The Development of the Tramcar Truck—with reference to Manchester.

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There has been very little written about tramcar trucks but two books do cover the subject very well, "and, as with the previous articles on the bogies, the author has relied heavily on them". (These are E. Harper Charlton's "Electric Railway Car Trucks" (1966) — an American publication by H. E. Cox, and M. Goodwyn's "The Evolution of the British Electric Tramway Truck" (T. & L.R.S. — 1977).

The early manufacturers of electric tramcars had only previous experience of making cars which had been towed, either by horses or steam engines. The structure of these cars would obviously be much lighter and totally unable to stand up to the stresses likely to be encountered in a tramcar propelled by an electric motor. On horse cars the springing arrangements were often very simple ones. Normally the axle box hornways were fastened directly to the body frame and there was no separate truck as such.

It was quickly recognised that for electric tramcars a quite separate truck would be required, capable of housing the motor and the braking gear. The simple pedestal springing previously used would have to be substantially improved, providing support for the wheels and axles, and separately for the body. Walter S. Adams — Designing Engineer (J. G. Brill & Co.) wrote in 'Electric Railway Journal' June 13th 1925, page 927:—"In 1887 John A. Brill, youngest son of the founder of J. G. Brill, invented what is recognised as the first system of electric car trucks in which the truck frames supporting the motors, brakes etc. were independent of the car body" . . . . "These first trucks were of the cast pedestal type and had a unique system of springs, combining both coil and plate types as are used in most modern trucks, the entire spring action was provided by one set of coil springs arranged so that two coil springs were located at the sides of the journal box under the car body attachment frames". This arrangement apparently made it more difficult to apply the brakes when the car was loaded, so . . . . "subsequently the trucks were designed with axle box frames which rested on rubber cushions on the journal boxes". (Ibid page 928). Walter S. Adams also remarked:—"Coil springs over journal boxes cushion the truck frames and the suspended end of the motor. Their contribution to good riding is almost negligible".

An added difficulty was the increased overhang at front and rear of the body, beyond the truck ends as cars became longer, which produced pitching and jazzing, and the double deck arrangement very common in Great Britain, which increased a tendency to rolling as well. The trucks, as originally built, were of rigid construction with no provision for transverse or longitudinal movement of the axle sets. Vertical movement was, in theory, controlled by the springs.

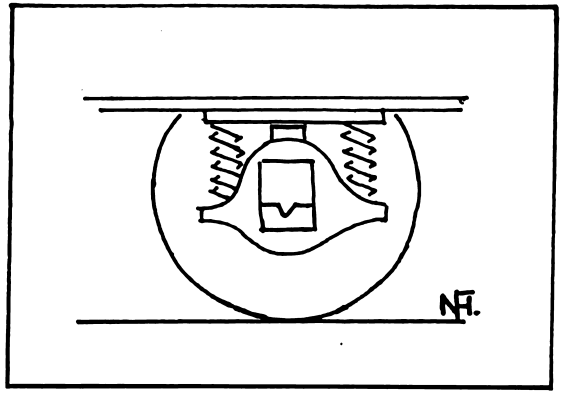


Fig. 1. The Brill Pedestal Mount — attached to car body.

