March 8, 1949. H. M. ARNOLD 2,464,112

CYLINDER HEAD FOR SUPERHEATED STEAM ENGINES

Filed Aug. 17, 1945 2 Sheets-Sheet 1

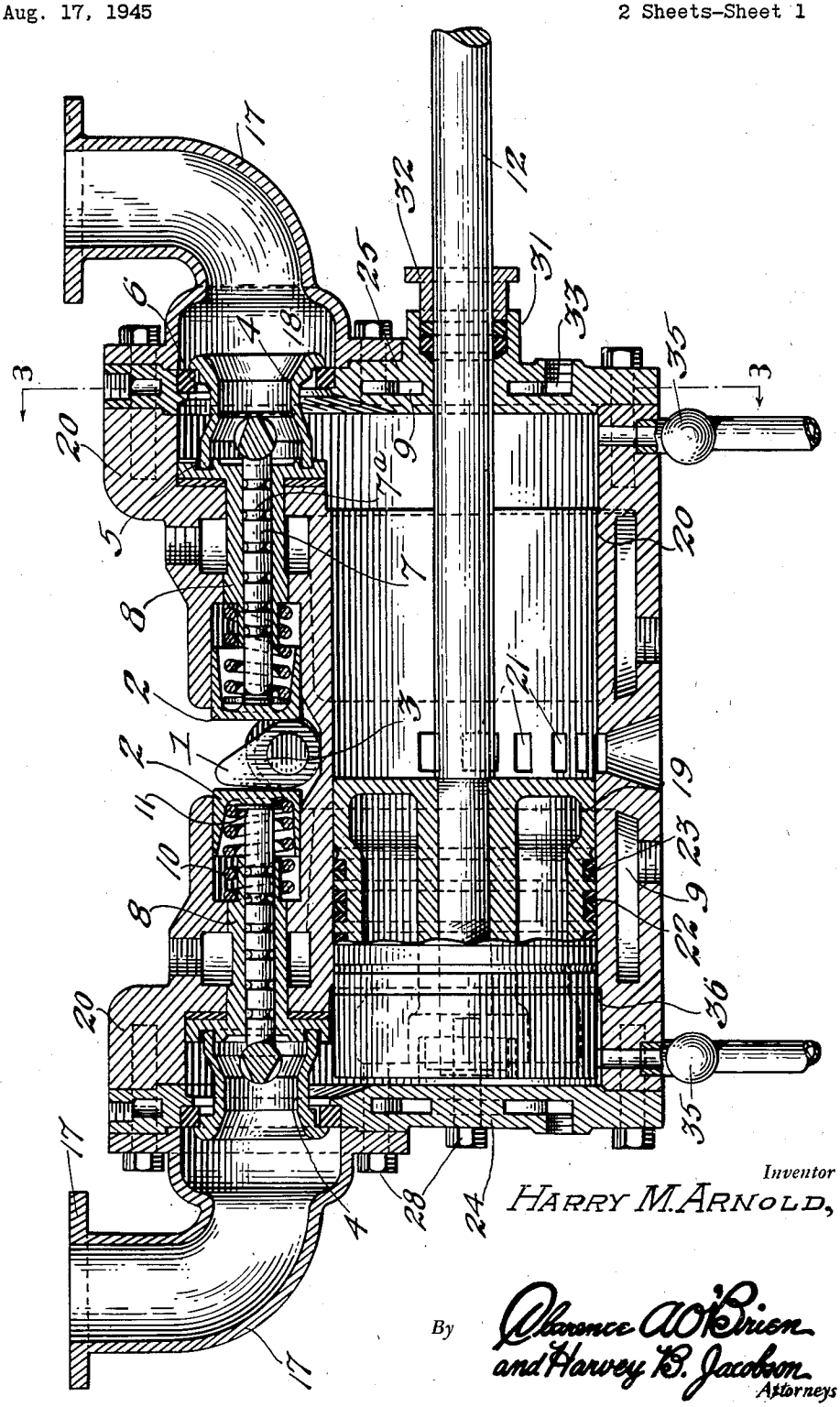


Fig. 1.

