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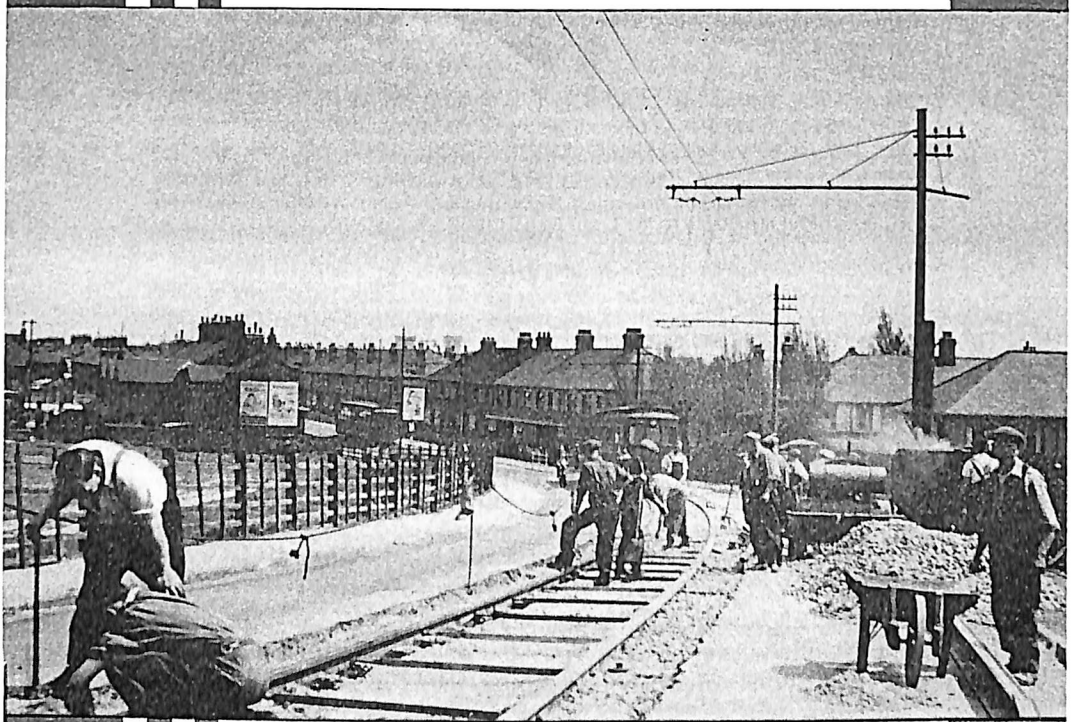

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The Development of the Manchester Bogie

N. F. Henley

Introduction

The development of the MAXIMUM TRACTION bogies, as fitted to the tramcars of the Manchester Corporation Tramways Department is an intriguing story, and one which constantly tempts the searcher into several dark tunnels of uncertainty and conjecture. The fact that so many records of the various tramways and tramcar suppliers have been destroyed is a real disaster, but an added obstacle to the rediscovery of more factual information is the loss of the persons most intimately associated with the developing tramways and their suppliers. However, that does not preclude any researcher from locating and delving into whatever material remains. One great difficulty the enthusiasts must expect to encounter is the alarming ease with which they can be side-tracked into following the many interesting, and varied, avenues leading from the main route. Having resisted these temptations, the final hurdle appears to be the many interpretations which can be placed upon the details which are unearthed.

Possibly this paper will exhibit many examples of these mistakes, but it is hoped that any misinterpretations will encourage others to set the record straight. In this way the exercise will have been well worth while.

At this point it is only fair to say that the writer has relied very heavily on the few books and pamphlets that are readily available—including the excellent works of E. Harper Charlton; J. H. Price; M. Goodwyn; and Clifford Taylor. In addition help has been readily forthcoming from many other sources including the many individuals giving freely of their time and generously sharing their knowledge.

