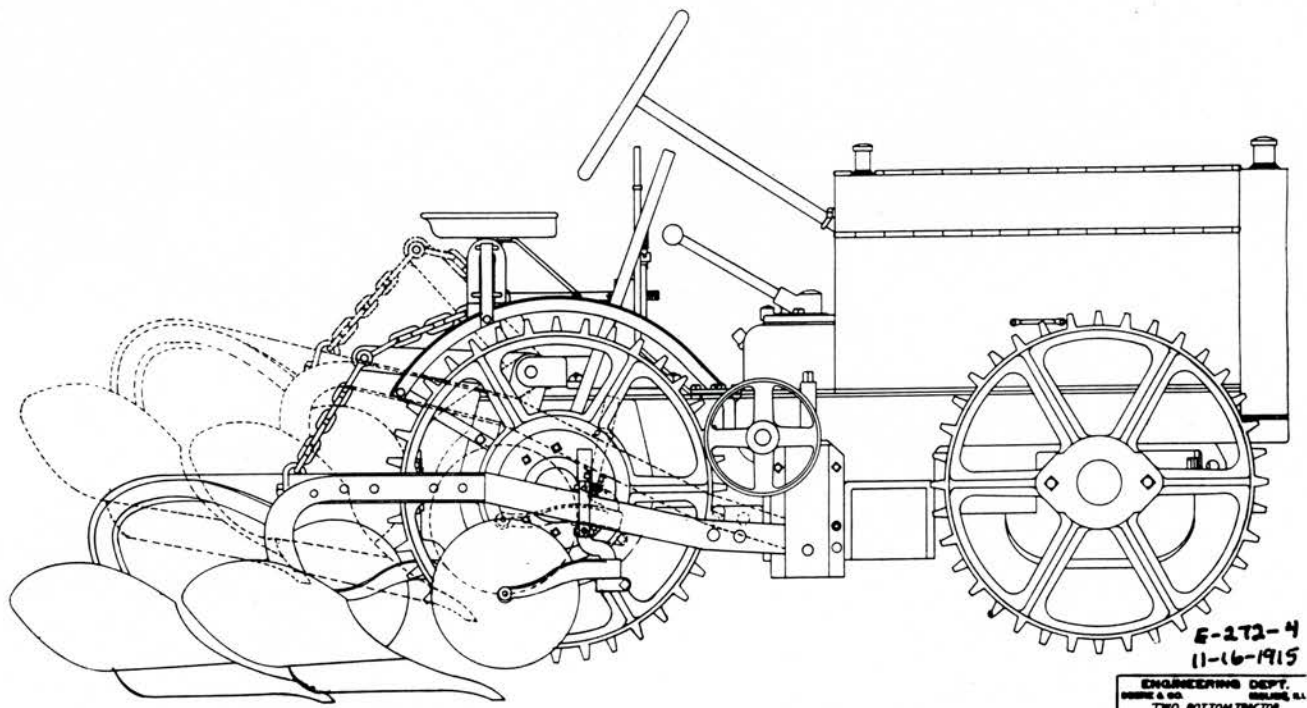
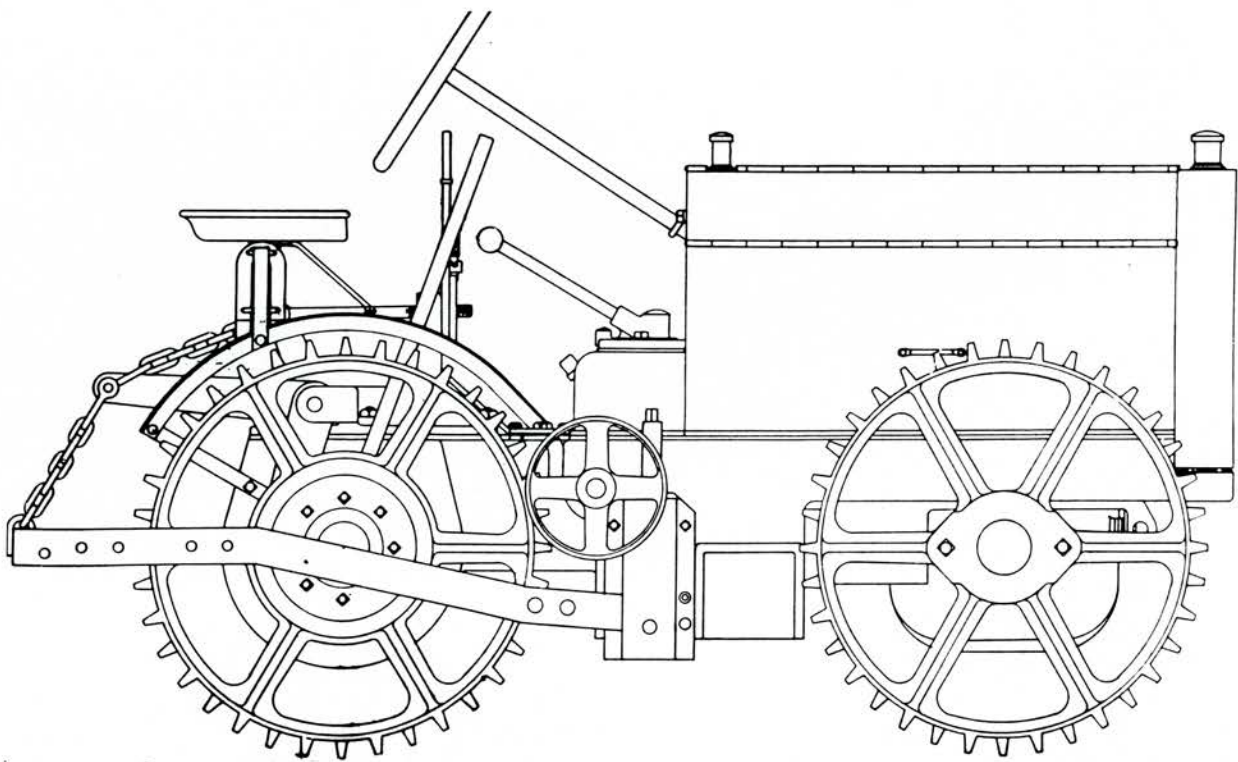


Figure 30

FIGURE 30 -- Fred Kirby at the wheel of the John Deere Model B-2 Tractor, built in 1916, which embodied improvements on the Model A-2 which had been constructed and field-tested the previous year.



