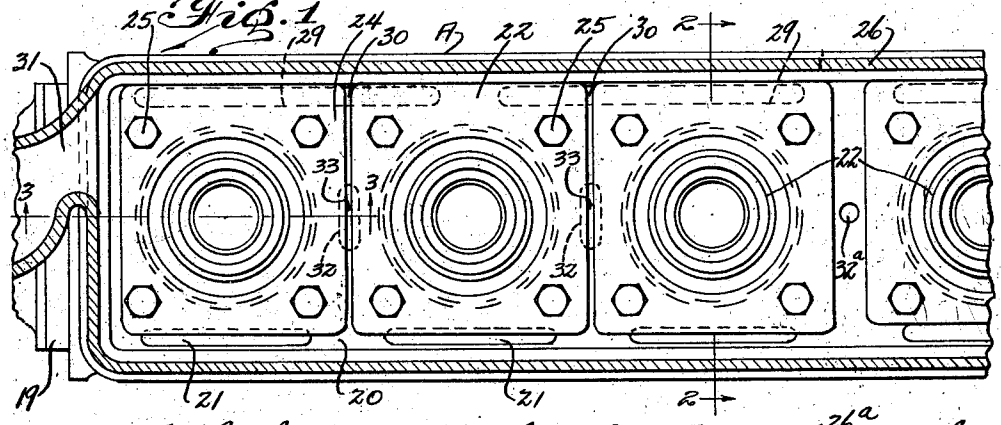
June 17, 1930. A. M. NIVEN 1,764,744

INTERNAL COMBUSTION ENGINE

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Fig. 1



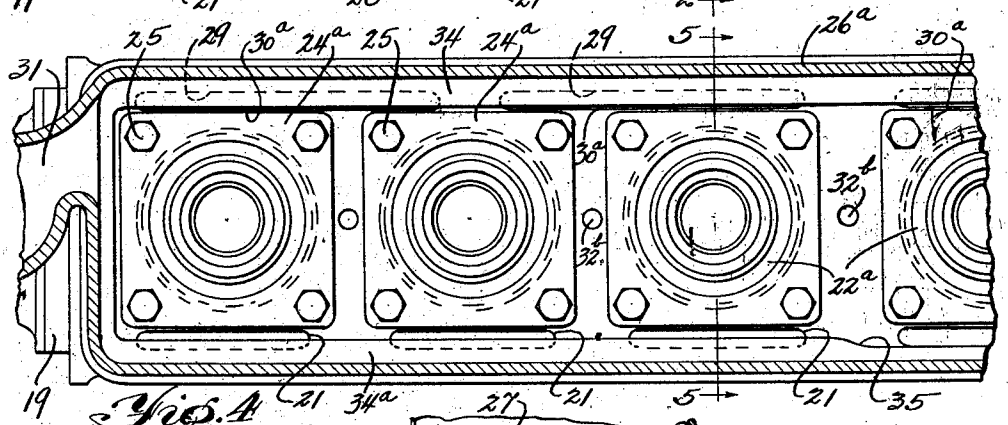




Fig. 4

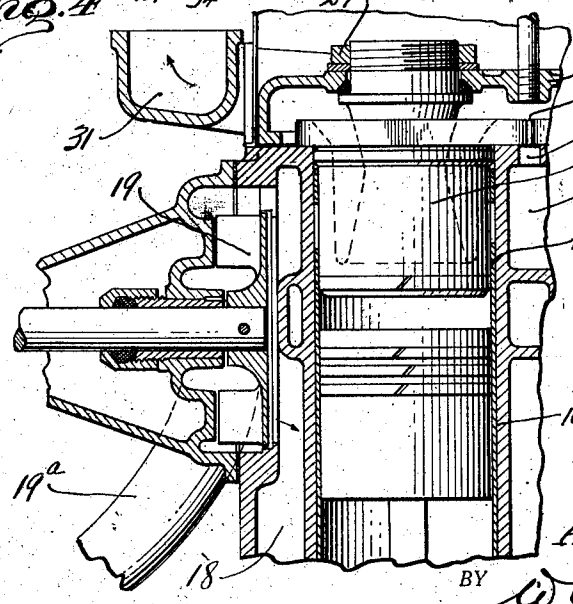



Fig. 3

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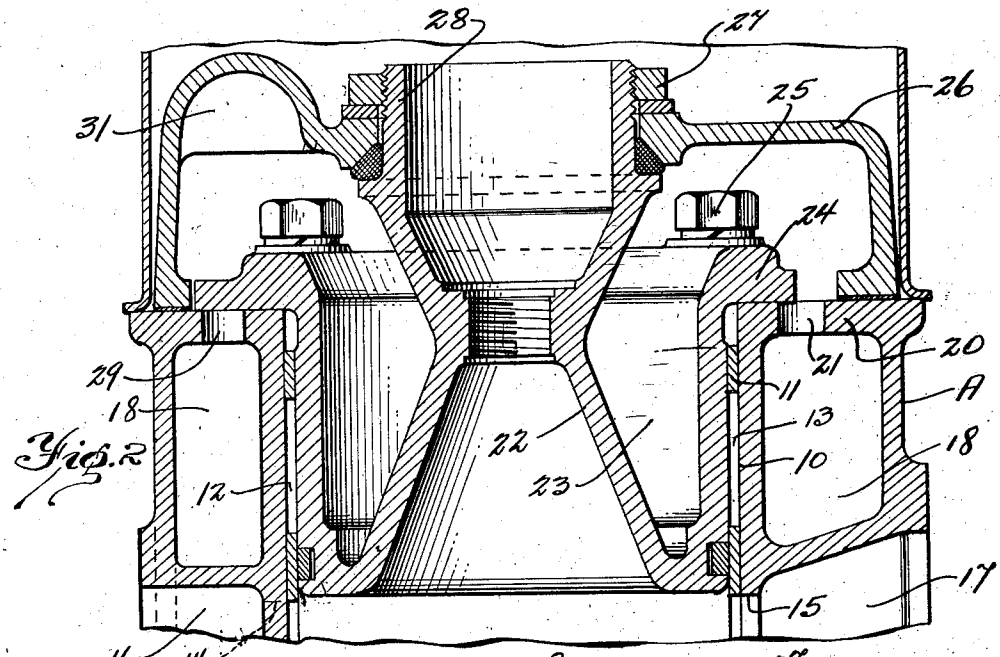



