Use of Labor-Saving Apparatus in Outside Plant Construction Work

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Introduction

IN the January issue of this Journal was discussed the adaptation of transportation equipment to telephone construction and maintenance work. Closely associated with the operation of such equipment is the problem of utilizing various labor-saving machinery which in many cases has been so designed as to form an integral part of the transportation unit.

It is the purpose of this article to describe some of the more important developments along this line such, for example, as the application of different types of derricks, trailers for various kinds of work, earth boring machines, numerous applications of air compressors and compressed air tools, etc., and in some instances to contrast the latest types of equipment with former manual methods of carrying out similar operations.

Pole Derricks

There are erected in the Bell System each year in the neighborhood of 600,000 new poles. In addition, the maintenance of the existing plant of over 14,000,000 poles involves the moving, removing, resetting and straightening of large numbers of poles annually. This immense task emphasizes the importance of devising means for offsetting, in so far as is practicable, the old manual methods of handling these poles on the job and from point to point in the field as occasion demands.

In 1914 there was developed and put into use a pole derrick of the tripod type which was mounted upon a 5-ton truck from which the derrick received the necessary power for operation. As the use of this derrick, which weighed something over ½ a ton, was extended it became apparent that while the fundamentals of the design and operation were reasonably well adapted to the average construction job, the weight and bulk of the apparatus introduced a very real factor with regard to the available truck capacity. The derrick members, being large and heavy, were difficult for the men to handle and there was not in all cases the desired amount of flexibility to meet the varied and often difficult requirements. This derrick, however, clearly demonstrated the inestimable value of apparatus cap-

able of doing in a few minutes the work ordinarily requiring a large gang of men, many times as long to complete.

An active period of development and experimental field work soon followed the advent of this labor-saving device which has resulted in making available a light type of high grade steel tube derrick.

Figs. 1 and 2 show a pole derrick of the latest type mounted on a 2½ ton truck. Fig. 1 illustrates the method of erecting a pole where the truck can be maneuvered into a position in close proximity to the proposed location of the pole. Fig. 2, on the other hand, shows the possibility of handling a pole at a considerable distance from the location of the truck, which for any reason may be more practicable or desirable.

These illustrations show the derrick in each of the two possible operating positions; in the first instance supported entirely upon the

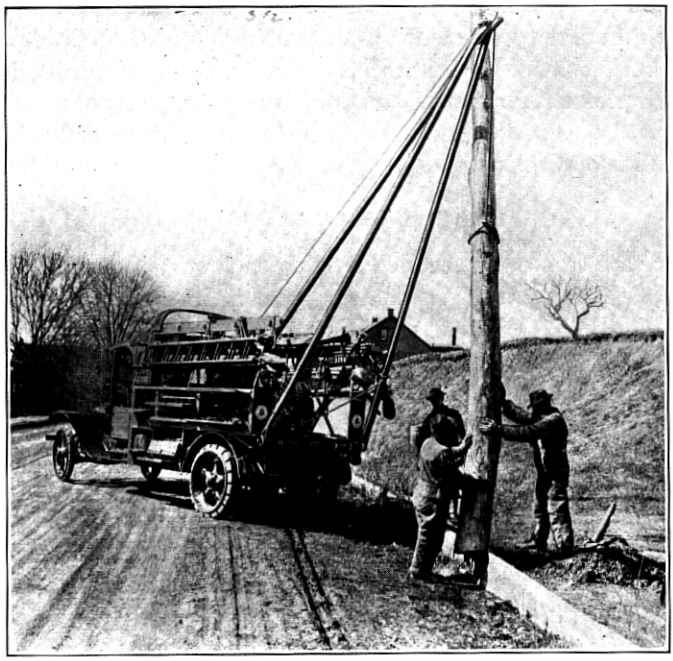

Fig. 1—Erecting Pole, all Derrick Members Mounted on Truck

truck, and in the second, supported from the ground by one of the three pipe members. The derricks of this type are constructed of high grade steel tubing having a strength at the yield point of approximately 70,000 pounds per square inch.

In order that country-wide conditions may be satisfactorily met, the present type of derrick has been made available in two general types which are known as the "middle" and "corner" types for use, as the names imply, from the rear middle or corner of the truck. Each of these types are further available in light and heavy weights, depending upon the lengths and the kinds of poles, cedar or chestnut or other kinds of similar weights, that are generally used in any particular part of the country.

As contrasted with the early type of derrick, the present types weigh from 370 to 520 pounds, depending upon the size used,

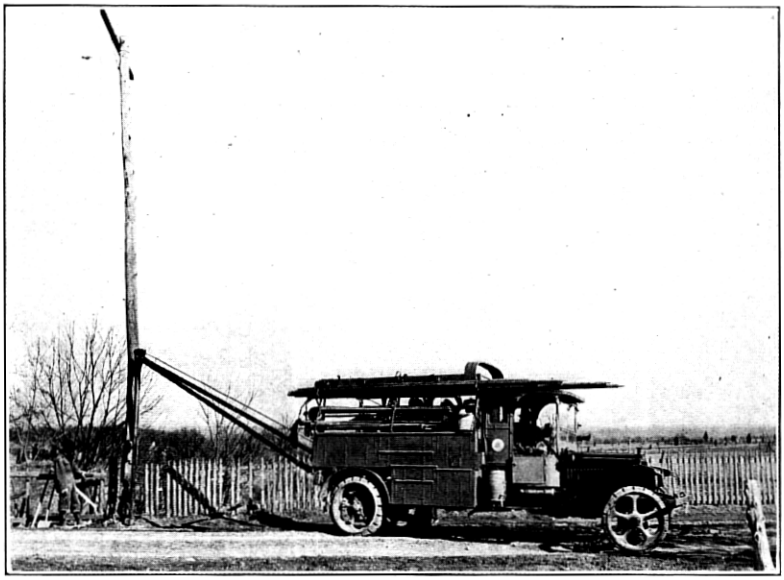

Fig. 2—Erecting Pole at Distance from Truck, One Derrick Member on Ground

and are capable of readily and safely handling any load within the limits of the winch rope capacity, which leaves a satisfactory margin when doing practically any work for which the derrick has a place in telephone construction. Each of the four classes of derricks above mentioned is designed with a view to making its operation as rapid as is consistent with safety. The chauffeur and one man can remove the derrick members from the carrying racks provided on the truck, assemble them and erect the derrick ready for work in from three to four minutes. The disassembling of the derrick requires about the same length of time.

