A. M. LEONI.

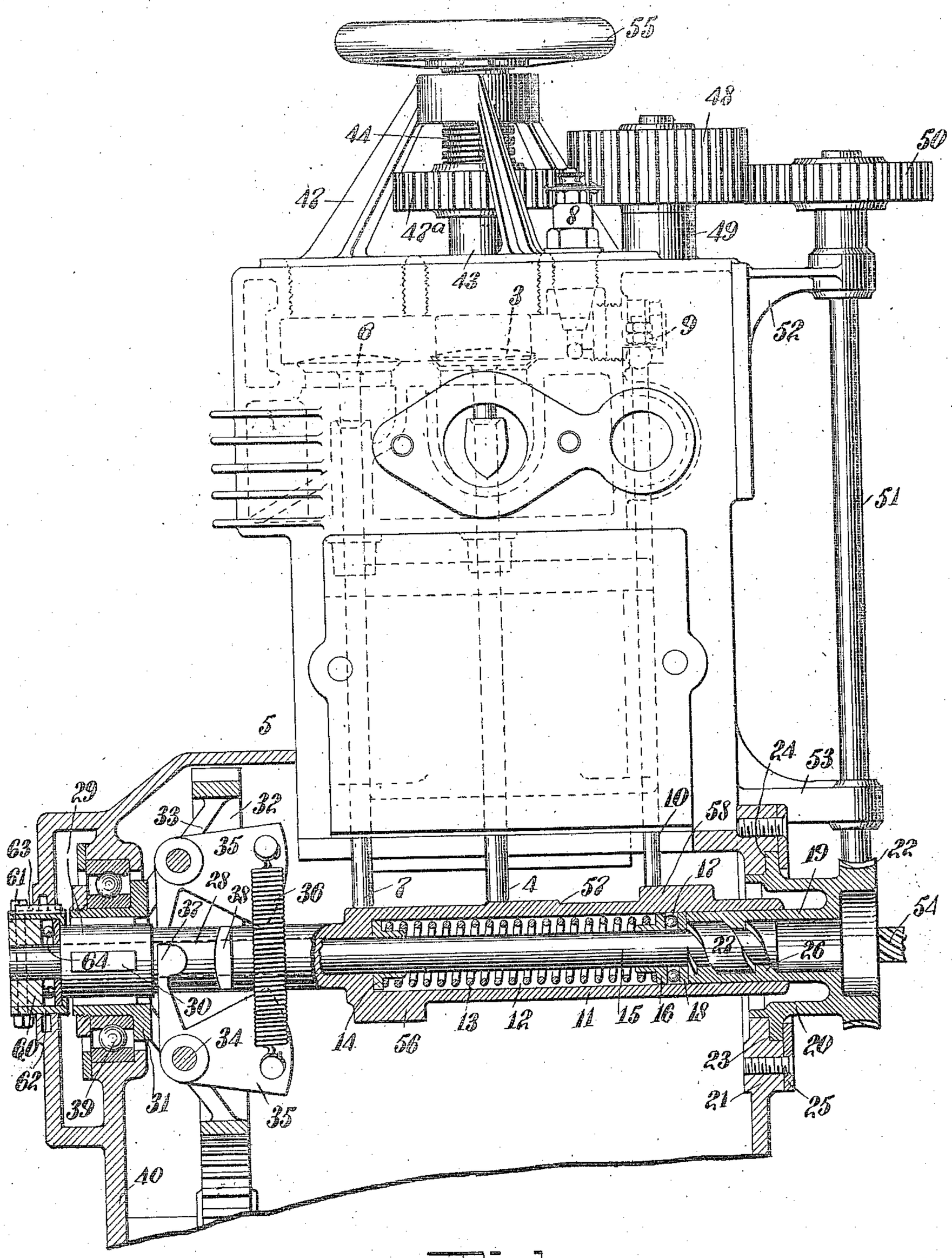
VARIABLE HORSE POWER GAS ENGINE.

APPLICATION FILED SEPT. 20, 1909.

983,150.

Patented Jan. 31, 1911.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 3.