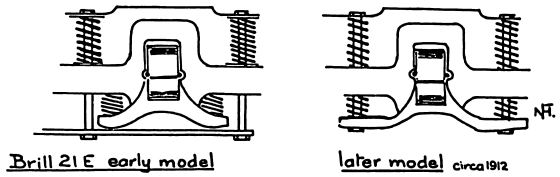


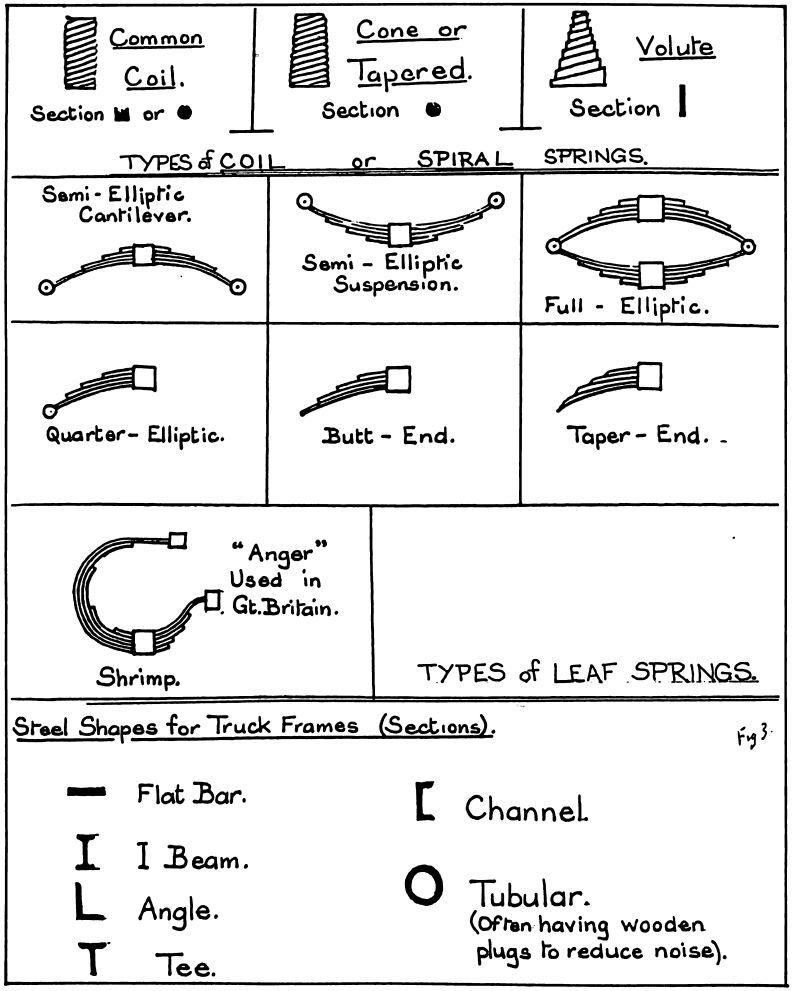
Fig. 2. The development of the 21E axle box springing. (Not to scale.)

As the use of longer cars became common the 'overhang' outside the wheelbase was increased and end to end oscillation became more pronounced. Coil springs were used extensively at first, but their sole use often produced what was known as sympathetic vibration. To overcome this a further refinement was the addition of rubber dampers, acting as simple shock absorbers. In another attempt to remedy this . . . . "the truck frames were extended and elliptical springs were installed on the extreme ends of the frames to function in connection with the coil springs on both sides of the journal boxes. This combination of coil and plate springs, working together, increased the stability of the car body and resulted in improved riding action". (Ibid. 928). Still later it was discovered that a combination of coil springs, often one within another, plus laminated, plate or leaf springs produced a very good combination. The use of combined leaf and coil springs lessened the tendency towards sympathetic vibration because the coil springs acted first due to their frictionless nature, whereas the friction between the plates of a leaf spring delayed their action. J. G. Brill claimed to be the first to recognise that the uniformity of springs was responsible for the rhythmic motion which developed into a gallop as the speed increased, and (they) developed a method of counteracting the oscillation by subduing the quick action of the coil springs by slow yielding leaf (plate) springs.

"The positioning of the elliptic springs (of whatever form) extended the spring base to give steady support. The placing of the coil springs was to be as close to the yokes as possible and almost over the heavy coil springs in/on the journal ears. This arrangement left the centre of the truck partially relieved of the weight of the car

body and more free to support the motors. Some play in the frame was allowed for in the spring posts — controlled by the torsional effect of the leaf springs. The positioning of the heavier coil springs (in the journal box ears) was such as to be directly under the pedestals so as to carry the weight of the frame. The equalising effect of these low level springs secured the correct positioning of the journal boxes".

The above account explains the thinking behind the 'original' springing of the 21E truck, wherein the coil springs were NOT in line but placed as nearly as possible underneath the pedestals. Subsequent findings seem to suggest that the company revised its ideas on this point, since they eventually placed the springs 'in line'. — using the wide wing axle boxes. (See Tramway & Railway World Vol. XXXII 8/8/1912 page 121. See diagram of the two fittings.



THE BRILL SINGLE TRUCK PROGRESSION

Brill No. 1 (1887). Named the patented Independent Rigid Truck. Pedestal mounted with enclosed coil springs, with diagonal bracing rods. Outside hung brakes from the top chord. Pointed pilot board.

Brill No. 4 (1889). No journal yokes but with axle box frame. Of arch bar construction. Note axle box wings. Brakes (outside) hung from chord. Pointed pilot board.

Brill No. 7 (1889). Outside brakes. Independent pedestal and frame. Similar to No. 6 (not shown).

Brill No. 12 (1891). Weight of the car carried on springs at the end of the journal box frame. The frame had no end cross pieces, but the motor mounting bars acted as two transoms near to the centre of the truck. Said, elsewhere, to resemble the McGuire No. 19 truck (1899) — but this had ¾ elliptic springs at the end — so the springing was quite different.