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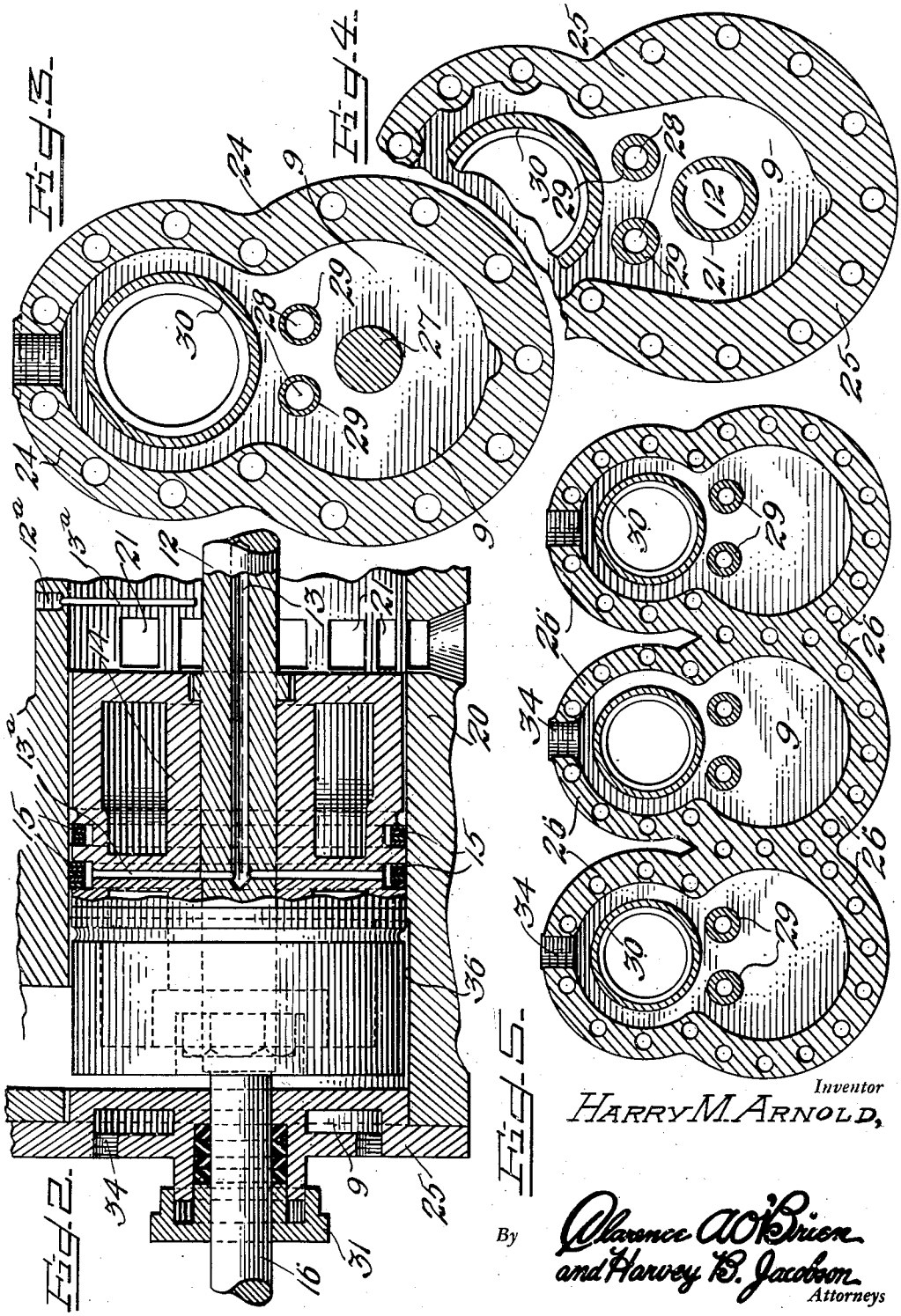


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 2.

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CYLINDER HEAD FOR SUPERHEATED STEAM ENGINES

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Application August 17, 1945, Serial No. 611,117

2 Claims. (Cl. 121—181)

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This invention relates to a steam engine using superheated steam and other very hot gases, the general object of the invention being to provide a circulating system for the cylinders, cylinder heads, pistons and packing glands of the engine which is so constructed and arranged that it will maintain the parts at a temperature that efficient lubrication of the various parts of the engine can be obtained by utilizing very little cylinder oil and in some cases by using moisture lubricated piston rings. When moisture lubricated rings are used, they may be dampened by introducing water into the piston, or by introducing water into a channel cut in the cylinder barrel, or by using moisture formed from a partial condensation of the expanding steam.

