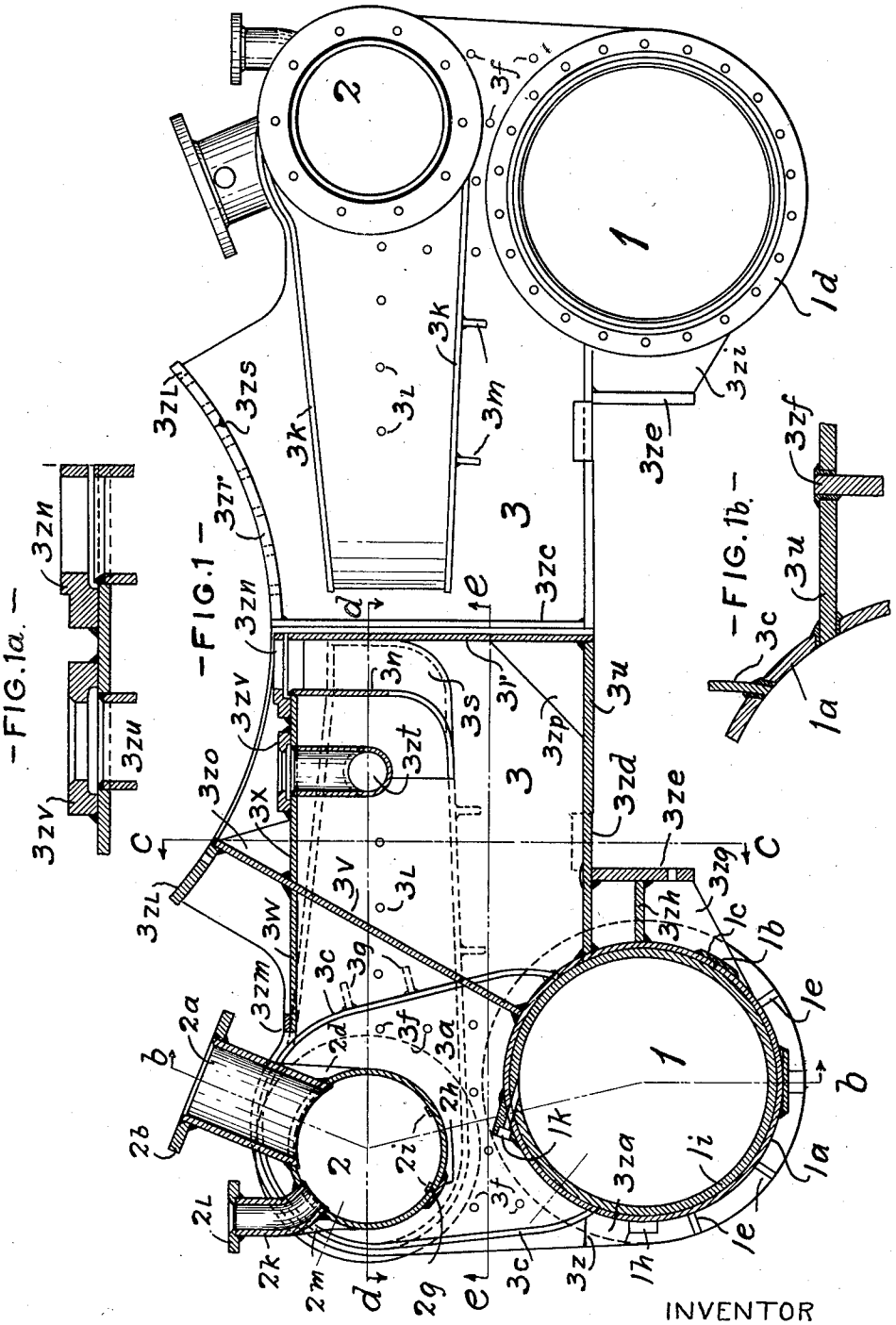
June 24, 1930. S. MILLER 1,767,005

LOCOMOTIVE CYLINDER AND ASSOCIATED PARTS
AND METHOD OF MANUFACTURING THE SAME
Filed March 25, 1929 4 Sheets-Sheet 1



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LOCOMOTIVE