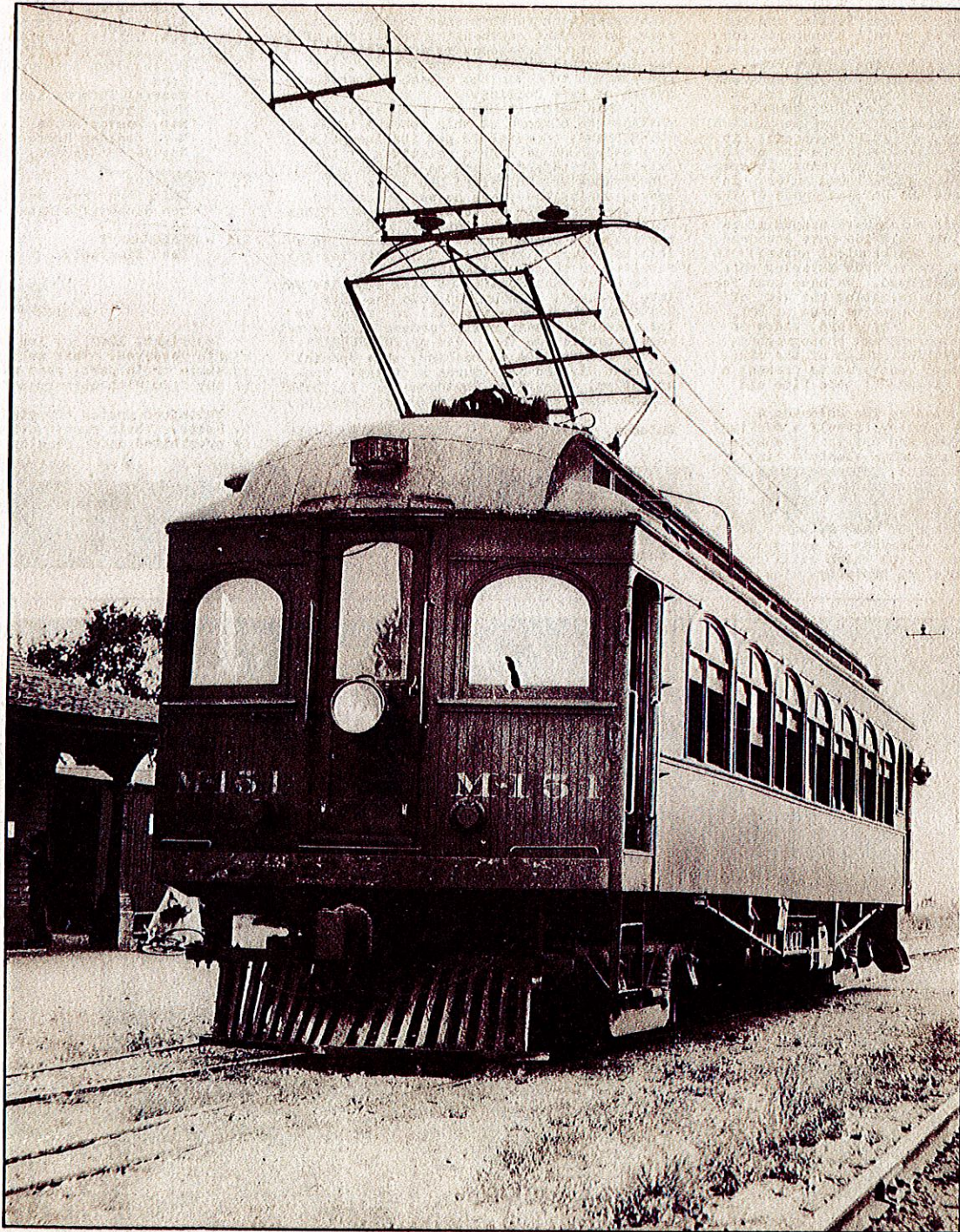


DENVER & INTERURBAN



Published by **INTERURBANS**

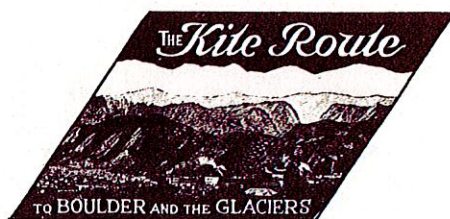
Foreword

Denver---financial, political and business capital of the Rocky Mountain region---and Boulder---seat of the University of Colorado---were connected by an interurban electric railway, The Denver & Interurban Railroad, from 1908 until 1926. Here was one of the west's outstanding interurbans---yet because it was built, operated and abandoned before the advent of railfan associations and the tremendous interest in rail transportation which exists today the D&I has not received a fraction of the attention it deserves.

That this is a distinct loss is apparent from even a cursory examination of the D&I. Here was a true interurban! It connected two areas of comparatively dense population; it operated large cars at high speeds; it led the way in the west with the use of AC single phase, 11,000 volt current; it operated by standard steam railroad rules. In more ways than one the D&I was ahead of its time.

The two decades which have passed since the D&I passed into oblivion have obscured certain details of a historical nature; in addition many of the records covering this line have been destroyed. We have been fortunate, however, in enlisting the aid of Mr. W. H. Edmunds, long-time head of D&I, and of Mrs. Andrew W. Whiteford, widow of the famous D&I motorman and photographer. With their cooperation enough of the missing facts have been recovered to present a fairly complete picture of this fine old interurban line.

