larger cities, the majority center in cities with a population under 500,000, where they have made serious inroads on the passenger traffic of the steam roads, and have developed transportation as a refined form of amusement for the masses. The millions of dollars paid annually into their coffers by the public is being regarded with envious eyes by the steam roads, who are bound, sooner or later, to make an effort to get some of the laboriously developed traffic of the electric, and it is still doubtful what form their onslaught on the business will take. Present indications are that some steam roads will add an electric passenger service in the vicinity of and connecting towns along their lines while maintaining their freight and through train service just as is done at present. There are many cases where this could be done without interfering with existing traffic, and in other cases an extra track or two can readily be built on the existing right of way. Such an electric service would steal a long march on interurbans, as on the well maintained roadway of the steam road running time could be made very far superior to the interurban schedule. And still the interurban will get the business, solely on the strength of its terminal facilities.

The next move of the steam road would be to so improve its terminal arrangements as to be able to run its electric passenger cars to the heart of the cities. To do this traffic arrangements may be entered into with street railways; they may be purchased outright, as at New Haven and at Syracuse; or the railroad may build its own track either on the surface of a street or on an elevated structure. While city governments, as a rule, are in no mood to grant privileges to steam railroads, the plan is workable. With this accomplished, the steam road becomes a very formidable competitor of the interurban for short haul traffic, and will no doubt get a share of its passengers. If an existing interurban does not parallel any steam road it is quite unlikely that it will ever be subjected to steam competition, and its returns would have to be something out of the ordinary to tempt investment in a parallel electric line. Both forms of competition will be quite out of the question if, as above outlined, terminal facilities are adequate, the roadway permanent, and the service as it should be in point of comfort and time.

So far, we have considered only the passenger traffic of the electric road. The future will no doubt see a greater development of freight service, but much is being done along these lines. The Toledo & Western, Buffalo & Lockport and Albany & Hudson are good examples of combined service, particularly the latter, because it has shown what a road can do in the line of heavy freight transportation, even if handicapped by 3 per cent. grades. Satisfactory freight returns depend to some extent on interchange of traffic with steam roads, but even without that, much can be accomplished if the business is handled right. The business should, however, receive consideration in planning the construction of the road and should not be an after-thought, grafted on a street railway construction. If the freight carrying and handling facilities are provided, the road which stands the best chance of success is naturally the one which opens new territory or new routes not touched by existing steam lines and does not come into competition with them. Such a road will always do a much heavier freight business than an electric road, which must win its share of traffic away from an existing steam road.

It is not the simplest thing in the world to handle a combined electric passenger and steam freight service over a single track road, but it can be done very satisfactorily by bringing to bear on the operating plans the highly developed and specialized modern system of railroad organization, and it is the best of business to keep the rails busy with revenue bearing loads of whatever nature every hour of the twenty-four.

Transportation securities will no doubt always hold their place in the favor of the public. Industrial corporations may come and go obedient to the shifting law of supply and demand and their securities will shift with this law, commanding fabulous prices to-day, down in the inky blackness to-morrow. But transportation must exist during good times and bad, war or peace, so long as there are people who demand communication with each other and transportation for their persons and goods. The extent to which electric railway securities can share in this general confidence will depend entirely on the skill displayed in financing, constructing and managing them. A high degree of strategy is just as valuable in railroad work as in warfare, but it will not win battles without the support of thorough organization, experience and loyalty to the work to be accomplished.

Applying to all that has been argued above, we may conclude that interurban electric railroads will work out their own destinies strictly in accordance with the amount of judgment which has been put into them. The road whose prosperous future seems most assured is the one which is located along a favorable route, constructed in a most permanent manner, equipped to handle freight on a modern scale and having the best terminal facilities for both freight and electric passenger service. For such a property competition, absorption and all the bugbears of modern finance can have no terrors, and if supplemented by skilful and experienced management it will survive as the fittest of them all.

Signal Batteries in Summer.*

BY H. S. BALLIET.

Previous articles have dealt with the maintenance of batteries during the winter; the principal thing being to prevent chilling or freezing. In summer the expansion of porcelain and glass and the evaporation of solutions are our chief trouble.

There is no uniformity of practice as to the use of either porcelain or glass jars in gravity batteries. Roads using porcelain claim that the breakage of jars in service is reduced to a minimum, very few interruptions being caused thereby. On the other hand, they agree that it is difficult to observe the action of the cell. This leads the maintainer, in an effort to save work, to take chances of having exhausted cells, dirty zincs or a dense solution. Many jars are broken and frequently small cracks started, afterward causing rupture when handled.

Experience indicates that it is economy to use porcelain for track batteries. Generally speaking, these cells are kept in chutes. In order that the highest standard may be maintained, they must have frequent inspection, usually once every two weeks, but this increases the liability to breakage, owing to the need of raising and lowering the jars.

When glass is used there is more breakage not only from lifting and lowering, but in handling them when renewing solution; but the action of the cell can be better watched and frequently a longer life maintained without danger of interruption by short circuits, dirty zincs or exhausted supply of sulphate of copper.