CYLINDER AND ASSOCIATED PARTS
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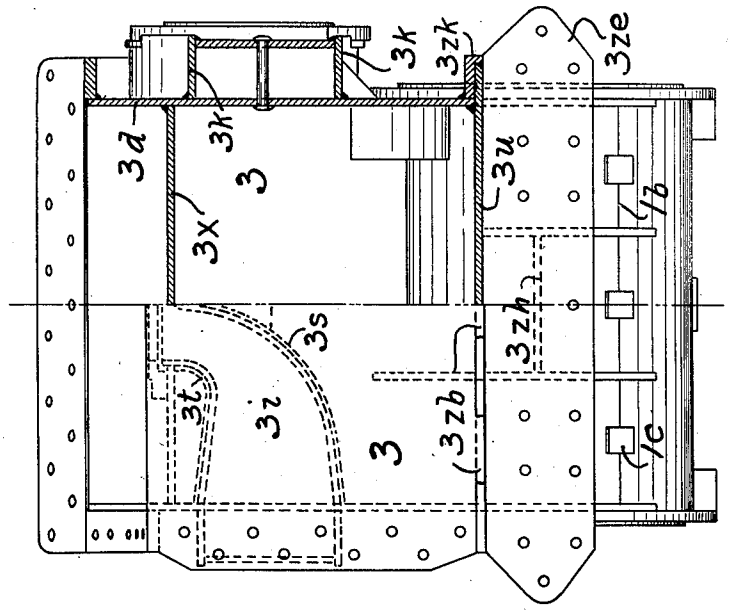
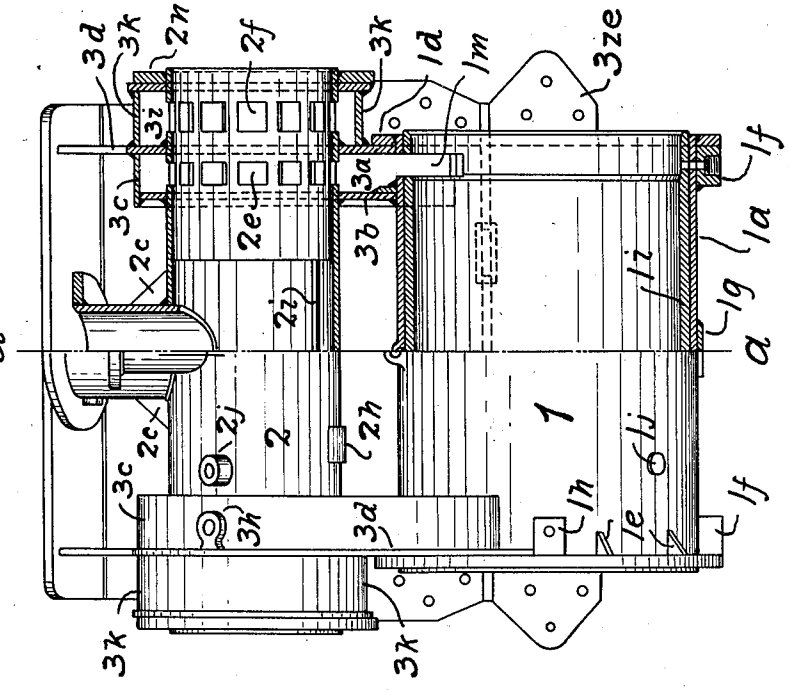
Filed March 25, 1929 4 Sheets-Sheet 2

