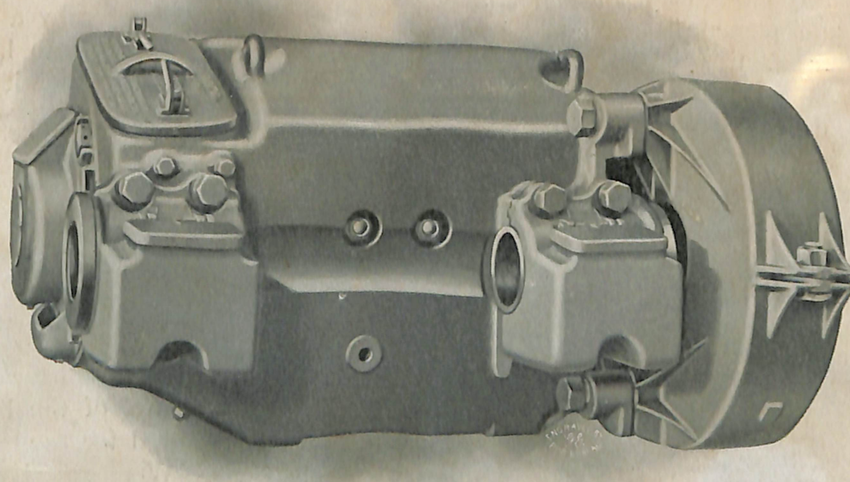
General Electric Company

RAILWAY DEPARTMENT

July 16, 1902 Bulletin No. 4294

THE GE-73 MOTOR.

The GE-73 motor was placed on the market about two years ago to meet the demands for a railway motor for heavy high speed interurban cars, or to handle trains requiring rapid acceleration with frequent



THE GE-73 MOTOR.

stops in connection with the General Electric train control system.

After an extensive experience with this motor under practical operating conditions, the General Electric Company now offers it with the full assurance that it will satisfactorily meet the requirements of this class of service.

In general design, the mo[illegible] is similar to the GE-55 and the GE-66 box frame type of motors, the former of which has a phenomenal record of successful operation during the past five years on numerous roads in this country and Europe, and the latter a motor of the same type of which the General Electric Company is now manufacturing 1800 for the Manhattan Railway, in addition to large numbers for other roads.

The construction of the GE-73 motor possesses marked advantages, some of which are briefly mentioned in the following description.

MAGNET FRAME.

The magnet frame is unsplit and is made of one piece of cast steel in the form of a cube with well rounded corners and large bored openings in each end, into which the frame heads carrying the armature shaft bearings are bolted. The armature is put in place or removed from the frame through these openings.

The axle bearing caps are bolted to vertical surfaces on the frame and the laminated pole pieces are bolted to the interior, top, bottom and sides of the frame by through bolts with nuts on the outside of the frame. The through bolts are readily renewed in case they break or the threads are injured and the outside nuts may be easily reached with a wrench.

Forged bails are cast into the four top corners of the frame to facilitate handling of the motor, and planed bosses on the four bottom corners permit the motor to be set up in exact position when desired.

The opening over the commutator is inclined at an angle so that the brush-holders and commutator may be easily reached under the car from the axle side of the motor, or if desired, through a trap door in the car floor. The opening is closed by a malleable iron cover with a felt gasket, and the cover is held in place by a quickly adjustable cam locking device.

There is an opening below the commutator and three openings in the sides of the frame at the pinion end. Any or all of the covers bolted over these openings may be left off for ventilation where the service conditions will permit. The armature and field leads are brought through rubber-bushed holes at the commutator end of the motor, on the side next to the truck bolster. This arrangement reduces to the minimum the movement of the leads when the truck swivels in taking curves.

BEARINGS.

The frame heads are made of malleable iron cast in one piece. In order to secure large and long bearings without sacrificing other desirable features of construction, the heads, in a cone shape, are extended well under the commutator shell and pinion-end armature core head. This construction forms a support for the bearing linings which is very strong and rigid.

The frame head castings have large oil wells into which oily wool waste is packed and comes into contact with a large surface of the armature shaft through an opening cut in the low pressure side of the bearing linings.

The linings are unsplit bronze sleeves, finished all over with a thin layer of babbitt metal soldered to the interior bearing surface. The babbitt furnishes an ideal bearing surface and is so thin that it does not allow the armature to rub on the poles in case it is melted out by overheating.

Waste oil is prevented from entering the interior of the motor by a series of oil deflectors which throw it into large grooves cast in the heads from which it is conducted away.

This form of bearing is fully equal in simplicity and reliability to the standard car box journal bearing. The method of lubrication and treatment is practically the same and the boxes are reached through large hand holes protected by swing covers, held in place by a spring. Records show that these armature shaft bearings have run 137,000 miles without renewal of the linings. The amount of oil required for the bearings is exceedingly small. Wide experience indicates that no other type of bearing equal to this has ever been placed on a railway motor.

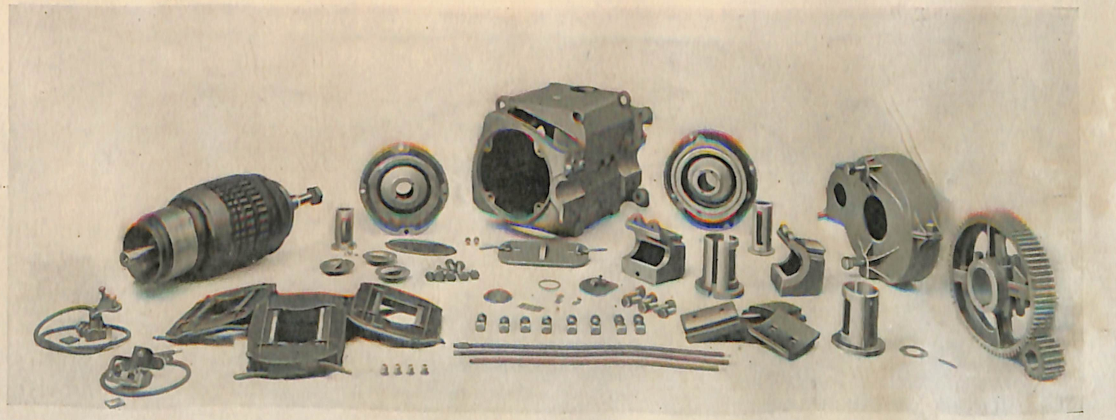
The axle linings are held in place by cast steel caps which are tongued and bolted to planed and grooved vertical surfaces on the frame. Large oil wells are cast in the caps and are packed with oily wool waste which comes into contact with a large surface of the axle through openings cut in the bearing linings. As with the armature shaft bearings, the method of lubrication is similar to that used for standard car box journals.

