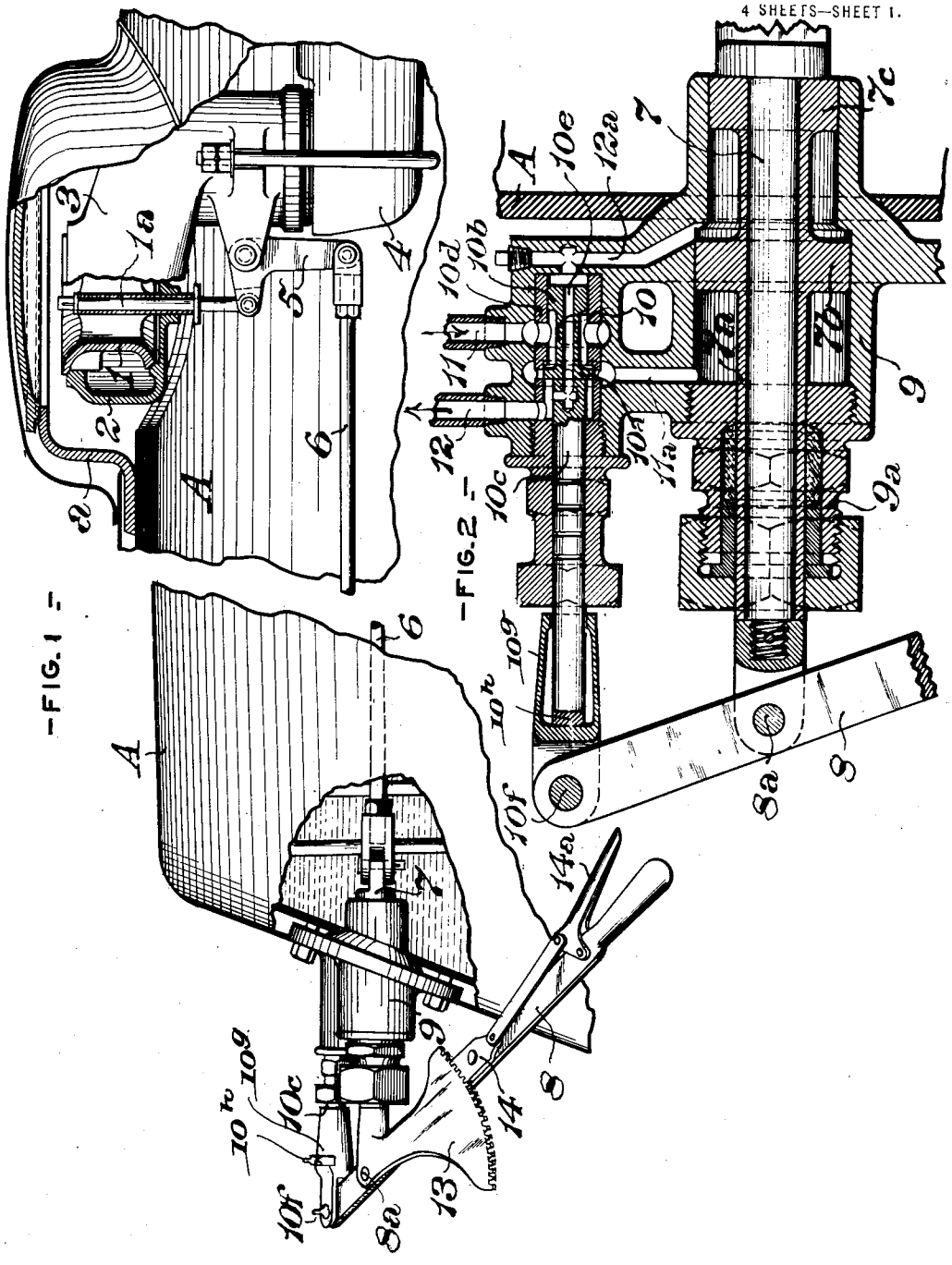
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THROTTLE VALVE OPERATION.

APPLICATION FILED JULY 29, 1920.

1,404,646. Patented Jan. 24, 1922.

4 SHEETS—SHEET 1.



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THROTTLE VALVE OPERATION.

