COMMERCIAL VEHICLES OF Great Britain

Vol·2
1920

The
B·F·GOODRICH·Co·LTD
117·123 Golden Lane·London·E·C

Commercial Vehicles of Great Britain

VOLUME II

1920

Published by

The B.F. Goodrich Co., Ltd.

117-123, GOLDEN LANE, LONDON, E.C.1

GOODRICH HEAD OFFICE AND DEPOTS.

Commercial Vehicles of Great Britain

VOLUME II - 1920

Introduction

IN publishing Vol. II. of this Handbook we think the users of commercial vehicles will understand why it could not be issued earlier.

We have evidence that the first volume was highly appreciated, and proved of great help to users of commercial vehicles. Number II. is more comprehensive, and will make an even wider appeal. All who have occasion to use it—manufacturers, traders, and users—will recognise this when reading the new articles on "A Standard System for Recording the Operating Costs of Commercial Vehicles" and "Lengthening the Life of the Motor Vehicle," incorporated in this volume. These two articles deal, from different points of view, with the outstanding problem of the present time, viz., *how to secure greater economy.* Nothing, we suggest, could be more immediately opportune, and we recommend the perusal of these two articles to everyone interested in commercial motor traction.

We wish to express our sincere thanks to those manufacturers who so willingly supplied us with the photographs and the specifications of the vehicles shown in this volume, also to the British Engineering Standards Association, and the Commercial Motor Users' Association (Incorporated) for their courtesy in co-operating with us to make this volume more useful and interesting.

We shall be grateful for any criticism or suggestions which will enable us to improve this Handbook, and thus help to increase its usefulness to the whole industry.

THE B. F. GOODRICH CO., LTD.

London, July, 1920.

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GOODRICH DEPOTS

in GREAT BRITAIN AND IRELAND

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A Standard System for Recording the Operating Costs of Commercial Vehicles

By S. V. Norton, Manager, Truck Tyre Sales, The B.F. Goodrich Rubber Co, Akron, Ohio.

A LARGE number of vehicle operators are either not making or not saving the money they should from their vehicles. Many of them are actually losing money. Why is this? Simply because vehicle owners have been too busy delivering their goods to ask themselves, first, "what does it actually cost me," and second "what ought it to cost?"

The first essential is to know the cost, for without this knowledge the delivery system may unwittingly be run at a loss. Having the exact information as to what it costs, the vehicle operator may, by study and comparison with other systems, satisfy himself as to what it ought to cost, and either economize by improving his methods, or charge his business or his customers more, if he finds it necessary, as a matter of sound business policy.

The delivery system should be run on a known basis of cost, just as any other department is, in a well-conducted business.

Under normal conditions, the margin of profit in most lines of trade is narrower than formerly, and the necessity of efficient management and close analysis is felt as never before. Rising costs must be studied because of ever increasing difficulty of obtaining labour and material.

Moreover, war time economies are demanded of every patriotic business man. We must not only contribute our money to win the war, but we must save wherever possible in the expenditure of labour and materials.

Hence it is particularly fitting at this time to study vehicle operating costs, and to urge that every vehicle operator employ some method or system for this purpose.

EXISTING COST SYSTEMS

Now it must not be supposed that the need for a system of recording vehicle operating costs has gone unanswered. On the contrary many methods have been created to supply this want. Various companies have in the past tried to devise schemes which they hoped might be adopted by all vehicle operators. Certain commercial vehicle journals have spent considerable time and money in evolving such forms, while manufacturers of both vehicles and tyres, have printed and distributed thousands of copies of cost systems prepared by themselves.

These "independent" cost forms have unquestionably had a beneficent influence on the industry. First of all, they have served to direct attention to the desirability of keeping a record of commercial vehicle costs. Many a vehicle owner who otherwise might not have considered the matter, has at least started to keep costs simply because a complete cost system has been put into his hands, generally without charge, by some vehicle or tyre manufacturer.

And these forms had a merit often lacking in "home-made" systems of cost accounting, in that they were generally compiled by experts and were complete. That is, they did not omit any essential item of cost chargeable to commercial vehicle operation. One of the first concerns to devise cost forms for commercial vehicles was The B.F. Goodrich Rubber Company, which brought out a complete expense record system in 1911.

THE GOODRICH EXPENSE FORMS

The system consists of but two forms :—The driver's daily card and the monthly expense record. The latter consists of twelve monthly sheets, bound in a book together with a thirteenth sheet, called the ledger sheet, upon which the totals of each monthly sheet are summarized. For the benefit of those who have not examined the Goodrich cost system, the following is a brief description :

This card was compiled and furnished for the benefit of truck owners by
THE B. F. GOODRICH COMPANY, Akron, Ohio.

Car No.______ Cap.______ On________ 191__

Driver____________ At ________

Weather____________ Temp.______

Road ____________________

Left and arrived		Odometer Reading	Miles	Load Lbs.
L		S		
A L		F S		
A L		F S		
A L		F S		
A L		F S		
A L		F S		
A L		F S		
A L		F S		
A L		F S		
A L		F S		
A		F		
Total				

Current or Gasoline Used________ Oil Used ________

Figure 1.

Figures 1 and 2 show respectively the face and reverse sides of the Drivers' Daily Card. This card is made of durable manilla cardboard, small enough to be carried either in the driver's pocket or in his hat. The face of the card provides for such information as will serve to indentify the vehicle and the driver, gives the essential facts of performances, such as number of trips, tons, miles, and time, and tells the supplies of petrol (or current) and oil used. The reverse side provides space for entering expenses met with on the road, and a place where the driver may report parts needing repair or replacement.

Figure 3 presents one of the twelve monthly sheets used to summarize the daily costs. The items of performance and supplies are entered on this form every day (or every week if more convenient) from the face of the Drivers' Daily Card. Other items, such as wages, tyres, garage, etc., are entered from invoices or from the firm's ledger.

Figure 4, the Ledger Sheet, provides a means for summarizing the data which appears on the monthly sheets. Briefly, it is made up of twelve rows of monthly "totals," giving the essential figures for an entire year on one sheet. But it should also be noticed that overhead charges, not included on the monthly sheets, appear on the Ledger Sheet. These charges must be taken into consideration before the true monthly expense can be totalled. The Ledger Sheet provides for this information in a convenient way. In addition to the information already mentioned, the Ledger Sheet provides space for figuring averages per month and per mile.

This system, which has proved serviceable to many vehicle operators, was designed to be flexible enough to cover the average installation, whether gas or electric, or both. There may be, however, certain kinds of delivery problems for which it might not be as satisfactory as some others.

DIFFICULTY OF DEVISING A STANDARD SYSTEM

Any individual system, however well designed, cannot serve the commercial vehicle industry adequately so long as several other cost systems, which may also be well designed, are in existence. The difficulty comes from a lack of uniformity in the treatment of various items of expense. Vehicle owners who use systems which have been compiled by authorities on commercial vehicle accounting or by general expert accountants, and which are generally complete, show results which are not subject to comparison because of varying methods of computing identical items. For the doctors have not agreed as to the proper way of figuring certain commercial vehicle costs. There are, for instance, at least four methods of figuring Depreciation, each one of which has its champions among those held to be experts in the field of accounting.

Two vehicle operators, "A" and "B," use systems devised by competent accountants. These systems are complete, in the sense that they include every item properly chargeable to vehicle operation. Consider the item of Depreciation. A's cost system provides that depreciation shall be figured at 20% a year, charging off the entire cost of the

EXPENSES.

Tolls and Sundries		Break downs or repairs		REMARKS.

Report—Parts needing repair or replacement

Figure 2

vehicle in five years. But B's cost system declares that depreciation must be figured on a mileage basis, allotting 80,000 miles as the expected life of the vehicle. Both operators use cost systems designed by experts, yet the difference in computing this one item alone may amount to £25 or £50 a year.

Take the item of Maintenance (which includes repairs). Charges for maintenance are unique in that they generally fall heavily on certain months or even years, while many months or even a whole year may be clear of them. Suppose a man operates a vehicle for a whole year without any considerable expense for repairs, but at the beginning of the following year finds it necessary to have his vehicle overhauled, at a cost of £100. It would be obviously wrong to let the first year go free of this maintenance charge, especially since nearly all the damage was done in that year, for which the bill was not rendered, so to speak, until the following year.

But there is a third possibility. As the vehicle ages, the charge for maintenance increases year by year. Should this charge be estimated at an average for each year, or should the actual expense be taken as it occurs each year? Thus we have three possible ways of figuring maintenance charges, each one of which is featured in some cost system which may be found already in print.

VARIOUS WAYS OF FIGURING COST

The cost of tyres may be computed in several ways by those who follow the guidance of various cost forms as well as those who devise their own system. Tyre expense is going on every minute the vehicle is in operation, but the purchase of tyres may occur at intervals separated by a year, or in some cases even two years. It is inaccurate, of course, to charge expense of tyres against the month in which they are bought, or even the year, if those tyres are also used in a part of the previous or the following year. The logical way of handling this item is to distribute the expense over every day the tyres are in service. But here again, two possibilities present themselves. Inasmuch as it is not known at the time the charge is entered, how long the tyres will last, shall the charge be estimated on the basis of the tyre maker's guarantee, or shall an attempt be made to estimate (from past experience), the probable life of the tyres? According as one or other of these plans is adopted, different results will be obtained.

Interest is an item which different accountants figure in different ways. There are at least half a dozen formulas in print, each one well vouched for, and each one describing a different way of computing interest. Which is the right method? Which should be made standard?

Unit-cost is another item upon which experts disagree. Commercial vehicle performance or work is generally referred to in terms of ton-miles; but package miles or thousand-feet miles are often used, according to the commodity carried. These different units are basically the same, being variations of the ton-mile, which is the standard unit.

Now the ton-mile, defined simply, is one ton of load hauled one mile. Easy to calculate, you say. But there are certain conditions of hauling which make it difficult to apply this simple formula. Thus, if a vehicle makes three or four deliveries on one trip, its tonnage and hence its ton-mileage is reduced. Again, if a vehicle picks up a load, or part of a

load, on a return trip, should this be reckoned as a delivery or not? These conditions have given rise to various formulæ for figuring ton-mileage, all of which give different results. As a consequence, although the cost of vehicle operation per day, month, or year, may be figured in the same manner for two or more vehicles, when an attempt is made to compare the *cost-per-unit-work* it is discovered that different vehicle operators are in fact speaking different languages, and that a comparison cannot be made.

FEATURES OF A STANDARD SYSTEM

From the foregoing it is obvious that almost any well-conceived standard system of commercial vehicle cost accounting would benefit the entire industry even though its rulings on some minor points might be open to debate. Take once more the item of Depreciation, which may be computed in at least four different ways. Suppose a standard system is selected as a way of computing this item, a method regarding which there might be some debate; if all or even the great majority of vehicle owners began to figure depreciation according to the standard formula an enormous gain would be accomplished, for a common denominator would be established by which one vehicle could be compared with a thousand vehicles in respect to this item. Suppose that certain inaccuracies were found to exist in the standard method; they would be the same for all participants and allowances could be easily made for them.

A standard system establishing a uniform method of figuring all the basic items of cost and performance, would provide a common language by which the experiences of all the vehicle operators in the country could be related and understood. It would unlock a great store-house of information, which is at present closed to the average vehicle owner. Whether its methods were correct in every detail or not, it would provide the common measure by which every installation could be judged. This must always be the supreme function of a standard cost system.

Let us examine this possibility further. Here are some of the facts which any well-conceived commercial vehicle cost system should reveal:

Number of Trips	Running time in hours and minutes (including stops)
Customers or deliveries	Average loading time per trip
Total loads in units	Average speed in miles per hour
Average load in units	Estimated running time per mile
Miles travelled	Estimated time per customer's stop (in minutes)
Round trip distance	Cost per day (at work)
Unit .... miles	Cost per mile
Miles per gallon of petrol	Cost per unit
Miles per gallon of oil	Cost per unit mile
Standing time at plant in hours and minutes	

These facts are of the utmost importance because they serve to analyze the cost of commercial vehicle operation with relation to the work performed. Some cost systems omit some of these facts. Some cost systems treat certain of these items in different ways.

STANDARD SYSTEM WOULD BENEFIT OPERATORS

Now suppose a standard system were adopted and widely used which would enable a great many vehicle operators to compute these items in the same way! The benefits to vehicle users would be enormous. A comparison of figures would bring to light many possibilities of economy, as well as many causes of waste. Expensive methods would have to go; time saving and money saving ideas would spread throughout the vehicle-using public.

Take the matter of supplies. A great deal of doubt exists to-day in the minds of vehicle owners as to which oil, which tyres, which accessories of all kinds are the "best." Many owners admit that there seems to be no way of finding out. Suppose now that a considerable number of vehicle owners kept their records of tyre costs in the same way. The reports from dozens, perhaps hundreds of vehicle owners, rendered in a uniform way, would tell a convincing story. They would establish proof regarding a matter which heretofore has been approached only by guess-work.

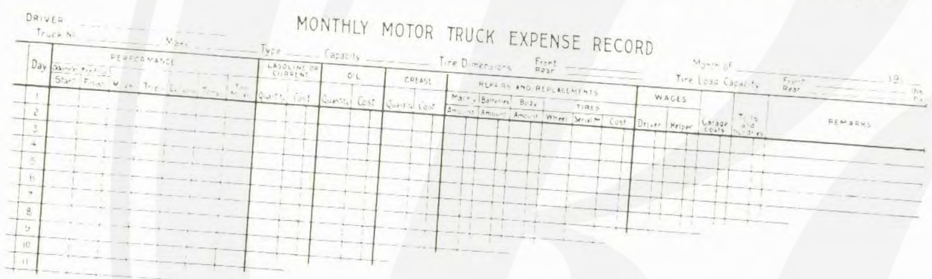


FIGURE 3

Now look at the matter from the point of view of the manufacturer, whether of vehicles or accessories. Many a vehicle, made honestly and well, has suffered from an unfair test, or from a report based on a system of reckoning which was prejudicial or incomplete. A standard system of computing costs would do much towards eliminating this unfairness, for not only would it prescribe a uniform manner of recording items of expense, but also items of performance.

Let us consider a concrete example. Two vehicles, of different makes, but of the same size and type, are used in similar lines of work. Both vehicles cover approximately the same mileage and deliver the same amount of merchandise per day. Now it happens that the two vehicle owners have different ideas of the manner in which performance or work should be figured. As a result one owner states that his vehicle performs 100 ton-miles a day, the other 200 ton-miles. Now the mischief is done when each owner sets out to figure his cost per unit of work (in this case per ton-mile). For although each man has recorded his items of expense in an accurate and complete manner, and as we have seen the total expense happens to be the same for each vehicle, the final result—the cost per ton-mile—is *twice as much* for one vehicle as for the other! Thus, the report is circulated that such and such a vehicle is very expensive to operate, or costs a great deal to deliver a certain amount of merchandise.

ADVANTAGES TO VEHICLE MAKERS

Consider the matter of maintenance or repair. Every reputable vehicle maker is searching constantly for information which will enable him to perfect his product. The world is his laboratory, and he would like nothing better than to receive reports from all his customers which would describe the shortcomings, and lay bare the weak points of his vehicle. Unfortunately that information is not now available to him, except in fragmentary form. And even in those rare cases where he does receive the complete history of an installation, the story is apt to be, as it were, in a "foreign language," which must be translated or interpreted before it can be of any use.

The maker of parts and accessories is in much the same case as the vehicle manufacturer. He is constantly in search of information, but it must be complete and must cover standard facts in a standard manner. Otherwise it may be worse than useless—it may be misleading.

In view of these evident advantages, why has not a standard cost system been established before? What are the difficulties which have stood and which may still stand in the way?

The major difficulty has often been expressed in these words: "It is impossible to devise a cost system suitable for vehicle owners in different lines of business. Conditions vary."

This statement has been made so frequently that it has come to sound authoritative. But let us analyze it. One vehicle owner operates his own garage, while another rents space in a public garage. Here is a difference in conditions which requires different methods of accounting. But both vehicle operators have the item of Garage Expense which is chargeable to their vehicles, and this item is fundamentally the same in both instances.

FUNDAMENTAL ITEMS OF EXPENSE

Here it is necessary to distinguish clearly between what is fundamental in a cost system, and what is merely a matter of detail. There are less than a dozen basic items of expense which are chargeable to the operation of ANY commercial vehicle. On the other hand, there may be as many as fifty sub-divisions of those basic items which may be used conveniently in various lines of trade. But the important fact to bear in mind is that they are sub-divisions, and not new or additional items of cost.

Take the item of maintenance. It is entirely possible that a certain vehicle owner may demand to know the cost of maintenance separately for axles, springs, motor, transmission, and body. Let us suppose that he has designed a cost system which shall give this information. He has done nothing radical in the way of cost accounting—he has created no new charges, but has merely taken a basic item and split it up into five component parts. The sum of the five parts gives maintenance—the same figure that he would arrive at if he kept that item intact. Moreover, he can compare his total charge for maintenance with the same charge as kept by another, even though that other operator has given no thought to the details which make up his maintenance item.

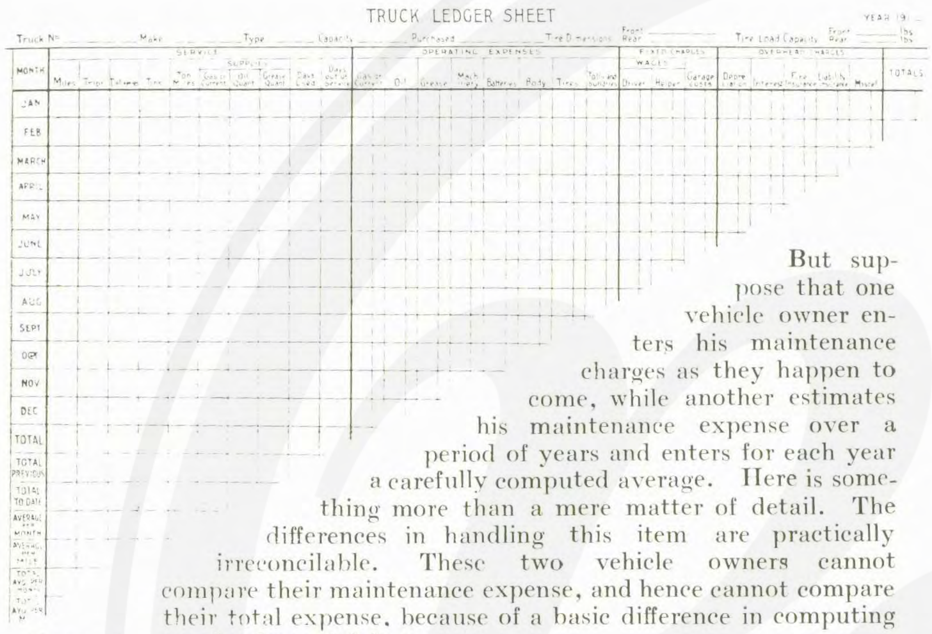


FIGURE 4

But suppose that one vehicle owner enters his maintenance charges as they happen to come, while another estimates his maintenance expense over a period of years and enters for each year a carefully computed average. Here is something more than a mere matter of detail. The differences in handling this item are practically irreconcilable. These two vehicle owners cannot compare their maintenance expense, and hence cannot compare their total expense, because of a basic difference in computing one fundamental item.

Looked at in this light, it will be seen that the popular difficulties are nothing more than questions of detail, and that the real problems to be solved are those which concern the manner of computing the basic items of expense. A standard cost system, therefore, must allow latitude to the requirements of truck owners in various lines of business, but it must be precise and almost dogmatic in laying down formulæ for the computing of basic items. How shall interest be computed? What is the proper basis for figuring depreciation? Maintenance? Tyre costs? Ton Mileage? These are some of the major questions which must be answered.

VARIABLE CONDITIONS MAKE COMPARISONS DIFFICULT

But it is argued that different haulage conditions render it impossible in many cases to make a fair comparison of two or more vehicle installations. In some communities roads are level and smooth, in others hilly and rough; in some localities traffic conditions are favourable, in others the reverse; then there are differences in business conditions, in number of stops, in distance between stops, in garage equipment, in length of hauls—there are in short a thousand and one variables which affect the cost and performance of commercial vehicles to such an extent that comparisons are bound to be misleading.

These variables undoubtedly exist. But it is one of the chief functions of cost accounting to recognize such conditions and put a value on each one of them. Adverse haulage conditions are like penalties attached to commercial vehicle operation—an accounting system tells how great

these penalties are. Thus road conditions in some localities may be so bad as to make vehicle operation unprofitable. The cost sheet should reflect this condition and give the warning.

These variable conditions, in fact, should give interest and zest to the comparisons of installations which will follow the establishment of a standard system. Suppose that two installations very similar in most respects show marked differences in one or two items of expense. Attention is at once called to these items and the conditions responsible for them are investigated. Perhaps a leak is discovered, perhaps the other man can suggest a better method—in any event the comparison is likely to benefit all who take part in it.

We have indicated earlier in this paper some of the attempts made in the past to supply a system of accounting for commercial vehicles. Several excellent systems were devised, which are still good and can be used to advantage by vehicle owners. But these systems, while invariably good, do not possess the quality of being standard. While expert advice was generally sought in devising them, sufficient importance was not attached to learning the needs of the many different classes of vehicle owners, with their varying conditions of service, equipment, character of load, type of vehicle, etc. Thus these forms, while generally based on sound principles of accounting, lacked adaptability to a wide range of vehicle operating conditions. Moreover, they did not receive the support of many vehicle owners as they were not the work of any considerable body of vehicle owners, but of special interests and distributed either for profit or to gain prestige—legitimate aims, surely, but fatal to any attempt to establish a standard system.

A STANDARD SYSTEM DEVISED BY VEHICLE OWNERS

What these former attempts lacked, seems to be abundantly supplied in the movement originated by the Truck Owners' Conference, Inc., of Chicago. This Conference started in 1917 as a group of vehicle owners who have gathered together at various times to discuss their individual problems, without interference from members of the trade or from individuals having some special brand or make of goods to sell. Under these conditions those who attended the meetings spoke with the utmost freedom, and plans and methods were disclosed and exchanged which proved of great value to all who had the operation of commercial vehicles in their charge. No attempt was made to form an association, while those who came to the meetings with the purpose of selling their own wares were rigorously excluded.

Now it is interesting that, while the Truck Owners' Conference desired to attack the problem of a standard cost system without delay, they were compelled to give it their close attention from the beginning of the first meeting. As we have indicated, the purpose of the Conference was to get vehicle owners together and compare their individual problems with the idea of making the best methods of each available to all, and cost of operation with relation to work performed, seemed to be the one standard by which different vehicle installations could be compared. That is not to say that if two vehicles of the same size and make are operated the same number of miles but at different expense, the vehicle having the lower expense should be judged, therefore, to be the more efficient, for conditions of service must be taken into consideration. But it was impossible to compare the efficiency of two or more installations until all conditions had been judged by a standard measure, that is, a standard system of costs.

The Truck Owners' Conference, therefore, in addition to discussing various problems of motor transportation, set itself the task of devising a standard cost system. And in this they found that the very circumstances which encouraged free and frank discussion on other matters, qualified them as never before to take up this new work. For they felt assured that any system they might evolve would proceed from the experience of hundreds of different owners, that it would be shaped, as far as possible, to serve the requirements of all lines of business and all kinds of vehicles, that it would pass the gauntlet of free and frank discussion, that it would not be adopted until approved by a very substantial number of vehicle owners, and that by reason of that approval it would have the stamp of authenticity and receive the support of a vast number of vehicle owners in a manner not accorded to any of the many systems devised independently by special interests and distributed for profit or prestige.

On this unassailable foundation the Conference is building. A committee was formed, not confined to a few experts, but having as well a considerable number of "practical" operators. Scores of cost systems already devised have been examined. The good points of each have been carefully considered, and will be adopted when feasible. Tentative forms have been drawn up. These forms have been changed again and again, as a result of the criticism of members of the committee and those who have attended the Conferences. Gradually the system is taking definite shape, and it has been decided that the work of the committee is so far advanced that its recommendations should be adopted by all vehicle owners interested in these Conferences.

ADOPTION AND DISTRIBUTION OF THE SYSTEM

It is hoped that as a result of this movement a cost system will finally be approved which may fairly take the title of a standard system. Every opportunity will be afforded at later meetings of the Conference to suggest changes or criticisms of the forms recommended by the committee, and if a substantial majority does not favour the proposed system, or cannot agree on modifications of it, no system will be adopted. But even if a system is endorsed and adopted, it will not be considered a final form, but will be subject to revisions and improvements as they are suggested from time to time. It is by no means the intention of the Conference to impose from above, a hard and fast system of keeping vehicle costs, but rather to foster the development of such a system by the vehicle owners themselves, upon whom, in the last analysis, it must depend for support.

Quite in keeping with the creation of the standard form is the manner in which it is proposed to distribute it. First of all, no one will be permitted to make a profit from its sale. Bids will be asked for the printing of the standard form, and the work will be let to the lowest bidder. A price will be established covering the actual cost of printing.

In view of the great number of copies which will be required, the price will probably be nominal. It is possible that electrotype plates will be made, and extra plates can be sent to different printers throughout the United States, if it is considered inadvisable to confine the work to one printer.

The distribution will be made through many of those agencies—which are at present circulating cost systems of their own. These will include notably, vehicle manufacturers and their agents, tyre makers, and magazines. When one considers the efforts put forth at the present time by these agencies to popularize the many and various cost systems which exist to-day, one has great hopes for the result which should come from combining these efforts into one standard system.

It is apparent that vehicle owners in the same or in different lines of business will, by the use of such a system, be able to answer the questions asked at the beginning of this paper, in respect to the delivery of goods by commercial vehicle, viz., "What does it cost me?" and, "What ought it to cost?" Whether they compare notes individually or through meetings of Motor Vehicle Clubs, or at future gatherings of the Truck Owners' Conference, the standard system will enable them to compare the performance and cost of their vehicles by talking a common language—one they may all understand.

