of pistons arranged in oppositely-located series, mounted in suitably-arranged cylinders, and connected by an intervening reciprocating frame. In these cylinders are produced cycles of operations through four strokes of the piston and two complete revolutions of the crank-shaft, the operations of admission, compression, explosion, and exhaust being performed successively in each cylinder or its explosive-chamber, receiving an igniting-spark once during two revolutions at the proper moment. The engine is designed to transmit power generated in the explosion-chamber in a constant succession of strokes imparted to the crank-shaft, thereby obviating the usual delay incident to the functions as carried out in engines of single or double cylinder construction, and the transmission of the forces is maintained throughout



the connected piston structure by means of an intervening frame, thus securing equal strain on the working parts of the engine and main shaft, while fully utilizing the generated power. The invention also refers to means whereby pairs of the cylinders are connected so as to insure simultaneous explosions therein, and assist in scavenging the chambers. The apparatus consists of a main framework constituing an inclosing case, a main shaft mounted in bearings therein, and provided with cranks, oppositely-disposed pairs of cylinders extending outwardly from each end of said framework, corresponding pistons mounted therein, and pitmen connecting the pistons of one pair of cylinders with the cranks, means for controlling the admission and exhaust to and from each of said cylinders, and communicating ports between said oppositely-disposed cylinders constituting each pair.

Process of Decarburizing.—Franz von Kügelgen and George O. Seward, Holcombs Rock, Va. 807,034.—De-



carburizing a metalliferous substance is done by fusing it as an electrode in presence of a substance having a high affinity for carbon.

Transmission-Gear for Gas-Engines.—Anson Groves Ronan, of Toronto, Canada.—807,048.—Improvements in transmission-gear for gas-engines; the objects of my invention are, first, to dispense with the usual half-time shaft and gearing thereon, making the drive-shaft perform functions of same; secondly, to reduce the weight of engines of this class; thirdly, to relieve the engine axle of all undue strain; fourthly, to lower the drive-shaft as far as possible and keep same horizontal, so that when engine is used for marine



807,048.

work the propeller will operate at the most efficient angle, and, fifthly, to vertically mount a pair of cylinders abreast and have them either together or singly operate the same drive-shaft. It is a combination with the engine-casing; or a first toothed pinion; the engine-pitman operating same; a second toothed pinion, and engine-pitman operating same, of the drive-shaft journaled in said engine-casing, and a toothed wheel keyed to said drive-shaft, and in mesh with said pinions from which it receives energy.

Steel Mixer.—P. L. T. Heroult, December 12th, 1905.— 807,027.—This invention is a "sign of the times;" for it is a supplementary application of electricity—on a large scale, to the conventional methods of steel manufacture; with a view of ensuring a more perfect product. "The largest charge ever smelted in an electric furnace has been about 4½ tons. It is proposed to make this mixer large enough to carry a charge of 300 or 400 tons; to be fed by five or six Bessemer or Siemens furnaces." The inventor describes a mixer for steel of considerable capacity, to secure uniformity in the product of an entire works, to secure a certain desulphiration and recarburation and conserve the oxidizable additions—such as silicon, manganese and the like—in order to reduce the quantities of these additions employed to a minimum. By reason of the metal being at a high temperature and in a very fluid condition, the oxides of silicon and manganese rise to the surface, leaving a clear product. Heat from the electric current has the advantage that it is nonoxidizing; moreover, the inventor maintains in the mixer a non-oxidizing atmosphere by the introduction, for example, of producer gas. The slag is thereby maintained deoxidized so as to favor the desulpheration of the metal. The mixer is closed. The aperture through which the electrodes pass is preferably made tight by a water-cooled pressure gasket. The atmosphere within the furnace is maintained under pressure by the gas introduced from the producer. In view of the magnitude of the steel receptacle, it is of primary importance that provision should be made to prevent loss by heat by radiation. In this appliance the inventor has adequately taken care of this contingency. With a pig-iron mixer the temperature of liquefaction is about 1,500 deg. C., and it is only necessary to pour in fresh iron from the blast furnace at sufficient intervals in order to maintain the mass in a liquid steel. With steel the temperature of liquefaction is 1,600 deg. to 1,800 deg. C., and i