Naturally, the greatest economies may be made in the application of this apparatus where the poles to be handled constitute a consecutive line, the holes for which have been dug in advance. However, because of the short time required for assembling and taking down the derrick, it is generally economical to use it for placing only one or two poles at a location. As indicative of the possibilities with regard to rapidity of operation, it may be of interest to note that in erecting a number of 30 to 35 foot poles under average conditions in a line for which the holes had previously been prepared, a gang of three men have averaged approximately two minutes per pole erected but not tamped.

The use of the derrick has thus far been described as applied to the economical erection of poles. There are, as a matter of fact, many other important uses for which the winch-operated, derrick equipped truck is well adapted, a few of which are enumerated below.

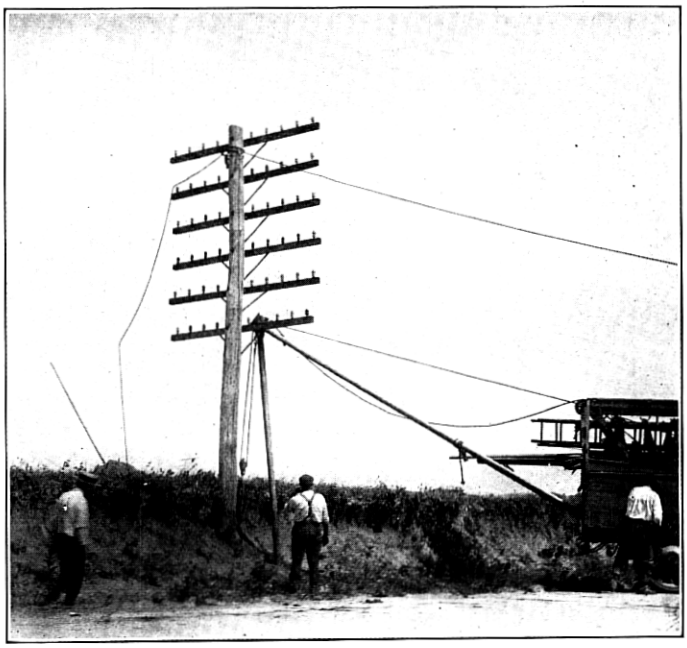

Fig. 3—Derrick in Position to Pull Pole Out of Ground

Road and highway changes and improvements throughout the country make it necessary for the telephone companies to annually move thousands of poles to the new highway limits or curb lines. In many instances these pole lines carry heavy loads of wire or cable

or both. With the pole derrick many of these moves can readily be accomplished without in any way disturbing the wire or cable loads. The derrick pulls the pole out of the ground and with the aid of the truck, the pole with its load intact is moved to the new location where it is lowered into the hole prepared without even untying a wire or loosening a cable clamp. It will also be readily appreciated that the rehandling of cable and particularly the untying of open wires is not only an expensive operation in point of first cost, but that each such operation is distinctly detrimental to the plant, shortening its life and greatly increasing maintenance expenses. It will be

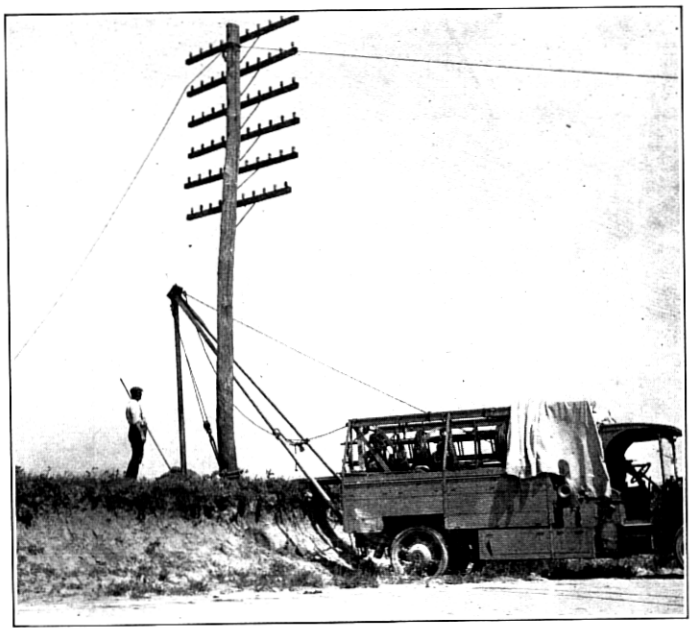

Fig. 4—In Position to Shift Pole to New Location. Pole Has Been Moved Over Bank with Wires Intact

seen, therefore, that the use of the derrick where practicable in connection with the moving of existing lines will largely eliminate the undesirable and costly procedure which is involved in the manual handling of the poles.

As an example of one of the many uses to which the pole derrick can very satisfactorily be put, Figs. 3 and 4 illustrate the initial and final steps in moving back a pole in a 6-arm lead of wires and lifting

it up an embankment to its new location in connection with highway widening. This particular line is about 60 miles long and the distance the poles were moved varied between 6 and 125 feet. It is reported that the move of this entire lead which averaged about 4 arms was completed without untying a single wire, without cutting any slack and with practically no trouble on the circuits. It is needless to say that the saving involved by being able to move this line rather than rebuild at the new location was an item of considerable importance.