The desirability of a standard cost system for commercial vehicles has been apparent for many years. The obstacle has been in turning the desire into accomplishment. The movement started by the Truck Owners' Conference is by far the most encouraging sign of action towards this end that the industry has yet seen, and as such deserves the support of every vehicle owner as well as every manufacturer of vehicles and vehicle parts. Its promise is such that no friend of the industry should neglect to lend his assistance to it. For if it succeeds, as it seems likely to do, there is scarcely one of us who will not in some way feel its benefits.

Lengthening the Life of the Motor Vehicle

By S. V. Norton, Manager Truck Tyre Sales, The B.F. Goodrich Rubber Co.
Akron, Ohio.

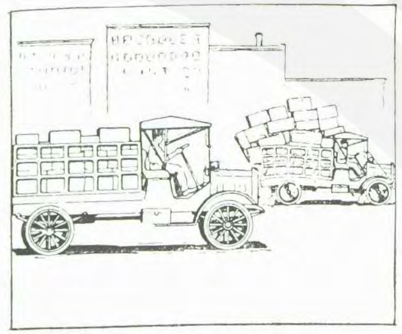
THE Motor vehicle of the present is not a speculation, but an investment. The time has gone by when the vehicle was sold with extravagant but vague promises, and bought with mingled misgivings and hopes. More and more the motor vehicle is becoming understood, and is being assigned to its proper place in the field of transportation. It is neither a worker of miracles, nor an extravagant and unprofitable piece of machinery. It is a carrier with known possibilities, distinguished from the horse-drawn vehicle by its greater speed and power on the one hand and its greater cost on the other. Under certain conditions it cannot economically replace the horse and wagon, but in most circumstances its greater speed and strength can be employed advantageously, so that a single vehicle may replace from three to ten, twenty, or even thirty horse units.

With the increasing knowledge of the vehicle as an efficient carrier, has come a better understanding of its limitations as a piece of machinery. When it is realized that a vehicle with proper care may last two, three or ten times as long as one that is neglected or abused, it will be seen that vehicle maintenance is one of the most important factors in the whole problem of the commercial vehicle transportation. It is our purpose in this article to point out the more important abuses to which the motor vehicle is commonly subjected, and to show how, by avoiding them, its life may be lengthened and its value as an investment greatly increased.

OVERLOADING

Perhaps the most common abuse to which the motor vehicle is subjected is that of overloading. It is hard to resist the temptation to "put on a little more" and get the same returns that another is securing from a more expensive investment. The vehicle will carry it—it does not groan or cry out—and the power plant seems well able to move the overload at the same speed as a capacity cargo. Moreover, didn't the salesman say, "*Our* vehicle, although it's rated as a three-tonner, will walk away with five tons as easy as not. It has a big factor of safety!"

It ought to be a sufficient retort:—"You can't get something for nothing." It may be pointed out that the factor of safety is for emergencies only, not every day use. It can be shown that well known manufacturers design different models for different capacities, even though these capacities are separated from each other by only one-ton or even half-ton intervals, and that a vehicle designed for four tons, for instance, may cost £100 more than the three-ton model and a similar amount less than the next size above. The average person, however, is not



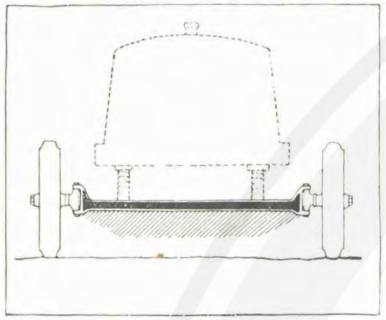
Who wins ?

satisfied by these general statements. He requires a more specific account of the matter. He wishes to know the reason why. And since good and sufficient reasons do exist, it ought to be possible to furnish them to the vehicle owner. He is really anxious to hear them.

Vehicles are manufactured by firms in competition with each other. In order to survive, a vehicle maker must design a vehicle that will deliver the most service for the money invested. This does not mean that the vehicle must be made as cheaply as possible. It means that strength and economy must be considered together. It will not do to build a vehicle that is enormously strong for the work intended, because such a vehicle would be unduly expensive whereas a lighter vehicle, having a much smaller factor of safety, would handle the work just as satisfactorily and at much less expense. There comes a point where increasing the factor of safety does not pay—does not pay either the purchaser or the seller. Moreover, the designer must constantly work to keep down the weight of the chassis. This has been the constant effort of pleasure car builders, and it holds true in greater measure for the vehicle maker. Extra weight means extra expense, both in selling price and operating cost.

WHAT IS FACTOR OF SAFETY? The factor of safety in a commercial vehicle, then, is large, but not boundless. It covers the maximum strains which a vehicle may encounter when used according to its rated schedule of speed and capacity, and provides a wide margin besides. It covers some of the abuses to which a vehicle is commonly subjected. It does not cover all. It could not cover all. There are conditions and combinations of conditions under which a vehicle five times as strong as those built to-day, would be smashed. The designer despairs of building a vehicle that will stand overloading and overspeeding over rough roads. Such a vehicle would be monstrous in weight, and extravagant in price.

Moreover, the term "factor of safety" is often misinterpreted. It does not mean a zone of absolute safety. It does not mean that a member which is designed with a factor of safety of four will not break until a stress of four times the normal is exceeded. Such a member may fail at a stress of two, or again resist up to eight. Factor of safety is provided because of man's confessed ignorance as to the precise effect of various strains and shocks. Tests of materials result in an average only. Two bars of steel indentical in size and apparently the same in stock may test, the one far above and the other far below the average for that kind of metal. Factor of safety is the best guess we can make



Shaded Diagrams showing Nature and Extent of Normal Bending Strain in an Axle.

to provide for these uncertainties.

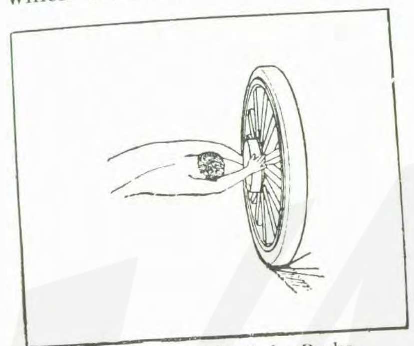
Again, factor of safety is computed with reference to the breaking point. But metal can be injured long before the breaking point is reached. Metal is subject to fatigue, in much the same manner as animal tissue. It can be worn out internally before showing any signs of strain on its surface. Thus drawing on the factor of safety, when it does not result in immediate harm is sure to cause a gradual and progressive damage which shortens the life of the metal by years. Moreover, it *reduces the factor of safety.* A piece of metal that originally had a factor of safety of six may, by repeated strains, be reduced to a factor of safety of only four, then two, then one, then nothing. In that way a vehicle may fail with only a slight overload, or none at all, leaving the owner still to be convinced that there was no flaw in the metal.

EFFECTS OF OVERLOAD ON AXLE. Let us consider some of the strains on specific parts of the vehicle which have a bearing on the factor of safety. One of the most important is the effect of overloading on axles. The accompanying illustration is a photograph of an axle spindle broken by overloading. The owner claimed that the spindle gave way when the vehicle was travelling along a smooth road with a capacity load. An examination of the damaged part showed that the metal was uniform, and contained no flaws. The appearance of the break tells the story. There is a band or zone in the middle having the granular appearance of steel that has just been broken. Above and below this band the surface is smooth, almost polished. The case is plainly one of progressive fracture. The original fracture was either above or below the middle zone, or it may have been both above and below. A severe overload, coupled perhaps with momentary overspeeding, strained the outer fibres of the steel beyond their elastic limit. The owner did not know that the axle was damaged. The two surfaces of the fracture rubbed together. A second overload on some later trip widened the break, and further weakened the axle. Further strains spread the fracture. *Still the axle held on.* This is proved because the fracture existed long enough for the surfaces to wear perfectly smooth. We know then that for some time the only thing which held the axle together was that narrow strip of metal in the middle. No better example of factor of safety could be desired. Finally, however, the inevitable happened. The factor of safety, having been

Photograph of Progressive Fracture in Steel Axle Spindle. (Courtesy of Sheldon Axle & Spring Co.)

reduced almost to one, gave way under only a normal strain. Overloading months before had weakened and finally ruined the axle.

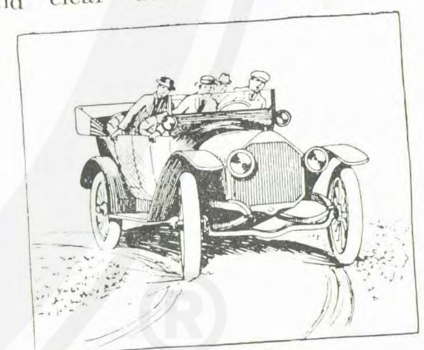
THE TWISTING STRAIN. Bending strains, however, are not the only kind of strains which bear increasingly on the axles from overloading. The torsional strain is very important. When the brakes are set firmly, the wheels and the rear axle become, as it were, one piece. The action of the road tends to cause the wheels to continue to revolve. The brakes, however, bind the wheels to the axle, and it is thus the axle which resists the turning of the wheels. This is a tremendous strain on the axle, because the force of the road is applied at the rim of the wheel and has a lever arm as long as the distance from the rim to the hub, whereas the axle is much smaller and resists with a leverage only about one-fourth as great. A good driver, of course, will not apply his brakes so hard as to lock the wheels. Not all drivers are good drivers, however. Let us suppose that the driver does jam on the brakes and lock the wheels. Let us suppose that in addition the vehicle is heavily overloaded. The vehicle being overloaded possesses additional momentum, and, being much heavier, increases the friction or grip of the tyres on the street. The torsion on the axle is enormous. It is double abuse, yet the engineer must design to take care of it and provide a factor of safety beside.



The Power Behind the Brake.

END THRUST. There is still a third kind of axle strain which is increased by overloading. It is end thrust on the axle bearings. This occurs when the vehicle swerves from its straight path, and especially when it rounds a corner. Some hint of the magnitude of this force is felt by the passenger in the rear seat of an automobile. When rounding a corner briskly a person may be slid clear across the seat and brought up sharply against the side of the car. The momentum of the body of a 150-pound man is, of course, nothing in comparison with the tremendous impulse with which a 5-ton load of merchandise plunges sidewise to the new direction of travel.

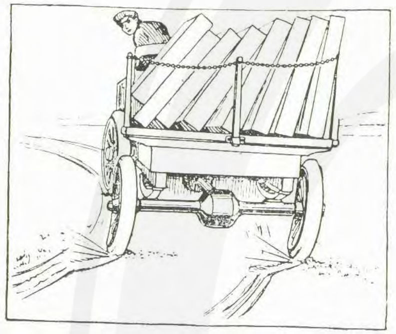
This is sometimes called the "skidding" strain. The term, however, is inaccurate. It is the resistance against skidding which sets up the strain. Skidding is the safety valve, the mechanical way of showing that the strain is too great to be endured. When the tyres finally slip and permit the vehicle to take a crab-like diagonal course,



Rounding the Curve.

part sidewise and part straight ahead, it means that the tremendous momentum of the vehicle has triumphed over the grip of the heavy wheels which are trying to force it to take a new course, and that it is following, in a measure at least, the original course along which the great inertia of its momentum strives to carry it. As a matter of fact the degree of skidding often indicates that the strain is light instead of heavy, for, if the road surface is slippery, the wheels will not hold at all. But on a dry, roughened surface, the tyres will hold true to their path, forcing the wheels and axles to take the full 100% of the side thrust.

The tendency of this strain is to push the axles through the hubs of the two outside wheels. In addition, there is a bending strain which tends to snap the spindle of the axle in two. Thus two strains are operating at once, the end thrust resisted by the bearings, and the bending or snapping strain resisted by the axle stock itself.



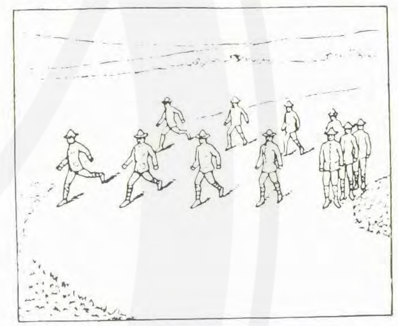
The "Skidding" Strain.

EFFECTS OF OVERLOAD ON THE WHEELS. This end thrust acts with special violence upon the wheel. A wheel, whether of wood or steel, is tremendously strong in resisting vertical strains. It has the enormous strength of an arch, and is further reinforced by its spokes, which not only support the arch but support each other. A test conducted on a 36 x 4″ dual wood wheel showed that it would bear a weight vertically of 114,000 pounds, or 57 tons. It is quite different, however, when a strain is imposed laterally at its rim. The wheel is not built to defend itself against pressure from that direction. Moreover, strains applied laterally at the rim act with great leverage against the hub, tending to " dish " the wheel even under normal conditions. What happens when the vehicle is overloaded? Let us consider that the weight is doubled. It is the same as multiplying these enormous strains by two. Double weight means double momentum, and therefore double end thrust. Not only that, double weight means double wheel traction on the road, and double grip. The tyres cannot slip or skid, the wheels cannot escape; they must stand up and meet the double strain. The two outside wheels with the axle spindles and axle bearings must take it all.

EFFECTS OF OVERLOAD ON SPRINGS. Next, let us consider the effect of overloading on springs. This can be measured almost exactly by the extent to which it is practised. In fact, while certain other parts of a vehicle yield only to extraordinary strains, the springs suffer a gradual and progressive deterioration from any overload, and generally, in exact proportion to its duration and amount. This can best be understood by considering briefly the problem of the spring maker who must design and manufacture springs for a given load.

A vehicle spring utilizes the principle that relatively strong material will bend readily if made up in a long strip. This, of course, is due to the fact that bending stresses can be applied with enormous leverage in comparison with the existing force which acts only through the thickness of the piece. A piece of hickory plank two inches thick and only two feet long is relatively stiff and hard to bend, but the same material fifteen or twenty feet long makes an excellent spring board. Moreover, a relatively long strip will bend through a long distance without seriously straining the fibres of the material. This is due to the fact that each unit of length contributes its deflection to the arc, making the total deflection at the extremities rather considerable. A short plank bent half an inch may suffer a more severe fibre strain than a long plank which bends several inches. The degree of fibre strain to which material is being subjected cannot be determined by the amount of absolute deflection, but by the relative deflection, that is, its amount of bend in comparison to its length and thickness.

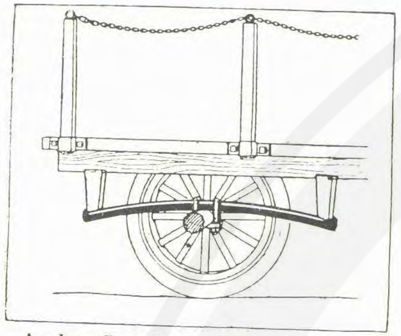
THIN OBJECTS BEND EASILY. The fibre stress in material caused by bending can be illustrated by the behaviour of men marching in a column which is turning a corner. As the corner is being rounded the men on the inside shorten their steps while those on the outside lengthen their strides considerably. If the column is a narrow one, consisting of men marching three abreast, the difference in strides is not great, but if the column is very wide, having fifteen or twenty men marching side by side, the men on the inside become almost huddled together, while those on the outside are obliged to increase their strides greatly in order to keep abreast on the turn.



A Mere Matter of Circumference.

The same thing, in terms of fibres instead of men, happens in material that is being bent. The fibres on the outside of the curve become stretched, those in the middle remain neutral, those on the inside become compressed. In a thin piece of material the fibres suffer a relatively small amount of stretching and compression in bending a given number of degrees. If the thickness is increased the fibres suffer greater distortion in bending the same amount. A strip of steel one-quarter inch thick may bend a certain distance a thousand times without breaking, while a piece one-half inch thick may snap on the first attempt.

THE MEASURE OF SPRING ACTION IS DEFLECTION. Two more facts in this connection may be mentioned here. The ultimate object of the spring designer is to secure so many inches of spring deflection per thousand pounds carried. This is the measure and the only measure of the effect of spring action. A spring that deflects one inch under a thousand pounds, will deflect two inches under two thousand and three inches under three thousand pounds, and so on until the elastic limit is reached. The same is true of a bar of metal not designed in any way for use as a spring. Such a bar might be used in place of a carefully designed spring and give substantially the same results, but it would be heavy

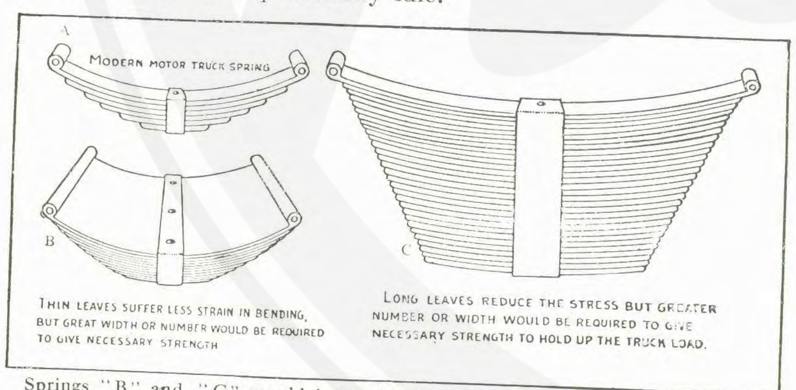


An Iron Rod might serve as a Spring.

and uneconomical in point of material used, and would probably fail early from fibre stress concentrated in two or three points instead of being distributed evenly along its entire length.

With the foregoing facts before us, let us consider how the spring designer is influenced and limited in building a spring. Let us suppose that he is designing a spring to carry, as its part of the capacity load, a weight of 2,000 pounds. In springs for pleasure cars a deflection of one inch per 100 lbs. is often figured on. If this were applied to the vehicle, the springs would deflect 20 inches under capacity load. Manifestly this would be excessive—not only would it cause undue fibre stress in the spring steel but it would permit too much bounce or vertical motion in the chassis. The spring designer must cut the deflection under load to about one-fourth that amount, or nearly the same as with the pleasure car. This does not mean that the springs will act as easily as those on the pleasure car, for although the total deflection under its load is about the same, it requires four times as much load to compress the stiffer vehicle spring, and road shocks will thus be resisted four times as much.

Robbing Peter to Pay Paul. Having determined the proper deflection for the capacity load, how can the spring maker build a large factor of safety into his spring? It will not do to make the spring stronger, because that will make it stiffer, too. It is the business of a spring to be springy, and in the degree to which it ceases to be flexible, it ceases to protect the car. By making the spring stiff, so that under load it deflects only half as much as formerly, it is possible to make it last indefinitely. But the small amount gained in that way, is spent many times over in repairs to the mechanism of the vehicle. Thus, a good spring cannot always be recognized by its durability until it is ascertained whether or not the spring is really working and flexing with every movement of the vehicle or whether it is practically idle.



Springs "B" and "C" would last indefinitely, but would ride no better than Spring "A," and would Cost and Weigh Eight or Ten Times as Much.

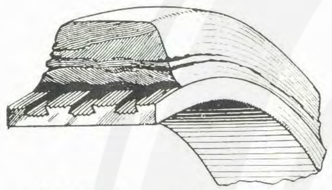
This, then, is the dilemma of the spring maker, and shows why in the best designed springs the factor of safety must be comparatively small. To anyone claiming that a certain vehicle is guaranteed to carry half as much again as its rated capacity, it is a proper retort to say: "In that case the springs must be too stiff for the rated capacity and consequently they must resist unduly the jolts and jars of the road, throwing a greater strain on the axles, and transmitting a greater shock to the mechanism of the vehicle. If they are correctly designed for the rated capacity, however, then this added load must have the effect of causing a greater stretching and compressing of the fibres of the spring steel than was ever intended, and although this may not cause an immediate fracture, nevertheless it must be wearing out the fibres of the steel at an undue rate and may have the effect of shortening the life of my springs by half."

Effects of Overload on the Frame. The effects of overloading on the vehicle frame are not so serious as with springs. There is no such strict limitation on the factor of safety which may be built into a frame, and with modern pressed-steel construction, there are not many cases of frame fracture. Nevertheless, there are certain points in the frame which are particularly susceptible to undue strains. These are the holes bored through the beams of the frame for attaching the mechanism of the motor and transmission. In modern practice these holes are made as few as possible. They cannot be entirely avoided, however, and they do constitute points of weakness which are the first to give under exceptional stress. This weakness is guarded against by engineers by building the frame out of stronger material than would otherwise be required.

Let us suppose that a vehicle carrying a capacity load drives over a beam or curb having a drop of some five or six inches. Such a condition is found in every city; it is by no means rare. Let us see what happens to the frame. The load, which was previously static, is given a downward motion. It acquires momentum, and forces the frame downwards with great power. The springs must yield, for if they resisted such a force they would be too stiff to protect the truck against normal shocks. Finally, the frame is brought up against the bumpers, if there be any, or directly against the axles. Without estimating the effect of this blow on the axle, let us consider the stress on the frame. It is almost as if the whole weight of the load were dropped on it from a height of three or four inches. The stress mounts up immediately to four, or five times that of the static load. It may break, or at least bend the frame. Now let us suppose that the vehicle is carrying a load of twice its rated capacity. The shock is increased not by addition but multiplication. The strain of five is multipled by two, making the enormous product of ten times the normal stress on the frame. It would be useless to design a frame to resist such strains, since it would have to be excessively heavy.

Two Times an Extraordinary Strain Equals an Accident.

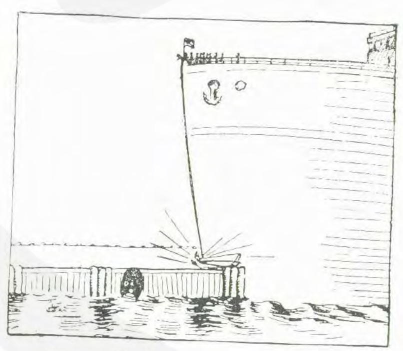
Effects of Overload on the Tyres. Consider next the effect of overloading on solid rubber tyres. Perhaps the best way to explain this is to compare it with the behaviour of a rubber band under tension. When you stretch a strong properly vulcanized piece of rubber and then release it after a moderate strain it will snap back into its original shape. You can do this indefinitely and it will continue to "come back." But if you stretch it until it breaks it can never be restored to its original form. The damage has been done, and the rupture is permanent. In the same way you may within certain limits compress a piece of properly vulcanized rubber if is not confined, and when it is released it will spring back to its original shape and size. But what is this compression? In reality, it is only another way of stretching the rubber. In the case of the tyre, the force of the load merely tends to displace the gum immediately between it and the road. This rubber, in turn, pushes aside the adjacent particles. When the force of this distortion, now exerted in a lateral direction, becomes greater than the ability of the rubber to hold together, it will give way. The effect is exactly the same as stretching the band beyond its limit. In the case of the latter, however, the rupture extends completely across the section, and the band gives way with a snap, while in the tyre the separation may not be apparent because the broken parts are held in place by others not yet noticeably affected. Nevertheless, the strength of the tyre has been vitally impaired, and it will be but a comparatively short time before the tread separates entirely from the base, like the break in the rubber band,—hence the great danger of ruining solid tyres from once overloading them.



A Solid Tyre broken down by Overload.

Effects of Overload on the Brakes. The effect of overloading on the brakes should also be considered. This is direct and proportional to the degree to which it is practised. While the cargo of the vehicle does not bear down upon the brakes, it increases the momentum of the vehicle in proportion to its weight. The effects of momentum are seen in everyday life. An ocean liner, going at the rate of a few inches a second, may crush in a heavy pier if it strikes it head on. A long freight train, heavily loaded, often cannot be brought to rest within half a mile, but the same train empty, can be stopped in less than half that distance. Icebergs, drifting slowly, can crush the strongest vessel.

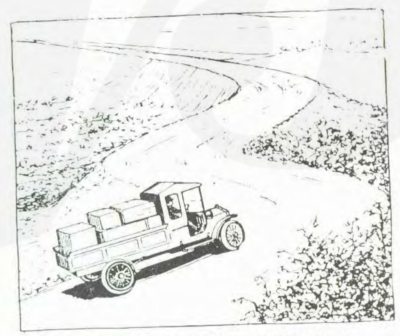
This same force is present in the motion of the overloaded vehicle. The brakes must be applied with greatly increased pressure in order to bring the vehicle to



Heavy Bodies are hard to Stop.

rest in a given distance. The skilful driver, in such a case, will allow a longer time in which to bring his vehicle to a standstill, but the average driver is used to seeing his vehicle slowed down at a certain rate, and if ordinary pressure on the brakes will not accomplish this, he will apply extraordinary pressure. Moreover, in emergencies the vehicle must be stopped *within a certain distance*, regardless of its momentum. There is nothing to do but to apply the brakes with grinding pressure, the effect of which is obvious.

Effects of Overload on the Transmission. The transmission does not escape the effect of overloading. As the load does not in any way rest upon the gears and shafts, it is not always easy to see how overloading can effect them. The answer is found in terms of the increased work which is put upon them. Obviously more effort is required to push a heavy wagon than a light one. In an overloaded vehicle, the increased effort is transmitted by the various teeth of the gears of the transmission and differential. These teeth are in effect so many levers, each one of which transmits the turning power of the engine to the driving wheels. Now, it may be said that the strain on the transmission is limited by the maximum torque or turning power of the motor, which is a fixed quantity and which is often reached without involving an overload, as when a vehicle with normal load is climbing a very steep grade. This is true, and the transmission of a vehicle is designed to withstand this maximum strain. However, under average conditions, these maximum strains are by no means frequent, just as steep grades are also not frequent. If a vehicle did nothing but climb a continuous steep grade, thus utilizing the maximum turning power of the motor, the transmission would have to be much more expensively designed and built, and with even these precautions against strain, it would be impossible to prevent a greatly increased wear and tear. An overload has much the same effect as making the vehicle climb a continual hill. While as a general thing it does not impose a sudden stress which the transmission cannot withstand, since this is prevented by the known limitations of the motor which creates the stress, it does cause an increased wear and tear of all gears, and shortens their life.