Brill No. 13 (1891). This was the first Brill truck to use coil and elliptic springing. Pilot board pointed. All these frames were of 'built-up construction' — the 21A being the first solid forged single truck by Messrs. Brill.

Brill No. 21A (1892). No springs over the axle boxes — rubber cushioning pads used. Note the continuing use of full elliptic springing at the ends of the frame.

Brill No. 21B (1894). Similar to 21A. Semi-elliptic springs used under the axle boxes. This truck was said to resemble the Blackwell design (date unknown) — see drawing for similarity.

Brill No. 21C (1894). Coil springs now introduced above the journal box ears — otherwise very similar to the 21A.

Brill No. 21D. Similar to the 21C — except for the ¾ elliptic springs, with coil spring mountings to the truck ends. Note the (reversed) similarity here to springing of the P 35 (semi-elliptic), with the coil spring attachment inwards from the truck end.

The side frames of trucks 4, 6, 7, 12 and (possibly) No. 13 were built-up with TWO side pieces (vertically mounted) — possibly with spacers. The Blackwell truck was used (about) 1900 in Toronto. Probably made by the Montreal Steel Company. This truck has been described (elsewhere) as resembling the Bemis Standard Motor Truck No. 26.

The composite (built-up) frame used bolts wherever possible, rather than rivets, but, where rivets had to be used, they eventually became loose — causing subsequent misalignment of the frames, motors and gears. 1890 saw the introduction of solid forged frames. The 21E was the logical outcome of all the experiments (1895-1896). Patents covering this early development date from 22/11/1887 to 23/4/1901.

Opposite:—
Fig. 3. Types of springing with details of the sections used — after E. H. Chorlton. Also details of sections used in truck frames.

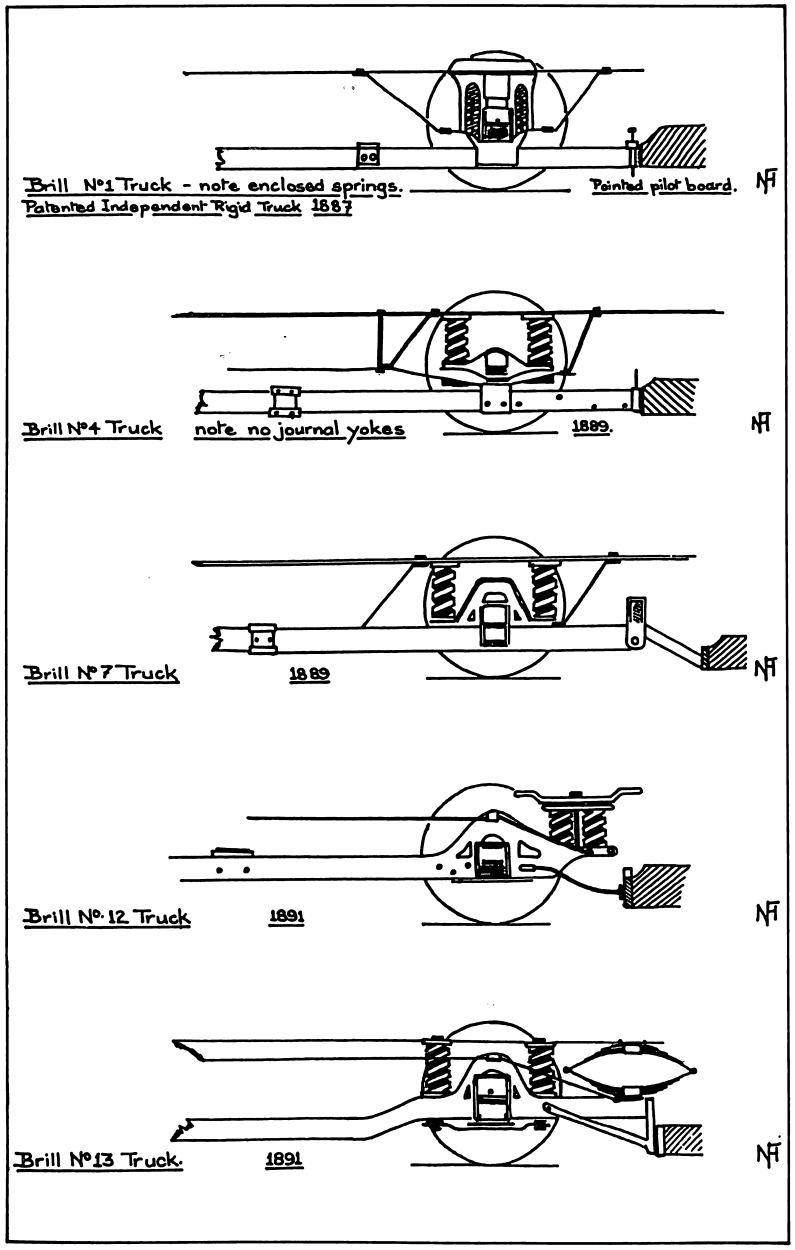


Fig. 4. The Brill Truck Progression. Nos. 1 to 13.