-FIG.3-



-FIG.2-



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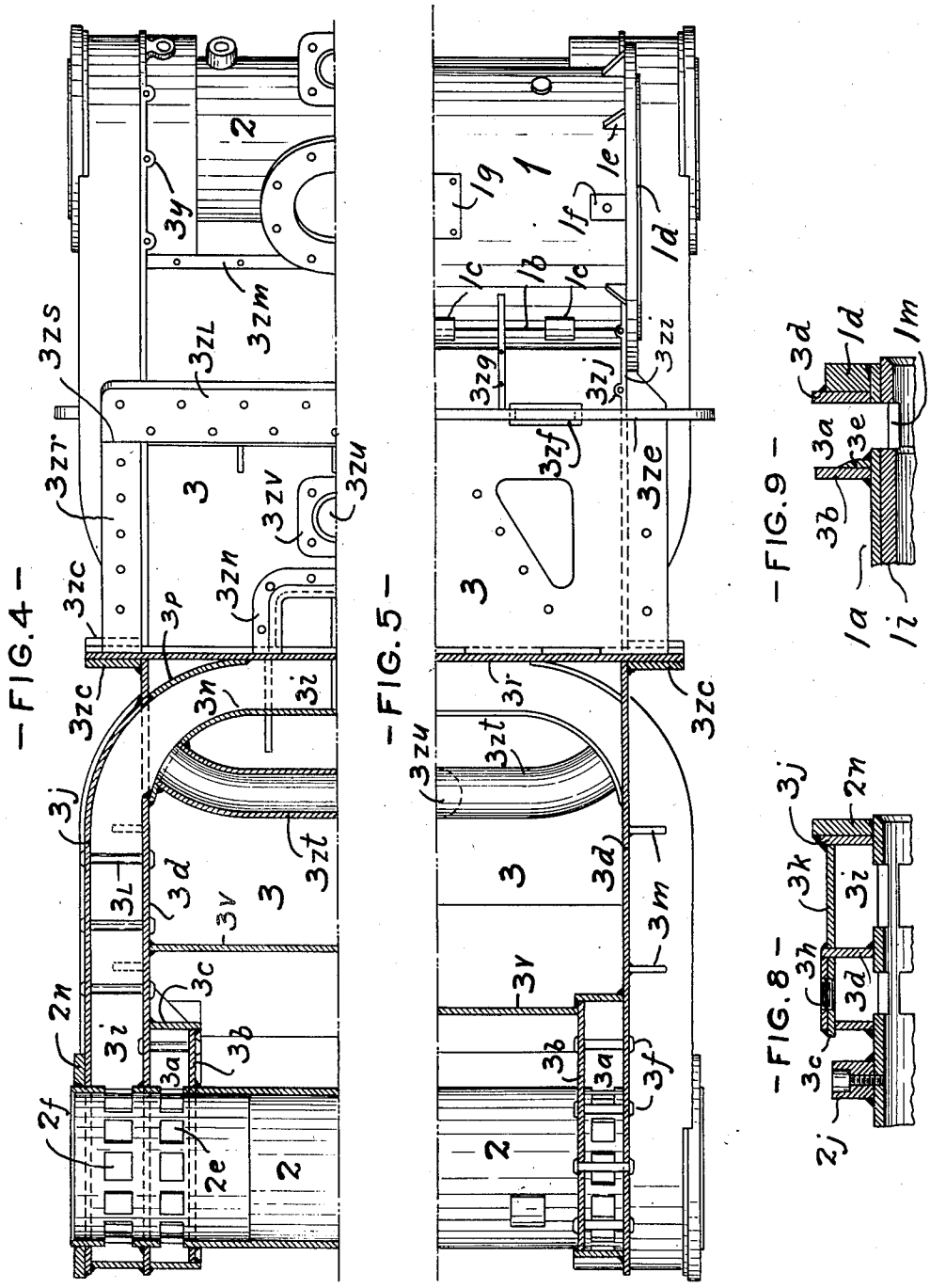

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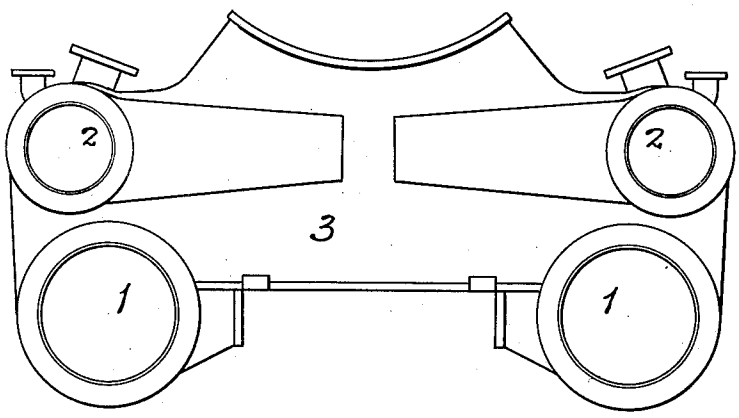
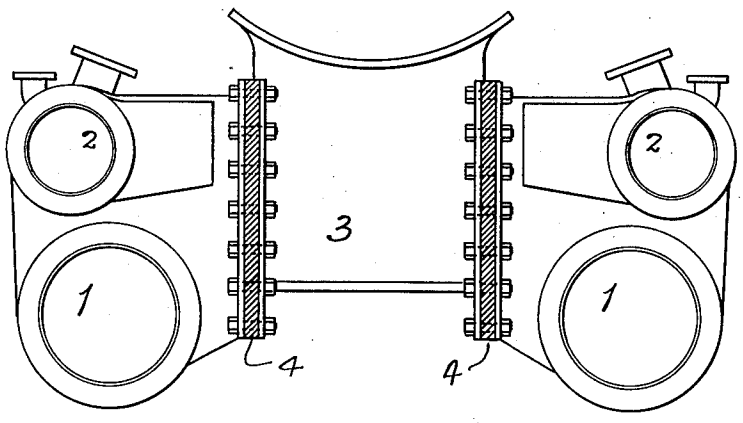
Filed March 25, 1929 4 Sheets-Sheet 4