When ordinary dry steam expands in a steam engine, considerable condensation occurs making possible oil-free cylinder operation. When very highly superheated steam is utilized the cylinder becomes dry and often times too hot for effective lubrication with the best cylinder oils now in use.

By cooling the cylinder to a temperature slightly below the condensation temperature of the expanding steam, a small amount of superheated steam will condense upon the cylinder barrel affording a moist surface. Highly superheated steam cools and condenses very slowly as compared with saturated steam so that the loss in power on the piston of the engine during the power stroke is far less than is experienced in the conventional saturated steam engine.

The heat absorbed by the jacketing system of the engine can be imparted to the boiler feed water so that less heat is required to evaporate the water in the boiler. To achieve this, the entire jacketing system must be made strong enough to withstand a pressure slightly above the boiler pressure used in connection with the engine. By mixing some steam or hot water from the boiler with the cold feed water, nearly any desired cylinder temperature can be maintained.

Still another important item to be considered in Uniflow steam engines utilizing very highly superheated steam, is uneven expansion of the cylinder and cylinder heads. Cylinders for use with highly superheated steam are often bored on a slight taper from each end to the center where the exhaust communicates with the cylinder, so the cylinder barrel will become of uniform bore when it is heated to a higher temperature at the ends than at the center. With the circulating system illustrated in this patent application, the entire cylinder assembly may be

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held at a uniform temperature thereby eliminating mechanical difficulties now experienced from uneven heating of the cylinder.

This invention also consists in certain features of valve construction and means of cooling the valve stems and valve guides. The combination and arrangement of the several parts are hereinafter fully described, illustrated in the accompanying drawings and specifically pointed out in the appended claims.

In describing the invention in detail, reference will be had to the accompanying drawings wherein like characters denote like or corresponding parts throughout the several views, and in which:

Figure 1 is a longitudinal sectional view through the engine.

Figure 2 is a fragmentary sectional view through a cylinder provided with a floating piston and piston rod so constructed that water can enter the piston through the piston rod, or through an opening in the side of the cylinder barrel.

Figure 3 is a transverse sectional view taken on a line 3—3 of Figure 1, and

Figures 4 and 5 are similar views of modified cylinder heads.

In these drawings and referring to Figure 1 the numeral 1 indicates a special form of oscillating cam so constructed that it can be used to actuate one or two valves, depending upon whether the engine is only single acting or double acting as illustrated in Figure 1. The cam 1 first contacts the follower 2 at a point nearly in line with the center of the cam shaft 3. At this point the velocity of contact is very slow and the lifting power of the cam is very great. The numeral 4 indicates a double beat tubular valve having its inner and outer ends flared to admit steam into the cylinder internally and externally of the valve and also having an adjustable seat and labyrinth seal in the inner valve seat 5, while the main portion of the tension on the valve during closed position rests against the outer valve seat 6 to prevent leakage of the steam. The valves are provided with valve stems 7 having annular grooves 7a to collect moisture for a seal; the condensation occurs in the valve guides 8 which are cooled by the jacketing system 9 of the engine. The springs 10 hold the valves 4 in closed position and are secured to the stems 7 by the pin and washer 11.

In Figure 2 it will be seen water enters the hollow piston rod 12 and is conducted through the passage way 13 to the center of the piston 14. The water passes through small radial open-

ings 13a to the annular surface of the piston 14 and is trapped between the sealing rings 15 and is forced into contact with the cylinder wall 20. With large size pistons, particularly in horizontal engines, the wear between the cylinder and piston may be eliminated through the use of another cross-head and an extended rod 16 passing through the other end of the cylinder. The entire weight of the piston 14 is supported by the piston rod 12 and the extended tail rod 16 which in turn transmit the load to any one of a number of conventional cross-heads now in common use (not shown). Only the rings 15 contact the cylinder barrel 20 to prevent steam from blowing past the piston 14. When excessive temperatures are employed, a water jacketed packing gland 31 may be necessary for the piston rod 12 and tail rod 16. Another method of moistening the piston rings 15 and the cylinder barrel 20 where the rings contact it, is to introduce water through the passage way 12a in the cylinder barrel 20 and distribute it around the cylinder barrel by use of a groove 13a. The rings will pick up moisture as they pass to and fro over the groove 13a.