Fig. 2

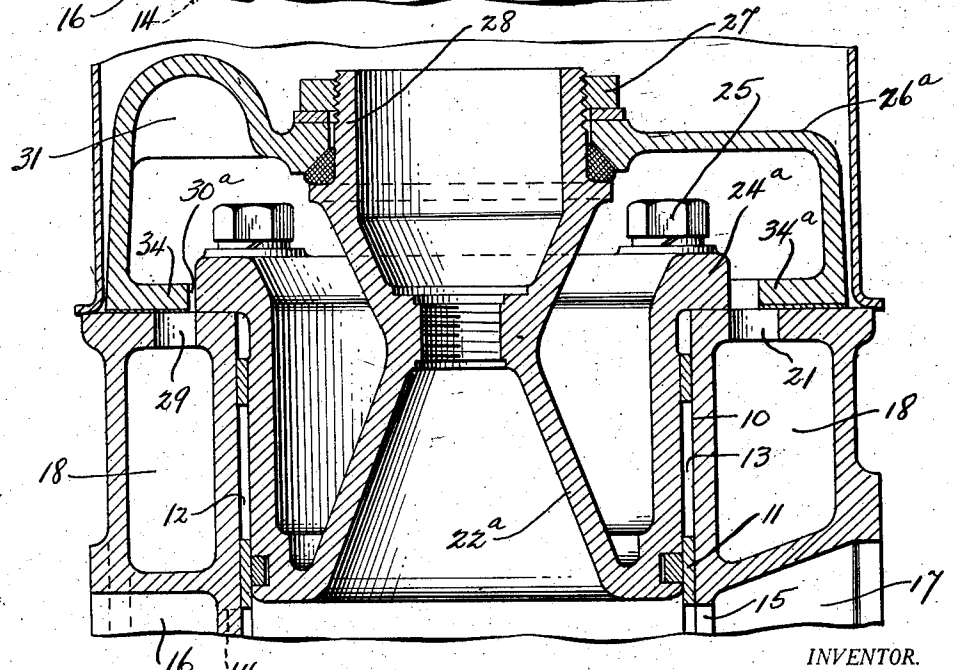



Fig. 5

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# UNITED STATES PATENT OFFICE

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## INTERNAL-COMBUSTION ENGINE

Application filed December 16, 1927. Serial No. 240,377.