— FIG. 6 —



— FIG. 7 —



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1,767,005

UNITED STATES PATENT OFFICE

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LOCOMOTIVE CYLINDER AND ASSOCIATED PARTS AND METHOD OF MANUFACTURING THE SAME

Application filed March 25, 1929. Serial No. 349,597.

This invention relates, generally, to the cylinders and to associated parts, such as the steam chest, cylinder saddle, steam delivery pipe, and exhaust passage of steam locomotives, and to methods of manufacturing the same. An object of the invention is to provide a structure formed from metal plate, which will be of increased strength, and of greatly reduced weight; which is capable of being more easily repaired; which is more effectively resistant to stresses resulting from temperature variations; and which is free from injurious initial shrinkage stresses. A further object of the invention is to provide a method by which such structures can be manufactured with facility at a minimum cost for labor and material.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is a front view, half in elevation, and half in vertical section, on the line *a a* of Fig. 2, of a fabricated structure, including working cylinders, steam chests, cylinder saddle and other associated parts, illustrating an embodiment of the invention; Fig. 1^a, a section, on an enlarged scale, showing the exhaust connection and feed water heater outlet; Fig. 1^b, a similar section, showing the joints of the port passage walls and the saddle bottom wall, with one of the cylinders; Fig. 2, a side view, half in elevation, and half in vertical section, on the line *b b* of Fig. 1; Fig. 3, a view, half in side elevation, and half in vertical section, on the line *c c* of Fig. 1, of the built up or fabricated cylinder saddle member; Fig. 4, a top view, half in plan, and half in horizontal section on the line *d d* of Fig. 1; Fig. 5, a bottom view, half in plan and half in horizontal section, on the line *e e* of Fig. 1; Fig. 6, a front view, illustrating a structural modification; Fig. 7, a similar view, partly in section, illustrating another structural modification; Fig. 8, a partial sectional plan view, on an enlarged scale, showing the joints of the steam and exhaust passages with the steam chest; and, Fig. 9, a partial vertical section, on an enlarged scale, showing the joint of a steam passage with a working cylinder.

In the practice of the invention, referring descriptively to the specific embodiment thereof which is herein exemplified, and first to Figs. 1 to 5 inclusive, plates of wrought metal, such as iron, steel, or suitable alloys, of proper thickness and sizes, are prepared in the shapes necessary to form the locomotive working cylinders, each indicated as an entirety, by the numeral, 1; the steam chests, each indicated as an entirety by the numeral, 2; a cylinder saddle, indicated as an entirety by the numeral, 3, said saddle being a built up or fabricated structure, and being interposed, as in ordinary practice, between the cylinders, 1, 1; and other associated parts. Said constituent members are then connected by welding, as hereinafter described, into a fabricated structure, which is novel and useful in the art, and possesses qualities and capabilities not found in cast metal constructions. It has been an object to so locate the welding joining the parts, that the welds will, as far as possible, not be injured by stresses, and furthermore, the jointures between the main elements of the structure are additionally strengthened by tenons on one piece which fit into enlarged mortises in the adjacent piece, with the intervening space filled in with welding material.