The D&I was owned by The Colorado & Southern Railway Company (itself a Burlington property) 100%, and originally contemplated construction of an electric line from Denver to Fort Collins, Colorado, including a street railway system in Fort Collins. The street railway system was built first, commencing operation early in 1907, and was operated as a branch of the D&I Railroad Co. until the fall of 1918 when it was sold to the City of Fort Collins which still operates it as a municipal property. The main



line never went further than Boulder, however, on account of changing conditions of travel. As this account is interested in the interurban aspect of the D&I, it will not attempt to cover the detached streetcar system of Fort Collins.

At this point it may be of interest to outline the history of this special issue of INTERURBANS. Special #5 had its inception in a telephone call from relatives of the late Mr. Whiteford. Were we interested in photographs Mr. Whiteford had taken of D&I scenes during the years he was associated with the company? We were, and negotiations which followed brought into INTERURBANS' possession a large amount of material impossible to secure elsewhere. This material has resulted in this publication.

We trust that Special #5 will find its way into the hands of many who rode the Kite Route and whose memories will be jogged by its content. Their reminiscences will be welcome material for the pages of INTERURBANS.

For convenience in reading, this Special has been divided into three sections: Construction, Operation, Abandonment. The bulk of the Whiteford photos appear in Operation.

October, 1947

Ira L. Swett

COVER PHOTO: D&I motor M-151 posed for her picture one afternoon in 1909 at the Westminster station. Typical of the photos taken by Andrew Whiteford, this shows with unsurpassed clarity all details of the handsome car.

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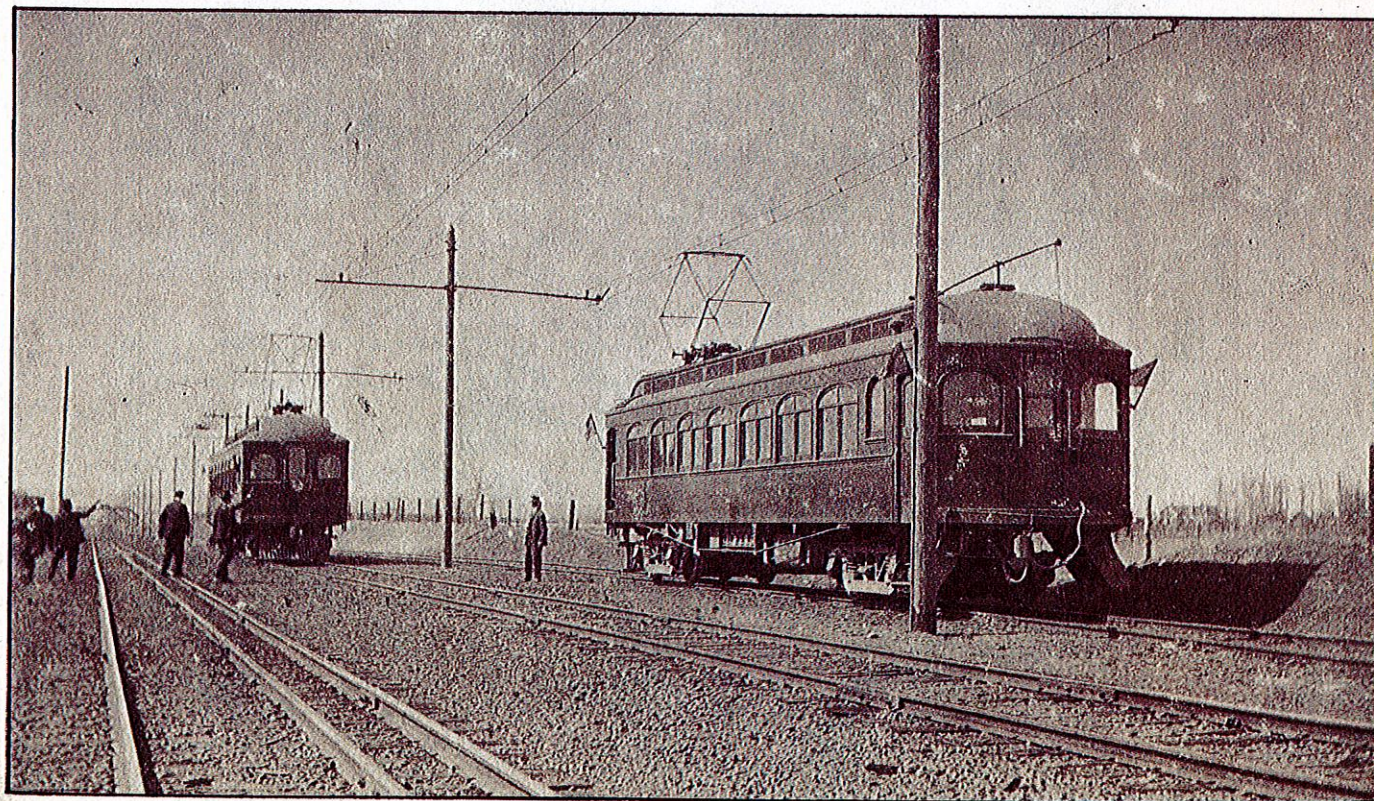
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A magnificent action photo by Andrew Whiteford. Special M-155 at right has headed in the hole for its meet with a regular train, M-152. Officials on the ground flag down the fast-stepping interurban to deliver special orders to its crew.