No complete account of the development of the Manchester Corporation Tramways Department type maximum traction bogie (MxT) would be complete without (a) a reminder of what a bogie is and (b) a brief look at the earlier history of events in the United States of America where electric tramcars (streetcars/ interurbans) had developed earlier than was the case in Great Britain.

What Constitutes a Bogie?

Before attempting to answer this question it is advisable to remember that a bogie (truck in USA) comprises many parts, and it is probable that, in many cases, the manufacturers did not make all the parts themselves but sub-contracted some of the work, as is current practice in the motor car industry.

M. Goodwyn in his book "The Evolution of the British Electric Tramcar Truck"[1] on page 4 writes:—

"What constitutes a bogie/truck?

1. It must guide and carry the vehicle safely along the track.
2. It must provide a resilient support for the vehicle and its load.
3. It must accommodate the means of propulsion.
4. It must provide the means of stopping/braking."

Any reader wishing to follow the development of other types of bogie is advised to read Mr. Goodwyn's interesting and informative book.

The type of bogie with which this section is concerned is the maximum traction type—equipped with a single motor where the majority of the weight, usually about 75%, is carried on the driving axles. The most common example is the J. G. Brill 22E type, and its imitators, which was produced well into the 1920s. M. Goodwyn, ibid page 11, said "...the MxT bogie predominated in Gt. Britain—of the 200 or so designs of bogie in use here less than one quarter were equal wheel bogies". No less than fifteen manufacturers in Gt. Britain produced their own version of a MxT bogie, whilst E. H. Charlton[2] quotes eighteen American manufacturers as making them in the USA.

Inevitably several of the MxT bogies produced over the years resembled one another simply because many, if not all, of the options had been tried—successfully or unsuccessfully. The saga of these 'copies' will become evident as the story unfolds. The reader is invited to see the similarity of the springing of the Burnley type MxT bogie to the Series 11 of J. G. Brill.

It is likely that many makers' name plates were removed from bogies during overhaul and repainting—never to be replaced. This adds to the confusion as to who the makers were, but it must be remembered that some manufacturers incorporated their names into the castings of parts used on the bogies.

In passing it is worth noting a notice by J. G. Brill in *Tramway and Railway World* for 2 June 1910, the final sentence of which reads:—"All genuine Brill-made trucks bear the J. G. Brill Company's name plate and Shop Order Number. We caution any contractors offering a 'Brill type' of truck as a Brill truck."[3]

