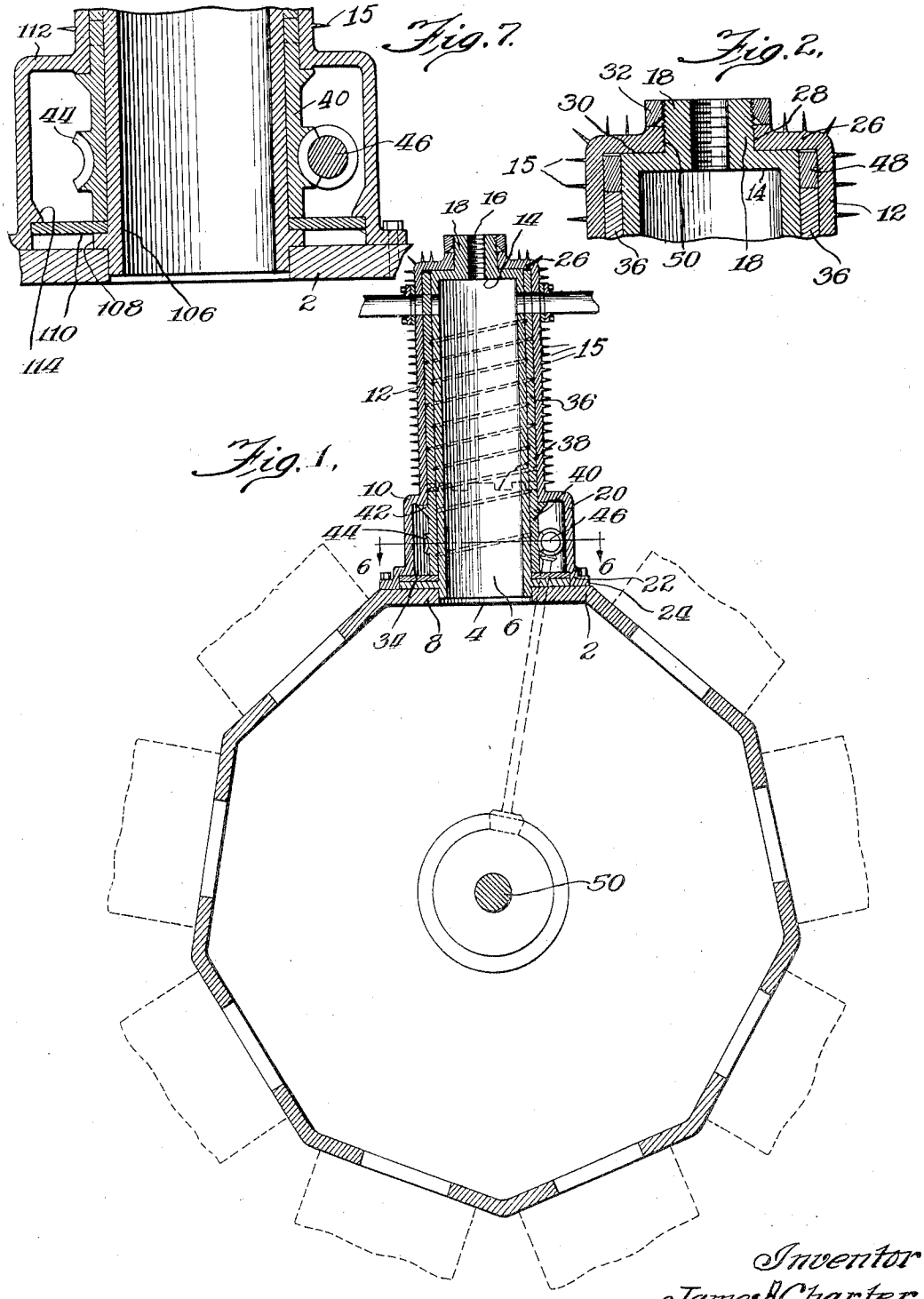
June 12, 1934. J. A. CHARTER 1,962,426

GAS ENGINE

Filed Aug. 27, 1927 2 Sheets-Sheet 1



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GAS ENGINE

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Fig. 4.

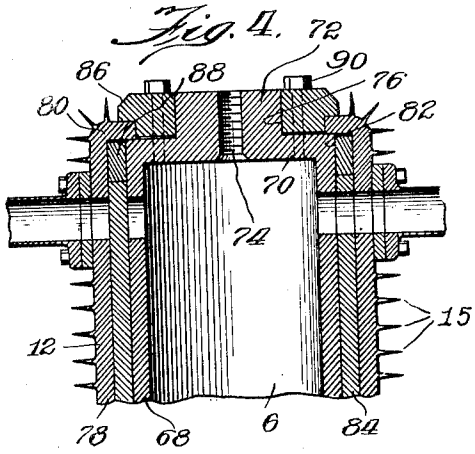


Fig. 3.