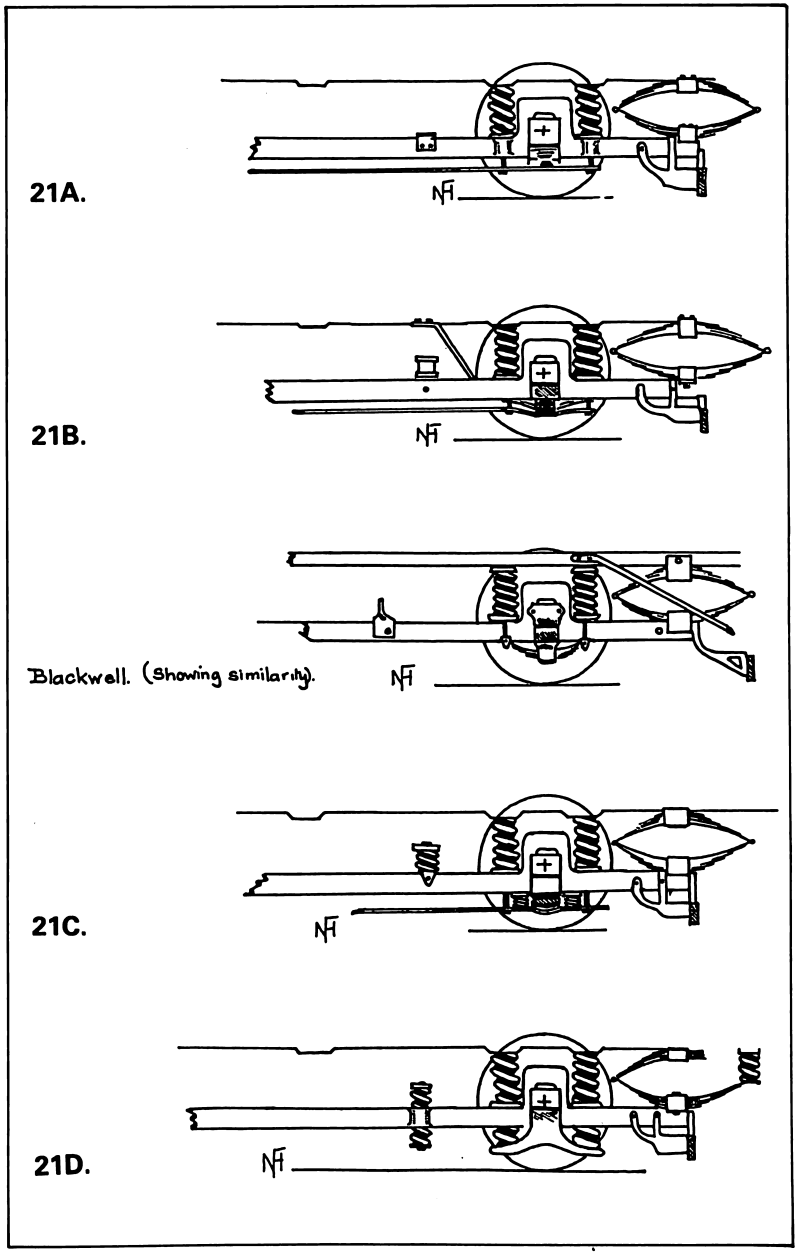


Fig. 5. The Brill Truck Progression. Nos. 21A to 21D.

