G.E. 247 Traction Motors

(600 Volt 40 H.P. Continuous)

Originally designed by the G.E. Company U.S.A. about 1912, the 247 motor concept was to provide a medium size traction motor on a mass production basis to satisfy the needs of,

(a) Heavier City and light Inter-urban cars of 4 motor design, then being built,

(b) Improved performance in both acceleration and braking modes without the excess of bigger motors and associated larger wheel diameters with increased step heights and,

(c) To reduce wear and impact on the lighter track construction of many systems of the time.

The basic design of the motor (with variations in size and voltage) became universally popular with engineers in the construction and operation of many car types, until the event of the P.C.C. Car and Dr. Hirschfield in the early 1930's, when the traditional axle hung 40 H.P. motors were gradually superseded with horizontallly mounted and fully sprung 55 H.P. motors of a radically new design, including forced draft ventilation, with a significant reduction in impact forces, noise and rough riding inherent in the original truck layouts.

Under licence, the Australian General Electric Company produced large numbers of 247 motors from the 1920's to the middle 1950's for Melbourne, Sydney, Adelaide, Brisbane and other cities engaged in new car construction and re-motoring.

Electric Braking (247 Motors)

Apart from traditional emergency braking (reversing the motor polarity while the car is in motion) using the car momentum and motors as generators (known as "bucking the motors") to provide retardation, little had been achieved in building this principle into a normal service braking application, namely dissipating the energy generated in the form of heat at the resistance groups, (commonly known as "dynamic braking").

Notable exceptions were experiments in the 1950's when a Sydney "R.I." class car was equipped for service on the steeply graded Neutral Bay route, while in Melbourne, two newly constructed "W.T." class cars (Bourke St. Electrification) were temporarily fitted out to evaluate the benefits of a combined air-electric braking systems in both cases with a moderate degree of success. Main drawbacks to the system were -

(a) Limited control of field excitation due to a dependance on the residual magnetism in the motor casing.

(b) High transient voltages in armature windings (a consideration of importance using older motors) and

(c) Matching electric braking with the "self-lapping" air systems in normal practise.

Weak Field Control (247 Motors)

With increasing bus competition during the 1920's and general traffic congestion, it became apparent that either complete replacements or re-motoring of existing cars would be necessary, both expensive propositions and financially beyond the capacity of operators with many thousands of older cars in service.

It was the major manufacturers who finally came to the aid of the industry with a package known as "Weak Field Control", a complete equipment that could be adapted to existing cars (including those with direct control and "K" series controllers).

Basically, the system consists of switching a resistance across the motor fields, weakening excitation and as a consequence reducing armature reaction, increasing motor speed and "Torque", a technique that had been previously available only with the more expensive and sophisticated control apparatus in service on fast inter-urban and main line railroad equipment.

M and M.T.B. Weak Field Control Cars
740-741, 750-751, 785

During 1934 a decision was made to electrify the Elizabeth St. Brunswick cable routes including a new fleet of cars of the "W5" class. These cars were to incorporate many of the improvements inherent in the "W3" and "W4" developments during the late 20's and early 30's, such as upholstered seating, a new truck design and all steel construction.

While braking on the new cars was to be of the standard straight air, self-lapping system , a new control system known as English Electric or Clyde type controllers was selected, although still a direct control system, the new controllers featured 10 notches of acceleration as against 8 of the "K" series equipment, providing greater riding comfort, the main contact assemblies in these controllers consisting of sets of parallel contacts closed by a series of cams on the main sequence barrel, another feature of the mechanics of these controllers was the fact that the ratchet switch opened the line breaker circuit before disengaging the main contact assemblies, reducing arcing damage, (distinguishing these cars by the particular line breaker sounds).

With five notable exceptions, nearly all "W5" class cars to the 800-850 group were similarly equipped.

Cars 740-741 (Drg R.4262)

Control - W.H. V.A 23 (automatic acceleration)
23 steps

Step 22 Motors 1 and 2
"Weak Field"

Step 23 Motors 3 and 4
"Weak Field"

Motors - Westinghouse 55 HP 300 V
(4 Motors, 2 Groups 2 x 300 V connected in series)

Cars 750-751 (Drg R. 4284)

Control - G.E. "P.C.M. (Auto-acceleration)
19 steps

Steps 6,7,8,9 (series)
Field Weakening during acceleration)

Steps 11,12,13,14 (parallel)
Field Weakening during acceleration)

Step 19 (full parallel)
Field Weakening controlled by Field Shunt relay

Motors - G.E. 247 A x 2 40 HP 600 V

Car 785 (Drg R. 4483)

Control - "E.E" Remote Cont. actor Control
16 Steps

Step 15 Motors 1 and 3 "Weak Field"

Step 16 Motors 2 and 4 "Weak Field"

Motors - G.E. 247 A x 2 40 HP 600 V

Note this equipment was the predecessor of the now standard "R.C.1." and "R.C.2" Control (without Weak Field)

Comment (247 Motors)

Cars 750-751

In the case fo these cars "Field Weakening" is utilised during acceleration in both the "Series" and "Parallel" stages by closing contactor 4, it must be understood here that acceleration is controlled by an acceleration relay dependant on the Summated Traction Load, to keep motor current within rated limits, however on reaching "step 19 (full parallel) another Current Relay (Field Snunt) (when current is within acceptable limits) will introduce "Field Weakening" on this step.

Car 785

"Field Weakening" on this car was manually selected during the final stage of the parallel sequence, although satisfactory in operation, without a current limit relay was too subject to the drivers' judgement resulting in "Flashovers" and associated substation disturbances.

Noel H. Gipps 1957 A.E.T.A.

The writer is indebted to the following personnel for their assistance in compiling this article -

Messrs. P.M. Ireland, B.J. Roberts, L. Eliasson and N. Ohlsen of Preston Workshops and Mr. R.J. Tippett, Senior foreman electric running sheds.