FIELD COILS.

The field coils are wound on cast bronze spools, which are insulated with mica and asbestos and then wound with flat copper ribbon with asbestos ribbon between turns. The outside layers of copper are covered with a specially prepared tape and bound in with a canvas dressing, filled with a compound to prevent the entrance of moisture.

The construction of the coil makes it solid and compact and especially well adapted to radiate heat; the insulating material used makes it semi-fireproof. In case of injury repairs are easily made.

The bronze spools have finished bosses on top and bottom, which rest on corresponding bosses on the frame and pole pieces. The spools are held between these bosses when the laminated pole pieces are bolted in place.



PARTS OF THE GE-73 MOTOR.

ARMATURE.

The armature is wound with three coils per slot. The coils are wound two turns per coil on accurately shaped forms and pressed in steam molds in units of three coils each with insulation between adjacent coils. These triple coils are insulated with specially prepared fabric, which has been developed by the General Electric Company after exhaustive experiments. As a final protection, principally from mechanical injury, the coils are taped and then filled with a special compound.

The windings are especially well protected from carbon dust, oil or mechanical injury. The pinion-end core head extends out under the end windings, with a flange extending up past the ends of the coils. The windings at both ends are covered with a strong canvas dressing securely bound in place.

Following a long established practice of the General Electric Company, no bands are allowed to project above the armature core. Some years ago a special device was developed for securing the ends of the band wires, independent of solder. Armature bands and windings on General Electric railway motors never come off because of insecure or insufficient binding. The bands are put on to stay.

COMMUTATOR.

Conforming to the standard practice of the General Electric Company, the commutator segments are made of hard drawn copper, insulated throughout with the very best grade of mica. The cone micas are built up and pressed hard and compact in steam molds. The segment mica is made of a somewhat softer quality, with the view of making it wear down evenly with the copper.

Much care is taken in the construction of the commutator. The coned surfaces are machined with extreme care and cleaned to prevent possible short circuits, and creepage distances are made long to prevent grounding.

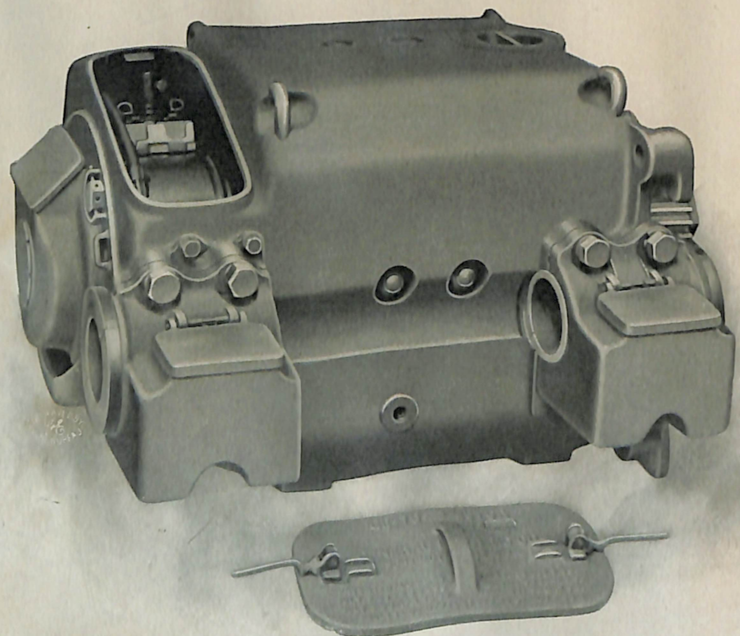
The excellent commutating qualities of the motor, together with the good construction of the commutator and deep segments, insure a long life for the commutator.

The commutator shell and cap are made of cast steel and the parts are extremely strong. The segments are clamped very tight and the cap is pressed home in a hydraulic press previous to tightening the commutator nut. The commutator will be found to keep its shape well.

BRUSH-HOLDERS.

The brush-holders, two in number, are made of cast bronze and have two carbon brushes per holder. The brushes slide in finished ways and are pressed against the commutator by independent fingers which give a practically uniform pressure throughout the working range of the brushes. The arrangement of the springs actuating the fingers is such that there is but slight pressure on the pins on which the fingers pivot. This prevents any tendency of the fingers to stick on the pins and reduces the wear to the minimum.

There is a "pig-tail" or shunt between the fingers and the brush-holder body to prevent current passing through the springs or pivoting pins.



THE GE-73 MOTOR.

The brush-holders are adjustable to allow for wear of the commutator. They are clamped on mica insulated studs, sliding in finished supports which are bolted to the frame. This method of insulating brush-holders was developed by the General Electric Company some years ago and has been applied to a number of motors with marked success. There is a great advantage in using the highest quality of insulating material which is not injuriously affected by heat or moisture.

VENTILATION.

In the construction of the GE-73 motor,

special attention has been given to the matter of ventilation. As previously mentioned there are a number of openings in the magnet frame, and in service which will permit of it, the covers may be left off, thus securing a free circulation of air between the exterior and interior of the motor.

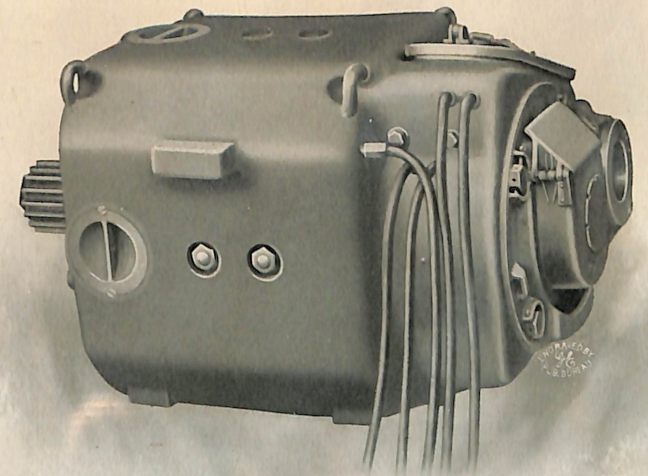
The armature is so constructed that when turning, it draws a large volume of air into the interior of the core and expels it along the exterior. So well ventilated is the armature that it becomes a powerful blower at full speed, and the large volume of air passing through it in addition to small electrical and mechanical losses keeps it unusually cool. A strong point in the construction is that ventilation is effected without sacrificing necessary protection to the armature windings.