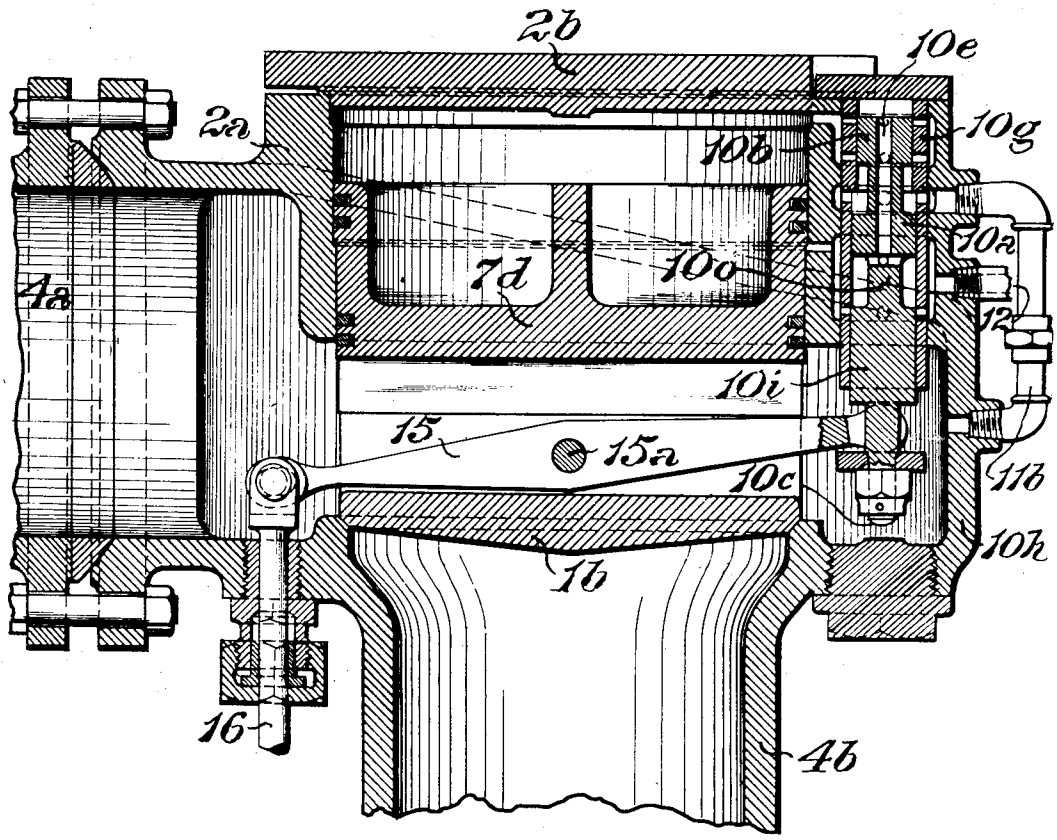
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4 SHEETS—SHEET 2.

—FIG. 3 —



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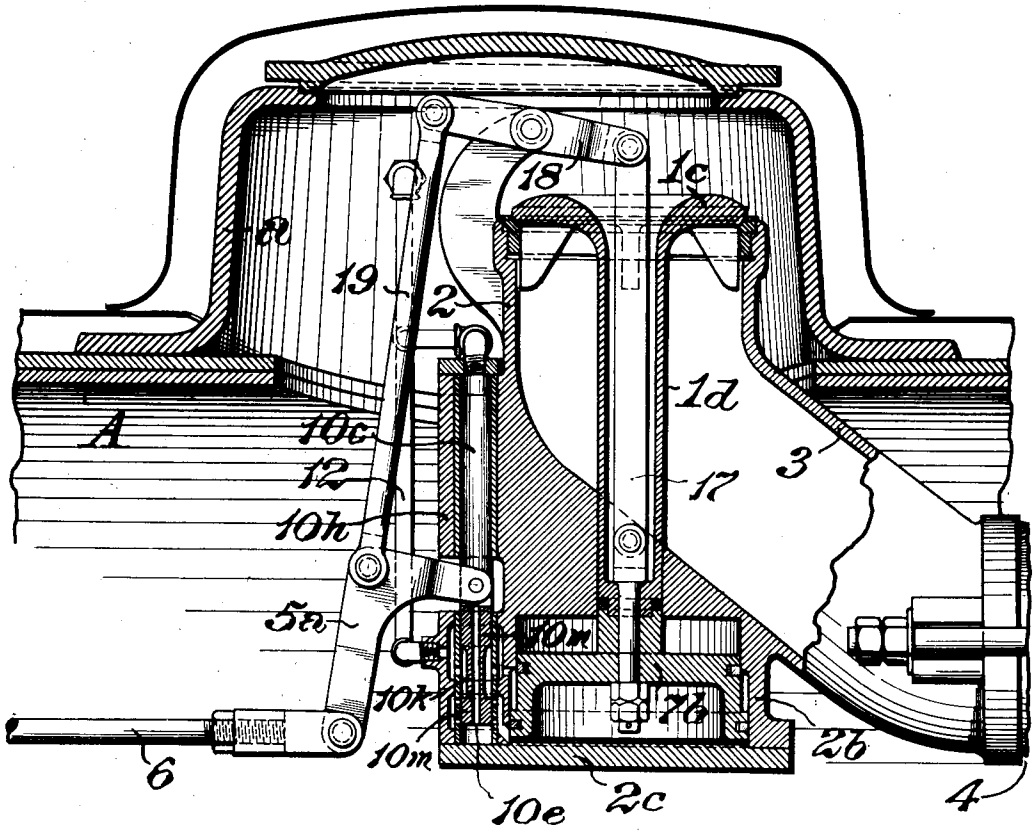
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4 SHEETS—SHEET 3.