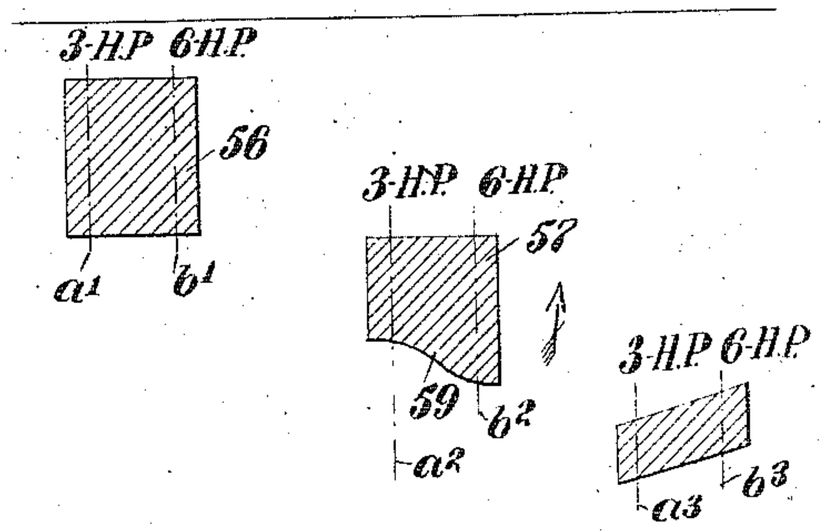
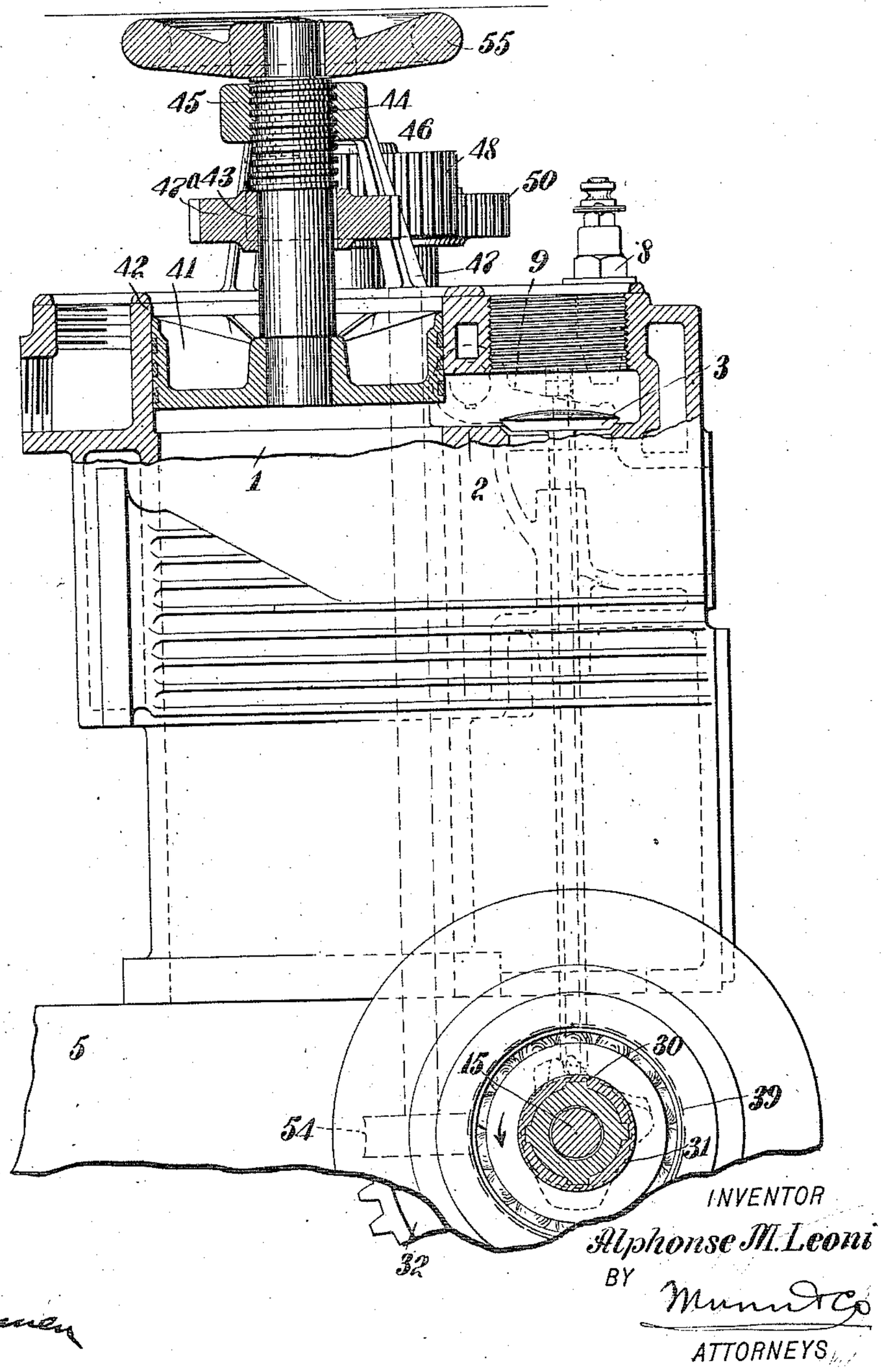