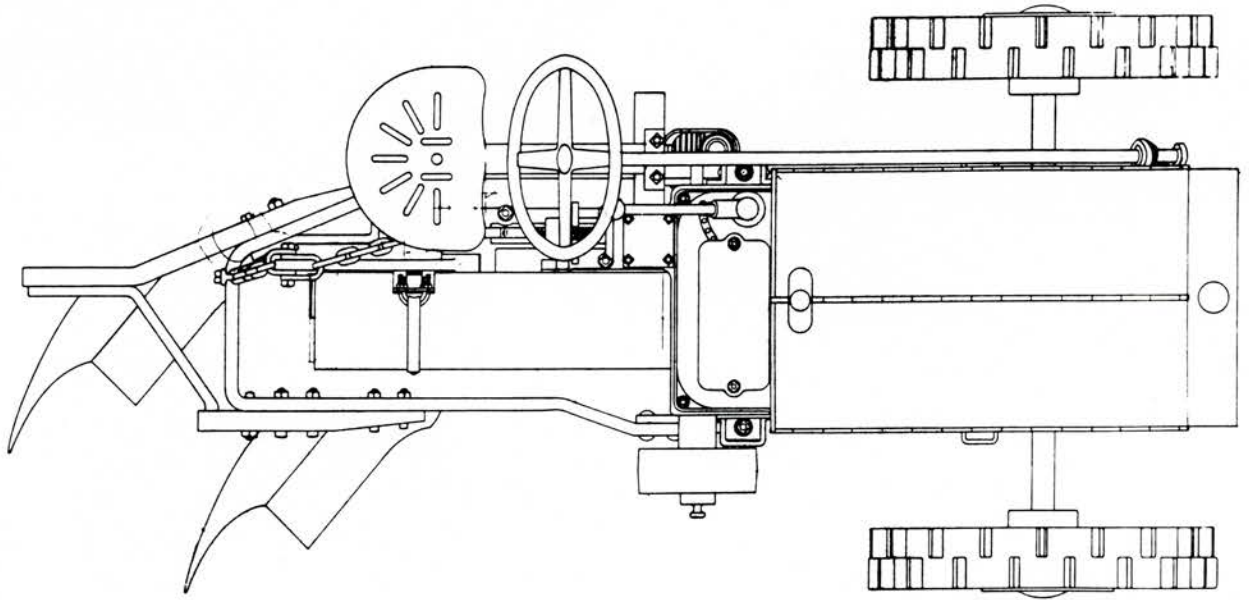
E-272-4
 11-16-1915
 ENGINEERING DEPT.
 BUREAU OF ENGINEERING
 TWO BOTTOM TRACTOR
 JOHN L. DAIN, DESIGNER
 JOHN L. DAIN, ENGINEER
 JOHN L. DAIN, ENGINEER
 JOHN L. DAIN, ENGINEER



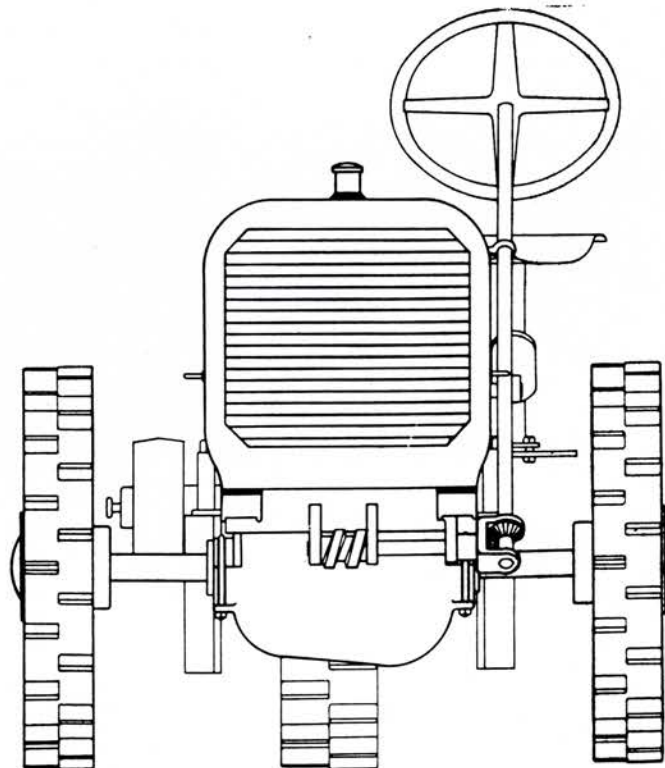
E-272-1
 11-1-1915
 ENGINEER
 BUREAU OF ENGINEERING

Figures 31 and 32

FIGURES 31 and 32 -- These drawings and those in Figures 33 through 36 show details of the A-2 two-plow tractor built under supervision of Max Sklovsky in 1915, concurrently with Mr. Dain's development of a three-plow tractor. The two machines had a number of similar features, but in many ways were distinctly and uniquely different.



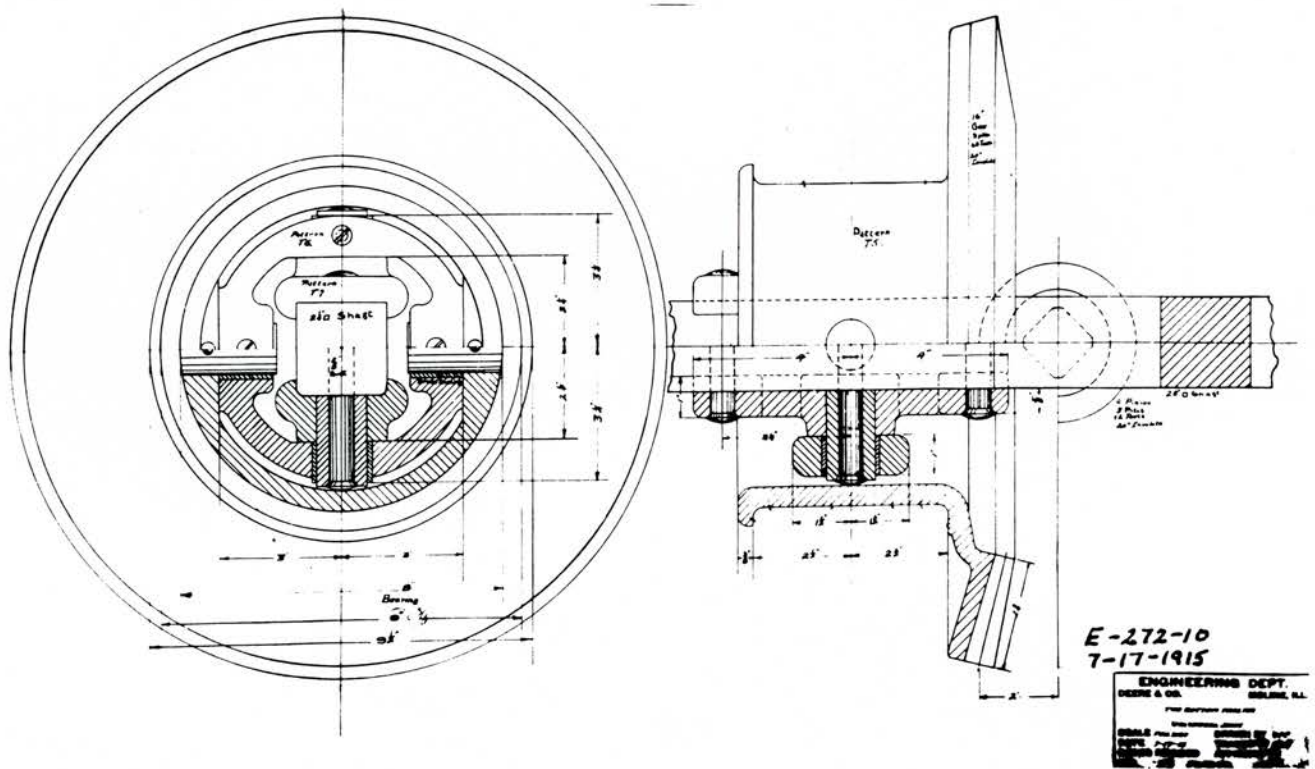
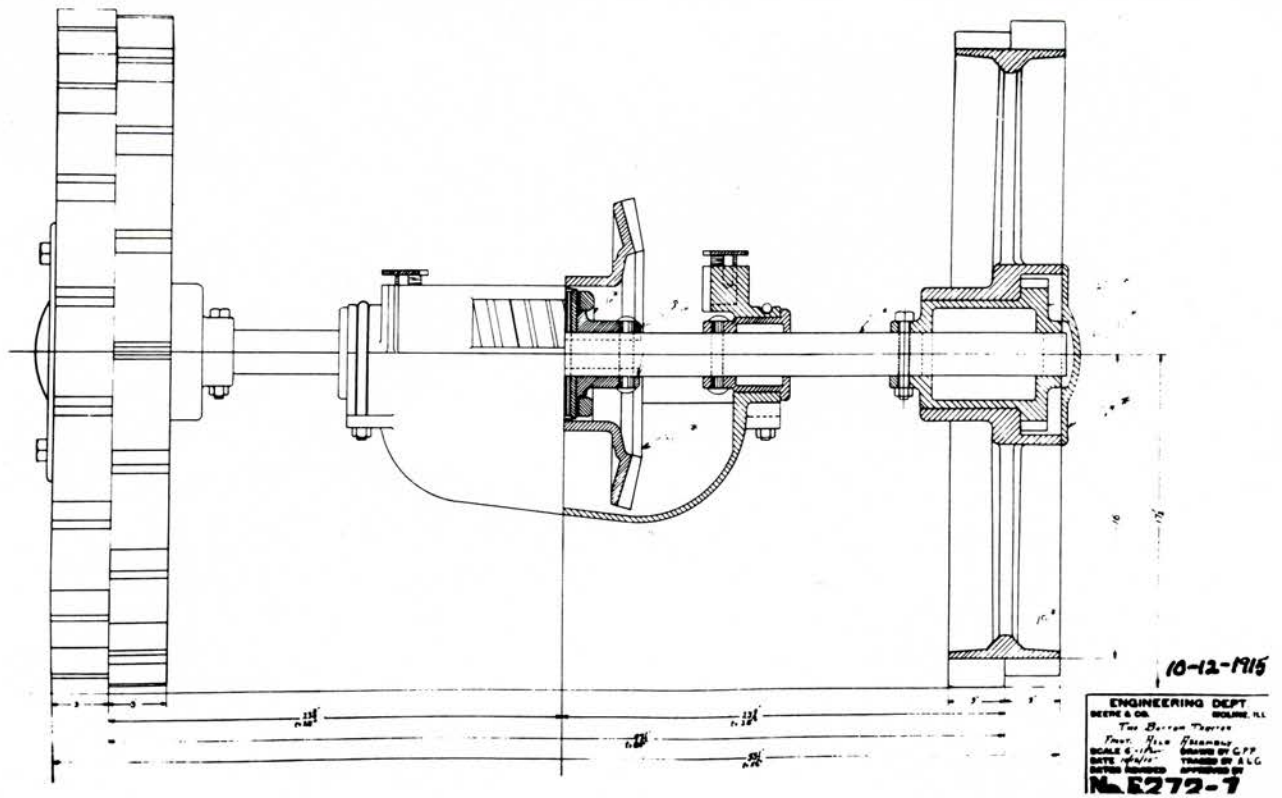
11-4-1915
 ENGINEERING DEPT.
 BROWN & CO.
 THE BOSTON TRADING - PLAN VIEW
 WITH PLANS
 SCALE 2"=1'
 DATE 11-4-15
 DRAWN BY
 CHECKED BY
 APPROVED BY
No. E-272-2