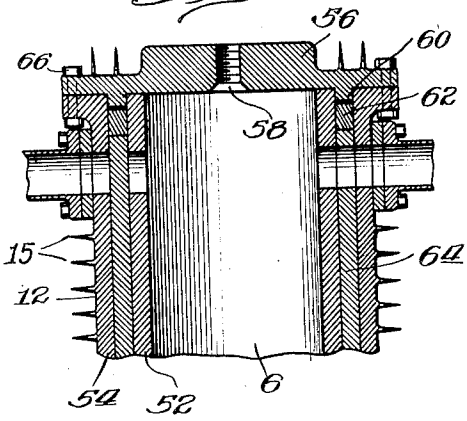


Fig. 5.

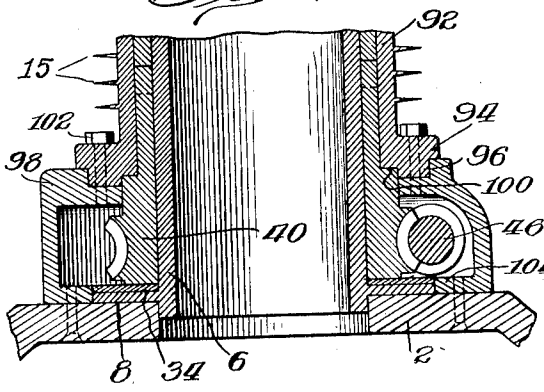


Fig. 6.

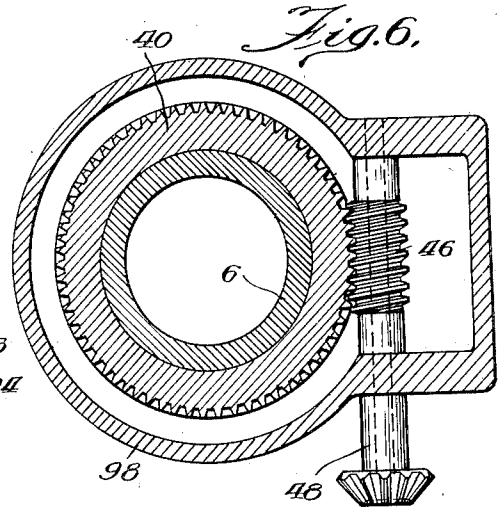
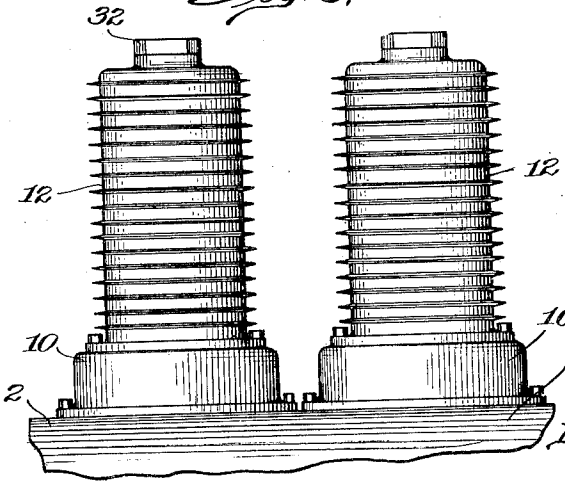


Fig. 8.



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GAS ENGINE

James A. Charter, Chicago, Ill.

Application August 27, 1927, Serial No. 215,991

19 Claims. (Cl. 123—80)

My invention relates to internal combustion engines and particularly to the general type wherein a sleeve valve is adapted to operate in a space concentrically arranged between the inner working cylinder and the outer jacket.

