AGRICULTURAL INVENTIONS.

Mr. Joseph Amstutz, of Harlan, Ind., has patented an improved rake reel for reapers and mowers, which is so constructed as to raise and straighten fallen, lodged, tangled, and twisted grain and grass, and hold them in proper position while being cut, and thus allow the machine to cut short, tall, lodged, fallen, tangled, and twisted grain and grass with facility and thoroughness, leaving no scattered stalks and leaving grain in good condition for being bound.

Mr. William S. Neal, of Perdue Hill, Ala., has invented a combined cotton chopper and cultivator, so constructed that it may be readily adjusted as the character of the work to be done may require.

An improvement in the class of grain drills or seeders whose drill tubes have detachable points or hoes has been patented by Mr. William H. Wilson, of Xenia, Ohio. The improvement consists in constructing the point or hoe proper with a tubular shank, and in securing it to a drill tube by a wedge.

An improved grain rick frame has been patented by Mr. Cornelius Geiger, of Tarborough, Ga. This invention relates to portable grain supporters, the object of which is to secure small grains from damage when stacked in the straw, especially on bottom lands subject to overflow, and particularly adapted for the use of rice planters.

Correspondence.

The Edison Light

To the Editor of the Scientific American:

With this I send you the report of Profs. Brackett and Young on the efficiency of Mr. Edison's machine for generating electricity.

As undoubtedly comparisons will be drawn between the figures there given and those which have been given by Dr. Hopkinson for the Siemens machine, an analysis of his figures is not out of place. In *Engineering* for May 9, 1879, a full report of the tests of Dr. Hopkinson may be found.

He assumes, in calculating the work which is done in the circuit, that a gravity Daniell's cell has an electromotive force of 1·125 volts, though this form of cell is the weakest of any. In the calculations which the makers of other machines have rated the efficiency of their machines, 1·079 volts has been assumed as the electromotive force of a Daniell's cell. As the work varies with the square of the E. M. F., his figures for work in the current must be multiplied by $\left(\frac{1\cdot079}{1\cdot125}\right)^2 = 0\cdot919$; that is, 91·9 per cent of the work given by his figures should be taken in comparing the Siemens with other machines. I take experiments 9, 10, 11, and 12 as representing very nearly the conditions of practical use. These show, according to his figures, 3·803 erg-tens in the current to 4·161 erg-tens given the machine by the belt, or 91·5 per cent as the efficiency of the machine. Using the correction mentioned, 84 per cent will be the true number. Taking the resistance of the machine as 0·683 ohm, which it would be after running a short time, these experiments show 52 per cent in outside work; that is, of 5·55 horse power given the machine by the belt, 2·89 horse power were effective outside.

Profs. Brackett and Young show 90·7 per cent converted, and 83·9 available outside.

I hope this statement will be sufficient to end the discussion into which I was drawn some time since regarding Mr. Edison's machine. He then claimed that $\frac{9}{10}$ of the power in the current could be made available; now tests show $\frac{13}{15}$ of the energy in current are available.

It is not "childish," then, to make an armature with about one eighth of an ohm resistance, as was claimed by others at the time. Yours,

FRANCIS R. UPTON.

REPORT OF COMPARISON BETWEEN THE PRONY AND EDISON DYNAMOMETERS, AND UPON THE EFFICIENCY OF THE EDISON DYNAMO-ELECTRIC MACHINE, BY PROFS. C. F. BRACKETT AND C. A. YOUNG, OF THE COLLEGE OF NEW JERSEY, PRINCETON, N. J.—EXPERIMENTS MADE APRIL 3, 1880.

FIRST COMPARISON BETWEEN THE DYNAMOMETERS.

The lever arm of the Prony was held down by the action of a spring balance applied at division 12, corresponding to a virtual circumference of 12 feet. The weight of the balance was 5·41 pounds, which is to be added to all its readings. The balance was read by Mr. Upton. After the experiment, the Edison dynamometer, transmitting no work, as read by Prof. Brackett, indicated (the mean of five readings, ranging from 990 to 995) 994·2 pounds. During the experiment the readings were made by Prof. Brackett and recorded by Prof. Young.

Duration of test, 10 minutes.

Number of revolutions of Prony shaft, determined by counter, 5,664.

Number of revolutions of main shaft, 1,880.

Mean indication of Edison dynamometer, deduced from Prof. Brackett's ten readings, varying from 920 pounds at beginning to 935 at end of experiment, 925·7 pounds.

From this, taking the mean reading of the zero, 994·2 pounds, we have $\frac{994\cdot2 - 925\cdot7}{2} = 34\cdot25$ pounds.