—FIG. 4.—



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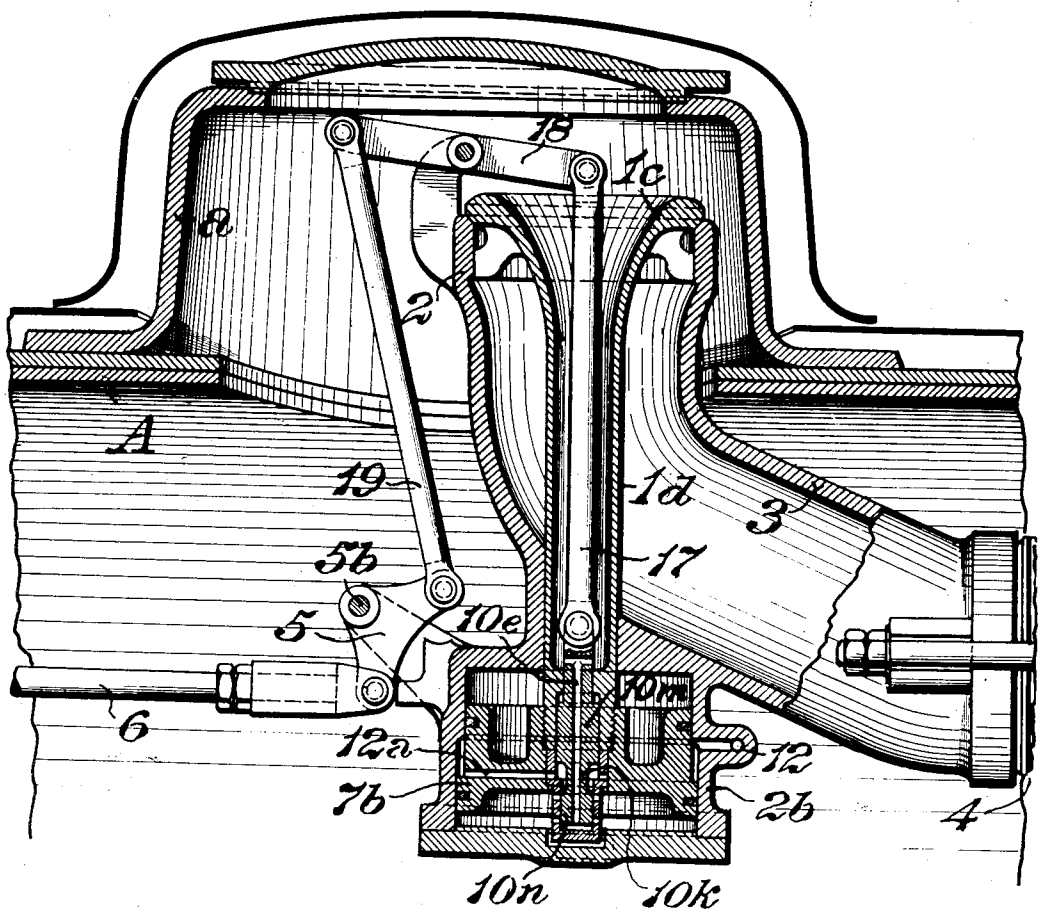
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4 SHEETS—SHEET 4.