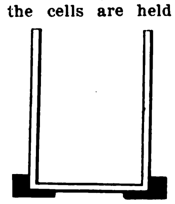
The question of broken jars is, however, not so serious where two cells in multiple are employed, with reasonably short track sections, as with three cells in series-multiple and long track sections. In the former the track relay will work when one cell is removed or broken, as only part of the source of supply is lost; while in the latter, the potential is reduced and after the passage of a train, the relays will not become energized.

In cases where track batteries are not renewed every six weeks, it is common to find that the solution is evaporated sufficiently to cause the zinc to be exposed. This is liable to increase the internal resistance of the cell and cause interruption; fluctuations of voltage will take place during a spell of wet track and the track relay will fail to operate. Sometimes such interruptions are erroneously classed as "leak in track section" or "escapes." To guard against this evaporation, a number of remedies have been suggested; principal among which are the application of crude or kerosene oil on top of the solution or the use of air-tight enclosures.

Track batteries should, of course, be kept dry; yet they have been known to work while completely flooded, being submerged for six days, delivering current uninterruptedly during that time and failing only when the supply of sulphate of copper became exhausted.

Batteries used for other than track purposes are usually kept in wells and houses. When placed in wells, a great difference is noticed as compared with those kept in chutes. In the latter the changes in temperature shorten their life. In the warmer months of summer there will be breaks, apparently due to expansion and contraction of the material of the jar. Sometimes the passage of trains will set up a vibration within a well which will disturb the cells and their contents and cause cracks.

To establish air circulation, thereby anticipating about 90 per cent. of the breaks in jars, a strip, shown in the illustration, has been designed, by which the cells are held above the shelf level, thus not only allowing the free circulation of air but preventing the accumulation of dirt under and around the bottom of the cell. This plan has been in use for several years and has accomplished its object beyond anticipation.



The strips are straight, a pair supporting a row of jars. Strips are usually made in 4 ft. lengths. These strips also prevent cells from being thrown off the shelves by vibration, an accident which has been known to cause interruptions.

Glass jars are frequently shattered by repeated blows on the top edges by zincs which are caused to move up and down by the passage of trains. In a number of cells which were fitted with hard rubber cushions, placed between the zinc carrying wire and the top edge of the jar, this cause of damage was overcome. Extra heavy rubber tubing and tape were also partially successful.

Battery jars which have a lid or cover, such as the Edison Primary and the Nungesser, etc., often break, owing to the weight which is suspended from the lid. This is readily demonstrated by putting porcelain lids on glass jars; for glass jars tin lids seem to be the most successful.

In a certain territory comprising many thousand cells of battery of several prominent designs, half of the jars are glass and the other half porcelain, practically all being in wells. Records for a period of three years

*Articles by Mr. Balliet on the performance of automatic signals under unfavorable conditions were published in *The Railroad Gazette*, of Feb. 26, March 25, April 15, May 20, July 1 and July 8.

indicate that the breaks in glass, while in service, are about two to one of porcelain. The total number of breaks from all causes, in all types, is less than two hundred a year. The number of trains stopped at signals on account of these broken cells is very small when a rigid inspection is maintained. Few interruptions need occur with acid batteries, because it takes from one to six days for the solution to leak through an ordinary crack.

Records have been kept to show the comparative length of life of batteries using glass and porcelain; they indicate an increase of about 20 per cent. with glass over porcelain. This is apparently due to the ability of maintainers to run all cells nearer to complete exhaustion, owing to the fact that they can make a closer inspection.

There are very few cases where either glass or porcelain cells crack when kept in battery enclosures fixed on concrete foundations, or attached to posts which are set on concrete.

When porcelain jars are used, inspection is limited to taking readings with a low reading volt-meter. If the cell is of the acid type, the zinc and the other element may be raised through the oil film, but this is objectionable, for it is liable to break the wires, adding another cause of interruption.

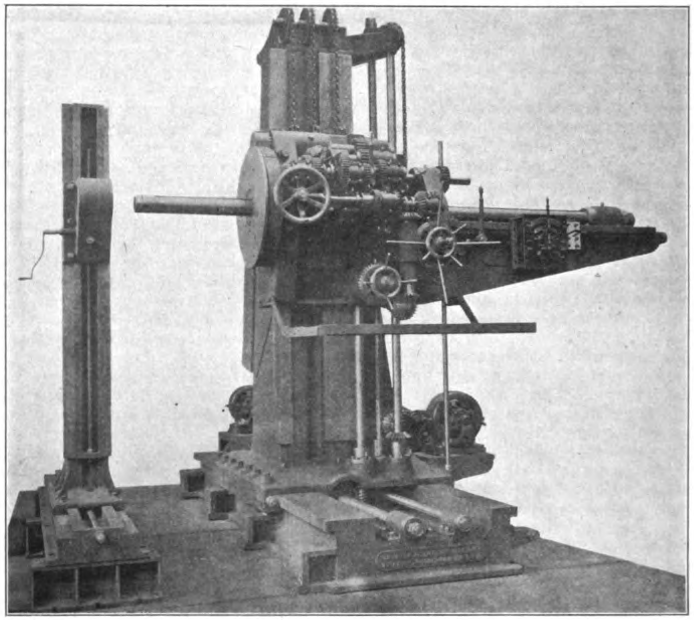


Fig. 1.—The Detrick & Harvey Horizontal Boring Machine.

