Specializing Transportation Equipment in Order to Adapt it Most Economically to Telephone Construction and Maintenance Work

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INTRODUCTION

IN this paper is described in a general way the interesting application of motor vehicles and their associated apparatus in connection with outside plant construction and maintenance work, outlining through the successive stages of development what has been accomplished in this respect up to the present time. In order to present a comprehensive picture covering this field of activity, the more primitive types of equipment, together with the manual methods of doing work, are shown in comparison with representative instances of higher development during the past few years in which this phase of the work has been given particular consideration.

The telephone system is different from most public utilities in that it is responsible for a universal service throughout the United States. Wherever the highways and byways may lead, and in many instances where no traveled way could well exist, will be found the familiar and indispensable telephone, with the wire and cable on pole line and in underground conduit. Irrespective of the remoteness of the territory, of the subsurface or the climatic conditions involved, there must always be found a way to construct and maintain the telephone plant. To install this widely distributed plant and continuously safeguard the service in response to the ever increasing public demands, it is essential that facilities be provided for the prompt and safe transportation of quantities of heavy, bulky materials and gangs of men to any point in the telephone system during emergencies as well as under normal conditions, and that provision also be made to supplement the necessary manual operations in every way possible by the proper adaptation of mechanical apparatus.

It might be helpful in this consideration to compare the construction problems of the Telephone Companies with the production problems of any large manufacturing concern. The transportation of raw materials, of the products during manufacture, and of the finished products, together with the application of labor saving machinery in this connection, unquestionably constitute a very real problem to the manufacturer. In this case, however, all of the activities are so completely concentrated and under his control to such an extent as

to greatly simplify the efficient and economical operation of all units involved. Let us consider this large, self-contained manufacturing plant completely dismembered, with the various machines and manufacturing processes widely scattered over distances of many miles instead of a few feet, and we have a very fair comparative picture of the relative importance of the Telephone Companies' transportation and construction apparatus problems in providing and maintaining efficient service. Because of this fundamental condition which obtains in the telephone industry, all outside plant machinery units must be portable, of comparatively small capacity and yet of high efficiency.

To meet these exacting requirements the Bell System is ever on the alert to avail itself of every possible advantage in the development, adaptation and application of transportation equipment, machinery and methods. By means of this mechanical equipment the heavy units of material are handled with ease, safety and dispatch by the gangs, leaving them fresh for the lighter detail work requiring dexterity but practically no heavy, straining effort.

When one speaks of automotive and construction apparatus or machinery developments as applied to the telephone business, such developments must naturally appeal to many as being foreign to and rather difficult to closely associate with the furnishing of telephone service. We are, however, in the midst of a truly mechanical age and the more we study and experiment with the adaptation of mechanical equipment to the new lines of telephone activity, the broader seem to be the fields of applicability and the more evident becomes the necessity of closely coordinating the various phases of adapting commercial equipment and developing new types of apparatus for telephone use.

It is the intention in the following to outline a number of the more important developments associated with the adaptation of mechanical methods to outside plant construction and maintenance work. In presenting the picture contrasting the construction methods of today with the earlier practices, one cannot but note the remarkable developments and improvements which have come about.

Transportation Equipment

It is reported that some forty years ago, after deliberating for an entire day the directors of one of the now large Associated Companies decided that the volume and nature of the company's business warranted the purchase of a horse and buggy.

Figure 1 represents such an outfit as was probably purchased and

which, in connection with the telephone business of today, is about as rare as the motor vehicle is common-place.

Fig. 1—Horse-Drawn Vehicle in Telephone Service—Courtesy *Telephone Review*

As representative of some fifteen years later we have illustrated in figure 2 the one-horse, light construction wagon, the predecessor of the three-quarter and one ton motor vehicles which now handle light

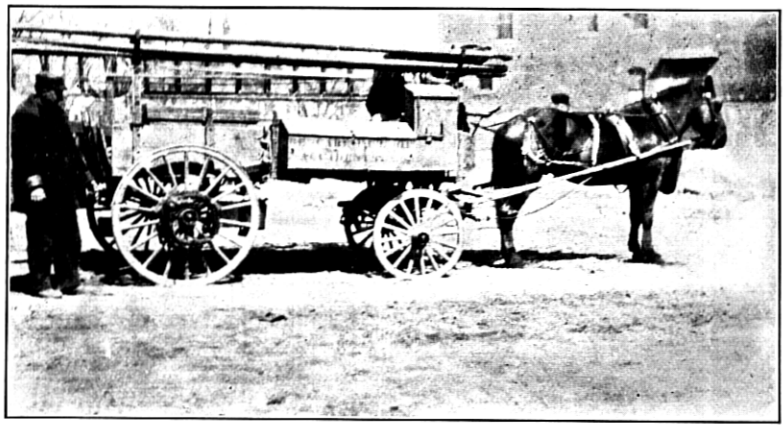

Fig. 2—Light Construction Truck of about 1896

construction, certain classes of station installation work, section line work, etc. It is interesting to note the improvised reel on the rear wheel of the wagon and also the warning "BE CAREFUL OF ACCIDENTS" which is printed on the side of the body. These features are indicative of the fact that the labor saving equipment and "safety first" movements which have now reached such broad proportions in many other industries were recognized as important factors in the System at least as far back as 1896.