E-272-3
 11-8-1915
 ENGINEERING DEPT.
 BROWN & CO.

Figures 33 and 34

FIGURES 33 and 34 -- The whole body of Sklovsky's A-2 tractor, including the engine pan, was a single casting, without doubt the first so made. The wagon-type axle of the powered front wheels made steering almost impossible, a difficulty corrected when the B-2 was built in 1916.



Figures 35 and 36

FIGURES 35 and 36 -- Further details of the Sklovsky A-2 tractor.

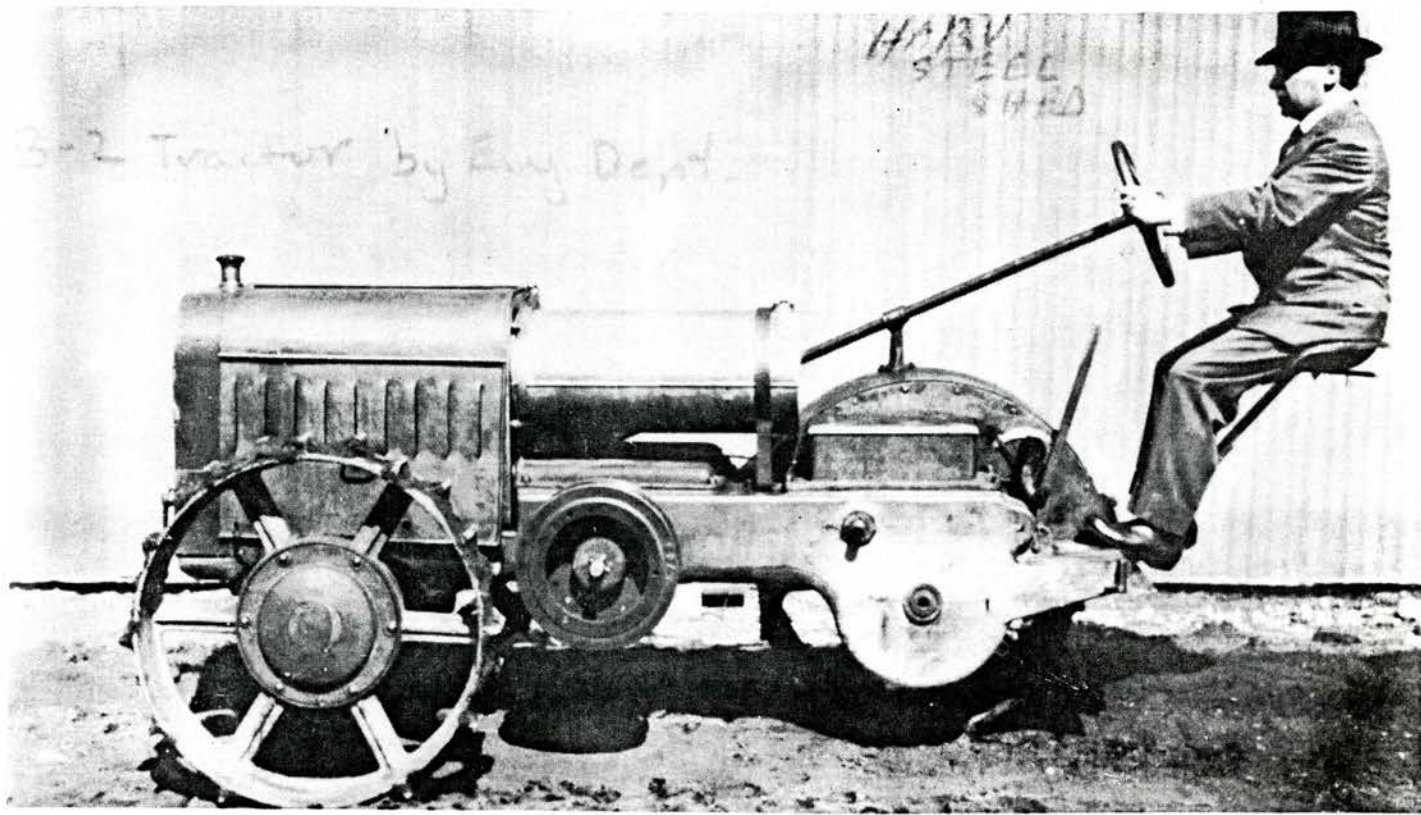
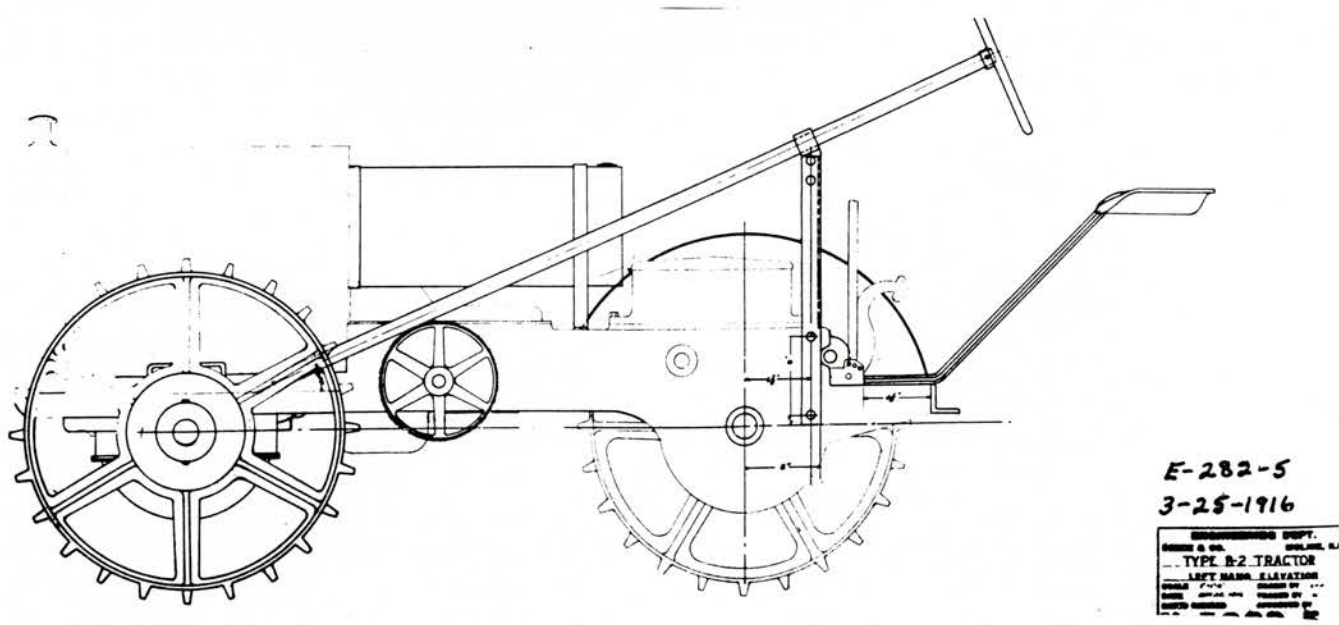