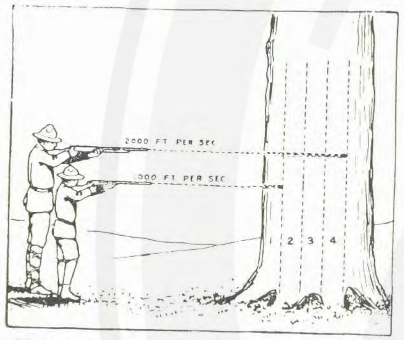
An Overloaded Truck Climbs a Perpetual Hill.

Again the vehicle driver complicates the question. He is accustomed to seeing the vehicle perform at a certain speed on a given grade, and selects his gears accordingly. But the overloaded truck will lag behind this performance, and a gear ratio which would carry along a normally loaded truck, will just fall short of sufficing for the overloaded vehicle. The driver, shifting his gears by instinct, will continually "crowd" the vehicle, using the gear ratio to which he is accustomed for a certain work.

Effects of Overload on the Motor. Finally, the effect of overloading on the motor is much like that on the transmission. When too great a strain is placed upon the motor it defends itself by ceasing to work altogether. While the motor resists being put to extraordinary exertions by going on a strike, it will submit to a wide range of tasks without complaining. However, additional effort is obtained only at the price of additional wear and tear. There is additional strain on the crankshaft and the connecting rods, the gas explosions are more violent, the motor is frequently run at a greater speed than would otherwise be required, and often the cooling surface of the radiator does not suffice for an increased and sustained demand, resulting in serious damage to the motor.

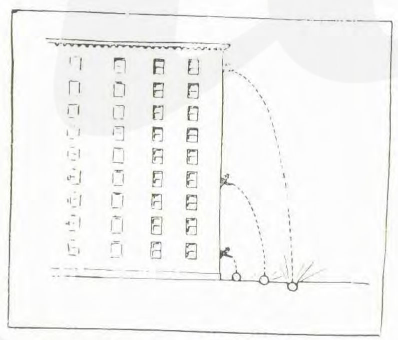
OVERSPEEDING

Hand in hand with Overloading is Overspeeding, an abuse as common and perhaps fully as disastrous to vehicle longevity. Overloading causes a strain, but overspeeding introduces a jolt. Overloading breaks down, but overspeeding smashes to pieces. While each abuse has its peculiar effect, and each alone is capable of ruining a vehicle, they often are seen together, and here they are irresistible.



Twice the Speed—Four Times the Blow.

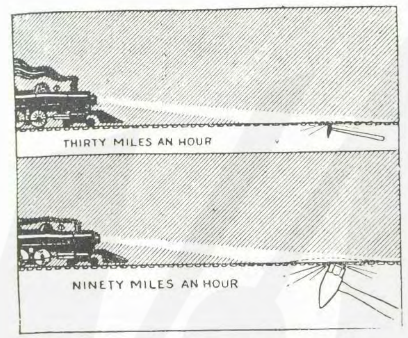
What is Speed? At the outset we are faced by this physical fact—that the energy of a moving body varies as the square of its velocity. Double the speed of a projectile and its capacity for delivering a blow is multiplied by four. Triple the speed, and the energy is increased nine times. If one bullet has twice the speed of another bullet of similar shape and weight, it will penetrate a target four times as deep. If you drop a weight out of a first-story window it will develop a certain velocity in its fall but you will have to carry it up three more stories and drop it out of the fourth-story window in order to give it twice the velocity at the time it strikes the ground. If an object falls from a ninth-story window it will be travelling when it strikes the ground at a rate of speed only three times as great as if it fell from the first-story, but the blow will be nine times as violent. And, similarly, if the speed of a vehicle is increased from ten to thirty miles an hour, each irregularity in the road will strike a blow nine times as violent as before.



Energy Varies as the Square of the Velocity.

Engineering problems which are simple when low speed is involved, become enormously difficult when an increased velocity must be reckoned with. This is the reason why railroad trains running at eighty or ninety miles an hour have not proved a practical success. At such enormous speeds the slightest irregularity in the rails, or the wheels of the locomotive, or any of the wheels of any of the coaches, strikes a sledge-hammer blow which is destructive of the strongest construction in train or road-bed.

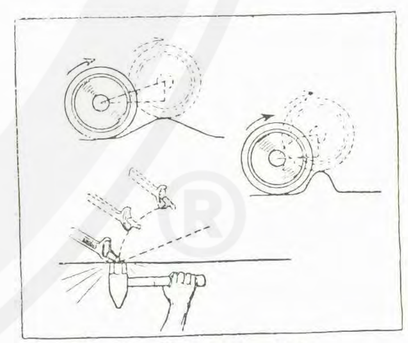
Some years ago a certain railroad put into effect on part of its system a train service involving a speed of ninety miles an hour. They experienced some trouble with broken rails and weakened road-bed. This was finally traced down to one locomotive, and it was found upon closer examination that one of the driving wheels was off centre by one-eighth of an inch, so that the whole wheel had an eccentric motion, being slightly low during one-quarter of its revolution and slightly high during the opposite quarter. If this irregularity were to be expressed graphically and drawn to scale it would be represented by a line so nearly level that the eye could hardly discern the gradual sag in it. At moderate speed it would have caused no trouble. At the speed of ninety miles an hour, however, this irregularity was passed over in a small fraction of a second, and delivered a sledge hammer blow to the rail, and back again through the locomotive.



Three Times the Speed—Nine Times the Blow.

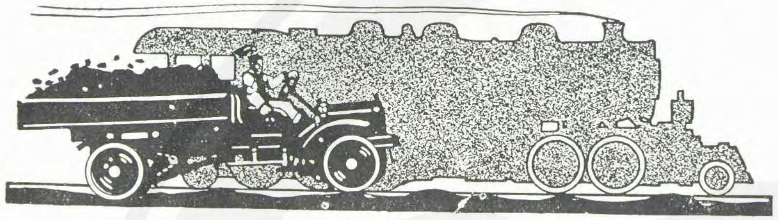
While the motor vehicle has an advantage over the locomotive in that its wheels are shod with rubber which absorbs small shocks and deadens larger ones, it is at a much greater disadvantage with respect to the road surface over which it travels. In comparison with the steel rail the average road is literally a series of hills and valleys.

Let us consider what happens when a vehicle strikes a road hump when travelling at 20 miles an hour. We will take for example an irregularity measuring roughly 6 inches on its slope and 3 inches in perpendicular height. At 20 miles an hour the vehicle wheel will pass from level ground to the summit of the hump in 1/44th part of a second. The wheel and axle are thrown upwards at a velocity of nearly 10 feet per second. This, however, is a gentle rise in comparison with that shown at the right. Here the elevation of the wheel and axle is almost instantaneous, and the force of the blow is very much greater.



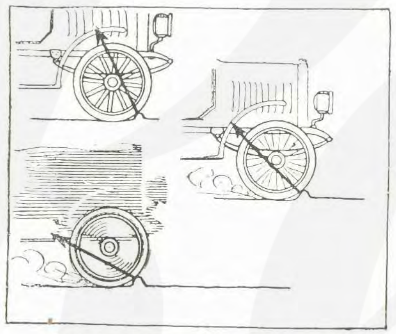
The Path of the Axle.

SPEED—AND THE DIRECTION OF THE BLOW. Not only does increase of speed greatly increase the violence of road shocks, but it changes their direction. A wheel passing slowly over



The Road v. The Steel Rail.

an elevation delivers and receives a shock in very nearly a vertical direction, for the forward motion of the vehicle is small in comparison with its weight, which acts downward. As the speed is increased the vehicle wheel in addition to bearing down on road obstacles, strikes a horizontal blow at them, so that the reaction of the road thrusts backwards in a diagonal direction through the wheel and springs. Such a shock instead of meeting the full cushioning effect of the springs, passes to some degree lengthwise through them and strikes a dead blow on the axles and vehicle mechanism.

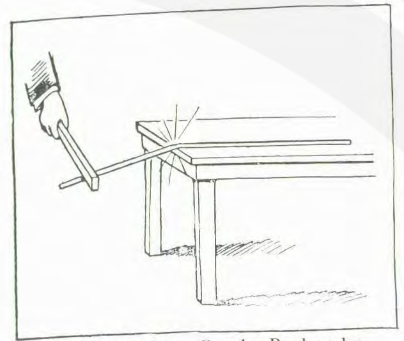


Speed increases the Horizontal Component of Road Shocks.

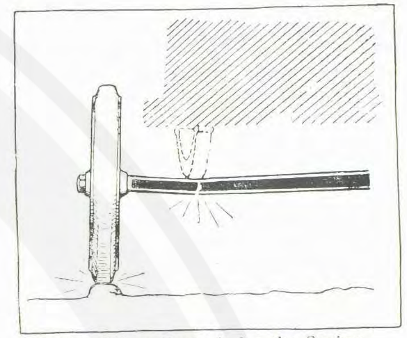
SPEED—AND THE INERTIA OF MATTER. While increasing speed greatly increases the force of blows from road irregularities, it has another effect which it seems impossible to guard against by ordinary measures. This is the effect of suddenness of shock, due to the inertia of matter.

A few homely examples will serve to illustrate this fact. A door standing ajar on well oiled hinges can be pushed to by a gentle shove, but if you hit it a sharp blow with your fist the door will remain practically motionless while your knuckles will be severely bruised. If a rod is laid upon a desk so that part of it overhangs, and is struck a sharp blow on its projecting end, it will bend and perhaps break, even though very gentle pressure at the same point would have been sufficient to lift the heavier end. The force is applied so suddenly that there is not time for it to act throughout the whole mass of the object.

The axle of a vehicle may be aptly compared to the rod. That part of the axle to which the wheel is attached may be compared to the projecting end of the rod, since it is at that point that the blow is delivered. The rest of the axle corresponds to that part of the rod lying on the desk, because it is comparatively free to move, being held down by flexible springs which yield readily to gradual pressure. Going at moderate speed the wheel rises and falls, taking the whole axle with it, but if excessive speed is practised a blow may come so fast that there is



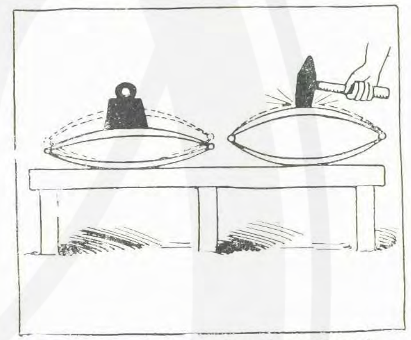
Yielding Objects Can be Broken by Sudden Shocks.



Not Time Enough for the Spring to Act.

not *time* to distribute it along the axle and through the spring. The axle suffers a sudden strain, and if it has been weakened by repeated strains, may even snap off, precisely as the rod in the experiment.

It may seem strange to the average person to learn that this same thing is true of so responsive a device as a steel spring. We know that there is an enormous amount of energy in a hammer blow, because we can drive a nail with a few sharp taps of a hammer whereas a man may bear with all his weight on the same nail without making it enter the wood a particle. Tests by spring manufacturers, however, show that a sharp or sudden blow with a hammer on a spring produces practically no deflection whatever.

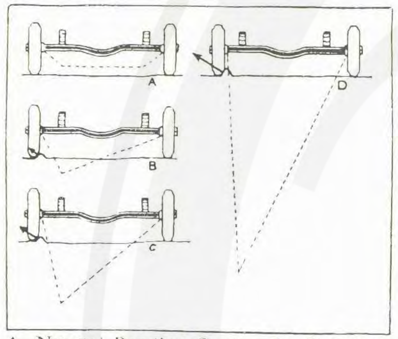


Even a Steel Spring Requires Time in which to Yield.

SPEED—AND THE CAUSE OF VIBRATION. From this we may discover the reason for the most destructive effect of speed,—namely, vibration. Anyone who has ridden in a vehicle knows that when the speed is increased the vibration becomes very severe. This is due not only to the greater violence of the road shocks, but to the fact that the vehicle springs and, in fact, all parts of the vehicle cannot absorb the blows as fast as they are delivered, but receive them rigidly and transmit them unsoftened to neighbouring members.

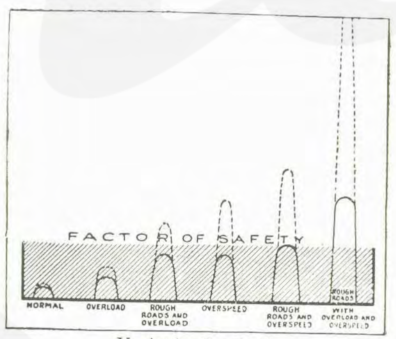
There is no question that vibration is the most serious agent of ruin to which the commercial vehicle is subject. It is a multiplication of the dreaded hammer blow, the most destructive force which can attack machinery. It begins at the axles and fills them with fatigue, which acts upon them much as a disease. It attacks the springs, which are tuned for heavier and slower shocks. It climbs through the springs into the mechanism of the truck and there it works its worst havoc. It attacks every moving part. It seizes with special delight on loose parts, because looseness means play, and play means room to swing the hammer and greatly increase the hammer blow. It is everywhere. It is as pervasive as rust. It skips nothing, but brings about a general deterioration in every piece of metal. And it is caused by speed—blows that come *too* fast for the vehicle to absorb. Thus a vehicle driver who constantly overspeeds his vehicle, even though he does it so skilfully as to avoid direct breaking strains, cannot escape the consequence, for he is bringing about a general deterioration, a premature old age of all the parts, so that the time may soon come when it is possible to say : "Last month the vehicle worked perfectly; to-day it is beyond repair."

SPEED UPSETS CAREFUL CALCULATIONS. This discussion may serve to give some hint of the many variables which enter into the problem of vehicle design when the factor of speed is introduced. Vehicle manufacturers have made the point that a vehicle correctly designed for use in New York or California might be entirely too weak for service in parts of Colorado or New Mexico. This is due not to the factor of load but to the factor of speed. A speed of ten miles an hour might be considered low on some roads, and might be reckless overspeeding on others. A speed of double or triple the normal might be practiced with safety on a boulevard, while a speed of five miles an hour on an uneven road surface in connection with an overload might wreck the vehicle. If the tyres are allowed to wear down so that there is very little depth of cushion between the wheel and the road, a speed of six miles an hour may cause more serious shocks to the vehicle than a speed of twelve miles an hour on new tyres.



A—Normal Bending Strain. B—Plus Road Shock on Inside of Wheel. C—Plus Overload. D—Plus Overspeed.

THE DIFFICULT PROBLEM OF VEHICLE DESIGN. The problem of the commercial vehicle engineer is immensely difficult. The bridge builder knows his maximum load; the locomotive designer reckons with smooth rails and a definite speed; the erector of skyscrapers has his weight and wind strains within reasonably certain bounds. But the motor vehicle builder stands with reference to his problem as a man surrounded by mountain peaks, some of which pierce the clouds. The commercial vehicle, equipped with solid tyres and relatively stiff springs, travelling over the roads of the present may encounter strains ranging from the normal to ten, twenty, or even thirty times the normal. A vehicle can be smashed to bits in a stretch of road only twice its length. The terrific impact which strikes it under certain conditions can only be compared to the force of a projectile. These strains can be largely avoided by avoiding overload, which breaks a vehicle down, and overspeed which smashes it to pieces. Both are harmful, both cause strains which test severely the factor of safety of the vehicle, but taken together they represent more than a severe strain, they constitute an accident.

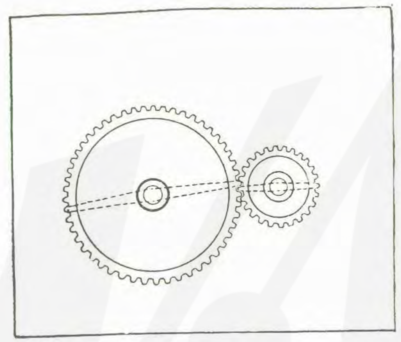


Variable Strains!

ERRORS IN DRIVING

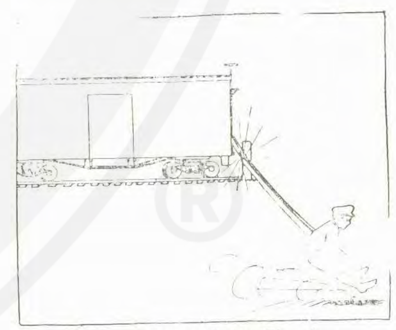
Besides overloading and overspeeding, there is another important cause of vehicle breakdown. This is bad driving, especially with reference to the selection of gears and management of the clutch. The principles underlying gear selection are rather widely understood because of familiarity with pleasure car practice in this respect. Most vehicle manufacturers publish excellent instruction books on this subject, which are available upon the request of the vehicle owner.

THE FUNCTION OF THE GEARS. The function of the change-speed gears is that of levers, used to multiply the power of the engine. The motor is an infant with respect to the load which it must move, and is no more capable of starting a heavy vehicle under its own power than a boy is capable of moving a freight car. A boy, however, by means of a long lever, can start the car in motion and after it is in motion he can use a shorter lever and finally dispense with levers altogether, keeping the heavy freight car moving by his own exertions unaided by mechanical power.


Gears are Levers in Circular Form.

Gears are levers made in circular form for the sake of compactness. Proper selection of gears consists in choosing the right leverage for the work in hand. The skilful driver knows by the behaviour of the engine whether or not he has selected the proper levers for the task. On the other hand, more than one driver has attempted to start his vehicle on high speed gear.

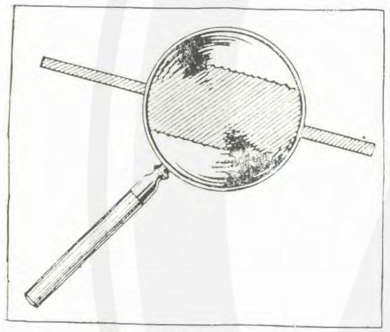
MANAGEMENT OF THE CLUTCH. Inseparably bound to this problem is the proper management of the clutch. Let us return to the example of the boy and the freight car. If the boy selects a lever too short to move the car he may struggle with it indefinitely without results. If, however, he runs a few yards and hurls his weight against the lever, two things may happen,—the car may start forward with a lurch, and—the lever may break. The motor of the vehicle may be compared to the boy who gets up momentum by running and then throws his weight against the lever. It is the management of the clutch which determines whether this strain shall be sudden or gradual. If the clutch is thrown in sharply the full momentum of the engine with its heavy fly wheel is brought up suddenly against the lever or train of levers in the transmission. *Even when these levers* or gears are set in their proper ratio the impact of the engine is so sudden that there is scarcely time


"Throwing in" the Clutch.

for them to act. The engine stalls, or the clutch finally slips, but in the meantime the gear teeth are strained, but not so severely as the driving shaft, which is subjected to an enormous tortional stress, as also the crankshaft of the engine. These strains are even more severe if the wrong gears are in mesh. The more serious fault, however, is the sudden engagement of the clutch, which does not *allow time* for the engine to stall before the impact of its momentum takes full effect on the transmission. This is the crux of the driving problem. It is possible for an unskilful driver to wreck the driving mechanism of a vehicle in a single forenoon. On the other hand, proper management of the clutch and proper selection of the gears prolong the life of the vehicle almost indefinitely.

LUBRICATION

A chapter instead of a paragraph might be written on the necessity of lubrication. It is possible to *burn out* a vehicle in ten minutes' time by running it without oil. Steel, however polished and smooth to the eye and touch, has in reality a rough surface. Under the microscope it shows a jagged outline. If two pieces of steel are rubbed together, the minute edges engage and tear each other, and as they are destroyed new edges appear, so that the process of destruction goes on rapidly and without interruption. Oil fills up these microscopic depressions and further places a film between rubbing surfaces which actually prevents them from *coming into contact*. Most vehicle manufacturers provide charts and directions which describe fully what grade of oil to use, where and when to apply it and in what quantities. Neglect of this elementary care of the motor vehicle brings prompt and complete destruction.



Why Oil is Needed.

THE HUMAN EQUATION

Even though the vehicle owner, however, understands thoroughly these various mechanical principles which bear upon the length of life of his vehicle and is anxious to apply them intelligently, he is still confronted with the human equation which he must solve. This is the vehicle driver. How to make him understand what forces are at work when the loaded vehicle is in motion, and how to persuade him to hold these forces in proper control, is a problem not in physics but human nature. Various expedients have been tried. Perhaps the most successful is the bonus plan, by which the driver is made, as it were, a partner in the special business of keeping down the expense of vehicle maintenance. Records

are kept of the cost of repairs, tyres, etc., and based upon the showing at the end of a specified term, a bonus is paid to the driver. This plan has been tried out by several large vehicle owners here and abroad and has met with considerable success. Another plan has been to devote a whole day to training the new or inefficient driver in the art of engaging and disengaging the clutch, starting, stopping, and shifting gears under all conditions of load, speed and grade. A new and interesting suggestion has come from a New York merchant, who has replaced young and headstrong drivers with grey-haired men. The caution and judgment which these men bring to their task is regarded as the most valuable qualification the vehicle driver can possess. Vehicle manufacturers are giving more and more attention to the driver problem, and some of the larger companies have established schools to which drivers and traffic superintendents can go and learn the practical as well as the theoretical side of this art.

The Money Value of Additional Years. We have attempted in these pages to point out the more common abuses of the commercial vehicle, by the avoidance of which its life may be greatly prolonged. It must not be supposed that, because we have collected so many danger signals and displayed them together in this article, we believe the motor vehicle a questionable investment. The wonderful growth of the industry in the past few years disposes at once of this idea. Regarding it purely in the light of an investment, however, we would emphasize the fact that its value may be destroyed within a comparatively short time through these abuses whereas its productive life may be prolonged indefinitely if they are avoided. From long and extensive contact with it under all conditions, we believe the modern, well-built vehicle is one of the most valuable instruments for building business, cutting costs, and meeting competition.

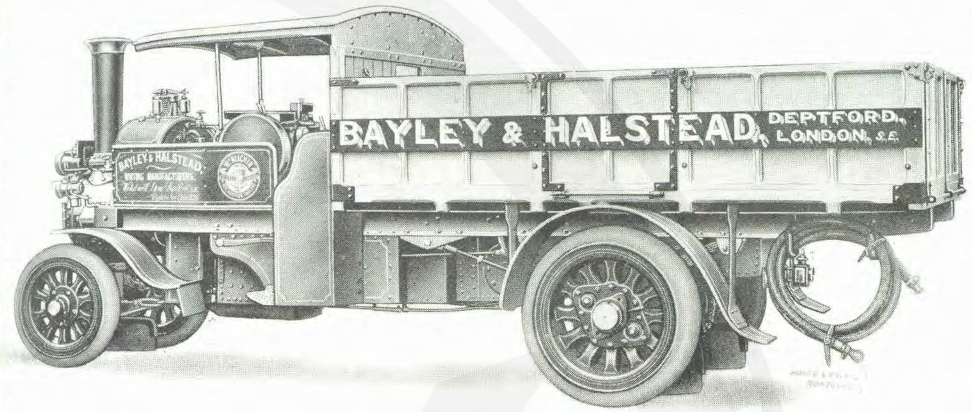
ALBION MOTOR CAR CO., Limited,
Scotstoun, Glasgow.

SPECIFICATIONS

Models	20 H.P.	32 H.P. B.W.	32 H.P. B.B.	32 H.P. B.P.
Capacity	D.B. 30-cwt., D.C. or 15-seater, D.D. & 30-cwt. handtipper	50-cwts.	60-cwts.	60-cwts.
Drive	Bevel gear	Chain	Chain	Chain
Engine (R.A.C.)	19·6 H.P.	32.4 H.P.	32.4 H.P.	32.4 H.P.
Cylinders	4	4	4	4
Bore	$3\frac{1}{2}$ in. (89 m/m)	$4\frac{1}{2}''$ (114 m/m)	$4\frac{1}{2}''$	$4\frac{1}{3}''$
Stroke	$5\frac{1}{2}$ in. (140 m/m)	5″ (127 m/m)	5″	5″
Wheel Base	11′	13′ 1″	13′ 1″	14′ 5″
Tread Front	5′ 1″	5′ 10″	5′ 10″	5′ 10″
Tread Rear	$4'\ 9\frac{1}{2}''$	5′ 6″	5′ 6″	5′ 6″
Tyres Front	860 × 90 m/m single solid	870 × 100 m/m single solid	870 × 100 m/m single solid	870 × 100 m/m single solid
Tyres Rear	860 × 90 m/m twin solids	870 × 110 m/m twin solids	880 × 120 m/m twin solids	880 × 120 m/m twin solid
Frame	Channel section steel	Channel section steel	Channel section steel	Channel section steel
Front Axle	H-section	Butler type built up axle	Butler type built up axle	Butler type built up axle
Rear Axle	Live axle	Solid fixed axle	Solid fixed axle	Solid fixed axle
Springs Front	Semi-elliptic	Semi-ellipticle anchored front, slipper at rear		
Springs Rear	Semi-elliptic	Semi-ellipticle slipper, front and rear	Semi-ellipticle, slippers front and rear.	
Carburettor	Automatic	Automatic (Albion-Zenith).		
Cooling System	Albion-Murray Patent combined pump and fan.			
Oiling	Mechanical Lubricator.	Albion-Murray Patent mechanical lubricator		
Ignition	H.T. Magneto.			
Control	Hand throttle and ignition control	Hand throttle and ignition control and foot accelerator throttle control.		
Transmission	Three speed gear box			
Brakes	Foot acting on drum fixed to gear box, hand internal expanding type.			
Steering Gear	Worm and segments.			
Equipment	Useful tools, lamps (side and tail), horn, etc.			
Price	On application.			

Tyre Equipment—Goodrich Tyres furnished when specified.

Continued on page 80.

