# A brief description of the Baker valve gear

As a result of the widespread application of Walschaerts valve gear in locomotives, several other patented forms of outside valve gear were developed that were designed to improve upon it. One such was the Baker gear.

This was one of the first locomotive valve gears that did not employ some form of link and link block in the reversing mechanism. All moving parts of the gear operate on pins or trunnions. One motion of the gear is derived from an eccentric crank attached to the crank pin on the main driving wheel of the locomotive. Additional motion to give the valve lead is provided by a combination lever that is connected to, and is operated by, the main crosshead. This feature of the valve movement is achieved by means of the combination lever (sometimes known as the lap-and-lead lever), which is connected between the valve rod and the valve stem. The lower end of the combination lever is connected to the crosshead via the union link.

Since the crosshead provides the same amount of movement for the combination lever at all times, the amount of the lead is the same at all times. This feature is known as 'constant lead'.

The general appearance of the Baker gear is illustrated in Figure 1. I have coloured the separate parts of the assembly for easier interpretation. There are two types of gear frames, the long version and the triangular version, the operating parts of the gear being exactly the same in either. The triangular frame is used when the general design of the locomotive will permit its application. Its compact construction makes it possible to support it on a single frame crosstie or guide yoke. The long frame requires to be supported at both ends and is used where the design of the locomotive will not permit the operating parts of the gear frame to be located close to a rigid engine frame crosstie or guide yoke.

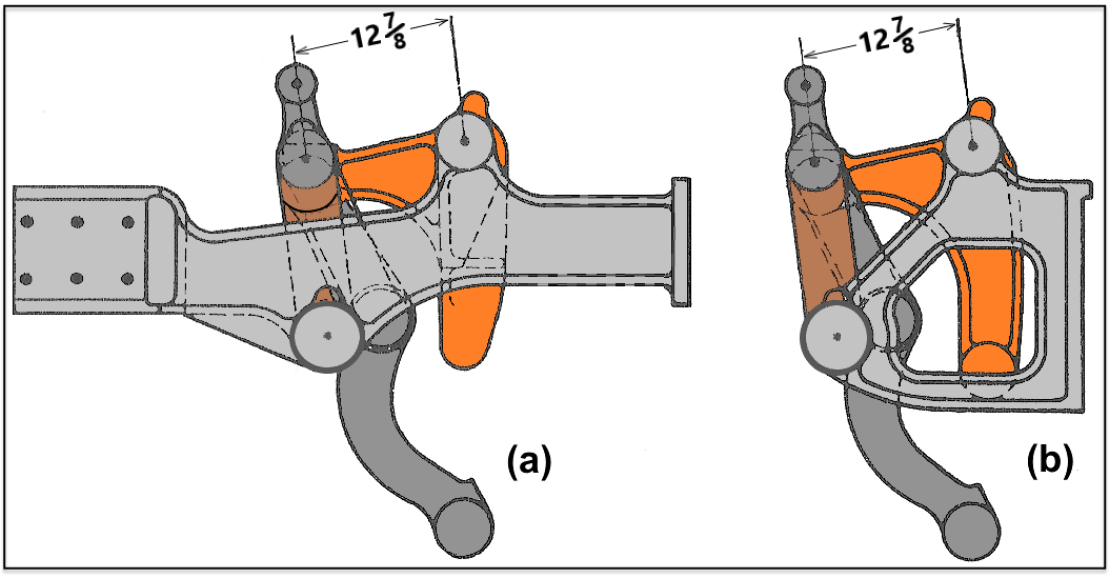


Figure 1

The construction of the Baker gear is so compact that a drawing of the parts in working position is difficult to interpret. Figure 2 shows the gear parts in the operating positions with one side of the gear frame cut away so that the positions of the bell crank on the gear connecting rod are shown. This illustration

also shows the positions of the reverse yoke and the radius bar. Concealed portions of these parts are indicated by dotted lines.