INTERURBANS



The National Electric Railway News Digest

1414 SOUTH WESTMORELAND AVENUE
LOS ANGELES 6, CALIFORNIA

Presents Its Special Number Five,

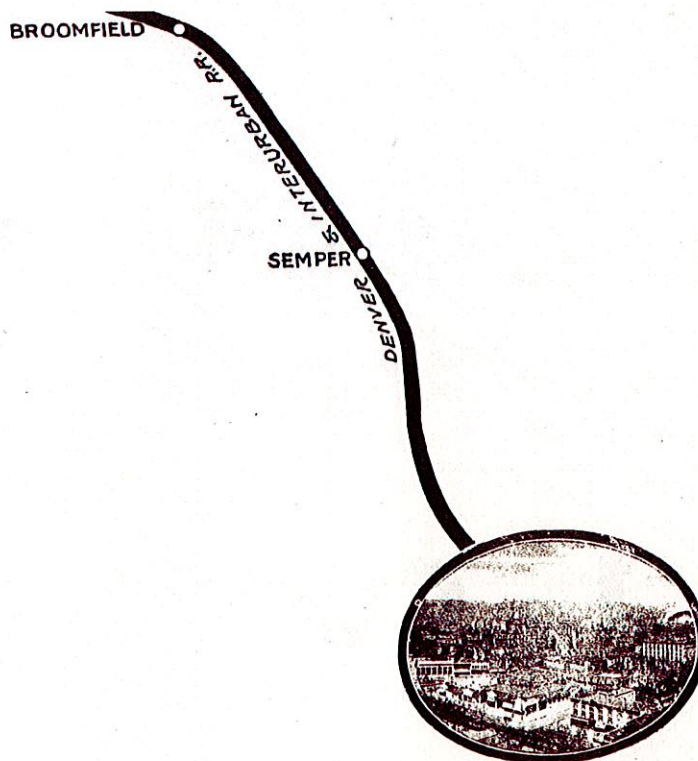
The

DENVER & INTERURBAN

Railroad

Price, One Dollar

October, 1947





I - CONSTRUCTION

ABOVE: WHITEFORD PHOTO OF EXCURSION
TRAIN AT ELDORADO SPRINGS, 1914.



Building the Line



Converting the Colorado & Southern's Denver-Boulder lines to electric operation was not a simple matter. Inasmuch as the D&I trains were to augment, not replace, steam trains, an additional heavy flow of traffic would descend upon the then single track system; not only did C&S operate both standard and narrow gauge steam trains over the affected trackage, but trains of the Burlington Route entered and left Denver over this line as far as Burns Junction (see map). The double-tracking of the portion of the line from Denver to Louisville Junction was therefore regarded as inescapable.

The double-tracking began at Louisville Junction on the Marshall branch and at a point a short distance north of Louisville Junction on the Louisville branch. These two new tracks for D&I trains joined a short distance south of Louisville Junction and the new electric junction was labeled "D&I Junction."

From D&I Junction southward to a point slightly north of Utah Jct. (a junction for steam trains only) the new track closely paralleled the original track. This double track stretch had trolley wire only over the new track, C&S deeming it advisable to keep its steam and electric trains segregated wherever possible. From Utah Junction the new electric track veered east to the suburb of Globeville, where D&I made track connection with the Denver City Tramway system, its cars continuing to

the downtown Denver terminal at 16th & Arapahoe Sts. over Tramway track using the city system's 550 volt DC current and operated by Tramway men.

Northward from Louisville Junction to Boulder the two routes retained their original track, although considerable work had to be done to the roadbed to smooth it up for high speed electric operation. The branch from Marshall up to Eldorado Springs at the mouth of South Boulder Canyon was electrified also. Local conditions in Boulder made it advisable for D&I trains to operate on city streets using direct current at 550 volts. New track was therefore constructed in Boulder on Pearl St. and on 12th St., with a siding for D&I cars constructed into the C&S Depot grounds.

Track construction standards were high, being those required by the C&S and Burlington railroads. Rail of 70 and 80 pounds was used, electrically connected by No. 0000 bonds. Slag blasted from the waste pile of the Globeville smelter was used to ballast the entire line. Maximum grades encountered on the two main lines were held to 1.25%, while the Eldorado branch had practically continuous grades ranging up to 2% with compensated curves.

Electric trains were operated to Boulder via either route and returned via the other, making a continuous loop; total mileage per round trip was 57.24 miles.

Official mileage figures given in an official C&S report were:

From	To	Mileage
16th & Arapahoe, Denver	Globeville	4.26
Globeville	D&I Junction	15.23
D&I Junction-Marshall	Boulder	13.24
D&I Junction-Louisville	Boulder	13.04
Marshall	Eldorado Springs	3.30
East Boulder	West Boulder	1.78
TOTAL D&I MILEAGE.....		50.85



Electrical Equipment



C&S decided to cast the D&I's lot with Westinghouse and its single-phase, high voltage alternating current system. It will be remembered that this decision was made at a time when leading electrical engineers the nation over were at bitter odds over the comparative merits of AC and DC operation of electric railways. General Electric sponsored DC, while Westinghouse just as warmly espoused the cause of AC. Here a word or two on the advantages and disadvantages of the two might be welcome:

The principal merit of the single-phase system lies in its ability to operate at high voltage with a single overhead conductor; therefore power can be transmitted over long distances with a minimum of copper. Its main disadvantage lies in its higher first cost. Also, the weight of AC equipment carried on the cars amounts to about $2\frac{1}{2}$ times the weight of comparable DC equipment. The single-phase equipment on a car might amount to as much as 70% of the weight of the car and trucks light---whereas DC equipment to do the same work would come to about 20% of the weight. Thus ran the arguments back in 1907. After hearing them out, C&S decided that the D&I would be an AC road using Westinghouse equipment.

