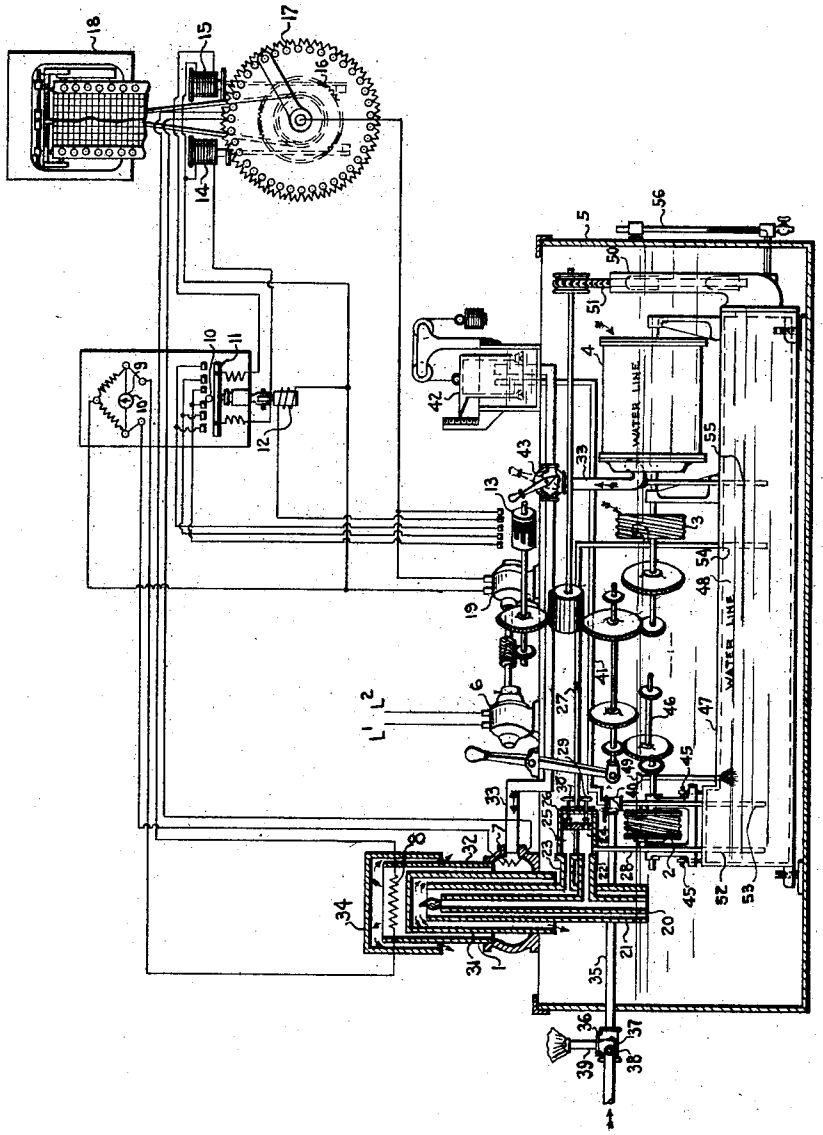
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METHOD OF AND APPARATUS FOR ASCERTAINING THE RELATIVE CAPACITIES OF PUMPS AND THE LIKE

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METHOD OF AND APPARATUS FOR ASCERTAINING THE RELATIVE CAPACITIES OF PUMPS AND THE LIKE

Original application filed January 28, 1921, Serial No. 440,616. Divided and this application filed June 8, 1927. Serial No. 197,418.

This invention relates to methods of and apparatus for ascertaining the relative capacities of pumps and the like and for adjusting said capacities accordingly.

This application is a division of my copending application Serial No. 440,616, filed January 28, 1921, which has resulted in Patent No. 1,662,802, dated March 13, 1928.

An object of the invention is to facilitate the testing of pumps purporting to be of certain relative capacities in order to ascertain from time to time whether the same adhere to their standard of operation, and to provide for ready and accurate adjustment to compensate for possible errors disclosed by such testing.

Other objects and advantages of the invention will hereinafter appear.

To this end the invention may be said to consist essentially of apparatus for ascertaining the relative capacities of pumps and the like comprising means for driving the pumps at constantly proportioned rates and means for automatically comparing the quantities of substance handled by the pumps respectively.