Fig. 3—Heavy Construction Truck Carrying Gang, Tools and Materials, 1896

The heavy construction gang unit of 1896 shown in Figure 3, brings to mind the original method of employing large gangs which, with practically no labor saving equipment available, necessarily had to handle the heavy features of outside construction work by "main strength".

In the interval between the advent of the horse-drawn vehicle and that of the motor vehicle into the telephone business, bicycles were used to some extent. These comparatively slow, energy consuming vehicles, however, soon were superseded by the motorcycles which for a few years, principally during the period between 1914 and 1920, were considered a very necessary factor and played an important part in connection with the maintenance and, to a lesser extent, the construction of the telephone plant.

Several hundred machines of these types were at one time used by the various companies, but experience has indicated that their use results in high maintenance, that they present many features hazard

ous to the employees and general public, and that they are more or less detrimental to the health of those who use them to any great extent.

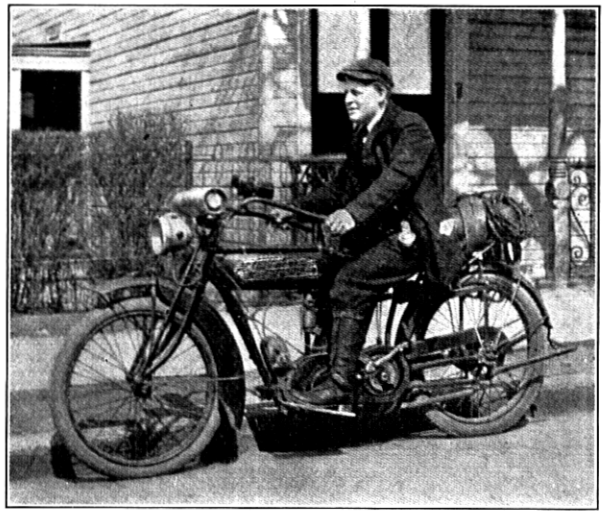

Fig. 4—Motorcycle which was Used for Maintenance Work—Courtesy *Telephone Review*

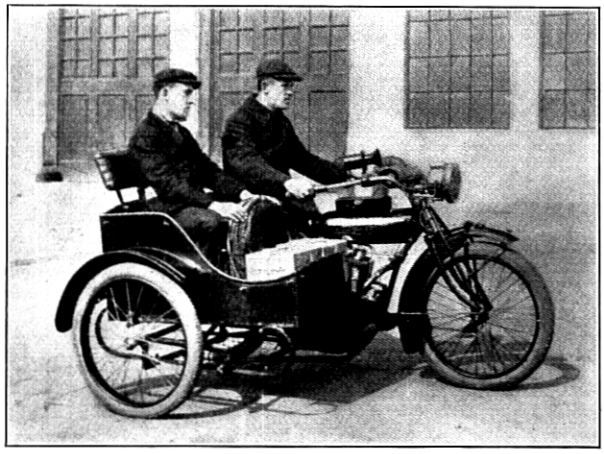

Fig. 5—Motorcycle with Sidecar Used for Instrument Installation Work—Courtesy *Telephone Review*

While the motorcycles have the advantage that they can generally worm their way through traffic more readily than an automobile, this advantage is completely overbalanced by the universal tendency to speed in riding motorcycles, by the many serious accidents from

skidding on wet pavements, the difficulty in riding over roads having deep wheel tracks, the entire lack of weather protection for the rider, and the instability of the sidecar outfits when turning corners. The use of motorcycles by the Telephone Companies is now practically, if not entirely, obsolete.

The many adaptations of the Ford car have proven in over the motorcycle by a large margin from practically every viewpoint. There are now more than 5,000 Fords in the service of the Associated Companies. This group of cars is often referred to in telephone parlance as the "mosquito fleet" and it is interesting to note that the building up of this fleet had its inception as late as about 1914.

Approximately 80 per cent of these Fords are equipped with various types of boxes and specially designed bodies which permit the carrying of light loads of materials and tools. On account of their large numbers, low operating costs and remarkable ability to negotiate almost impassible roads, they go far toward coordinating the operation of the widely scattered units of the Telephone System.

