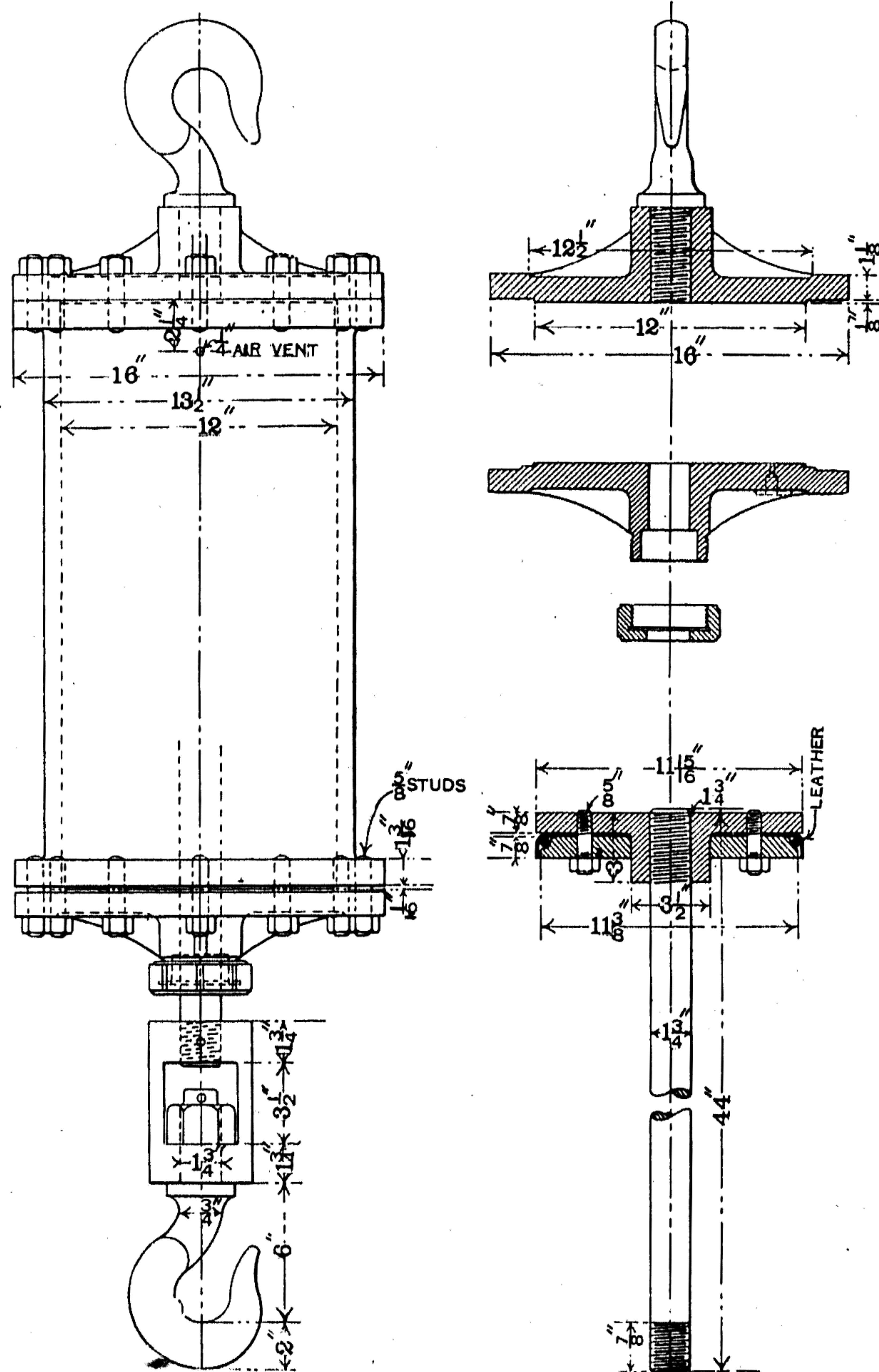


The length of the cylinders are made to suit the hoist which is required, but the larger size in the driving wheel shop are made 36 in. long, which gives a stroke of 33 in. In a future issue we trust to be able to publish a full and complete account of a pneumatic plant as applied to a large shop, showing all of the various apparatus that has been designed therefore.

The valves which are used on the New Haven Road are globe valves, admitting the air beneath the piston and exhausting into the atmosphere of the shops by the same means. The packing is tight enough, so that the weight can be held suspended safely without any danger of settling for an almost indefinite time. The uses of compressed air, as we have already said in describing the Norwalk air compressor in another column, is meeting with wider and wider applica-



LARGE PNEUMATIC HOIST, N. Y., N. H. & H. R. R.

tion for shop uses and hoisting purposes, and is well worthy the investigation of those who are interested in the economical production of machine work.

THE FIRST-CLASS BATTLESHIP "ROYAL OAK."

