three sections, in pairs, a wide range of these pairs being at hand for use with different sizes of pin holes. The set standing on the left end of the link is for use with larger holes. The lower ends of the gauging pins are tapered, with a corresponding taper in the bore of the segmental sections. The gauging pins are thus made solid, and perfectly central and in line with the eccentric rod hole. A gauge, C, corresponding in construction to a height gauge, placed between the saddle pin and gauging pins in turn, locates the saddle in its central position. When thus located correctly, with regard to the two determining factors, the link and saddle are clamped together and the two bolt holes in the saddle drilled through the previously drilled holes in the link.

LINK BLOCK.—From the fact that the link block is such a small member, it is made in sets of four from a forged wrought iron block. This wrought iron block is first planed on its flat surfaces, and then drilled to gauge with four holes for the rocker shaft connection. Following this, the block of four is milled to the required radius on the rig shown in fig. 5, previously described. The drilled holes are the determining points from which to set the block up in the machine. The four pieces are then cut from the block. Both planed sides are then faced off in the lathe, concentric with the drilled holes, to form bosses on each side, over which the retaining collars fit. After drilling the rivet and oil holes, each block is case-hardened, followed by lapping out the central hole and a grinding of the arc surface of the blocks in the radius grinding machine. This completes the link block up to the stage of assembling.

THE LINK BLOCK PLATES are made from thin forged blocks, faced on a milling machine and bored in a lathe one at a time. The large edge radius is given the plates by mounting them 12 at a time in a miller and running over the edges with a formed cutter of the correct shape. After drilling the rivet holes, they are case-hardened, followed by a surface grinding which leaves them ready for rivetting to the link block, four rivets being required.

THE LIFTING LINKS are also wrought iron forgings. The first machining is that of facing the four faces on the miller to give the necessary surfaces from which to work. Both ends are then drilled to jig for the insertion of bushings. Following this, the link is milled all over, including the round ends and flat sides, completing the machining by drilling the oil holes. Hardened steel bushings are then ground and pressed into the drilled ends, this operation being followed by a facing off of the first-milled surfaces by a cutter on a mandrel working in the hardened bushings.

THE TUMBLING SHAFT is a built up forging. The first operation is that of turning the body for the end journals, these turned ends acting as guiding points from which the balance of the machining is done. Slotting the faces of the bosses follows, gauging from the finished surfaces of the journals.

Next in order comes the boring and reaming of the two lifting link arms, the reach rod arm and the spring arm in the machine shown in fig. 9. The shaft is held between centres, A, mounted on the stands B, across which the centres are adjustable. The stands, B, are attached to a surface plate base, C, and may also be adjusted to suit the size of the piece being machined. The arms to be bored and reamed are centred by set screws top and bottom in the steadying castings, D, bolted to the base C. The first operation after correctly aligning horizontally and vertically, is that of drilling the bosses. A drill rod held in the chuck E, is guided in a bushing in the support F, against the first boss. Stand G guides the drill rod for the second boss. There is also a third support at H.

The second or reaming operation, is performed by the reamer rod I, held in the chuck E, and guided into the drilled holes by the supports. The outside of the boss ends are turned by the use of a cutter head, J, mounted on a guiding bar. Following this, the previously slotted boss faces are faced off by a facing cutter through the cutter bar as at K. The reach rod and spring arm bosses are machined in a similar manner.

After removing from the special machine, the metal on the boss opposite the arm, which could not be removed by the cutter head, is slotted off by standing the bosses on end over centres in the slotter. Ground bushings are then forced in to the holes in the reach rod and spring arms. Likewise, the lifting link pins are ground into their arms and there set, completing the machining of

Canadian Northern Railway Ten Wheel Superheater Locomotives.