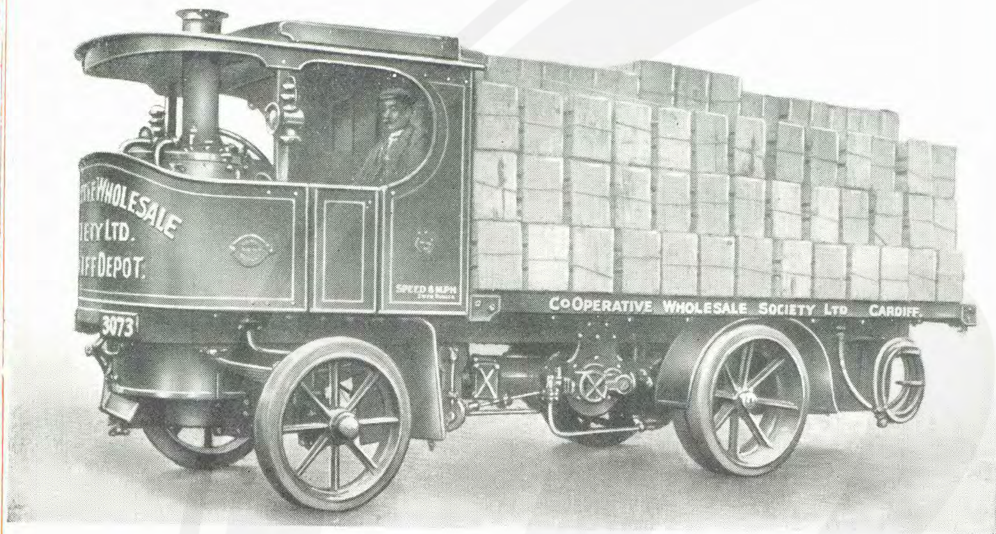


WM. ALLCHIN, Limited,
Globe Works, Northampton.

SPECIFICATIONS

Models			
Capacity (tons)	3-tons	4-tons	5-tons
Horse Power	28	30	32
Bore	H.P. $3\frac{5}{8}''$, L.P. $5\frac{3}{4}''$	H.P. 4″, L.P. $6\frac{1}{2}''$	H.P. $4\frac{3}{8}''$, L.P. $7\frac{1}{4}''$
Stroke	6″	7″	8″
Wheel Base	12′ 6″	13′ 0″	13′ 9″ or 14′ 3″
Tread Front	4′ 3″	4′ 3″	4′ 7″
Tread Rear	6′ 9″	6′ 11″	7′ 1″
Tyres Front	Single 850 × 140 m/m or 140 for 680		Single 850 × 160 m/m or 160 for 670
Tyres Rear	Twin 1030 × 140 m/m or 140 for 850		Twin 1050 × 160 m/m or 160 for 850
Frame	Channel girders		Channel girders
Front Axle	Special steel forging		Special steel forging
Rear Axle	Rolled Nickel Steel		Rolled Nickel Steel
Springs	Semi-elliptic, leaves		Semi-elliptic, leaves
Transmission	From crankshaft to fixed stud shaft, thence by roller chain to compensating gear on back axle.		From crankshaft to fixed stud shaft, thence by roller chain to compensating gear on back axle.
Control	By regulator valve, double high pressure gear and reversing lever.		By regulator valve, double high pressure gear and reversing lever,
Steering	By hand wheel to worm and wheel with chains to front axle.		By hand wheel to worm and wheel with chains to front axle.
Brakes	Patent double contracting foot, pedal brakes which are adjustable.		Patent double contracting foot, pedal brakes which are adjustable.
Prices	On application.		

Tyre Equipment—Goodrich Tyres fitted when specified.



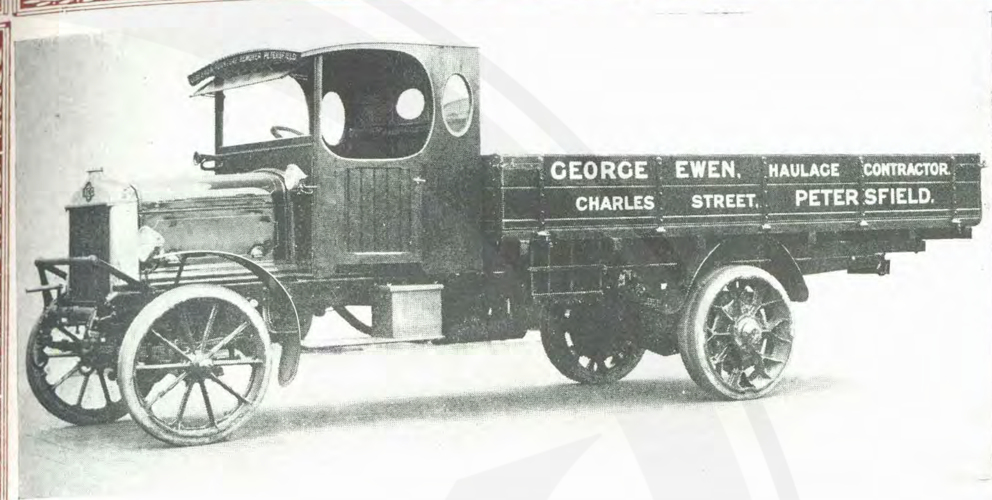
THE "ATKINSON" (STEAM) COMMERCIAL VEHICLES
ATKINSON & CO.,
Frenchwood Works, Preston.

SPECIFICATIONS

Models	6 tons (10-tons with trailer)	4 tons
Capacity	6-tons (10-tons with trailer)	4-tons
Horse Power	40	35
Wheel Base	10' 6"	10' 0"
Tread Front	5' 5"	5' 5"
Tread Rear	5' 0"	5' 0"
Tyres Front	970 × 160 or 160 for 771 singles	900 × 160 or 160 for 720 singles
Tyres Rear	1070 × 160 or 160 for 870 twin	950 × 140 or 140 for 771 twin
Frame	British standard channels.	
Front Axle	Cold drawn tube, forged steel.	
Rear Axle	Tempered steel, live axle.	
Springs	Extra long, half-elliptic.	
Transmission	Single chain; no gear box.	
Control	By steam throttle valve and engine reversing lever.	
Brakes	Hand, steam, or combination of both.	
Steering	Improved Ackermann (screw and nut).	
Prices	On application.	

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—*Boiler:* Vertical, with horizontally inclined straight water tubes and with superheater; no screwed tubes, coke fired underneath footplate, top portion of outer shell easily removable for cleaning interior. *Engine:* Simple, self-oiling, slow speed, enclosed, hard steel ball valves for high temperatures, operated by cams under forced lubrication. *Transmission:* Simplest possible, sprocket on crankshaft, roller chain and chain wheel on rear axle. *General:* Simple, solid, get-at-able in every part, easy driving, stoking, oiling and cleaning, positive control by one man, comfortable cab free from dust, draughts, smoke or flames, long springs, long wheel base, smooth and stable running.



ASSOCIATED EQUIPMENT CO., Limited,
Walthamstow, London, E.17

SPECIFICATION

Model	YB or YC
Capacity	3 to 4-tons (5 tons if fitted with heavy type springs).
Drive	Worm driven rear axle
Chassis Weight	3-tons, 8-cwt.
Engine	45 HP.
Bore	5"
Stroke	6"
Wheel Base	14' 2⅜"
Tread Front	5' 8"
Tread Rear	5' 8"
Tyres Front	1010 × 120 single or 120 for 850
Tyres Rear	1010 × 120 twin or 120 for 850
Frame	Channel section, pressing in high tensile steel
Front Axle	H-section stamping
Rear Axle	Continuous casting type, with steel tubes pressed in
Springs Front	Semi-elliptic
Springs Rear	Semi-elliptic
Carburettor	Approved
Cooling System	Pump circulation
Oiling System	Forced feed
Ignition	Magneto
Control	Hand with foot accelerator
Clutch	Cone
Transmission	4-speed and reverse spur gear box
Brakes	Internal expanding. Both hand and foot operate on drums in rear wheels.
Steering Gear	Worm and nut type steering box.
Equipment	Full kit of tools, etc.
Prices	£1,300 chassis with tyres

Tyre Equipment—Goodrich tyres furnished when specified.

ASSOCIATED EQUIPMENT CO., Limited, Walthamstow, London, E.17

SPECIFICATION

Model	A.E.C. "K" Type.
Capacity	3½-tons (including body)
Drive	Undertype worm
Chassis Weight	2-tons 5-cwt.
Engine (R.A.C.)	24.5 H.P. developing 30 B.H.P. at 1050 R.P.M.
Bore	100 m/m
Stroke	140 m/m
Wheel Base	14′ 2¼″
Tread Front	5′ 8″ (at road contact)
Tread Rear	5′ 10″
Tyres Front	Solid 920 m/m × 100 m/m fitting 771 m/m std. rims.
Tyres Rear	Twin ditto
Frame	Flitch type nickel steel outer plates, ash fillings.
Front Axle	H-section steel stamping.
Rear Axle	Centre steel casting with extension tubes pressed in.
Springs Front	Semi-elliptical.
Springs Rear	Semi-elliptical, self-compensating for varying loads.
Carburettor	Zenith.
Cooling System	Water pump circulation.
Oiling System	Pump and trough lubrication system.
Ignition	H.T. magneto.
Control	Foot accelerator.
Clutch	Dry multiple plate type.
Transmission	3-speed chain drive gear box; dog clutch engagement.
Brakes	Foot and hand operating on separate drums in rear wheels.
Steering Gear	Worm and nut type.
Equipment	Tool kit; electric lighting set fitted if specified.
Prices	On application.

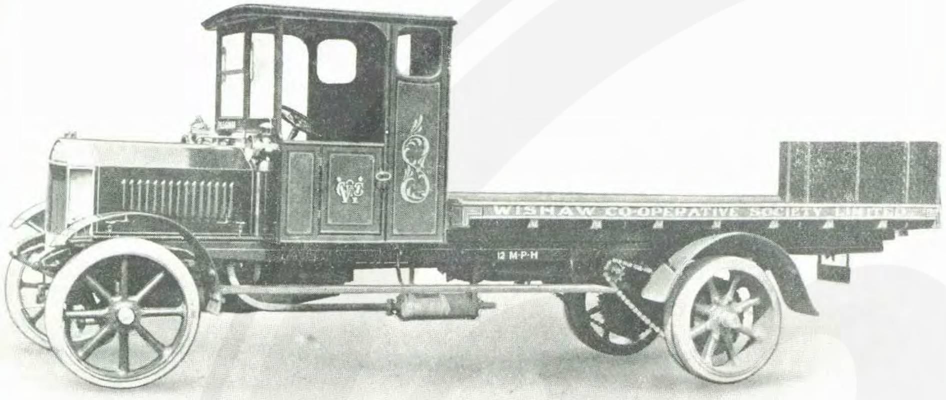
Tyre Equipment—Goodrich Tyres furnished when specified.

THE AUSTIN MOTOR CO., Limited, Northfield, Birmingham.

SPECIFICATION

Model	1½ tonner
Capacity	30 cwt.
Drive	Overhead worm
Chassis Weight	34 cwt.
Engine	22.4 h.p. R.A.C. rating
Cylinders	Four
Bore	3¾″
Stroke	5″
Wheel Base	10′ 6″
Tyres	Cushion
Frame	Pressed steel, channel section
Front Axle	I-section, special swivels and swivel arms
Rear Axle	Full floating
Springs, Front	Semi-elliptic, 3′ long
Springs, Rear	Semi-elliptic, 4′ long
Carburettor	Automatic
Cooling System	Centrifugal pump and gilled tube radiator
Oiling System	Gear wheel pump
Ignition	High tension magneto
Control	Central
Clutch	Single plate
Brakes	Pedal-operated on countershaft, hand operated on rear wheels.
Steering Gear	Worm and wheel
Equipment	Driver's cab, screen and side curtains, light luggage rail. Bonnet and front mudguards. Two acetylene head lamps, two side and one tail lamps, speedometer, mechanical horn and special tool kit.
Price	On application.

Special Note—Electric lighting and starting equipment, together or separately, can be fitted as extras.



THE "BELHAVEN" (PETROL) COMMERCIAL VEHICLES
BELHAVEN LIMITED.
Belhaven Works, Wishaw.

SPECIFICATION

Model	C
Capacity	3-ton
Drive	Chain
Chassis Weight	2 tons 5 cwt
Engine (R.A.C.)	30/35 HP
Cylinders	4
Bore	110
Stroke	140
Wheel Base	14′ 0″
Tread Front	5′ 0″
Tread Rear	5′ 0″
Tyres Front	Single 900 × 120 or 120 for 720
Tyres Rear	Twin 900 × 120 or 120 for 720
Frame	Pressed steel.
Front Axle	Special steel forged.
Rear Axle	Rolled nickel steel.
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Zenith.
Cooling System	Pump and fan.
Oiling System	Forced feed.
Ignition	High tens'on magneto.
Control	Throttle and ignition levers on steering column and foot accelerator.
Clutch	Cone.
Transmission	Sliding dog clutches. Three speeds forward and one reverse.
Brakes	Foot external contracting, hand internal expanding.
Steering Gear	Worm and segment.
Equipment	Useful Tools, etc.
Prices	On application.

Tyre Equipment—Goodrich Tyres fitted when specified.

Special Note—Reliability, low running cost, governed engine. Capacity rating is for useful loads.

The "CALEDON" CHASSIS (PETROL) COMMERCIAL VEHICLES
CALEDON MOTORS, Limited,
98, Duke Street, Glasgow.

SPECIFICATIONS

Models	B	C	D	E
Capacity	3-tons	3½-tons	4-tons	Special passenger type
Horse Power	32	32	40	40
Bore	110 m/m	110 m/m	120 m/m	120 m/m
Stroke	140 m/m	140 m/m	140 m/m	140 m/m
Wheel Base	13′ 3″	13′ 3″	14′ 3″	14′ 3″
Tread Front	5′ 6″	5′ 6″	5′ 6″	5′ 6″
Tread Rear	5′ 2″	5′ 2″	5′ 2″	5′ 2″
Tyres Front	920 × 110 or 110 for 771	930 × 120 or 120 for 771	930 × 120 or 120 for 771	930 × 120 or 120 for 771
Tyres Rear	920 × 110 or 110 for 771	930 × 120 or 120 for 771	1010 × 120 or 120 for 850	1010 × 120 or 120 for 850
Frame	Pressed high tensile steel 6″ deep.			
Front Axle	Deep-forged I-beam.			
Rear Axle	Nickel chrome steel with floating bushes in hubs.			Worm driven live axle
Springs	Semi-elliptic			
Carburettor	Claudel-Hobson			
Cooling System	Thermo-syphon			
Ignition	High-tension magneto.			
Control	Throttle on top steering column. Ignition on dash.			
Clutch	Ferodo-faced cone.			
Transmission	Four speed and reverse.			
Drive	Chain	Chain	Chain	Worm
Brakes	Foot brake on driving bevel spindle.			Hand brake to drum on rear wheels. All Ferodo lined
Steering Gear	Irrevers'ble worm and segment.			
Prices	On application.			

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—Specially designed for reliability and economy. Accessibility and inexpensive renewal of wearing parts a noticeable feature, particularly appealing to the Colonial and foreign markets.

THE "CHURCHILL" PETROL COMMERCIAL VEHICLES

Manufactured by

DURHAM, CHURCHILL & CO.

Chambers Lane, Grimesthorpe, Sheffield.

SPECIFICATION

Models	1 at present
Capacity	3-tons
Drive	Chain
Chassis Weight	3-tons 2-cwts
Engine R A.C.,	45 h.p.
Cylinders	4 in. pairs
Bore	5"
Stroke	6"
Wheel Base	14' 9"
Tread Front	5' 4½"
Tread Rear	5' 4½"
Tyres Front	830 × 120 or 120 for 670
Tyres Rear	930 × 110 or 110 for 770
Frame	Steel channel 5" × 2½" section.
Front Axle	Butler Patent H-section.
Rear Axle	3% Nickel axle, steel 3½" dia.
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Claudel-Hobson.
Cooling System	Pump.
Oiling System	Forced feed
Ignition	H.T. Simms magneto.
Control	Ignition and throttle, also foot accelerator.
Clutch	Metal to metal (Durham-Churchill Patent).
Transmission	4-speed "Churchill" Gear box through bevel differential to chain drive.
Brakes	Side brake, internal expanding, Ferodo lined, operating on wheel drums. Foot brake operating on drum at rear of gear box.
Steering Gear	Irreversible worm and sector.
Price	On application.

Tyre Equipment—Goodrich Tyres furnished when specified.

THE "CLAYTON" (STEAM) COMMERCIAL VEHICLES

CLAYTON WAGONS, Ltd.,

Titanic Works, Lincoln.

SPECIFICATION

Capacity	5-tons
Horse Power	35
Bore	4" and 7¼"
Stroke	7"
Wheel Base	14' 2"
Tread Front	4' 3" (4' 0" track)
Tread Rear	6' 11½" (5' 10½" track)
Tyres Front	900 × 160 or 160 for 720
Tyres Rear	1050 × 160 twin, or 160 for 850
Frame	Rolled channel
Front Axle	36-ton hammered steel
Rear Axle	40-ton steel
Springs	Laminated plate type
Transmission	From crankshaft to countershaft, thence by chain to compensating gear on rear axle.
Control	Reversing gear, stop and double high-pressure valve.
Brakes	Internally expanding, one in each rear wheel.
Steering Gear	Chain operated by worm gear.
Prices	On application.

Tyre Equipment—Goodrich Tyres furnished when specified.

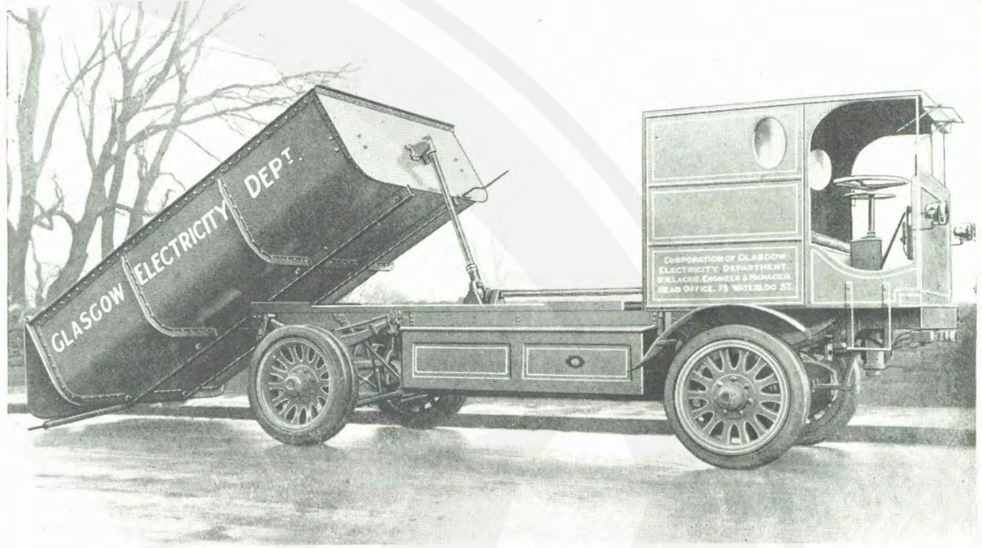
Special Note—Boiler, Locomotive, working pressure 200-lbs. per square inch; Engine, compound, double high-pressure, over type.

THE "COMMER CAR" (PETROL) COMMERCIAL VEHICLES
COMMERCIAL CARS, Limited,
Luton.

SPECIFICATIONS

Models	2G	RC	CC	3P
Capacity	2-tons	3½-tons	5-tons	30 Pass.
Drive	Worm	Chain	Chain	Worm
Chassis Weight	2-tons	2 ton 18 cwt.	3 tons 12 cwt.	2 tons 15 cwt.
Engine (R.A.C.)	25	32	36	40
Bore	100	110	115	115
Stroke	120	140	140	140
Wheel Base	11′ 0″	12′ 9″	12′ 6″	14′ 3″
Tread Front	5′ 6″	5″ 6″	5′ 6¼″	5′ 8″
Tread Rear	5′ 0″	5′ 8″	6′ 1½″	5′ 6½″
Tyres Front	870 × 100 or 100 for 720	930 × 120 or 120 for 771	880 × 120 or 120 for 720	930 × 120 or 120 for 771
Tyres Rear (twin)	870 × 100 or 100 for 720 twin	930 × 120 or 120 for 771	1030 × 140 or 140 for 850	1010 × 120 or 120 for 850
Frame	Pressed steel	Rolled steel	Pressed steel	Pressed steel
Front Axle	H-section	H-section	H-section	H-section
Rear Axle	Live	Solid	Solid	Live
Springs Front	Semi-elliptic, all types.			
Springs Rear	Semi-elliptic, all types.			
Carburettor	Claudel, all types.			
Cooling System	Thermo-syphon, all types.			
Oiling System	Automatic splash.			
Ignition	H.T. magneto, all types.			
Control	Gate	Special	Special	Gate
Clutch	Cone, all types			
Transmission	Worm	Chain	Chain	Worm
Brakes	2	2	2	2
Steering Gear	Irreversible type, worm and segment.			
Equipment	Useful tools.			
Prices	On application.			

Tyre Equipment—Goodrich Tyres fitted when specified.



C. T. (ELECTRIC) COMMERCIAL VEHICLES.
Manufactured by
ELECTROMOBILE (LEEDS) Ltd.,
Prospect Works, Otley.

SPECIFICATIONS

Capacity	½-ton	1-ton	2-tons	3½-tons	5-tons
Drive	On two rear wheels; patented enclosed concentric transmission			Patented enclosed internal gear transmission on all four wheels	
Chassis Weight	32 cwts.	36 cwts.	2 tons 11 cwts.	3 tons 18 cwts.	4 tons 7 cwts.
Wheel Base	8′ 2″	8′ 2″	10′	11′	11′
Tread Front	5′ 3″	5′ 3″	66″	66″	66″
Tread Rear	5′ 3″	5′ 3″	66″	66″	66″
*Tyres Front (Single)	75 m/m	90 m/m	100 m/m	140 m/m	160 m/m
*Tyres Rear (Single)	90 m/m	100 m/m	90 m/m (dual)	100 m/m (dual)	120 m/m (dual)
	* (These tyres are all 771 m/m fitting.)				
Frame	Rolled steel rivetted			Rolled steel rivetted	
Speed	15	14	13	12	10
Miles	40-50	35-40	30-40	30	25
Front Axle	Rectangular box section tubing, nickel steel swivels			Direct drive to all four wheels; all units alike and interchangeable	
Rear Axle	Direct drive to rear wheels			Direct drive to rear wheels.	
Springs Front	Half elliptic			Half elliptic	
Springs Rear	Half elliptic			Half elliptic	
Battery Equipment	42 cells lead, 60 cells alkaline type; capacity to suit service requirements.				
Motor	Series traction type specially designed for our transmission, large overload capacity.				
Steering Gear	Worm and sector in gear case.				
Transmission	Enclosed gears			Enclosed gears	
Brakes	Expanding type on rear wheels and Electric			Contracting on four wheels and Electric	
Equipment	As required.				
Prices	On application.				

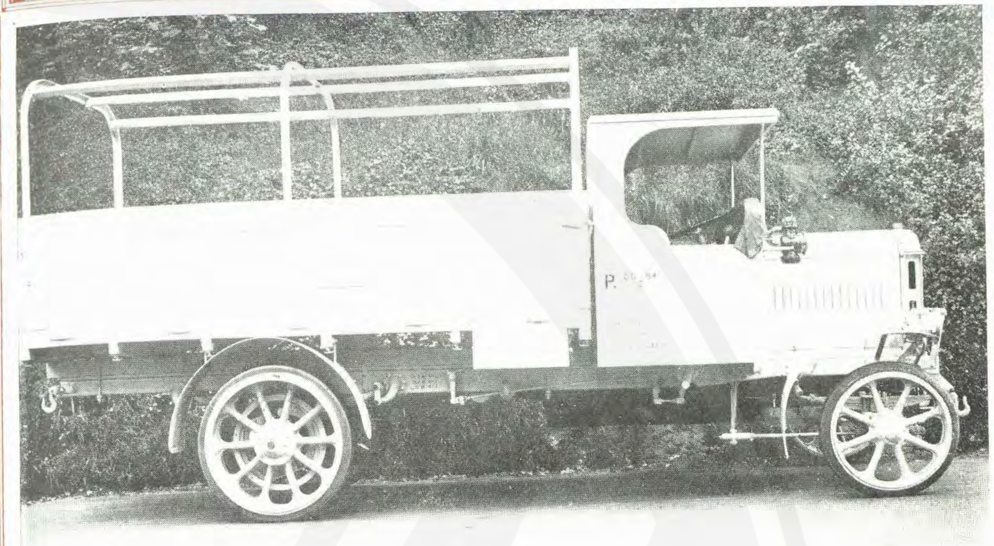
Tyre Equipment—Goodrich Tyres furnished when specified.

THE DAIMLER CO., Limited,
Daimler Works, Coventry.

SPECIFICATIONS

Models	CJ	CK
Capacity	2/3-tons	2/3-tons
Drive	Worm	Worm
Chassis Weight	49½-cwt.	50½-cwt.
Engine	4-cylinder, 22.4 H.P.	4-cylinder, 22.4 H.P.
Bore	95 m/m	95 m/m
Stroke	140 m/m	140 m/m
Wheel Base	11' 6"	13' 6"
Tread Front	5' 3"	5' 3"
Tread Rear	5' 3"	5' 3"
Tyres Front	920×100 or 100 for 771 m/m.	920×100 or 100 for 771 m/m.
Tyres Rear	Twin 920×100 or 100 for 771 m/m.	Twin 920×100 or 100 for 771 m/m.
Frame	Flitch plate	Flitch plate
Front Axle	I-section, with wheels on bronze bearings	I-section, with wheels on bronze bearings
Rear Axle	Full floating type	Full floating type
Springs Front	Semi-elliptic	Semi-elliptic
Springs Rear	Semi-elliptic	Semi-elliptic
Carburettor	Zenith	Zenith
Cooling System	Centrifugal pump	Centrifugal pump
Oiling System	Trough splash, throttle controlled	Trough splash, throttle controlled
Ignition	Magneto	Magneto
Control	Foot-operated accelerator pedal	Foot-operated accelerator pedal
Clutch	Cone, lined with fabric	Cone, lined with fabric
Transmission	Four speed and reverse gear box	Four speed and reverse gear box
Brakes	Hand, internal expanding; foot, internal expanding, acting on rear wheels	Hand, internal expanding; foot, internal expanding, acting on rear wheels
Steering Gear	Irreversible worm	Irreversible worm
Equipment	Tool kit, etc.	Tool kit, etc.
Prices	£1,050	£1,050

Tyre Equipment—Goodrich Tyres furnished by arrangement when specified.