The objects of my invention are to provide a new method of engine construction and assembly; to provide an improved engine construction wherein the inner working cylinder and the jacket are mounted on the crank case or other support and in such relation to each other as to form an absolutely uniform concentrically disposed space therebetween for the reception and operation of the sleeve valve; to provide a novel construction and assembly of the inner working cylinder and jacket with relation to each other and upon the crank case or other support whereby the opposite ends of the cylinder and jacket are accurately centered and guided, particularly by ground, machined or finished surfaces; to provide an accurate space there-between whereby the sleeve valve may freely operate without binding; to provide a novel construction and assembly of the working cylinder and the jacket upon the crank case, and particularly in the utilization of spacing rings having accurately ground edges and the utilization of spacing rings for providing a concentric space between said members of uniform cross section longitudinally of the cylinder wherein the valve sleeve is free to operate without binding; to provide a novel means and manner of mounting the working cylinder directly upon the crank case and to provide accurate means for spacing the lower portion of the gear casing from the working cylinder whereby accurately to center the cylinder on the casing and this last named construction includes the provision of a housing for the gear ring which operates the sleeve valve; to provide an improved construction for accurately centering and guiding the upper portion of the working cylinder with respect to the outer portion of the jacket whereby two members are accurately centered and guided and are spaced apart to provide an exact concentrically disposed space there-between for the reception of the valve sleeve; to provide a novel means for assembling the working cylinder, the valve sleeve and the outer casing or jacket on to the crank casing and to provide novel means for assembling the outer ends of the working cylinder and jacket while maintaining an accurate concentric space therebetween; to construct the inner working cylinder, the valve sleeve and the outer casing or jacket of metals having variant coefficients of expansion which are selectively arranged so that when the engine becomes heated after operation, the space between the inner cylinder and jacket will slightly enlarge whereby to permit the sleeve to operate more loosely or freely than when the engine is first starting; to provide these and other objects of my invention as will be apparent from a perusal of the following specification when taken in connection with the accompanying drawings wherein:

Figure 1 is a sectional view of an engine containing one form of my invention, the engine being shown as one unit of a radial type of airplane motor.

Figure 2 is a modified view of the structure shown in Figure 1 and illustrates the utilization of a spacing ring at the top between the inner working cylinder and the jacket.

Figure 3 is still another modification showing the use of a separate cylinder head.

Figure 4 is yet another modification showing the use of a clamping ring for uniting the inner working cylinder and jacket.

Figure 5 is a modification of the structure shown in Figure 1 which also may be used in connection with the other figures, and illustrates the manner of mounting the lower portion of the jacket on the crank case.

Figure 6 is a sectional view taken through the gear ring at the lower portion of Figure 5.

Figure 7 is still another modification of the construction illustrated in Figures 1 and 5, and showing the use of a spacing ring instead of a prolonged flange on the inner working cylinder for maintaining the absolute centering and spacing of the lower portion of the jacket and cylinder.

Figure 8 is a perspective view showing the manner in which my invention may be applied to a plurality of cylinders arranged longitudinally in line.

In its broad aspect my invention comprises a new method of constructing and assembling a gas engine upon a crank case or other base and in a manner which not only promotes simplicity in construction and ease of assembling and ease in taking down or dismantling the engine as for repairs or replacement, but also in a manner which insures the correct centering and longitudinal alignment and the absolute accurate spacing apart of the inner working cylinder and the outer jacket or casing so as to provide therebetween an absolute concentrically disposed space of uniform cross section throughout the length of the working cylinder and jacket in which the valve sleeve may operate. In my improved method

the crank case or basal support in either of the radial type as shown in Figure 1, or the straight line type shown in Figure 8, is provided with the conventional bearings for the crank shaft and the shaft carrying the connecting rod and piston. I first erect the inner working cylinder upon this crank case and to this end the crank case or basal support is provided with an accurately machined opening 4 of the exact diameter to receive the inner working cylinder 6. This cylinder is centered and guided in the crank case or base through this opening 4 and the cylinder carries a lateral basal flange 8 spaced somewhat from its bottom end. This flange rests upon and acts as a seating member on the base and is formed with an accurately ground and finished outer circumferential edge of such exact size as to fit perfectly into a finished or ground surface of the jacket or outer casing 10 hereinafter described. This jacket may be either arranged as a water cooled jacket or with fins 15 for air cooling.