The above illustration shows the derrick in position to pull a pole out of the ground, the top of the pole being temporarily side-guyed.

In Fig. 4 the pole is shown after having been pulled out of the ground and placed on top of the embankment. The derrick is ready to shift and slide the pole back to the new hole. Two men and the chauffeur pulled and completed the moving of this pole with its load of six arms of wires in twenty-five minutes.

Fig. 5—Derrick Operating Under Difficult Conditions

As a further example of the usefulness of the derrick in pole work, Fig. 5 shows a job where the pole derrick was operated under rather unusual conditions to erect a pole at the side of the road where the pole hole was dug under water and the pole erected in barrels. It

would be difficult to pike a pole into such a hole because there is nothing against which to rest the butt while raising it.

Another important function of the derrick is that in connection with the resetting of poles or the removal of abandoned poles when it is necessary to remove the butts. The slow and laborious process of pulling the pole out of the ground with a jack or other equipment is practically eliminated as the derrick, properly handled, is capable of doing the greater part of this work in much less time, more economically and with greater safety to the men.

In addition, it might be pointed out that the derrick equipped truck is also becoming more and more indispensable in connection with the handling or moving of any heavy loads in the storage yards, in unloading or in moving stock supplies of poles under adverse conditions and many other uses.

Fig. 6—Erecting Pole by Manual Methods. Contrast with Previous Operations

In contrast with the mechanical methods of erecting and handling poles as previously shown, Fig. 6 shows the old manual method of erecting a large pole. Not only is the number of men required large,

but the observance of most rigid precautions does not entirely preclude the possibility of hazard to the men when handling the heavier poles. Further, the pole locations are not always such that a considerable number of men with pikes can properly distribute themselves about the pole so as to complete the raising and lowering operations in a reasonably safe and efficient manner.

Earth Boring Machines

One of the slowest and most difficult physical tasks connected with outside construction work is that of digging pole holes. It is estimated that upwards of 1,000,000 holes must be dug annually to accommodate the poles erected in new locations, and those replaced, moved and reset in the Bell System. Under soil conditions reasonably free from obstructions a man can generally average about three holes per day with perhaps five to six as a maximum under ideal soil conditions, while in more difficult digging one or possibly two holes may represent a good average day's work. It probably requires somewhere in the neighborhood of 3,500,000 man-hours per year simply to dig pole holes.

For a number of years the availability of a practical pole hole digger has been the objective of telephone linemen. Development work has progressed rapidly during recent years and the high point of perfection which has been reached in automobile truck design and performance has greatly simplified the adaptation and increased the practicability of the boring apparatus. It is of interest to note in this connection that the solution of the problem comes at a time when there is a pronounced shortage of common labor.

The construction in 1914 of that portion of the transcontinental line extending across Nevada, marks the first really economical application of a machine to bore pole holes. In about 1917 the need for labor relief led to renewed activity in connection with adapting the fundamental principles of the original boring apparatus to machines sufficiently flexible to meet the general and rather exacting requirements of telephone work.

Fig. 7 shows one of the latest developments in earth boring machines, which is cleancut and rugged. This machine is mounted upon a 4-wheel drive truck and is otherwise specially equipped which enables it to reach practically any location where it is necessary to bore holes for the erection of poles. As a matter of fact it has been demonstrated that these machines are able to reach approximately 95% of the pole locations. Further, the machine being equipped

with a pole raising derrick makes possible the digging of the hole and the erecting of the pole with but one setting of the truck.

With the boring machine from 30 to 80 poles per day can be set in their holes by a force of three men. This, of course, does not include straightening the poles and backfilling the holes. To do this amount of work with manual labor only would ordinarily require from 15 to 50 men. It is of particular interest to note that the more difficult the digging, exclusive of rock, of course, the greater the saving by using

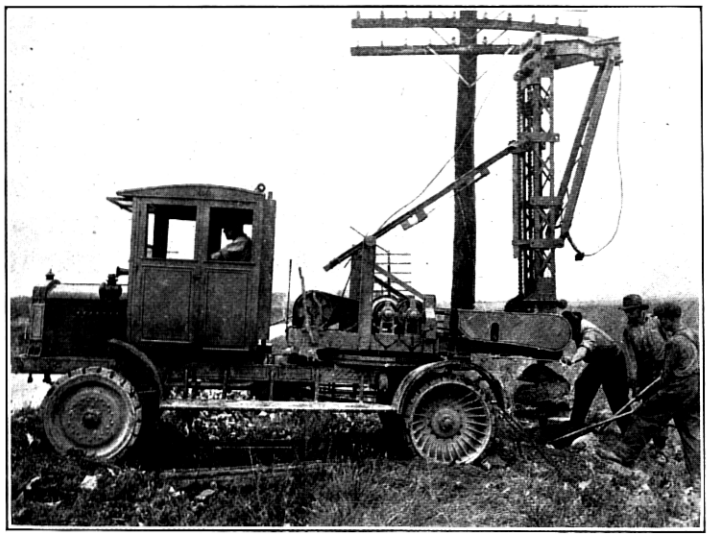

Fig. 7—Boring Hole for "H" Fixture

the machine. It might be mentioned that one of the most important features of the boring machine is its ability to bore holes through frost thus enabling a more uniform apportionment of pole work over the entire year. This feature is also of particular value in connection with the restoration of service subsequent to sleet storm breaks in winter at which time hand digging is in many cases a practical impossibility.

Fig. 8 illustrates the ability of this 4-wheel drive outfit to negotiate difficult ground conditions. In this instance one rear wheel has dropped into a hole while traveling over a plowed field covered with snow. It required only a few minutes to lift the wheel by moving the turn table so that the auger was just behind the buried wheel, then raising that corner of the truck by forcing down the auger with

power from the engine, sliding a skid board under the wheel thus raised, lowering the wheel to this board and driving away.