Westinghouse, Church, Kerr & Co. obtained the contract to install the required overhead, feeders, etc., and were also the successful bidders on the big new power plant at Lafayette, near Louisville, where steam generators brought into being the 11,000 crackling volts to be fed to the big green cars. From the Lafayette plant two feeders ran to D&I Junction where they fed into the interurban's overhead system. An interesting switching system set-up was contrived at D&I Junction (see diagram) whereby

power from either or both of the feeders could be made to supply current to one or all of the three trolley legs: Denver Section, Louisville Section, or Marshall Section. The 11,000 volt 25-cycle AC current was fed to cars through a catenary supported No. 0000 trolley wire 22 feet above the rails and supported by a $7/16$ " steel cable to which it was clipped at ten foot intervals. Care had to be taken in placing the trolley wire on curves, for a one-inch track elevation resulted in a $4\frac{1}{2}$ inch deviation of the pantagraph. No additional feeders were required along the route due to the use of the AC system. The messenger cable was carried on porcelain insulators supported by angle-iron brackets. Poles were spaced 120 feet apart on tangents and sufficiently close on curves so that pull-offs were not necessary. A ground wire ($7/16$ " stranded galvanized steel cable) was strung over the pole tops for the entire length of the line; this afforded a cheap and convenient way to ground the brackets, gave excellent lightning protection, and served as a continuous return circuit to augment the bonded and cross-bonded track rails. The overhead wire was connected to the track at every fifth pole and the track was provided with ground plates.

Three steam construction trains were used by the contractors in electrifying the C&S. The first train installed poles, and so efficient did it become that in one day 26 men installed 117 poles, including digging holes and tamping. The second train erected the brackets; five freight cars fitted with scaffolds on their roofs worked simultaneously on four or five poles, 18 men being able to erect 150 brackets daily. The third

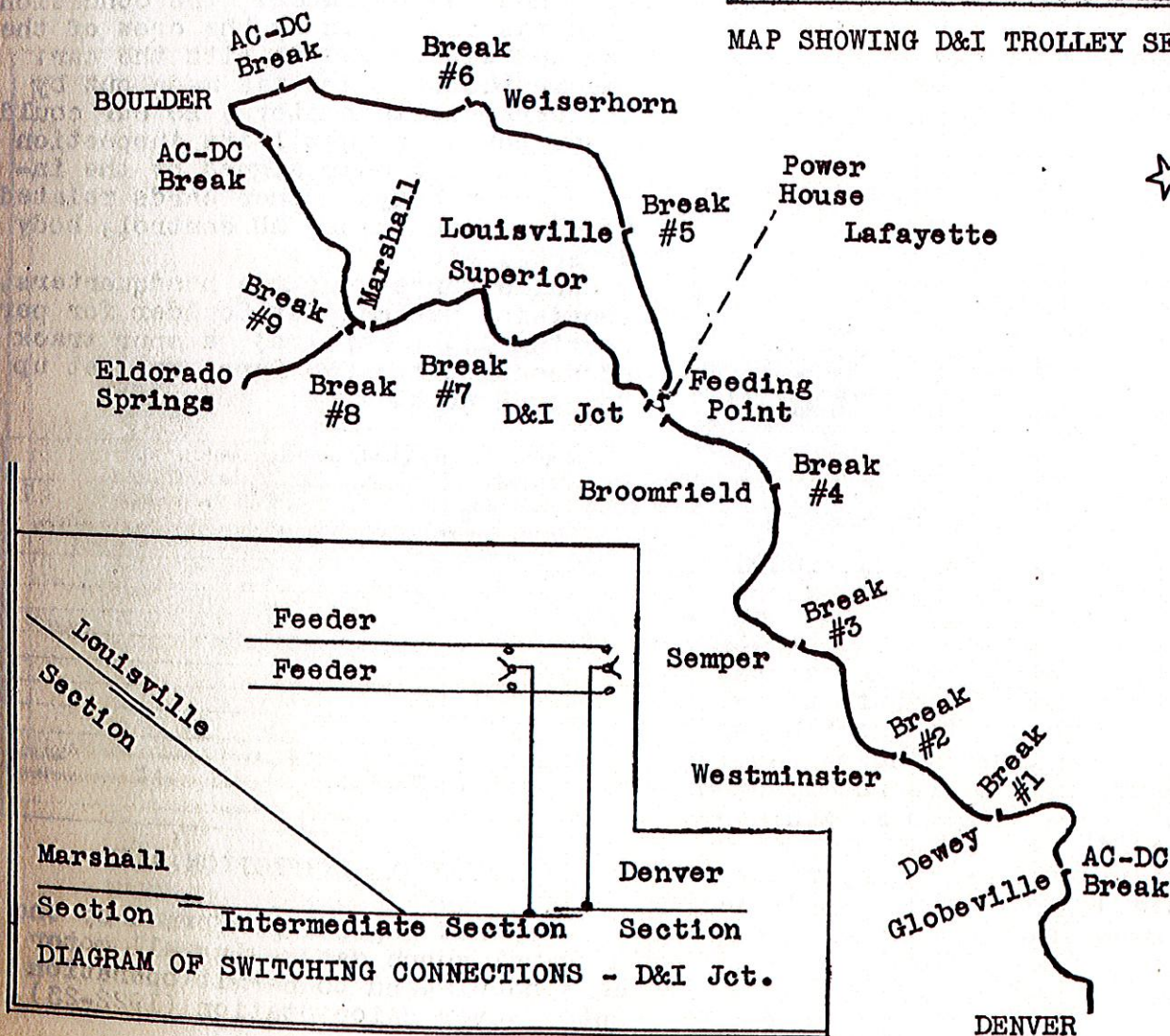
train strung the wire, a derrick car paying out wire over elevated rollers. This train's best day saw some seven miles of copper put up.