In the form shown in Figures 1 and 2 of the drawings, the upper end of the inner working cylinder 6 is preferably formed with an integral top which preferably extends as at 14 at a right angle to the plane of the cylinder wall and is provided with a concentrically located threaded opening 16 for the reception of the usual spark plug or other ignition device. This top portion 14 on its exterior surface projects outwardly to form an extended neck 18 concentrically surrounding the bore 16. The outer portion of this neck is threaded while the adjacent portion is provided with a finished or ground annular surface. The jacket 10 has a wall 12 arranged to enclose the cylinder. It is slightly larger in diameter throughout practically its whole length to provide a space between it and the outer cylinder wall. The lower portion of the jacket is of increased diameter to provide a housing 20 for the sleeve valve gear ring hereinafter described. This housing is provided with an annular shoulder 22, the inner wall of which is machined, ground or otherwise finished to an accurate dimension and the outer wall of this lower portion of the housing is provided with annular flange 24 by which the jacket may be bolted to the crank case 2. The outer end of the jacket is provided with an in-turned annular flange 26 extending transversely to the main wall 12 of the jacket so as to overlie the similarly formed wall of the closed end of the cylinder 26. The bored wall 28 of this flange 26 of the jacket has a ground or finished surface to accurately fit the corresponding lower ground wall of the neck 18. The contacting walls designated at 30, Figure 2, are preferably very slightly spaced apart so as to permit free longitudinal expansion of the cylinder within the jacket. In addition I provide a clamping ring 32 which engages the outer threaded wall of the neck 18 and which engages the outer end of the in-turned flange 26 of the jacket and thereby holds the outer end of both the jacket and cylinder in assembled relation. At the inner end of the cylinder and jacket I provide a spacing ring 34, preferably of steel and formed with inner and outer accurately finished peripheral edges. This gear ring rests upon the flange 8 with the outer finished edge lying against the inner finished edge of the shoulder 22 and its inner edge resting against the lower outer wall of the cylinder 6. This provides an accurate spacing member for the lower portions of the cylinder and jacket whereby to maintain them in predetermined spaced apart relation. In addition by reason of the accurately ground or finished wall portions of the neck 18 and the inner end of the flange of the jacket, the later is guided and centered upon the cylinder at its outer end so that the space between them is of uniform concentric cross section throughout.

In this space the sleeve valve 36 is adapted to operate. This sleeve valve is provided at its lower end with substantially clutched shaped teeth 38 which in turn engage similar teeth formed on the outer end of the gear ring 40. This gear ring in effect forms a continuation of the sleeve valve. The gear ring is formed with a shoulder 42 having a ground joint engaging the under surface of the gear housing 20 for accurate spacing and also to hold the gear ring in position. In addition the gear ring is provided with teeth 44 which mesh with a gear 46 mounted within the jacket in any desirable manner, as for instance on a cross shaft 48 as shown in Figure 6 in the drawings. The opposite end of gear ring 40 rests upon the steel spacing ring 34, which later ring prevents wear and supports the gear ring. The cross shaft 48 is driven in any desirable manner from the central shaft 50 in the crank casing. In addition the cylinder 6 and the sleeve valve 36 and the gear ring 40 are suitably lubricated by means of oil grooves shown and claimed in my prior Patent No. 1,453,304 of May 1st, 1923.

In Figure 1 of the drawings, the sleeve valve 36 extends the entire length of the cylinder and lies sustantially flush with the juncture 30 of the two adjacent wall surfaces of the ends of the cylinder and jacket.

In Figure 2 of the drawings I have shown a modification wherein the sleeve 36 terminates short thereof and a spacing ring 48 is inserted between the outer portion of the cylinder 6 and the jacket 12. In this case these adjacent or spaced walls of the cylinder and jacket are provided with ground or finished surfaces whereby the space between the cylinder and jacket in which the sleeve 36 rotates is accurately maintained of desired diameter so that the sleeve is free to operate therein and will not bind. This upper spacing ring 48 together with the ground joint 50, together with the lower spacing ring 34, which is shown in Figure 1, but not in Figure 2, all serve to insure the uniform concentricity and accuracy of this valve sleeve space so that when the jacket and cylinder are assembled the jacket is guided and centered upon the cylinder by means of these ground joints and by means of these upper and lower spacing rings. This is an important feature of my invention.

In Figure 3 of the drawings, I have shown a modified structure wherein the cylinder 52 and the jacket 54 are closed at their outer ends by means of a transversely disposed head 56 provided with a central aperture 58 for the spark plug. In this construction the uniform concentricity and accurate spacing of the jacket from the cylinder is assured by means of an annular flange 60 on the under surface of the head 56 which fits between the outer ends of the cylinder and jacket. The adjacent faces of this flange 60 and of the cylinder and jacket are ground or finished. If desired, as an additional spacing means, I may use a spacing ring 62 immediately below the flange 60 and between it and the outer end of the valve sleeve 64. In such case the ground and finished surfaces are provided. The head is bolted to the jacket by means of the bolt 66.

In still another modified form of my invention, Fig. 4, the cylinder 68 is provided with a closed end 70 terminating in an annular neck 72. This neck is bored centrally as at 74 for a spark plug and is provided with a peripheral, ground surface 76. The jacket 78 is formed with an in-turned flange 80 which overlies the outer end or shoulder 82 of the cylinder and this jacket is of larger diameter so as to be spaced from the outer walls of the cylinder to provide for the sleeve valve 84.