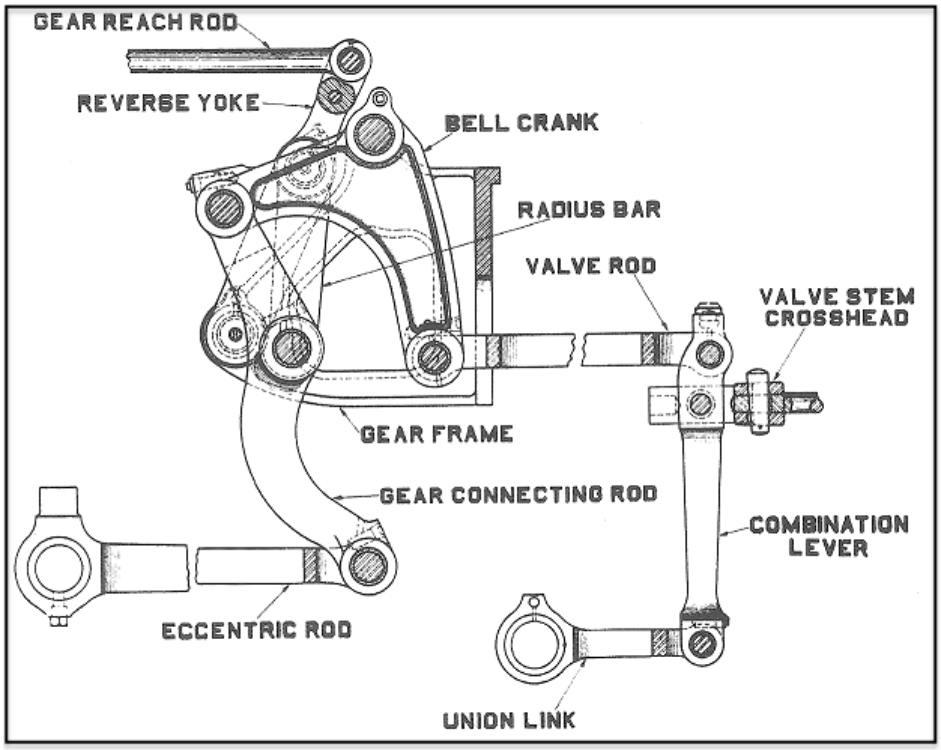


Figure 2

Figure 3 is a cross section through the gear, near the reverse yoke.

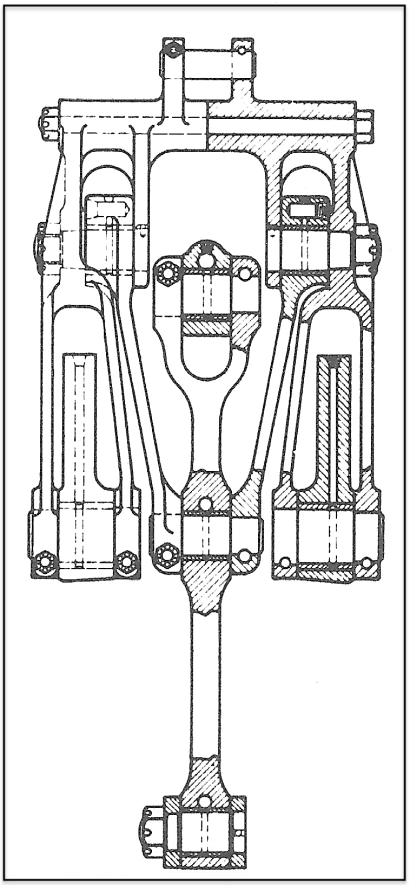

Figure 3

Figure 4 provides a clearer idea of the shapes of the various parts.