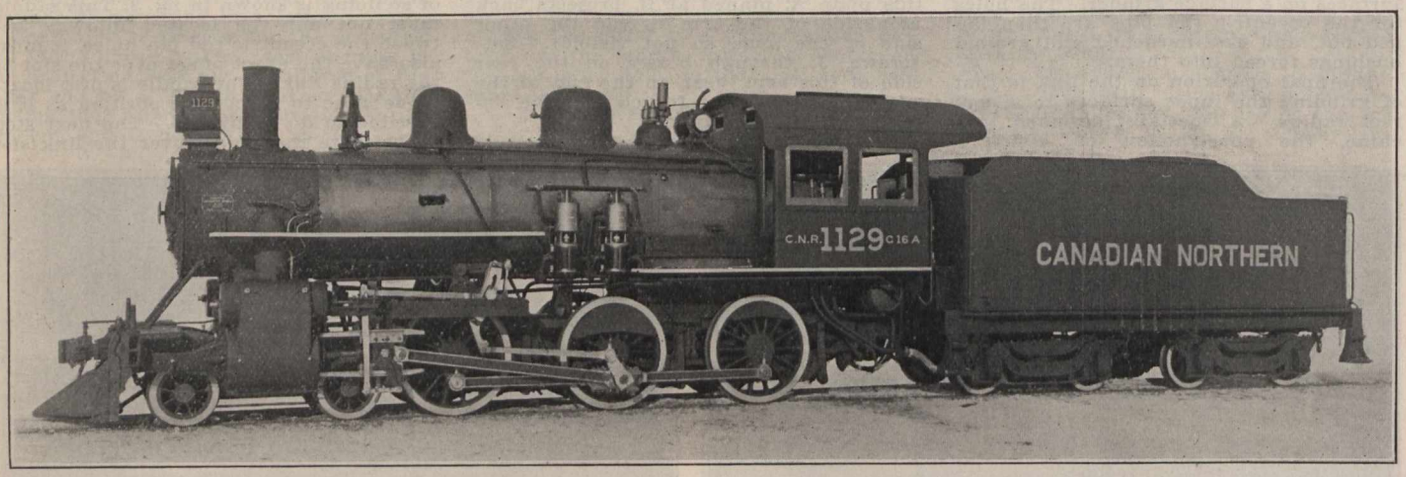
Within the past few months the Canadian Northern Ry. has received 20 ten wheel locomotives from the Montreal Locomotive Works. Though of moderate weight, these locomotives are of more than ordinary interest, because of the number of features presented in the design which are said to be new on Canadian railways and which are quite a radical departure from present practice.

Among these will be noticed the arrangement of steam pipes connected to the cylinders outside of the smoke box; the so-called self centering guide for the valve stem crosshead and the guide for the extended piston rods. All of these have been quite widely adopted on United States lines. These same details were applied to 20 heavier 10 wheel locomotives constructed by the same builders for the C.N.R. in 1911.

One of the accompanying illustrations shows an arrangement of the outside steam pipes similar to the one here employed. An air tight joint is provided where the steam pipes are carried out through the smoke box. This arrangement removes much of the obstruction to draught in the smoke box which is present with steam pipes of the ordinary construction. It also eliminates the live steam passages in the cylinder saddle, thereby greatly simplifying the coring of the cylinder. This also reduces any tendency of cylinders cracking in service, due to the difference in temperature between the live steam and the exhaust steam passages which exists in the ordinary cylinder construction where the two passages are side by side. This is of special importance where highly superheated steam is used. A much better joint to the cylinders is also obtained; as eight bolts of equal length with a symmetrical circular flange are used in place of four or six bolts, as in the case of the bent inside steam pipe. Should a small leak occur, this arrangement also prevents any injurious effect on the steaming of the engine. A leak would merely waste steam, but would not interfere with the vacuum in the smoke box, as it does in the case of ordinary inside steam pipe construction.

One of the principal advantages of the design of valve stem guide lies in the fact that it can be erected, taken down and replaced without lining up, at the same time insuring that the guide is absolutely in line with the centre of the piston valve chamber. This device consists of a guide made integral with the back head of the valve chamber. It is consequently self-centering and is also self-supporting, no bracing from the crosshead guides or any other source than the cylinder being required. The guide is so designed as to be easily adjustable for wear. Liners are provided on the top and bottom, which in case of wear, may be removed or inserted as may be required. This arrangement makes it possible to use a straight design of combination lever without forks which is connected to the crosshead by a pin passing through the wings of the latter. This affords more lateral stability than is provided in other designs.

In the design of guide for the extension piston rod, the self centering principle is also employed. As a result, the guide can be removed and replaced without requiring lining, and at the same



Canadian Northern Railway Ten-Wheel Superheater Locomotive.