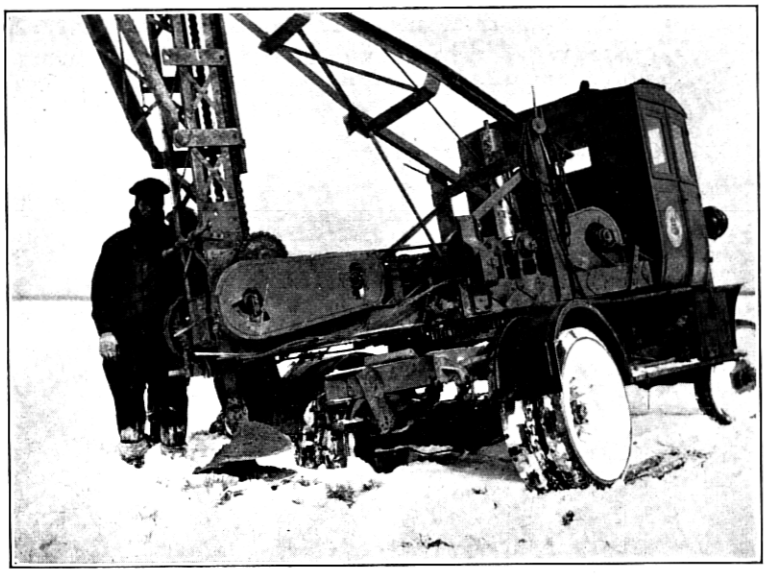

Fig. 8—Machine Extricating Itself from Hole

Cable Reel Trailers

To meet the need for a device suitable for trailing a single reel of cable and also for use as a reel "set-up" preparatory to a "pull" of either underground or aerial cable, a type of cable reel trailer has been developed as illustrated in Figs. 9 and 10.

A number of trailers of this type have been in service for some length of time and their use has brought out many advantages, some of the more important of which are:

A reel of cable can be loaded on and unloaded from the trailer in less time and with less effort than when a reel is carried in the body of the truck. In this connection, it might be pointed out that an important safety feature is involved in that the hazards to the men in loading and unloading heavy reels of cable by the old method are practically eliminated. Of course, even where reels of cable are carried in the truck the use of the winch and spindle as previously discussed in the January issue eliminates the hazard that was present in the old method of loading and unloading, involving the use of skids.

Fig. 9—Truck Being Used to Load Reel of Cable on Trailer

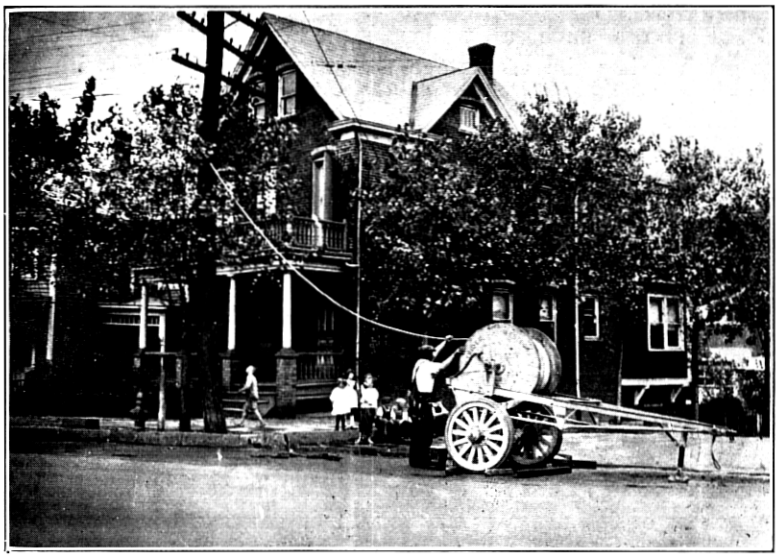

Fig. 10—Cable Being Pulled into Rings from Reel "Set-up" on Trailer

Fewer men are required for loading, unloading and "setting-up." For example, two men with a chauffeur and truck (not necessarily equipped with a winch) can satisfactorily handle a 3-ton reel of cable with the trailer, where ground conditions are such that they can maneuver the reel on the ground.

Where a single reel of cable is to be used for one "pull" or for a number of short "pulls," the trailer is used to haul the reel to the job and to "set up" the reel for each "pull." The reel may be trailed, in addition to carrying materials, tools, etc., in the body of the truck, thus making it unnecessary to unload or disarrange the equipment regularly carried on the truck.

When delivering a number of reels, one reel may be trailed in addition to carrying one or more on the body of the truck, thus materially increasing the hauling capacity of the truck, with a proportionate reduction in delivery costs.

As the photographs indicate, these trailers are equipped with springs and rubber tires which afford material protection to the cable while in transit.

Pole Trailers

For the transportation of poles under ordinary conditions, the use of a two-wheel trailer with the poles balanced on the trailer and towed behind the truck is ordinarily the most satisfactory method. Fig. 11 shows such a trailer loaded and ready for action. This method has the advantage that the trailer loaded with poles can be readily detached from the truck and left at any desired location, thus releasing the truck for other work. Also, in case of the load being stuck on a hill or in the mud, the trailer can be readily detached while the truck runs forward and from the top of the hill or from firm ground, pulls the trailer load of poles by means of the winch line.

Limiting the weight to conform with requirements of state laws materially limits the size of the load in hauling chestnut and creosoted pine poles. However, in the case of cedar poles, the bulk of the load rather than its weight is ordinarily the limiting factor.

To meet these different conditions, three sizes of pole trailers have been designed, a heavy duty trailer rated at about 8 tons with ample overload capacity, a medium duty trailer rated at 5 tons, and a light duty trailer of 2½ ton capacity for use in districts where it is desirable to maintain a standard tread between the wheels rather than to use the narrow tread dinkeys for the lighter pole loads.