Fig. 2.



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VARIABLE-HORSE-POWER GAS-ENGINE.

983,150. Specification of Letters Patent. **Patented Jan. 31, 1911.**

Application filed September 20, 1909. Serial No. 518,469.

To all whom it may concern:

Be it known that I, ALPHONSE M. LEONI, a subject of the King of Italy, and a resident of Highland, in the county of Ulster and State of New York, have invented a new and Improved Variable-Horse-Power Gas-Engine, of which the following is a full, clear, and exact description.

This invention relates to explosion engines or gas engines.

The object of the invention is to produce a gas engine which may be arranged in such a way that the horse power may be made to vary between wide limits. In other words, the engine is constructed in such a way that its horse power can be regulated not only by regulating the amount of explosion charge, but also by regulating the explosion chamber itself. In this way the horse power may be set at any point desired between the maximum and minimum limit and, furthermore, when at the maximum limit, the engine may be controlled by a governor. In any intermediate horse power position, the valves and sparking device are affected so as to adapt them to the particular power which the engine is expected to develop.

The invention consists in the construction and combination of parts to be more fully described hereinafter and particularly set forth in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a side elevation and partial section of a gas engine constructed according to my invention, certain parts being broken away; Fig. 2 is an end elevation and partial section, certain parts being broken away; and Fig. 3 is a diagrammatic view representing a portion of the shaft developed so as to indicate the relative positions of the cams which operate the admission valve, the exhaust valve and the sparker.

Referring more particularly to the parts, 1 represents the cylinder of a gas engine having an admission port 2 near the upper end thereof. The gas is admitted by an admission valve 3 having a valve stem 4 which passes downwardly through the base or housing 5 of the engine, as indicated. Near this admission valve 3, an exhaust valve 6 is provided, which is also provided with a valve stem 7 which passes downwardly through the base of the engine housing, as illustrated in Fig. 1. At a suitable point a spark plug 8 is provided, with which coöperates a sparking device 9. This sparking device is operated by a sparking stem 10 which passes down through the engine base, as indicated in Fig. 1. These stems or rods 4, 7, and 10, are parallel with each other, and their lower ends lie against a cam sleeve 11. This cam sleeve is of tubular form and presents a bore 12 in which a coil spring 13 is received. This spring thrusts against a loose collar 14 disposed around an adjusting shaft 15 which is disposed within the sleeve, as indicated. The right end of this spring thrusts against a collar 16 which has an antifriction bearing against balls 17 which run on a collar 18. This collar thrusts against the end of a nut sleeve 19. The outer end of this nut sleeve is formed into a hub 20 which is rotatably mounted in the wall 21 of the end of the engine base, as indicated in Fig. 1. At a suitable point this hub is formed into a helical gear 22, the purpose of which will appear more fully hereinafter. The hub 20 is formed with an outwardly projecting flange 23 which is received in a counterbore or seat 24 in the outer side of the wall, and an annular keeper plate 25 is secured on the wall on the outer side, and this plate projects over the flange 23 and retains the hub, although it permits it to rotate.