Steam enters the steam chest, 2, through the delivery pipe, 2^a, which has a bolting flange, 2^b, welded to its upper end, and its lower end welded to the steam chest. The upper edge of the flange, 2^b, is chamfered where it encircles the pipe, 2^a, providing a ring space of triangular cross section, which is filled by welding material, and the corner formed by the under side of the flange, 2^b, against the outer circumference of the pipe, 2^a, is filled with welding material to form a fillet. To further stiffen the joint of the pipe, 2^a, with the steam chest, 2, the gussets, 2^c and 2^d, are corner welded, where they abut the walls of the delivery pipe, and the steam chest. The lower end of the delivery pipe, 2^a, projects through the wall of the steam chest 2, and is welded thereto, both inside and outside.

The steam chest, 2, may be formed from a flat plate, in which is cut a centre opening

for the delivery pipe, and also two rows of rectangular ports, 2^e and 2^f, for the inlet and outlet, respectively, of the steam. After development, this flat plate is rolled to a cylinder and butt welded at 2^g, for its entire length. To give additional strength to the jointure, two short length welt strips, 2^h, which overlie the abutting margins of the steam chest are welded thereto.

The steam chests are internally bored to provide shoulders for the cast valve bushings (not shown) which are forced into place by pressure. For the purpose of guiding the piston valve as it is inserted and to prevent the packing rings from dropping out of their slots in the valve, two guide strips, 2^i, are welded to the inner surface of the steam chest. These guide strips are machined to provide a smooth and accurate surface. Bosses, 2^j, are welded to the outer surface of the steam chests properly located to take the plugs, customarily used to secure the valve bushings in place.

Connection for a relief valve is made by inserting a curved pipe, 2^k, through the wall of the steam chest and welding it thereto, and having its upper end welded to a bolting flange, 2L, of suitable shape. The relief valve pipe, 2^k, is further stiffened by the gusset, 2^m, welded to it, and to the steam chest. A circular flange, 2^n, internally chamfered, is fitted over each end of the steam chest, and the angular space at the chamfer is filled with welding material. These flanges form the bolting connections for the heads which close the ends of the steam chest. They are set a sufficient distance inwardly of the ends of the steam chest, 2, to enable the ends of the steam chest to form a steam tight seat against the heads.

Port passages for conveying the steam to and from the cylinders, are formed by the inner walls, 3^b, the covering walls, 3^c, and the outer walls, which latter are part of the front and rear saddle walls, 3^d. In order to make all of the welds accessible, the inner walls, 3^b, are set within the edge of the covering walls, 3^c, and the welding is applied as a fillet. The walls, 3^b, are cut out for the reception of the steam chest barrel and shaped therebelow to fit against the curve of the cylinder barrel, with welding all around the outer circumference of the steam chest and for the entire length of the joint with the cylinder barrel. The front and back walls, 3^d, of the saddle, are shaped to provide a fillet weld with the covering walls, 3^c. To give additional strength, the lower extremities of the walls, 3^c, are made of sufficient length to extend to the inner circumference of the cylinder barrel, passing through rctangular openings therein of larger transverse dimensions than the plate, the intervening space being filled in by welding. The jointure is also reinforced by a fillet weld as shown in Fig. 1^b. The steam port, 1^m, through the cylinder barrel being narrower than the width of the passage 3^a, a deflecting strip, 3^e, is welded into the corner formed by the juncture of the wall, 3^b, with the cylinder barrel as shown in Fig. 9. To prevent bulging of the side walls, of the port passage, 3^a, due to high steam pressures, stays, 3^f, are provided, formed of short lengths of round bar iron, which project through both side walls and are welded to the outside surfaces thereof. Additional bracing is provided by the brackets, 3^g, welded to the inner surface of the saddle walls, 3^d, and to the outer surface of the covering walls, 3^c. To provide peepholes for use in setting the valves, bosses 3^h, formed with suitable openings normally closed by plugs, are welded to the cylinder.