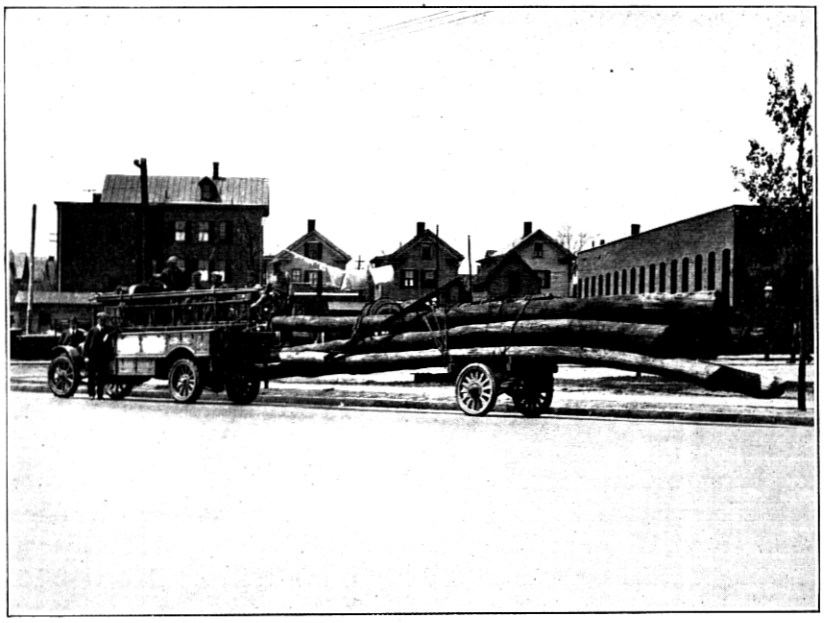

Fig. 11—Balanced Load of Chestnut Poles on Trailer

Block Gang Trailer

Fig. 12 illustrates a type of trailer which has been developed recently for the use of gangs doing interior block construction work. In a

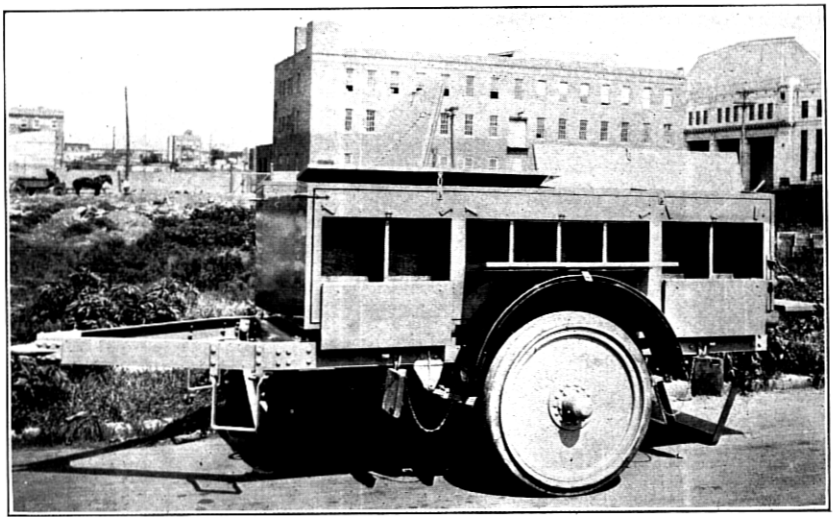

Fig. 12—Trailer Equipped with Special Body for Interior Block Construction Work

case of this kind, the gang is ordinarily located on a job from one-half day to three or four days, and since the power equipment on a truck would be of no value in connection with placing a cable on the rear walls of buildings, for instance, it is more economical to serve this gang by means of a trailer.

This light type of trailer contains sufficient space for carrying all the necessary miscellaneous tools and materials required in connection with block work and the compartments into which it is divided are such that these articles can be arranged in an orderly and readily accessible manner, thus making for increased efficiency in executing the work.

Concrete Mixers

In connection with the construction of underground conduit and particularly in the work of building concrete manholes, which are now being employed to a rather large extent, it is essential that concrete mixers be available which will be especially adapted to telephone work. Some of the requirements of this service are that the outfit be of light weight, compact, embody maximum portability, and be reliable in operation. The failure of a mixer on a telephone job may seriously handicap the operations of a large gang of men.

Fig. 13 shows a commercial type of mixer which has been modified

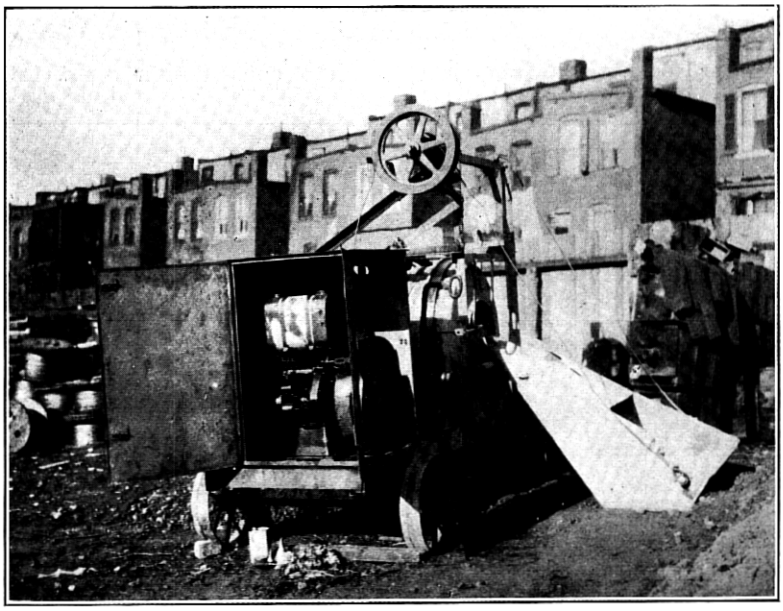

Fig. 13—Concrete Mixer Adapted to Meet Telephone Construction Requirement

in several respects to meet the particular requirements of telephone construction work.