The nut sleeve 19 is of tubular form, and at its inner end is formed with large screw threads 26, and the end of the adjusting shaft 15 is formed into a screw head or screw 27 which engages the threads 26. The cam sleeve 11 is extended at its end remote from the hub 20 so as to form a cam shaft 28. This shaft 28 has an enlarged neck 29, which is provided with keys 30 which afford means for securing upon the shaft the hub 31 of a gear wheel 32. This gear wheel 32 is offset toward the right, as indicated; the rim of the wheel being secured to inclined spokes 33. On the spokes 33, pivot pins 34

are provided for securing governor weights 35. These governor weights are connected by a helical spring 36 which is extended when the weights fly outwardly under the centrifugal force. The weights 35 have toes 37 which project toward each other, but on opposite sides of the shaft, and these toes are adapted to coöperate at certain times with shoulders 38 formed on the side of the cam shaft, as will be readily understood. The hub 31 is rotatably mounted in a ball bearing 39 which is formed in the end wall 40 of the engine housing. By means of this gear 32, the cam shaft 28 is rotated in a two to one ratio from the main shaft of the engine, that is the engine shaft makes two complete revolutions while the cam shaft is making one revolution. This arrangement adapts the engine for operating as a four-cycle engine.

The cylinder 1 has a movable head 41 which is mounted in a counterbore 42 of the cylinder. This head is provided with a central spindle 43 which extends upwardly, and this spindle is formed near its upper end with an adjusting screw 44 which makes a threaded engagement with the hub 45 of a spider 46, said spider having legs 47 which extend downwardly and seat on the upper edge of the cylinder casing, as will be readily understood. On the spindle 43 there is provided a gear wheel 47^a, and this gear wheel meshes with an idler gear wheel 48 which is mounted on a suitable hub 49 on the upper end of the cylinder casing. This idler 48 meshes with a gear wheel 50 which is rigidly mounted on a vertical shaft 51 which extends down at the side of the cylinder, said shaft being suitably mounted in brackets 52, 53. The lower end of this shaft is provided with a helical gear 54 which meshes with the helical gear 22, as shown. The upper end of the spindle 43 is provided with a hand wheel 55 for rotating the same. It should be understood that when the hand wheel 55 is rotated, the cylinder head 41 can be moved up or down in the end of the cylinder so as to enlarge or reduce the volume of the explosion chamber between the cylinder head and the piston. In Fig. 2 the cylinder head is shown in its most depressed position, which gives the most reduced volume for the explosion chamber. When the handle is rotated so as to raise the cylinder head, the gear 47^a maintains contact with the gear 48 by reason of the fact that the gear 48 is of great width, as shown.

The arrangement of the cams on the cam shaft is illustrated in Fig. 3, in which view the shaft is represented developed. The arrow on this view indicates the direction of rotation. The cams are all formed integral with the cam sleeve. The exhaust cam 56 is in line with the exhaust valve stem 7, while the inlet cam 57 is in line with the stem 4. A sparking cam 58 is provided which is in alinement with the sparking stem 10. The direction of rotation is indicated by the arrow. The cam 56 is of rectangular form, while the inlet cam 57 has a rectangular forward end with respect to the direction of rotation, and a curved rear edge 59. The cam 58 is in the form of a rhomboid and has its longitudinal axis inclined with respect to the axis of the cam shaft. In addition to this, the end of the cam 58 which is remote from the cam 57 is disposed forwardly with respect to the direction of rotation. The right end of the cam 57, that is, the end disposed toward the sparking cam 58, is of greater weight than the opposite end. In the normal position of the cam shaft, the engine illustrated is supposed to operate at about three horse power. In this position of the cam shaft, the shaft is disposed as far to the right as possible, as viewed in Fig. 1. The path of the stems 7, 4, and 10, as the cams pass them, will then correspond to the position of the dotted lines a', a^2, a^3, shown on these cams in Fig. 3. When the hand wheel 55 is rotated so as to increase the volume of the compression chamber or explosion chamber, the cam shaft will be shifted bodily toward the left in a manner which will be described hereinafter, so that the stems of the valves and the sparker will come opposite to the lines b', b^2, and b^3 on the cams. This will evidently increase the length of the admission period so that a greater volume of gas and air, which is to form the charge, will be admitted. It will also be evident that this shifting of the cam shaft will also alter the ignition time so that it will occur relatively earlier in the stroke. Of course, if desired, changes in the relation of the cams may be made so as to get different special effects or results which may be required.

