larger wheel in finding a diameter equal to the smaller wheel tracks nearer the outer rim thus forces the smaller wheel to track nearer the flange. Curvature of tracks also has considerable effect in causing sharp flanges. The wheels on one side of a six wheel truck are frequently forced ¾ in. out of line with each other, by the curvature of the track rails. A great saving of material in steel wheels can be made by taking those with worn flanges out of service before they reach the limits allowed by the M.C.B. wheel defect gauge. Steel wheels are frequently found on which the flanges are so much worn that ¾ in. of metal has to be turned off the tire thickness in order to restore the tread and flange to the standard shape, while the opposite wheel on the same axle, which generally wears hollow, does not require more than ¼ in. to be turned off. When we consider that ⅛ in. of tire thickness is worth a day's wages, it is well worth while to inspect wheels closely under cars at home terminals for evidences of worn flanges. The M.C.B. wheel defect gauge is the only gauge in regular use for detecting worn flanges, but it was primarily intended for limiting the wear on cast iron wheels which cannot be re-turned, and it is unsuitable for gauging the flange thickness on wheels which can be re-turned, because it allows such wheels to get in the condition before mentioned. A very suitable gauge for limiting the flange wear of wheels which can be re-turned is the M.C.B. flange limit gauge for remounting cast iron wheels for cars of 80,000 lb. capacity and over. When the bottom inside corner of this gauge (which is nearest the throat of the wheel flange) rests on the wheel tread, the flange is usually so worn that seldom more than ⅜ in. is required to be turned off to restore the standard shape. The use of this gauge will save further waste of good material and frequently prevent the necessity for remating wheels. A similar advantage, but somewhat less, could be obtained by limiting the worn vertical height of flanges to ⅞ in. instead of 1 in. on wheels which can be re-turned.

The axles are made of steel, and are of sufficient strength to carry the loads, and to withstand the shocks they are liable to get under ordinary conditions. The shocks received from the track strain the axles as much as the load. All other parts of the truck which have to carry the load of the car should be proportionately strong with the axle. The whole load of the car is distributed on the axle journals, which are located outside the wheels. These are finished smooth, by rolling, so as to reduce friction and prevent heating. Axles are also becoming universally used as a source of power to generate electricity for lighting passenger cars. The revolving axle is harnessed to drive a dynamo which is frequently supported by the truck frame. The journals are enclosed by a metal box which also holds a brass bearing on the journal, a wedge to keep the bearing in place and the oil and waste necessary to keep the journal and bearing lubricated. The purpose of the box is not only to hold these parts, but also to keep out dirt and water. The causes of hot boxes are numerous, but the troubles may generally be attributed to lack of proper movement of the parts in relation to each other, or to lack of proper lubrication. When inspecting journal boxes, it is well to see that they have freedom to move in pedestals, that covers fit well and are tight, that dust guards fit well around the wheel seat, and inside the box, but have freedom to move in the box, that journal collars are not too large nor too small, and that they have no sharp or rough edges to catch or tear the packing, that journals are perfectly smooth and that there is some clearance between the collar and the end of the bearing or between the side lugs of the bearing and the stops for same inside the box, that the bearing is central on the journal, that the wedge is resting on the bearing in proper relation to it and to the box, and that clearance is provided for the wedge to rock on its rounded surface under the top of the box; also that the packing is of good quality, free from grit, well oiled, and well packed in the bottom of the box to a height half way up the journal.

Journal bearings are made of brass because it is much softer than steel, and therefore will not get hot so readily from the friction created in service; but brass is costly and they are lined by a cheaper and softer metal called babbit, which is composed of lead and other ingredients which give it the required hardness for wear, and yet render it soft enough to adjust itself to the varying diameters of journals. Bearings on which the linings have become worn can easily be relined by melting off the old lining, retinning the connecting surfaces where necessary and recasting the old babbit metal as a new lining. It is not to be expected, however, that the new lining will adhere to an old bearing, as well as to a new bearing, on account of the oil which has saturated the brass, therefore, when melting the babbit, the bearing should be made so hot that the tinning will be burnt off and the oil on top of the molten babbit should all be skimmed off before any metal is taken out of the caldron to be recast. Grooves on each side of the inside of the bearing are good to form keyways for the lining so that it cannot move out of place should it become loose, but this is not provided for in the M. C. B. standard designs. Some railways re-bore the old brass, thus providing a surface practically as good as on new brass.