This invention relates to internal combustion engines and refers more particularly to improved means for the distribution and circulation of the cooling water. A further feature of the invention resides in facilitating the casting operations of the engine cylinder block.

My invention is primarily adapted for use in sleeve valve engines of various types but may also be used to advantage in other types of engines.

It is desirable especially in sleeve valve engines to provide a flow of the cooling water in the cylinder water jacket upwardly mainly along one side of the engine such as the exhaust side and across the cylinder heads to a discharge conduit or header generally located along the opposite side of the engine. It is desirable to provide for the elimination of steam pockets in the cylinder water jacket at points remote from the cylinder jacket outlet to the cylinder water jacket, this being customarily done by boring small holes through the cylinder top wall. Such construction offers a decided disadvantage, however, since difficulty necessarily is experienced in coring the cylinder water jacket in the portions thereof remote from the cylinder water jacket outlet. One object of my invention resides in providing relatively large openings in the cylinder block top wall not only at the cylinder jacket outlet but also at points remote therefrom whereby the water jacket top wall is provided with ample openings for support of cylinder water jacket cores, the general coring operations of the cylinder block being thereby facilitated. In the engine assembly such of the core openings as are not desirable from the standpoint of proper water circulation are closed off, my invention providing for conveniently attaining this end through the cooperation of the cylinder heads or the cylinder head jacket cover.

A further feature of my invention resides for conveniently regulating the amount of cooling water from the cylinder jacket to the cylinder head jackets in proportion to the proximity of the cylinder heads to the water circulating pump. Thus, by varying the effective opening area between the cylinder jacket and the various cylinder head jackets of the engine so that the openings nearest the water pump are smaller than the openings remote from the water pump where the water supply is ordinarily less, I am enabled to efficiently distribute the amount of water circulated to the various cylinder head jackets, substantially equalizing the cooling effect for the various engine cylinder heads and exhaust passages. I prefer for convenience and simplicity to utilize the same means to attain this end that I employ in facilitating the cylinder jacket coring and the prevention of steam pockets aforesaid.

Further objects of my invention reside in the particular combination and arrangement of parts as hereinafter described and claimed.

In the drawings, in which like reference characters represent corresponding parts,

Fig. 1 is a sectional plan view of the engine looking downwardly on the cylinder heads,

Fig. 2 is a section along 2—2 of Fig. 1,

Fig. 3 is a section along 3—3 of Fig. 1,

Fig. 4 is a view corresponding generally to Fig. 1 but illustrating a modified embodiment of my invention, and

Fig. 5, is a section along 5—5 of Fig. 4.

Referring to the drawings reference character A represents the cylinder block casting having a plurality of cylinders 10 accommodating one or more sleeve valves 11 having intake and exhaust ports 12 and 13 respectively cooperating with cylinder intake and exhaust ports 14 and 15, and cylinder intake and exhaust passages 16 and 17. The cylinder block A is jacketed at 18 for receiving water circulated around the various cylinders 10 by a suitable pump 19 having a water inlet $19^a$. The top wall 20 of the cylinder block is provided along one side, preferably the exhaust side, with openings 21 adjacent the cylinder heads 22. These cylinder heads may have a jacket 23 extending into the respective cylinders, being spaced therefrom to accommodate the

sleeve valves and seated on the cylinder block top wall 20 by a flange 24. Studs 25 serve to secure the cylinder heads in position. Above the cylinder heads is located a cylinder head cover 26 conveniently seated on the cylinder block top wall 20 by clamping nut 27 engaging the barrels 28 of the various cylinder heads.