DENNIS BROS., Limited,
Woodbridge Hill, Guildford.

SPECIFICATION

Model	War Office Subsidy.
Capacity	3/4-tons
Drive	Dennis worm.
Chassis Weight	3-tons 3-cwt approx.
Engine (R A.C.)	40 H.P. at 1,000 revs. p.m.
Bore	115 m m
Stroke	150 m m
Wheel Base	13' 0"
Tread Front	5' 6"
Tread Rear	5' 6" to centre of twin tyres.
Tyres Front	880×120 or 120 for 720
Tyres Rear	1050×120 or 120 for 881
Frame (width of)	2' 8¾"
Front Axle	Special section with ball thrust bearing to the steering heads.
Rear Axle	Worm gearing
Springs Front	Semi-elliptic
Springs Rear	Semi-elliptic
Carburettor	Claudel-Hobson
Cooling System	By pump
Oiling System	By pump
Ignition	High tension magneto.
Control	Hand and foot.
Clutch	Cone lined Ferodo
Transmission	Propeller shaft enclosed by torque tube anchored to frame.
Brakes	Foot and hand expanding.
Steering Gear	Worm and sector with connections on Ackermann principle.
Equipment	Kit of useful tools, 1 head, 2 side, 1 tail lamps, front mudguards.
Prices	On application.

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—Easy starting, easy driving, very accessible. Perfectly reliable.

THREE (ELECTRIC) COMMERCIAL VEHICLES.
EDISON ACCUMULATORS, Limited.
15, Upper George Street, London, W.2.

SPECIFICATIONS

Models	W	EA
Capacity	1-ton	2-ton
Drive	Gear	Gear
Wheel Base	8′ 0″	10′ 0″
Tread	4′ 8″	5′ 9″
Tyres Front	34 × 3½, 28″ fitting	870 × 100 or 100 for 720
Tyres Rear (twin)	36 × 4, 30″ fitting	920 × 100 or 100 for 771
Frame	Channel	High tensile steel
Speed	12 m.p.h.	11 m.p.h.
Miles	45	35-40
Front Axle	Drop forged I-beam section	Drop forged alloy steel
Rear Axle	Hollow steel, torpedo shaped, enclosing motor, etc.	Heat treated 3% nickel steel
Springs Front	Semi-elliptic	Semi-elliptic
Springs Rear	Semi-elliptic	Semi-elliptic
Battery Equipment	60A-6 Edison cells 225AH	60A-8 Edison cells 300AH
Motor	Series type of ample capacity	Series type of ample capacity
Steering Gear	Improved wheel-steering mechanism.	Worm and sector
Transmission	Epicyclic balance gear in hollow axle and rear wheels	Twin motor type chain to countershaft, Cardan shaft to bevel pinion and crown wheel
Brakes	Two sets, contracting and expanding type	One set on motor shafts, one set on rear wheel drum, interlocked with circuit-braker
Prices	Upon application.	

Tyre Equipment—Goodrich Tyres furnished when specified.

Continued on page 83.

ENFIELD-ALLDAY COMMERCIAL VEHICLES
ENFIELD-ALLDAY MOTORS, Limited,
Small Heath, Birmingham.

SPECIFICATION

Capacity	2-tons
Horse Power	25-30
Bore	100 m/m
Stroke	130 m/m
Wheel Base	12′ 3″
Tread Front	5′ 6″
Tread Rear	5′ 6″
Tyres Front	770 × 100 or 100 for 621
Tyres Rear	870 × 100 or 100 for 720
Frame	Pressed steel
Front Axle	Forged steel
Rear Axle	Chain drive
Springs	Half elliptic
Carburettor	Zenith
Cooling System	Thermo-syphon
Ignition	Magneto
Control	Hand and foot
Clutch	Cone
Transmission	Side chains, enclosed
Drive	Bevel
Brakes	Two
Steering Gear	Worm and Sector
Price	On application

Tyre Equipment—Goodrich Tyres furnished when specified.

BRITISH ENSIGN MOTORS, Limited,
Hawthorne Road, Willesden Green, London, N.W.10.

SPECIFICATION

Model	TEC4
Capacity	4-ton
Drive	Overhead worm
Chassis Weight	3-tons 4-cwt.
Engine (R.A.C.)	40 HP
Cylinders	4
Bore	5″
Stroke	6″
Wheel Base	13′ 6″
Tread Front	5′ 5½″
Tread Rear	5′ 8¼″
Tyres Front	900 × 120 or 120 for 720
Tyres Rear	1010 × 120 (twin) or 120 for 850
Frame	Pressed steel
Front Axle	I-section stamping
Rear Axle	Full, floating
Springs Front	Semi-elliptic
Springs Rear	Semi-elliptic
Carburettor	Claudel
Cooling System	Pump
Oiling System	Pressure
Ignition	Magneto
Control	Gate change, 4 speeds, hand, & foot accelerator
Clutch	Ferodo faced cone
Transmission	Propellor shaft and worm
Brakes	Internal expanding, both sets on rear wheels
Steering Gear	Worm and wheel
Equipment	Tool kit, etc.
Prices	On application.

Tyre Equipment—Goodrich tyres fitted when specified.

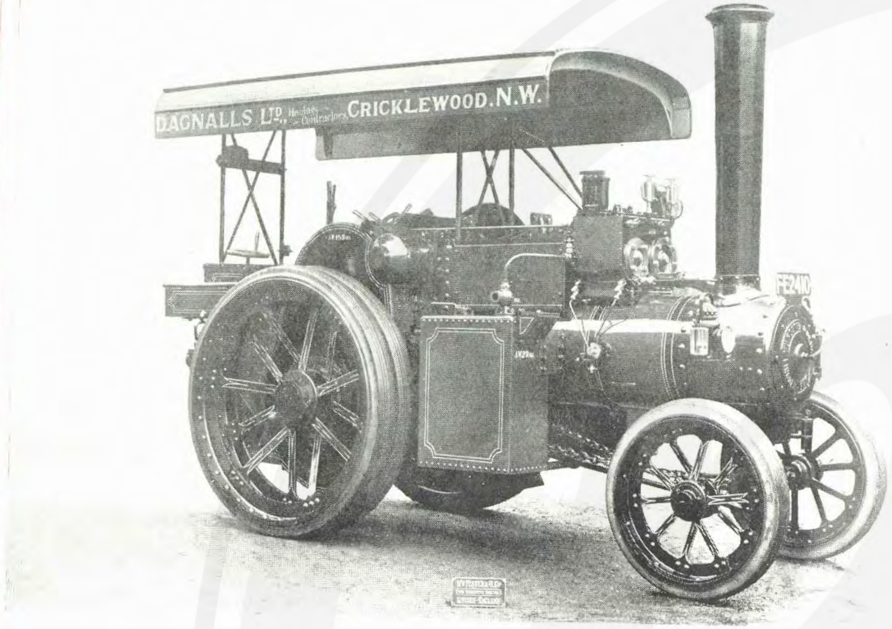
Special Note—Long wheel base 14′ 9″ supplied for charabanc work.

FODENS, Limited,
Elworth Works, Sandbach.

SPECIFICATIONS

Models	3-ton	5-ton
Horse Power	30	35
Wheel Tread, Front	4′ 6″	4′ 6″
Wheel Tread, Rear	6′ 10″	7′ 4″
Tyres, Front	140 m/m single, for 670 m/m rim.	160 m/m single, for 670 m/m rim.
Tyres, Rear	140 m/m twin, for 850 m/m rim.	160 m/m twin, for 850 m/m rim.
Frame	Channel girder.	
Axles	Special steel forgings.	
Springs	Semi-elliptic.	
Transmission	Two-speed gears from crankshaft to second-motion or stud shaft, and by roller driving chain to compensating gear on real axle.	Two-speed gears from crankshaft to second-motion or stud shaft, and by roller driving chain to compensating gear on rear axle.
Control	By sliding regulator or throttle valve, including the "Foden" double high pressure arrangement. The usual reversing gear is fitted.	By sliding regulator or throttle valve, including the "Foden" double high pressure arrangement. The usual reversing gear is fitted.
Brakes	Band brake operated by foot pedal on drum affixed to both driving wheels.	Band Brake operated by foot pedal on drum affixed to both driving wheels.
Steering Gear	Worm, wheel and chains to front axle.	Worm, wheel and chains to front axle.
Prices	On application.	

Tyre Equipment—Goodrich Tyres furnished when specified.

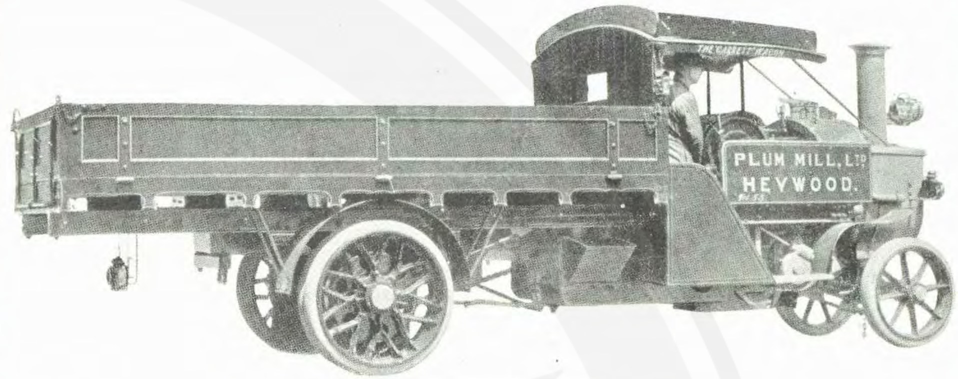


THE FOSTER TRACTOR (STEAM).
WILLIAM FOSTER & CO., Limited.
Lincoln.

SPECIFICATION

Model	1919
Capacity (tons)	6-tons gross
Horse Power	25 BHP
Bore	4½" and 6¾"
Stroke	9"
Wheel Base	8' 0"
Tread Front	5"
Tread Rear	12"
Tyres Front	970 × 160 or 160 for 771
Tyres Rear	1500 × 160 or 160 for 1340 (twin)
Frame	None
Front Axle	2¼" dia.
Rear Axle	4" dia.
Springs	Laminated
Transmission	Gearing
Control	Simple
Brakes	To lock hind wheels
Steering	Worm
Equipment	Useful tools
Price	On application.

Tyre Equipment—Goodrich Tyres will be furnished when specified.



GARRETT, LEISTON.

THE GARRETT PATENT (STEAM) VEHICLES
Manufactured by
RICHARD GARRETT & SONS, Limited,
Branch of Agricultural and General Engineers, Ltd., Central House, Kingsway, W.C.
Leiston Works, Leiston.
SPECIFICATIONS

Models	No. 5 Heavy	No. 3 Light
Capacity	5-tons approx. and further 3-tons in separate trailer	3 tons approx.
Horse Power	35	30
Wheel Base	13' 4", or to suit customer	12' 10¼", or to suit customer
Tread Front	4' 6"	4' 6"
Tread Rear	7' 3½"	6' 8"
Tyres Front	850 × 140 or 140 for 681	850 × 140 or 140 for 681
Tyres Rear	1070 × 160 or 160 for 871	1030 × 140 or 140 for 851
Frame	Rolled steel	Rolled steel
Front Axle	Rectangular section steel forging specially treated	Rectangular section steel forging specially treated
Rear Axle	Garrett's Patent parallel type, with claw clutch drive	Garrett's Patent parallel type, with claw clutch drive
Springs	Semi-elliptic	Semi-elliptic
Transmission	From crankshaft to fixed stud shaft, thence by roller chain to compensating gear on back axle.	From crankshaft to fixed stud shaft, thence by roller chain to compensating gear on back axle.
Control	By throttle on steam chest forward and reverse by lever on engine.	By throttle on steam chest forward and reverse by lever on engine.
Brakes	Internal expanding ring brakes fitted to each hind driving wheel and auxiliary powerful locomotive "post" type brake on main axle. Both brakes instantaneously operated by levers from driver's platform.	Internal expanding ring brakes fitted to each hind driving wheel and auxiliary powerful locomotive "post" type brake on main axle. Both brakes instantaneously operated by levers from driver's platform.
Steering	Through steering wheel to worm wheel and worm.	Through steering wheel to worm wheel and worm.
Prices	On application.	

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—Garrett's Patent Superheater effects large economies in fuel and water consumption, especially in the case of long continuous journeys, and can be supplied, if preferred ; but in any case we fit our piston valve gear, constituting an enormous advantage over the ordinary flat slide valve type.

Any special type of body work can be fitted to the chassis to suit customers' requirements.

THE GARRETT PATENT (ELECTRIC) COMMERCIAL VEHICLES

Manufactured by

RICHARD GARRETT & SONS, Limited,

Branch of Agricultural and General Engineers, Ltd., Central House, Kingsway, W.C.

Leiston Works, Leiston.

SPECIFICATIONS

Models	No. 3	No. 4	No. 5
Capacity	$1\frac{1}{2}$-tons	2/$2\frac{1}{2}$ tons	$3\frac{1}{2}$-tons
Drive	Single series, wound motor (capable of an overload of 300%) of the totally enclosed type.		
Chassis Weight (with battery)	$3\frac{1}{2}$-tons	$3\frac{3}{4}$-tons	$4\frac{1}{4}$-tons
Wheel Base	9' 10"	10' 3"	11' 0"
Tyres Front	920 × 110 or 110 for 771	930 × 120 or 120 for 771	950 × 140 or 140 for 771
Tyres Rear	Twin 920 × 90 or 90 for 771	920 × 100 or 100 for 771	920 × 110 or 110 for 771
Track Front	5' 6"	5' $8\frac{3}{4}$"	5' $7\frac{1}{4}$"
Track Rear	5' 4"	5' 4"	5' $5\frac{3}{4}$"
Frame	Rolled steel, channel section.		
Speed	11 m.p.h.	10 m.p.h.	8 m.p.h.
Miles	30	30-35	30-35
Front Axle	H-section nickel steel	H-section nickel steel	H-section nickel steel
Rear Axle	Round section nickel steel	Round section nickel steel	Round section nickel steel
Springs Front	Long semi-elliptic	Long semi-elliptic	Long semi-elliptic
Springs Rear	Long semi-elliptic	Long semi-elliptic	Long semi-elliptic
Battery Equipment	193 A.H.	226 A.H.	300 A.H.

(Special batteries can be fitted if required).

Continued on page 81.

THE GARNER (PETROL) COMMERCIAL VEHICLES.

HENRY GARNER, Limited,

Birmingham.

SPECIFICATION

Model	15
Capacity	36-cwts, including body
Drive	Internal gear (heavy construction)
Chassis Weight	30-cwts.
Engine (R.A.C.)	22.5 h.p.
Bore	$3\frac{3}{4}$"
Stroke	5"
Wheel Base	11' 6"
Tread Front	57"
Tread Rear	57"
Tyres Front	36 × $3\frac{1}{2}$ single
Tyres Rear	36 × 3 twin
Frame	Pressed steel.
Front Axle	I-beam section.
Rear Axle	Internal gear.
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Stromberg.
Cooling System	Thermo-syphon.
Oiling System	Pump and trough.
Ignition	Battery, with distributor.
Control	Variable ignition, handle, throttle and accelerator.
Clutch	Multiple disc, dry plate.
Transmission	Three speeds and reverse.
Brakes	Two on rear axle.
Steering Gear	Irreversible differential screw and nut type.
Equipment	Lighting set, horn, runners on frame, kit of tools.
Price	£695

Tyre Equipment—Goodrich Tyres fitted when specified.

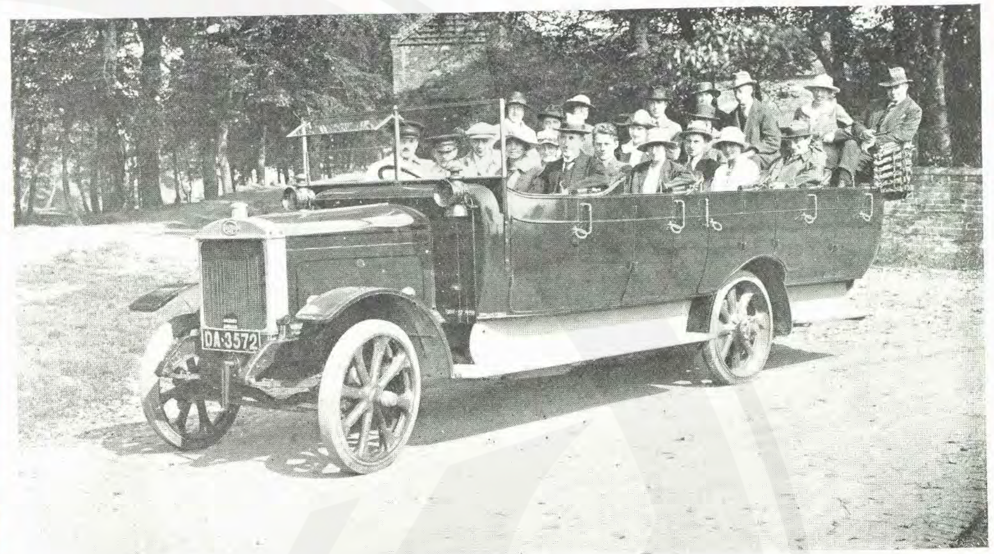
THE "G V" ELECTRIC COMMERCIAL VEHICLES
GENERAL VEHICLES COMPANY Limited,
43, Shoe Lane, London E.C. 4.

SPECIFICATIONS

Capacity	½-tons	1-ton	2-tons	3½-tons	5-tons
Drive	Chain	Chain	Chain	Chain	Chain
Chassis Weight	2,165 lbs.	2,900	4,050	5,940	6,895
Wheel Base	89″	104″	113″	133″	142″
Tread Front	56″	60″	61″	65″	69″
Tread Rear					
Tyres Front	$36 \times 2\frac{1}{2}$	$36 \times 3\frac{1}{2}$	36×4	36×6	36×7
Tyres Rear	$36 \times 2\frac{1}{2}$	$36 \times 3\frac{1}{2}$	$35 \times 3\frac{1}{2}$ Dual	36×5 Dual	36×6 Dual
Frame	Rolled steel	Rolled steel	Rolled steel	Rolled steel	Rolled steel
Speed	16	14	12	10	9
Miles	45	45	45	35	30
Front Axle	$1\frac{7}{8}'' \times 1\frac{3}{4}''$	$1\frac{5}{8}''$ squ.	$2\frac{5}{16}''$ dia.	$2\frac{3}{4}''$ dia.	$2\frac{3}{4}''$ dia.
Rear Axle	$1\frac{3}{4}''$ dia.	2″ dia.	$2\frac{5}{16}''$ dia.	$2\frac{3}{4}''$ dia.	$2\frac{3}{4}''$ dia.
Springs Front	$36'' \times 2''$	$40'' \times 2''$	$46'' \times 2\frac{1}{2}''$	$48'' \times 3''$	$48'' \times 3''$
Springs Rear	$40'' \times 2''$	$44'' \times 2''$	$48'' \times 2\frac{1}{2}''$	$54'' \times 3''$	$54 \times 3''$
Battery Equipment	Ironclad or Edison	Ironclad or Edison	Ironclad or Edison	Ironclad or Edison	Ironclad or Edison
Motor	G.E.C. Series wound	G.E.C. Series wound	G.E.C. Series wound	G.E.C. Series wound	G.E.C. Series wound
Steering Gear	Pinion and sector	Pinion and sector	Pinion and sector	Pinion and sector	Pinion and sector
Transmission	Double reduction	Double reduction	Double reduction	Double reduction	Double reduction
Brakes	Service and emergency	Service and emergency	Service and emergency	Service and emergency	Service and emergency
Equipment	Tool box, tools, horn, lamps, Hubodometer, charging plug and cable.				
Prices	On application.				

Tyre Equipment—Goodrich Tyres.

Special Note—Design patented 1907. Over 6,000 in daily use.



THE GUY (PETROL) COMMERCIAL VEHICLE.
GUY MOTORS, Limited,
Fallings Park, Wolverhampton.

SPECIFICATION

Capacity	2-tons
Engine	25 H.P.
Cylinders	4
Bore	4″
Stroke	$5\frac{1}{2}''$
Wheel Base	$12'\ 4\frac{1}{2}''$
Tread Front	Wheel track 5′
Tread Rear	Wheel track 5′
Tyres Front	870 × 100 or 100 for 720
Tyres Rear	870 × 100 or 100 for 720
Frame	Deep channel steel main and sub-frame.
Front Axle	H-section.
Rear Axle	Double reduction bevel and spur gears.
Springs Front	Wide special alloy steel.
Springs Rear	Wide special alloy steel underslung.
Carburettor	Zenith.
Cooling System	Centrifugal pump and fan.
Oiling System	Automatic.
Ignition	H.T. magneto.
Control	Throttle by pedal, and lever on dash ; Magneto by lever on steering column
Clutch	Fabric-lined cone.
Transmission	Gear box, four speeds and reverse.
Brakes	Foot on bevel pinion ; hand on back wheels.
Steering Gear	Worm type with complete worm wheel.
Equipment	Useful tools.
Prices	On application.

Tyre Equipment—Goodrich Tyres furnished when specified.

THE "HALLEY" (PETROL) COMMERCIAL VEHICLES
HALLEY'S INDUSTRIAL MOTORS, Limited,
Yoker, Glasgow.

SPECIFICATION

Model	P
Capacity	3 and 3½-tons
Drive	Live axle (worm)
Chassis Weight	3-tons 1-cwt.
Engine (R.A.C.)	35 H.P.
Cylinders	6 cylinders
Bore	3½" dia.
Stroke	6"
Wheel Base	13' 4" and 14' 7"
Tread Front	5' 6¾"
Tread Rear	5' 1½"
Tyres Front	930 × 120 or 120 for 771
Tyres Rear	930 × 120 or 120 for 771
Frame	5' × 2½" rolled channel
Front Axle	H-sect'on
Rear Axle	Cast "Pot" type, worm reduction, bevel differential
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Zenith.
Cooling System	Pump.
Oiling System	Pump and splash.
Ignition	Magneto, variable.
Control	Hand and foot throttle.
Clutch	Plate, Ferodo faced.
Transmission	4 speed box.
Brakes	Two, independent expanding type.
Steering Gear	Worm and wheel.
Prices	On application.

Tyre Equipment—Goodrich Tyres fitted when definitely specified.

Special Note—Chassis guaranteed for two years.

THE "HALLFORD" (PETROL) COMMERCIAL VEHICLES
J. & E. HALL, Limited,
10, St. Swithin's Lane, London' E.C.4.

SPECIFICATIONS

Models	CC	CC	E1A1	E1A1	EE
Capacity	1½-tons	2½-tons	3-tons	4-tons	5-tons
Drive	Encased chains	Encased chains	Encased chains	Encased chains	Encased chains
Chassis Weight	1 ton 18 cwt.	2 tons 3 cwt	3 tons 3 cwts.	3 tons 6 cwts	3 tons 10 cwts.
Engine (R.A.C.)	25	25	32	32	38
Cylinders	4	4	4	4	4
Bore	100	100	110	110	120
Stroke	140	140	140	140	140
Wheel Base	10' 10"	12' 4"	12' 0"	13' 6"	15" 0"
Tread Front	90	100	120	130	140
Tread Rear	90	100	120	130	140
Tyres Front	860 × 90 or 90 for 720	870 × 100 or 100 for 720	900 × 120 or 120 for 720	900 × 130 or 130 for 720	900 × 140 or 140 for 720
Tyres Rear	860 × 90 or 90 for 720 twin	870 × 100 or 100 for 720 twin	1010 × 120 or 120 for 850 twin	1010 × 130 or 130 for 850 twin	1010 × 140 or 140 for 850 twin
Frame	Pressed steel	Pressed steel	Pressed steel	Pressed steel	Pressed steel
Front Axle	Butler's	Butler's	Solid	Solid	Solid
Rear Axle	Solid	Solid	Solid	Solid	Solid
Springs Front	Semi-elliptic	Semi-elliptic	Semi-ell'ptic	Semi-elliptic	Semi-elliptic
Springs Rear	Semi-elliptic	Semi-elliptic	Semi-elliptic	Semi-elliptic	Semi-elliptic
Carburettor	Zenith	Zenith	Zenith	Zenith	Zenith
Cooling System	Pump and tubular radiator.				
Oiling System	Pump and semi-splash.				
Ignition	Magneto	Magneto	Magneto	Magneto	Magneto
Control	Hand and foot with governor.				
Clutch	Internal cone.	Internal cone.		"Ferodo" leather.	
Transmission	Sliding gear, select've three-speed		Sliding gear, selective four-speed		
Brakes	Hand and foot.				
Steering Gear	Worm and segment.				
Equipment	Tyres, front wings, complete set of tools and horn.				
Prices	On application.				

Tyre Equipment—Goodrich Tyres fitted when specified

Special Note—The Hallford gained the GOLD MEDAL and SPECIAL DIPLOMA in the 1907 R.A.C. Trials of Commercial Vehicles, the HIGHEST AWARD ever given to a commercial vehicle.