Journal bearing wedges or keys are made of steel, either cast or drop forged, and others are made of malleable iron. Wedges partially hollow on the tops came into use a few years ago, but have since been condemned on account of the ribs bedding into the tops of the boxes and thus doing away with the usefulness of the camber on the wedge, which is designed to eliminate the strains caused where the two track rails are not of equal height in relation to each other.

Journal box packing should act like a lamp wick, so that it will keep the oil continually in contact with the journal. In order to do this, the packing should not only be in sufficient quantity to reach the journal, but it should have the quality of permanent springiness, as packing which sags soon loses contact with the bearing. It is for this reason that wool waste is better than cotton. Packing which has been in service gets clogged and lumpy, and contains dirt, cinders and metal, which not only interferes with the process of lubrication, but injures the journal. Such packing should be removed and renovated when cars are undergoing repairs. The renovating process is done by heating the packing so that it will loosen and allow the solid matter to fall apart.

Dust guards should be capable of keeping dirt and cinders from entering the back of the journal box at all times. They should fit close to the axle, but without injuring it. The height and width should be such that they will have as much freedom to move in the slots in the boxes as the axles have, but the thickness of the guard should almost fill the slot. The method of closing up the top of the dust guard slot in the box with a piece of tapered wood seems to leave something to be desired, as the blocks are frequently missing.

Truck frames have to transmit the load of the car to the axle journals and have to take the shocks from the track in return. They have also to keep the other parts of the truck in their proper places. There are two kinds of truck side frames most generally used for freight cars, one kind is the arch-bar type, built of rolled steel bars, and the other consists of a steel casting. The arch-bar type has its faults, which are principally that its parts become loose under the severe usage they get. These parts are bolted together, the strains cause the bolts to get loose, and the nuts become slack and eventually there would be numerous breakdowns if inspectors and repair men were not continually on the look out for parts getting slack. The cast steel frames are more expensive, and though they overcome some of the troubles of the arch-bar type, it is more difficult to obtain a casting to replace one that is broken, and also more difficult to put it in place when it is obtained. The welding of cast steel frames which have broken into two or more pieces does not produce good results and should only be used as a temporary expedient, and such frames should be replaced at the first opportunity. Small cracks may, however, be welded with good results. Attempts have been made to rivet the arch-bars together, and, while this is some improvement, it becomes a difficult proposition for repairs to be made at places where there are no facilities for cutting rivets. Other attempts have been made to improve the side frames by using two bolts at each column. This is of some advantage, because by using two bolts or two rivets in line, their size can be reduced with a corresponding increase in the area and strength of the arch-bars. Columns for arch-bar trucks are best made of cast steel because cast iron columns, even if very thick, will not stand the shocks delivered to them, neither will malleable iron castings. The truck frames are also so arranged as to hold the springs which carry the bolsters, and also to provide attachments for the brakes.

The bolsters being supported at the ends only and having to carry one-half of the car body at the center, have to be strong and substantial. There are two kinds of bolsters being made, those built of rolled steel sections and those made of steel castings. Both kinds are giving good satisfaction and it is largely a question of cost as to which is the more satisfactory of the two.

The springs to a large extent reduce the jarring which a car would otherwise get from the track. The helical form of spring is generally made of round steel bars, turned into coils of a uniform diameter, rising one above the other. The strength of these springs increases as the thickness of the steel increases and as the diameter decreases. The adding of coil upon coil simply gives the spring so much more movement and does not increase its strength to carry a load. These springs simply distribute the shocks and do not absorb any of them. Elliptic springs are made of flat steel plates put together in layers and arched. The strength of these springs increases as the thickness and number of the plates increases and as their length decreases. Elliptic springs are no stronger than semi-elliptic springs, and the additional half of the spring sim-