Along the side of the engine opposite to the side having openings 21, are other relatively large openings 29 through the wall 20, these openings facilitating supporting the cylinder jacket cores and generally assisting the casting operation as will be readily understood. At the same time these openings cooperate as hereinafter described with the cylinder heads or cylinder head cover for preventing the formation of steam pockets in the cylinder jacket. To this end the cylinder head flanges 24 for the most part cover the openings 29, a relatively small portion of such openings being uncovered such as the portion 30 intermediate adjacent cylinder heads. The portions 30 while preventing steam pockets in the cylinder jacket will not materially effect the desired main flow of water upwardly from the cylinder jacket 18 through openings 21 along the exhaust side of the engine and across the cylinder heads into jackets 23 and thence to the outlet conduit or header 31 along the intake side of the engine. Thus the exhaust passages 17 are maintained in a cooled condition. If desired the cylinder heads 22 may be provided with deflecting means for circulating the water downwardly into the jacket 23 during its travel across the cylinder heads, this being no feature of this invention. Additional openings 32 through wall 20 may be provided intermediate adjacent cylinders, these openings likewise assisting in the casting operation of the cylinder block and being likewise for the most part covered by the flanges 24 of the cylinder heads, leaving a relatively small effective opening 33 for preventing steam pocket formations in the cylinder jacket in the vicinity of such points. At the engine center where the usual central relatively wide crankshaft bearing usually requires a greater spacing between the central pair of cylinders than between other adjacent cylinders, a smaller opening $32^a$ may be provided instead of extending the flanges of adjacent cylinder heads to cover a larger opening, thereby avoiding the necessity for a cylinder head having a flange differing from others used in the engine.

Where the pump 19 is located at the end of the cylinder block as illustrated, I may extend the cylinder head flanges 24 for those cylinders nearest the pump so as to overlie a portion of the openings 21 and thereby reduce the effective area of these openings. The remaining cylinders more remote from the pump do not have their cylinder head flanges extended over the openings 21. If desired this variation in effective area for the openings 21 may be graduated for each cylinder in proportion to its distance from the pump but I find it convenient and practicable from a manufacturing standpoint to relatively increase the effective area of the openings for the three end cylinders remote from the water pump for the same amount in a six cylinder engine as illustrated, the other three cylinders having the openings 21 relatively restricted by the same amount. This facilitates manufacture of the cylinder heads. By reason of the graduation in the effective areas of the openings 21 substantially the same quantity of water will circulate through each cylinder head of the engine, insuring substantially the same cooling for the cylinder heads remote from the pump as for the cylinder heads in the proximity of the pump. Where the water pump is located intermediate the ends of the cylinder block appropriate adjustment may be made in the relative sizes of the effective openings 21 for the cylinders in proximity to the pump and for those cylinders remote from the pump as will be readily understood.

With reference to Figs. 4 and 5 I have illustrated a modified form of my invention attaining the same advantages as described in connection with the embodiment illustrated in Figs. 1 to 3, by reason of a somewhat simpler and cheaper construction, this form being preferred for these reasons. In these views the cylinder block as before is cast with the relatively large openings 29 in addition to the openings 21, and where desired relatively small openings $32^b$ intermediate adjacent cylinders. These corresponding openings have the same functions and advantages as set forth in connection with Figs. 1 to 3. However, the cylinder head flanges $24^a$ are constructed the same for each cylinder head $22^a$ and do not overlie the openings 29 or the openings 21. Instead, the cylinder head cover $26^a$ has its seating flange 34 along the intake side of the engine extended inwardly over the major portion of openings leaving only a relatively small passageway $30^a$ which corresponds to opening 30 of Fig. 1 for the elimination of steam pocket formations. Likewise, when desired, the opposite cover seating flange $34^a$ along the exhaust side of the engine may be extended over a portion of the openings 21 which are nearest the pump 19, the cover flange $34^a$ stepping outwardly at 35 so as to entirely uncover the remaining openings 21 supplying those cylinder heads remote from the pump, with circulating water.

What I claim as my invention is:

1. An internal combustion engine of the sleeve valve type comprising in combination a cylinder block having a plurality of engine water jacketed cylinders, water jacketed cylinder heads for the cylinders, said cylinder block having a top wall provided with water outlet means adjacent the cylinder heads along one side longitudinally of the cylinder block permitting passage of water from the cylinder jacket to the cylinder head jackets, said top wall having core openings therethrough longitudinally along the other side of said cylinder block, water outlet means for the cylinder head jackets along the last said side of the cylinder block, and means closing the major portions of said core openings thereby restricting the passage of water from the cylinder jacket to the cylinder head jackets and to the said cylinder head jacket outlet means for the most part to the said top wall water outlet means and thereby preventing the formation of steam pockets in the cylinder jacket in the vicinity of said core openings.