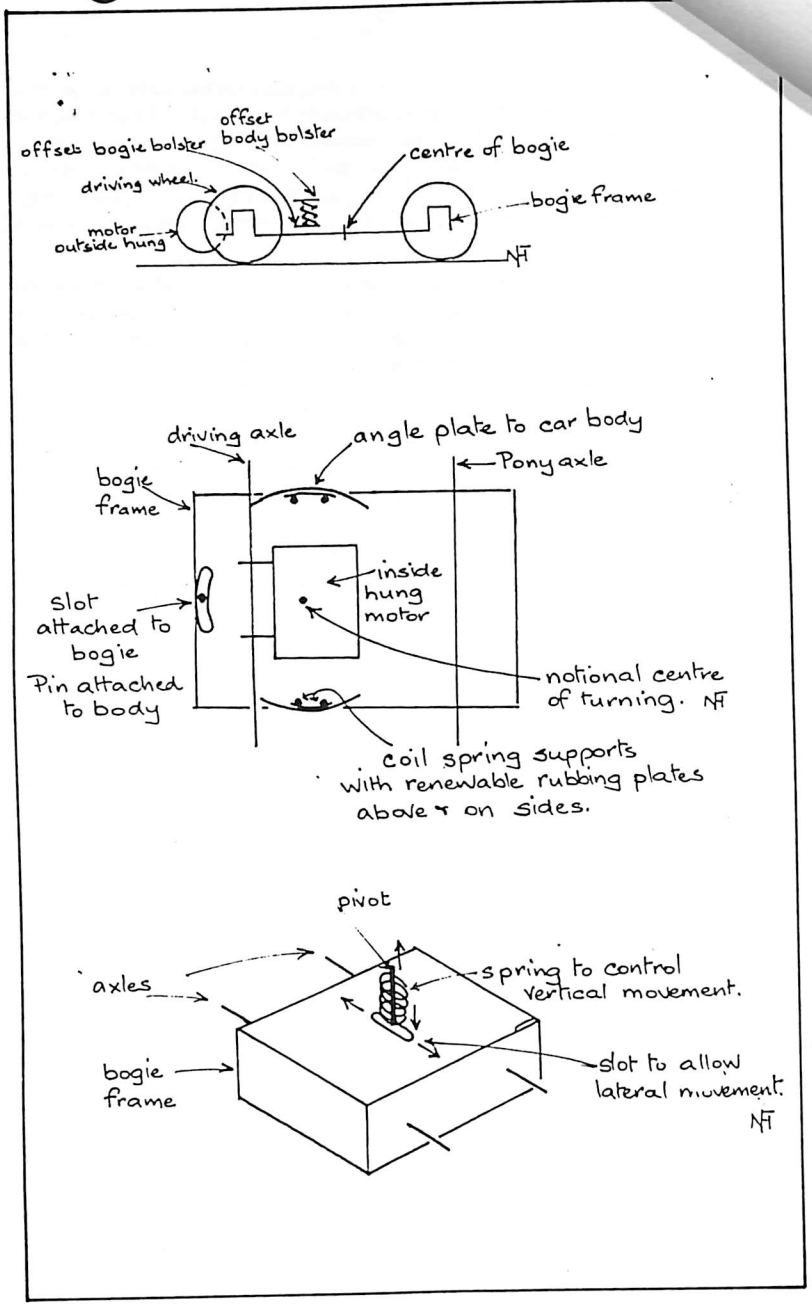
Brill's solution was the centreless bogie, i.e. with no king pin, but a notional centre and three point control of the bogie turning movement. This method left the centre of the bogie free for the inside mounting of the motor.

Readers with model railway interests will be familiar with the simple bogie as fitted to pre-war Hornby locomotives and carriages, sometimes refined by the addition of a coil spring mounted around the king pin and even with a simple slot (on top of the bogie structure) to permit a small amount of lateral movement.

The next problem of designing a MxT bogie was how to place an additional percentage of the weight on to the driving axle. As we shall see Reckenzaun produced the simple answer by "off-setting" the bolster from the mid point of the bogie wheel base towards the driven axle.

(1) Tramway & Light Railway Society, 1977.
(2) E. H. Charlton, "Electric Railway Car Trucks", page 13. Published by Harold E. Cox (1967).
(3) Quoted in full by J. H. Price in his book "The Brush Electrical Engineering Co. Ltd., and its Tramcars", pages 25-6. Tramway and Light Railway Society 1976.