FIG. 5.



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THROTTLE-VALVE OPERATION.

1,404,646. Specification of Letters Patent. Patented Jan. 24, 1922.

Application filed July 29, 1920. Serial No. 399,948.

To all whom it may concern:

Be it known that I, CHARLES F. PRESCOTT, of Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Throttle-Valve Operation, of which improvement the following is a specification.

My invention relates to the operation of appliances employed for controlling the flow of fluids from a source of supply to a desired point of delivery, of the general class or type known as "throttle" or "stop" valves, and its object is to provide a novel and improved method of, and means for, actuating valves of said type, whereby their opening and closure, to any desired degree or extent, may be effected with substantially greater expedition, and with less exertion of power by the operator, than is practicable under prior and present practice, and whereby, also, the maintenance of the valve in any adjusted position may be effectively assured.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is a vertical longitudinal central section through the rear portion of a locomotive boiler, illustrating an application of my invention; Fig. 2, a horizontal central section on an enlarged scale, through the adjusting valve mechanism; Fig. 3, a vertical central section through a marine boiler throttle valve; and, Figs. 4 and 5, vertical longitudinal central sections through portions of locomotive boilers, illustrating, respectively, modifications of structural detail.

Throttle valves applied in present standard locomotive practice are either of the double or the single seated poppet type, and are manually operated, through intermediate connections, by a throttle lever journalled on the outside of the back head of the boiler. The double seated valves are considerably out of balance, due to the difference of the areas of the two seats. In practice, the unbalanced pressure amounts to from 1000 to 1500 pounds, so that there will be no danger of the valve being accidentally jarred open. The throttle rod is usually one and one quarter inches in diameter, and the pressure which acts upon it, and tends to open the valve, is from 180 to 245 pounds. There is consequently about six times as much pressure tending to keep the valve closed as there is pressure tending to open it, and unless a large ratio of leverage is provided, the valve will be difficult to handle. It is frequently inconvenient to make the leverage ratio sufficiently great. In view of the difficulty of maintaining the accurate contact of the valve discs with the two seats, valves of this type have latterly given place to single seated poppet valves, which, being unbalanced and normally held to their seats by boiler pressure, it is necessary to relieve such pressure before they can be unseated, which is done by preliminarily admitting boiler steam below them by unseating a small so-called pilot valve, thereby establishing substantial equilibrium of pressures on their opposite sides, upon which they can be manually operated through connections similar to those of double seated valves. With either type of valve, however, the transverse sectional area of the throttle rod which extends to the outside operating lever, is subject to boiler pressure, and when the valve is seated, this pressure acts in opposition to the unbalanced pressure tending to hold the valve to its seat, but not to a sufficient extent to unseat the valve. This condition renders the opening movement of the valve a matter of difficulty. After the valve has been opened, the pressure in the steam delivery pipe acts to balance the valve, so that only its weight tends to close it. The pressure on the inner end of the throttle rod, tends to increase the valve opening, and if the teeth of the lever latch and quadrant are not in perfect condition, the valve will open further than is necessary or desirable.

In the operation of the locomotives using superheated steam, which practice is now becoming practically standard, it has been found of substantial advantage to admit a small quantity of steam to the cylinders, when drifting, instead of entirely shutting it off, in order to promote lubrication, for which purpose it is usual to crack, or slightly open, the throttle valve, so as to admit steam of low pressure, not exceeding, say, 15 to 20 pounds, to the cylinders. The high boiler pressure, which, in many cases, exceeds 200 pounds, tends to close the throttle valve, so that with worn teeth on the lever latch and quadrant, it is practically not possible to maintain the valve in slightly

open position. The resultant accidental and undesired closure of the throttle valve, causes damage to the distribution valve chests, the pistons, and the cylinders, due to the charring of the lubricant therein by the high temperature.