I also provide a clamping ring 86 which is provided with a peripheral inner shoulder 88 so that ring 86 overlies the in-turned flange 80 of the jacket 78. The walls of this shoulder and of the contacting flange 80 are ground or finished.

I also provide a steel or other hardened metal spacing ring 88 to lie between the opposed walls of the jacket and cylinder and the contacting walls thereof are ground or finished so as to provide an accurate concentric space in which the sleeve valve 84 operates. The clamping ring is provided with bolt holes to receive the clamping bolts 90 whereby the ring 86 holds the cylinder and the jacket in assembled position, the ground surfaces thereof and the spacing ring 88 serving to center and guide the one upon the other so as to insure that they are accurately spaced apart for the free operation of the valve sleeve.

In Figure 5 of the drawings I have shown a modified construction for the inner or lower portion of the jacket and cylinder walls. In this construction the cylinder 6 is preferably formed with its flange 8 and with the valve gear ring 40 resting upon the spacing ring 34. The lower end of the jacket 92 instead of having an integral extension forming a housing for the gear ring, terminates short of the crank case 2 and is provided with an annular flange 94 formed on its under surface with an annular laterally extending flange 96. The walls of the flange 94 and of the lateral flange 96 are ground or otherwise suitably finished. In this construction the gear housing 98 is formed as a separate piece being grooved annularly at its upper or outer portion to receive the annular lateral flange 96. In addition the gear ring 40 is provided with an annular shoulder 100, the walls of which are also ground or suitably finished. Bolts 102 pass through the flange 94, the flange 96 and the upper portion of the housing 98 to hold these parts in assembled position. The shoulder 100 of the gear housing cooperates with the inner wall of the flange 94 of the jacket so that the gear ring is held from movement in an outward direction longitudinally of the cylinder and is held from movement in the opposite direction since the gear ring rests upon the spacing ring 34. The lower portion of the housing 98 is formed with an in-turned flange 104 which is suitably bolted to the crank casing 2. The inner peripheral wall of this flange 104 is provided with a ground or finished surface which abuts the finished surfaces of the flange 8 and the spacing ring 34 whereby the lower end of the cylinder and of the jacket and gear housing are guided and centered with respect to each other and with respect to the machined opening in the crank casing 2.

It will be understood that any of the constructions herein shown and described for the upper portion of the cylinder and jacket may be utilized in combination with any constructions shown for the lower portion of the cylinder and jacket, there being a cooperative relationship between the accurate centering and guiding of the outer end of the cylinder with respect to the jacket and the lower or inner end of the cylinder and jacket whereby to maintain the accurate concentricity of the space there between and in which the sleeve valve operates.

In Figure 7 of the drawings I have shown another modification of my construction which is similar to that of Figure 1 except that the engine cylinder 106 is formed with a relatively narrow flange 108 adapted to overlie the crank casing 2 and in this instance I rely upon the spacing ring 110 alone to maintain the accurate spacing between the cylinder 106 and the jacket 112. In this instance the lower portion of the housing of the jacket is formed with a shoulder 114 adapted to receive the outer portion of the spacing ring 110 and all contacting surfaces are ground and finished just as heretofore described in connection with the other figures.

Another very important feature of my invention resides in forming the cylinder, the valve sleeve, and the jacket, of different alloys having different coefficients of expansion. These alloys are selected so that when the engine is first started and is relatively cold, or cool, the sleeve will fit relatively tightly between the cylinder and jacket, but as the engine becomes hotter, or hot, the rates of expansion of the cylinder, sleeve and the jacket will permit the sleeve to work more loosely in its space between the cylinder and jacket. It is well known that when an engine is hot, after it has been working for some time, the sleeve may work more loosely than it does when the engine is colder and without impairing the efficiency of the engine. To this end by constructing the sleeve of an alloy which has a greater co-efficient of expansion than the cylinder and by forming the jacket of an alloy which has a greater co-efficient of expansion than the sleeve, the relative expansions of these three members can be nicely regulated or adjusted to produce the desired effect.

It will thus be manifest that I have provided an extremely simple engine construction which may be easily and quickly assembled and that the construction is most readily adaptable to a multi-cylindered assembly since each unit engine may be installed, taken down, or repaired without touching any other unit engine.