Opposite:—
Fig. 1. THE ELEMENTS OF THE BOGIE TRUCK *(N. F. Henley*



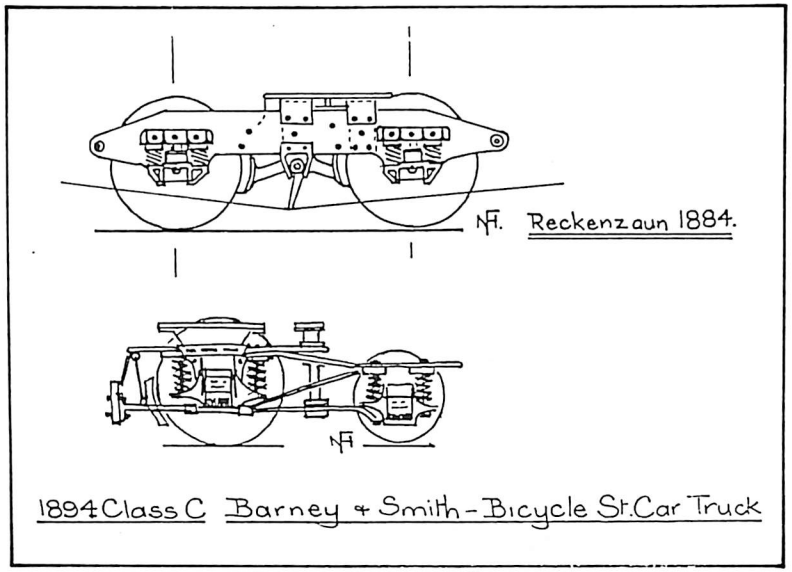


Fig. 2. EXPERIMENTAL BOGIE TRUCKS
Above: Reckenzaun 1884.
Below: Barney & Smith 1894.

The Origin of a Name (Maximum Traction)

By definition a MxT bogie can only be one where the power is applied to all the axles and all the wheels. Since this is not the case with the MxT bogies an alternative name, and some might say a more apt description, is the 'one motor' or 'single motor' bogie. This name did appear on some advertising material.

The origin of the maximum traction name is clouded in some obscurity. The first bogie, whereby weight was unequally distributed in order to place more weight on the driving wheels, must surely be the version designed by Anthony Reckenzaun in 1884. This bogie, with equal sized wheels, had about 70% of the weight directed upon the driving wheels by means of an off-set bolster and king pin. This bogie was tried out on a battery tramcar in Battersea (1885)—where it proved to be quite successful. Later Reckenzaun experimented with a car in Berlin equipped with worm drive, rheostatic braking and series/parallel control—obviously a man before his time! However, there seems to be no record of Reckenzaun, who died in America in 1893, ever having used the term maximum traction to describe his bogie. Perhaps this is because so little has been written about this man.

Probably the next variant was the Barney & Smith version, known as the Bicycle Truck (1894)—with three point 'suspension'. The Barney & Smith "c" type (1894) was equipped with one motor and was of MxT design, and was first used in Dayton, Ohio. Other variations resulted in the development of the "E" class (1895) and the class "I" (1899). This latter bogie was known as the Suspension Spring Truck and was built of solid rolled bars. The "E" type had semi-elliptic springs under the bolster plate.

The Brill Progression

This now leads us on to J. G. Brill of Philadelphia to whom E. H. Charlton attributes the origin of the name Maximum Traction—in connection with the firm's Class 11 bogie.

Brill 10 (1890). A pivotal truck with king pin, equal wheels, inside mounted single motor bogie. The bolster was located closer to the driving axle instead of being at the mid point of the wheel base. The frame was of arch-bar construction with the brakes located outside. A name given to this type of bogie was the MINIMUM TRACTION TRUCK (bogie).

Brill 11 (1891). A MxT bogie with no load on a centre plate. The single motor was mounted inside and the brakes were outside, although stated to be inside. It was named the Maximum Traction Truck (bogie)—with about 80% of the weight directed on to the driving wheels.

Brill 11A (1891). This bogie was similar to the class 11, except that the axle-box frame was taken inside the pony wheels (small non-driven wheels, sometimes erroneously termed guide wheels). The brakes were said to be inside as was the motor, but the illustrated 11A shows the brakes to be outside. This shows how carefully the records must be interpreted. The frame was an assembled structure.

Brill 11B (1891). A bogie with no mechanical centre, but with roller guides on the sides and a radial casting on the small end of the bogie. The frame was built-up, with the illustrative details of the brakes differing from the descriptive details. It was similar to the 11.

Brill 11C (1892). A replacement for the 11A. The upper chord of the side frame was brought inside the pony wheels with springs placed on the narrowed bogie frame ends. Motors and brakes were mounted inside—again the descriptive and illustrative details differ. There were no centre plates and this was another built-up bogie.