As ordinarily constructed, the throttle valves of stationary and marine engines are of the single seated poppet type, and are operated by a threaded stem, passing through a bonnet and engaging an exterior nut, and rotated by a hand wheel on the stem. The operation of a throttle valve of this construction is necessarily and obviously slow. Marine engines of sea going vessels are generally equipped with automatic governors, designed to control the speed of the engine within a determined limit, the purpose of their application being to prevent racing, when the propeller wheel is lifted out of the water by the pitching of the ship in heavy weather when the sea is very rough. None of these governors has been found to be entirely reliable, and they frequently become deranged and inoperative, in which case the speed of the engine must be controlled by manual operation of the throttle valve. Such control is very difficult, due to the frequency with which it must be exerted, and the comparatively slow movements of the screwed throttle valve stem, and the desirability of a quickly movable throttle valve has been fully recognized. The racing of a ship's engine imposes a heavy strain on the propeller shaft, which is a frequent cause of broken shafts and lost wheels, which accident leaves the ship at the mercy of the elements until remedial measures can be applied, with the risk of foundering in the meantime. Further, the desirability of a quickly movable throttle in manoevering a ship to avoid collisions and when docking, is obvious, and its advantage in stationary engines, in preventing damage when the load is suddenly relieved from the engine by broken bolts or shafts.

In the practice of my invention, the results of increased expedition in the adjustment of a throttle valve in different desired positions; its maintenance in adjusted position; and the reduction of manual power required to operate it, which the foregoing recital of the objections obtaining under the conditions of present practice indicate to be unquestioned desiderata, are attained by a method of operation which consists in substituting for the existing one of the direct exertion of the manual power of the operator, the following, to wit: the application to the throttle valve, as the motive power by which it is moved into and out of, and maintained in different desired positions, of the pressure of the fluid which said valve controls, and effecting and determining, in both direction and degree, such application of motive power, by the manual adjustment of an independent adjusting valve mechanism. My invention likewise comprehends mechanism for the practice of the above stated method, embodiments of which, adapted to practical operation, will now be described.

Referring first to Figs. 1 and 2, my invention is exemplified as applied in the operation of a throttle valve, 1, of the double seated poppet type, which is fitted to seat in a throttle box or chest, 2, supported, in the usual manner, in the steam dome, *a*, of a locomotive boiler, A. The throttle box is connected, by a stand pipe, 3, to a steam delivery or dry pipe, 4, leading to the cylinders of the locomotive, communication between the steam space of the boiler and said dry pipe being, as usual, controlled by the adjusted positions of the throttle valve. Said valve is fixed upon a stem, 1^a, which is coupled to the upper arm of a bell crank lever, 5, journaled on the stand pipe, 3, and the lower arm of said lever is coupled, by a throttle rod, 6, to an adjusting stem, 7, which passes through the back head of the boiler, A, and is coupled, at its outer end, by a pin, 8^a, to an adjusting lever, 8.

The adjusting stem, 7, is fitted to slide in a casing, 9, the inner end of which is of greater transverse sectional area than the unbalanced area of the throttle valve, and is open to boiler pressure, and the casing is bored out to two different diameters, the smaller, at and adjoining its inner end, and the larger, at and adjoining its outer end. The stem is surrounded by, and secured to, a sleeve, 7^a, upon which are fixed two pistons, 7^b, 7^c, fitting, respectively, in the larger and the smaller bores of the casing. The sleeve, 7^a, works, through a suitable stuffing box 9^a, on the outer end of the casing.

An adjusting valve, 10, on which are formed a larger piston, 10^a, and a smaller piston, 10^b, is formed on or fixed to a valve stem, 10^c, and is fitted to slide in a ported bushing, 10^d, fixed in the casing, 9. A longitudinal port, 10^e, extends through the adjusting valve. The outer end portion of the valve stem, 10^c, fits freely in a sleeve, 10^g, which is coupled, by a pin, 10^f, to one end of the adjusting lever, 8. The valve stem bears on the sleeve, 10^g, through the intermediation of a removable transverse key, 10^h, which, when the appliance is in condition for operation, is inserted, and held in position, between the outer end of the valve stem and the adjacent face of the sleeve, as clearly shown in Fig. 2. It will be seen that, under this construction, inward movement may be imparted to the valve stem by the adjusting lever, 8, but that it cannot be moved outwardly by said lever. An important function, which is performed by the provision of the removable

key, 10^h, is that of preventing malicious or unauthorized opening of the throttle valve, as, when said key is removed, which should be done whenever the locomotive is temporarily left under steam and unguarded, it will be impossible to open the throttle valve, for the reason that the inward movement of the sleeve, 10^g, effected by the movement of the adjusting lever, will not, when the key is removed, be sufficient to permit the sleeve to bear on the valve stem and impart inward movement thereto. A further feature of substantial practical value is presented in the fact that if a pin should drop out, or a connection break, the throttle valve would be immediately automatically closed, thus affording an effective safeguard against accident in such case.