The American Influence

Yet again the Americans were first on the scene when Britain's tramways were developing and the familiar names of J. G. Brill and Edgar Peckham appear in the story once more. Single trucks may be classified into three types, rigid, radial or sub-trucks. At first the rigid trucks predominated, the other modifications evolving later. Further development became necessary largely to overcome the problem of the limited wheelbase imposed on the rigid truck by the many tight curves in small, narrow streets in many British towns. The frames may be classified as forgings, castings or fabrications. The two firms above differed markedly in their productions, Brill eventually concentrating on forgings and Peckham continuing with fabrications for the side frames. Peckham's products are easily distinguished by the shape, structure and maker's name emblazoned all over the frame. Brill is reputed (Goodwyn page 6) to have remarked on "Peckham's patchwork of frames". Quoting from Brill's advertising material . . . . "Experience of the Brill Co has shown that side frames of one piece solid forgings without bolts or rivets to hold them together are the best type. They have outlasted other constructions such as cast steel, pressed steel etc. . . .". It certainly seems to be the case that in this instance Brill chose the wiser course, since the Peckham manner of construction eventually showed signs of weakness — the side frames becoming loose with the consequential need for re-rivetting. This did not mean that Brill was always the winner because subsequently Peckham's later ideas proved to be more popular, with intense competition between Peckham's P 22's and Brill's 21E swing link trucks.

The Brill & Peckham truck development is depicted in the sketches made from photographs in E. H. Charlton's book.

(To be continued

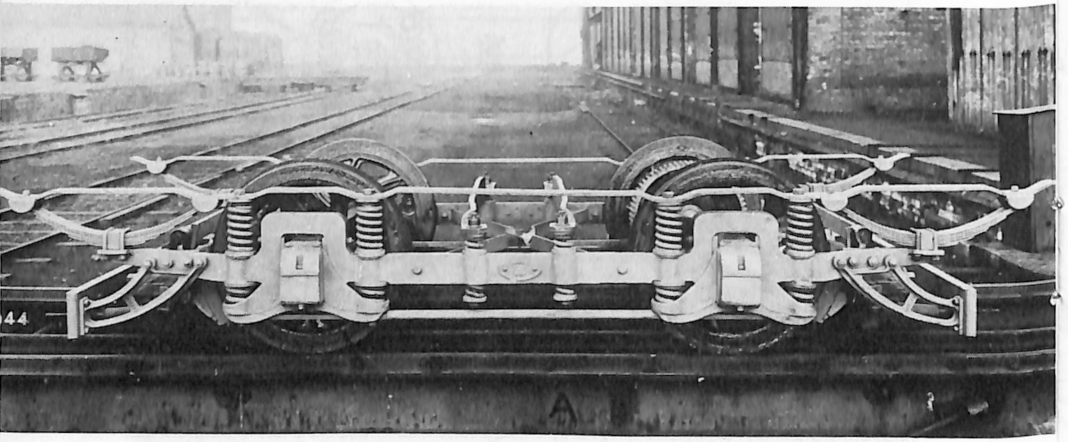


Fig. 6. Brush type 21E with in-line coil springs. *(Brush photo A9208 courtesy Leicestershire Record Office*

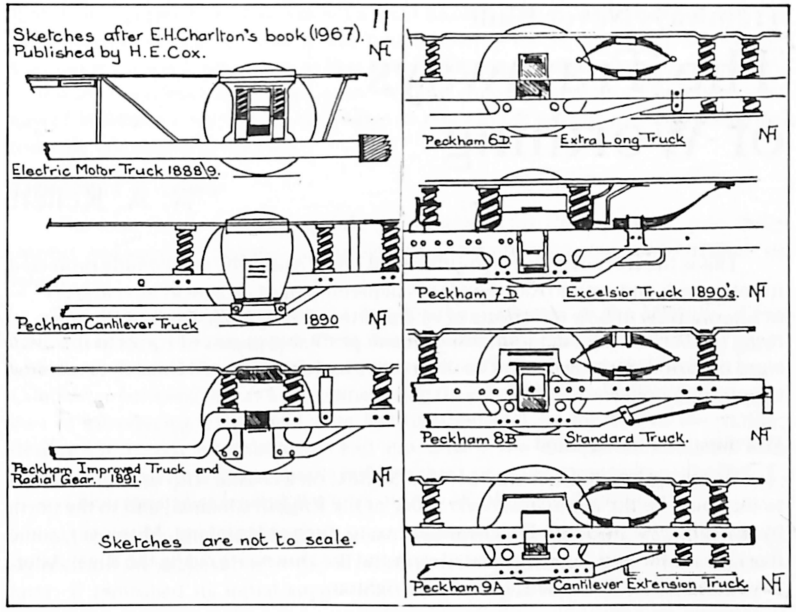


Fig. 7. The Peckham Progression.

The earliest trucks of 1888-1891 were soon superceded by improved versions using additional leaf springs to give better riding qualities.

(Sketches based on E. H. Charlton's photographs

Fig. 8. (Below). Peckham Standard Single Truck 8B.