By any one of the foregoing constructions the accurate alignment, guiding and centering of the cylinder in the crank case opening, the valve sleeve on the cylinder, and the jacket on the cylinder and valve sleeve and gear casing are absolutely assured by the provision of the various ground or finished joints located in a manner to produce this accurate centering, and in addition these ground joints cooperate with the upper and lower spacing rings and the details of construction of the cylinder, the sleeve and the jacket to insure the absolute concentricity of the space between the jacket and cylinder in which the valve sleeve operates. This space is accurately formed and maintained of uniform cross section throughout the length of the cylinder whereby to prevent binding of the valve sleeve, and whereby to permit the correct films of lubricating oil to flow between the valve sleeve surfaces and the inner walls of the jacket and cylinder. Particular attention is directed to the advantageous construction of the ground outer surface of the neck of the cylinder and the ground inner surface of the inwardly projecting annular flange of the jacket, which is of slightly larger bore than the cylinder by means of which construction when the jacket

is assembled on the cylinder there is a guiding and centering function affected thereby at the top which cooperates with the centering means at the bottom for positively holding the jacket and cylinder in true concentric relation so that the revolving valve can rotate there-between without binding. This same upper guiding and centering function is present in the various constructural forms herein shown and described, as is also the guiding and centering present at the lower portion of the cylinder and jacket and the various constructions herein shown and described.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In a device of the class described, the combination of a crank case having an opening, a cylinder having a lateral flange near its base, and said cylinder having its lower end fitting within said opening with the flange resting on said crank case, the outer edge of said flange being machined, a jacket having a lower extension of larger diameter than its upper part, said extension having an inner machined wall contacting and enclosing the machined edge of said flange, and said lower extension being bolted to said crank case, a hardened steel spacing ring superimposed on said flange and having ground inner and outer edges contacting and lying between the inner ground wall of said jacket extension and the cylinder wall whereby to space apart the jacket and cylinder wall a predetermined distance concentrically about the cylinder, and a valve sleeve disposed in said space.

2. In a device of the class described, the combination of a crank case having a machined aperture, a cylinder having its lower extremity fitting in said aperture and having a flange resting on the crank casing, a jacket having a lower extension of larger diameter than its upper part, said extension having an inner machined wall surrounding said cylinder and in spaced relation therefrom, said jacket being attached to the crank casing, a spacing ring having machined inner and outer edges contacting the inner machined wall of said jacket and said cylinder respectively to maintain them in accurately spaced relation and a valve sleeve disposed within said space with its lower end supported on said ring.

3. In a device of the class described, the combination of a crank case having an opening, a cylinder having a flange resting on said crank case, the outer edge of said flange being machined, a jacket enclosing said cylinder and spaced therefrom and having a lower extension of larger diameter than its upper part to provide a housing, said extension having a machined inner wall contacting and enclosing the machined edge of said flange, and means for fastening said extension to the crank case, and a valve sleeve operatively disposed in the space between said cylinder and jacket.

4. In a device of the class described, the combination of a crank case having a machined aperture, a cylinder having its lower extremity fitted in said aperture and having a flange resting on the crank case, a jacket surrounding said cylinder, a valve sleeve between said cylinder and jacket, a gear ring operatively connected to the lower end of said sleeve and lying between said jacket and cylinder, a hollow gear housing of larger diameter than the jacket enclosing said gear ring, the lower end of said jacket, and the upper and inner portions of said gear housing and the shouldered surface of said gear ring having accurately finished walls and arranged to form an assembled joint there-between, bolts passing through the lower portion of said jacket and the upper portion of said gear housing for maintaining them in assembled position, the lower portion of said gear housing having an inner finished wall adapted to receive and contact with the finished circumferential edge of the flange on the cylinder, a steel spacing ring superimposed on said flange with its outer finished edge in contact with the finished edge of the lower portion of said gear housing and with the inner wall of the cylinder, the lower end of the gear ring resting upon said spacing ring and bolts passing through the lower portion of said gear housing and the crank casing.

5. In a gas engine, the combination of a base, a cylinder thereon provided with an outer wall, said cylinder having its outer end formed with an angularly disposed wall forming a shoulder, a jacket surrounding said cylinder and spaced therefrom and having an inner machined wall. said jacket having an angularly disposed wall adapted to overlie and be clamped against the corresponding wall of the cylinder, means for holding the upper portion of said cylinder and jacket in rigid spaced position and a valve sleeve operatively disposed between said jacket and cylinder.