THE "KARRIER" (PETROL) COMMERCIAL VEHICLES

Manufactured by

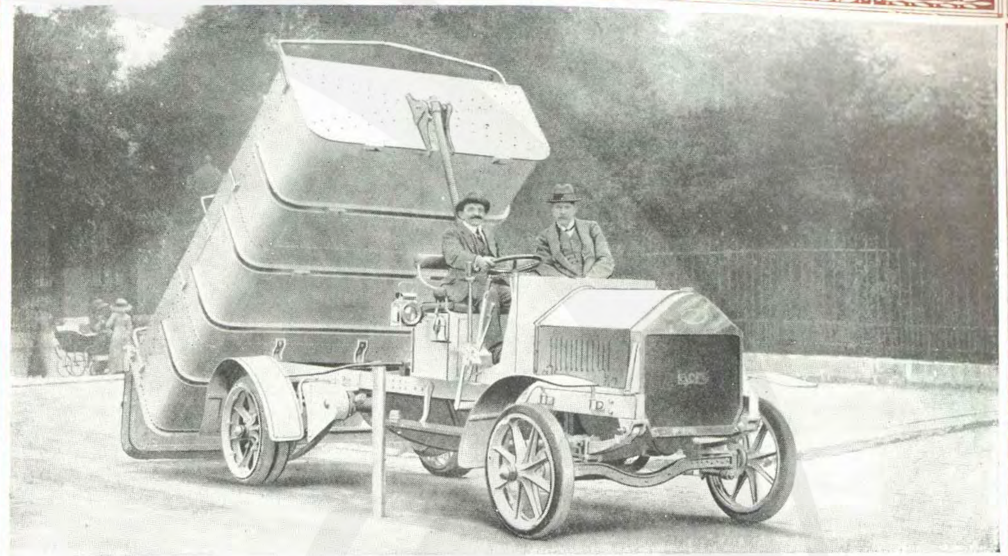
KARRIER MOTORS LIMITED,

Karrier Works, Huddersfield.

SPECIFICATIONS

Models	K3	K4	K5
Capacity	30 seat chassis	3/4-tons	5-tons
Drive	Live axle		
Chassis Weight	3-tons 7-cwt.		3-tons 12-cwt.
Engine (R.A.C.)	40 H.P.		
Cylinders	Vertical		
Bore	5″		
Stroke	6″		
Wheel Base	14′ 0″		
Tread Front	5′ 8″		
Tread Rear	5′ 6″		
Tyres Front	880 × 120 or 120 for 720		880 × 120 or 120 for 720
Tyres Rear	Twin. 1050 × 120 or 120 for 881		Twin. 1050 × 140 or 140 for 881
Frame	Pressed steel.		
Front Axle	I forging.		
Rear Axle	Solid steel forging.		
Springs Front	Semi-elliptic.		
Springs Rear	Semi-elliptic.		
Carburettor	Spray and pump.		
Cooling System	Pump.		
Oiling System	Splash.		
Ignition	H.T. Magneto.		
Control	Hand and foot.		
Clutch	Leather cone.		
Transmission	Bevel and spur gears.		
Brakes	Hand and foot.		
Steering Gear	Worm and sector.		
Equipment	Dynamos, electric lighting sets, tools and spares.		
Prices	On application.		

Tyre Equipment—Goodrich Tyres furnished when specified.



THE LACRE (PETROL) COMMERCIAL VEHICLES,

THE LACRE MOTOR CAR CO., Ltd.

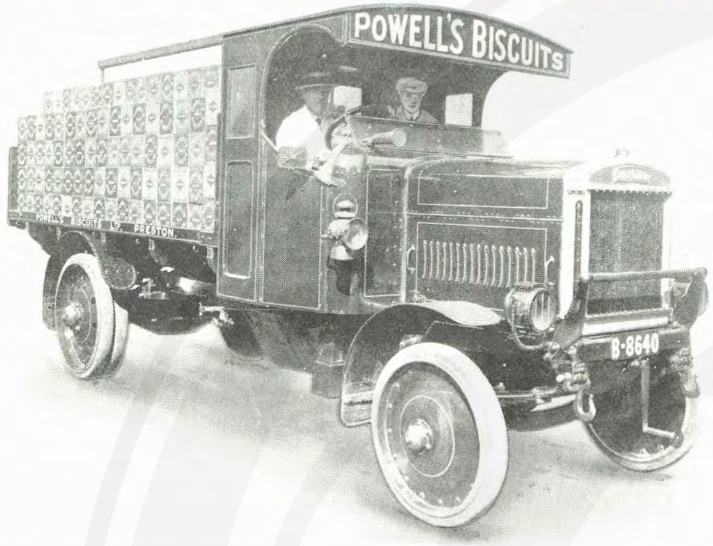
78 York Road, Kings Cross, N.1

SPECIFICATIONS

Models	O	N	K	L
Capacity	2-2½-tons	3-tons	5-tons	Sweeping gear, tank and spraying gear
Drive	Chain	Double reduction worm and spur	Double reduction worm and spur	Chain
Chassis Weight	2-tons 3-cwt.	2-tons 12-cwt.	2-tons 15-cwt.	1-ton 5-cwt.
Engine (R.A.C.)	30	38	38	15
Cylinders	4	4	4	4
Bore	4·33″	4⅞″	4⅞″	69 m/m
Stroke	5″	5″	5″	120 m/m
Wheel Base	12′	13′	14′	8′ 9″
Tyres Front	870 × 100 or 100 for 720	910 × 120 or 120 for 771	910 × 140 or 140 for 720	65 m/m
Tyres Rear	870 × 100 or 100 for 720	1020 × 120 or 120 for 850	1030 × 140 or 140 for 850	65 m/m
Frame	Straight rolled steel	Straight rolled steel	Straight rolled steel	Channel section steel
Front Axle	Built-up type	Built-up type	Built-up type	Built-up type
Rear Axle	From solid bar	From solid bar	From solid bar	Nil
Springs Front	Semi-elliptic	Semi-elliptic	Semi-elliptic	Semi-elliptic
Springs Rear	Semi-elliptic	Semi-elliptic	Semi-elliptic	Semi-elliptic
Carburettor	Zenith-Lacre	Zenith-Lacre	Zenith-Lacre	Zenith
Cooling System	Pipe to pump	Pipe to pump	Pipe to pump	Pump
Oiling System	Forced	Forced	Forced	Splash
Ignition	By H.T. magneto	By H.T. magneto	By H.T. Magneto	By H.T. Magneto
Control	Hand and foot	Hand and foot	Hand and foot	Hand
Clutch	Leather cone	Leather cone	Leather cone	Leather cone
Transmission	To rear wheels by roller side chains	By universal jointed shafts to pinions and external tooth wheels attached to road wheels		To rear wheels by roller chain
Brakes	Independent hand and foot	Independent hand and foot	Independent hand and foot	Independent hand and foot
Steering Gear	Worm and sector	Worm and sector	Worm and sector	Thread and nut
Equipment	Spares and tool kit	Spares and tool kit	Spares and tool kit	Spares and tool kit
Price	**£900**	**£1,100**	**£1,200**	**£650**

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—Prices are subject to cancellation or alteration without notice.



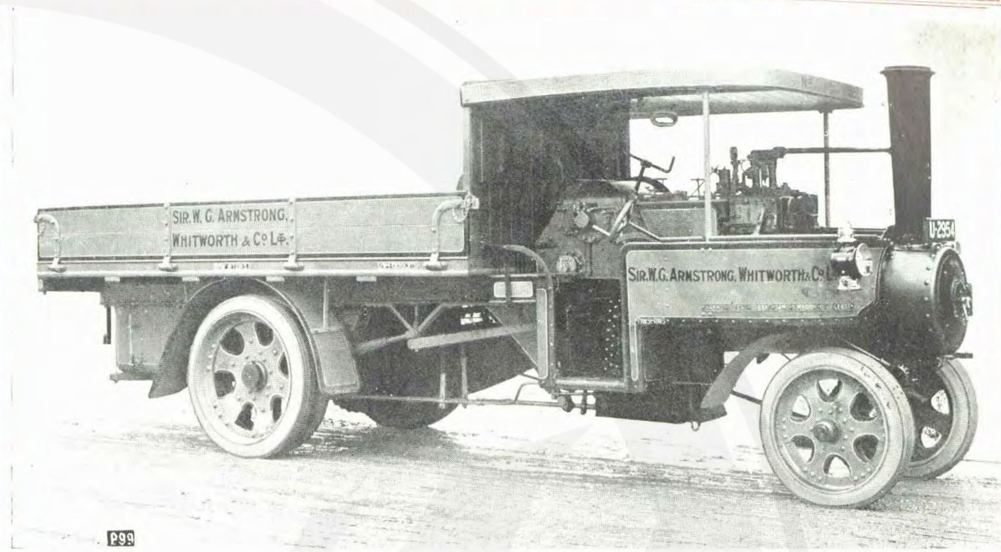
THE LEYLAND (PETROL) COMMERCIAL VEHICLES
LEYLAND MOTORS, Limited,
Leyland, Lancashire.

SPECIFICATIONS

Models	A	C	C1	D (Overseas)
Capacity	2-tons	3-tons	3-tons	3-tons
Drive	Worm	Worm	Worm	Bevel
Engine	24-26	30-32	30-32	36-40
Cylinders	4	4	4	4
Bore	4″	4½″	4½″	4⅝″
Stroke	5″	5″	5″	6″
Wheel Base	11′ 9″	13′ 1″	14′ 2¾″	14′ 0″
Track Front	5′ 6″	5′ 6″	5′ 6″	5′ 6″
Track Rear	5′ 4½″	5′ 4½″	5′ 4½″	5′ 4″
Tyres Front	(870) 100 for 720	(870) 110 for 720	(870) 110 for 720	(1050) 110 for 881
Tyres Rear	(920) 100r for 771	(920) 110r for 771	(920) 110r for 771	(1050) 110r for 881

Models	G2 (Standard)	G3 (Passenger)	G4 (long frame)	G5 (Passenger)
Capacity	4-tons	4-tons	4-tons	4-tons
Drive	Bevel	Worm	Bevel	Worm
Engine	36-40	36-40	36-40	36-40
Cylinders	4	4	4	4
Bore	4⅝″	4⅝″	4⅝″	4⅝″
Stroke	6″	6″	6″	6″
Wheel Base	14′	14′	15′ 1½″	15′ 1½″
Track Front	5′ 6″	5′ 6″	5′ 6″	5′ 6″
Track Rear	5′ 4″	5′ 4″	5′ 4″	5′ 4″
Tyres Front	(880) 130 for 720	(880) 130 for 720	(880) 130 for 720	(880) 130 for 720
Tyres Rear	(1050) 130r for 881	(1020) 130r for 850	(1050) 130r for 881	(1020) 130r for 850

Continued on page 82.



MANN'S PATENT STEAM CART & WAGON CO., Limited,
Pepper Road Works, Hunslet, Leeds.

SPECIFICATIONS

Models	5-ton wagon	3-ton wagon
Capacity	5-tons	3-tons
Horse Power	35	30
Wheel Base	12′ 5″	12′ 0½″
Tread Front	3′ 5″	3′ 6″
Tread Rear	5′ 4½″	5′ 2½″
Tyres Front	850 × 160 or 160 for 670	850 × 140 or 140 for 680
Tyres Rear	1070 × 160 or 160 for 871	1030 × 140 or 140 for 850
Frame	Rolled channel	Rolled channel
Front Axle	Steel forging	Steel forging
Back Axle	Live axle, steel	Live axle, steel
Springs	Plate type	Plate type
Transmission	Four shafted, cut gears to final chain.	Four shafted, cut gears to final chain.
Control	Throttle, reverse lever and steerage all to driver's side.	Throttle, reverse lever and steerage all to driver's side.
Brakes	Quick acting foot brake and screw brake, in addition to reversing gear.	Quick acting foot brake and screw brake, in addition to reversing gear.
Steering	Direct worm and quadrant.	Direct worm and quadrant.
Prices	On application.	

Tyre Equipment—Goodrich Tyres fitted when specified.

Special Note—All wagons have driver's footplate at side, and are therefore controlled completely by one man, with uninterrupted view of roadway.

MAUDSLAY MOTOR CO., Limited,
Parkside, Coventry.

SPECIFICATIONS

Capacity	3-ton	28 seat char-a-banc	28 seat char-a-banc	4-ton	5-ton	5-ton
Chassis Weight	3t. 5c. 3q.	3t. 5c. 3-q.	3t. 5c. 3q.	3t. 7c. 1q.	3t. 10c. 3q.	3t. 11c.
Engine (R.A.C.)	32.4	32.4	40	40	40	40
Cylinders	4	4	4	4	4	4
Bore	4½″	4½″	5″	5″	5″	5″
Stroke	5″	5″	5″	5″	5″	5″
Wheel Base	13′ 6″	14′ 6″	14′ 6″	13′ 6″	14′ 6″	15′ 6″
Tread Front	5′ 6″	5′ 6″	5′ 6″	5′ 6″	5′ 6″	5′ 6″
Tread Rear	5′ 6″	5′ 6″	5′ 6″	5′ 6″	5′ 6″	5″ 6″
Tyres Front	900 × 120 or 120 for 720	900 × 120 or 120 for 720	900 × 120 or 120 for 720	900 × 130	900 × 140 or 140 for 720	900 × 140 or 140 for 720
Tyres Rear	1050 × 120 or 120 for 881	1050 × 120 or 120 for 881	1050 × 120 or 120 for 881	900 × 130	1050 × 140 or 140 for 881	1050 × 140 or 140 for 881
Frame	Rolled steel channel					
Front Axle	Heavy					
Rear Axle	Heavy banjo type					
Springs Front	Semi-elliptic					
Springs Rear	Semi-elliptic					
Carburettor	Zenith	ditto	ditto	ditto	ditto	ditto
Cooling System	Thermo syphon and pump.					
Oiling System	Forced feed by pump through crankshaft.					
Ignition	Connor magneto.					
Control	Ignition and throttle control on steering wheel and foot accelerator.					
Clutch	Cone leather and metal.					
Transmission	Worm	worm	worm	Double reduction, bevel and spur.		
Brakes	Propeller shaft and rear wheels.					
Steering Gear	Worm and segment.					
Equipment	Usual kit of tools.					
Prices	On application.					

Tyre Equipment—Goodrich Tyres furnished if circumstances permit

THE McCURD MANUFACTURING CO., Limited,
Edgware Road, Cricklewood.

SPECIFICATION

Model	**4-tons**
Horse Power	40
Bore	4½″
Stroke	5½″
Wheel Base	13′ 6″
Tread Front	5′ 6″
Tread Rear	5′ 6″
Tyres Front	900 × 120 or 120 for 720.
Tyres Rear	1050 × 120 or 120 for 881.
Frame	Pressed steel channel section 6½″ × 2½″ × 19′ 10″ × 3′ 2½″
Front Axle	Solid forging.
Rear Axle	Full floating type.
Springs	Semi-elliptic.
Carburettor	Zenith No. 42.
Cooling System	Water pump, centrifugal.
Ignition	Bosch.
Control	Ignition only on steering wheel. Throttle on dash.

Continued on page 83.

THE "NAPIER" (PETROL) COMMERCIAL VEHICLES

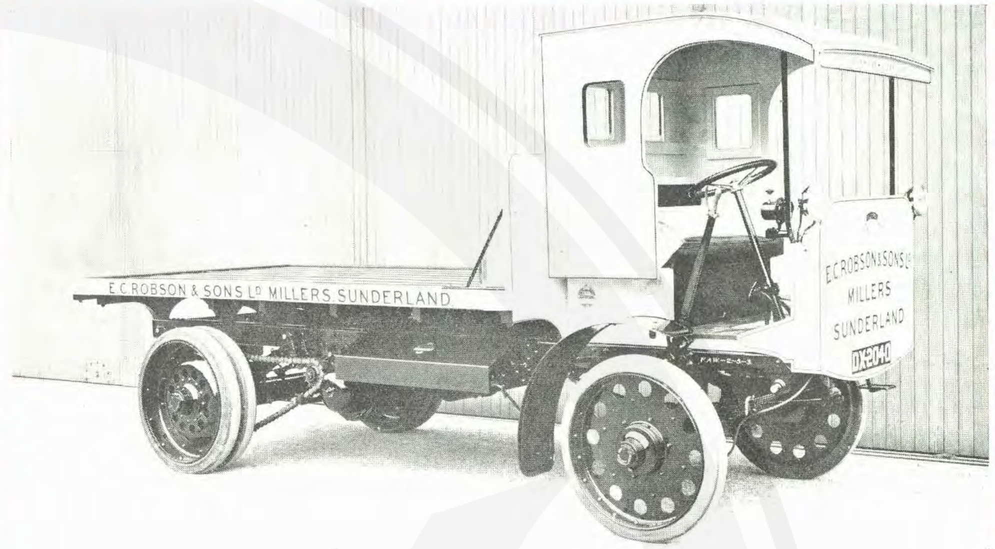
D. NAPIER & SON, Limited,

14, New Burlington Street, London, W.1.

SPECIFICATION

Model	B72a
Capacity	2-tons
Drive	Worm $\frac{4}{31}$
Chassis Weight	2-tons approx.
Engine	25/30 H.P. ; 4 cylinders
Bore	$3\frac{11}{16}''$
Stroke	5″
Wheel Base	10′ 6″
Tread Front	5′
Tread Rear	4′ 8″
Tyres Front	100 for 720 or 870 × 100
Tyres Rear	100 for 720 twin or 870 × 100
Frame	Channel section pressed steel 6″ deep, 2″ wide, $\frac{3}{16}''$ thick
Front Axle	H-section drop forging.
Rear Axle	Very strong forging.
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Solex.
Cooling System	Pump, circulating.
Oiling System	Automatic forced speed.
Ignition	H.T. magneto.
Control	Hand lever quadrant and accelerator pedal.
Clutch	Single disc type, with hardened steel disc.
Transmission	Four speeds forward and reverse.
Brakes	Two, one foot on main shaft ; hand, internal expanding.
Steering Gear	Worm and wheel, irreversible type.
Equipment	Kit of tools, etc.
Prices	On application.

Tyre Equipment—Goodrich Tyres furnished when circumstances permit.



THE "ORWELL" (ELECTRIC) COMMERCIAL VEHICLES

RANSOMES, SIMS & JEFFERIES, Limited,

Orwell Works, Ipswich.

SPECIFICATIONS

Models	**MO40 Tipping Wagon**	**MO70 Lorry**
Capacity	2-tons	$3\frac{1}{2}$-tons
Drive	Front drive	Chain (rear wheel)
Chassis Weight	With battery 2 tons 18 cwts 3 qrs.	With battery 3 tons 16 cwts 3 qrs.
Wheel Base	9′ 4″	$10' 4\frac{1}{2}''$
Tread Front	5′ 3″	5′ 3″
Tread Rear	5′ 3″	$5' 10\frac{1}{4}''$
Tyres Front	900 × 120 × 741 single	900 × 120 × 741 single
Tyres Rear	950 × 140 × 771 single	900 × 120 × 741 twin
Frame	Pressed steel, channel scct'on	Pressed steel, channel section
Speed	Loaded 12 m.p.h.	Loaded 8 m.p.h.
Miles	Per charge 30-45	Per charge 25-40
Front Axle	H-section high tensile steel forging	H-section h'gh tensile steel forging
Rear Axle	H-section high tensile steel forging	H-section high tensile steel forging
Springs Front	Long semi-elliptic	Long sem'-elliptic
Springs Rear	Long semi-elliptic	Long semi-elliptic
Battery Equipment	40 cells "Ironclad Exide" 226 AH	40 cells "Ironclad Exide" 258 AH
Motor	2, $2\frac{3}{4}$ h.p. normal rating	2.$3\frac{3}{4}$ h.p. normal rating
Steering Gear	Worm and wheel	Worm and wheel
Transmission	Direct single helical	Double reduction, double helical to chain countershaft
Brakes	Internal on each wheel	Internal on each wheel
Equipment	Lamp, horn, tools, etc.	Lamp, horn, tools, etc.
Prices	On application.	

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—Each model may be had either as a lorry or tipping wagon. The above illustration shows no battery box.

THE "PAGEFIELD" (PETROL) COMMERCIAL VEHICLES
WALKER BROS. (WIGAN), Limited.
Pagefield Works, Wigan.

SPECIFICATIONS

Models	F type	N type	W type	K type Municipal type
Capacity				
Useful loads	Passenger	4	5	4
Drive	Worm	Double reduction	Double reduction	Worm
Chassis Weight	53 cwts.	65 cwts.	73 cwts.	53 cwts.
Engine (R.A C.)	40 h.p.	40 h.p.	40-50 h.p.	40 h.p.
Cylinders	Four	Four	Four	Four
Bore	4¾″	4¾″	5″	4¾″
Stroke	5½″	5½″	6″	5½″
Wheel Base	14′ 6″	13′ 8″	14′ 9″	8′ 0″
Tread Front	5′ 9″	5′ 9″	5′ 9″	5′ 6″
Tread Rear	5′ 7″	5′ 7″	5′ 7″	5′ 4″
Tyres Front	880 × 120 or 120 for 720	880 × 120 or 120 for 720	900 × 140 or 140 for 720	880 × 120 or 120 for 720
Tyres Rear	880 × 120 twin or 120 for 720	1050 × 120 or 120 for 881 twin	1070 × 140 or 140 for 881 twin	880 × 120 or 120 for 720 twin
Frame	Pressed steel	Pressed steel	Pressed steel	Pressed steel
Front Axle	Drop forged	Drop forged	Drop forged	Drop forged
Rear Axle	Steel forging	Steel forging	Steel forging	Steel forging
Springs Front	Semi-elliptic	Semi-elliptic	Semi-elliptic	Semi-elliptic
Springs Rear	Semi-elliptic	Semi-elliptic	Semi-elliptic	Semi-elliptic
Carburettor	Zenith	Zenith	Claudel-Hobson	Zenith
Cooling System	Pump	Pump	Pump	Pump
Oiling System	Forced	Forced	Forced	Forced
Ignition	High-tension mag.	High-tension mag.	High-tension mag.	High-tension mag.
Control	Hand and foot	Hand and foot	Hand and foot	Hand and foot
Clutch	Cone	Cone	Cone	Cone
Transmission	4 speeds and reverse	4 speeds and reverse	4 speeds and reverse	4 speeds and reverse
Brakes	Foot, loco type Side, int. expanding	Foot, loco type Side, int. expanding	Foot, loco type Side, int. expanding	Foot, loco type Side, int. expanding
Steering Gear	Worm and wheel	Worm and wheel	Worm and wheel	Worm and wheel
Equipment	Useful tools	Useful tools	Useful tools	Useful tools
Prices	On application.			

Tyre Equipment—Goodrich Tyres furnished when specified.

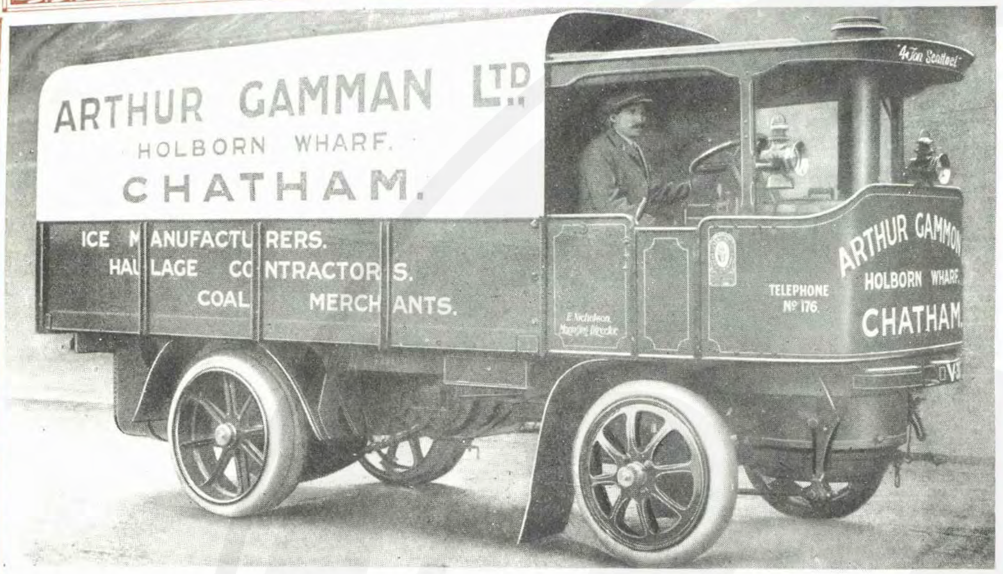
Special Note—All rear axles are machined from solid forgings of high tensile steel made in our own forge.

THE "SCOUT" (PETROL) COMMERCIAL VEHICLES
"SCOUT MOTORS," Limited,
Scout Works, Salisbury.

SPECIFICATION

Model	3 Tonner
Capacity	3-tons in addition to weight of body
Drive	Carden shaft, gear box, 4 speeds and reverse
Chassis Weight	3-tons
Engine (R.A.C.)	32
Cylinders	
Bore	114 m m
Stroke	140 m m
Wheel Base	13′ 6″
Tread Front	5′ 5″
Tread Rear	5′ 8″
Tyres Front	900 × 120 or 120 for 741
Tyres Rear	900 × 120 twin or 120 for 741 twin
Frame	7½″
Front Axle	"H" section
Rear Axle	Live axle, double reduction gear.
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Specified.
Cooling System	Thermo-syphon.
Oiling System	Forced feed lubrication.
Ignition	High tension magneto.
Control	Foot.
Clutch	Cork insets.
Transmission	Four speeds and reverse gear box.
Brakes	Foot to drum on carden shaft; hand to rear wheels.
Steering Gear	Worm and sector.
Equipment	Kit of tools, side and tail lamp.
Price	On application.

Tyre Equipment—Goodrich fitted when specified.



THE "SENTINEL" STEAM COMMERCIAL VEHICLES

Manufactured by

SENTINEL WAGON WORKS (1920), LTD., Shrewsbury.