2. An internal combustion engine of the sleeve valve type comprising in combination a cylinder block having a plurality of engine water jacketed cylinders, water jacketed cylinder heads for the cylinders, said cylinder block having a top wall provided with water outlet means adjacent the cylinder heads along one side longitudinally of the cylinder block permitting passage of water from the cylinder jacket to the cylinder head jackets, said top wall having core openings therethrough longitudinally along the other side of said cylinder block, water outlet means for the cylinder head jackets along the last said side of the cylinder block, and means overlying the major portions of said core openings thereby restricting the passage of water from the cylinder jacket to the cylinder head jackets and to the said cylinder head jacket outlet means for the most part to the said top wall water outlet means and thereby preventing the formation of steam pockets in the cylinder jacket in the vicinity of said core openings.

3. In a circulatory cooling system for an internal combustion engine of the sleeve valve type, the combination of a cylinder, a head therefor, means providing a cooling space above said head, a cooling jacket about said cylinder having openings into said space arranged on opposite sides of the longitudinal plane of the engine including the cylinder axis, and means closing the openings on one side of said plane sufficiently to cause the major portion of the cooling medium entering the said space to pass through the opening on the other side of said plane but permitting the passage of gases through the first said opening.

4. In a circulatory cooling system for an internal combustion engine of the sleeve valve type, the combination of a cylinder, a head therefor, means providing a cooling space above said head, a cooling jacket about said cylinder having openings into said space arranged on opposite sides of the longitudinal plane of the engine including the cylinder axis, and means overlying the openings on one side of said plane sufficiently to cause the major portion of the cooling medium entering the said space to pass through the opening on the other side of said plane but permitting the passage of gases through the first said opening.

5. In a circulatory system for an internal combustion engine, a cylinder having a surrounding cooling jacket with core openings at the upper end thereof on opposite sides of the longitudinal plane of the engine including the cylinder axis, and means overlying the core opening on one side of said plane sufficiently to substantially restrict the flow of cooling medium from the cylinder jacket to the core opening on the other side of said plane but permitting passage of gases through the first said core opening.

6. In a circulatory system for an internal combustion engine, a cylinder having a surrounding cooling jacket with core openings at the upper end thereof on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head having a jacket portion depending in said cylinder, a header, means closing the core opening on one side of said plane sufficiently to restrict the flow of cooling medium from the cylinder jacket to the cylinder head jacket for the most part through the core opening on the other side of said plane but permitting passage of gases through the first said core opening, and an outlet header for receiving the cooling medium from the cylinder head jacket located on the first said side of the said plane.

7. A sleeve valve engine comprising in combination a cylinder block having a jacketed cylinder, said block provided with openings on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head member for the cylinder, a cylinder head cover member, one of said members closing the major portion of the opening on one side of said plane.

8. A sleeve valve engine comprising in combination a cylinder block having a jacketed cylinder, said block provided with openings on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head member for the cylinder, a cylinder head cover member, one of said members closing the opening on one side of said plane sufficiently to restrict the major flow of cooling medium to the cylinder head member to the opening on the

other side of said plane but leaving sufficient effective opening to prevent the formation of a steam pocket in the vicinity thereof.

9. A sleeve valve engine comprising in combination a cylinder block having a jacketed cylinder, said block provided with openings on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head member for the cylinder, and a cylinder head cover member, said cylinder head cover member having a portion restricting one of said openings.

10. A sleeve valve engine comprising in combination a cylinder block having a jacketed cylinder, said block provided with openings on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head member for the cylinder, and a cylinder head cover member, said cylinder head cover member cooperating with the opening on one side of said plane to restrict the flow of cooling medium to said cylinder head member for the most part to the opening on the other side of said plane.

11. A sleeve valve engine comprising in combination a cylinder block having a jacketed cylinder, said block provided with openings on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head member for the cylinder, and a cylinder head cover member, said cover member having a flange seating on the cylinder block and overlying the major portion of the opening on one side of said plane.

12. A sleeve valve engine comprising in combination a cylinder block having a jacketed cylinder, said block provided with openings on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head member for the cylinder, and a cylinder head cover member, said cover member having a flange seating on the cylinder block and overlying the major portion of the opening on one side of said plane, the opening on the other side of said plane being substantially unrestricted.