The *Royal Oak*, built by Messrs. Laird Brothers, of Birkenhead, is one of the largest battleships constructed for the British Navy, and was built under the Naval Defense Act. Her dimensions are: Length, 380 ft.; breadth, 75 ft.; mean draft, 27.6 ft.; displacement, 14,150 tons; freeboard forward, 19.6 ft.; aft, 18 ft.; indicated H.P. natural draft, 9,000; forced draft, 11,000; speed, natural, 16 knots; forced, 17 1/2 knots; coal carried at the designed load draft, 900 tons; coal endurance at 10 knots, 5,000 knots; total weight of armament, 1,910 tons; height of heavy guns above water-line, 23 ft.; length of the belt or side armor, 250 ft.; greatest thickness, 18 in.; protective deck, 3 in.; total weight of armor, backing, and protective deck, about 4,500 tons. As befits her enormous bulk and weight, the construction of the ship has been made exceptionally strong. The hull alone absorbs over 9,500 tons of the total displacement. She is built entirely of mild steel, the stem and stern-posts and shaft brackets being formed of steel castings. The hull from end to end is largely subdivided, for the purpose of minimizing to the fullest possible

extent the danger arising from damage to the bottom plating from rocks or torpedoes, and that this form of construction is effectual was exemplified when H.M.S. *Howe* went ashore at Ferrol. The framework has been specially designed with reference to the great weight to be carried, and additional stiffness is secured by double longitudinal bulkheads, which form a passage for easy communication below the water line from end to end, and within these are placed the auxiliary magazines. A protective steel deck, 2 1/2 in. in thickness, extends under water from the bow for about 76 ft., and from the stern for a distance of about 72 ft. From this deck, and resting upon an armor shelf, is built a belt of steel-faced armor, with a backing of teak. The lower edge of the belt extends 5 ft. 6 in. below the load draft-line, while the upper edge is carried 3 ft. above the line. The greatest thickness is 18 in., the belt itself extending over a length of 250 ft., out of a total length of 380 ft., and terminating in armored bulkheads. At the fore and after ends of the belt, and rising directly from the protective deck, are the barbettes, strongly framed in mild steel, protected by teak backing and armor 17 in. thick. Superimposed upon the thick belt is placed another belt of light armor, 4 in. thick at the sides and 3 in. on the screens, running across the ship, and behind this side armor coal bunkers are arranged, whereby additional protection is secured. On the level of upper edge of the armor belt there is also a 3 in. steel deck, worked so that horizontal deck protection extends from end to end. The guns are protected by 6 in. screens, and the gun crews by armored emplacements, and in order to procure a safe passage for the ammunition from the several magazines to the guns of the secondary armament, armored tubes have been specially fitted. It is also to be noted that, with a view of preventing water from finding its way below the protective deck, means are provided for closing the several openings by water tight covers, while in the case of those which must necessarily remain open, coffer dams have been fitted with the same object. She is lighted throughout with an installation of over 620 electric lights, and equipped with four search lights of 25,000-candle power, each of which will be worked by dynamos under protection. The ship in action will be fought from either of two conning towers, of which the forward one is armored to the extent of 14 in., and the after one to 3 in. The port and starboard engine and boiler-rooms are separated by middle-line longitudinal bulkheads extending the whole length, and there are also longitudinal bulkheads at the sides extending throughout the machinery space, forming coal bunkers and wing spaces. On the platform, *débris*, and lower decks is placed the auxiliary machinery for the working of the ship, including steering engines, electric engines, and hydraulic pumping engines, as well as a fully-equipped workshop and numerous store-rooms. The officers and crew are placed on the main and belt decks. The officers' accommodation consists of very completely fitted cabins situated aft, the superior officers being located on the main deck. The admiral's suite of rooms, which are especially handsomely fitted, are at the extreme aft end of the main deck, and communicate with a handsome stern walk. The upper deck extends from stem to stern without a break, and above it is a continuous bridge-deck extending the whole length between the barbettes, and on this deck are the conning towers surmounted by the navigating bridge and chart house. The boats, of which there are 21, including two torpedo-boats, are stowed amidships. A strong steel derrick is fitted to the mainmast for lifting them, and the foremast is also fitted with a derrick for working those of a lighter description. The masts, which are built of steel, are fitted with military and signaling tops, and there are two funnels on the same athwartship lines. The armament of the *Royal Oak* will comprise four 13.5-in. 67-ton guns, mounted *en barbette* in pairs, and firing a projectile weighing 1,250 lbs., with a powder charge of 630 lbs.; ten 6-in. 100-pdr. quick-firing guns, the four on the main deck being mounted in casemates protected by 6-in. armor, while the six on the upper deck are mounted on sponsons; sixteen 6-pdr., and nine 3-pdr. quick-firers; eight small machine guns; and two 9-pdr. field guns. The auxiliary armament is distributed all over the ship, and extends from bow to stern, the top, sides, and bridges having a considerable number disposed upon them. The main armament is worked by hydraulic machinery, supplied by Sir W. Armstrong, Mitchell & Co. The other guns are all worked by hand, the 6-in. by one man, the others being employed for feeding purposes. The ship is also fitted with seven torpedo tubes, of which two are submerged. The number of torpedoes carried is 18. The main propelling machinery consists of two sets of engines of the triple-expansion inverted type. Each set is placed in a separate engine-room. The cylinders are 40 in., 59 in., and 88 in. in diameter respectively, with a stroke of 51 in.; they are entirely independent castings, and are bolted together by