3 Sheets--Sheet 1.

G. W. DAIMLER.

Gas Motor Engines.

No. 153,245. Patented July 21, 1874.

Fig. 1.

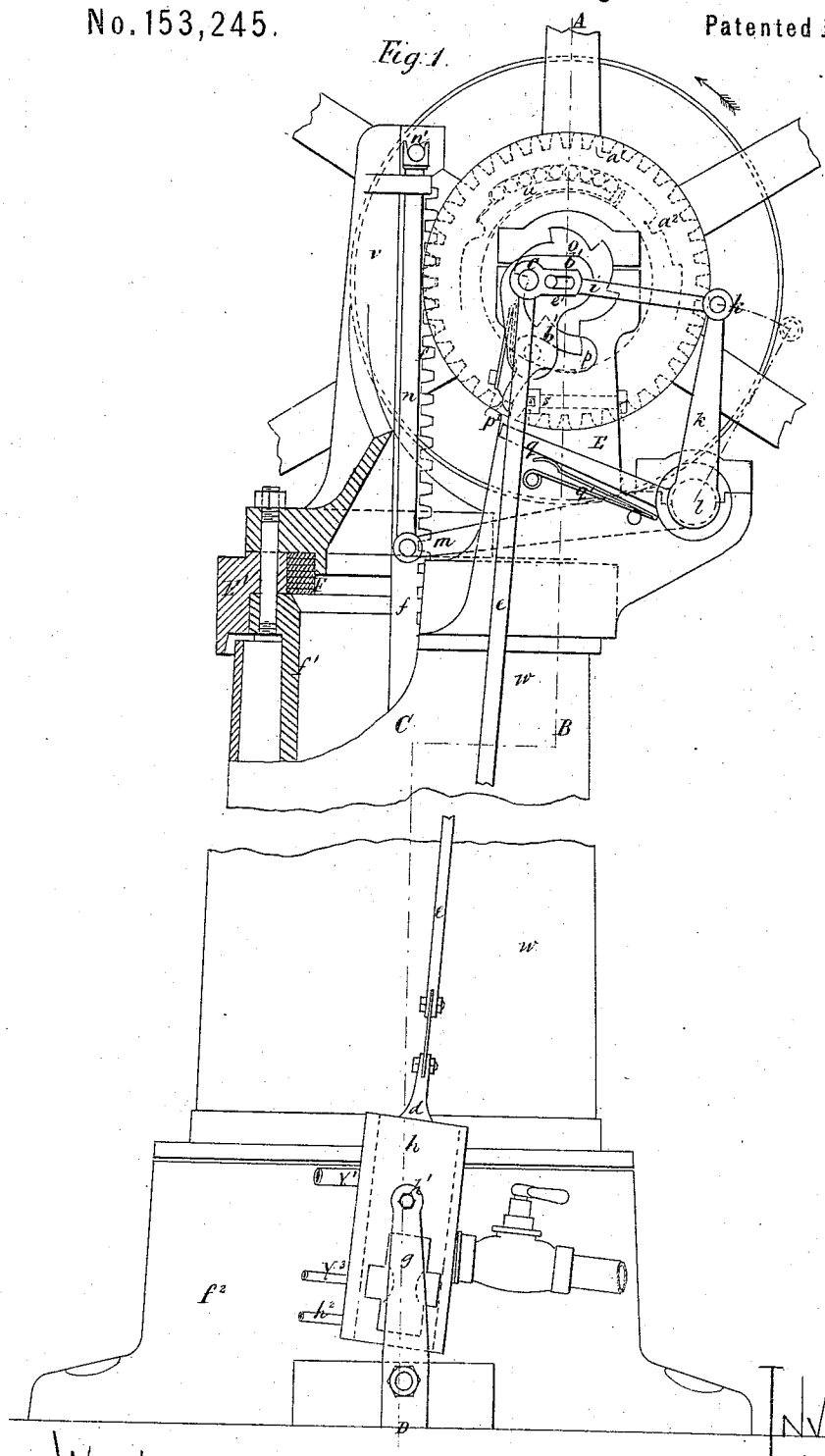

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Fig. 2

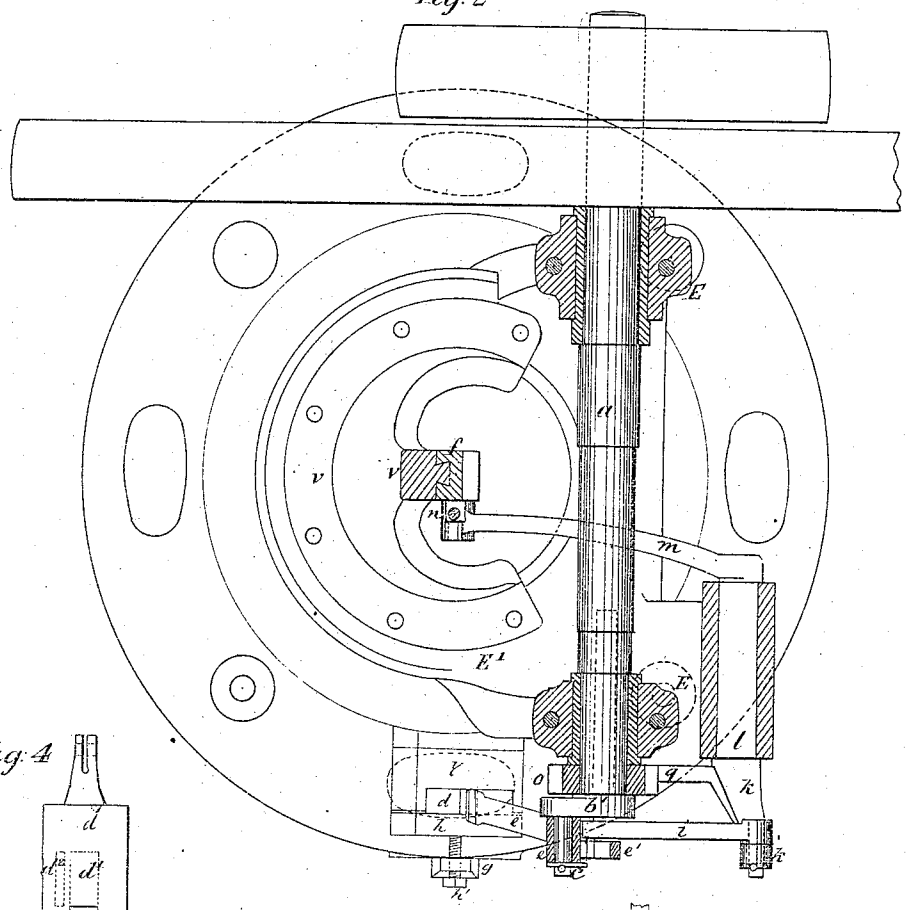

Fig. 4

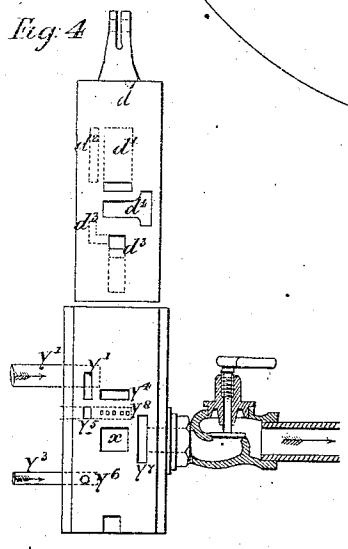

Fig. 5

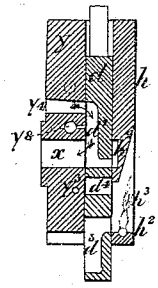

Fig. 6

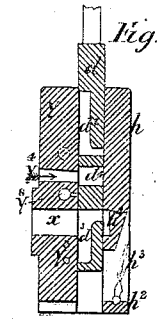

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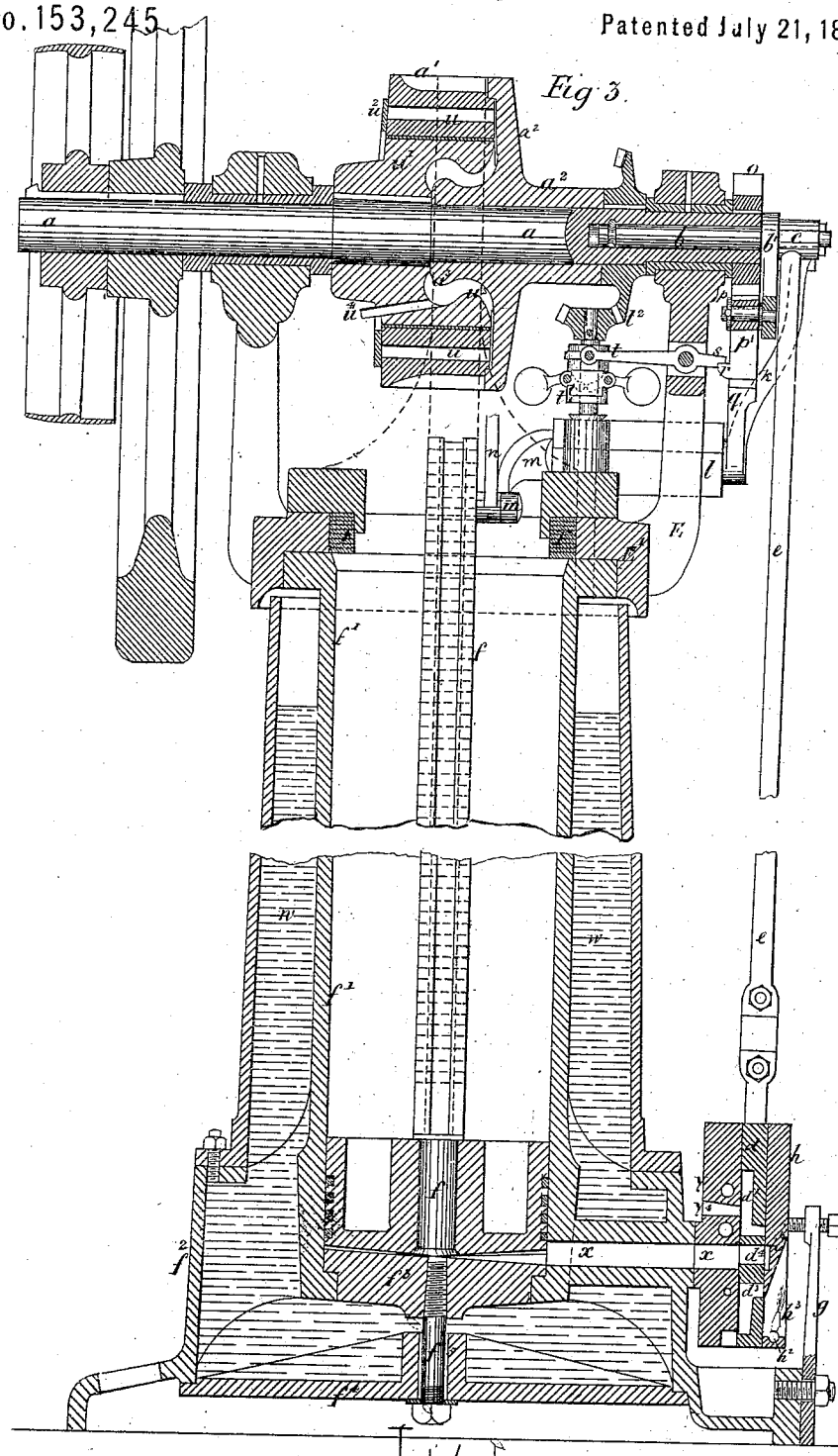
Fig 3.



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UNITED STATES PATENT OFFICE.

GOTTLIEB WILHELM DAIMLER, OF MUELHEIM-ON-THE-RHINE, GERMAN EMPIRE.

IMPROVEMENT IN GAS-MOTOR ENGINES.

Specification forming part of Letters Patent No. **153,245**, dated July 21, 1874; application filed March 24, 1874.

To all whom it may concern:

Be it known that I, GOTTLIEB WILHELM DAIMLER, of Muelheim-on-the-Rhine, in the German Empire, civil engineer, have invented an Improvement in Gas-Motor Engines; and do hereby declare that the following description, taken in connection with the accompanying drawings hereinafter referred to, forms a full and exact specification of the same, wherein I have set forth the nature and principles of my said improvement, by which my invention may be distinguished from others of a similar class, together with such parts as I claim and desire to secure by Letters Patent—that is to say:

In the specification of a patent granted to E. Langen and N. A. Otto on the 13th August, 1867, No. 67,659, was described a gas-motor engine, which operated in the following manner: A piston fitted to an open-topped cylinder, kept cool by a water-jacket, was raised so as to draw into the cylinder a mixture of air and combustible gas at atmospheric pressure, and a kindling-flame to ignite the gaseous mixture. The expansion resulting from the ignition propelled the piston rapidly upward, after which, the products of combustion being cooled within the cylinder, the superior pressure of the external atmosphere forced the piston downward. The piston-rod had on it a rack, which geared with a wheel on the engine-shaft. This wheel was connected to the shaft by a clutch, which permitted it to revolve freely in the one direction while the piston made its upstroke, but by which it drove the shaft while the piston descended. The shaft was provided with a heavy fly-wheel to keep it running while the piston was ineffective on it, and with cams or eccentrics for working a slide to admit the gaseous charge and igniting-flame into the cylinder, and to permit the escape of the products of combustion, and also for moving the piston so as to draw in the gaseous charge.

The present invention relates to improvements in the construction and arrangement of parts of engines of this kind, having reference chiefly to the construction and working of the slide so as to control one passage for ingress to and egress from the cylinder, to the guiding of the piston-rod and the connecting it with the slide-gear in such a manner that the working of the one is made dependent on the position of the other, and to the application of a governor to the slide-gear, so that the speed of the rotating shaft shall regulate the expenditure of gaseous fuel. The nature of these improvements will be understood on reference to the accompanying drawings and to the figures and letters marked thereon.

Figure 1 represents a front view, partly in section, of the improved engine. Fig. 2 is a plan, partly in section. Fig. 3 is a vertical section on line A B C D of Fig. 1, and Fig. 4 is a front view of the slide and the face on which it works.

a is the engine-shaft, mounted in bearings on brackets E, projecting from a ring, E′, which is bolted on the cylinder-top, the opening in the ring E′ being sufficiently large to admit of the piston *f* being taken out of the cylinder without dismounting the shaft *a* or its bearings. On the shaft *a* is mounted the toothed ring a^1, with its clutch *u*, similar in action to that described in the specification above referred to, the toothed ring a^1 being always in gear with the rack *f*, which constitutes the piston-rod, but being so clutched to the shaft *a* that it turns freely and independently of the shaft in the one direction when the piston ascends, but that in the other direction, when the piston is descending, it is engaged with the shaft. This, as explained in the former specification referred to, is effected by mounting the nave a^2, to which the toothed ring a^1 is attached, loose upon the shaft, and arranging within the toothed ring a^1, and between it and the nave u^1, which is fixed on the shaft, curved wedge-pieces and rollers *u*, which give a bite by friction when the toothed ring turns in the one direction, but relieve themselves when it turns in the other direction. Although this kind of clutch is substantially the same in principle and action as that formerly described, I have contrived certain modifications in the construction of the parts, which I will now describe. The toothed ring a^1 is preferably made of wrought-iron, but the hollows between its teeth are not cut out to the outer edge, a portion of the