13. A sleeve valve engine comprising in combination a cylinder block having a plurality of jacketed cylinders, said block having an upper wall provided with fluid outlet openings spaced longitudinally of the engine on one side of the longitudinal plane of the engine including the cylinder axes, cylinder head means for the respective cylinders receiving cooling fluid from said openings, cover means for the cylinder heads cooperating therewith to provide cooling fluid chambers for the cylinder heads, a pump for circulating cooling fluid from the cylinder jackets to the cylinder head chambers, one of said means cooperating with an opening in the proximity of the pump to restrict the fluid flow therethrough relative to another of said openings more remote from said pump thereby substantially equalizing the flow of cooling fluid through the openings.

14. An internal combustion engine comprising in combination, a cylinder block having a jacketed cylinder, said block having an upper wall provided with a relatively large core opening elongated in the direction longitudinally of the cylinder block and located to one side of the cylinder, means providing a jacketed space above the cylinder, said cylinder block upper wall provided with a second opening located at the other side of the cylinder and establishing communication between the cylinder jacket and said jacketed space above the cylinder, and water passage restricting means associated with said elongated core opening.

15. An internal combustion engine comprising in combination, a cylinder block having a jacketed cylinder, said block provided with relatively large core openings elongated longitudinally of the cylinder block on opposite sides of the longitudinal plane of the engine including the cylinder axis, a cylinder head member for the cylinder, a cylinder head cover member, one of said members closing the major portion of the opening on one side of said plane.

16. A sleeve valve engine comprising in combination a cylinder block having a plurality of jacketed cylinders, said block having an upper wall provided with fluid outlet openings spaced longitudinally of the engine on one side of the longitudinal plane of the engine including the cylinder axis, cylinder head means for the respective cylinders receiving cooling fluid from said openings, cover means for the cylinder heads cooperating therewith to provide cooling fluid chamber for the cylinder heads, a pump for circulating cooling fluid from the cylinder jackets to the cylinder head chambers, said cover means cooperating with an opening in the proximity of the pump to restrict the fluid flow therethrough relative to another of said openings more remote from said pump, thereby substantially equalizing the flow of cooling fluid through the openings.

17. A sleeve valve engine comprising in combination a cylinder block having a plurality of jacketed cylinders, said block having an upper wall provided with fluid outlet openings spaced longitudinally of the engine on one side of the longitudinal plane of the engine including the cylinder axis, cylinder head means for the respective cylinders receiving cooling fluid from said openings, cover means for the cylinder heads cooperating therewith to provide cooling

fluid chambers for the cylinder heads, a pump for circulating cooling fluid from the cylinder jackets to the cylinder head chambers, said cover means provided with a flange seating on the cylinder block and cooperating with an opening in the proximity of the pump to restrict the fluid flow therethrough relative to another of said openings more remote from said pump, thereby substantially equalizing the flow of cooling fluid through the openings.

18. A sleeve valve engine comprising in combination a cylinder block having a plurality of jacketed cylinders, said block having an upper wall provided with fluid outlet openings spaced longitudinally of the engine on one side of the longitudinal plane of the engine including the cylinder axis, cylinder head means for the respective cylinders receiving cooling fluid from said openings, cover means for the cylinder heads cooperating therewith to provide cooling fluid chambers for the cylinder heads, a pump for circulating cooling fluid from the cylinder jackets to the cylinder head chambers, said cover means provided with a flange seating on the cylinder block and arranged to overlie one or more openings in proximity to the pump to a relatively greater extent than those more remote from said pump, thereby equalizing the flow of cooling fluid through the openings.

19. A sleeve valve engine comprising in combination a cylinder block having a plurality of jacketed cylinders, said block having an upper wall provided with fluid outlet openings spaced longitudinally of the engine on one side of the longitudinal plane of the engine including the cylinder axis, cylinder head means for the respective cylinders receiving cooling fluid from said openings, cover means for the cylinder heads cooperating therewith to provide cooling fluid chambers for the cylinder heads, a pump for circulating cooling fluid from the cylinder jackets to the cylinder head chambers, said cover means provided with a flange extending longitudinally thereof and seating on the cylinder block, said flange having a portion set back more remote from said pump and arranged to overlie an opening in proximity to the pump to a relative greater extent than another of said openings more remote from said pump, thereby substantially equalizing the flow of cooling fluid through the openings.

In witness whereof, I hereunto subscribe my name this 10th day of December, A. D. 1927.

ARCHIE MACPHAIL NIVEN.