GEAR, PINION AND GEAR-CASE.

The gear is made of a superior grade of cast steel and the pinion from forged steel, extra hammered, to improve the quality of the metal. The gears have a 5¼″ face and the distance between gear centers is such that either a No. 2½ or No. 3 pitch may be used, depending on the gear ratio desired.

The teeth are accurately cut by special tools in the General Electric Company's large department specially organized for doing this work.

The gear case is made of malleable iron and is of an improved design. Radiating from the points where it is attached to the motor frame are strengthening ribs to prevent the case from cracking when subjected to the excessive vibration received in service. Both



GE-73 MOTOR--FRONT VIEW.

the top and the bottom halves of the case are bolted to the motor frame in order to minimize lateral vibration.

SUSPENSION.

The GE-73 motor is designed for a nose suspension. A cast lug on the front of the frame rests on a bracket secured to the truck transom. A forged strap is bolted over the top of the lug to prevent the motor from rising. Motors are mounted on or removed from the truck from above when the truck is out from under the car, no pit being required.

WEIGHTS AND DIMENSIONS.

General dimensions and weights of the

GE-73 motor will be found on the motor suspension diagram, page 11, and weights of equipments on page 9.

ADVANTAGES.

The GE-73 motor as a type possesses a number of advantages, some of which may be briefly summarized as follows:

With the box type of motor maximum capacity can be obtained in minimum space, or a motor of given size may be designed with larger factors of safety than with other types. Considering how limited is the space into which a railway motor has to be crowded, the extreme severity of the service and the very adverse conditions, the importance of large factors of safety is readily appreciated.

With the GE-73 motor, trouble from loose cap or frame bolts is eliminated. The field coils are all connected together inside the magnet frame. There is no break in the frame magnetic circuit and no chance for oil from the axle bearings or water to get into the motor as sometimes happens at the joint between the two halves of a split frame motor.

No other type of motor in the same space permits of so large bearings and superior method of lubrication. This type of motor may use all available space on the truck to the greatest advantage, and permits in consequence, a longer commutator and more ventilating space than can be secured in any other type of motor. With no other type can so large an armature be used on so large a cross section of copper on the armature and field coils. No other type with equally good constants for a given output can be built so light. Considering convenience of handling, efficiency and reliability of operation and low cost of maintenance, no other type in large sizes is equal to it.

RATING.

On account of the electrical efficiency and good ventilation of the GE-73 motor, its capacity for continuous service is high. The motor is rated at 75 H.P. based on a temperature rise by thermometer of not more than 75°C. above the surrounding air after one hour's run at 500 volts, the temperature of the surrounding air not exceeding 25°C.

This method of rating has been in use for a number of years, and while it does not necessarily give an exact measure of the capacity of a motor to perform all classes of service, it is a convenient and now well understood rating which conveys an approximate idea of the relative sizes of motors, sufficiently close for general use. In addition, a motor run at this rating will receive a very good all around test of commutation, bearings, brush-holders, heating, etc.

The predetermination of the capacity of a motor to perform a given service is a problem, the solution of which necessitates a complete knowledge of the mechanical, electrical and thermal characteristics of the motor. Knowing these characteristics, it is possible to calculate the losses in a motor while performing any specified service. There is but one way of determining how hot a motor will run with these losses, and that is by reference to actual tests of the motor under the same or similar service conditions.

Manifestly, the heating of a given motor in service depends absolutely on the character of the service and consequently no reliable estimate can be made of the necessary capacity, or characteristics of the motor for successful operation, without a complete knowledge of the operating conditions. The weight of car or train, schedule speed, location and number of stops, duration of stops, profile and plan of road and voltage are necessary for a complete and careful analysis of the problem.

The General Electric Company carefully tests each type of motor for efficiency, I^2R losses, core losses, friction losses, speed, commutating capacity, etc., at various voltages and amperes.

Exhaustive tests are made to determine the capacity of the motor to dissipate heat under operating conditions. For this purpose motors are put into actual service on the Company's experimental track (more than two miles in length) and run day after day over a wide range of known service conditions, careful temperature measurements being taken, until sufficient data is obtained to show what temperature different parts of the motor will reach, not only with various total losses, but with various distributions of these losses.

Possessing such complete information covering all the characteristics of a given type of motor, the Company's engineers are in a position to determine with much assurance the adaptability of the motor to handle any specified service. The problem then becomes not a matter of guesswork, but of calculation.

As the power required to operate an equipment affects not only the heating of the motors, but also the total amount and cost of power for operating the road, careful calculations are made to determine the most suitable characteristics of a motor for a given service and the most economical gear ratio to use. The possibilities for saving power by careful design and proper selection of gear ratio are much greater than ordinarily appreciated.

For convenient reference, and to enable customers to quickly determine with considerable accuracy the capacity of the GE-73 motor to handle cars or trains under ordinary service conditions, a table based on tests, such as have been described, has been prepared showing schedule speeds for various gear ratios with varying number of stops per mile and different weights per motor.

The table will be found useful not only for determining the service capacity of the motor, but also for laying out practical operating schedules.

As the reputation of its motors and the interests of its customers are involved in the selection of motors, the General Electric Company desire to aid and co-operate with customers in selecting motors adapted for their service. To this end, customers are furnished with blank service data sheets to fill out, showing the character of the service which it is desired to operate. The General Electric Company's great experience in this class of work enables it to render valuable assistance, and long experience has indicated that co-operation is mutually beneficial.

The blank form shown on page 12 will be gladly furnished to prospective customers.

Speed, torque and efficiency curves of the GE-73 motor with various gear ratios, corresponding to gear ratios given in the table, will be found on pages 13-17. These curves are convenient for general reference.

The diagram of the motor, showing external dimensions and axle preparation on page 11, will enable truck builders and car manufacturers to adapt trucks and cars for the proper reception of the motor.