Figure 37

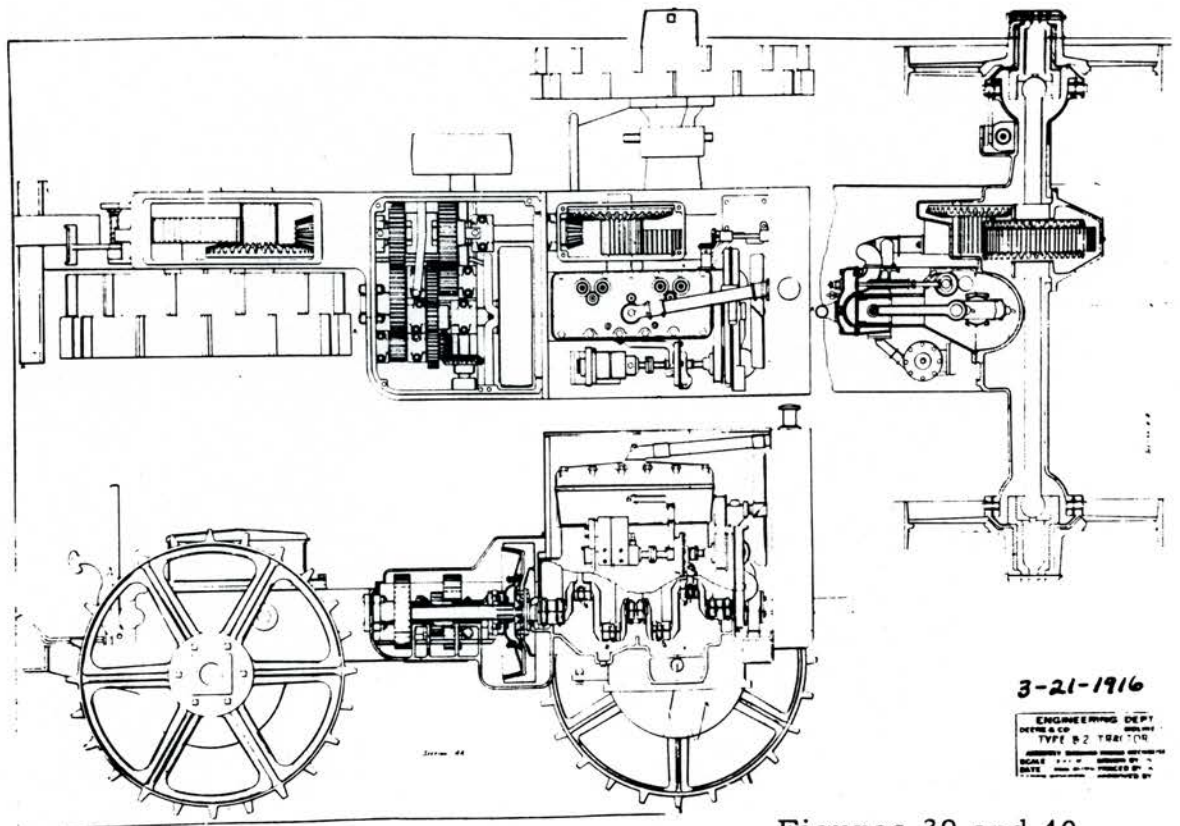
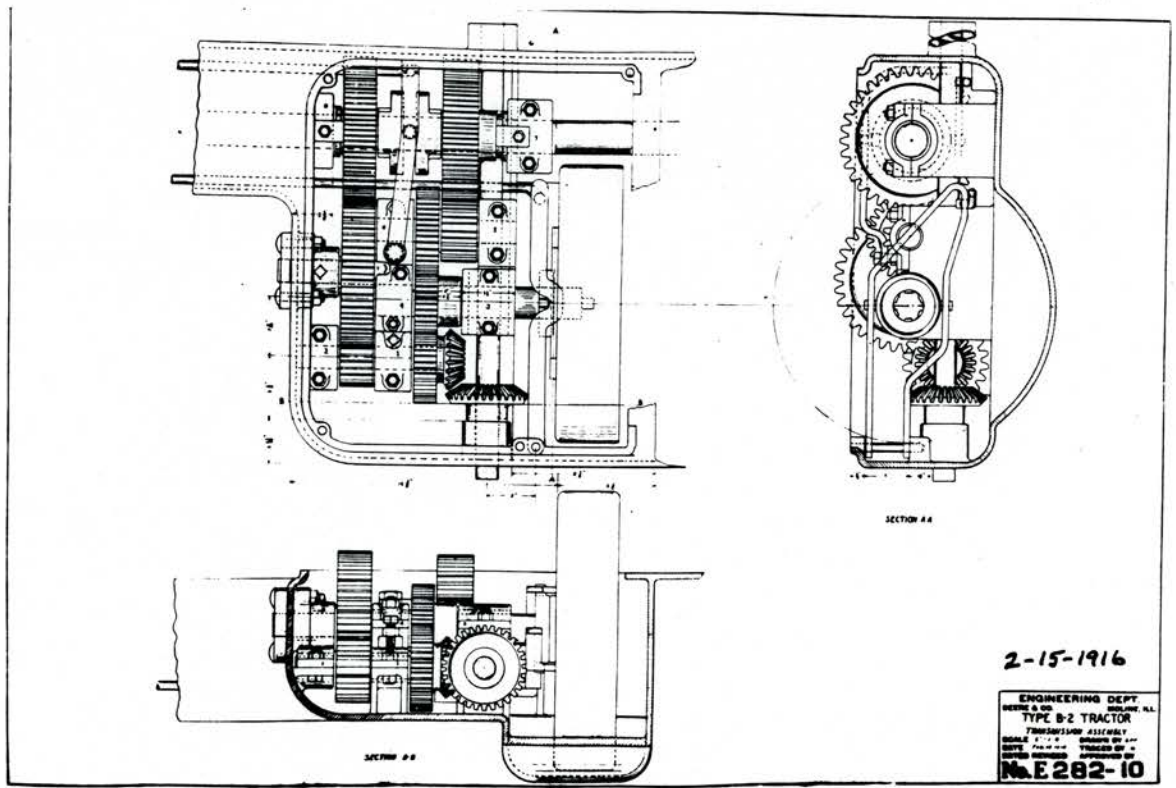
FIGURE 37 -- Mr. Sklovsky on the B-2 tractor, which had a 4-cylinder Northway engine. Some work also was done toward designing a third tractor, the D-2, which was to have had a one-cylinder, hopper-cooled engine. However, the United States' entry into world conflict was rapidly approaching, and Mr. Sklovsky and his staff were facing increasing war work demands. Interrupted by the war, development of the Sklovsky tractor was never resumed.