To cut down possible sources of service interruptions, the overhead trolley wire was sectionalized at average intervals of three miles. These section-breaks were located at passenger stations where someone was always on duty: Dewey, Westminster, Semper, Broomfield, D&I Junction, Superior, Marshall (here also was a section-break for the Eldorado line), Boulder, Weiserhorn, and Louisville. Trolley wires overlapped at these breaks so there was continuous power supply.

Special AC-DC current breaks were installed at Globeville and at both sides of Boulder where the 11,000 volt AC trolley joined the 550 volt DC trolley. Specially constructed

trolley pole derailleurs were installed at the ends of the DC wire, so designed and placed that should the conductor forget to pull down the pole as his car passed from the DC section the pole would be thrown from the wire and pulled down by the retriever before it could come into contact with the AC wire. The use of DC within Boulder required the construction of a substation there; it consisted of a brick structure on 12th St. near the western edge of the city. The Boulder sub contained a 300-kw GE synchronous motor which in turn fed to the Boulder trolley wire at 550 volts DC. Construction of the Boulder sub lagged behind the remainder of the electrification, so that steam engines hauled D&I cars through Boulder for a short time.

MAP SHOWING D&I TROLLEY SECTIONS



In case of emergency which removed the Interurban Loop downtown from use temporarily, a wye was located at the barn by means of which cars could be turned and sent back to Boulder.

The shop crew kept a careful check on the interurban cars. The electrical engineer was responsible for the recording of defects and repairs made. A complete card index system was inaugurated to give a complete and convenient reference record as to the condition of each car. The Car Movement Card, for instance, was filled out by the hostler and showed the trains to which each car was assigned and operated. The Condition Card was filled in by the crew of the car and was turned in with the car. The Inspection Card was made out by the carhouse inspectors; no car could leave for a run until its inspection card had been duly signed by the inspector on duty. Other cards related to wheel condition, MU control, body defects, etc.

Along the south wall of the building was located a row of blocked-off rooms and offices. Starting at the rear and going to the front, these were: the forge and blacksmith shop, the machine shop, the winding room, the boiler room, a store room, and a pair of offices. Suitable machinery (such as a 24" engine lathe, a vertical drilling machine, emery wheel stands, etc.) made the shop capable of performing fairly heavy repairs.

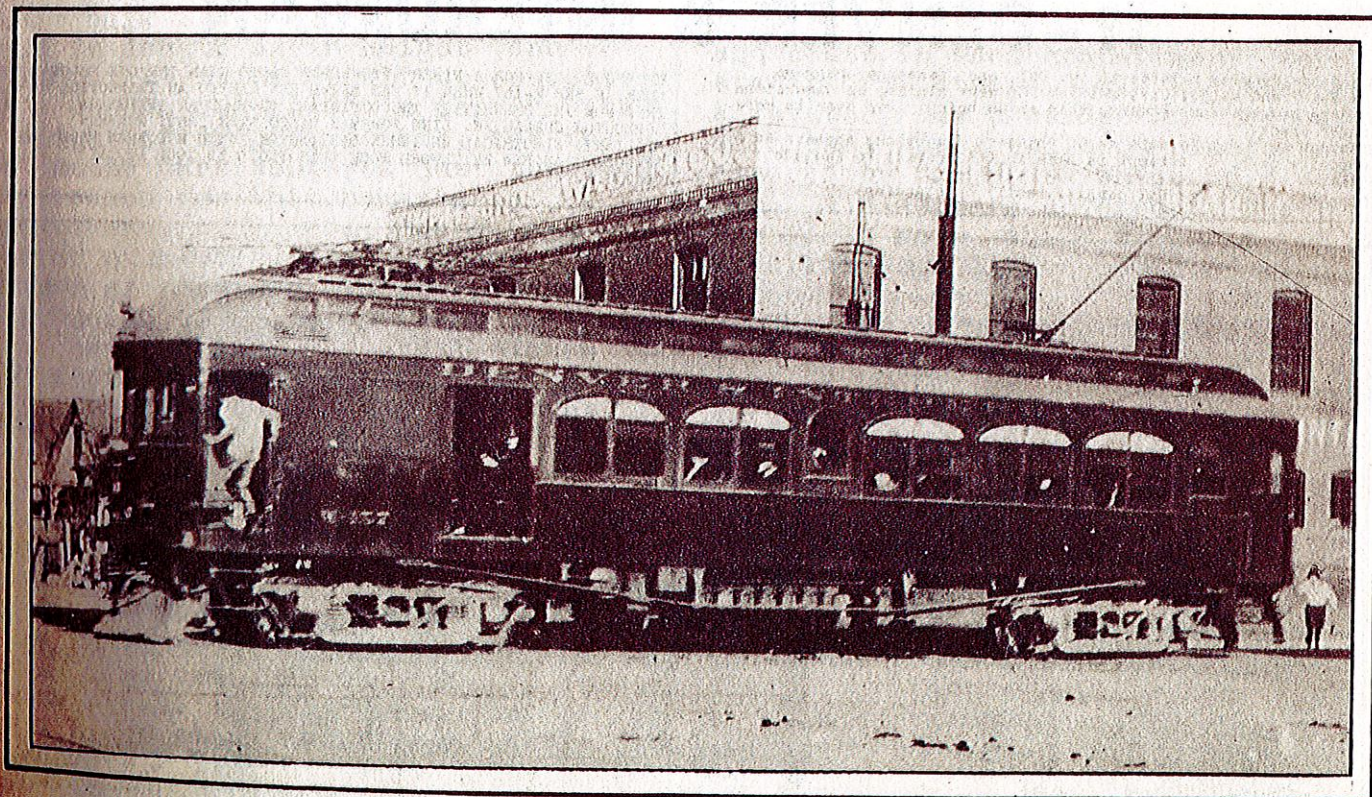
VIEW OF INSPECTION CARD

In 1923 when D&I cars began using the Union Station as their Denver terminal, the original shops were abandoned (due to their location); the railway later sold them to a paper company which used the building as a warehouse. Some time later the structure was completely gutted by fire.