The barrel, 1^a, of the cylinder, 1, is made in a similar manner to the steam chest, that is, by rolling a flat plate to cylindrical form, and welding the abutting edges together as shown at 1^b. Short welt strips, 1^c, are applied at spaced intervals to overlie the abutting edges and are welded throughout to the cylinder barrel. The flanges, 1^d, which form the bolting connections for the cylinder heads, are bored with a chamfer and the space so formed is filled in by welding material. Further stiffness is added by the bracket ribs, 1^e, which are welded to the flanges and the barrel. Bosses, 1^f, for the cylinder drain cocks, are blocks of suitable size welded to the flanges and the barrel, while the seat for a cylinder cock operating cylinder, if required, is provided by welding a plate, 1^g, of suitable dimensions, on the center of the barrel at the bottom. Indicator plug bosses, 1^h, are applied similarly to the drain valve bosses, 1^f. It is intended that after the barrel, 1^a, is assembled in the structure it will be bored out for the insertion of a cast metal bushing, 1^i, as regularly used to provide a suitable bearing surface for the sliding piston, replaceable means for absorbing wear, and to make a steam tight joint with the cylinder heads. Bosses, 1^j, welded to the outside of the barrel, are for the customarily used bushing plugs used in addition to the pressure fit to hold the bushing, 1^i, in place, while the boss, 1^k, welded to the top of the cylinder barrel, forms the oil pipe connection.

The exhaust passages, 3^i, leading the steam from the valve chests to the common exhaust outlet, substantially duplicate in form the cored passages used in cast structures. From the valve chests, they are disposed outside of the saddle, and lead toward the centre of the locomotive. Passing through the front and rear saddle walls, they curve to approach each other and deflect upwardly at the centre, to direct the exhaust steam outwardly through the common exhaust pipe base. At the chests, the exhaust passages, 3^i, occupy the

space between the saddle front and rear walls, 3^d, and the steam chest bolting flanges, 2^n. The outer vertical walls, 3^j, of the exhaust passages are plates welded all around to the flanges, 2^n. The plates, 3^k, forming the top and bottom walls of the exhaust passages extend around the chests and along the top and bottom edges of the plates, 3^j, being attached to them and to the saddle walls, 3^d, by fillet welding. Bracing between the vertical flat walls of the exhaust passages 3^i, is provided by the stays, 3L, which are applied similarly to the steam passage stays, 3^f, and by the bracket ribs, 3^m. The exhaust passages extend through apertures provided in the front and rear saddle walls, 3^d. Inside of the cylinder saddle, the exhaust passages, are formed of the curved side plate, 3^n, extending from the front to the rear saddle wall and welded to the inner surface thereof, the short curved plates, 3^p, extending from the saddle front and rear walls, 3^d, to the saddle side wall, 3^r; the upwardly curved bottom plates, 3^s, and the top curved plates, 3^t. The plates, are set slightly within the edges of the top and bottom plates, 3^k, to permit welding in the corners.