metal being left at the end of each hollow, as shown, to act as a shroud for the teeth, giving them greater strength. The nave a^2, of cast-iron, is made with a lip to overlap a grommet on the other face of the toothed ring, and is shrunk on, so as to strengthen it against the bursting strain of the wedge-clutch within it. A ring-plate, w^2, is screwed on the outer face of the toothed ring to keep the wedge-clutches and rollers from shifting endwise, and to enable these to be readily taken out for inspection or repair. The loose nave a^2 is made with a boss, a^3, projecting into a recess within the fixed nave w^1, which is made with a bulge, w^3, so that the oil employed to lubricate the loose nave, and escaping into the cavity within the fixed nave, is kept by the bulge w^3 from flowing outward into the clutch, and is allowed to issue by a small pipe, w^4. The rack f is grooved at the back and works on a dovetail guide formed on the bracket v, which is secured on the top of the cylinder, and thus the rack is prevented from getting too deeply or too little in gear with the wheel a^1, and is always truly guided in a direction parallel to the axes of the cylinder. Under the bracket v is fixed an annular buffer, F, of caoutchouc, against which the piston can strike in case of its too violent propulsion upward. The lower part of the cylinder f^1 is spread out to form a stand, f^2, for the engine, and on this extended part is bolted the water-jacket w, which is carried up the whole height of the cylinder, instead of extending only partially up the cylinder, as described in the former specification referred to. By this means a volume of water is kept in contact with the cylinder for cooling the same sufficient to render a continuous circulation of water unnecessary. The jacket extends under the cylinder, and below it is a space to which free access is given for circulation of air. The cylinder-bottom f^3 rests on a shoulder in the cylinder, and below the cylinder is a cover, f^4, which forms the bottom of the water-casing. Both the covers, f^3 f^4, are secured in their places by one central bolt, f^5. From the bottom of the cylinder a passage, x, extends to the slide-facing, which is placed somewhat obliquely, as shown in Fig. 1, so as to bring the axis of the slide in line with that of the shaft a, from which it is worked. The slide-cover h is held in place by a strong spring, g, provided with a set-screw, h^1, which bears against the cover with a pressure that can be adjusted by screwing it more or less forward. The slide-face y has through it a passage, y^4, for admission of air, and has in it a hole, y^1, to which is connected the pipe for the supply of combustible gas. The slide d has in its upper part two recesses, d^1 d^2, of which the one, d^1, faces the opening y^4, and the other, d^2, faces the hole y^1 from the gas-supply, and in certain positions of the slide puts this hole in communication with another hole, y^5, in the facing, from which hole there is a passage having a number of small apertures, y^6, opening toward the recess d^1 of the slide. When the slide is moved down so as to bring this recess to face the passage x, and the piston is caused to rise somewhat for drawing in the charge of gas and air preparatory to performing its stroke, air enters by the passage y^4 and recess d^1, and gas enters by y^1, d^2, and y^5, and the small holes y^6, also to the recess d^1, and the air and gas, mingling, enter the cylinder by the passage x. Besides the gas-supply pipe y^1, there are two other gas-pipes, y^3 and h^2, the one communicating with a hole, y^6, in the slide-facing, and the other with a jet, h^3, which is kept burning immediately outside a hole in the slide-cover h. In the slide d there is a hole, d^3, and recesses communicating with it, by which, when the slide is about the middle of its stroke, the flame h^3 is put in communication with the gas from y^3. As the slide ascends, cutting off the supply of gas and air, the inflamed gas in d^3 is brought into communication with the gaseous mixture in the passage x, and the contents of the cylinder are thereby ignited, their expansion propelling the piston upward. A recessed hole, d^4, in the slide is made wide enough to extend over the passage x, and also over a passage, y^7, at the side thereof in the slide-facing. This latter passage communicates with an eduction-pipe, as at Fig. 4, which may be provided with a screw-valve for moderating the issue of the products of combustion. When the slide descends again to or near its middle position, as shown in Fig. 3, the products of combustion issue from the cylinder by the passage x, the holes d^4 and y^7, and the eduction-pipe and valve. A recess, h^4, in the slide-cover allows a portion of the gas and air to pass from the recess d^1, through the passage d^4, into the cylinder, when the slide is in such a position that both d^1 and d^4 are over the recess h^4, whereby an increased area of passage for the gas and air into the cylinder is afforded, and the passage d^4 is cleared of the products of combustion from the previous explosion.

Fig. 5 shows the slide in position for the supply of the gaseous mixture to the cylinder, and Fig. 6 shows it in position for the ignition of the charge in the cylinder.

The working of the slide d so as to operate in the manner described, in due accord with the movement of the piston, is effected by mechanism which will now be described, which mechanism also imparts to the piston that portion of its upward movement which is necessary for drawing the gaseous charge into the cylinder, and is so arranged as to be under the control of a governor.

The end of the rotating shaft a is bored up, and a spindle, b, is fitted therein so that it may revolve freely. On the end of the spindle b is a crank, b', the pin c of which is connected by a rod, e, to the slide d. The crank b' also carries a spring-pawl, p, engaging with the teeth of a ratchet-wheel, o, fixed on the shaft a. When this pawl is engaged with any of the ratchet-teeth, the shaft, revolving in the direction of the arrow, Fig. 1, drives the crank