Units of this type which are now in service are operating very satisfactorily, both from the viewpoint of reliability and adaptability to the work. This outfit will mix as much concerte as ten men and will do it much better.

Fig. 14—Pouring Concrete Manhole. Note 4-way Chute for Distribution

Fig. 14 shows one of the batch mixers in service pouring a concrete manhole, the concrete being uniformly distributed to all sides of the structure by means of a four-way chute. In connection with the broadening use of concrete manholes it might be mentioned that the availability of improved compressed air tools has greatly simplified and cheapened the making of any changes that may be required subsequent to the initial construction of the manholes.

In order to provide a concrete mixer unit having maximum portability and having proper capacity and operating features for telephone work, we have cooperated with the manufacturer in the development of such a unit which is shown in Fig. 15. This consists of a batch mixer permanently mounted upon a Ford 1-ton truck chassis and operated through a suitable power take-off from the Ford engine. This unit loads from the ground by means of a power loader and distributes the concrete from the opposite side of the drum through a long swinging adjustable chute (not shown). A small trailer if desired

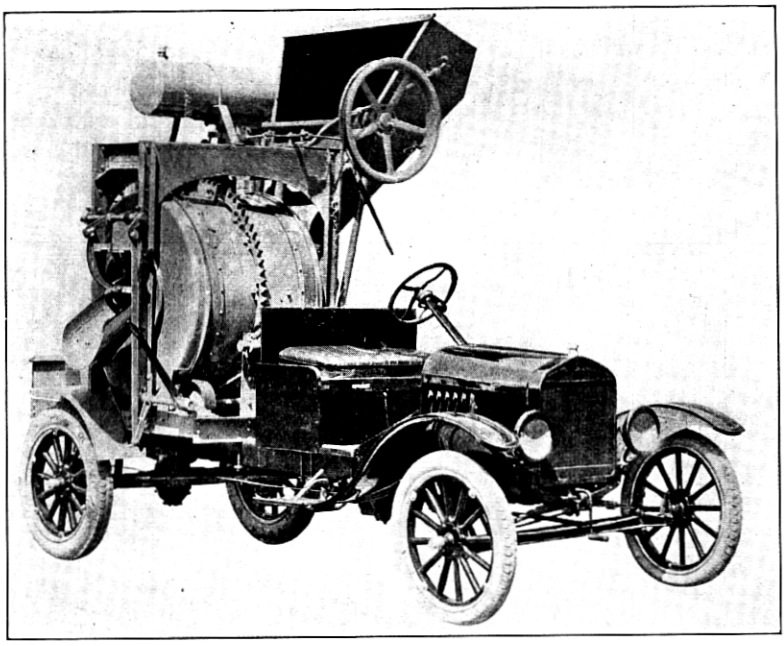

Fig. 15—Concrete Mixer on Ford One-Ton Truck. Maximum Portability for Small Jobs

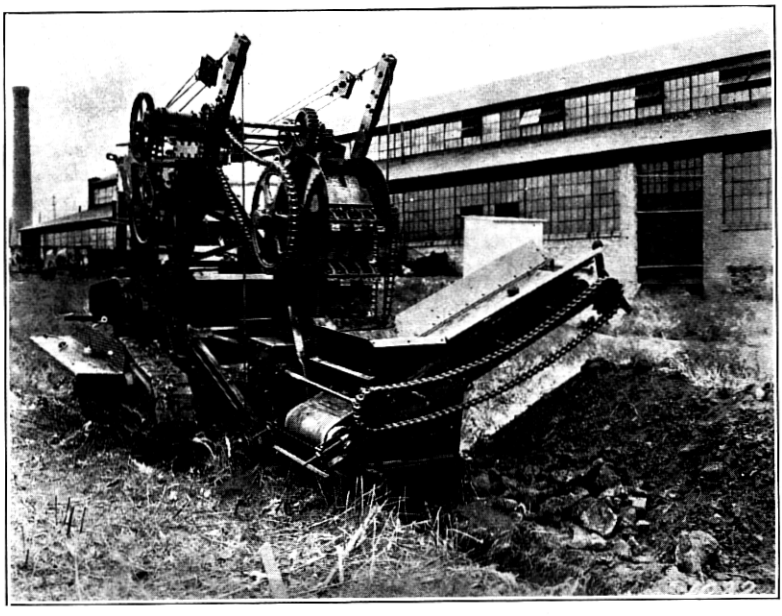

Fig. 16—Light Weight Trenching Machine.

can be used behind the Ford truck to transport the supplies and tools necessary in connection with isolated jobs.

Trenching Machines

Where it is necessary to do a considerable amount of trenching for underground conduit in outlying districts, it is sometimes possible to utilize a trenching machine with marked economy. In fact under normal conditions a machine of this kind will dig trench about as fast as a gang of 50 men.

The machine shown in Fig. 16 is a recent development which has advantages over the older type units in that the size and weight are such as to admit of its being transported from point to point on a heavy truck or trailer.

Pumps

In handling the water from excavations and also from manholes where splicers are working, the diaphragm pump illustrated in Fig. 17 is giving a good account of itself, particularly because of certain features incorporated in the design which especially adapt it to telephone conditions.