SPECIFICATIONS

Models	5-6-tons	5-tons (Tipper)	3-4-tons	3½-tons (Tipper)
Capacity	6-tons	5-tons	4-tons	3½-tons
Horse Power	35 h.p.	35 h.p.	30 h.p.	30 h.p.
Wheel Base	10′ 4½″	10′ 4½″	9′ 9″	9′ 9″
Tread Front	5′ 3″	5′ 3″	5′ 3″	5′ 3″
Tread Rear	5′ 2″	5′ 2″	4′ 11″	4′ 11″
Tyres Front S.	900 × 160 or 160 for 720		900 × 160 or 160 for 720	
Tyres Rear (twin)	1050 × 160 or 160 for 850		950 × 140 or 140 for 771	
Frame	Pressed steel.			
Front Axle	Special steel.			
Rear Axle	Chrome nickel steel forging.			
Springs	Semi-elliptic.			
Transmission	Direct from crankshaft to compensating gear on rear axle.			
Control	By main throttle, forward and reverse by engine lever.			
Brakes	Large hand brake on rear axle, also pneumatic brake on engine.			
Steering Gear	Improved Ackermann type, through steering wheel and bell crank to front wheels.			
Prices	On application.			

Tyre Equipment—Goodrich Tyres furnished when specified.

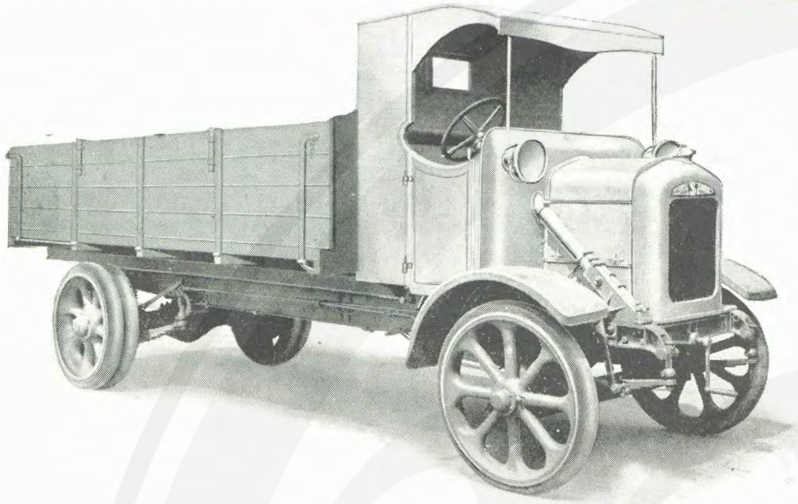
Special Note—*Boiler:* Straight water-tube type, compact and interior entirely accessible. Superheated steam and feed water heater. *Engine:* Slow running, totally enclosed in oil baths. *Transmission:* No change-speed gears. *General:* Short overall length, maximum body space, all controls under one man, and perfectly clear view for driver.

THE STAR ENGINEERING CO., Limited, Wolverhampton.

SPECIFICATIONS

Models	25/30-cwt.	50-cwt.
Capacity	25/30-cwt.	50-cwt.
Drive	Worm.	Bevel and spur.
Chassis Weight	1-ton 17-cwt. 2-qrs. 4-lbs.	2-tons 13-cwt. 1-qr.
Engine (R.A.C.)	20.1	20.1
Bore	90 m/m	90 m/m
Stroke	150 m/m	150 m/m
Wheel Base	11′ 6″	12′ 6″
Tread Front	4′ 9″	5′
Tread Rear	4′ 9″	5′
Tyres Front	840 × 80 or 80 for 720	870 × 100 or 100 for 720
Tyres Rear	840 × 80 or 80 for 720	870 × 100 or 100 for 720
Frame	Channel.	Channel.
Front Axle	H-section.	H-section.
Rear Axle	Full-floating.	Full-floating.
Springs Front	Semi-elliptic.	Semi-elliptic.
Springs Rear	Semi-elliptic.	Semi-elliptic.
Carburettor	Zenith.	Zenith.
Cooling System	Pump.	Pump.
Oiling System	Forced feed.	Forced feed.
Ignition	Magneto.	Dual.
Control	Foot and hand acc. and R.H. gear control.	Foot and hand acc. and R.H. gear control.
Clutch	Leather cone.	Leather cone.
Transmission	Four speeds and reverse.	Four speeds and reverse.
Brakes	External on gear box.	Internal on rear wheels.
Steering Gear	Worm and wheel.	Worm and wheel.
Equipment	Useful tools.	Useful tools.
Prices	On application.	

Tyre Equipment—Goodrich Tyres furnished if specified.



STRAKER-SQUIRE, Limited,

Angel Road, Edmonton, London, N.18.

SPECIFICATION

Model	A
Capacity	5-tons
Drive	Worm
Chassis Weight	3-tons 8-cwts
Engine	55 H.P.
Bore	4½″
Stroke	6½″
Wheel Base	14′ 6″
Tread Front	6′ 0″
Tread Rear	6′ 0″
Tyres Front	1030 × 140 or 140 for 850
Tyres Rear	1030 × 140 twin or 140 for 850
Frame	Pressed steel 9″ deep.
Front Axle	Drop forged H-section.
Rear Axle	Full floating live axle.
Springs Front	2¾″ wide × 4′ 3″ long.
Springs Rear	4″ wide × 5′ 6″ long
Carburettor	Smith.
Cooling System	Assisted Thermo-syphon.
Oiling System	Valveless Plunger pump.
Ignition	Magneto.
Control	Ignition and throttle on column.
Clutch	Single disc Ferodo-lined.
Transmission	Four-speeds and reverse.
Brakes	Both in back wheels, 22″ diam. drums.
Steering Gear	Screw and nut.
Equipment	Full kit of tools, speedometer, lamps and horn.
Prices	On application.

Tyre Equipment—Goodrich Tyres furnished when sp:cified.

Special Note—Low petrol and oil consumption combined with ample power (the motor gives 65 H.P. on the brake), splendid springing both light and loaded. Spec'al design and high grade steels g ve low chassis weight, combined with ample strength for maximum loads.

JOHN I. THORNYCROFT & CO., Limited,

Basingstoke

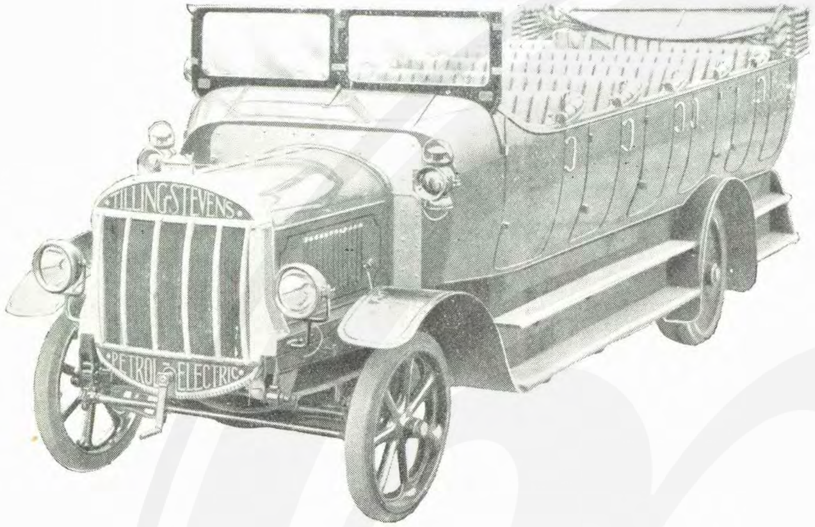
SPECIFICATIONS

Models	BT	X	J	Q
Capacity	2½-tons	3½-tons	4¾-tons	6-tons
Drive	Worm driven live axle	Worm driven live axle	Worm driven live axle	Worm driven live axle
Chassis Weight	2 tons 1 cwt. 3 qrs.	2 tons 14 cwt	3 tons 5 cwt.	3 tons 10 cwt
Engine (R A.C.)	25·6 B.H.P.	32·4 B.H.P.	32·4 B.H.P.	32·4 B.H.P.
Bore	4″	4½″	4½″	4½″
Stroke	5½″	6″	6″	6″
Wheel Base	11′ 8″	13′ 0″	13′ 7½″	14′ 1″
Tread Front	5′ 2½″	5′ 7¼″	5′ 7¼″	5′ 11½″
Tread Rear	4′ 8″	5′ 4″	5′ 6″	5′ 10″
Tyres Front	900 × 85 or 85 for 741	1030 × 100 or 100 for 881	880 × 120 or 120 for 720	880 × 120 or 120 for 720
Tyres Rear	900 × 90 or 90 for 755	1030 × 110 or 110 for 881	1050 × 120 or 120 for 881	1050 × 160 or 160 for 850
Frame	Pressed steel channel section.			
Front Axle	Steel forging I-section.			
Rear Axle	Cast steel centre casing with tubular sleeves.			
Springs Front	Long semi-elliptic.			
Springs Rear	Long semi-elliptic.			
Carburettor	Solex.			
Cooling System	Pump and fan.			
Oiling System	Forced lubrication.			
Ignition	H.T. Magneto.			
Control	Hand and foot.			
Clutch	Cone type, "Ferodo" lined.			
Transmission	Three speeds and reverse	Four speeds and reverse	Four speeds and reverse	Four speeds and reverse
Brakes	Foot on gear box, hand on road wheels.			
Steering Gear	Worm and nut type.			
Equipment	Necessary tools and spanners.			

Prices on application to John I. Thornycroft & Co., Ltd., 10, Grosvenor Place, London, S.W.1

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—Load capacities given above are gross loads, including the weight of the body



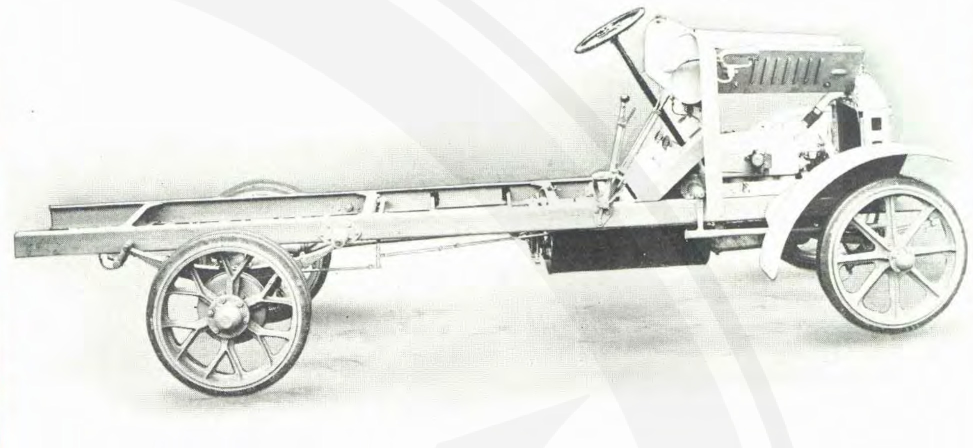
TILLING-STEVENS MOTORS, Limited, Maidstone.

SPECIFICATIONS

Models	TS4	TSB3	TSB4
Capacity	3 to 4-tons	4-tons	2½-tons
Drive	Worm	Worm	Worm
Chassis Weight	3-tons 18 cwt.	3½-tons	1-ton 17 cwt.
Engine (R.A.C.)	36	40	27
Bore	4¾″	5″	105
Stroke	6″	6″	125
Wheel Base	14′ 6″	14′ 6″	12′ 0″
Tread Front	5′ 10¼″	5′ 10¼″	4′ 10¼″
Tread Rear	5′ 8″	5′ 8	4′ 9″
Tyres Front	120 for 720 or 900 × 120	140 for 720 or 900 × 140	100 for 720 or 870 × 100
Tyres Rear	120 for 850 or 1010 × 120	140 for 850 or 1030 × 140	100 for 720 or 870 × 100
Frame	Pressed steel	Pressed steel	Pressed steel
Front Axle	H-section, drop forging	H-section, drop forging	H-section, drop forging
Rear Axle	Live, full floating	Live, full floating	Live, full floating
Springs Front	Sem -elliptic	Semi-elliptic	Sem -elliptic
Springs Rear	Semi-elliptic	Semi-elliptic	Semi-elliptic
Carburettor	Zenith	Zenith	Zenith
Cooling System	Pump	Pump	Pump
Oiling System	Gear pump, supplying troughs	Gear pump, supplying troughs	Gear pump, supplying troughs
Ignition	H.T. magneto	H.T. magneto	H.T. magneto
Control	Throttle pedal, Electric control levers on steering column	Throttle pedal RH	Throttle pedal
Clutch	None	Ferodo faced cone	Ferodo faced cone
Transmission	Electric	4 speeds and reverse	4 speeds and reverse
Brakes	Both internal on rear wheels	Both internal on rear wheels	Internal and external on rear wheels
Steering Gear	Worm and sector	Worm and sector	Worm and sector
Equipment	Useful tools.		
Prices	On application.		

Tyre Equipment—Goodrich tyres furnished when specified.

Special Note—T.S.4 is a petrol-electric chassis. T.S.B.3 and T.S.B.4 are gear driven.



THE VULCAN (PETROL) COMMERCIAL VEHICLE.

Manufactured by

THE VULCAN MOTOR & ENGINEERING CO. (1906) Ltd., Crossens, Southport.

SPECIFICATION

Model	**30-cwt. Commercial Chassis.**
Capacity	30-cwt.
Drive	Overhead worm
Chassis Weight	32¾-cwts.
Engine (R.A.C.)	20.1
Cylinders	
Bore	90 m/m
Stroke	130 m/m
Wheel Base	11′ 5″
Tyres Front	860 × 90 or 90 for 720 singles.
Tyres Rear	860 × 90 or 90 for 720 twin.
Frame	Straight [section.
Front Axle	I type, drop steel forging.
Rear Axle	Full floating type.
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Zenith.
Cooling System	Pump.
Oiling System	Splash, forced to troughs under big ends.
Ignition	M.L.
Control	Foot accelerator and hand lever on steering wheel.
Clutch	Ferodo cone.
Transmission	Cardan shaft.
Brakes	Foot external on drum behind gear box. Hand, internal expanding on rear wheels.
Steering Gear	Four life worm and wheel.
Equipment	Kit of tools and bulb horn.
Price	**£750**

Tyre Equipment—Goodrich Tyres furnished when specified.

THE W. & G. (PETROL) COMMERCIAL VEHICLES
W. & G. du CROS, Limited,
177, The Vale, Acton, W. 3.

SPECIFICATIONS

Capacity	30-cwts.	2-tons
Drive	Overhead worm	Overhead worm
Engine	25 H.P.	25 H.P.
Cylinders	Four	Four
Bore	95 m/m	95 m/m
Stroke	140 m/m	140 m/m
Wheel Base	10' 6"	11' 3½"
Tread Front	5' 0"	5' 0"
Tread Rear	4' 7"	4' 7"
Tyres Front	860 × 90 or 90 for 720	870 × 100 or 100 for 720
Tyres Rear	860 × 90 or 90 for 720	870 × 100 or 100 for 720
Frame	High tensile steel	High tensile steel
Front Axle	H-section	H-section
Rear Axle	Live axle, full floating type	Live axle, full floating type
Springs Front	Semi-elliptic	Semi-elliptic
Springs Rear	Semi-elliptic	Semi-elliptic
Carburettor	Zenith	Zenith
Cooling System	Pump and fan	Pump and fan
Oiling System	Forced feed	Forced feed
Ignition	High tension magneto	High tension magneto
Control	Ignition, throttle and foot accelerator	Ignition, throttle and foot accelerator
Clutch	Ferodo lined cone	Ferodo lined cone
Transmission	Three speeds and reverse	Four speeds and reverse
Brakes	Foot and side brakes internal expanding on rear wheels	Foot and side brakes internal expanding on rear wheels
Steering Gear	Worm and nut	Worm and nut
Prices	On application.	

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—The load capacities mentioned above are in addition to the weight of the body and usual equipment.

THE YORKSHIRE COMMERCIAL MOTOR COMPANY, [illegible]
Pepper Road, Hunslet, Leeds.

SPECIFICATIONS

Capacity	5/6-tons	4-tons	3½-tons
Horse Power	40	40	32
Bore	H.P. 4½", L.P. 7½"	H.P. 4½", L.P. 7½"	H.P. 4", L.P. 7"
Stroke	7½"	7½"	6½"
Wheel Base	12' 6"	11'	9' 9"
Tread Front	6' 5"	6' 5"	5' 9"
Tread Rear	6' 6"	6' 4"	6' 2"
Tyres Front	Single 160 m/m section for 670 m/m rim.	Single 160 m/m section for 670 m/m rim.	Single 140 m/m section for 670 m/m rim.
Tyres Rear	Twin 160 m/m section for 850 m/m rim.	Twin 140 m/m section for 850 m/m rim.	Twin 140 m/m section for 670 m/m rim.
Frame	Channel steel.	Channel steel.	Channel steel.
Front Axle	Steel forging, with centrally pivoted cudgeons.	Steel forging, with centrally pivoted cudgeons.	Steel forging, with centrally pivoted cudgeons.
Rear Axle	Best Yorkshire iron.	Chrome Vanadium steel.	Chrome Vanadium steel.
Springs	Semi-elliptic.	Semi-elliptic.	Semi-elliptic.
Transmission	From crankshaft to intermediate shaft, thence by roller chain to compensating gear on back axle.	From crankshaft to intermediate shaft, thence by roller chain to compensating gear on back axle.	From crankshaft to intermediate shaft, thence by roller chain to compensating gear on back axle.
Control	By throttle on steam pipe, forward and reverse by lever on engine.	By throttle on steam pipe, forward and reverse by lever on engine.	By throttle on steam pipe, forward and reverse by lever on engine.
Brakes	Band brake, working on large drums, bolted to each hind wheel, also band brake on second motion shaft.	Band brake, working on large drums, bolted to each hind wheel, also band brake on second motion shaft.	Band brake, working on large drums, bolted to each hind wheel, also band brake on second motion shaft.
Steering Gear	Ackermann type with powerful screw.	Ackermann type with powerful screw.	Ackermann type with powerful screw.
Prices	On application.		

Tyre Equipment—Goodrich Tyres furnished when specified.

ALBION MOTOR CAR CO., Limited—*continued from page 36.*

SPECIFICATIONS

Models	32 H.P. B.L.	32 H.P. B.N.	32 H.P. B.T. (Pan-technicon Chassis)	32 H.P. B.R.
Capacity	80-cwts	80-cwts.	72-cwts.	29 seater
Drive	Chain	Chain	Chain	Chain
Engine (R.A.C.)	32.4 H.P.	32.4 H.P.	32.4 H.P.	32.4 H.P.
Cylinders	4	4	4	4
Bore	4½″	4½″	4½″	4½″
Stroke	5″	5″	5″	5″
Wheel Base	13′ 1″	14′ 5″	14′ 5″	14′ 5″
Tread Front	5′ 10′	5′ 10″	5′ 10″	5′ 10″
Tread Rear	5′ 7″	5′ 7″	5′ 7″	5′ 6″
Tyres Front	870 × 100 m/m single solid	870 × 100 m/m single solid	870 × 100 m/m single solid	870 × 100 m/m single solid
Tyres Rear	900 × 140 m/m twin solids	900 × 140 m/m twin solids	900 × 140 m/m twin solids	870 × 110 m/m twin solids
Frame	Channel section steel	Channel section steel	Channel section steel	Channel section steel
Front Axle	Butler type built up axle	Butler type built up axle	Butler type built up axle	Butler type built up axle
Rear Axle	Solid fixed axle	Solid fixed axle	Solid fixed axle	Solid fixed axle
Springs Front	Semi-ellipticle anchored front, slipper at rear.			
Springs Rear	Semi-ellipticle, slippers front and rear.			
Carburettor	Automatic (Albion Zenith).			
Cooling System	Albion-Murray Patent combined fan and pump.			
Oiling	Albion-Murray Patent mechanical lubricator.			
Ignition	H.T. magneto.			
Control	Hand throttle and ignition control and foot accelerator throttle control.			
Transmission	Three-speed gear box.			
Brakes	Foot acting on drum fixed to gear box. Hand internal expanding type.			
Steering Gear	Worm and segments.			
Equipment	Useful tools, lamps (side and tail), horn, etc.			
Price	On application.			

Tyre Equipment—Goodrich Tyres fitted when specified.

THE GARRETT PATENT (ELECTRIC) COMMERCIAL VEHICLES

continued from page 56.

Motor (capable of 300% overload)	6 H.P.	6 H.P.	8 H.P.
Steering Gear	Special adaptable worm and nut, giving easy adjustment of backlash.		
Transmission	From motor to countershaft by silent chain in oil bath, and thence by silent roller chains to rear wheels. Ball and roller bearings throughout.		
Brakes	Internal expanding hand brake and external contracting foot brake, both acting on rear wheels.		
Equipment	Sangamometer with automatic cut out, main switch, main fuse, lighting switches and fuses, plug for hand lamp, receptacles for E.V.C. plug; electric front and tail lamps, speedometer, hydrometer, all necessary tools and accessories.		
Prices	On application.		

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—The Garrett patent control gear reduces cost of current and prevents damage to motor or battery, besides ensuring easy and safe control. The single motor gives equal power with less weight than with the double motor system, besides reducing cost of upkeep. The batteries are sectionalised and carried in special trucks, so arranged as to be readily withdrawable for inspection. Any special type of body work can be fitted to the chassis to suit customers' requirements.

LEYLAND MOTORS, Ltd.—*continued from page 64.*

SPECIFICATIONS

Models	G6 (long Wheel Base)	G7 (Passenger)	G8 (Overseas)	P2	Q2
Capacity	4-tons	4-tons	4-tons	5-tons	6-tons
Drive	Bevel	Worm	Bevel	Bevel	Bevel
Engine	36-40	36-40	36-40	40-48	40-48
Cylinders	4	4	4	4	4
Bore	4⅝″	4⅝″	4⅝″	5″	5″
Stroke	6″	6″	6″	6″	6″
Wheel Base	15′ 10″	15′ 10″	15′ 1½″	15′ 1½″	15′ 10″
Track Front	5′ 6″	5′ 6″	5′ 6″	5′ 6″	5′ 6″
Track Rear	5′ 4″	5′ 4″	5′ 4″	5′ 4″	5′ 5½″
Tyres Front	(880) 130 for 720	(880) 130 for 720	(1050) 130 for 881	(900) 140 for 720	(900) 160 for 720
Tyres Rear	(1050) 130T for 881	(1020) 130T for 850	(1050) 130T for 881	(1030) 140T for 850	(1050) 160T for 850

Frame	Pressed nickel steel.
Front Axle	Ackerman type stamped nickel steel.
Rear Axle	Bevel or worm.
Springs Front	Semi-elliptic.
Springs Rear	Semi-elliptic.
Carburettor	Claudel-Hobson.
Cooling System	Water pump circulation.
Oiling System	Forced feed lubrication.
Ignition	Single H.T. magneto.
Control	Hand and foot.
Clutch	Cone type.
Transmission	By gate change 4 speed and reverse gear box.
Brakes	Two, footbrake back of gear box, hand brake on rear road wheels.
Steering Gear	Worm and sector.
Equipment	Useful tools.
Prices	On application.

y Equipment—Goodrich Tyres furnished when specified.

Special Note—The Company also manufacture large numbers of Turbine pump motor fire engines of 350 and 500 gallons capacity, Municipal vehicles of all types, and Steam wagons.

The McCURD MANUFACTURING CO., Ltd.—*continued from page 67.*

SPECIFICATION

Clutch	Cone Ferodo Fibre lined.
Transmission	Selective sliding gears, four and reverse.
Drive	Overhead worm.
Brakes	13″ dia. foot brake, external contracting on rear main shaft of gear-box. 16″ dia. hand brake, external contracting rear wheels Ferodo lined.
Steering Gear	Worm and worm gear.
Equipment	Useful tools.
Prices	On application.

Tyre Equipment—Goodrich Tyres furnished as optional equipment.

Special Note—Same specification serves for our five tonner, except that a heavier frame is used, and suitable springs and gearing. The wheel base and frame length can always be varied to fulfil customers' special requirements.

EDISON ACCUMULATORS, Ltd.—*continued from page 50.*

SPECIFICATION

Model	LN
Capacity	5-ton
Drive	Chain
Wheel Base	11′ 10″
Tread	6′ 0″
Tyres (Front	36×6, 30″ fitting
Tyres Rear (twin)	36×6, 30″ fitting
Frame	Pressed steel
Speed	8 m.p.h.
Miles	30
Front Axle	Drop forging, I-section
Rear Axle	Rectangular nickel steel forging
Springs Front	Semi-elliptic
Springs Rear	Semi-elliptic
Battery Equipment	60A-12 Edison cells 450AH
Motor	Series type of ample capacity
Steering Gear	Worm and sector
Transmission	Differential countershaft and roller chains
Brakes	Cam operated expanding bands
Prices	Upon application.

Tyre Equipment—Goodrich Tyres furnished when specified.

Special Note—The above by no means represents all the types and sizes of Edison accumulator vehicles we supply. The information only refers to those models selected as specimens. We also have chassis of the following load capacities in various models: ½-ton, 1-ton, 2-ton, 3½-ton and 5-ton.

Relation of Tyre Equipment to cost of Maintenance of Commercial Vehicles

Extracts from the Paper Delivered Before the Motor Truck Club of America by S. V. Norton, Manager, Truck Tyre Sales, The B. F. Goodrich Rubber Company, Akron, Ohio.

WITH the passing of horse-drawn, and the coming of motor-propelled, vehicles the question of tyre equipment has assumed an importance demanding the most careful attention. Fundamentally, the tyre must perform three functions: (1) It must secure traction. (2) It must preserve the mechanism of the vehicle. (3) It must cushion the load.

In view of the fugitive nature of rubber tyres as compared with steel, the question naturally arises, "Why use rubber?" The answer is simple. We use it for lack of anything better. Steel tyres slip; others may overcome this feature, but they lack resilience. Rubber is not wholly satisfactory, but it is the best material known for the purpose. To-day, with careful selection and intelligent use, a rubber tyre will do its work well, and comparatively economically. Rubber manufacturers are the first to acknowledge that they do not know all about rubber. Nevertheless, much has been learned through experience, and they realise the importance of acquainting its users with its possibilities and its limitations.