The end of the shaft 15 has a head 60 rigidly attached thereto by bolts 61, and this head is enveloped by a bushing 62, which slides freely in and out in an opening formed in the wall of the housing. A key 63 on the side of this bushing slides in a groove in the edge of the opening, as indicated, so that the head and shaft 15 cannot rotate though they may shift longitudinally. On the inner side of the head a ball bearing 64 is formed for the end of the cam shaft, as shown.

When the hub 19 is rotated to shift the cam shaft, the key 63 holds the shaft 15 against rotation, so that this shaft and the cam-shaft shift bodily to the left. When the cam shaft is shifted over to the 6-horse-power position, the shoulders 38 will be

near the toes 37, so that the governor can act on the cam-shaft to shift it toward the right, if the speed of the engine becomes too great. Shifting the cam-shaft to the right reduces the period of admission and also affects the sparking time so as to reduce the power that the engine will develop.

If desired, the cam shaft can be set in different intermediate positions, giving different intermediate periods of admission. In any position the volume of the explosion chamber corresponds perfectly to the admission period and to the sparking time.

Attention is called to the tapered or conical form of the cam 57 and to the inclined position of its edge 59. On account of this peculiar form, this cam will give a continuous variation from the minimum period of opening of the valve, to the maximum period.

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

1. In a gas engine, a cylinder, a movable head in the cylinder having means for adjusting it relatively to the cylinder to regulate the capacity of the explosion chamber, a valve for the cylinder, a valve mechanism adapted for operating said valve, a cam shaft having graduated means adapted for operating the valve mechanism, the said cam shaft being adapted to be shifted longitudinally of its length, means adapted for so shifting the cam shaft, and gearing connecting the cylinder head with the last-mentioned means.

2. In a gas engine, a cylinder having an explosive chamber, the capacity of which may be regulated, means adapted for regulating the capacity of the explosion chamber, a cam shaft disposed at an angle relatively to the axis of the cylinder having means, graduated longitudinally thereof, adapted for operating a valve, and igniting mechanism, the cam shaft being adapted to be shifted relatively to the cylinder, means adapted for so shifting the cam shaft, and gearing connecting the first-mentioned with the last-mentioned means.

3. In a gas engine, a cylinder, a head therefor adapted to be moved relatively thereto, a spindle having a thread secured to the head, a nut secured relatively to the spindle, in which the thread meshes, a cam shaft having graduated means adapted to be shifted relatively to the cylinder, means adapted to so shift the cam shaft, and gearing connecting the spindle and the last-mentioned means.

4. A gas engine having a movable cylinder head, means for adjusting said cylinder head to regulate the volume of the explosion chamber, a cam shaft, valves adapted to be driven thereby, said cam shaft having cams giving a different valve action when said cam shaft is shifted longitudinally, and means for shifting said cam shaft longitudinally when said cylinder head is adjusted.

5. In a gas engine, a cylinder, a head therefor adapted to be moved relatively thereto, means adapted to so move the head, a shaft, gearing connecting the said means with the shaft, a cam shaft disposed at an angle to the first-mentioned shaft, means adapted to shift the cam shaft relatively to the cylinder, and gearing connecting the said shaft with the last-mentioned means.

6. An explosion engine having a cylinder with a movable cylinder head, means for adjusting said cylinder head to vary the volume of the explosion chamber, valves for controlling the admission and exhaust from said cylinder, a shifting cam shaft having cams controlling the action of said valves and adapted to produce different valve actions when shifted to different positions, and automatic means for shifting said cam shaft when said cylinder head is adjusted.