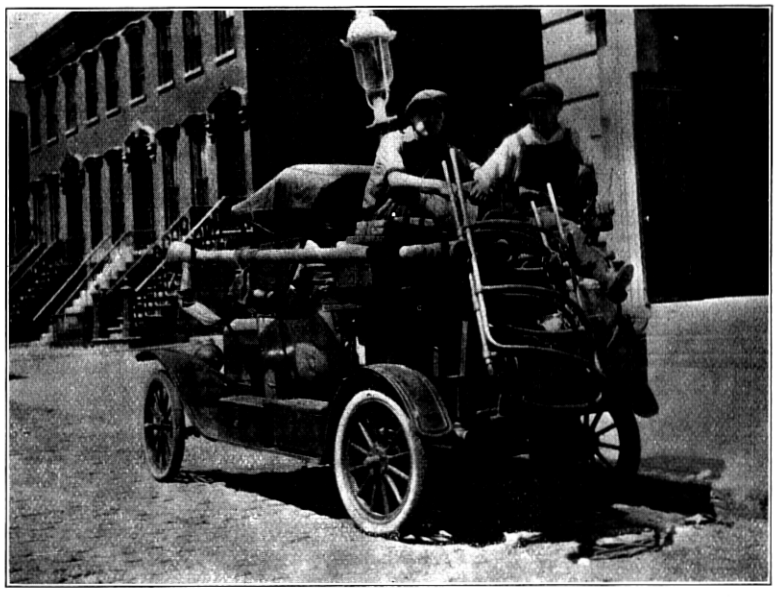

Fig. 6—A Seriously Overloaded Ford Carrying Splicers and Their Supplies

In telephone work the Ford runabouts average approximately 9,000 miles per car per year. Normally, their net loads vary from 150 pounds to 750 pounds, although in emergencies they are sometimes seriously overloaded.

Fig. 6 shows a telephone company Ford seriously overloaded while transporting splicers' equipment. In fact, the net load carried by this particular car, including the four men, was about 1,300 pounds. This illustrates a case where the service for which the vehicle was originally supplied, has outgrown the load-carrying and space capacity of the unit. Of course, if this practice were permitted to continue or become general, it would be expensive, both from a motor vehicle operating and gang service viewpoint, not to mention the hazard presented in carrying two of the men in such a precarious position.

It is apparent that in order to find a particular item of tools or material on this car it might be necessary to completely unload. As regards the effect upon the car, the tires frequently blow out, the front construction requires constant attention to keep it tight, the springs depress to the extent that the fenders are permitted to ride upon the tires, the steering is difficult, etc.

Fig. 7—Ford Truck Equipped with Modern Side Box Body

As soon as it was recognized that this particular service was outgrowing the transportation unit, a special side box body upon a high speed one-ton Ford truck was developed and is now undergoing service trials in order to properly provide a unit having ample space and load-carrying capacity. Fig. 7 shows some of the latest ideas in the design of such an outfit. Note the ample kerosene tank slung

under the rear end of the body with a convenient filler pipe on the rear end of the left side box and a faucet under the tank with hose connection for filling the splicers' furnaces with kerosene.

As an illustration of a Ford runabout especially adapted for the work of serving an installer and helper in placing telephone sets together with the inside wiring and the drop wires from pole to house, Fig. 8 is presented.

Fig. 8—Ford Runabout of the Latest Type in Installation Service

It will be noted that in this design the body extension back of the seat is limited in order that only a small weight over-hang back of the rear axle is possible. This is important in order not to overstrain the rear spring. The body design is made as light in weight as practicable in order to provide ample net load carrying capacity.

There are now on the market innumerable Ford accessories which are claimed to correct all of the ills to which the Ford is subject. Careful studies and field trials, however, indicate that by far the greater portion of these devices are of no advantage and many are actually detrimental to the efficiency and safety of operation. However, through careful selection and in some cases modification of

certain of these accessories to meet specific telephone service requirements it now seems probable that somewhat more efficient, economical and safer operation will be realized.

Fig. 9—Heavy Construction Gang Truck, 1910. One of the First in Telephone Service

About 1910, carefully prepared studies indicated the practicability and economy of utilizing gasoline driven motor trucks for the transportation of men, supplies and construction equipment of various kinds.

The first automobile trucks were proven in over horse drawn vehicles on the basis of using the trucks as purely transportation units. However, it soon developed that there were many possible economical applications of the motor truck in connection with the placing, moving and removal of pole lines, aerial cables, underground cables, wires, etc., bringing into use the many accessory devices such as winches, derricks, earth boring machines, various types of trailers, pumps and other safety and labor saving apparatus. The importance of some of these devices in telephone construction work will later be described.

The motorizing of the Bell System has been very rapid since 1910. Because of the widely scattered distribution of outside telephone plant it is necessary, in transporting the workmen, together with their tools and materials, to employ in the Bell System approximately

3,000 trucks and tractor-trucks of from ½ ton to 15 tons capacity. These together with the "Mosquito Fleet" and the relatively small number of supervisory passenger cars of a better class, make a total motor vehicle strength of over 8,000 units in the Bell System. In addition to this Company owned equipment, there are employed annually by the Associated Companies several hundred hired motor vehicles.

In the neighborhood of 25,000 employees depend upon the System's transportation equipment as an indispensable part of their daily work, that is, in its capacity of labor saving machinery as well as in moving the men, together with their tools and materials, from their bases of operation to the job and back, and also between jobs. The annual cost of providing this transportation service for the Bell System is in the neighborhood of twelve to fourteen million dollars. Although this total is a sizable amount, it is actually small when compared with the service rendered and when considered upon the basis of slightly less than $6 average cost per car per day used, including all units from 750 to 30,000 pounds net carrying capacities.

Studies are constantly being made in connection with the opportunities presented along the line of increasing the mechanical efficiencies and lowering the maintenance costs of the various units. As the result of this work much is being accomplished in conserving the working time and energy of the men by employing proper labor saving facilities with the motor vehicles in order to do practically all of the slow, heavy work by proper application of power from the motor vehicle engines. The continuation of this field of study should tend toward offsetting the constantly increasing construction costs.