Let us assume that the tyre, when originally applied, was selected in accordance with the tyre manufacturer's schedule of carrying capacities, with a view to sustaining a known portion of the load. So long as the tyre is used in accordance with the schedule, provided the roads over which it travels are reasonably good, it should deliver uninterrupted service for upwards of 7,000 miles on rear wheels, and considerably more than this on fronts. I can give you many instances of exceedingly satisfactory mileage delivered as a result of careful, intelligent usage. Fortunately, commercial motor vehicle makers are beginning to realise the important part played by drivers in the satisfactory performance of their vehicles, and drivers' schools are being organised for the purpose of reducing the cost of maintenance through intelligent handling.

But at the same time, motor vehicle users must expect to receive unsatisfactory results through carelessness and neglect of tyres. Perhaps the most common abuse to which vehicle tyres are subjected is that of overloading. Much has been written and said about this matter, but among motor vehicle owners and drivers it seems to be little understood. What actually happens to rubber when it is overloaded? Let me explain. When you stretch a strong, properly vulcanised piece of rubber and then release it after a moderate strain, it will snap back into its original shape. You can do this indefinitely and the rubber will continue to "come back." But if you stretch it until it breaks, it can never be restored to its original form. The damage has been done and the rupture is permanent. In the same way, you may compress a piece of properly vulcanised rubber within certain limits, and when it is released it will spring back to

its original shape and size. This process may be repeated indefinitely, so long as its limit of compression has not been reached, and you will not destroy its elasticity. The first time it is compressed beyond its power of resistance, however, the rubber will break down just as inevitably as when stretched beyond its limit of elongation. The disintegration is permanent, and no method of treatment will ever bring it back to its normal condition. Thus you see the great danger of ruining solid tyres simply from once overloading them. "How is it," you ask, "that tyres may be overloaded and still not show it?" The answer is that the rupture may not be apparent because the broken parts are held in place by others not yet noticeably affected. The strength of the tyre has been vitally impaired, however, and it will be but a comparatively short time before the whole rubber structure begins to disintegrate and give way.

Over-speeding has a tendency to generate heat within the tyre as a result of the rapid displacement and release of the rubber, as well as friction with the road surface. This effect is, of course, more noticeable in hot weather, when contact with heated pavements adds even more heat to the tyre. Again, the probability of cutting the tread of the tyre is much increased when the vehicle is running at high speed, due to the additional momentum with which bumps and depressions are encountered. The serviceable life of the tyre is practically reduced to 25% of what might be normally expected of it.

We know of no anti-skid device that does not (to some extent) injure tyres. Some devices are more injurious than others. The loose chain has been found the least so, because it works itself around the wheel and provides an equal distribution of the wear and strains. Stationary devices are most injurious, because the wear and strain are constantly confined at the points of bearing.

The traction (rear) wheels are liable to spin more or less in slippery places, which produces a sharp blow on the tyres where these devices are in contact. The force of such blows increases as the distance between the cross-pieces of the device is increased because of the momentum the wheels gain between these points. Less injury will result if such devices are used only temporarily to pass over soft, slippery places. It is also advisable to use a device having numerous cross-pieces.

Great injury results from careless and continued use of anti-skid devices on pavements or hard roads where there is littie or no need for them.

To get maximum service, tyres must be run under reasonable road conditions. From the point of view of tyre-economy the selection of a better roadway, though considerably longer than a more direct route which has bad roads, is always advisable if possible.

In the same way, injuries resulting from running solid tyres in car lines are serious and readily apparent. The rigid construction does not permit of ready distribution of a part of the load to the lower flange of the rail, and the major part of the load is carried upon the upper level. This throws the entire load on to one-half of the tyre tread, with the result that it is rapidly worn or broken away on one side, eventually leaving the width of the tyre reduced by one-half to carry the original full load.

It is obvious that a tyre will prematurely fail under these conditions. Moreover, the additional wear produced by getting into and out of the lines has a decidedly costly effect on the life of a tyre.

The weakening of one unit of a dual tyre in this manner naturally throws an overload on its mate at the point of injury, which may cause it to fail.

It must not be supposed from this long array of danger signals that it is impossible to operate motor vehicles economically and at the same time with a normal amount of wear and tear on the tyres. It is distinctly possible to do this, as the constantly increasing number of satisfied users of motor vehicles abundantly testifies.

Moreover, in justice to the motor vehicle user as well as the tyre manufacturer, it should be said that under certain conditions it is unquestionably good business to use the vehicles so hard and so continuously that you deliberately wear out both tyres and mechanism prematurely, with the object of making large profits in a comparatively short period. Such cases are rare, however, and it should be well understood that both tyre and vehicle guarantees are forfeited when a man overloads, overspeeds, and overworks his machine in so-called intensive service.

At this point the question naturally arises, "What does a motor vehicle tyre guarantee really mean?" Some users seem to feel that if a tyre is guaranteed by its manufacturer for a certain number of miles, it cannot be destroyed before it delivers its guaranteed mileage. Mr. A. E. M. Turner, of London, a well-known European authority on motor vehicle engineering, writes as follows on this subject in *The Commercial Vehicle*:

"Unfortunately for the user who has bought a small and perhaps cheap section of tyre, there may be attached to them a so-called guarantee, of, say, 10,000 miles; that is, the mileage which the tyre maker assumes the tyres will do. This guarantee is really only of value if the tyre maker wants to retain the business, and I will try to explain how it operates. The user must keep a record of mileage run, and assuming after 3,000 miles there is one failure out of the set, he writes to the tyre maker pointing out the failure and asks for a new tyre to replace the one worn out. If the user's figures are accepted (mileage recorders are not infallible and returns may be queried), then the user gets a new tyre, for which he is charged in full, while a credit of 7,000 miles is allowed. Of course, there has been a delay; the wheel has to be taken off the vehicle, sent to the tyre manufacturer and returned. In about three weeks another tyre possibly fails, and the process is repeated over and over again.

"The user then begins to find that he is losing a lot of working time with his vehicle for which he gets no value; he is busy checking invoices and worrying around, and finally after, say, six months of incessant annoyance, he decides to have a decent make and large section of tyre. He then finds that he has to bear the loss of the mileage between that accomplished by each tyre and the elusive 10,000-mile guarantee, which thus proves of no value. This may mean two-thirds of the invoiced cost. Then he has to bear the expense of wheel alterations, fitting new steel and

tyres, at a considerable capital cost, whereas all this trouble might have been avoided if good advice had been tendered to him in the first instance."

If space permitted, I should like at this point to give you some idea of the difficulties confronting the men in charge of adjustments for the tyre companies. There is no disposition, I am sure, for the tyre companies to evade any reasonable responsibility for defects of materials and workmanship which may give rise to short mileage. On the other hand, there are so few ways of checking the abuses which fall upon motor vehicle tyres for which the tyre manufacturers are frequently held responsible, that the task of the average tyre adjuster is not an easy one.

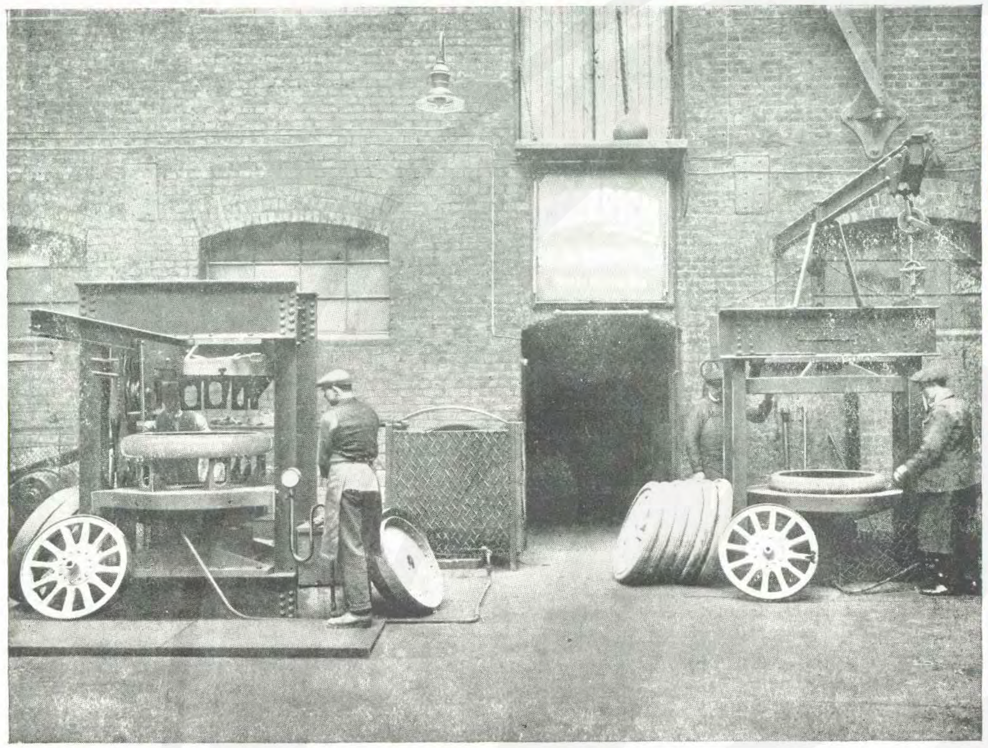
With this brief mention of the difficulties alluded to, let us consider how commercial motor vehicle users can reduce the relative cost of tyre equipment, as compared with the cost of the other factors in the upkeep of his vehicle. In other words, "What is the secret of tyre economy?" Fundamentally, the vehicle is only saving or earning money when it is in service, consequently that tyre equipment which enables the vehicle to give most continuous service is the most economical. This applies equally well for both gas and electric vehicles, as will be shown later.

First of all, the most economical tyre equipment for any vehicle is the largest which can be used and still be compatible with the size of the machine. It is poor economy to use small tyres which have to be renewed frequently, and which provide no factor of safety in case of overload. If tyres used as original equipment fail to deliver guaranteed mileage, renewals should be made with a tyre of large enough size to provide for the nature of the work involved, either as regards the loads carried or the roads over which the vehicle operates.

Next, the tyre when applied should be so attached to the wheel that it need not be removed until it has delivered its expected mileage, and has been worn down so that it no longer cushions the load. In Europe the Demountable Tyre has not been considered as satisfactory in this respect as the Pressed-On type, and in this country Demountable Tyres as a rule do not give as high mileages as Pressed-On types. At the same time, the Demountable type has its advantages, although it will always necessarily embody mechanical features which may give trouble, such as loosening of bolt equipment, improper application, etc. In the Pressed-On type these sources of trouble are removed, although, of course, in the case of these tyres, renewals when necessary have to be made at a greater sacrifice of time and labour.

The next most important factor in tyre economy unquestionable is careful driving. Two vehicles of the same make, travelling over the same route, and doing identically the same kind of work, may show differing costs of maintenance, due to the carefulness or carelessness of the drivers. The bonus system, as used abroad, has a tendency to promote careful driving, and unless other means are provided to bring this about, should be encouraged.

Tyres should be given frequent and careful inspection, as they are often an index of the general condition of the machine and of the care of the driver—they really afford a check on the way in which the vehicle has been used.



THE "GOODRICH" BAND TYRE FITTING PRESS.

FIFTEEN HELPFUL SUGGESTIONS

For the Fitting and Detaching of Solid Band Tyres.

1. Carefully clean the dirt and rust from the friction face of the rim or steel wheels with a rag soaked in paraffin oil, and remove any unevenness with a smooth file.

2. Measure the outside diameter or the circumference of the rim (or steel wheel), and compare the dimensions thus found with those stated in our price list for the size of tyre to be fitted.

3. If the rim is found to be too large but thick enough to stand reducing, it must be turned down to the correct size. Should this not be possible, a new rim will be necessary.

4. If the rim (or steel wheel) is too small, and provided that the difference in the diameter is not greater than 3 mm., such deficiency is to be made up by using a layer of sheeting zinc of the required thickness and about one inch wider than the rim, which must be laid round the rim, cut into with metal scissors all along the projecting upper edge inch by inch, burred over on that side and temporarily held tight against the face of the rim by means of the contracting steel tape, the position of which must gradually be lowered in order to prevent the zinc packing from slipping while the tyre is being pressed on. For instance, if the rim (or steel wheel) is 2 mm. too small in diameter, then use sheet zinc of 1 mm. thickness all round the wheel and the tyre will fit properly. If the difference is but 1 mm. use 1 mm. packing half way round. When a tyre has been fitted in this manner the metal packing which projects from under the tyre must be carefully chiselled away flush with the tyre so as to make a clean job of it. On some occasions it will not always be possible to procure sheet zinc; as an alternative sackcloth or canvas may be used, although in cases where it is necessary to resort to canvas for this purpose, this must be carefully wrapped evenly round the tyre to the required thickness, the ends of the canvas being kept in position

by string ties, after which the tyre must be pressed evenly on to the wheel, the canvas
round the tread being cut away at the base as soon as it has been ascertained that the
packing provides a tight fit sufficient to make a permanent fixture.

5. Care must be taken that the wheel is placed dead in the centre of the lower
table of the hydraulic press; the bevelled edge of the rim on that side of the wheel
which has no fixed flange pointing upwards.

6. Apply Russian tallow (heated in order to make it liquid) with a brush round
the upper edge of the steel band, which is in the tyre. If tallow is not at hand soft
soap must be used.

7. Lay the tyre on the wheel and then make sure that the outlet valve of your
press is shut. Work the lower table up by means of the pumps, or if the water is
supplied from the main pressure pipe, by opening the inlet valve, after which the wire
guard must be closed.

8. Commence pressing on, but stop the press by ceasing to pump (or if main
pressure is used by turning off the inlet valve) when the tyre is about ¼ inch on the
wheel, so as to ensure that it has an even grip all round. If necessary lower the press
by opening outlet valve (if main pressure is used the inlet must first be turned off), lift
the tyre off the wheel and place it right. Then press the tyre into the required
position, working the press slower towards the end.

9. If overlapping rims are on the wheel 4-6 concave blocks, according to the size
of the tyre, should be used to get the tyre right in the middle of the wheel. These
blocks must be placed on the steel band of the tyre as near as possible to the rim (or
face of the steel wheel) but not touching same, and they should be held in position till
they are gripped by the upper table. There is danger of forcing a tyre out of shape,
and even breaking it, if a block gets on the rim. If the block is not well on the tyre
band it may slip off into the rubber and separate it from the band, or it may even fly
out from the press and hurt the workmen.

10. Concave blocks are also to be used for fitting twin tyres, and each tyre must be
fitted separately in order to determine exactly the pressure required. Care is to be
taken that projecting hubs, sprocket or pinion wheels are not damaged during the
process of tyre fitting, and if necessary the wheel must be supported and kept clear of
the lower table of the press by resting on convex blocks, which, however, must bear
the wheel on its rim or outer edge and not touch the spokes or felloes.

11. The following table is a guide for admissible minimum and maximum pressures.
Try to be near the medium:

Tyre Section.	Minimum Pressure.	Maximum Pressure.
65 mm.	8 tons	22 tons
75	8	24
85	10	25
90	10	27
100	13	30
120	13	40
130	13	40
140	13	45
160	13	49

12. The total pressure in tons used for each individual tyre fitted must be put on
record in a special book where the size of tyre, number and date when fitted have
been entered. The pressure gauge must be kept under observation during the whole
process of fitting.

13. When double-action hand pumps are used the lever working the large diameter
plunger is for low pressure, in order to get the press table up quickly; the lever
working the small diameter plunger serves when high pressure is required and when
the actual fitting of the tyre commences.

14. In order to detach tyres it is necessary to support the wheel by resting it on
convex blocks; the tyre or tyres are then pushed off the wheel. It is quite wrong,
however, to reverse this process by pushing the wheel through the tyres, as serious
damage may be done through a heavy drop of the wheel, even if it is only a few inches.

Should the detaching seem impossible owing to the steel band and steel rim
being rusted together, sprinkle paraffin oil between the rim and steel band and let it
thoroughly soak through, when it will soon eat the rust away, and thus enable the
tyres to be pressed off. Higher pressures are usually necessary for detaching tyres.

15. The wire guard must be closed whenever hydraulic pressure is applied.

We have installed a Band Tyre Fitting Press in each of the following Branches: Manchester, Leeds, Bristol, Birmingham, Newcastle, and shall shortly instal one in Glasgow and Norwich

The Commercial Motor Users Association.

(Incorporated.)

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C.M.U.A. Traffic Rules and Recommendations

1. Drive on left or near side of the road.

2. A vehicle is under " town control " when it can be stopped in about 30 feet, and under " close control " when it can be stopped in about 10 feet.

3. Vehicles in crowded traffic must always be driven under " close control."

4. In turning corners to the right curve out wide; those to the left turn close to the kerb, both under " close control." Whenever the driver's view is limited, his control of his vehicle should be so complete that he can pull up within half the distance that he can see ahead of him.

5. Vehicles meet—driver's right arm to driver's right arm.

6. Overtake on right or off side only.

7. Overtaking demands special care on the part of the driver of the overtaking vehicle. Give proper warning and overtake without undue delay.

8. When necessary to overtake at corners, bends in the road, crossings, or street refuges, extra caution is required.

9. Meet or overtake a led animal so that the person in charge is between you and the led animal.

10. Go down hills under " town control."

11. HAND SIGNALS.

    Stop—Right forearm verticle.

    Turning to Right—Right arm horizontal.

    Slow Down—Right arm horizontal, palm of hand down and moved slowly up and down.

    Turning to Left—Right arm horizontal and then swept to left.

    Pass—Right arm waved low from rear to front.

ALL SIGNALS TO BE GIVEN ON THE RIGHT HAND SIDE OF THE CAR AND IN AMPLE TIME TO BE OF USE.

The Commissioner of Police of the Metropolis considers these recommendations suitable.

(Abstracted by permission of the C.M.U.A.)

Weights of Materials commonly Hauled by Commercial Vehicles

METALS.

	Wt. per Cu. Yd.
Aluminium	4495
Brass	14470
Bronze	14900
Copper	14900
Iron, Cast	12150
Iron, Wrought	12960
Lead	19160
Steel	13220
Tin	12375
Zinc	11785

WOOD.

Ash	1215
Cedar	1063
Elm	1026
Hemlock	648
Hickory	1296
Mahogany	1377
Oak, red	1242
Oak, live	1863
Oak, white	1296
Pine, white	756
Pine, yellow	1026
Poplar	810
Spruce	756
Walnut	972

COKE AND COAL.

Anthracite	1485-1782
Bituminous	1350-1485
Cumberland	1421
Cannel	1358
Charcoal (hardwood)	499
Charcoal (pine)	486
Coke	621-864

LIQUIDS.

Water	1674
Petrol	1188
Muriatic Acid	2025
Nitric Acid	2052
Sulphuric Acid	3105
Linseed Oil	1592
Petroleum	1485
Tar	1674
Vinegar	1809
Fuel Oil	1475

STONE, BRICK, CEMENT, Etc.

Asphalt	2329
Brick, soft	2700
Brick, common	3024
Brick, hard	3375
Brick, pressed	3645

STONE, BRICK, CEMENT, Etc. *cont.*

	Wt. per Cu. Yd.
Brick, fire	3780-4050
Brickwork in mortar	2700
Brickwork in cement	3024
Cement, Rosendale	1620
Cement, Portland	2106
Clay	3240-4050
Concrete	3240-3780
Earth, loose	1944-2160
Earth, rammed	2430-2970
Glass	4212-4644
Gravel	2700-3240
Granite	4320-4590
Gypsum	3510-4050
Lime, quick	1350-1485
Limestone	4590-5400
Marble	4320-4860
Masonry	3780-4320
Mortar	2430-2700
Pitch	1944
Plaster of Paris	1998-2160
Quartz	4455
Sand	2430-2970
Sandstone	3780-4050
Slate	4590-4860
Stone (various)	3645-5400
Trap	4590-5400
Tile	2970-3240
Soapstone	4482-4725

BEER.

	Pounds.
Cases, 24 pints	60
Cases, 24 quarts	100
$\frac{1}{8}$ barrels	50
$\frac{1}{4}$ barrels	100
$\frac{1}{2}$ barrels	200
1 barrel	380
Casks	760

MILK.

10 gallon cans	110
Case 12 qt. bottles	60
Case 20 pt. bottles	60

PRODUCE.

Flour in barrels	220
Sugar in barrels	360
Sugar in $\frac{1}{2}$ barrels	150

PIANOS.

Unboxed	700-900

GRAIN.

Wheat per bushel	60
Corn per bushel	56
Oats per bushel	30

British Standard Rim Diameters for Solid Tyres.

EX. REPORT No. 71-1917.

In July, 1916, the Committee were asked by the Society of Motor Manufacturers and Traders, Ltd., to standardise Solid Tyre Band Circumferences. The Committee agreed to undertake the work, and for this purpose some representatives of the Society's Solid Tyre Committee were nominated by the Society to confer with Sub-Committee H. As a preliminary to standardising the internal circumferences of the Solid Tyre Bands, it was found essential to reduce the manufacturing tolerances allowed on the circumferences of the Standard Wheel Rims so as to ensure a satisfactory metal to metal fit between the Wheels and Tyres. The Sub-Committee was consequently enlarged to include representatives of the Automobile Wheel Makers, and a representative of the Commercial Vehicle Committee of the Society of Motor Manufacturers and Traders Ltd. Having agreed on a reduction in the manufacturing tolerances to be allowed on the Standard wheel rim circumferences, some tentative tolerances for the internal circumferences of the tyre bands, based on a metal to metal fit between the tyre band and wheel rim, were drawn up and the proposed limits were submitted to a number of the leading wheel makers and tyre manufacturers in this country for criticism, and after due consideration of the replies received the limits given in the following Report were agreed to. It is confidently hoped that when these revised limits are worked to in practice the trouble that has been experienced through the want of fit between the wheel rims and tyres, often necessitating the use of loose packing pieces, will be eliminated and the use of raised flanges rendered entirely unnecessary.

EX. REPORT C.L. 8564-1920.

The urgent need for reducing the great number of sizes of Rubber Tyres in use on Automobiles having been recognised by the British Rubber Tyre Manufacturers' Association, a scheme for that purpose was suggested by them and submitted to the British Engineering Standards Association for consideration and eventual issue as British Standards. The scheme was considered and certain modifications were made to the proposals, and these are embodied in the present Report and have been accepted by the British Rubber Tyre Manufacturers' Association. In consultation with the American Society of Automotive Engineers (one of the sponsor bodies of the American Engineering Standards Committee), the S.A.E. Standard Tyre sizes, both pneumatic and solid, have been included in the list, a further step thus being taken in the direction of Anglo-American co-operation.

British Standard Dimensions of Wheel Rims and Tyre Bands for Solid Rubber Tyres for Automobiles.

FIT OF TYRE BANDS ON RIMS.

The Tyre Bands of the Solid Rubber Tyres shall be a metal to metal fit on the Wheel Rims.

METRIC SIZES.

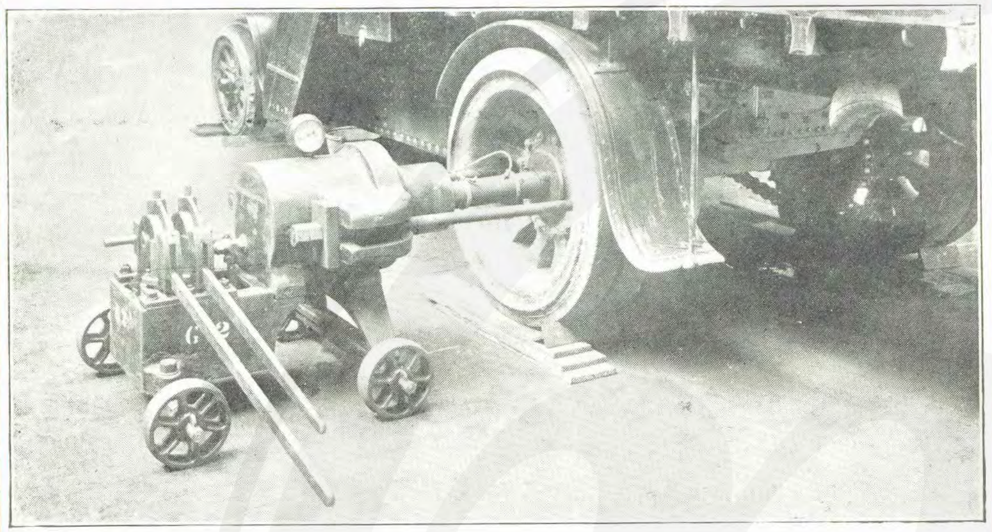
Wheel Rim Diameters. millimetres	Tyre Sections (Width at Base). millimetres					
670	—	—	—	140	160	180
720	90	100	120	140	160	180
771	—	100	120	140	160	180
850	90	100	120	140	160	180

Sections larger than 180 mm., if made as single tyres in lieu of twins, to be made to 850 mm. rim diameter only.

INCH SIZES.

Nominal Overall Tyre Diameters. inches	Tyre Sections (Width at Base). inches										Actual Rim Diameters. inches
32	3	3½	4	—	—	—	—	—	—	—	26
34	—	3½	4	5	—	—	—	—	—	—	28
36	—	3½	4	5	6	7	8	10	—	—	30
40	—	—	—	5	6	7	—	10	12	14	34

* The information on these two pages (94 & 95) has been abstracted by permission of the British Engineering Standards Association, from their publications Report No. 71, revised 1917, and "British Standard List of Rubber Tyres for British Standard Rims" (C.L. 8564-1920).



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Full particulars on request.

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BAND TYRE DEPARTMENT.

Date ____________

Dear Sirs,

We are interested in your specifications as listed in "Commercial Vehicles of Great Britain," published by the B.F. Goodrich Co., Ltd., 117–123, Golden Lane, London, E.C., and would like to receive your catalogue and terms. We are engaged ____________ in the business and operate ____________ horses, also ____________ Commercial Vehicles.

Yours faithfully,

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Date ____________

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Yours faithfully,

Name ____________

Address ____________

Date ____________

The B.F. Goodrich Co., Ltd.,
117–123, Golden Lane, London, E.C.

Dear Sirs,

Please send us, post free by return, copy of your Millimetre and Inch Band Tyre Catalogues with current prices and terms.

Yours faithfully,

Name ____________

Address ____________