The saddles, 3, are composed of the front and rear plates, 3^d, previously mentioned, the bottom plates, 3^u, the inside plates, 3^r, previously mentioned, the diagonal plates, 3^v, extending from the cylinder barrel to the boiler fit, and the top plates, 3^w and 3^x. Front and rear plates, 3^d, extend from the inside plate 3^r to a distance beyond the outer wall of the steam passages, and are shaped at the top to a contour to join the boiler fit. They are also shaped to provide for the attachment of the covering jacket. The bosses, 3^y, of half round bars, welded on, are tapped out for the screws holding the jacket in place. The plates, 3^d, are shaped to pass over the tops of the cylinder barrels, to which they are also welded, and terminate at the line 3^z, which is in line with the top of the bottom plate, 3^u. The plate, 3^{za}, is a filler, to complete the line of the jacket. The plate 3^{za}, is butt welded at the line, 3^z, and corner welded to the cylinder. The plates, 3^d, are welded to the cylinder bolting flanges, 1^d, the steam chest barrels, 2, and for the full length of the exhaust passage walls, 3^k. The inside plate, 3^r, has tongues, 3^{zb}, fitting into corresponding notches formed in the bottom plate, 3^u, and is welded thereto for its entire length inside the saddle. Its front and rear vertical edges are stiffened by the bars, 3^{zc}, which are welded to it and to the front and rear plates, 3^d, their purpose being to give sufficient length of bearing for the bolts connecting the two cylinder saddles together. The bottom plate, 3^u, extends from the inside plate, 3^r, to the cylinder barrel, to which it is welded, as shown in Figs. 1^b and 2. This plate forms the seat where the cylinders rest on the frames and is machined for an accurate fit at 3^{zd}. To attach the cylinders to the frame the bolting flange, 3^{ze}, is welded to the underside of the bottom plate, 3^u, and is tenoned thereto at 3^{zf}. To brace the bolting flange, 3^{ze}, from the cylinder barrel, there are inserted the bracket ribs, 3^{zg}, welded to the cylinder and to the flange, and connected by the horizontal plate, 3^{zh}. In line with the saddle plates, 3^d, the fillers 3^{zi}, similar in outline to the ribs, 3^{zg}, are welded in, and provided with bosses, 3^{zj}. Screw holes in these bosses, together with those in the ribs, 3^{zg}, form the attaching means for the cylinder jacket. Bottom plate 3^u, is notched front and back in line with the frame fit for L shaped blocks, 3^{zk}, which form the abutments against the frame fit, and are welded all around. Diagonal plates, 3^v, previously mentioned, extend between the front and rear cylinder saddle walls, and from the cylinder barrels to the boiler fit. Each is welded, both sides, to the front and rear saddle walls, and to the cylinder on its bottom edge, while, at its top, it is welded to the inside of the rectangular heavy bar flange, 3aL, which forms the side bolting connection to the smokebox. Top plate, 3^x, is horizontal and covers the inside of the saddle, being welded along all of its edges, while top plate, 3^w, in line with the plate, 3^x, extends outwardly from the diagonal plate, 3^v, and at its outer edge, has a strip, 3^{zm}, welded on, which is tapped out for screw holes to attach the cylinder jacket. The top plate, 3^x, is cut out for the exhaust pipe outlet, which is welded to it at its upper end, and the opening is surrounded by a steel casting, 3^{zn}, to form the base for the exhaust pipe. Steel is used so as to weld around its edges to the top plate, 3^x, and the recessed underside clears the protrusion of the exhaust outlet through the top plate. Gussets, 3^{zo} and 3^{zp}, welded in all corners, provide additional stiffness to the saddle structure. To attach the saddle to the smokebox, the bolting flange composed of the side bars 3aL, and the front and back bars, 3^{zr}, which are curved to fit the radius of the smokebox, is provided. The bars, 3aL, are welded to the bars, 3^{zr} at 3^{zs} and form a heavy rectangular frame welded on the sides to the diagonal saddle plates, 3^v, and front and back to the saddle plates, 3^d. The thickness is such as to provide a bolt bearing of a length, equivalent to that used with cast cylinders.

Exhaust steam for the feed water heater is collected by the curved pipe, 3^{zt}, which is welded, at its ends, to exhaust passage wall, 3^n, and is discharged through the vertical central outlet, 3^{zu}, consisting of a piece of similar pipe mitered into, and fillet welded to, the pipe 3^{zt}. The upper end of the outlet, 3^{zu}, is welded to the saddle top plate 3^x, and the opening surrounded by a base, 3^{zv},

having studs for the connection of a heater pipe in the smokebox. This base, 3^{zv}, is provided with a recess in its underside to clear any protrusion of the outlet, 3^{zu}, through the plate, 3^{x}. It is made of steel so as to weld around its edges to the plate, 3^{x}.

The structural modification shown in Fig. 6, is similar in its details to the construction just described, but differs in that both cylinders and associated parts are combined in one unitary structure, instead of in a structure composed of two separable halves.

In the modification shown in Fig. 7, the structure is made in three separable parts connected together through the locomotive frames, 4, but the general details of construction are consistent with those of the two part construction.

The term "efficiently weldable" as used in the claims is intended to embrace those metals capable of making welded jointures of greater efficiency than the jointures formed by welds between cast iron or cast steel parts.

The advantages to be derived from the use of wrought metal plates are, that due to the greater strength of such plate over cast construction, relatively thin plates can be employed, producing a structure of materially greater strength and of much lighter weight. Furthermore such plate construction is better adapted to withstand vibrations and heat variations than cast constructions and accordingly are not liable to breakage from these causes, which so frequently happens with cast constructions. Another advantage of plate construction is that when repair or renewal of a part is necessary only the portion or part affected, need be cut out, and a new portion or part welded back into the structure or the old portion or part straightened or otherwise treated and restored to its place by welding. With cast constructions, on the other hand, the entire structure frequently must be scrapped.

When both cylinders are welded into a single integral structure, the greatest stiffness and the greatest saving in weight is accomplished, at the same time eliminating the labor required to join two half saddles together on the centre line. A further advantage of the invention is that of eliminating both the cost of patterns and the expense incurred in their storage and maintenance in serviceable condition, which latter item is of paramount importance where but few castings are made from each pattern and an extensive variety of patterns must constantly be kept on hand.