The realization of the most important savings in the motor vehicle field, that is by making the truck units serve the gangs as labor saving machines in addition to their use as transportation equipment, involves the use of winches driven from the truck engines, derricks for all kinds of pole work, for handling loading pots, etc., suitable trailers for transporting poles, reels of cable and other materials, the use of quick acting safe drawbars for trailing loads behind the trucks, the use of the truck equipment for pulling the proper tension into aerial cable strand and for pulling in the aerial cable, the use of the power equipment with suitable accessory appliances for pulling in or removing underground cable, of power driven collapsible reels for quickly pulling down and coiling up open wire, employing improved methods with the assistance of the power equipment for the handling of all heavy loads (such as reels of cable on and off trucks), and for numerous other uses. In addition to these savings, important

economies can be realized by equipping the construction units with suitable bodies to meet the various construction requirements.

In reviewing the progress in the use of motor vehicles it is interesting to note that in the first few years it became apparent that in order to properly utilize the units it would be necessary to equip them with special side box bodies, winches, derricks, etc. Designs for these various items of equipment were prepared in accordance with the best information at hand and the resulting units of about 1914-1916

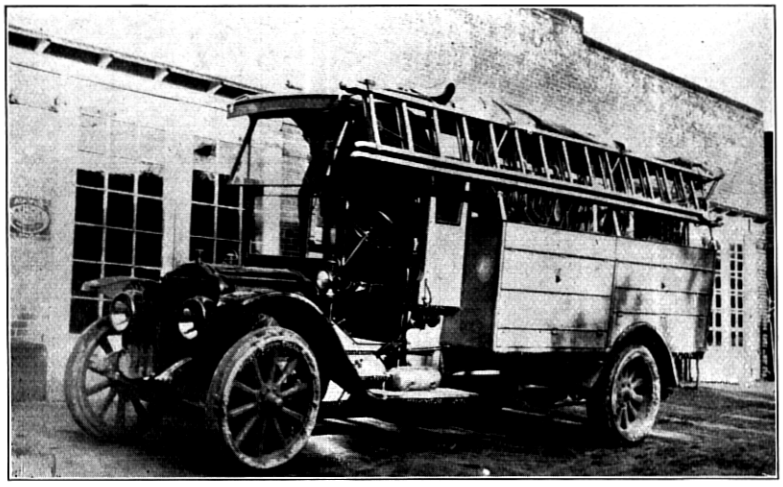

Fig. 10—An Old Type of Side Box Body Construction

were so heavy and bulky that some of the 3-ton trucks carrying this equipment were loaded practically to capacity exclusive of their complement of material, tools and men. This led to the introduction of 5-ton truck units in heavy construction work. Figure 10 shows an old type of body equipment in which the arrangement and size of the side box compartments was such that practically no free load capacity was available. A rear view of this outfit would more clearly indicate the absolute lack of space for carrying materials such as reels of strand and cable, etc.

In the past few years and at the present time, the developments are toward lighter weight, more efficient bodies and labor saving equipment as is illustrated in figure 11 and later in this paper under the discussion of winches.

The use of this equipment is permitting a material reduction in gang sizes which in itself further reduces the weight to be carried on the

truck. The net result is that instead of a 3 or 5-ton unit weighing loaded 18,000 or 25,000 pounds, it is possible to handle the work more satisfactorily with 2 or 2½-ton units weighing in the neighborhood of 12,000 pounds.

The advantages gained by this reduction in truck size are large. Not only is the initial and operating cost of the equipment much less but the more important feature is that these 2-ton trucks can penetrate and economically operate in territories where a heavier

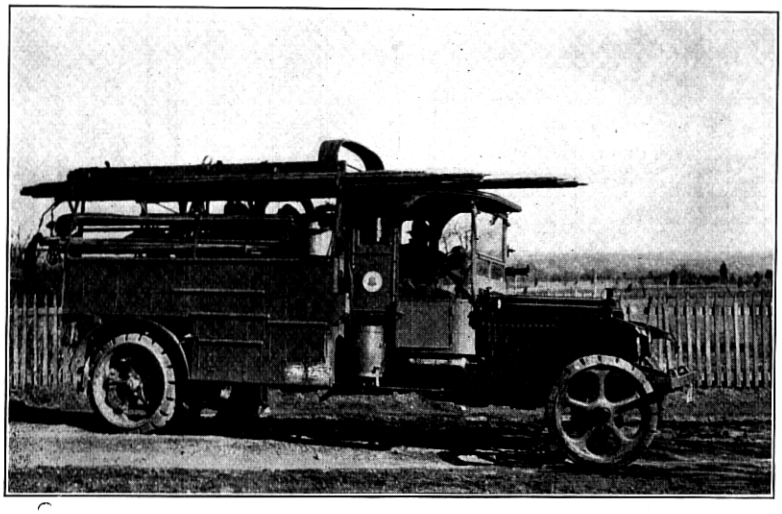

Fig. 11—Latest Type 2-Ton Heavy Construction Unit

unit could not negotiate the roads. Many country bridges will not carry more than 6 tons. Also, on narrow country roads, the comparatively shorter wheel base of the 2-ton truck permits easier turning around or maneuvering.