E-282-5
 3-25-1916
 ENGINEERING DEPT.
 COLE & CO. BRIDGE, N.J.
 TYPE B-2 TRACTOR
 LEFT HAND ELEVATION
 SCALE 1/4" = 1'-0"
 DRAWN BY
 CHECKED BY
 APPROVED BY

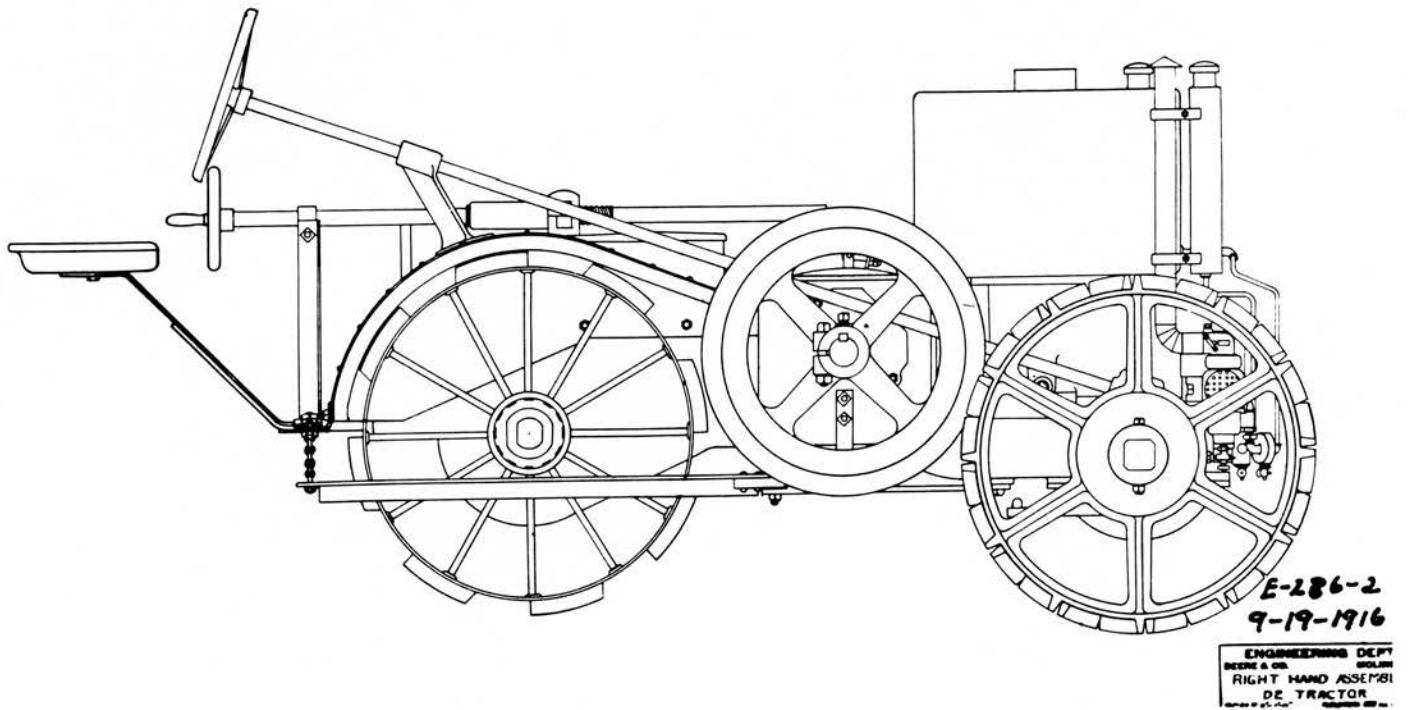
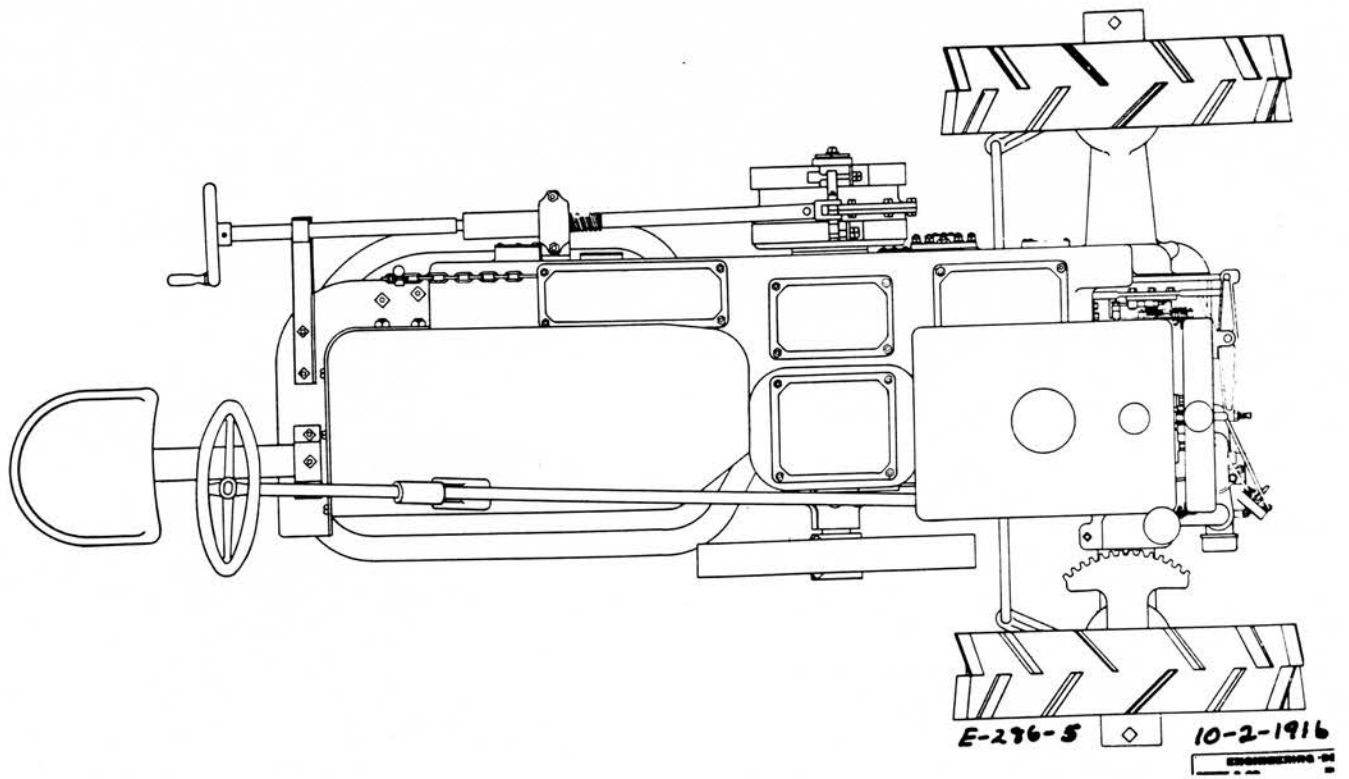
Figure 38

