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ИСТОРИЯ СОРТИРОВОЧНОЙ СТАНЦИИ ДАУТИ СИСТЕМА УПРАВЛЕНИЯ ВАГОНОМ

Аннотация: основная часть мировых железнодорожных перевозок по-прежнему сортируется на сортировочных станциях, которые в идеале должны обеспечивать высокую пропускную способность, а также позволять вагонам медленно буксироваться друг с другом, чтобы избежать повреждений. Поскольку для обеспечения достаточного разделения между последовательными вагонами в зоне переключения необходима относительно высокая скорость, эти требования не всегда совместимы.

Ключевые слова: система Даути, вагон, замедлитель, форсирование.

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A HISTORY OF THE DOWTY MARSHALLING YARD WAGON CONTROL SYSTEM

Annotation: The bulk of the world's railway traffic is still sorted in marshalling yards, which ideally must handle a high throughput and also enable wagons to buff together slowly to avoid damage. Since a relatively high velocity is essential in the switching area to provide sufficient separation between consecutive wagons, these requirements are not readily compatible.

Keywords: Dowty system, wagon, retarder, boosting.

The earliest yards managed as best they could with little or no automatic control, relying heavily on 'chasers' who ran alongside, pinning down the brakes as appropriate-a tiring and dangerous job. In the UK the first mechanical clasp-type retarder yard introduced between the wars employed a single stage of retardation following the king switch (first division of the track below the 'hump')and was manually controlled. The system eventually developed to incorporate secondary retarders also, usually serving about six sidings each. Individual sidings control, though preferable, was generally ruled out on cost. These latter yards often employed automatic control to take into account wagon weight, rolling resistance and wind forces, but even this sophistication could not compensate for a system inherently unsuited to the duty. The difficulties become clear when it is realized that from the hump to the end of the siding may amount to half a mile or more. In all weathers, to control accurately the motion of a wagon running under gravity over a long distance by the application of braking forces at two distinct and fixed points only, is clearly impossible. Indeed, tests conducted by British Rail at Temple Mills and Margam revealed that only 30 per cent of wagons buffered-up within the designed speed range of 0-2.13 m/s (0-7 ft/s); 20 per cent stopped short and 50 per cent collided at unacceptable velocities **(1).** Apart from delays due to short-runners, much damage to rolling stock occurred from high-speed impacts, this in 1960 being computed at over &1000000per annum in the UK, to say nothing of damage to freight. This figure may sound high but no worker subjected to the non-stop resounding crashes inseparable from such yards would doubt it. Against this background, in the autumn of 1958 the author turned his attention to a radically new approach **(2).** The company by which he was employed was currently manufacturing its own design of hydraulic buffers for freight wagons and was thus well equipped to enter the new market. At this period the UK possessed no less than 1250000 wagons of all sorts and origins, a quantity exceeding the whole of Continental Europe.

2 General approach The concept consisted of controlling wagon speeds over virtually the whole journey through the yard by means of hydraulic devicesdispersed along the rails. Suchan aim promised the maximum possible performance, coupled with zero damage, although the potential took a number of years to realize fully for reasons explained later. The history and development of the Dowty wagon control system falls naturally into two parts, the original concept which relied heavily on power-assistance, and the present simplified version which in virtually every instance is powered entirely by gravity, thus providing great reductions in capital and operating costs. Firstly however, it is necessary briefly to explain the gradient profiles for a Dowty yard and to note how they differ from the conventional approach with clasp-type retarders. Optimum profile compared with a clasp retarder installation, using primary and secondary units, and the higher ‘hump’ in the latter will be noted. This is necessary because a much greater speed through the switching area is essential to prevent catch-ups where wagons of widely differing rolling resistance and wind resistance are running purely under gravity and without external control. The constant gradient through the switching area in the Dowty system is sufficient to maintain virtually all wagons at the design velocity, the retarders limiting the speed to the required figure. Just inside the sidings a closely packed group of low-speed retarders, known. As deceleration units, are fitted in order to reduce rapidly the speed of incoming wagons to an acceptable value for buffing. Taking the yard as a whole, the actual determination of gradients and disposition of units on the track is an involved and complicated procedure worthy of a paper in itself, that cannot be described here. Suffice it to say that the early methods of manual calculation combined with ‘inspired guesswork’ have given way to sophisticated computer techniques thus saving a great deal of labour in the process.