Figs. 11, 12, 13 and 18 present illustrations of some of the latest developments in line construction truck design and associated equipment. The particular type of body shown has been selected as an example from the various types employed by the Telephone Companies because of its broad use and because it so well illustrates the general development which is taking place. The outfits shown, except in Fig. 13, are of 2 to 2½-ton capacity and perhaps the most outstanding feature is that of the rugged and compact body arrangement, each detail of which has been specially designed to meet a particular construction need. The tool and machinery equipment is applicable to the most exacting requirements of the average outside

construction job. The arrangement is such that all necessary tools and materials can be carried in a safe and orderly manner, and the truck power plant, through the introduction of suitable winch equipment, is available for the heaviest duty, slow speed work, as well as the lightest duty, high speed work which may be encountered.

A more complete description of some of the principal features embodied in this combination material distributing, tool and gang delivering unit, power plant and general work shop, may be of interest.

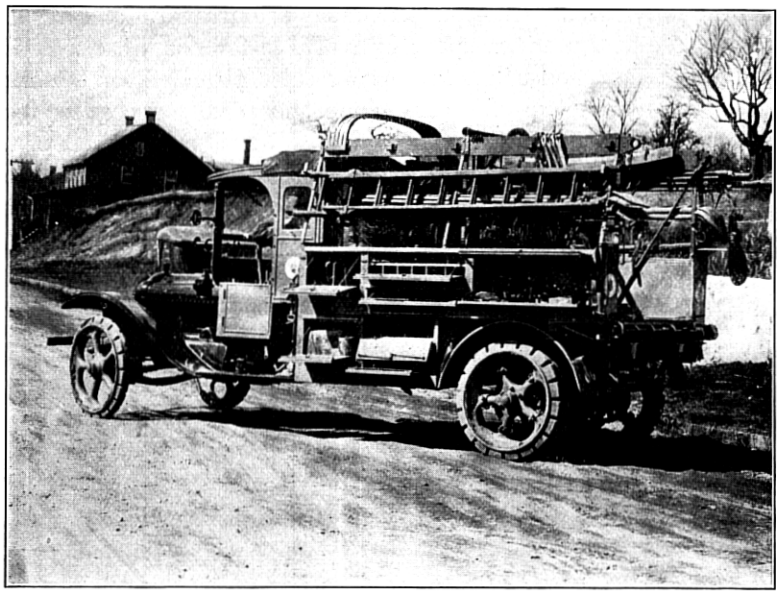

Fig. 12—Latest Type 2-Ton Heavy Construction Unit Showing Tool, Material and Locker Compartments Open

With regard first to some of the more important points incorporated in the body: Every construction crew must carry a large number of different comparatively small materials and tools. The old method of piling the mixed tools and materials in large boxes carried in the truck body led to much lost time on the job in looking for particular items as required in the course of the day's work. The foreman could never be quite sure as to just what he had on his truck, which resulted in two unsatisfactory and uneconomical conditions: First—otherwise unnecessary extra trips were made between the job and the storeroom to secure materials thought to be on the truck but which could not be located when needed. Second—due to the lack of orderly

arrangement, much more material was generally carried than was actually needed, which resulted in excessive loads upon the trucks and in the aggregate an unnecessarily large material supply balance for the company.

The new type of body is the result of careful field study. In this particular one, of the several designs necessary to meet the requirements of the subdivisions into which the construction work naturally divides itself, it will be noted that side boxes are provided of such sizes as to satisfactorily house in an orderly manner the small tools and materials, suitable hangers and racks are arranged to carry the larger tools and materials, space is available for chauffeur's chains, tools, grease, etc., and compartments are also provided for the extra clothing and lunches of the men. Safe and readily accessible locations are provided for the heavier equipment, such as members of the pole derrick, digging bars, shovels, ladders, etc. Fig. 13 shows a close up view of the orderly and readily accessible arrangement of tools and materials.

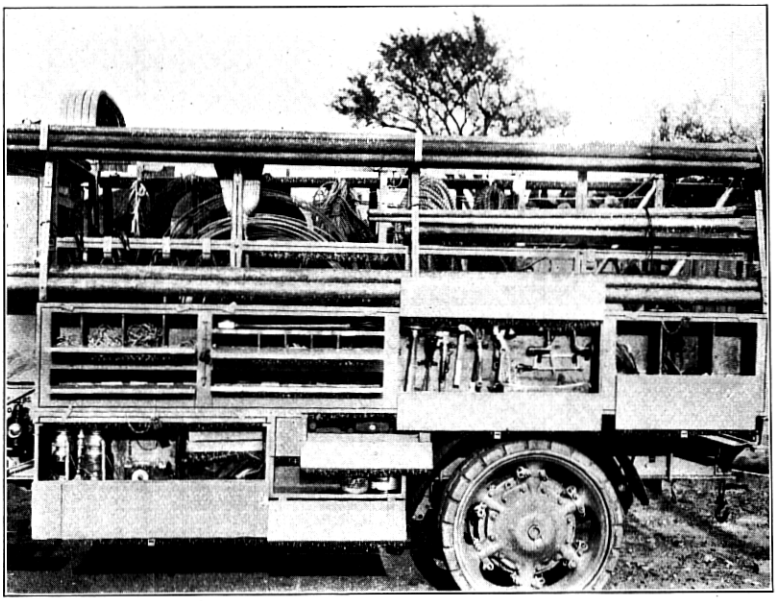

Fig. 13—Side Boxes Opened Showing Arrangement of Tools and Materials

It should be particularly noted in this connection that the truck body arrangement is such that with its full complement of tools and materials there is available a maximum of free load space.

