

1. Defective brake cylinder packing leathers, due to being worn, cracked, cut, porous, off center and applied reversed.
2. Loose brake cylinder piston follower nuts.
3. Dry and dirty brake cylinders.
4. Expanders out of place or not fitted.
5. Release valve or "bleeder" leakage.
6. Pressure cylinder head gasket leakage.
7. Cylinder pipe leakage with detached equipment. The last mentioned is usually due to no provision for reasonable flexibility in the pipe, and to the cylinder moving when the brake is applied and released. On roads handling much of such equipment this cause for defective brakes will be relatively much more prominent.

In addition to the ineffective brakes due to the foregoing causes, as disclosed by terminal brake tests, are others resulting from:—8. Bad order brake rigging, such as rods broken, due to being cut by axles or to flaws, broken brake hangers and beams. 9. Good order brakes received cut out and left so without test, or cut out on the trip for insufficient reason, all uncarded. 10. Leaks at or near branch pipe connections to triple valves (requiring cutting out), due to shifted main brake pipes or to brake cylinders and auxiliary reservoirs being loose at the bracket connections. 11. Piston travel over 10 in. (U.S. Federal rules designate such as ineffective brakes.) As regards brake beams, a recent tabulation on a mountain division of one road showed an average for a week, based on conductors' reports, of 2 beams down per day. The principal causes were hanger pins out or hangers broken. A partial explanation is the difficulty of seeing the hanger pin cotters and keys, due to the varied and obscured locations.

Retaining valve.—Trains cannot be held down steep grades, with the air brakes, without the aid of retaining valves, and no part of the air brake requires less to maintain it if once properly installed; also, no part gets less needed attention. A very few years ago, while examining the piece work list for freight brake repairs on a large, level grade railway, the omission of any price for testing and repairing the retaining valve and its pipe was noted. The results are obvious. It is difficult for level grade roads, and even level grade divisions of roads having mountain grades, to appreciate that they must give these parts good attention if trains are to be handled safely down mountain grades. Willingness to pay mountain grade roads for repairs necessary to make retaining valves hold will not answer. The time now required to put the rest of the brake equipment in sufficiently good order is so excessive at mountain grade terminals as to generally preclude doing anything for retaining valves. We must depend essentially on the valve and its pipe being properly installed and on needed repairs being made when the brake is cleaned.

Underlying cause.—Rightly termed, the brake cleaning faults indicated are merely symptoms, and the real or underlying cause for this portion of the unsatisfactory freight brake maintenance is superficial inspecting, testing and repairing. The main reasons for this are undue haste, the pressure applied to get quantity without equal insistence on quality, unskilled men, and insufficient supervision. A letter to X asks why less brakes were cleaned last month than the previous one, or why less than by Y. Then there is the daily, local pressure to "have those B.O. loads ready at — o'clock," and like pressure to have the repair track ready to pull at the appointed time, each occasionally requiring more speed than will

permit of good work. The letter enquiry mentioned is always undesirable, as such comparisons cannot be made fairly. If there is good reason to believe more should be done generally, then the air brake man should personally look into it on the ground. The daily pressure, understandingly applied, is largely necessary, but the almost entire absence of a balancing pressure and provision for good work, and the more or less inadequate time, lack of sufficient proficient workmen, and needed tools and material to accomplish, will inevitably result in superficial repairing.

One very competent railway air brake man is confident that with good, initial brake installation and with efficient cleaning and lubricating, freight brakes will, as a rule, be reasonably efficient for 9 to 12 months. The results with many brakes apparently support this contention. But, even if this is impossible, the gap between it and the actual condition shown in table 1 proves that a big improvement is easily practicable.