The new shops, built in 1922 and 1923, were located at 3625 Fox St., on the opposite side of the river. The main shop was 50' x 180', brick and steel construction, complete with power car lifts, power crane and track turn tables. An addition to the main shop carried all the necessary tools for car maintenance with lathes, overhead cranes and everything necessary in a modern shop of this type. The storehouse was also made a part of this section.

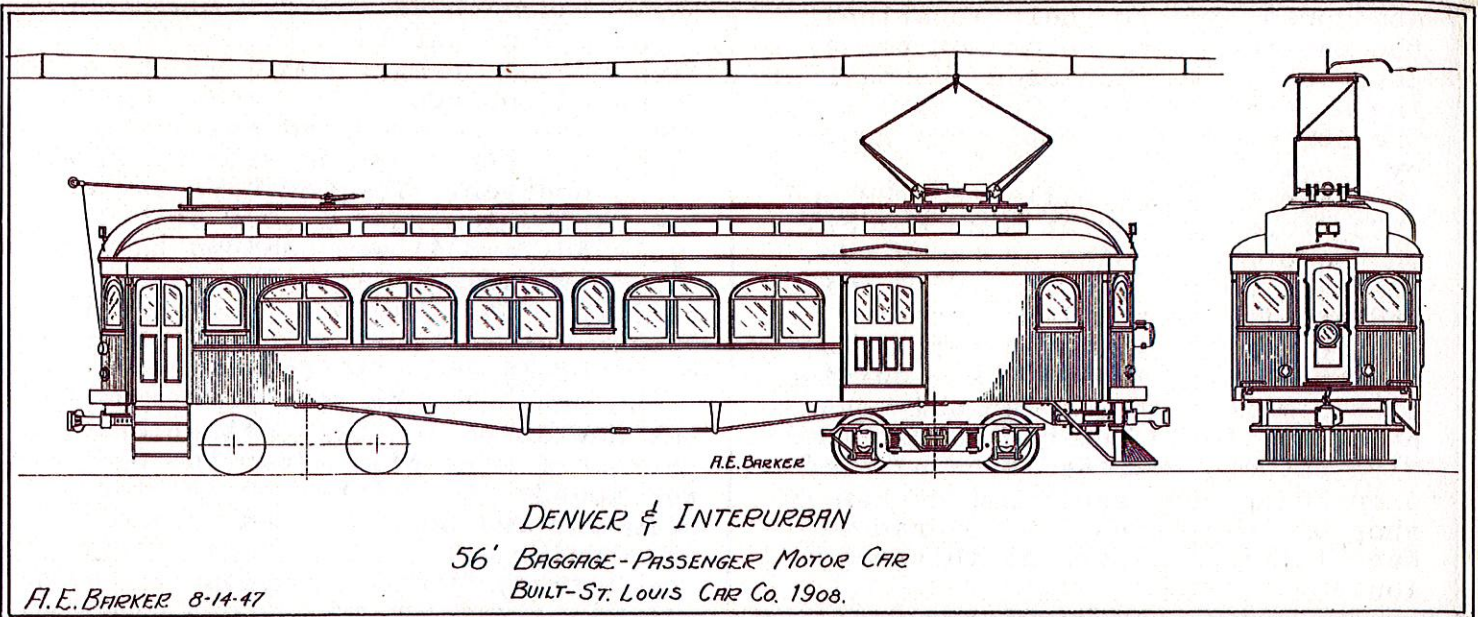
The new car house was rather unusual in one respect, that being the trolley line inside the building. Inasmuch as the original shop building and car barn was on the line of the tramway company, it was arranged for 600 volt direct current throughout the overhead system inside the barn. Not so with the new barn, however. The new barn was on trackage which used 11,000 volt 25 cycle AC, and it was decided to put this high voltage into the barn. A specially designed door and control system was worked out which operated very safely and satisfactorily.

No unusual jobs were performed by the new shops in their rather brief period of service. After the D&I was abandoned, the new shops were sold and are now occupied as a manufacturing and office location for the Safeway Shovel Company.



ONE OF THE FEW PHOTOS OF A D&I CAR OPERATING ON DIRECT CURRENT. THE UNKNOWN PHOTOGRAPHER STOOD IN THE DOORWAY OF THE D&I'S OLD BARN IN DENVER ONE MORNING IN 1919 AND SNAPPED THE M-157 OUTWARD BOUND TO BOULDER. OBSERVE THE GENTLEMAN IN THE HIGH SILK TOPPER RIDING IN STATE IN THE BAGGAGE COMPARTMENT, HIS DIGNITY NOT AT ALL DISTURBED BY THE YOUTH SCRAMBLING IN THE MOTORMAN'S DOOR.