With the further thought of conserving the health of the crew when operating in sections where suitable drinking water cannot be obtained, a sanitary keg is provided for carrying an ample supply of pure water. Paper drinking cups are used.

A safe, clean, dry, convenient location for the "Safety First" kit is built into the top of the cab.

A small vise for the use of the gang and chauffeur is attached to one of the running boards.

The cab also incorporates every possible feature of safety and protection to the driver, and a tarpaulin is so arranged as to provide maximum protection for the men in case of bad weather.

As may be noted, in Fig. 12 a spindle and sheave have been provided which can be mounted across the top body rails either at the rear end or the middle of the truck in order to permit the use of the winch rope for loading and unloading cable reels or reels of strand without the use of skids.

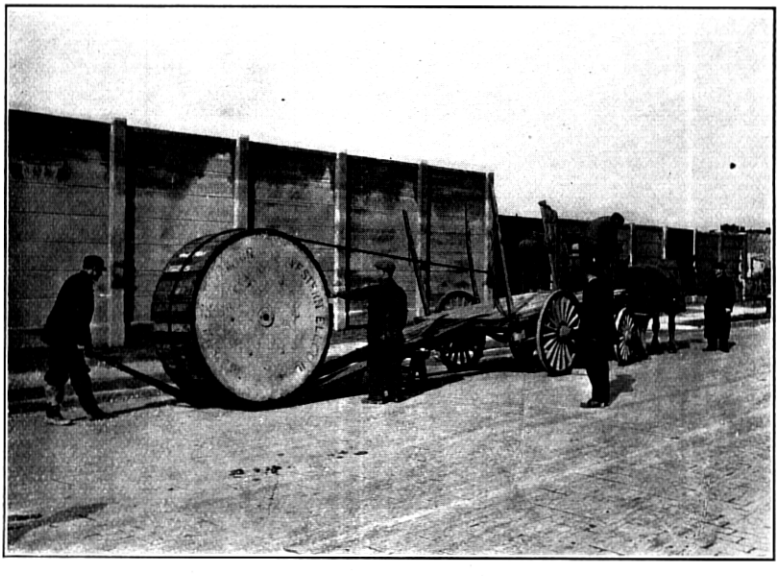

Fig. 14—Loading Cable Reel on Horse-drawn Truck by Means of Two-Man Power Hand Winch

Fig. 14 shows the old manual method of loading a reel of cable on a horse-drawn truck. This operation involves the slow and laborious method of rolling a two- or three-ton load up an inclined plane by means of a hand winch. It should be noted that six men are engaged

in handling this reel and that at least two of them must of necessity occupy positions which present more or less hazard in the event that the winch rope should break or some part of the mechanism otherwise fail to hold the suspended load. This familiar method of winch operation by means of a manila rope laboriously wound upon a ratchet stop drum by two men, was limited entirely to loading and unloading heavy items of material from the truck platform. For this purpose it was, however, a great improvement upon former methods even though it was very slow and not entirely free from danger.

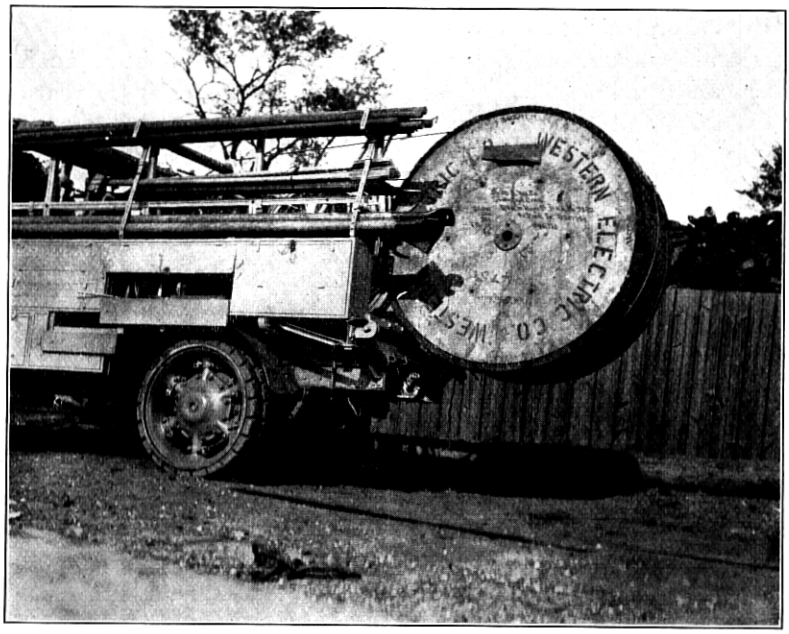

Fig. 15—Loading Cable Reel by Use of Sheave and Spindle with Rope Sling, Without Skids

In Fig. 15 a similar reel of cable is being loaded on a motor truck by means of the engine operated winch in conjunction with the sheave and spindle feature previously mentioned. In this case the possibility of hazard to the workman is completely removed. The reel is loaded in a fraction of the time required by the old manual method and the entire operaton, after adjusting the winch line, is completed by the chauffeur from his position in the cab. In the event that the winch rope or other parts of the mechanism should fail, the result would be a vertical drop of the reel of cable, perhaps slightly damag-

ing the reel, but the employees are not required to take positions where they are in any danger.