An embodiment of the invention as applied to the testing of pumps adapted to deliver respectively test gas, combustion air and cooling air to a gas calorimeter, is illustrated in the accompanying drawing and the same will now be described it being understood that the invention illustrated is susceptible of various modifications without departing from the scope of the appended claims.

This drawing illustrates a calorimeter which, in its general features is similar to that described in connection with my aforementioned Patent No. 1,662,802. Thus test gas combustion air and cooling air are supplied under like conditions of pressure, temperature and saturation, and in regulated proportions by volume, to a burner for combustion of the gas and combustion air and absorption by the cooling air of the heat so liberated. Resistance thermometers or the like, are arranged in the stream of cooling air to be subjected respectively to the temperature of the latter before and after the heat exchange, said resistance thermometers being connected in a Wheatstone bridge having associated devices arranged to be influenced thereby for operating a suitable instrument to indicate the heating value of the test gas.

A constant volumetric proportioning of the test gas and cooling air is maintained, the combustion air being also constantly proportioned to effect complete combustion of the gas. Any variation in heating value of the test gas thus tends to cause variation in the temperature difference of the resistance thermometers and such variation is utilized to actuate a rheostat in a manner to restore the balance of the Wheatstone bridge, the degree and character of the rheostat regulation thus effected being indicated by the recorder.

Referring to the drawing the same illustrates an associated gas burner and heat exchange device indicated generally at 1, both of said elements being of special construction. The three fluids aforementioned are supplied through suitable conduits to said device by means of pumps including a gas pump 2, a combustion air pump 3 and a cooling air pump 4, and preferably comprising separate wet displacement meter structures having a common liquid seal comprising water or other liquid contained within a tank 5. Said pumps are further adapted to be power driven at speeds bearing a constant ratio to one another by means of a suitable motor 6.

Resistance thermometers 7 and 8 are so associated with the device 1 as to be subjected respectively to the temperature of the cooling fluid before and after the heat exchange. Said resistance thermometers are utilized in a Wheatstone bridge to control a galvanometer 9, having associated with its needle 10 a switch 11 having an operating solenoid 12 which serves in conjunction with a contact drum 13, to be driven by the motor 6, to control the operating electro-magnets 14 and 15 of a ratcheting mechanism 16. Said ratcheting mechanism in turn is utilized for varying the resistance of an adjusting rheostat 17 connected with the Wheatstone bridge. Also a recorder 18 is operatively connected with the driven member of said rheostat whereby

the former serves to indicate and record the degree and character of the rheostat adjustments required to maintain or restore the balance of the Wheatstone bridge upon variation in heating value of the test gas, the indications of the recorder thus constituting an accurate measure of such value of the gas.

In practice the motor 6 is preferably supplied from a suitable source L^1 L^2 either of direct or alternating current, whereas the Wheatstone bridge and its associated devices, including the operating electro-magnets for the ratcheting device, are supplied with direct current from any suitable source such as D. C. generator 19 driven by the motor as illustrated. The aforedescribed instrumentalities are adapted to function in general precisely as in said prior patent and since no broad novelty of such method or apparatus is claimed herein no further description of such instrumentalities is deemed necessary.

It is to be observed that the aforedescribed constant volumetric proportion of the several fluids will be maintained only if the relative capacities of the individual pumps continue unchanged, whereas owing to corrosion of the material of any of the pumps or to deposits of tar or other gas constituent within the gas pump such relative capacities of the pumps tend to vary from time to time to an extent which might if uncorrected tend to introduce serious error into the indication or recording of the device.

For this reason the means to be now described are provided for checking the relative capacities of the gas and cooling air pumps, these being the two for which constant relative capacities are particularly important, the two air pumps, moreover, being subjected to substantially similar conditions and therefore having less tendency to vary with reference to one another. It is, however, to be understood that similar means may, if desired, be provided for checking the relative capacities of the air pumps.

In practice the cooling air pump is ordinarily of considerably larger capacity than that of the gas pump and is driven at a materially higher speed than the latter, owing to the relatively large volume of air required to absorb the heat of combustion of the gas without an inconveniently large rise in temperature of such cooling fluid, whereas in the present device the speed ratio of said pumps is maintained constant during normal operation. However, for the purpose last described, a change speed transmission device is provided whereby the relative speed of the two pumps may be so far changed as to render the volumetric rates of delivery of said pumps presumptively equal. The fluid connections of the respective pumps are also commutated to cause both pumps to act upon the same body of fluid, preferably air, and suitable indicating means are employed for ascertaining the relative rates of action of said pumps, whereby if the speed ratio be maintained constant the relation of such rates of action upon the same body of fluid constitutes a measure of the relative capacities of the pumps.