The table on page 10 giving estimated schedule speeds in miles per hour for the GE-73 motor is based upon motors operating with 500 volts line pressure at the motors.

The duration of the stops has been taken as 10 seconds each.

The maximum estimated temperature rise of motors above the surrounding air in each case is not more than 65°C. with motors closed and is based on operation of motors under average normal conditions. While the temperature rise will not usually exceed the estimate of 65°C. *it should be noted that temperatures can not be guaranteed* since results can be affected by the manner in which equipments are handled by different motormen.

The table does not specify schedule speeds with the higher speed gears and a large number of stops per mile and multiple running, for the reason that the schedule which it is possible to make with multiple running would heat the motors in excess of 65°C. rise. However, schedules are given which may be made with a temperature rise of less than 65° C. when motors are in series.

The schedules starred are for motors in series, that is, on a basis of an average potential of 250 volts across each motor.

This part of the table, viz., that giving schedules for series running, will be found convenient in cases of mixed service, that is, partly suburban or interurban and partly city.

As running with motors in series gives a lower schedule and also lower heating of motors than running in multiple, it may be possible that there are service conditions composed of series running in the city and multiple running between cities where an equipment would handle a heavier car than indicated in the table, or a higher speed gearing might be used for the same weight of car. Further, motors with high speed gears may be able to handle a city service with multiple running and the usual number of stops per mile without a temperature rise exceeding 65° C., provided a large part of the total distance run is suburban or interurban service where but few stops are made. If it is important to take advantage of these points, full information should be furnished the General Electric Company for complete analysis.

In applying the tables to mixed conditions where there are numerous stops per mile in the city service and but few stops per mile in the suburban and interurban service, the schedule for each class of service should be taken separately and a resulting schedule for the combined service obtained.

The schedule speeds given are based upon the operation of motors under favorable conditions. To allow for normal delays caused by curves, grades, slow downs, etc., the schedule speeds in the table are 10 % below theoretical schedule speeds, that is, it is assumed that delays incident to these causes will equal six minutes per hour. If local conditions are such that this allowance is thought to be insufficient, the schedules given should be reduced 1.84% for each additional minute of delay. Excessive track or car friction, head winds, or improper handling of cars may reduce the schedule. Also, if in addition to the regular stops, there is an unusual number of slow downs, curves or grades, schedule speeds will be reduced. If curves and grades are *numerous* or *excessive*, or conditions are *special* or *abnormal* and an extensive analysis is necessary, complete information should be furnished the General Electric Company before deciding on the motor equipment to be used.

The schedule speeds in the table should be decreased by the percentages given below for a less voltage than 500. For each one per cent. reduction in voltage, there will be approximately the following reduction in schedule:

$\frac{1}{3}$ Stop per mile .... 0.7 % ($\frac{7}{10}$ of 1 %)
1 Stop per mile .... 0.5 %
3 Stops per mile ...... 0.2 %
7 Stops per mile ...... 0.1 %

For an increase in voltage, the schedule may be increased by approximately the same per cents as it is decreased for a reduction in voltage. It should be borne in mind, however, that there will be an increase in temperature at the increased voltage and schedule. However, as there will be somewhat less heating of motors at a lower voltage and schedule, it is permissible to increase the schedule on parts of the line by increasing the voltage, provided there is a corresponding decrease in voltage and schedule on other parts of the line.

As the number of stops per mile increases, the schedule that can be made with the same weights but with different speed gears becomes more nearly the same.

When the same schedule is made with different speed gears, the heating of the motors is less with the low speed than with the high speed gears.

Under ordinary service conditions the watt hours per ton mile for a given schedule are less with the low than with the high speed gears. Therefore, in order to operate with the lowest power consumption and also with the lowest heating of motors, the lowest speed gears, that is, the highest gear ratio which will make the required schedule, is generally the one best suited for the service.

The maximum speeds in the table are approximate free running speeds on a level and under favorable conditions. Excessive track or car friction or head winds will necessarily affect the speed. Tractive effort is taken at 20 pounds to 50 pounds per ton, depending on the speed and weight of the car. An examination of the motor curves will show the tractive effort assumed for the various speeds.

In determining "TONS PER MOTOR," the total weight of the car or train, including load, motors, controllers, rheostats, etc., divided by the number of motors, should be taken.

In ordinary service the average and not the maximum load may be taken. The average passenger load may be represented by the seating capacity and the average weight per passenger may be assumed as 140 pounds. If the motors operate a large per cent. of the time with maximum load, the maximum and not the average load should be taken.

The tables do not apply when motors are used for electric brakes as the heating of the motor is thereby increased.

APPROXIMATE WEIGHT IN POUNDS.

Motor complete with gear and gear case	4022
Double motor equipment, complete, with K-13 controller	9634
Double motor equipment, complete, with Type M controller	10985
Four motor equipment, complete, with L-4 controllers	19382
Four motor equipment, complete, with Type M controller	20682

Gear ratios, with characteristic letters and numerals corresponding with two-turn armatures and 120 turn fields, are as follows:

GEAR RATIO.	PITCH NO.	MOTOR.	CHARACTERISTIC NO.
4.3	3	GE-73-C-8	79
3.41	$2\frac{1}{2}$	GE-73-C-9	80
2.95	$2\frac{1}{2}$	GE-73-C-10	81
2.57	$2\frac{1}{2}$	GE-73-C-11	82
2.12	$2\frac{1}{2}$	GE-73-C-12	83

ERRATA.

Page 9.