Mean tension on Prony arm, 9·011 pounds, varying gradually from 10·91 pounds at beginning to 7·66 pounds at end of experiment, including weight of scale.

Work registered by Prony, 9·011 (lb.) × 12 (ft.) × 5,664 (rev.) = 612,460 ft. lb.

The diameter of main pulley is 38 inches.

The angle between belts of Edison dynamometer is taken at 44°. Assume $K = \left(\pi \times \text{sec. } 22° \times \frac{38}{12}\right) = 10\cdot7297$. Then the Edison dynamometer registered K (ft.) × 1880 (rev.) × 34·25 (lb.) = 690,880 ft. lb. That is, the Prony recorded 88·6 per cent of the work carried by the Edison dynamometer.

The comparison does not seem to us satisfactory on account of the considerable change in the conditions during the experiment.

SECOND COMPARISON.

Constants and observers as before.

Duration of test, 4 minutes.

Number revolutions of Prony, 2,281.

Number revolutions of main shaft, 752.

Mean tension on arm of Prony, 11·35 lb., varying from 11.60 to 10·97 in seven readings.

Initial reading of Edison dynamometer (mean of five), 994·2.

Final reading of Edison dynamometer (mean of five), 994·2.

Mean during comparison, 911·57.

(Mean of seven readings, varying from 910 to 915 lb.)

Work according to Prony, 11·35 (lb.) × 12 (ft.) × 2,281 (rev.) = 310,680 ft. lb.

Work according to Edison instrument, K (ft.) × 752 × $\left(\frac{994\cdot2 - 911\cdot57}{2}\right)$ = 333,360 ft. lb.

In this comparison the Prony registers 93·2 per cent of work indicated by the Edison dynamometer.

We regard this test as fairly reliable, the conditions having been very constant, and the outstanding difference of 6·8 per cent being reasonably accounted for by slip of belts and friction of journals between the two dynamometers.

TESTS OF THE EFFICIENCY OF THE DYNAMO-ELECTRIC MACHINE.

During both these tests the thermometer of the calorimeter and the Edison dynamometer were read as often as every minute, and great pains were taken to keep the water thoroughly stirred. The calorimeter was a galvanized iron vessel, 16·42 inches in diameter and 24½ deep.

The wire coil was wound upon a light wooden frame, so constructed as to serve as a very efficient stirrer.

The thermometer was an excellent instrument, by James Green, graduated to fifths of a Fahrenheit degree, each degree being about three-sixteenths of an inch in length.

Prof. Brackett read the dynamometer.

Prof. Young read the thermometer and made the records.

Mr. Upton and others, the speed of the main shaft and the indications of the high resistance galvanometer in the laboratory.

CONSTANTS.

Weight of calorimeter (empty)	22·63 lb.
Heat capacity of same (taking specific heat at 0·112).....	2·53 lb.
Weight of wooden frame.....	5·71 lb.
Heat capacity of frame (s. taken at 0·30).....	1·71 water lb.
Weight of wire coil (54¼ turns, each turn weighing 5·84 grammes)....	0·70 lb.
Heat capacity of wire (s., 0·10).....	0·07 water lb.
Resistance of coil in calorimeter...	1·720 ohms.
Resistance of leading wires taken as $\frac{1}{800}$ of coil.....	0·0057 ohm.
Resistance of wire on revolving armature.....	0·140 ohm.
Resistance of coil on field magnets,	1·470 ohms.

FIRST TEST.

Total weight of calorimeter with contained water and everything in place	197·5 lb.
Hence from preceding data the heat capacity of whole.....	172·77 water lb.
Temperature of air.....	72·2°
Temperature of water at beginning.	63·8°
Temperature of water at end.....	80·5°
Gain during experiment.....	16·7°
Duration of experiment...13m. 50s.	13·83⅓ m.
Dynamometer at beginning (free)...	994·2
Dynamometer at end (free).....	995·
Mean dynamometer zero...	994·6
Speed of main shaft, beginning.....	174 per min.
Speed of main shaft, end.....	170
Mean.....	172
Mean reading of dynamometer during experiment.....	771·75 lb.

(Varying from 760 to 781, 16 readings.)

E. M. F. of current maintaining field was 61 divs. of galvanometer, on which 168 d. corresponded to 16 Daniell cells, *i.e.*, E. M. F. $= \frac{61}{168} \times 16 \times 1\cdot079$ volts.

Energy expended on driving armature, as indicated by dynamometer = K (ft.) × 172 (rev.) × 13·833⅓ (min.) × $\left(\frac{994\cdot6 - 771\cdot75}{2}\right)$ = 2,844,600 foot pounds.