FIGURE 38 -- Additional construction details of the Sklovsky B-2 tractor.



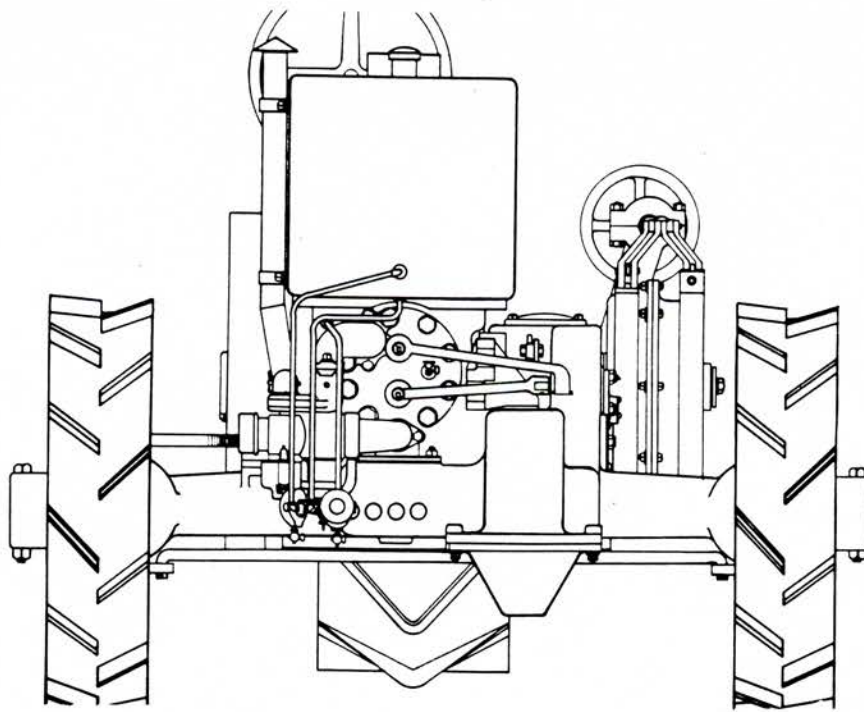
Figures 39 and 40

FIGURES 39 and 40 -- These drawings show additional construction details of the B-2 tractor built under supervision of Max Sklovsky.

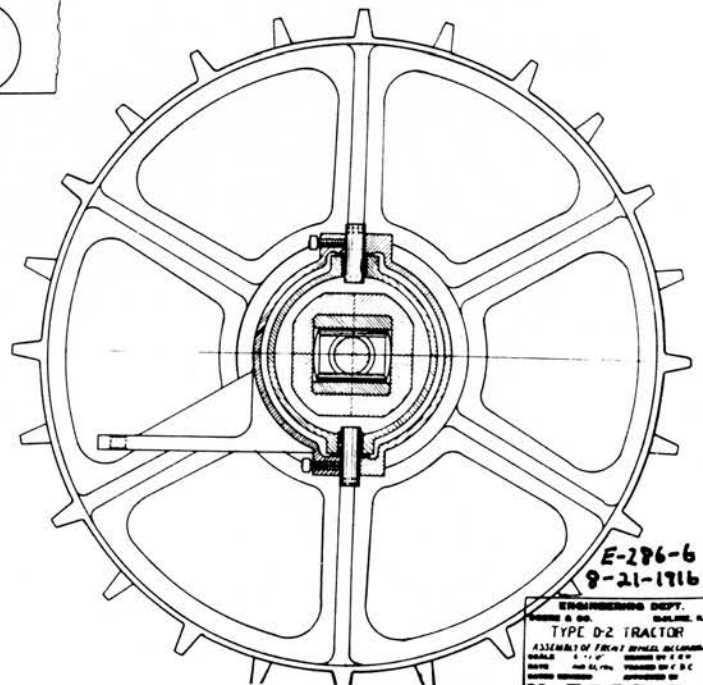
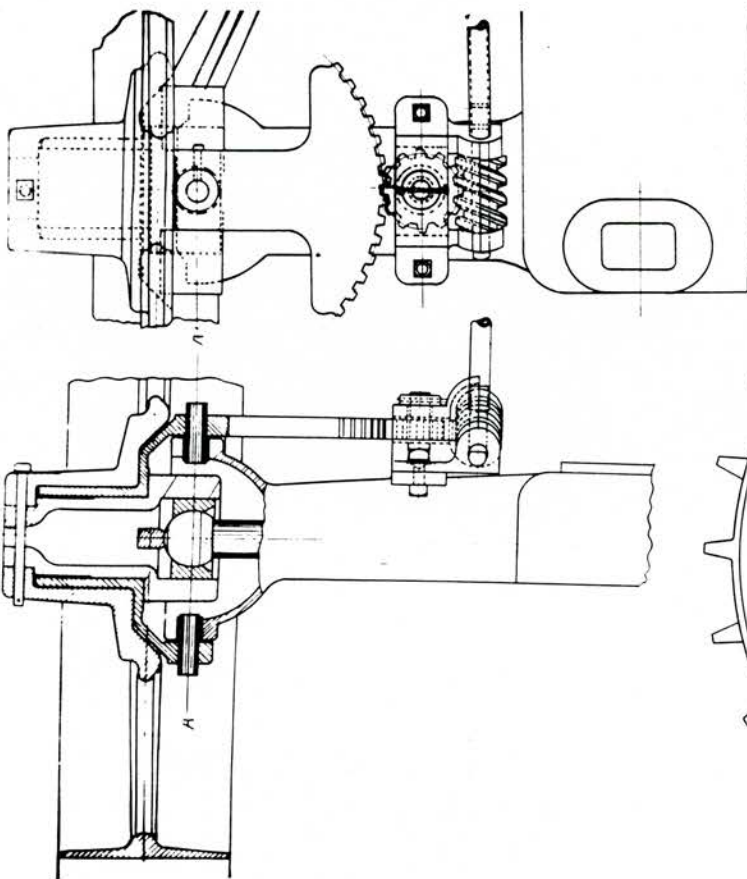


Figures 41 and 42

FIGURES 41 and 42 -- Drawings of the proposed D-2 tractor, which would have had several modifications over the B-2. However, its development was brought to a halt by the first World War.