A steam supply pipe, 11, leads from the steam space of the boiler into the space between the pistons, 10^a and 10^b, of the adjusting valve, and an exhaust pipe, 12, leads from the bushing, 10^d, to a suitable point of discharge, as to the atmosphere. A steam supply and exhaust passage, 11^a, extends from ports in the bushing to the bore of the casing in which the larger piston, 7^b, works, and a relief or drain passage, 12^a, extends from the annular space between the pistons, 7^b and 7^c, to a communication with the open end of the bushing, 10^d, adjoining the smaller piston, 10^b, of the adjusting valve. A quadrant, 13, fixed to the sleeve, 7^a, of the adjusting stem, is coupled therewith, by the pin, 8^a, to the adjusting lever, 8. A latch block, 14, is fitted to slide on the adjusting lever, and is adapted to be engaged with, and disengaged from the teeth of the quadrant by a latch handle, 14^a.

In the operation of the construction above described, when it is desired to open or unseat the throttle valve, 1, the adjusting lever, 8, is unlatched from the quadrant, 13, and swung outwardly or to the left in Figs. 1 and 2, in which movement it pivots on the pin, 8^a, as a fulcrum and moves the stem, 10^c, of the adjusting valve, 10, inwardly, thereby opening the passage, 11^a, to the exhaust pipe, 12, and exhausting pressure from the left hand side of the larger piston, 7^b, to the atmosphere. The boiler pressure acting upon the smaller piston, 7^c, thereupon moves said piston, and the connected throttle rod, 6, outwardly, and through the connection, thereof with the bell crank lever, 5, and throttle valve stem, 1^a, unseats the throttle valve. In this outward movement of the throttle rod and its connections, the preponderance of boiler pressure on the larger piston, 10^a, of the adjusting valve, 10, moves the stem, 10^c, and adjusting valve, 10, in the same direction. When the throttle valve has been unseated to the desired degree, which is determined by latching the lever to the quadrant the adjusting valve has moved into position to bring the passage, 11^a, into communication with the steam pipe, 11, thereby admitting steam to the left hand side of the larger piston, 7^b, which admission continues until the pressure on said piston balances that acting on the smaller piston, 7^c, and on the unbalanced portion of the throttle valve, and the weight of said valve and attached parts, when motion will be automatically arrested, and the throttle valve will be maintained at practically the desired unseated position. In seating the throttle valve, the cycle of operations will naturally be reversed, that is to say; the adjusting lever, 8, is unlatched, and swings inwardly, or to the right in Figs. 1 and 2, in which movement it withdraws the sleeve, 10^g, from its bearing on the key, 10^h, and outer end of the stem, 10^c, of the adjusting valve, 10. The latter being then free to move, is automatically moved outwardly by the preponderance of boiler pressure on its larger piston, 10^a, thereby opening communication from the steam supply pipe, 11, through the passage, 11^a, to the left hand side of the larger piston, 7^a, of the adjusting stem, the pressure thus admitted moving said piston to the right, and, through its connections with the throttle valve, seating said valve.

The unbalanced area of the adjusting valve is so small that the tendency to wear the teeth of the latch and quadrant is practically nil, while its effect is to take up constantly all lost motion in one direction, so that extreme delicacy of operation is attainable.

Figs. 3 to 5 inclusive illustrate structural modifications of means for the application of my invention, in each of which it is, without variation of operative principle, applied in connection with a single seated poppet throttle valve. As shown in Fig. 3, which illustrates a construction suited to marine or stationary engines, the throttle valve, 1^b, is fitted to seat in a throttle box or chest, 2^a, which is closed at its top, by a removable cap, 2^b, and to control communication between a main steam supply pipe, 4^a, leading from the steam space of a boiler, and a steam delivery pipe, 4^b, leading to an engine. A differential actuating piston, 7^d, the smaller diameter of which is greater than that of the throttle valve, 1^b, is formed integral with or fixed to, said valve, and is fitted to slide in a bored out section of the throttle box above it. An adjusting valve, 10^e, of the piston type, is fitted in a bushing, 10^g, fixed in a casing, 10^h, on one side of the throttle box, said valve being fixed to a stem, 10^c, and having an end piston, 10^b, an intermediate piston, 10^a, of greater diameter, and an opposite end piston, 10^i, of the same diameter as the intermediate piston. A longitudinal port, 10^e, extends through the valve, from the outer face of the piston, 10^b, to the space between the pistons, 10^a and 10^i, and a steam supply pipe, 11^b, connects the space between the pistons,