7. An explosion engine having a cylinder with a movable cylinder head, valves for controlling the admission and exhaust from said cylinder, a cam shaft mounted to rotate and slide, resilient means tending to hold said cam shaft against sliding, means for shifting said cam shaft when said cylinder head is adjusted to give an increased horse power, and a governor adapted to shift said cam shaft when running at a maximum horse power and tending to reduce said horse power.

8. An explosion engine having a cylinder with a movable cylinder head, means for adjusting said cylinder head, a sleeve nut, a screw received in said nut, a cam shaft rotatably mounted and adapted to be shifted when said screw is shifted by said nut, valves controlling the admission and exhaust from said cylinder, said cam shaft having cams controlling the action of said valves, and means for controlling said cam shaft when said cylinder head is adjusted.

9. An explosion engine having a cylinder, a movable cylinder head in said cylinder, means for adjusting said cylinder head, valves controlling the flow to said cylinder, a rotatable sleeve nut, means for rotating said sleeve nut when said cylinder head is adjusted, a cam shaft rotatably mounted on said sleeve nut, and a screw in connection with said cam shaft and engaging said nut and affording means for shifting said cam shaft when said nut is rotated.

10. A gas engine having a cylinder, a cylinder head adjustably mounted in said cylinder, means for adjusting said head, a cam shaft, valves controlled by said cam shaft, means for shifting said cam shaft

to vary the power developed by said engine, a spring constraining said cam shaft toward a position giving a maximum horse power, and a governor adapted to coöperate with said cam shaft, opposing the action of said spring and adapted to reduce the power developed by said engine.

11. In a gas engine, a cam shaft adapted for operating igniting mechanism, a threaded member adapted to be rotated, and means for shifting the cam shaft adapted to be operated by the rotation of the threaded member.

12. In a gas engine, a cam shaft adapted for operating valve mechanism, a threaded member, means for shifting the cam shaft adapted to be operated by the threaded member, and means adapted for engaging the thread on the threaded member to operate it.

13. In a gas engine, a cam shaft adapted for operating igniting mechanism, a threaded member adapted to rotate, means for shifting the cam shaft in one direction adapted to be operated by the rotation of the threaded member, means adapted for engaging the thread on the threaded member to operate it, and governor mechanism adapted for shifting the cam shaft in the opposite direction.

14. In a gas engine, a cam shaft having a shoulder, valve mechanism adapted to be operated by the cam shaft, a wheel mounted for rotating with the shaft, a member pivoted to the wheel, a toe on the pivoted member for engaging the shoulder to shift the cam shaft, and a spring for holding yieldingly the said pivoted member with its toe away from its shoulder.

15. In a gas engine, a housing, a cam shaft having a shoulder disposed in the housing adapted for operating igniting mechanism, a gear wheel, adapted to be driven by the engine, connected to the cam shaft but which permits the cam shaft to be shifted relatively thereto, a member with a weighted arm pivoted to the gear wheel, the member having also a toe adapted to engage the shoulder on the cam shaft for shifting it.

16. In a gas engine, a cylinder having an explosion chamber, a movable head in the cylinder having means for adjusting it relatively to the cylinder to regulate the capacity of the explosion chamber, igniting means for the cylinder, a cam shaft having means graduated longitudinally thereof for operating the igniting means, the cam shaft being adapted to be thrust relatively to the igniting means, and gearing connecting the cylinder head with the cam shaft to shift the latter.

17. In a gas engine, a cylinder having an explosion chamber, a movable head in the cylinder having means for adjusting it relatively to the cylinder to regulate the capacity of the explosion chamber, igniting means for the cylinder, a cam shaft having means graduated longitudinally thereof for operating the igniting means, the cam shaft being adapted to be thrust relatively to the igniting means, gearing connecting the cylinder head with the cam shaft to shift the latter, and a governor connected with and adapted to move the cam shaft.

18. In a gas engine, a cam shaft adapted for operating igniting mechanism, a threaded member, yielding means for shifting the cam shaft adapted to be operated by the threaded member, and means adapted for engaging the thread on the threaded member to operate it.