6. In a gas engine, the combination of a base, a cylinder thereon provided with a machined upper wall and an angularly disposed adjacent wall forming a shoulder, said adjacent wall having an extension formed with a machined exterior wall, a jacket surrounding said cylinder, the upper portion of said jacket having a machined inner wall lying parallel to and spaced from the machined upper wall of the cylinder and having an angularly disposed adjacent wall overlying the corresponding wall of the cylinder and having an inner circumferential wall machined and contacting the machined wall of the extension whereby said jacket and cylinder are maintained in accurately spaced relation and a valve sleeve in said space.

7. In a gas engine, the combination of a base, a cylinder thereon provided with a machined outer wall and an angularly disposed adjacent wall forming a shoulder, said adjacent wall having an extension forming a neck, said neck having a machined lower exterior wall portion and a threaded upper exterior wall portion, a jacket surrounding said cylinder, said jacket having a machined inner wall lying parallel to and spaced from the machined wall of the cylinder and having an angularly disposed adjacent wall overlying the corresponding wall of the cylinder and having an inner circumferential machined wall contacting the machined wall of the extension or neck, and a threaded ring threading onto the upper portion of the neck and engaging the upper portion of the jacket whereby to clamp said cylinder and jacket in assembled relation and whereby they are held in accurately spaced relation with a circumferential space of uniform diameter and cross section there-between and a valve sleeve in said space.

8. In a gas engine, the combination of an apertured base, a cylinder having its lower end therein, said cylinder having a flange supported on the base, a jacket having upper and lower machined or finished inner wall portions and enclosing said cylinder, and upper and lower spacing rings having inner and outer edges contacting the outer machined upper and lower surfaces of the jacket

and cylinder respectively to maintain said jacket and cylinder in spaced relation and a sleeve valve operatively positioned in the space there-between.

9. In a gas engine, the combination of an apertured base, a cylinder having its lower end resting upon said base, the upper portion of said cylinder having an end wall disposed at right angles thereto to provide a shoulder the outer surface of which is finished, a jacket surrounding said cylinder and having upper and lower inner finished wall portions, said jacket having an inwardly extending flange at right angles to the main walls of the jacket to provide a shoulder, said inwardly extending flange having its inner surface lying upon the end surface of the end wall of the cylinder, a valve sleeve operatively disposed within the space between the cylinder and jacket with the end of the sleeve lying substantially flush with the inner surface of the inwardly extending flange on the jacket, a spacing ring disposed between the lower inner finished surface of the jacket and said cylinder, means for clamping the outer end of the cylinder and jacket in assembled relation and means for clamping the outer end of the jacket to the crank case.

10. In a device of the class described, the combination of a base having a machined aperture, a cylinder resting on the base, the outer end of the cylinder being closed and extended at right angles to the length of the cylinder wall to provide a right angled shoulder, a jacket surrounding the cylinder and having an inwardly extending flange extending at right angles to the wall of the jacket and lying on the outer wall of the closed end of the cylinder, said jacket being of larger diameter than the cylinder so as to provide a space there-between, the opposed inner walls of the jacket and cylinder forming a space there-between, a spacing ring lying in said space, a sleeve valve disposed in the space between the lower portion of said jacket and cylinder, and another spacing ring disposed between said jacket and cylinder at the opposite ends thereof, said spacing ring having finished peripheral edges to contact finished walls of the jacket and cylinder respectively and means for attaching said jacket to the crank case.

11. In a gas engine, the combination of an apertured base, a cylinder resting on the base, the outer end of the cylinder lying at right angles to the wall of the cylinder to provide a shoulder, a jacket of larger diameter than the cylinder resting on the base, said jacket having an inner extending flange lying at right angles to the wall of the jacket and lying substantially in contact with the outer angularly disposed wall of the end of the cylinder, means for holding the outer ends of the jacket and cylinder in assembled relation, a valve sleeve disposed between said jacket and cylinder and means on the inner and outer portions of the jacket and cylinder for holding them in accurately disposed concentric relation to permit the free movement and operation of the valve sleeve there-between and means for attaching the jacket to the base.

12. In a device of the class described, the combination of an apertured base, a cylinder resting on the base, a jacket of larger diameter than the cylinder surrounding it in spaced relation therefrom, a head disposed transversely to the walls of the cylinder and closing the outer end of the cylinder, the outer portion of the head being bolted to the jacket, said head having an integral angular flange disposed between the outer end of the jacket and cylinder walls, the opposed walls of the flange, jacket and cylinder being ground to provide an accurately spaced fit, spacing means between the lower end of the jacket and cylinder, and a valve sleeve operatively disposed within the space between said jacket and cylinder.