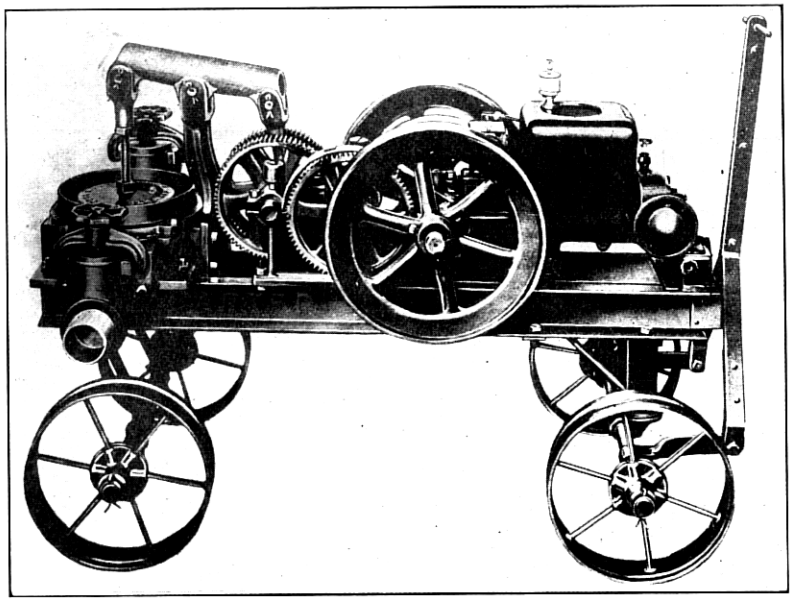

Fig. 17—Enclosed Discharge Diaphragm Pump. Capacity One Barrel per Minute

This little unit will pump water at the rate of over one barrel per minute and discharge it through a hose away from the job to any location desired. It will operate all day with practically no attention, upon a gallon or two of gasoline. When pumping under ordinary conditions it will handle water faster than 12 men with hand pumps.

One very desirable feature of the diaphragm pump is that it is self-priming. For instance, if splicers are working in a manhole the pump can be started and the initial volume of water removed, then as seepage water enters the manhole it will be immediately taken up and discharged without any attention from the splicers or helpers.

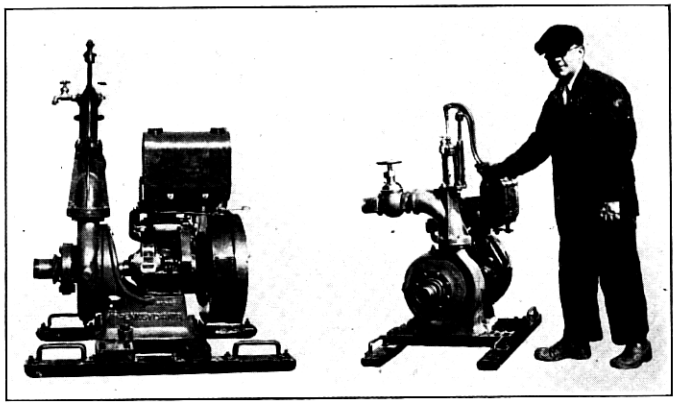

Fig. 18—Light Weight Centrifugal Pump. Capacity Seven Barrels per Minute

For handling larger volumes of water there has just been developed, as the result of careful study and cooperation with the manufacturer, a new type of centrifugal pump shown in Fig. 18. This unit consists of an air cooled engine similar to that used in the concrete mixers. On the end of the engine shaft is mounted the centrifugal pump impeller. The pump casting also forms a base for the engine.

As an indication of the capacity of this pump it might be of interest to note that it would not be possible to get enough men with hand pumps around a manhole to handle water as fast as this unit. It will pump seven barrels of water per minute and mounted on skids as shown it weighs only about 500 pounds.

In the case of trucks which do a considerable amount of underground cable placing in districts where water must be removed from manholes in advance of the cable placing operation, centrifugal

pump equipment mounted on the truck is desirable. As soon as the gang arrives at a wet manhole, the pump if promptly applied will remove the water in the few minutes during which preparations are being made for placing the cable, so that ordinarily the gang is not delayed in the least by the water.

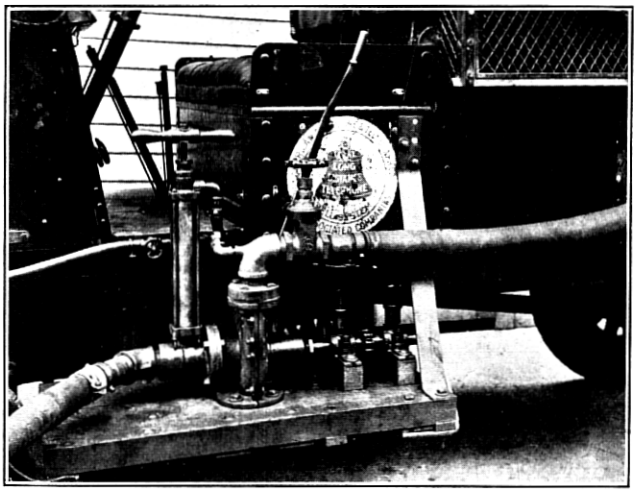

Fig. 19—Centrifugal Pump Mounted on Underground Cable Placing Truck

There are several points in favor of locating the pump on the running board as shown in Fig. 19 rather than in the body at the rear of the cab as has been the usual practice in the past. With the running board installation the water is not carried up into the truck body where it has a tendency to get into the tool and material boxes and equipment and also to cause deterioration of the body. In addition space is economized and the pump is located considerably lower than would otherwise be the case, thus resulting in a reduction of the suction lift for the water between its level in the manhole and the pump impeller.

Air Compressors and Compressed Air Tools

Of the many applications for mechanical equipment to offset the scarcity and high cost of certain types of labor such as for excavating, etc., the use of air compressors and compressed air tools is of prime importance in the outside plant construction work. Through special adaptations to meet each peculiar condition, this class of labor saving equipment has been made available for use on such jobs as the opening

of all kinds of street pavements preparatory to laying underground conduit, cutting frozen ground, loosening the earth in excavating instead of using picks, drilling rock preparatory to blasting for underground conduit or for pole holes, tamping back filled earth, cutting iron pipe covering from cable, etc.