Railroad Shop Tools.

(Continued.)

BORING MACHINES.

The accompanying illustration, Fig. 1, shows the 72 in. horizontal boring, drilling and milling machine made by the Detrick & Harvey Machine Company, Baltimore, Md. The machine consists of a horizontally revolving spindle, having a horizontal traverse parallel to the bed-plate and at right angles to the column runway. The spindle is mounted in a saddle having a vertical movement of 72 in. on the face of the column, and the column has a horizontal movement of 72 in. on the runway. Fast and slow power movements for the saddle and column, and power feeds and quick return for the spindle in either direction, are provided. Hand feeds are also provided for all motions. The runway is a box casting, ribbed and flanged. The top surface consists of a front and rear slideway, 14 in. and 8½ in. wide respectively. The width of the slideway over all is 56 in. and the depth under the slideway is 18 in. The column is a tapering box-shaped casting, with a base 71 in. wide x 81 in. long. At the rear and side of the column are the driving gearing and the motor for rotating the spindle and for feeding the column and the saddle. The spindle saddle is box section with a bearing on the vertical face of the column 56 in. long. The saddle is counterbalanced and has a 37-in. bearing for the spindle rotating sleeve. The bearings for the driving shafts and gears are cast on the saddle. The spindle is hammered steel, 5½ in., 6 in. or 6½ in. in diameter, with a No. 6 Morse taper hole in the end. The spindle is ground to a sliding fit in a sleeve 46 in. long. The sleeve is slightly tapered on the outside and revolves in the saddle on a bronze bushed bearing 37 in. long. Bronze and steel thrust washers are provided on the front and rear, and take-up collars are provided for wear. When motor driven, the rotating mechanism for the spindle consists of a 7½ h.p. reversible motor of the constant speed type, direct connected to the driving gearing and mounted on the base of the column. The work bed or bed plate is a flat box-shaped casting 12 in. deep, with T slots on its top surface. It is tongued and bolted to the runway. The dimensions of the bed plate are made to conform to the requirements of the customer. The outer support for the boring-bar consists of an upright post, carrying on its vertical face a vertically adjustable bearing for the end of the boring bar. This bearing is fitted with a stationary bushing, with a vertical bearing of 24 in. on the face of the post. The post slides horizontally, parallel to the main column on a supplementary bed resting on the bed plate. The adjustments in the outer support are made by screws hand operated. The boring and drilling feeds are eight in number. They are reversible and range from .007 to .4 per revolution of the spindle. The milling feeds to the saddle and column are also eight in number, ranging from .01 in. to .5 in. per revolution of the spindle. The speeds to the spindle are 20 in number, 10 through the sleeve gear and 10 through the face plate gear. The changes of speed are made by means of a cone of geers and by levers operating clutches. Four changes of speed are obtained by shifting of the levers and without changing the step of the cone. All power and hand movements, fast and slow, for the spindle, saddle and column are controlled by the operator from his platform attached to the saddle. Levers are conveniently placed within reach of the operator. The rapid movement of saddle and column is obtained by an independent reversible motor of 7½ h.p., mounted on a supplemental base at the rear end of the runway. The saddle has a 72-in. vertical movement and the spindle has a 72-in. adjustment. The column has 72-in. (or more if desired) horizontal traverse. The distance from the center of the spindle to the bed plate in its lowest position is 48 in., and in its highest position, 120 in.

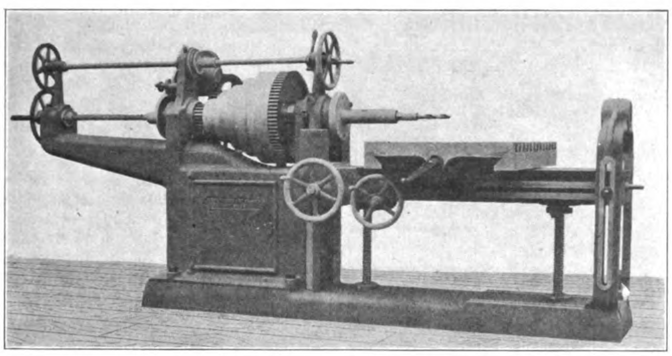


Fig. 2.—The Sellers Horizontal Boring Machine.

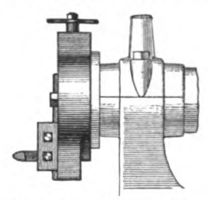


Fig. 3.—Sellers Facing Attachment.

The horizontal drilling and boring machine shown in Fig. 2 is made by Wm. Sellers & Company, Philadelphia, Pa. The spindle of this machine is 2⅞ in. in diameter and has an adjustment of 30 in. The feed is variable from the finest to over ½ in. per revolution of the spindle. The power feed is operated instantly by a positive clutch. The machine also has quick hand traverse and hand feed. The ratio of the back gear is 12 to 1 and the largest step on the cone is 20 in. in diameter for a 3-in.