Fig. 16 shows the first type of power winch application to telephone construction work. This unit consisted of a slow speed, heavy duty, single cylinder, gasoline engine unit permanently mounted on a-horse-drawn truck. It was used principally for pulling in underground cable and was a great improvement over the former method of pulling by means of horses. It will be noted that on this winch steel rope was used.

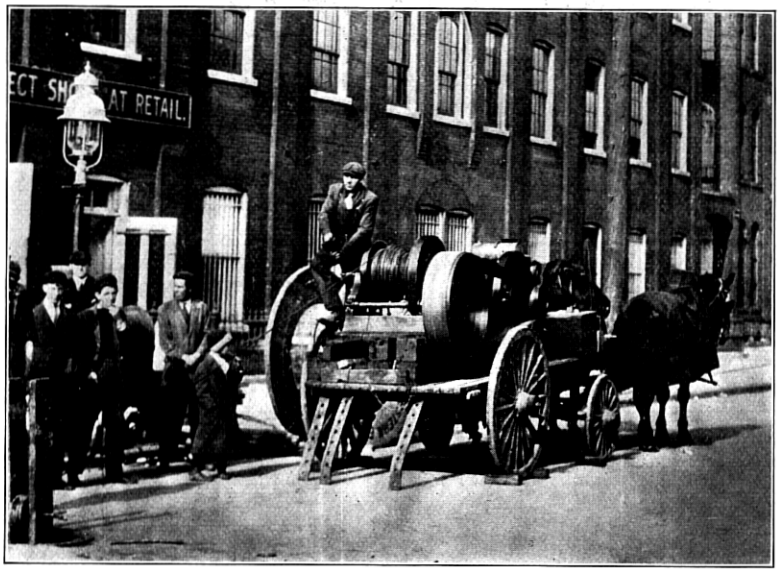

Fig. 16—Old Type Gasoline Engine Driven Winch on Horse-Drawn Truck

With the engine propelled truck came the possibility of utilizing the truck power through a special power take-off to drive a winch which would not only be more powerful, but also much more rapid in action and distinctly superior with regard to the important feature of control.

Fig. 17 illustrates one of the original types of power winch on a 5-ton truck chassis. This was an adaptation of one of the best hoisting winches then available and some ingenious controls were developed at the time in order to facilitate or in fact, even permit of its operation on the trucks.

While this unit was a wonderful labor saving device and opened up the possibilities of the broad field of usefulness for truck operated

winches, its size and weight were such that it could not well be used on trucks of less than 5-tons capacity. It will be noted that the winch extends well up to the cab window and would practically fill the front end of the body. Its net weight exclusive of the truck power take-off was 2,300 pounds.

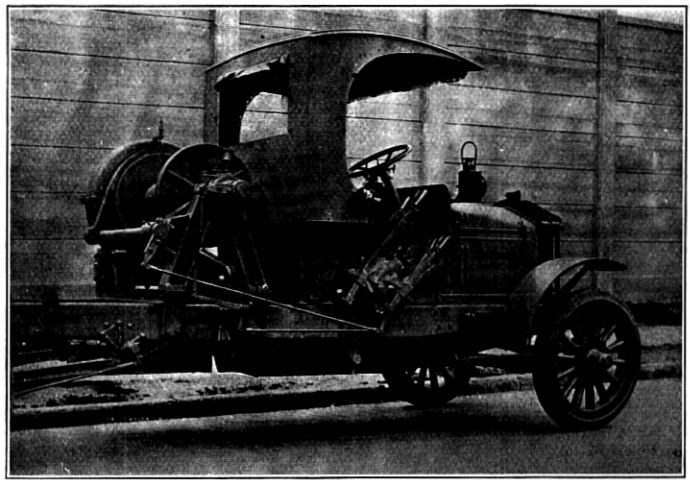

Fig. 17—Old Type Heavy Winch on 5-Ton Truck Chassis

The desirability and in fact the indispensable need of using winches on the smaller trucks has led to the development of a very compact light weight unit which will handle about 900 feet of 7/16″ steel rope and withstand a pull of 10,000 pounds on a single line. Experience indicates, that this winch is capable of meeting the maximum requirements generally encountered in construction work.

The compactness of this winch is illustrated by Fig. 18 which shows it below the cab window with only the upper half of the drum projecting above the floor line in order to give the rope proper clearance in winding and unwinding. This winch weighs slightly less than 500 pounds.

In closing this discussion of motor vehicle application to telephone work it might be of interest to examine the curve in Fig. 19, which shows the rate of growth of the motor vehicle fleet in the Bell System.

This curve prepared from such information as is now available presents a reasonably accurate picture of the motor vehicle development which began in the Bell System as early as 1904.