E-286-4
10-3-1916



E-286-6
9-21-1916

ENGINEERING DEPT.
 MODEL NO. 11
 TYPE D-2 TRACTOR
 ASSEMBLY OF PARTS
 DRAWN BY J. H. B.
 CHECKED BY J. H. B.
 APPROVED BY J. H. B.
 DATE 9-21-1916

Figures 43 and 44

FIGURES 43 and 44 -- These are additional drawings of the proposed D-2 tractor.

DEERE & COMPANY'S EARLY TRACTOR DEVELOPMENT

Chapter 4 -- SINGLE-ROW MOTOR CULTIVATOR

The first attempts to design a tractor for cultivating row crops followed the pattern established for horsedrawn cultivators, except that a steering wheel replaced the harness reins. On both horse-drawn cultivators and early motor cultivators, the operator steered the outfit with his hands and manipulated the cultivating rigs with his feet.

A troublesome difference between horses and tractors immediately became obvious.

On horsedrawn cultivators, the operator's double job was easy, for horses soon learned to follow the rows, permitting the operator to give his full attention to dodging the rigs.

But if tractors didn't grab an occasional mouthful of corn leaves, neither did they learn to follow the corn rows. So cultivating, which had been a comparatively easy job with good horses, suddenly became tough, exacting work with the early motor cultivators, for the operator had to perform two unrelated functions simultaneously -- looking ahead and steering the tractor, and looking down and manipulating the rigs.

Examples of this type of tractor or motor cultivator were the Moline Universal and the Avery. In both of these outfits there was no coordination between steering and cultivating. This type of motor cultivator proved to be impractical, because a tractor operator could not successfully coordinate two unrelated functions.

Several Hit on Same Answer

United States Patent Office records show that early in 1916 there was considerable activity, by several individuals working independently of each other, on basic changes in motor cultivator design.

It is rather a coincidence that Ronning & Ronning, E. A. Johnston, Joseph Dain and Theo Brown all conceived the idea of a motor cultivator in which a pivot-axle type of horse-drawn cultivator, with laterally swinging rigs, formed the front portion of the tractor. In this construction the steering of the tractor and the shifting of the cultivator rigs were accomplished with one and the same operation.

J. B. O'Donnell of Sheldon, Ia., seems to have been the first to place a pivot-axle cultivator ahead of the tractor, but he did not use laterally swinging rigs. He filed his patent application July 14, 1915.

Mr. Dain's Historic Sketch

The first record of Deere & Co. in the development of the motor cultivator is a sketch by Joseph Dain dated Feb. 8, 1916. This sketch preserved in the Deere & Co. Patent Department files, is shown in Figure 45. Patent application was made June 6, 1916, and Patent No. 1,667,843 was issued May 1, 1928. This structure was never built.