Referring again to Figure 1 it will be seen the superheated steam enters the engine through the pipes 17 and valve chests 18. Steam is alternately admitted to the two ends of the cylinder by the valves 4 and after pressing the piston 19 to the opposite end of the cylinder 20 it exhausts through the centrally arranged Uniflow exhaust ports 21. The piston 19 is supported by load carrying rings 22 while sealing rings 23 wipe the moisture to the exhaust ports 21. The piston heads 19 are a little small in diameter so expansion due to elevated temperatures will not cause metal to metal contact with the cylinder 20. The jacketing system 9 surrounds the end portions of the cylinder 20 and the valve guides 8. A jacket 9 is formed around the packing gland 31 and the packing is held in position by the insert 32. The piston 19 is a single piece mounted on the piston rod 12. Bolts 29 hold the cylinder heads 24 and 25 and the valve chests 18 securely to the cylinder 20. Drain and relief valves 35 should be used on the cylinder to relieve excess compression when starting the engine from rest and to allow any condensation, which may accumulate in the ends of the cylinder 20, to be blown out. A long counter-bore 36 extends into each end of the cylinder 20 so the piston rings 22 and 23 contact only the portion of the cylinder barrel 20 backed up directly by the circulating system 9.

Referring now to Figures 3, 4 and 5, three types of cylinder heads are illustrated in section and are denoted by numerals 24, 25 and 26. The cylinder head 24 is intended for the end of the cylinder where the piston rod 12 does not enter. The core of solid metal 27, affords additional strength so a large flat surface is avoided. Two cores 29 are provided and tapped for cylinder head bolts 28. The circulating chamber 9 surrounds the valve seat flange 30 and the cores 27 and 29.

Numeral 25 denotes a cylinder head of different shape. The bolts 28 are set in closer to the flange 30. The core 27 is bored for a piston rod 12 while the cores 29 are taped for bolts 28. The circulating chamber 9 is formed around the bolts 28 and flange 30 and also encircles the cores 27 and 29.

The cylinder head 26 is intended for an engine having several cylinders made together. The cores 29 are tapped for bolts 28. The cores 27 are omitted but must be used if a piston rod 12 is to pass through, or if high jacketing pressures are involved. The circulating chambers 9 are independent of each other and each has its own entrance 33 and exit 34 for the cooling agent. The entrance 33 in Figures 3, 4 and 5 is cut away but can be distinctly seen in Figure 1.

This improved engine promotes expansion of very high temperatures by superheated steam because most of the heat losses from the steam are prevented while the steam is entering the cylinder. Experience has shown that in a reciprocating engine operating at high piston speed, the steam enters the cylinder and expands in a very small fraction of one second. When highly superheated steam is employed only a very small amount of the steam adjacent the cylinder barrel will have time to cool and condense. The resulting loss in mean effective pressure on the piston is very small as compared with the great loss of mean effective pressure resulting from condenation in the conventional reciprocating engine using saturated steam.

While the drawings show the invention applied to an engine of the type shown in Figure 1, it will, of course, be understood that the invention can be used with other types of engines such as the single acting engine as well as in cylinder constructions embodying two or more cylinders in one cylinder block.

It is thought from the foregoing description that the advantages and novel features of the invention will be readily apparent.

It is to be understood that changes may be made in the construction and in the combination and arrangement of the several parts provided that such changes fall with in the scope of the appended claims:

I claim:

1. In a steam engine of the reciprocating piston type, having a cylinder, a piston mounted for reciprocation, a piston rod projecing from one end of the cylinder, and an intake valve at one end thereof, a cylinder head for the end of the cylinder through which the piston rod projects said cylinder head having an opening for the piston rod and another opening in alignment with the corresponding intake port, the cylinder head having a water jacket chamber surrounding both openings and separated from them by walls of substantially uniform thickness and an opening at each end of the water jacket chamber for the admission and discharge of a cooling medium, whereby the metal enclosing the piston rod and the intake valve will be cooled in succession by a cooling medium flowing through the water jacket chamber.

2. In a superheated steam engine of the reciprocating piston type, having a cylinder, a piston mounted for reciprocation, a removable cylinder head for one end of the cylinder, and an intake valve opening in the cylinder head, the cylinder head having a water jacket chamber of an extended area, concentric with the cylinder, said chamber surrounding the intake valve opening, which is separated therefrom by a wall of uniform thickness, the wall of the cylinder head having an inlet opening and outlet openings at opposite ends of the water jacket chamber, whereby a cooling liquid will flow the entire length of the water jacket space and completely surround the inlet valve opening.

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