19. In a gas engine having an explosion chamber, the capacity of which may be regulated, means adapted for regulating the capacity of the explosion chamber, a cam shaft adapted for operating valve mechanism, and means for shifting the cam shaft in one direction adapted to be operated by the first-mentioned means.

20. In a gas engine having an explosion chamber the capacity of which may be regulated, means adapted for regulating the capacity of the explosion chamber, a cam shaft adapted for operating valve mechanism, means for shifting the cam shaft in one direction adapted to be operated by the first-mentioned means, and governor mechanism adapted for shifting the cam shaft in the opposite direction.

21. In a gas engine, a hollow cam shaft having an inner shoulder, a shaft having a threaded portion disposed within the cam shaft, a spring disposed within the hollow cam shaft around the second-mentioned shaft and against the shoulder, a threaded member which meshes with the threaded portion of the second-mentioned shaft and which is adapted for compressing the spring, and means for rotating the threaded member relatively to the second-mentioned shaft.

22. In a gas engine, a hollow cam shaft having an inner shoulder, a shaft having a threaded portion disposed within the cam shaft, a spring disposed within the hollow cam shaft around the second-mentioned shaft and against the shoulder, a threaded member which meshes with the threaded portion of the second-mentioned shaft and which is adapted for compressing the spring, means for rotating the threaded member relatively to the second-mentioned shaft, an outer shoulder on the cam shaft, a wheel keyed to the cam shaft, and a member pivoted to the wheel, the member having a toe for engaging the outer shoulder.

23. In a gas engine, a hollow cam shaft

having an inner shoulder, a shaft having a threaded portion disposed within the cam shaft, a spring disposed within the hollow cam shaft around the second-mentioned shaft and against the shoulder, a threaded member which meshes with the threaded portion of the second-mentioned shaft and which is adapted for compressing the spring, means for rotating the threaded member relatively to the second-mentioned shaft, an outer shoulder on the cam shaft, a wheel keyed to the cam shaft, a governor weight pivoted to the wheel, a toe engaging the outer shoulder, and means for holding the toe yieldingly on the outer shoulder.

24. In a gas engine, a hollow cam shaft having an inner shoulder, a shaft having a threaded portion disposed within the cam shaft, a spring disposed within the hollow cam shaft around the second-mentioned shaft and against the shoulder, a threaded member which meshes with the threaded portion of the second-mentioned shaft and which is adapted for compressing the spring, means for rotating the threaded member relatively to the second-mentioned shaft, an outer shoulder on the cam shaft, a wheel having a hub keyed to the cam shaft, an outer bearing for the hub, a governor weight pivoted to the wheel, and a toe on the governor weight for engaging the outer shoulder.

25. In a gas engine, a cam shaft having an outer shoulder, a wheel having a hub keyed to the cam shaft, an outer bearing for the hub, a governor weight pivoted to the wheel, and a toe on the governor weight for engaging the outer shoulder.

26. In a gas engine, a casing, a hollow cam shaft having an inner shoulder, a shaft having a threaded portion disposed within the hollow cam shaft, a spring disposed around the second-mentioned shaft and against the shoulder, the second-mentioned shaft being keyed to the casing but being adapted to be thrust relatively thereto, a threaded member which meshes with the threaded portion of the second-mentioned shaft and which is adapted for pressing the spring, and means for rotating the second-mentioned member relatively to the shaft.

27. In a gas engine, a cam shaft having a shoulder, a spring engaging the shoulder, a threaded member, a second threaded member meshing in the first threaded member, which is adapted for compressing the spring, and means for rotating the second threaded member relatively to the first threaded member.

28. In a gas engine, a cylinder having an explosive chamber, a movable head in the cylinder having means for adjusting it relatively to the cylinder, to regulate the capacity of the explosion chamber, a cam shaft having a shoulder, a spring engaging the shoulder, a threaded member, a second threaded member meshing in the first threaded member, which is adapted for compressing the spring, and gearing connecting the cylinder head with the second threaded member to rotate it relatively to the first threaded member.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALPHONSE M. LEONI.

Witnesses:
GIUSEPPE MAGNI,
BOCCA GIUSEPPE.