Brill 11D (1892). As the 11C but now with forged frames and a single bearing at the pony wheel end. The development of the 11 series sees the increasing use of side-bearings. The similarity to the much later development of the Burnley type in Gt. Britain will be obvious to the reader. The weighting of the pony wheels has yet to receive additional refinement. (See diagrams overleaf.)

The Development of the Brill 22 Type (1894 onwards).

The Brill 22 type had at least four changes readily visible to the eye, without a change of designation in the firm's catalogues.

1). It had two side-bar supported body springs, but no axle box or motor support bar springs.

2). It added a spring over the axle-boxes.

3). Springs appeared on the motor support bar as well as over each axle box.

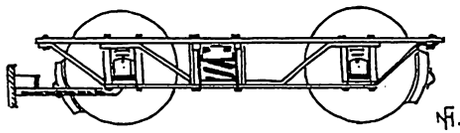
4). It had side bars, two body springs and axle box springs as before.

(Continued on page 244

Overleaf:
THE BRILL PROGRESSION
Fig.3. Series 10 and 11. Fig.4. Series 22.

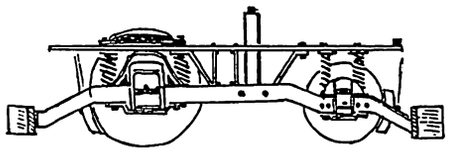
Fig.3.

Drawings not to scale



NF.

N°.10 Pivotal Truck.



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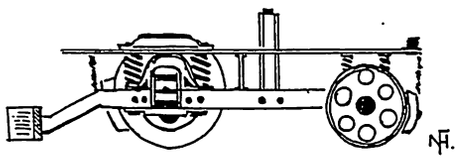
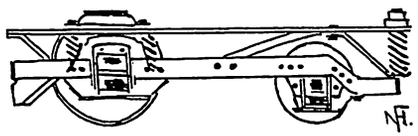
N°.11 Max. Traction Truck



NF.

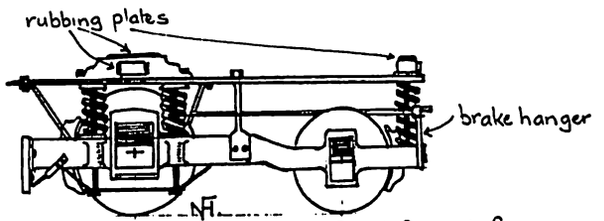
N°.11-A Side Frames and Upper Chords-inside pony wheels.

N°11-B M×T Without Mech^L. Centre Similar to 11.



NF.

N°11-C. M×T Top Chord Narrowed Single bearing - Pony Wheel End. No Centre Plate. Built-up frame



N°11D
From photograph (schematic)

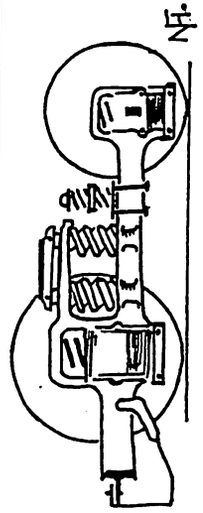
Solid forged frame
Narrowed upper chord.

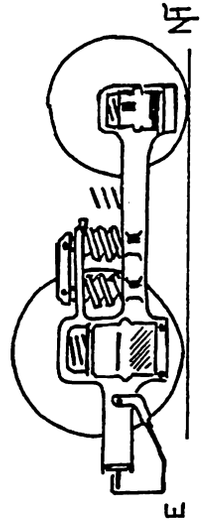
22 or 22A. Named 'Eureka'. 1894. Replaced 11 Series. Cast Steel Frames. No centre bearing. Pony Wheel brakes inside. Inside motor mounted on side frame. 22B as above but with rubber pads on journal boxes. (Also 1894). Frame forged. 22C Experimental only. 22D None built.

22E. Solid forged. Motor mounting finally inside. Brakes as 22A. (pony wheel) Driving Wheel Brakes inside or outside.