In practice the illustrated system of slidable gears may be employed for reducing the speed of the air pump and increasing the speed of the gas pump to the necessary degree to render the rates of delivery of the two pumps equal providing that no change in the relative capacities thereof has occurred. Further the gas intake conduit 35 is provided with a three-way valve 40 controlling a branch passage 41 leading to the interior of a gasometer 42 which is balanced to atmospheric pressure. The cooling air conduit 33 is likewise provided with a three-way valve 43 or the like whereby the delivery side of the cooling air pump may be likewise connected with the interior of the gasometer. Under these conditions upon operation of the pumps the cooling air pump serves to force air into the gasometer while the gas pump serves simultaneously to exhaust air therefrom. Thus any difference in the rates of action of the two pumps upon the air will result in a change of volume of air within the gasometer bell with a consequent vertical movement of the latter in accordance with the character and degree of such difference, the degree of such movement of the bell being indicated upon the illustrated scale. Said scale is preferably calibrated so as to indicate percents of error in the indication of the complete device, upon the pumps being operated to a given extent, whereby in testing or comparing similar complete devices whose indications differ to a known degree, the portion of such difference, that is to say, the error of one device assuming the other as a standard which is due to the foregoing cause is at once ascertainable.

In practice the aforementioned given extent of operation of the pumps is preferably such as to involve one or more exact revolutions of the cooling air pump thereby eliminating possible error due to unequal capacities of different portions of the pump. The corresponding relatively large number of revolutions of the gas pump ordinarily serves to obviate similar errors due to like condition of said latter pump.

Since as aforestated, the gas pump is the one having the greater tendency to change its internal capacity during service, the means now to be described are provided for adjusting said pump to correct for variations in its capacity as disclosed by the foregoing test, it being of course understood that the other pumps may be provided with similar adjusting means if desired. In practice such

rality of adjusting screws 45 which provide for raising or lowering the gas pump bodily within the tank whereby a greater or lesser portion of its internal volume is brought above the level of the sealing liquid, and the desired pumping capacity regulation is effected.

Also the foregoing parts are preferably so correlated that during the aforedescribed adjustment of the said gas pump the same is adapted to swing substantially in an arc about the center of the said drive shaft 46 whereby proper co-action of the intermeshing gears is maintained under all conditions.

In the operation of the complete device, it is desirable that the level of the sealing liquid be maintained substantially constant with reference to the height relation of the several pumps thereto since any material variation in such relation tends to impair the accuracy of the results indicated. Also it is of importance to provide for draining the various fluid conduits of sealing liquid or other substances which may be condensed from or otherwise deposited by such fluids between the individual pumps and the device 1.

To such end an auxiliary reservoir is provided within the main liquid tank and adapted to contain a separate reserve supply of sealing liquid.

In practice the aforedescribed pumps are preferably mounted upon a common support 47 located within the tank and provided with an internal chamber 48 to contain such reserve fluid, the level of fluid within such chamber being maintained somewhat below that of the tank. A weir 49 serves to connect the interior of said tank with the interior of said chamber and also to determine the height of liquid within the former. Said support is further provided with a tubular portion 50 extending upwardly above the level of liquid in the tank and serving to connect the chamber 48 with atmosphere. A chain and bucket 51, or other preferred type of pump is arranged preferably within the extension 50 and adapted to be driven by the motor 6 for conveying continuously from the chamber 48 to the tank a quantity of fluid somewhat in excess of that which is lost from the tank due to evaporation and other causes. The excess of liquid so supplied to the tank is adapted to flow back into the chamber by means of the weir 49. Also the several fluid conduits are provided with self draining tubes 52, 53, 54 and 55 extending within the chamber 48 and terminating below the surface of the liquid therein for sealing thereof. Liquid may be introduced into the chamber 48 through the extension 50 at any time, a gauge glass 56 or the like being preferably provided for indicating the height of liquid therein. No definite height of liquid within the chamber need be maintained, provided the quantity of such liquid be sufficient to provide for continuous operation of the pump 51 and also provided the level of liquid within the aforedescribed drain pipes be maintained well below the seals of the gaseous fluid pumps.