Weights	*should be*	4137	*instead of*		4022
"	"	9974	"	"	9634
"	"	10274	"	"	10985
"	"	20250	"	"	[illegible]
"	"	19750			

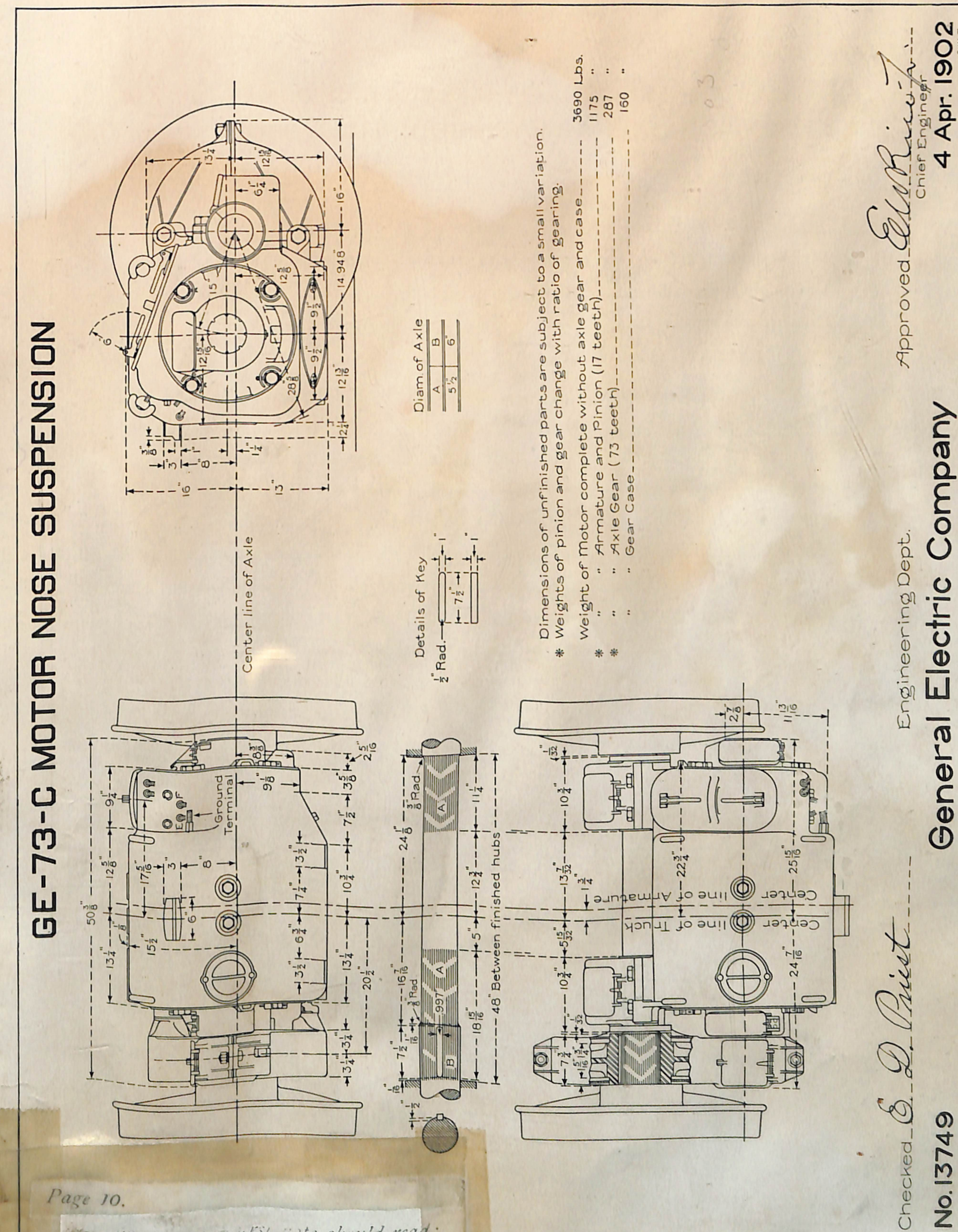
In same column — K 13 should be K-6

SCHEDULE SPEEDS GE-73-C MOTOR.

Arm. 2 Turns, Fields 120 Turns, 500 Volts, 33" Wheels. READ BULLETIN CAREFULLY BEFORE APPLYING TABLES.

STOPS PER MILE.	GEAR RATIO.	TONS PER MOTOR.									
		6	7	8	9	10	12	14	16	18	22
1/8	4.30	25.3	24.9	24.0	23.5	22.9	21.8	21.1	20.4	20.0	19.4
1/8	3.41	27.3	26.6	25.8	25.3	24.7	23.5	22.7	....	....	....
1/8	2.95	28.6	27.9	27.2	26.6	25.9	....	....	....	....	....
1/8	2.57	30.4	29.8	29.0	....	....	....	....	....	....	....
1/8	2.12	34.4	33.7	....	....	....	....	....	....	....	....
1/4	4.30	24.4	23.8	23.3	22.7	22.0	21.0	20.2	19.6	19.2	18.7
1/4	3.41	26.5	25.8	25.1	24.5	24.0	23.0	22.1	....	....	....
1/4	2.95	27.8	27.1	26.5	25.7	25.1	....	....	....	....	....
1/4	2.57	29.4	28.7	28.1	....	....	....	....	....	....	....
1/4	2.12	32.5	31.8	....	....	....	....	....	....	....	....
1/2	4.30	22.6	22.2	21.8	21.4	20.8	19.9	19.3	18.7	18.2	17.6
1/2	3.41	24.9	24.2	23.6	23.1	22.7	21.6	20.8	....	....	....
1/2	2.95	26.1	25.4	24.8	24.2	23.7	....	....	....	....	....
1/2	2.57	27.3	26.7	26.0	....	....	....	....	....	....	....
1/2	2.12	29.6	29.0	....	....	....	....	....	....	....	....
1	4.30	20.2	19.9	19.6	19.2	18.9	18.2	17.6	17.1	16.7	16.1
1	3.41	22.1	21.6	21.2	20.7	20.2	19.5	18.8	....	....	....
1	2.95	23.1	22.5	22.1	21.6	21.0	....	....	....	....	....
1	2.57	24.1	23.3	22.8	....	....	....	....	....	....	....
1	2.12	25.3	24.6	....	....	....	....	....	....	....	....
2	4.30	16.5	16.4	16.3	16.2	15.9	15.4	14.9	14.4	14.0	13.4
2	3.41	17.9	17.6	17.3	17.1	16.8	16.2	15.6	....	....	....
2	2.95	18.7	18.3	17.8	17.4	17.1	....	....	....	....	....
2	2.57	19.2	18.7	18.1	....	....	....	....	....	....	....
2	2.12	19.5	19.0	....	....	....	....	....	....	....	....
4	4.30	12.6	12.5	12.4	12.2	12.0	11.7	11.4	11.1	11.0	10.5
4	3.41	13.2	13.0	12.9	12.7	12.5	12.1	11.8	....	....	....
4	2.95	13.4	13.3	13.1	12.9	12.7	....	....	....	....	....
4	2.57	13.6	13.4	13.2	....	....	....	....	....	....	....
4	2.12	*11.5	*11.2	....	....	....	....	....	....	....	....
6	4.30	10.3	10.2	10.2	10.1	10.1	10.0	9.6	9.4	9.1	8.7
6	3.41	10.7	10.6	10.5	10.4	10.2	9.9	9.7	9.5	....	....
6	2.95	* 9.0	* 8.8	* 8.7	* 8.5	* 8.3	....	....	....	....	....
6	2.57	* 9.2	* 9.1	* 8.9	....	....	....	....	....	....	....
6	2.12	* 9.6	* 9.3	....	....	....	....	....	....	....	....
8	4.30	8.7	8.7	8.7	8.7	8.7	8.5	8.2	8.0	7.8	7.5
8	3.41	* 7.6	* 7.5	* 7.4	* 7.3	* 7.1	* 6.9	* 6.6	....	....	....
8	2.95	* 7.9	* 7.8	* 7.6	* 7.5	* 7.3	....	....	....	....	....
8	2.57	* 8.1	* 8.0	* 7.8	....	....	....	....	....	....	....
8	2.12	* 8.5	* 8.3	....	....	....	....	....	....	....	....
Max. speed Dbl. Eqp.	4.30	29.1	28.7	27.5	26.8	26.1	24.9	23.9	23.1	22.5	22.1
	3.41	31.3	30.5	29.6	29.0	28.2	27.1	26.1	25.3	....	....
	2.95	33.1	32.2	31.4	30.5	29.7	....	....	....	....	....
	2.57	35.3	34.5	33.8	....	....	....	....	....	....	....
	2.12	39.8	38.8	....	....	....	....	....	....	....	....