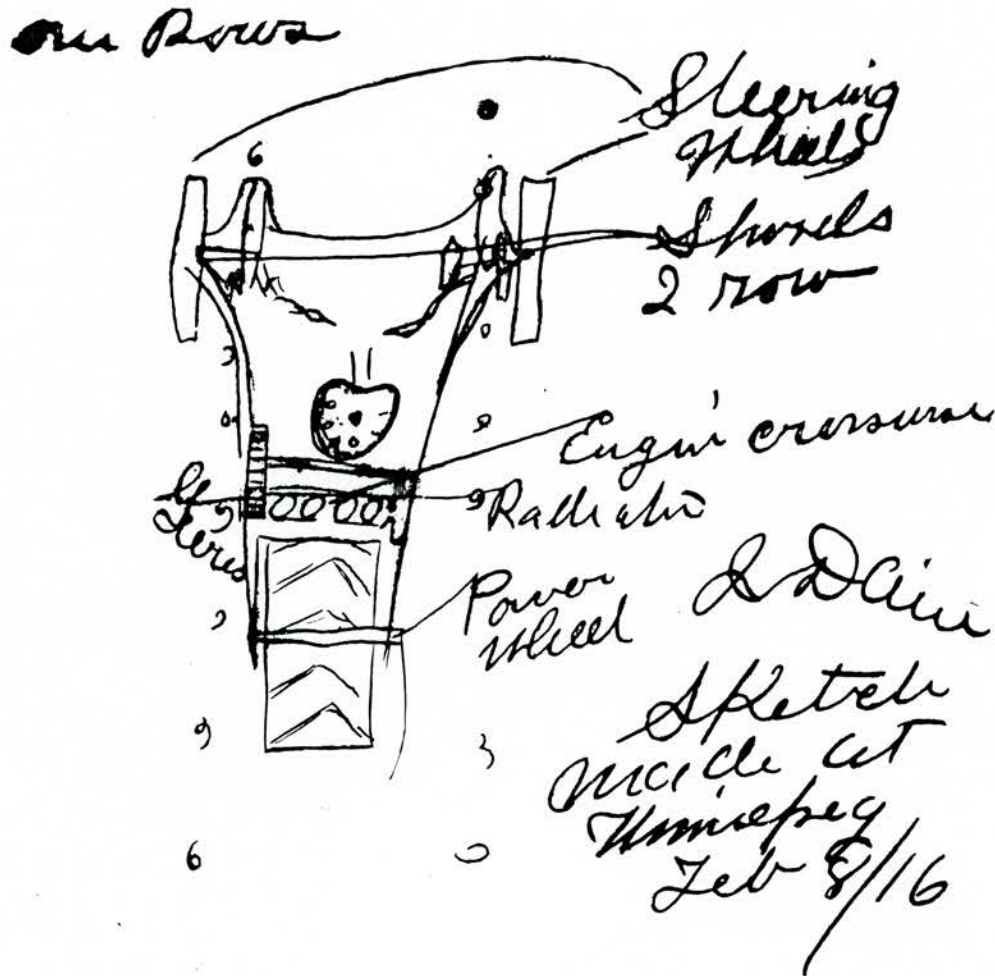


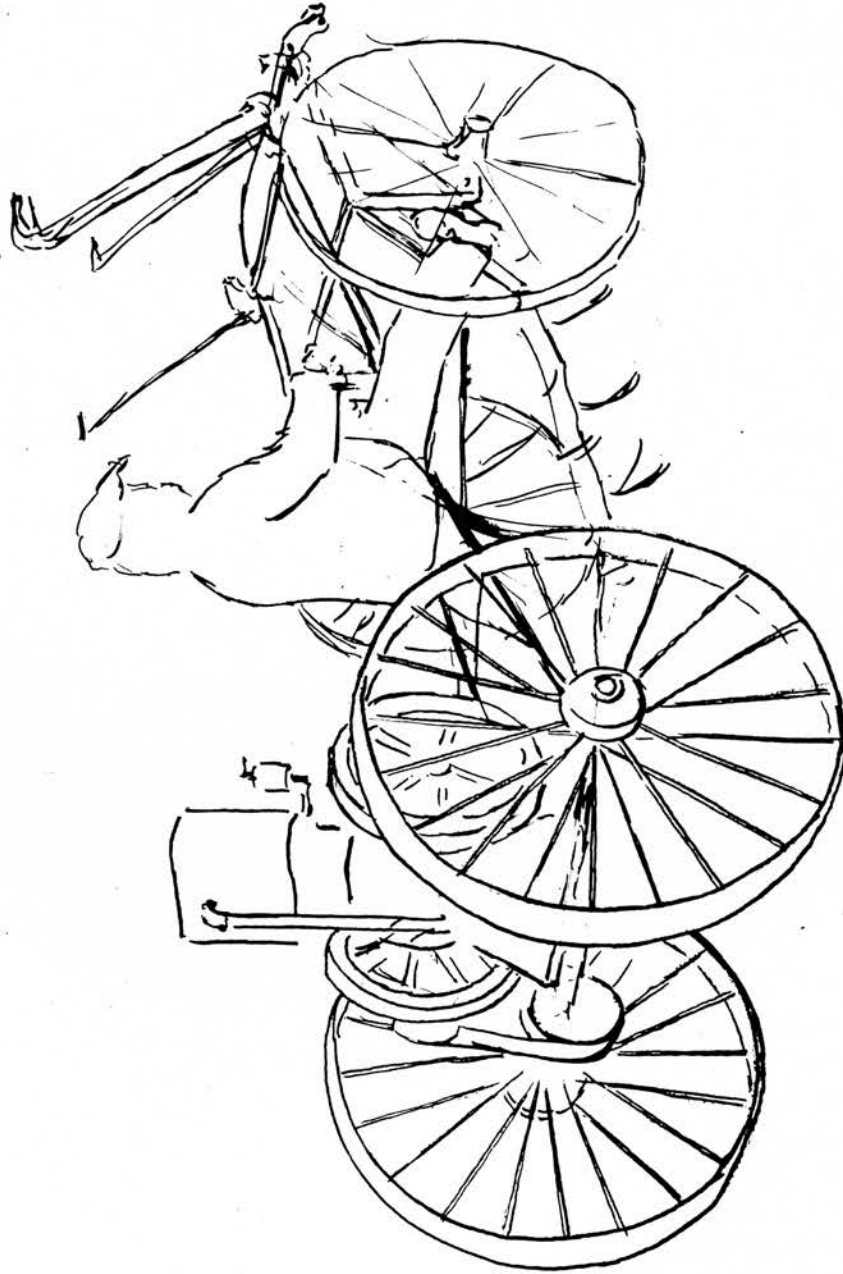
Figure 45

FIGURE 45 -- This sketch by Joseph Dain, made Feb. 8, 1916, apparently is the earliest record of Deere & Co. activity in tractor cultivators.

O 622-10M-2-16

DEERE & COMPANY

MEMORANDUM



Lee Brown

MARCH 30 1916

Witness Mr. Cimmer = Mr. Duffield

Figure 46

FIGURE 46 -- On March 30, 1916, Mr. Brown made this sketch of a proposed motor cultivator. In June the motor cultivator was completed and placed in operation.

The next activity was on March 30, 1916. An entry of that date in Theo Brown's diary reads: "Dr. W. E. Taylor suggested that we work on a cultivator pushed by a tractor. I sketched it out." This sketch and the Deere & Co. Patent Department notes are shown in Figures 46 and 47.

DEERE & COMPANY

March 30, 1916.

Mr. Theophilus Brown submits a sketch of a cultivator and tractor coupled together, the object of the structure being that the control of the cultivator accomplishes the guiding of the tractor.

Tractor cultivators up to this time have always had the tractor situated in front of the cultivator. The guiding being accomplished by the driver steering the tractor proper. This has disadvantages in that the cultivator does not respond as quickly to the guiding of the tractor as it should to do good cultivating, and the operator in watching the guiding of the tractor does not have time to observe the work and control the cultivator as he should.

In the structure proposed by Mr. Brown the action of guiding the cultivator gives immediate response to the cultivating parts as in the ordinary operation of a cultivator, and simultaneously the tractor is caused to follow in the same direction; in other words the single action of the operator in guiding and operating the cultivator as it should be operated also controls the travel of the tractor.

In the sketch submitted it is proposed to use a K.C. cultivator which has pivot wheels and is so arranged that the gangs shift laterally in conjunction with the wheels. When it is desired to turn at the ends or when traveling on the road the pivot wheels are to be locked or stiffened and the pair of wheels as an entirety swung about a central pivot on the frame. It is contemplated as a possibility to so rearrange the cultivating rigs that the pivot wheels can be used for steering at the ends on the road.

The real feature of the basic thought ^{is} exemplified in the sketch, is the control in respect to guiding of both cultivator and tractor by a single action of the operator.

Figure 47

FIGURE 47 -- This reproduction of Deere & Co. Patent Department notes (made the same day as Mr. Brown's sketch, Figure 46) explains two important principles of the Brown tractor cultivator -- placing the power unit and drive wheels at the rear, and linking the front pivotal wheels to the movable rigs to combine the two operations of steering and dodging while cultivating.

Brown's First Cultivator

Work was started immediately to build a motor cultivator following the ideas shown in the sketch. It was a matter of adapting a K.C. cultivator to be pushed by a power unit, consisting of a 7-1/2 h.p. New Way air-cooled engine, mounted on a truck supported by manure spreader wheels and using spreader drive sprockets and chain (Figure 48). On June 1 this outfit was used to cultivate corn (Figures 49, 50 and 51) with a considerable measure of success, and it was continued in use throughout the cultivating season. Minor changes were made from time to time to improve performance.

Early in July, H. H. Bliss, our Washington patent attorney, came to Moline to get a better understanding of the features that might be patentable in this motor cultivator (see Figure 54).

On July 13, 1916, George W. Mixter reported to the Board of Directors on the subject of the tractor cultivator as follows:

"A machine built by Mr. Brown which places the drive wheel at the rear with the cultivator in front has been working for about a month. Its principal features are that one dodges corn by pivoting the front wheel with one's feet and at the same time dodging the rigs. The cultivator, in fact, being an ordinary two-row cultivator reduced to a single row. Combination is a pivoted joint between the front and rear members controlled by a steering wheel, which is used principally for turning at the end of the row.

Engine Was Big Share of Cost

"The machine in the field was hastily constructed from available parts and is driven by a 7-1/2 h.p. New Way engine. It has proven distinctly a success and very attractive. The machine, other than the engine, weighs about 700 pounds and will cost about \$28.00 (1.25 steel), or \$35.00 (2.25 steel). The New Way engine was billed to us at \$115.00, but this price is probably excessive. It looks as though the machine could be sold to the farmer for \$300.00, and ultimately for \$250.00." (NOTE: The thinking then was in terms of farm implement construction and design.)

"It is probable that applications of Mr. Dain and Mr. Brown for patents will ultimately involve quite complete patent protection on the particular combination this machine represents; possibly the protection can be made quite broad. The Plow Department is at once going ahead with a carefully designed machine with a single cylinder New Way motor, meanwhile other motors are being investigated."