What I claim as new and desire to secure by Letters Patent is:

1. The method of ascertaining the relative capacities of displacement pumps, which comprises simultaneously operating a plurality of such pumps at constant relative rates of speed, causing said pumps to act in series upon a common body of fluid, and ascertaining the relative difference in quantities of the fluid handled by the pumps respectively during a given period of operation thereof.

2. The method of ascertaining the relative capacities of fluid pumps and the like, which comprises operating the same at constantly proportioned rates, such as to render the quantities of fluid handled thereby approximately equal, interconnecting the intake of one of said pumps with the delivery of another of said pumps, and ascertaining the difference in quantity of fluid handled by the pumps respectively.

3. The method of ascertaining the rate of delivery of a fluid pump which comprises causing said pump and a standard pump to act in series upon the same body of fluid, a fixed speed ratio of said pumps being maintained, and ascertaining the character and value of any consequent differential action of said pumps.

4. Apparatus for ascertaining the relative capacities of pumps and the like comprising means for simultaneously driving said pumps at constant relative rates of speed, means for causing said pumps to act in series upon the same body of fluid, and differentially operated pressure responsive means associated with said pumps for continuously indicating the proportional difference in quantities of such fluid handled by the pumps respectively during a given period of operation thereof.

5. Apparatus for ascertaining the relative capacities of pumps and the like comprising means for driving the pumps at constantly proportioned rates of speed, means for causing said pumps to act in series upon the same body of fluid, and means associated with said pumps for automatically indicating the relative difference in quantities of such fluid handled by the pumps respectively during a predetermined period of operation thereof.

6. Apparatus for ascertaining the relative capacities of pumps and the like comprising means for driving said pumps at constant relative rates such as to render the quantities of substance handled thereby approximately equal, means to interconnect said pumps for causing the same to act in series upon the same body of fluid and means to be included in said latter means for ascertaining and indicating differences in the rates of action upon such fluid by the respective pumps.

7. Apparatus for ascertaining the relative capacities of pumps and the like comprising means for driving said pumps at constant relative rates such as to render the quantities of substance handled thereby approximately equal, means to interconnect said pumps for causing the same to act in series upon the same body of fluid, a differential fluid pressure meter to be included in the connection between said pumps and having a part adapted to move in accordance with the character and degree of difference in rates of action upon such body of fluid by the respective pumps, and means for indicating the character and degree of movement of said part.

8. In apparatus for relatively adjusting the capacities of a plurality of wet displacement pumps having a common liquid seal, the combination with means for maintaining substantially a constant height of such seal with reference to the height of said pumps of means for effecting vertical adjustment of certain of said pumps relatively with reference to said seal.

9. The combination with a fluid pump of the wet displacement type and provided with a liquid seal, of means for maintaining substantially a constant height relation between said pump and the surface of said seal, comprising a support for said pump located within the body of said seal and having a chamber to contain a reserve supply of sealing liquid, a weir to connect said seal with the interior of said chamber for determining the height of liquid of the seal and a pump to be operated continuously for conveying liquid from said chamber to said seal.

10. The combination with a fluid pump of the wet displacement type and provided with a liquid seal and a delivery conduit passing below the surface of said seal, of a support for said pump located within the body of said seal and provided with a chamber containing a reserve supply of sealing liquid to be maintained at a level below that of said seal, said chamber having a hollow extension projecting above the level of said seal, a pump to act continuously for transferring liquid through said extension to said seal, means providing a return flow of liquid from said seal to said chamber and a drain to connect said delivery conduit with said chamber.

11. The combination with a plurality of wet displacement pumps normally adapted to act upon different fluids respectively, the normal capacities of which pumps are definitely proportioned relatively to each other, of common driving means for said pumps, and means for ascertaining relative variations in the normal capacities of said pumps, said means comprising change speed gearing for effecting operation of said pumps jointly at rates of speed inversely proportional to the normal capacities thereof respectively, means to interconnect said pumps for causing the same to act in series upon the same body of fluid, and means to be included in said latter means for ascertaining and indicating differences in the rates of action upon such fluid by the respective pumps.

In witness whereof I have hereunto subscribed my name.

HORACE N. PACKARD.