OUTSTANDING INTERURBAN CARS *By A. E. Barker*



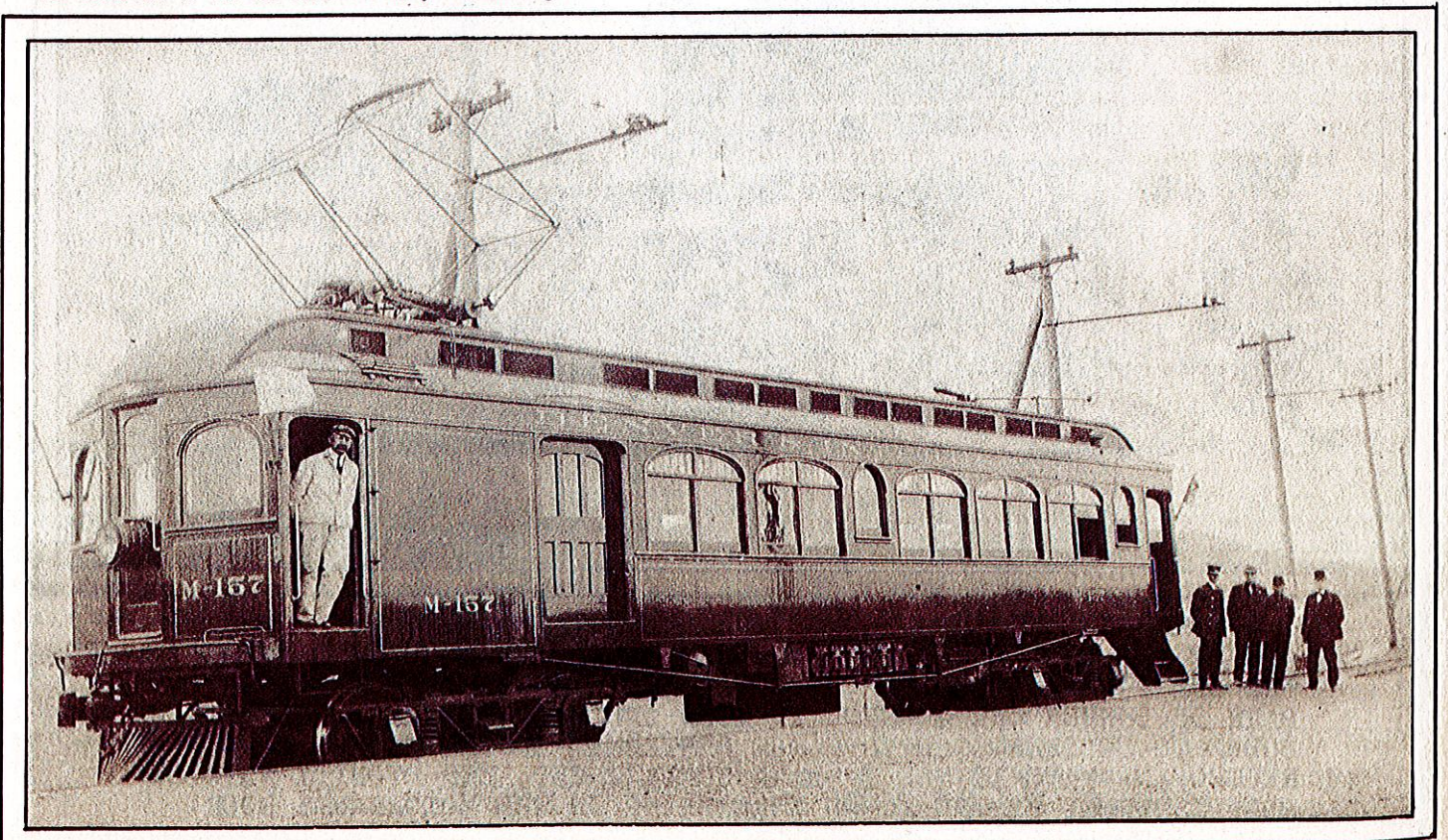
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The above drawing relates to two D&I cars, passenger-baggage combos M-157 and M-158; cars M-151-M-156 were similar in dimensions but had no baggage compartment, this space being given over to more passenger space.

Inasmuch as complete data as to physical dimensions appears on the opposite page, no attempt is made in the drawing to include such data.

So---hats off to the D&I cars....really outstanding!

WHO COULD ASK FOR A FINER INTERURBAN PHOTO THAN THE ONE BELOW! HERE WE SEE M-157 WHEN IT WAS BRAND NEW MAKING AN INSPECTION TRIP FOR THE BENEFIT OF THE OFFICIALS GROUPED AT THE REAR: CONDUCTOR ORENAMYRE, LINE FOREMAN HARDCASTLE, SHOP FOREMAN WILLIAMS, ELECTRICAL ENGINEER DARLINGTON, WITH MOTORMAN FRED SPENCER. ANDREW WHITEFORD TOOK THIS PHOTO IN 1908 AT D&I JUNCTION.



Cars

NUMBERING SCHEME: PASSENGER MOTORS: M-151, M-152, M-153, M-154, M-155, M-156
COMBINATION PASSENGER-BAGGAGE MOTORS: M-157, M-158
PASSENGER TRAILERS: 201, 202, 203, 204

C&S ordered twelve cars from St. Louis Car Company for the D&I. Of the twelve, eight were motors and four were trailers. In addition, C&S turned over to its interurban subsidiary two old wooden open-end passenger coaches with ends built out to accomodate radial couplers. These fourteen cars proved ample to handle the D&I's passenger traffic, even on special occasions.