Speed of four-motor equipment is 5 to 10% faster for same tons per motor.
*Motors running in series.



Page 10.

[illegible] first note should read:
[illegible] speed of four-motor equipment
i[illegible] 10% faster than two-motor equipment,
for same tons per motor.

[illegible] Company Bulletin No. 4294 [illegible]

DATA FOR GENERAL ELECTRIC COMPANY FOR RAILWAY EQUIPMENTS

ON THE.......... ....RAILWAY.

MOTOR CARS: (OPEN OR CLOSED)................

Weight of empty cars and trucks *not* including electrical equipment................tons (2000 lbs.)

Length of car over all, ... Length of car body, ... Seating capacity, ...

Capacity with standing load, ... If open car give number of benches, ...

TRAIL CARS: (OPEN OR CLOSED)................

Weight of empty cars and trucks.............tons (2000 lbs.). Length of car over all,..... ......

Length of car body,.......... Seating capacity,......... Capacity with standing load,.........

No. of trail cars handled by motor car,...... Hours during which trail cars are operated,........

At max. voltage the approx. max. speed desired on level is................miles.

Maximum line voltage is........ Minimum line voltage is....... Average line voltage is.......

Time (excluding layovers) required to make round trip.....minutes. Length round trip.....miles.

Distance round trip in city service.......miles. Suburban......miles. Interurban......miles.

Average number of stops on round trip in city service is.... Suburban is.... Interurban is....

(It is assumed that the average duration of stops will be 10 seconds each.)

Have motor cars single or double trucks?........... Diameter of car wheels is..........inches.

Number and duration of layovers, if any, ...

....

....

GRADES: Underscore grades which cars both ascend and descend in round trip.

Length in ft.	%	Length in ft.	%	Length in ft.	%	Length in ft.	%	Length in ft.	%

REMARKS (Particularly in reference to character of service not covered by previous questions.)

Dated,... Signed......................................

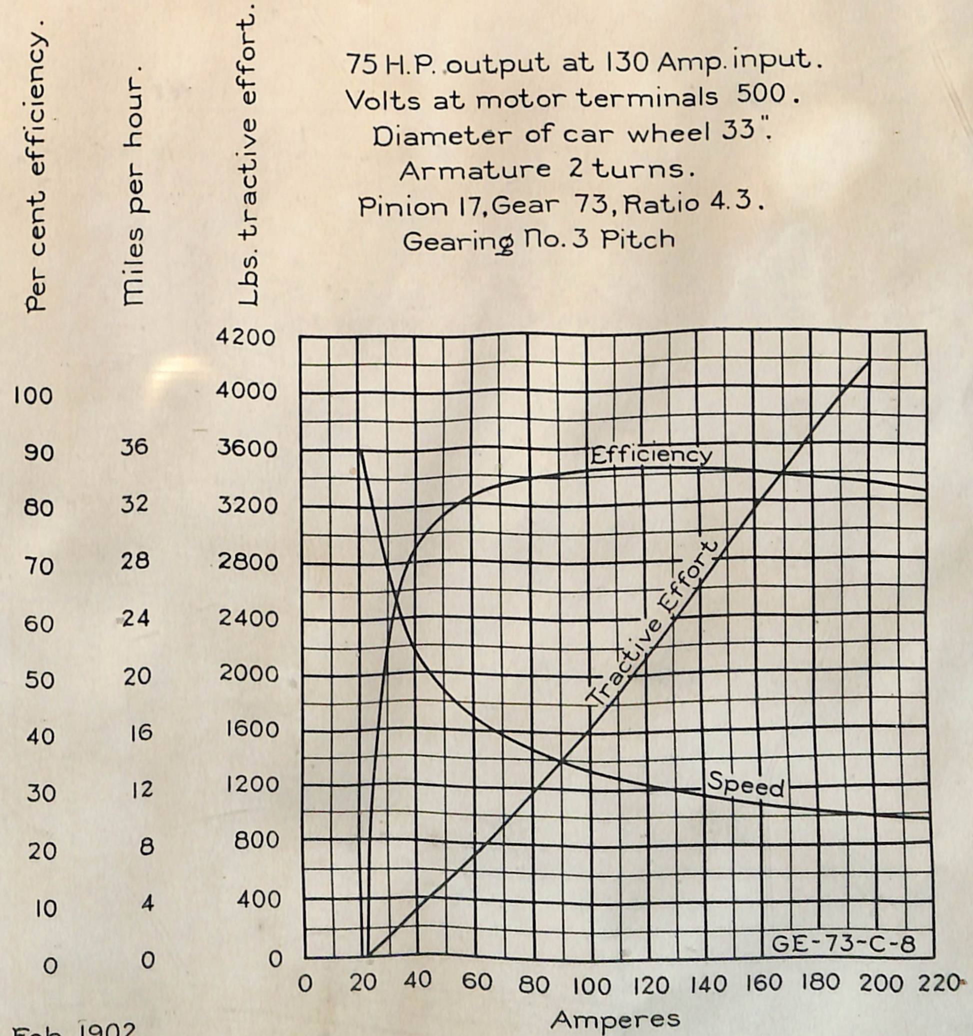
By...