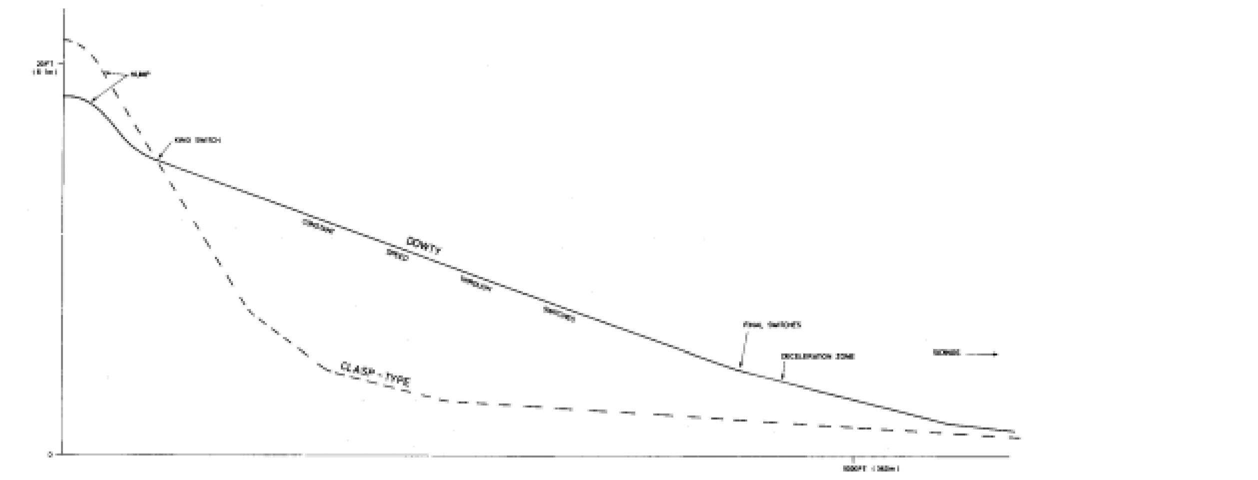

Fig. 1 Typical profilesof Dowty and clasp-type retarder yards

3 The hydraulic booster/retarder In the 1950s most rolling stock in this country ran on grease-box axle bearings, the efficiency of which, when well maintained, unfortunately did not compensate for shortcomings when neglected. The resulting wide scatter of rollability (rolling resistance) ruled out a purely gravity operated yard because of the excessive requirement for retarding capacity to cater for heavily laden good-running wagons. A boosting feature was thus essential to permit the use of lesser gradients. Ideally the hydraulic device should perform either a boost or retard function, depending on the speed of the wagon.For such a requirement the unit should accelerate all wagons running below a certain critical speed, and decelerate all those running faster. Typically this was ***3.66*** m/s (12 ft/s) in the switching area and 0.90 m/s **(3** ft/s) in the sidings. There was also a further requirement that sidings units must be directionsensitive, so that wagons recoiling after impact would not be boosted back up the line. The energy for boosting was to derive from a hydraulic power source, 100 bar (1500 lbf/in2) being the chosen pressure. The upthrust would be 14tonnes limited by the axle-loading of the lightest wagons in service. Even on paper, to meet such a specification was no easy matter, and for a time appeared impossible. On being impacted by the wheel flange, the unit had.

3.1 Mode of operation For boosting, a slowmovingwagon in driving the piston down, did not create enough flowto close the speed valve, and the displaced oil passed into the return (lowpressure) line, maintained at **5.5** bar (80 lbf/in2). At the bottom of the stroke the sleeve valve was pushed open, admitting high-pressure oil which closed the speed valve and provided thrust for boosting. Finally, a lostmotion device retrieved the sleeve valve to cut off the high-pressure supply. For retarding, the higher wagon velocity closed the speed valve, the oil being displaced via the relief valve. At the bottom of the stroke the sleeve valve again opened but to no avail since the internal pressure had motivated a shuttle valve to isolate the high-pressure supply. On the up-stroke the speed valve opened, admitting low-pressure oil to push the piston upwards. The shuttle valve could not return because the sleeve valve had sealed the appropriate port. At the top of the stroke the sleeve valve once more blocked admission of high-pressure oil, although the shuttle valve had meanwhile returned to its original open position. Although complex, this design performed well but sufferedfrom the drawback that during a retard stroke the whole of the energy was dissipated through the relief valve. For a large installation this amounted to an intolerable waste of power, and later embodiments removed the objection by permitting regeneration by means of a non-return or clack valve into the highpressure line. Apart from a longer stroke differs considerably from its predecessor.An understanding of the improved mode of operation may be gathered from the drawing, or alternatively can be found elsewhere **(3).** This was solved by fitting lugs to the guides forged integral with the head of the unit and employed to prevent rotation about a vertical axis. In addition, the provision of adequate areas in the very confined space available for hydraulic oils flows, amounting to some 160 l/min (35 gal/min) at wagon speeds of **3.66** m/s (12 ft/s) called for considerable ingenuity of the ‘quart into a pint pot’ variety. Any increase in size ***to*** provide more space would have been self-defeating, since flow is proportional to piston area. Since from calculation it was known that more retard strokes than boost strokes would be needed for optimum economy taking the yard as a whole, a self-contained retarder unit was also designed. This also employed a combined speed and relief valve, with a coil spring to return the unit. In certain production versions the spring was replaced by a pre-charge of nitrogen gas, separated from the oil by a floating piston, to provide a faster extension necessary to cater for higher critical speeds.

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