22 Special. Solid forged side frames. 4'6" wheelbase recommended. Heavier side frames. Brakes inside.

Schematic drawings - not to scale. 4/10/68





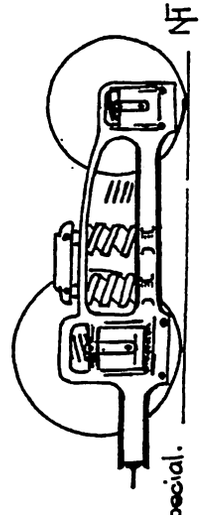


Fig. 4. THE BRILL PROGRESSION SERIES 22

The 22 was a MxT bogie with cast steel side frames, a single motor and the trade name Eureka—which had formerly been used for the 11D bogie. The 22 type replaced the 11 series, with no centre bearing, but with coil axle box and side bearing springs. The pony wheel brakes were inside hung and the driving wheel brakes could be hung inside or outside. The motors were inside mounted. Also designated the 22A.

Brill 22B (1894). With solid forged side frames, inside hung motors, outside brakes, equipped with rubber pads over the axle boxes. (Experimentation still proceeding.)

Brill 22C (1898). Only one pair of this experimental bogie seems to have been made.

Brill 22D. No record of this type having been made.

Bril 22E (1895). With inside motor, similar to the 22A, solid forged side frames with no centre bearing. Various changes were effected from time to time. At first the motor was suspended from a bracket riveted to the side frame. Later the motor was suspended on the frame by brackets and even later the springs were moved inside the frame to allow room for the brake rigging. All brakes were inside hung—again at variance with the illustrations. Pedestal springing was not visible in the earliest 22E's but was incorporated later. An even further refinement to the 22E type was the 22 Special.

Brill 22 Special. (No number/letter designation.) This design had a top chord or bar joining the tops of the two pedestals on each side frame, but had no support between the two side support springs. There was a spring over each axle-box but the motor support springs were barely visible. This model was intended for use as a bogie with greater carrying capacity. The wheelbase could be either four foot or four foot six inches. The eventual MCTD type of bogie bore a striking resemblance to this model and the Peckham P26.

Practices Adopted in the USA with reference to MxT bogies

The American electric street tramways were developed before the tramway systems in Britain. This experience gave American manufacturers an advantage over the few British rivals in supplying tried and tested products to the rapidly expanding systems here. So, at this point it is helpful to look at some of the practices adopted in the USA, where MxT bogies were used.

MxT bogies were generally fitted with the smaller pony (non-driving) wheels towards the centre of the car. This came to be regarded as the NORMAL position. When the bogies were fitted with the pony wheels nearer to the platforms this was termed the REVERSED position and was shown as MxT(R). It will be readily seen that the normal position was favoured since the 'overhang' at either end was less—so reducing a tendency to platform sagging. Now, whether the car operated with normal or reversed bogies, one bogie was always leading with the pony wheels (see fig. 5). St. Louis, USA, overcame this apparent 'problem' by operating single ended cars (with turning loops at terminii) with MxT bogies mounted as shown in fig. 5c. This practice was continued until 1910. Some other towns which adopted this fashion were Cleveland and Buffalo. As the exception to the 'rule' Cincinatti operated 49 or [illegible]ars with the pony wheels leading on single ended cars.