As explanatory of this curve it may be noted that previous to 1910 very few cars and no trucks were purchased. From 1910 to 1913 various types of equipment were placed in service largely upon an experimental basis. The results of these experimental installations were so favorable that from 1913 to 1919 the growth was very rapid

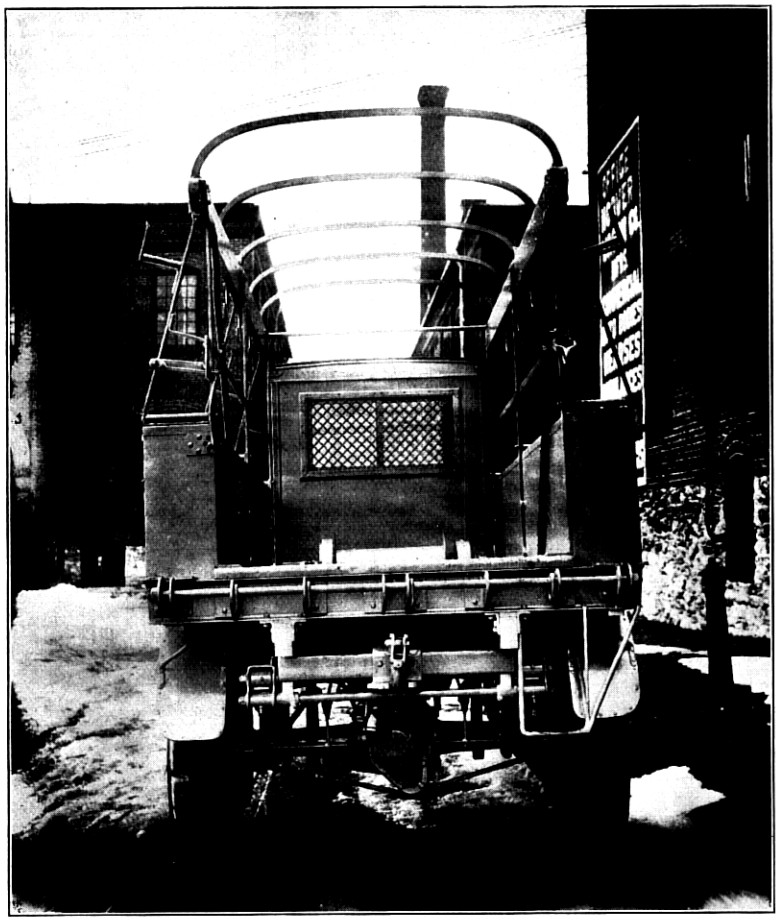

Fig. 18—Rear View of Latest Type 2-Ton Construction Truck Showing Winch Below Cab Window. Generous Clear Body Platform Space is Evident

due to superseding the large number of horse-drawn trucks with motor vehicles as well as providing additional motor vehicles to keep pace with the growth of the telephone industry. From 1919 to 1922 the slope of the curve indicates a slow, steady growth which corresponds

with the growth in requirements of the telephone construction and maintenance organizations in handling their steadily increasing activities.

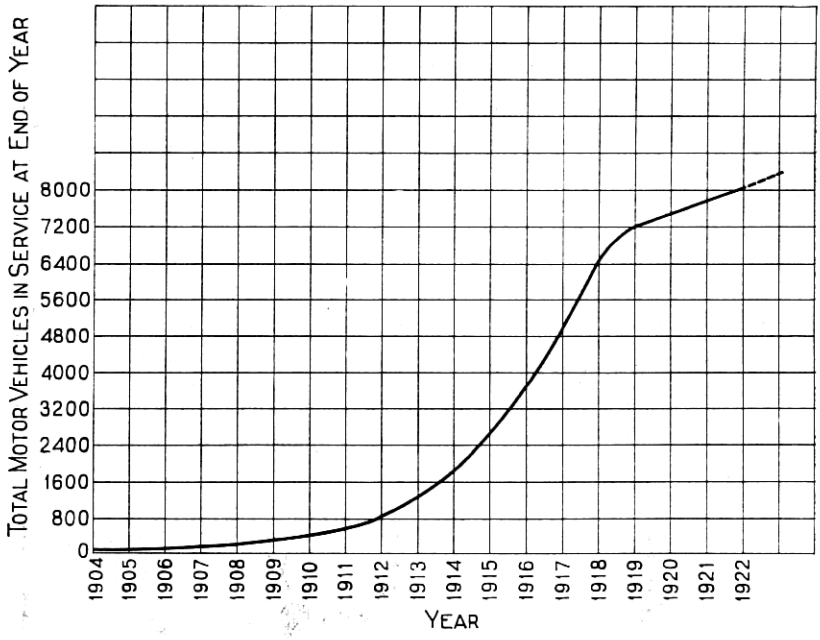

Fig. 19—Curve Showing Growth of Motor Vehicle Fleet in Bell System

From the foregoing it will be noted that a period of 40 years has witnessed a striking development in transportation and associated equipment as applied to telephone construction work, and studies now under way indicate that there is yet much to be accomplished.

In a future issue will be discussed the adaptation to telephone work of the more important items of labor saving machinery such as pole derricks, trailers of various types, earthboring machines, air compressors and compressed air tools, etc.