10^a and 10^i, with the main steam supply pipe, 4^a. A double armed floating lever, 15, which extends through a transverse passage in the throttle valve, and is pivoted on a pin, 15^a, fixed therein, is coupled, at one end, to the stem, 10^c, of the adjusting valve. The opposite end of the lever, 15, is coupled, by a rod, 16, to any suitable known manual operating mechanism (not shown) by which the lever may be moved about its pivotal axis as desired.

In the operation of unseating the throttle valve, which is normally held to its seat by the boiler pressure acting on the top of the actuating piston, 7^d, the adjusting valve, 10^o, is moved downwardly by the application of the manual power of the engineer to the operating mechanism to which the rod, 16, and floating lever, 15, are connected. This movement of the adjusting valve opens the ports leading through the bushing, 10^g, from the space above the piston to the interior of the bushing, and the steam in said space is thereby exhausted therefrom, through the longitudinal port, 10^e, of the valve, and released to the atmosphere through the exhaust pipe, 12. The throttle valve then becomes subject to the upward pressure of the boiler steam upon the excess area of the actuating piston, 7^d, by which it is unseated to the degree desired, which is governed by the movement of the adjusting valve upwardly by the floating lever, as in the construction first described. In seating the throttle valve, the adjusting valve is manually moved upwardly by the operator, thereby closing the space above the piston, 7^d, to the exhaust and admitting boiler steam thereto, the pressure of which, acting on the larger diameter of the piston, seats the throttle valve.

Fig. 4 shows another structural modification, in which a single seated poppet valve, 1^c, is, as in the construction shown in Fig. 1, seated in a throttle box, 2, supported in the dome, *a*, of a locomotive boiler, A, and communicating, by a stand pipe, 3, with the dry pipe, 4, leading to the locomotive cylinders. The throttle valve is formed on, or fixed to, a tubular stem, 1^d, the lower end of which is connected to a differential actuating piston, 7^b, the largest diameter of which is greater than that of the throttle valve, and which is fitted in a piston chamber, 2^b, cast on the lower portion of the throttle box, and closed by a removable head, 2^c. An adjusting valve, 10^k, comprising two pistons, 10^m, 10^n, connected by an intermediate body of smaller diameter, through which and through the pistons, there extends a longitudinal port, 10^e, and a stem, 10^c, is fitted to slide in a casing, 10^h, on the side of the throttle box. The actuating valve controls ports leading from its casing into the piston chamber, 2^b, and the outer end of its upper piston is open to boiler pressure. The spaces in the casing between the pistons of the actuating valve, and at the top of its stem, are connected with an exhaust pipe, 12, leading to a suitable point of discharge to the atmosphere. The throttle valve stem, 1^d, is coupled by a link, 17, to one end of a double armed lever, 18, journalled on the throttle box, and the opposite end of said lever is coupled, by a link, 19, to a floating bell crank lever, 5^a, one arm of which is coupled to the actuating valve, and the other to a throttle rod, 6, extending through the boiler to an external throttle lever of any suitable form, which is not shown.

In unseating the throttle valve, the cycle of operation is similar to that of the construction last above described, that is to say, the adjusting valve, 10^k, is first raised by inward movement of the throttle rod, 6, effected by the manual action of the engineer, the resultant movement of the adjusting valve, through the floating bell crank lever, 5^a, admitting boiler steam to the larger face of the actuating piston, 7^b, the pressure upon which thereupon unseats the throttle valve to the desired degree, determined by the movement of the throttle lever. The throttle valve is maintained in adjusted position by the pressure on the actuating piston, and when it is desired to close it, the throttle lever and throttle rod are moved outwardly, thereby lowering the adjusting valve to slightly below the position shown in Fig. 4, when steam will be exhausted from the actuating piston, and the throttle valve will be seated by its own weight and that of the connected piston, and the pressure above it.