General Electric Co.
Engineering Dept.

Railway Motor
Characteristic No. 79

GE-73-C-8

75 H.P. output at 130 Amp. input.
Volts at motor terminals 500.
Diameter of car wheel 33".
Armature 2 turns.
Pinion 17, Gear 73, Ratio 4.3.
Gearing No. 3 Pitch



5 Feb. 1902

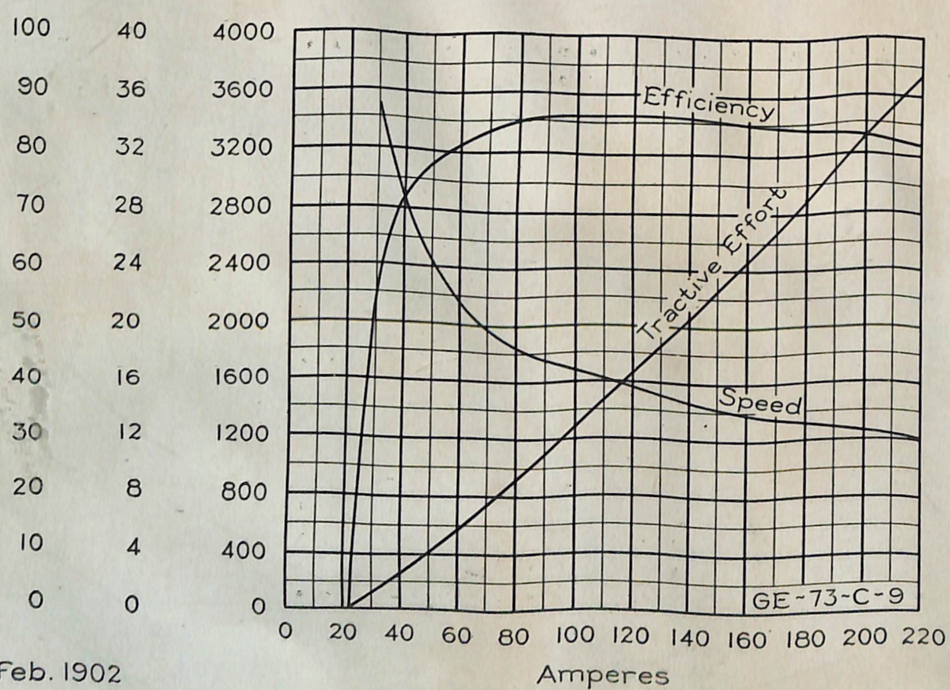
General Electric Co.
Engineering Dept.

Railway Motor
Characteristic No. 80

GE-73-C-9

Per cent efficiency. Miles per hour. Lbs tractive effort.

75 H.P. output at 130 Amp. input.
Volts at motor terminals 500.
Diameter of car wheel 33"
Armature 2 turns.
Pinion 17, Gear 58, Ratio 3.41.
Gearing No. $2\frac{1}{2}$ Pitch



5 Feb. 1902

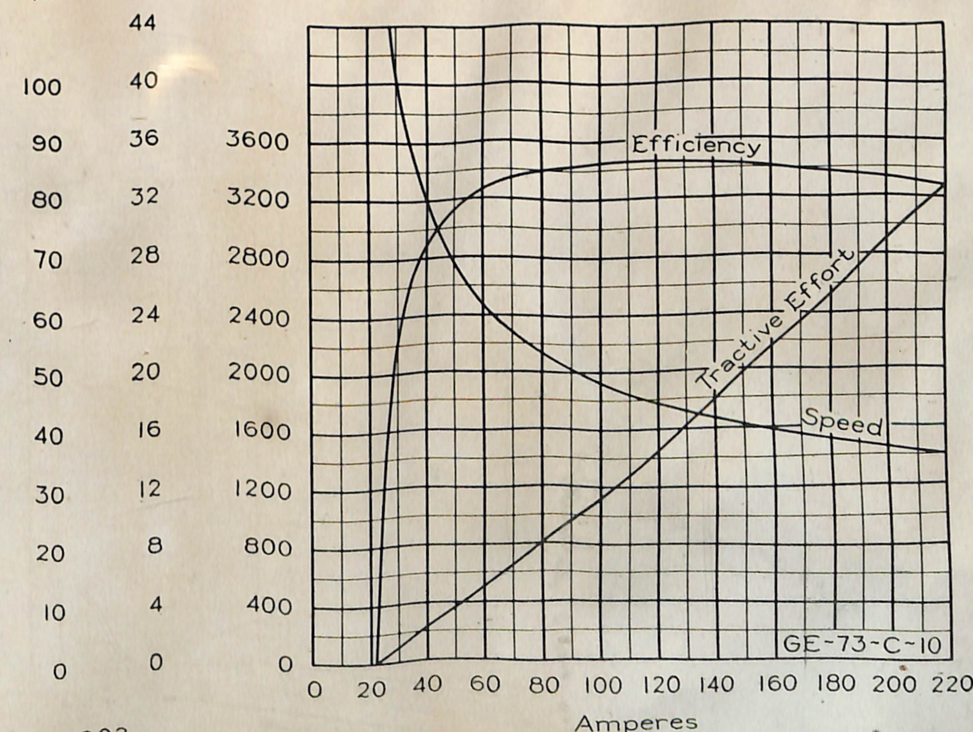
General Electric Co.
Engineering Dept.

Railway Motor
Characteristic No. 81

GE-73-C-10

Per cent efficiency. Miles per hour. Lbs. tractive effort.