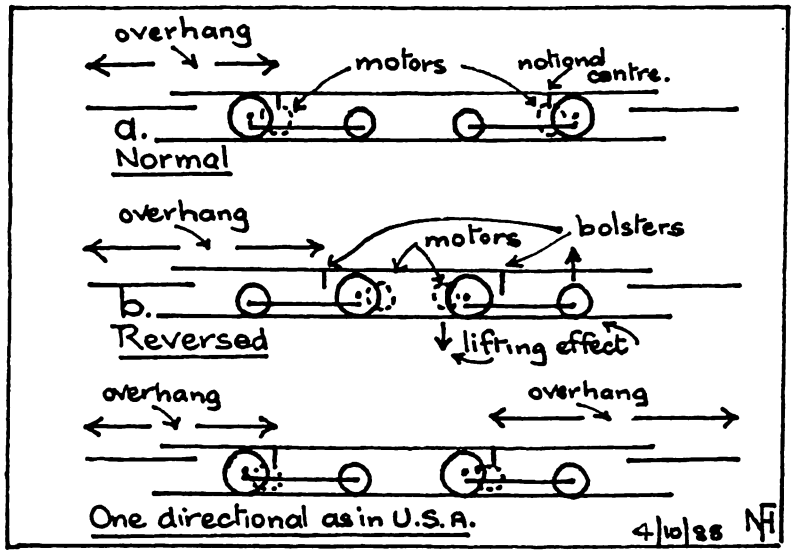


Fig. 5. THE POSITION OF MAXIMUM TRACTION TRUCKS

E. H. Charlton (page 12) said that "...it was not practical for the pony wheels to lead"—but where they did—"...the frames had to be heavier or weighted down". This was seen to be so with the Peckham P14 D8 bogie (1900) where a semi-elliptic five leaf spring was introduced on a transverse member.

The Merits of the Maximum Traction Bogie

With so many British operators preferring the MxT bogie to the equal wheel type there must have been some advantages. These are recorded as being:—

1). A lower loading height was possible because of the ability of the pony wheels to 'turn-out' under the car sills, whilst the driving wheels had less lateral movement due to the 'apparent turning centre' being closer to the driving axle (6" distance on 22E's).

2). To offer the advantage of a two bogie car (with the smaller turning circle) and the economy of only one motor per bogie (i.e. only two motors per car).

3). To overcome the problems of excessive wear (rails/flanges) on longer wheelsbase, single truck cars.

4). By avoiding a fixed turning centre (as with the bolster versions) it permitted the motor to be mounted within the wheelbase—thus utilising the full weight of the motor for rail-holding.

In "The Electric Railway Journal" of 28 June 1913, pages 1157-8, H. A. Benedicts lists the suggested operating conditions where MxT type bogies would function well. From these comments it appears that the Manchester Tramway System fulfilled all thes[illegible]asic requirements:—

Where there were no severe gradients, no severe weather conditions (rain apart), high speed was not demanded (i.e. below 25 mph) and lines were not too long. The steepest gradients recalled south of Manchester were the three hills leading from Mersey Square, Stockport—to Manchester, Hazel Grove and St. Petersgate. The latter was apparently rarely used by bogie cars in the later days. It is interesting to recall that the original Brill 22E's fitted to cars numbered 1-25 in Huddersfield were subsequently replaced by four wheel trucks. Huddersfield was reputed to have the steepest gradient on any British tramway system.

The MxT bogie was very commonly used in London, Birmingham, Manchester and Bolton, with the Brill 22E the most used MxT bogie in the world, showing the advantage of the centreless type over the bolster version MxT bogies.

The Negative Features of the MxT Type Bogie

The disadvantages of the MxT bogie must now be considered. The most common one was the tendency for the pony wheels to become derailed. To overcome this, various compensating devices were fitted to the main frames of the tramcars, so that additional weight was transferred on to the pony wheels on curves. In the case of bogies fitted with bolsters, necessitating the mounting of the motor outside the driving axle, the turning moment (i.e. lifting effect) of the motor—with its centre of gravity some 14" from the centre line of the driving axle—was an inbuilt aid to the pony wheels lifting (see fig. 6).