13. In a device of the class described, the combination of an apertured base, a cylinder resting on the base, a jacket of larger diameter than the cylinder surrounding it in spaced relation therefrom, a head disposed transversely to the walls of the cylinder and closing the outer end of the cylinder, the outer portion of the head being bolted to the jacket, said head having an integral angular flange disposed between the outer end of the jacket and cylinder walls, the opposed walls of the flange, jacket and cylinder being ground to provide an accurately spaced fit, spacing means between the lower end of the jacket and cylinder, a spacing ring between the outer walls of the jacket and cylinder immediately adjacent the angular flange on the head, and a valve sleeve operatively disposed within the space between said jacket and cylinder.

14. In a device of the class described, the combination of an apertured base, a cylinder resting on the base, the outer end of the cylinder having a wall which extends at right angles to the wall of the cylinder, said latter wall being provided with an extension in a direction axially of the cylinder to provide a neck, the walls of the neck and cylinder lying parallel and the walls of the neck and adjacent walls of the cylinder being finished, a jacket surrounding said cylinder in spaced relation therefrom to provide a space there-between, the outer end of said jacket having an angular inturned flange extending at right angles to the wall of the jacket and lying upon the outer transverse wall of the cylinder, a clamping ring surrounding the neck of the cylinder and having an inner finished wall and an outer peripheral shouldered wall which is finished and which overlies the in-turned flange of the jacket, bolts passing through said clamping ring and engaging the cylinder wall to clamp said jacket and cylinder in assembled relation, a sleeve valve operatively disposed between said jacket and cylinder and a spacing ring lying between the outer end of said jacket and cylinder walls, said spacing ring and said walls having finished surfaces and means for attaching said jacket to the base.

15. The method of constructing and assembling an internal combustion engine of the sleeve valve type, which comprises forming the crank case or support with a machined opening and forming the cylinder with a basal flange having an outer finished edge, erecting the cylinder in the crank case opening with the flange resting on the crank case, slipping a spacing washer on the cylinder so as to encircle the lower end of the cylinder and lie on the flange, slipping the valve sleeve gear ring on the cylinder so as to rest on the spacing ring, slipping the valve sleeve over the cylinder and coupling it to the gear ring, slipping the jacket over the assembled cylinder, and sleeve, and gear ring with the lower finished inner machined wall of the jacket, fitting the finished walls of the spacing ring and flange, fastening the upper end of the jacket and cylinder together and attaching the jacket to the crank casing.

16. In a device of the class described, the combination of a crank case having an opening, a cylinder having a flange resting on said crank

case, a jacket enclosing said cylinder and spaced therefrom and having a lower extension of larger diameter than its upper part to provide a housing, said lower extension having a machined inner wall, said cylinder having a peripheral machined surface for contacting the machined surface of said inner wall to thereby concentrically position the cylinder with respect to the jacket, and a valve sleeve operatively disposed in the space between said cylinder and jacket.

17. In an internal combustion engine of the sleeve valve type having a fixed cylinder composed of material having a given co-efficient of expansion, a floating sleeve valve encircling said cylinder composed of material having a greater co-efficient of expansion than said cylinder, and a jacket encircling said sleeve which is composed of material having a greater co-efficient of expansion than the sleeve, whereby running clearances between the sleeve and the surfaces associated therewith are maintained regardless of expansion in the material resulting from heat to which they are subjected under operating conditions.

18. The method of constructing and assembling an internal combustion engine of the sleeve valve type, which comprises forming the crank case or support with a machined opening and forming the cylinder with a basal flange, erecting the cylinder in the crank case opening with the flange resting upon the crank case, slipping a spacing washer on the cylinder so as to encircle the lower end of the cylinder and lie on the flange, slipping the valve sleeve gear ring on the cylinder so as to rest on the spacing washer, slipping the valve sleeve over the cylinder and coupling it to the gear ring, slipping the jacket over the assembled cylinder, sleeve, and gear ring with the lower finished inner machined wall of the jacket fitting the finished wall of the spacing ring, fastening the upper end of the jacket and cylinder together and attaching the jacket to the crank casing.

19. The method of constructing and assembling an internal combustion engine of the sleeve valve type, which comprises forming the crank case or support with a machined opening and forming the cylinder with a basal flange, erecting the cylinder in the crank case opening with the flange resting upon the crank case, slipping the valve sleeve gear ring on the cylinder so as to be supported by the flange, slipping the valve sleeve over the cylinder and coupling it to the gear ring, slipping the jacket over the assembled cylinder, sleeve, and gear ring with the lower finished inner machined wall of the jacket fitting the finished wall of the spacing ring, fastening the upper end of the jacket and cylinder together and attaching the jacket to the crank casing.

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