The further structural modification illustrated in Fig. 5, accords generally with the construction last described, varying therefrom in the following comparatively minor details. The adjusting valve, 10^k, is in this instance, fitted in the actuating piston, 7^b, instead of in a casing exterior thereto as in Fig. 4. It comprises a larger piston, 10^m, and a smaller piston, 10^n, and is continuously open, at its upper end, to the steam space of the boiler, through the tubular stem, 1^d, of the throttle valve, 1^c, which pressure acts also upon its lower end, through the longitudinal port, 10^e, which extends from end to end of the valve. An exhaust port, 12^a, extends through the piston, 7^b, from the space between the pistons of the adjusting valve to the exhaust pipe, 12. The adjusting valve, 10^k, is coupled, by a link, 17, to one end of a double armed lever, 18, journalled on the throttle box, 2, and the opposite end of said lever is coupled, by a link, 19, to a bell crank lever, 5, which, instead of being of the floating type, as in Fig. 4, is journalled, by a pin, 5^b, on the casing, 2^b, of the actuating piston. The

adjusting valve is manually movable, and its floating seat, with the throttle valve, follow it.

The operation of this construction corresponds, in all essential particulars, with that of the constructions illustrated in Figs. 3 and 4, and need not, therefore, be described.

It should be noted that in all the applications of my invention, the adjusting valve is to be so designed, as to its areas, that, in the event of breakage of the operating mechanism, it will take a position to automatically close the main throttle valve.

I claim as my invention and desire to secure by Letters Patent:

1. The improvement in the method of actuating a throttle valve, which consists in moving said valve in different desired directions, by the application of the fluid pressure which it controls, imparting such motive force to the throttle valve by the manual operation of an adjusting valve mechanism, and maintaining the throttle valve in adjusted position by the automatic action of the adjusting valve mechanism.

2. The improvement in the method of actuating a throttle valve, which consists in moving said valve into and out of different desired positions, by the action upon it of the fluid supply pressure which it controls, controlling such motive force, in direction and degree, by the manual operation of an adjusting valve mechanism, and maintaining the throttle valve in adjusted position by the automatic action of the adjusting valve mechanism.

3. The improvement in the method of actuating a throttle valve, which consists in moving said valve into and out of different desired positions, by the action upon it of the fluid pressure which it controls; controlling such motive force in direction and degree, by the manual operation of an adjusting valve mechanism; and maintaining the throttle valve in adjusted position by the automatic action of the adjusting valve mechanism.

4. The combination, with a throttle valve, of an actuating piston, connected thereto; an adjusting valve, controlling the supply and exhaust of motive fluid to and from the actuating piston; means for manual adjustment of the adjusting valve, and means for the automatic adjustment of said valve.

5. The combination, with a throttle valve, of an actuating piston, connected thereto; a differential piston adjusting valve, controlling the supply and exhaust of motive fluid to and from the actuating piston, said adjusting valve having a longitudinal port; a fluid supply pressure pipe, opening between the pistons of the adjusting valve; a fluid pressure exhaust port, communicating with the longitudinal port of said adjusting valve; and means for manually operating the adjusting valve.

6. The combination, with a steam boiler, of a throttle valve; a throttle rod coupled thereto; a casing, secured to the exterior of the boiler, and open, at its inner end thereto; an actuating stem, fixed to the throttle rod and extending through said casing; a throttle lever, coupled, intermediate of its ends, to said stem; a piston fixed on said stem, and continuously exposed to boiler pressure; a piston, of larger diameter, fixed on said stem; a differential piston adjusting valve, fitted to the casing, and controlling the admission and exhaust of steam to and from the larger piston of the actuating stem; a sleeve, fitting freely on the stem of the adjusting valve; a pivot pin, coupling the throttle lever to said sleeve; a toothed quadrant, fixed on the actuating stem; and a toothed latch block, adapted to slide on the throttle lever, and engage the teeth of the quadrant.

7. The combination, with a throttle valve, of an actuating piston, connected thereto; a differential piston adjusting valve, controlling the supply and exhaust of motive fluid to and from the actuating piston; a stem on which said adjusting valve is fixed; an adjusting lever, coupled to the actuating piston; a sleeve, coupled to said lever and fitting freely on the stem of the adjusting valve; and a removable key, fitted in said sleeve and transmitting pressure therefrom, in one direction only, to the adjusting valve.

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