While certain of the preferred forms of the invention have been described, it is to be understood that various modifications in form, material, assembly, and procedure, may be resorted to without departing from the spirit and scope of the invention claimed.

The invention claimed and desired to be secured by Letters Patent, is:

1. A locomotive working cylinder having oppositely disposed longitudinal edges of efficiently weldable metal, welded together.

2. A locomotive steam chest having oppositely disposed longitudinal edges of efficiently weldable metal, welded together.

3. In a structure for locomotives, the combination of a working cylinder having oppositely disposed longitudinal edges of efficiently weldable metal, welded together, and a steam chest having oppositely disposed longitudinal edges of efficiently weldable metal, welded together.

4. In a structure for locomotives, the combination of a working cylinder, a steam chest, and means supporting the cylinder and chest in operative position and fastened to one of the same by welding.

5. A locomotive cylinder saddle formed of a plurality of plates welded together.

6. In a structure for locomotives, the combination of a cylinder saddle comprising a plurality of plates welded together, and a working cylinder having oppositely disposed longitudinal edges of efficiently weldable metal welded together; and means for securing the cylinder to the saddle, comprising a groove and tongue joint and welding.

7. In a structure for locomotives, the combination of a cylinder saddle, comprising a plurality of plates welded together; a working cylinder, and a steam chest.

8. In a structure for locomotives, the combination of a steam chest of metal plate, and a pipe for supplying steam to the chest, welded thereto.

9. In a structure for locomotives, the combination of a steam chest of metal plate, and a relief valve pipe welded thereto.

10. In a structure for locomotives, the combination of a steam chest, a pipe for supplying steam to the chest, welded to the chest, and a relief valve pipe welded to the chest.

11. In a structure for locomotives, the combination of a cylinder of plate metal having a socket, and a saddle having an extension fitted into the socket and welded to the metal surrounding the same.

12. In a structure for locomotives, the combination of a plate metal cylinder formed with sockets, a steam chest, a passage for steam connecting the cylinder and chest, and having a wall formed with extensions fitted in the sockets and welded to the metal surrounding the same.

13. A locomotive cylinder saddle, comprising a steam exhaust passage, formed of a plurality of angularly joined plates, welded together.

14. A locomotive cylinder saddle, comprising a passage for conveying steam to a feed water heater, formed of a plurality of angularly joined plates welded together.

15. In a structure for locomotives, the combination of a cylinder saddle formed of angularly joined plates welded together; a steam chest formed of plate metal, and welded to the saddle; a cylinder formed of plate metal and welded to the saddle; and a steam passage communicating with the steam chest and the cylinder, and formed of angularly joined plates welded together.

16. In a structure for locomotives the combination of a cylinder saddle; a steam chest; a cylinder; a passage for supplying boiler steam to the chest; a passage for supplying chest steam to the cylinder; a passage for conducting exhaust steam to the smoke box; and a passage for conducting exhaust steam to the feed water heater, all of said parts being united into an integral structure by welding.

17. The method of manufacturing locomotive cylinders, and associated parts, which comprises the steps of shaping metal plate to form a cylinder with abutting longitudinal edges and shaping metal plates, to form a saddle, and welding the abutting edges of the cylinder together, the saddle plates together, and the cylinder to the saddle.

18. The method of manufacturing locomotive cylinders and associated parts which comprises the steps of shaping metal plate to form a cylinder with abutting longitudinal edges, and a steam chest with abutting longitudinal edges, shaping metal plates to form a saddle, and a steam passage from the steam chest to the cylinder, and welding the abutting edges of the cylinder together, the abutting edges of the steam chest together, the plates to form the saddle and the passage, and the cylinder and steam chest to the saddle.

19. The method of manufacturing locomotive cylinders and associated parts which comprises the steps of shaping metal plate to form a cylinder with abutting longitudinal edges, and a steam chest with abutting longitudinal edges, shaping metal plates to form a saddle, a port passage from the steam chest to the saddle, and an exhaust passage from the steam chest, and welding the abutting edges of the cylinder together, the abutting edges of the steam chest together, the plates to form the saddle, the port passage and exhaust passage, and the cylinder and the steam chest to the saddle.

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