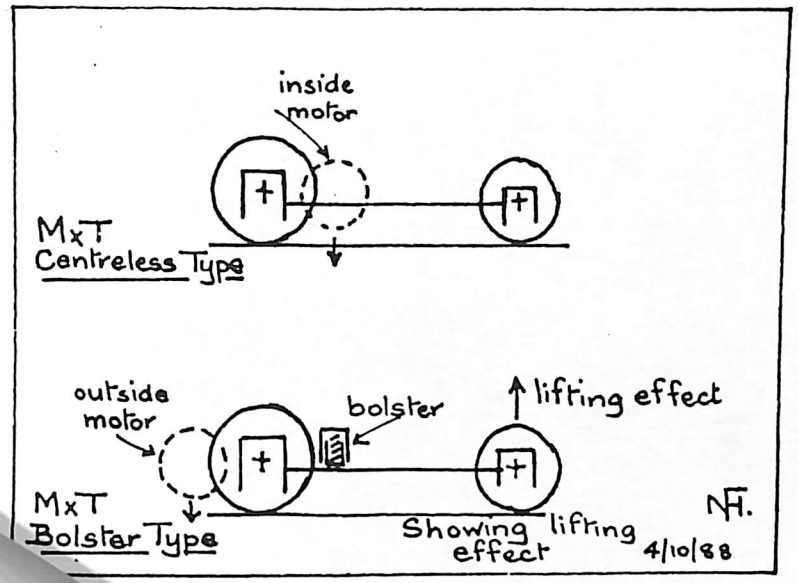


Fig .6. LIFTING EFFECT DUE TO OUTSIDE MOTOR

It is reported that New Orleans, USA, experienced much difficulty with pony wheel derailments and so the 226 cars equipped with 22E's in 1894 were all retrucked by 1901. Some Hill of Howth (Dublin) cars equipped with 22E's, were fitted with return springs at the pony wheel ends—to assist the return of the bogies to the straight position after leaving curves. This operator had experienced some difficulties with derailments.

Another disadvantage of the MxT(R) bogies was the increased overhang of the body (see fig. 5).

Great Britain as a Market for the American Manufacturers

The rapid growth in the number of electric tramcar operators in Gt. Britain occurred at a time then there were few British manufacturers able to supply trucks and bogies. Consequently the Americans, who had had several years start, were able to secure many of the initial orders for bogies through their ability to provide tried and tested products. From these manufacturers two names immediately present themselves, J. G. Brill of Philadelphia and The Peckham Co. of New York.

It has been reported elsewhere that J. G. Brill produced 219 differing types of bogies/trucks—though not all of these were for tramways. As has been quoted previously 18 American manufacturers produced their own version of the MxT bogie. Such was the American domination of the British market that when, eventually, the Brush Company of Loughborough produced its own type of bogie the Editor of the "Railway & Tramway World" (October/November 1900) is reported to have remarked "Why hasn't someone done it before?"

If a vacuum existed in this country it proved to be a stimulus for the Americans to set up agencies and factories here, and also for the British manufacturers to overcome any shortage of supplies by entering the market. It is possible that the many orders coming in at the beginning of this century ocurred during a further period of expansion in the USA, causing some delay to supplies over here. According to Goodwyn Brill had been exporting to Britain since 1890 and to Brush since 1897. This delay could be the reason why Manchester decided to accept Brush MxT(R) bogies when the normal 22E type had been chosen as being satisfactory—but this will be considered later when looking at the specimen car 'orders'.

The decision of the Brush Company to set up its own bogie/truck manufacturing plant must have been taken before 1898. This decision and the idea to employ an American, with experience in this field, to oversee the new development, is very well chronicled in J. H. Price's book on the Brush Co. (page 12), and in M. Goodwyn's book (page 27), where he says... "Brush was a truck manufacturer by 1898". Certainly it appears that by 1900 Brush had the capability to produce its own trucks and bogies.

(To be continued

Subscriptions

A further year has passed and readers are reminded that renewals are due with the Spring issue. Subscription rates for the next four issues will be £3.25 post paid and for members of the LRTA £2.50. Overseas rates will be £3.75 and £2.75 for members of the LRTA. Your continued support is appreciated.