Wasting material.—A natural corollary of the quantity only basis of repairing is the expensive "economy" resulting from failure to replace material that is worn out or otherwise defective. Illustrating: A gauge test of a newly-cleaned brake showed excessive cylinder leakage. Removal of the piston disclosed the cause as a badly worn and cracked packing leather. The workman assured us that he had noted the condition of the leather, but that, as he had recently been "jumped on for using too many leathers," he thought he had "better take a chance on that one." This was not local, for at another point, where we found much better work being done, we were asked to test a large accumulation of removed packing leathers, because there, too, they had been criticized for using too many packing leathers. We did so, and found all so defective as to unquestionably warrant removal. There is generally more reason to criticize undue retention of defective packing leathers, gaskets and rubber seats for emergency valve, than of applying new ones unnecessarily. All of such removed parts should be sent to a central point for inspection, so that any yet good may be saved, the best scrap value got from the others (pipe gaskets can be made from same), and to get ample evidence of wastefulness before criticizing adversely. Don't nag.

Car brake instructions and inspections. Various well known factors have long operated to cause rather frequent changes in a portion of the freight car brake repair force, and the war has magnified this. The new men are seldom properly instructed, and there is little adequate supervision of the work done. The remedy is to give the general air brake inspector an assistant whose main duty will be to instruct the car brake inspectors and repairmen, inspect their work, and inform local foremen of results. His instructions should be largely demonstrations of train, repair track, and shop inspecting, repairing and testing, requiring overclothes as part of his daily habit. The latter is imperative if he is to meet the demands.

A timely editorial in a railway periodical recently said: "In the present emergency, and particularly with the large labor turnover, it is more than ever necessary that adequate supervision be provided." Before the war the freight car brake equipment, complete, cost about \$75 a car for the 8 in. size and \$85 for the 10 in. size. Cleaning and repairing will cost over \$1 a car a year. Multiply these separately by the number of cars owned

and then consider whether the original investment and annual repair cost for cleaning only do not alone warrant a special inspecting and demonstrating instructor. If more proof is needed designate one or more "dead lines," points where all ineffective brakes will be found and repaired before being allowed to pass, then tabulate the periods such have run since the previous repairs were made and the causes for the short-time periods.

Time.—While trite to say that a car is earning only when it is moving, yet we should ever keep this in mind so as to help to avoid any unnecessary standing time. D. Willard, President, B. & O. Rd., in a remarkable address to the officers of that road last June, gave some astonishing figures on this, as shown by the following quotation:—"We have had tests made by our own people, and they have also been made on other railways, which show that the freight cars in this country are upon the average under control of the shippers 37% of the time—37% the shipper has the car; 6% out of that 37 being Sundays and holidays. That leaves 63% of the time of the car in the control of the railway. Now, what does the railway do with it? You may say, I suppose, that out of that 63, probably 45 or 50% of the time the car is moving on the road. Nothing of the sort. Only 11% of the total time of the car is it actually being moved. What happens to that other 52% of the time? Standing still in terminals, waiting to be switched, standing on connecting tracks with other railways, waiting to be repaired, being moved from the yard where the train left it to the warehouse—and things of that kind. Only 11% of the time is the car actually in motion; only 37% of the time is it under the control of the shipper; and the Baltimore & Ohio is not any worse than others—as a matter of fact, figures show that bad as we are, we were slightly better than the average, but that is the problem that confronts the railways."

Mr. Willard also stated that they were then making 28 miles a day with their freight cars, expressed the opinion that it should be 30, and advised that this gain of 2 miles a day would be equivalent to adding 6,000 cars to their equipment, and which would cost then, for steel hopper cars, approximately \$15,000,000. He said also that for some months their bad order cars had not exceeded 2½%. But does such a measure imply that the air brakes on the balance are in good order?

We should keep prominently before us the statement made in a railway periodical recently that "the cars must be kept in good condition, and when repairs are made they should be done thoroughly so that the equipment will not spend an excessive time on the repair tracks." While the car air brake repairs have not generally been made thoroughly, yet making such repairs has not contributed seriously to the percentage of bad order cars, those out of service for repairs. If this percentage could, for this reason, have been a little higher on our eastern lines during last summer, it would have helped materially to prevent the serious troubles experienced during the winter from inadequate control down steep grades.

One time saving not used as extensively as warranted is, where the destination of loads with defective brakes is a terminal, to mark them on arrival "B.O. when empty," with defect, and instruct switchmen to deliver same to the repair tracks promptly when empty.

Incoming freight train brake test.—It being obvious that we are far from the time when even fairly modern freight cars will reach the repair tracks for other work