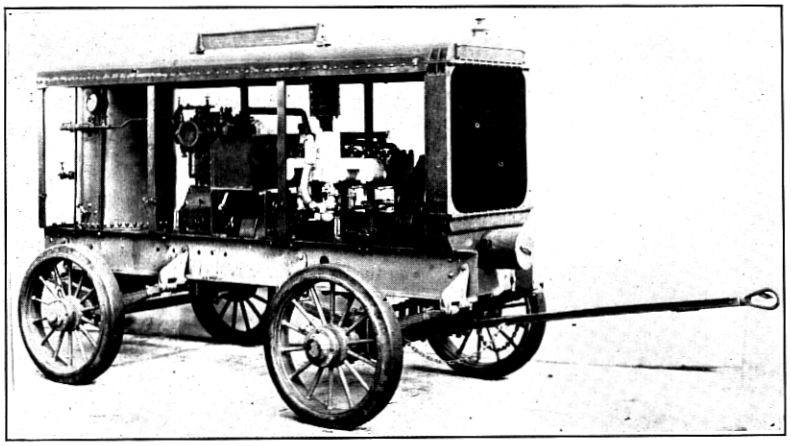

Fig. 20—Air Compressor Mounted on Trailer for Maximum Portability

Fig. 20 shows a new type of portable gasoline engine driven compressor unit which is being satisfactorily used for the larger jobs of opening street pavements, for rock drilling, etc.

Fig. 21—Removing Granite Blocks and Breaking Concrete Base

Where trenching work involves cutting through paved streets one compressor unit with three men will ordinarily accomplish as much in a given period of time as 27 men employing former methods.

In Fig. 21 two operators are shown opening pavement which consists of granite blocks set in cement, on a concrete base. One man goes ahead and wedges the blocks loose, while the man following breaks the concrete base. Some pavements of this type are very difficult to open. When the cement filling is of good quality the granite blocks often break before the cement loosens.

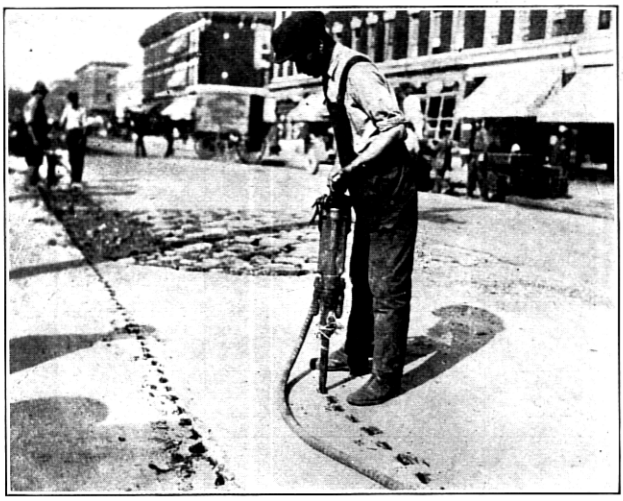

Fig. 22—Air Gun Cutting Asphalt

Fig. 22 shows an operator cutting asphalt pavement. With the wedge-shaped blade cutting at intervals as shown, small cracks are opened between the holes so that when cross cuts are made square blocks of asphalt can be readily lifted out.

The above illustrations contrast rather strikingly with the old methods of cutting pavements by means of sledges and bars as shown in Figs. 23 and 24.

In the use of the old manual method of cutting with sledges and bars there is always present a certain degree of hazard to the men. There is the possibility of the striker missing the steel and striking the holder's wrist, also the danger to the men's eyes from flying steel chips. These safety points, of course, are outside the labor saving considerations.

Fig. 23—Manual Method of Breaking Concrete. Contrast with Fig. 21

Fig. 24—Manual Method of Cutting Asphalt. Contrast with Fig. 22

While the labor saving is large in connection with opening street pavements, it is even greater in the work of drilling rock for blasting, where two men and a compressor can ordinarily do as much work in a given length of time as 35 to 40 men using hand methods.

In Fig. 25 is shown another interesting and efficient application of compressed air tools. Compressed air spades are being used to an increasing extent for loosening hard earth instead of doing this work by the usual pick method. A tool of this kind requires very little air and while this particular application is rather new, it is felt that further study may result in an appreciable saving over hand pick methods.

Fig. 25—Pneumatic Spade Replacing Hand Pick Method of Loosening Hard Soil

Compressed air can also be used to advantage in tamping back filled earth. Under certain conditions, however, it now seems that a suitable mechanically operated tamper will probably show greater economy on all except jobs in congested areas where the underground pipe interference is serious or where the trench or opening extends in a diagonal direction, thus often precluding the use of a rigid mechanical device.

The utilization of the portable air compressor is a comparatively recent development undertaken by the telephone companies in cooperation with one of the large air compressor manufacturers.

While the large capacity units have reached the stage where they give satisfactory operation, there is a field in the telephone business for a much more compact, lighter weight unit of lower capacity and cost, for such work as the opening of trench for subsidiaries, cutting frost, drilling rock for pole hole blasting, etc. With this in mind there has recently been developed in cooperation with an air compressor manufacturer, a type of compressor which is suitable for operating either one jack hammer for rock drilling or one tool for street opening with a corresponding capacity for other types of compressed air work. It is expected that the weight of this unit can through further study be reduced to such an extend that it will be practicable to mount it upon a Ford one-ton truck and still leave sufficient carrying capacity to handle the necessary guns, steels and hose for operating. Where there will be practically constant use for this lighter unit it may be desirable to mount it permanently upon the truck, while, in cases where the use will be intermittent, a very economical and convenient mounting can be made upon one of the Army type trailers.

Conclusion

In this article an endeavor has been made to cover in a very brief way some of the more important items of mechanical application which have a place in telephone construction work. The adaptation of mechanically operated tools and other devices to assist in the necessary manual operations will undoubtedly continue to occupy an important place in the work. Further study and development should result in many improvements in the present-day way of doing things which will make not only for marked economies of operation, but for greatly increased features of safety to the men engaged in constructing and maintaining the telephone plant.