b'; but when the pawl is disengaged, as shown in Fig. 1, the crank b' remains at rest. The head of the rod e is made with a loop, e', presenting a slotted hole, into which enters a pin on a rod, i, jointed to a lever, k. This lever is fixed to a rocking shaft, l, from which project two arms, m and q. The one arm, m, has jointed to its end an upright rod, n, which at its top presents a fork, n', that receives a pin projecting from the side of the rack piston-rod f. The other arm, q, is pressed upward by a spring, q'. While the piston is at the lower extreme of its stroke, the pin on its rod resting in the fork n', the arms m and q are kept down in opposition to the spring q', and the pawl p being engaged with the ratchet-wheel o, the crank b' is caused to revolve with the shaft a. In its revolution the crank b' works the slide d by means of the rod e, and it also works the lever k and rocking shaft l during part of its motion, raising the arm m and fork n', and thereby raising the piston, so as to draw the gaseous charge into the cylinder. During another part of the motion of the crank b' the arms m and q are depressed, but not to the full extent, the slot in which the pin of the rod i works permitting the spring q' to keep up the arm q in such a position that as the pawl p is brought round by the rotation of the crank, a tail, p', projecting from the pawl is caught by the end of the arm q, and the pawl is thus disengaged from the ratchet-wheel o, which goes on revolving, while the crank remains at rest. But on the piston fully descending, the pin on its rod, entering the fork n', pushes down the arm m, and thereby causes the arm q to be withdrawn from the tail p' of the pawl, whereupon the pawl p is caused by its spring to engage with the ratchet-wheel o, and the crank b' is again caused to revolve. The mechanism so far described has, therefore, not only the effect of giving to the piston and slide their proper movements when the cylinder is cleared of products of combustion by the full descent of the piston, but of arresting these movements when the cylinder is not completely cleared.

The working of the piston and slide is also controlled by means of a governor in the following manner: A governor, t^1, is worked by bevel-gear t^2 from the revolving shaft a. When the balls of the governor are expanded, owing to the rapid revolution of the shaft, a sleeve on the governor-spindle is raised, and the end t of a lever is raised, its opposite end s being depressed. On the tail p' of the pawl p is a projection, r, so placed that when the end s of the governor-lever is down this projection is brought by the revolution of the crank and pawl to catch on s. The pawl is thereby disengaged from the wheel o, and the crank b' remains at rest, so that the piston is not raised to charge the cylinder, nor is the slide moved. When, however, owing to the suspension of the moving force thus effected, the speed of the shaft a becomes abated, the governor-balls collapse, the sleeve descends with the end t of the governor-lever, the opposite end s rises clear of the projection r, the pawl p is permitted again to engage with the ratchet-wheel o, the crank b' is again caused to revolve, and the working of the engine proceeds.

By this arrangement of mechanism the governor is made to act, not by throttling the discharge from the cylinder, as described in the specification referred to, but by arresting the supply of gaseous fuel until the velocity of the shaft has become so far lessened that a fresh accession of the working force is required.

Having thus described the nature of this invention, and the best means I know of carrying it into practical effect, I would have it understood that I do not claim, generally, a gas-motor engine in which the combustion of a gaseous mixture propels a piston without doing work, and the superior pressure of the atmosphere causes the piston to make its return stroke do the work; nor do I claim, generally, for such engines a slide whereby the gaseous mixture is admitted to the cylinder and ignited by bringing it into communication with an external flame; but

I claim for a gas-motor engine of the kind above referred to—

1. The slide d, with ports and passages d^1 d^2 d^3 d^4, operating in combination with the slide-facing y, with ports and passages x y^1 y^3 y^4 y^5 y^6 y^7 y^8, and with the gas-jet k^3, for the admission of gas and air to the cylinder, for igniting the explosive mixture therein, and for discharging the products of combustion therefrom through one and the same passage, x, substantially as herein described.

2. The crank b', with its spring-pawl p, in combination with the ratchet-wheel o, and with the lever k, the rocking shaft l and its arms m and q, and rod with fork n n', arranged and operating substantially in the manner and for the purposes herein set forth.

3. The governor-lever s t, operated by the governor, in combination with the projection r on the pawl p, for regulating the expenditure of gas according to the velocity of the engine-shaft.

4. The toothed ring a^1, combined with the nave a^2 shrunk thereon, and with the ring-plate u^2 and wedge-clutch, substantially as and for the purposes herein described.

5. The recessed nave u^1 of the clutch u, having a bulge, u^3, and pipe u^4, operating in combination with the boss a^3 of the nave a^2, entering the said recess for preventing the oil from passing into the clutch, substantially as herein described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses this 7th day of February, 1874.

GOTTLIEB WILHELM DAIMLER.

Witnesses:
EMIL LOHMANN,
KASPAR BURGER.