Mention has already been made of the unusual size of the D&I cars. Their bulk manifested itself not so much in length as in height and weight. It is difficult to conceive of a wooden car 55'6" in length with a weight of 125,000 pounds, but the D&I motor cars achieved just that. The reason for this remarkable weight was, of course, due to the use of high-voltage AC current. The danger of fire was always present so D&I sought to minimize it by giving its cars floors of steel plates and roofs of sheet metal. The AC equipment carried on the cars was much heavier than comparable DC equipment would have been, and a partial duplication of the control system (necessary for DC operation) added some weight. Inasmuch as D&I cars were to operate on the same track as steam trains, C&S caused them to be built stronger than they would have been had they their own track at all times to run upon. A very heavy steel underframe was incorporated, plus an extra-heavy wooden body, lined with mahogany. The height of the cars was increased above normal by the use of 38" wheels, oversize trucks, and a body generously designed to afford ample headroom.

The four trailers were of the straight coach type, but the motors

were of two types: combine and coach. The combines had a motor-man's cab (no door on right side), a baggage compartment lined with mahogany and having drop seats for eight passengers, a smoking compartment with sixteen seats, and a passenger compartment seating 28. The motor coaches omitted the baggage compartment and used the space for more seats. Trail coaches had but one long passenger compartment. Seats in all cars were identical, being of the green Pantasote type with mahogany arm rests; end seats in each compartment were stationary, others could be reversed. A lavatory was provided at the rear of each car. Step wells on platforms were covered by trapdoors while cars were in use. Aisles were covered by heavy rubber floor mats, while a single row of electric dome lights provided illumination.

The D&I cars were the first in the west to have electrical equipment capable of operating on both 11,000 volts AC and 550 volts DC. Each motor car had four Westinghouse 148-A motors rated at 125 horsepower each. Cars were capable of train operation, MU control being standard. An air-operated Westinghouse pantagraph collected the AC current, while a wheel trolley pole was used on DC trackage. Control equipment was of the Westinghouse electro-pneumatic unit-switch type; on each car were 28 valves and 22 cylinders to operate its control system.

The following account is taken from a trade magazine of 1908 and no doubt will be of interest to the more technically minded of our readers:

"The 11,000 volt current is taken from the pantagraph trolley to an oil-insulated double-break electrically operated line switch and thence to the

primary of an auto-transformer carried under the car and thence to ground. From the secondary of the auto-transformer eight taps are taken to supply running current at graded voltages. This current, before being fed to the motors, is passed through preventive coils and through the group of unit switches. Separate switch groups are provided for the AC and DC motor control. The train-line cable carries twelve wires."

Air brake equipment consisted of the Westinghouse AMM brake which had automatic features for train operation. Moving parts of this system, like those of the unit-switch system, were

lubricated automatically.

Couplers were of the Washburn MCB type. Some cars had the MU train line coupler head mounted on top of the coupler knuckle; others placed it high on the dash where it escaped much of the dirt and was easier to couple. The conductor's signal was a push-button located in the jamb of the rear door. Headlights originally were carried on the roof but soon were lowered to a position rather high on the train door where they gave the D&I cars a particularly impressive appearance. Warning signals consisted of an air whistle and an air-operated gong.

General Information

Length: Motors 55'6"
Trailers 55'6"
Width: 10'0"
Height: 14'0" to Running Board
Weight: Motors 125,000
Trailers 66,250
Seats: Combos 46
Others 58
Body: Wood
Underframe: Steel
Trucks: Alco type A
Truck WB: 90" motors
66" trailers
Motors: 4 Westinghouse 148-A
Motor HP: 125
Wheel Diameter: 38"
Inside Width: 8'10 $\frac{1}{2}$ "
Inside Height: 9'2 $\frac{1}{2}$ "
Height, Rail to Sill: 3'9"
Length Baggage Comp: 8'0"
Length Forward Cab: 5'0"
Interior Trim: Mohogany
Brakes: Westinghouse AMM
Axles: 6 $\frac{1}{2}$ "
Bolsters: Cast Steel
Control: West. Electro-Pneu.
Couplers: Washburn
Curtains: Pantasote
Hand Brakes: Peacock
Heaters: Consolidated

Body Color: Pullman green
Exterior Trim: Gold
Pantagraph: Westinghouse air
Headlights: Crouse-Hinds AC-DC
Journals: 5 $\frac{1}{2}$ " x 10" Motors
5" x 9" Trailers
Pilot: Locomotive type
Registers: Ohmer
Roof: Sheet metal
Floor: Sheet steel
Sanders: Lintern
Seats: St. Louis Car Co.
Seat Material: Pantasote
Retrievers: Lord No. 4
Trolley Base: Nuttall
Wheels: Standard rolled steel
Car Weights:
Body, light: 46,000
Trucks without motors 13,900
Air & Electrical Ect. 15,000
Total, Motors 125,000
Total, Trailers 66,250
Builder: St. Louis Car Co.
Date Ordered: January 25, 1908
Date Delivered: June 1, 1908
Road Numbers:
Straight Motors: M-151-M-156
Combo Motors: M-157, M-158
Trailers: 201-204
(M-157 rebuilt to M-159, 1920)

ADDITIONAL TRUCK DATA: Motor trucks were Alco's standard Type A design of two-bar equalizer with swing bolsters, and were built to carry a maximum load of 38,000 pounds at center plate. Triple elliptic bolster springs were used. The trailer trucks were of the same design but lighter---carrying 25,000 pounds at center plate and weighing 11,400 pounds.