Energy expended on field of force, $\frac{6}{5} \times \frac{45\cdot25 \text{ (ft. lb.)}}{1\cdot47 \text{ (ohms)}} \times 13\cdot883 \text{ (m.)} \times \left(\frac{61}{168} \times 16 \times 1\cdot079\right)^2$ = 19,634 foot pounds.

Hence, total energy expended, 2,864,234 foot pounds.

Energy Realized.

a. In calorimeter = 772 × 172·77 × 16·7° =.....	2,227,420 ft. lb.
b. In leading wires $\frac{1}{300}$ of above...	7,425 ft. lb.
c. In armature $\frac{14}{172}$ of calorimeter,	181,302 ft. lb.

Hence,

Total energy realized	2,416,147
Total available (*a* + *b*).....	2,234,845

Hence,

Total efficiency..... ...	84·5 per cent.
Total available	78·2 per cent.

Remarks.

During this test the driving power was about 6¼ horse power; the electromotive force of the field current, 6·27 volts, giving a current through the magnet wires of about 4¼ webers; and the current developed by the machine was about 45 8 webers through a total resistance of 1·866 ohms.

SECOND TEST.

Total weight calorimeter and contents.....	200·00 lb.
Hence by preceding data, heat capacity =.....	175·27 water lb.
Temperature of air.....	71·1° to 71·8°
Initial temperature of water.....	63·2°
Terminal temperature of water....	79·9°
Gain.....	16·7°
Duration of experiment	9 minutes.
Speed of main shaft, beginning...	176 per m.
Speed of main shaft, middle	173 per m.
Speed of main shaft, end.....	177 per m.
Mean.....	175·33
Dynamometer reading before exp.,	985
Dynamometer reading after exp....	995
Mean dynamometer zero.....	990
Mean reading of dynamometer during the experiment (9 readings, between 645 and 666).....	656
Electromotive force of field (by high resistance galvanometer) = $\frac{145}{168} \times 16 \times 1\cdot079$ =.....	14·901 volts.
E. M. F. of dynamo current = $\frac{240}{51} \times 20 \times 1\cdot079$ =.....	101·55 volts.
E. M. F. of terminals of dynamo; current broken, $\frac{290}{51} \times 20 \times 1\cdot079$ =	122·71 volts.

Energy Expended.

a. In driving armature according to dynamometer, K × 175⅛ (rev.) × 9·0 (m.) × $\frac{990-656}{2}$ =..... 2,827,550 ft. lb.

b. In maintenance of field of force, $\frac{6}{5} \times 44\cdot25 \text{(ft. lb.)} \times 9 \text{(m.)} \times \frac{(14{,}901)^2}{1\cdot47}$ = 72,180 ft. lb.

Hence,

Total energy expended.....	2,899,730 ft. lb.

Energy Realized.

a. In calorimeter, 772 × 175·27 × 16·7° =	2,259,700 ft. lb.
b. In leading wires $\frac{1}{300}$ of above.....	7·532 ft. lb.
c. In armature $\frac{0\cdot14}{1\cdot72}$ of *a*.....	183·930 ft. lb.
Total energy realized (*a* + *b* + *c*)....	2,451,162 ft. lb.
Available (outside of machine) (*a* + *b*),	2,267,232 ft. lb.

Hence,

Total efficiency.....	84·5 per cent.
Available efficiency.....	78·2 per cent.

Remarks.

As a check we may compute the total efficiency from the galvanometer reading and the resistance: Energy developed, 44·25 (ft. lb.) × 9 (m.) × 101·55 (volts) × 1,866 (ohms) = 2,200,500 ft. lb.

The discrepancy is fairly explained by the defective insulation of long wires leading to the galvanometer, as it was raining at the time.

During the experiment the driving power was about 9½ horse power, and the current was 57·4 webers (according to galvanometer, 54·4).

Even with this current the spark at the commutator was very trifling.

SUMMARY.

	Total Efficiency.	Available Efficiency.
According to first test....	84·5 p. c.	78·2 p. c.
According to second test..	84·5 p. c.	78·2 p. c.

The Prony dynamometer is connected to the Edison dynamometer by a belt from the same countershaft, which is also belted to the electric generators. If we should assume the correctness of the Prony, and that the loss in the transmitting power between the Edison dynamometer and the arbor of the armature was only the same as between the two dynamometers, the above numbers would have to be increased in the ratio of 100 to 93·2 (see above), and we should have:

Total efficiency.....	90·7
Available efficiency	83·9

C. F. BRACKETT,
C. A. YOUNG.

Princeton, N. J., April 10, 1880.