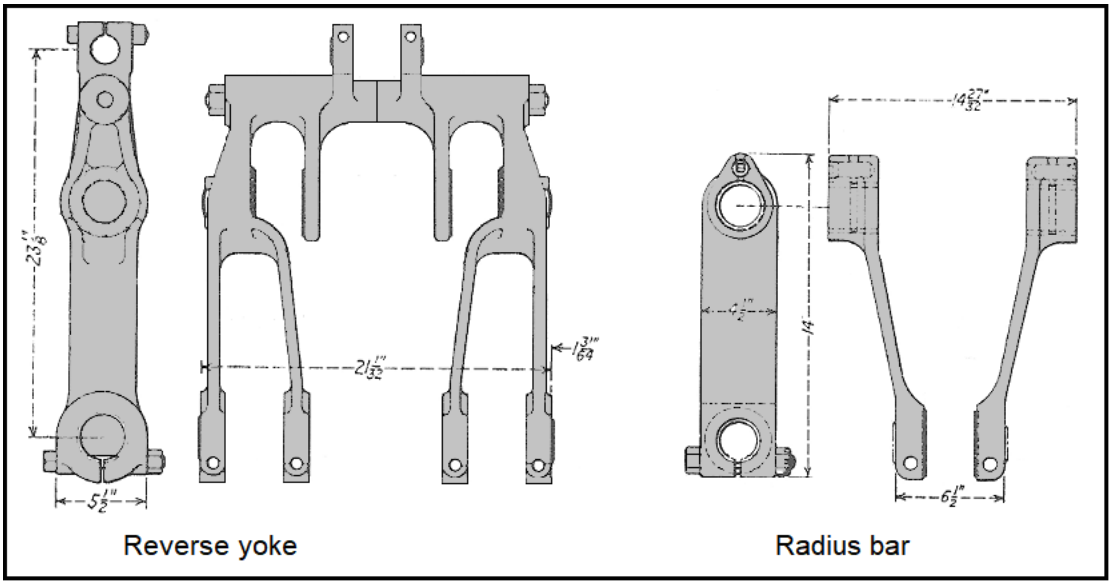


Figure 4

The illustration shows front and side views of the reverse yoke and radius bar. The trunnions at the bottom of the reverse yoke fit into the bearings at the rear of the gear frame. The jaw at the top of the reverse yoke connects with the gear reach rod. The larger bearings near the top of the reverse yoke, support the radius bar trunnions. The lower ends of the two halves of the radius bar are connected with the middle hole of the gear connecting rod by means of a pin which fits tightly in the two halves of the radius bar, and which has a working fit in the gear connecting rod. This forms a swinging support for the middle hole of the gear connecting rod while the gear is operating.

The top end of the gear connecting rod connects with the horizontal arm of the bell crank. The central bearing of the bell crank is supported by a large pin, which passes through the gear frame at the top and toward the front of the frame. The connecting pins and the trunnions our hardened steel. Needle (roller) bearings are used.

The Baker valve gear is made as three different types — standard, long-travel, and long-lap. These types cater for valve travel up to 9 inches. The long-travel and long-lap types are used on larger locomotives that require wider steam ports to permit the passage of large volumes of steam. The amount of valve travel is regulated by the amount of 'throw' imparted to the reverse yokes by the position of the gear reach rods, which—in turn—is regulated by the setting of the reverse lever.

The moving parts of the gear that are supported by the gear frame are driven by the eccentric crank attached to the main crank pin of the locomotive. The eccentric crank follows the main crank by approximately 90 degrees, or one quarter of a revolution. No angular advance is required, as the combination lever operates to provide lead for the valve in both forward and backward motion.

The eccentric rod converts the circular motion of the eccentric crank into a reciprocating motion at the lower end of the gear connecting rod. The motion of the gear connecting rod causes the movement of the bell crank, and the bell crank motion is transmitted to the valve by means of the valve rod.

It requires a degree of detailed study in order to understand the operation of the Baker valve gear. The relationship between, and relative movement of the various parts of the valve gear assembly appears complex until understood.

The radius bar serves as a swinging support for the gear connecting rod. This enables the middle of the gear connecting rod to swing forward and backward as its lower end is moved forward and backward by the motion of the eccentric rod.

When the crank pin and piston crosshead are at either the front or back dead centre, the eccentric rod is on its corresponding quarter and the gear connecting rod stands nearly vertical. Under these conditions, the reverse lever can be moved from the centre of the quadrant, either forward or back, without causing any appreciable movement of the bell crank or valve rod. The valve itself is moved by the combined movement of the union link and the valve rod. Since the low end of the combination lever derives its movement from the crosshead, its position in this case, is fixed by the fact that the main crank is on the dead centre.

Consequently, the valve's *stem* will always be brought to the same position when the crank pin reaches a dead-centre point regardless of the position of the reverse lever. Since this valve stem position is the lead position of the valve, the lead will always be constant for any position of the reverse lever. In other words, whenever the main crank is on either dead centre, the valve will be open the amount of the lead, regardless of the position of the reverse lever on its quadrant. It is this characteristic that gives the Baker gear constant lead in all positions of the reverse lever. While this feature may not be entirely desirable, it is fully compensated-for by the important advantages an outside motion affords.

In summary then, the Baker valve gear is an ‘outside’ gear, has no links or eccentrics, and the bearings of all its moving parts are pins or bushings. Valve movement is controlled by the reverse yoke pivoted in the gear frame. This carries the radius bar on its lower end and the gear connecting rod is pivoted. The gear connecting rod extends from the radius bar, bearing downward as it does so, to connect with the eccentric rod and bearing upward to connect with the bell crank.

With the reverse yoke in mid-gear the minimum vertical movement of the gear connecting rod is obtained. The travel of the valve is increased by means of the increased oscillation of the bell crank when the reverse yoke is moved toward either end. This is accomplished in part by means of a greater vertical movement of the three gear connecting rod bearings.

Looking from the side, when the lower end of the gear connecting rod is moved to the left, with the reverse yoke in forward motion, a lifting action of the gear connecting rod is produced and this moves the valve back by revolving the bell crank. By making the same movement of the lower end of the gear connecting rod it will cause a falling action of the gear connecting rod with the reverse yoke in back motion, thus reversing the movement of the bell crank and valve. The

valve was moved the amount of lap plus the lead in either direction, which makes the lead constant regardless of the cut-off.