75 H.P. output at 130 Amp. input.
Volts at motor terminals 500.
Diameter of car wheel 33"
Armature 2 turns.
Pinion 19, Gear 56, Ratio 2.95.
Gearing No. $2\frac{1}{2}$ Pitch



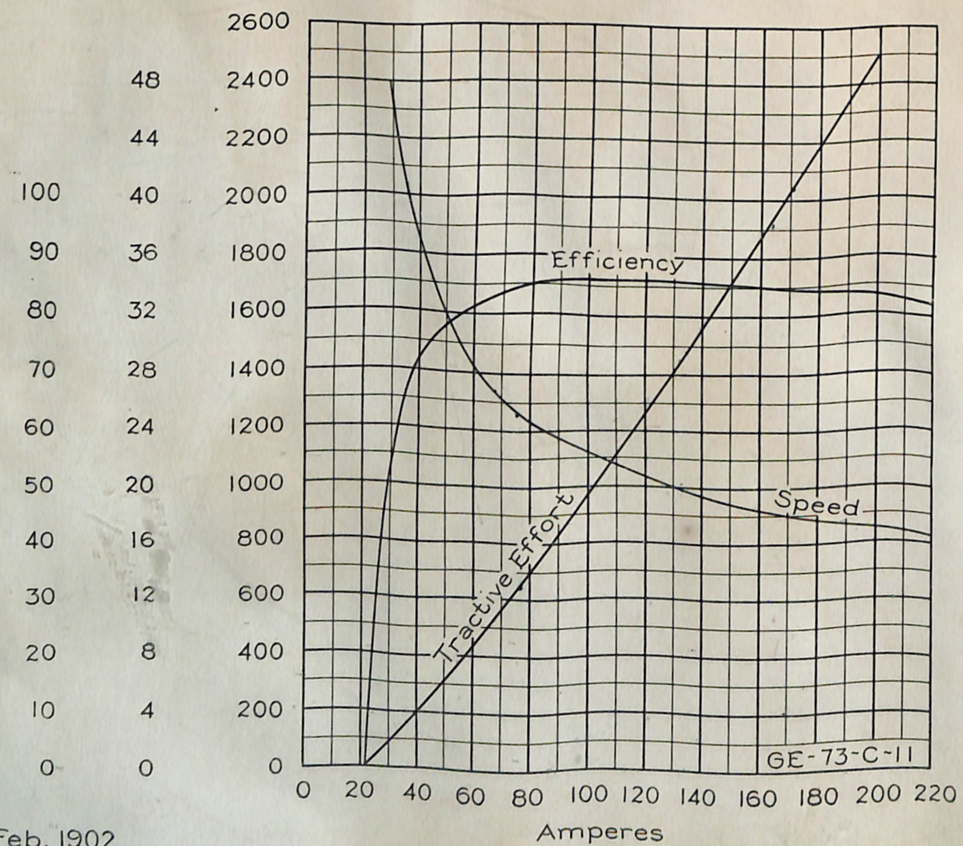
5 Feb. 1902

General Electric Co.
Engineering Dept.

Railway Motor
Characteristic No. 82

GE-73-C-11

75 H.P. output at 130 Amp. input.
Volts at motor terminals 500".
Diameter of car wheel 33".
Armature 2 turns.
Pinion 21, Gear 54, Ratio 2.57.
Gearing No 2½ Pitch



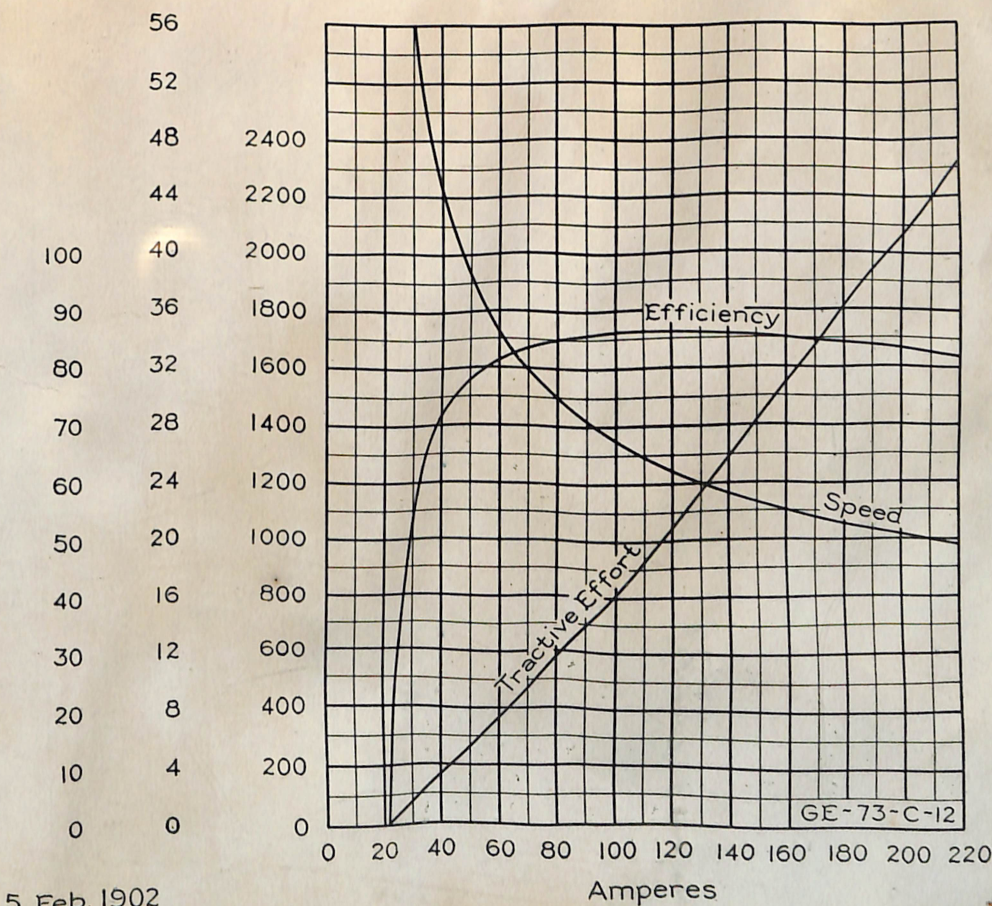
5 Feb. 1902

General Electric Co.
Engineering Dept.

Railway Motor
Characteristic No. 83

GE-73-C-12

75 H.P. output at 130 Amp. input.
Volts at motor terminals 500.
Diameter of car wheel 33".
Armature 2 turns.
Pinion 24, Gear 51, Ratio 2.12.
Gearing No. 2½ Pitch



5 Feb. 1902

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