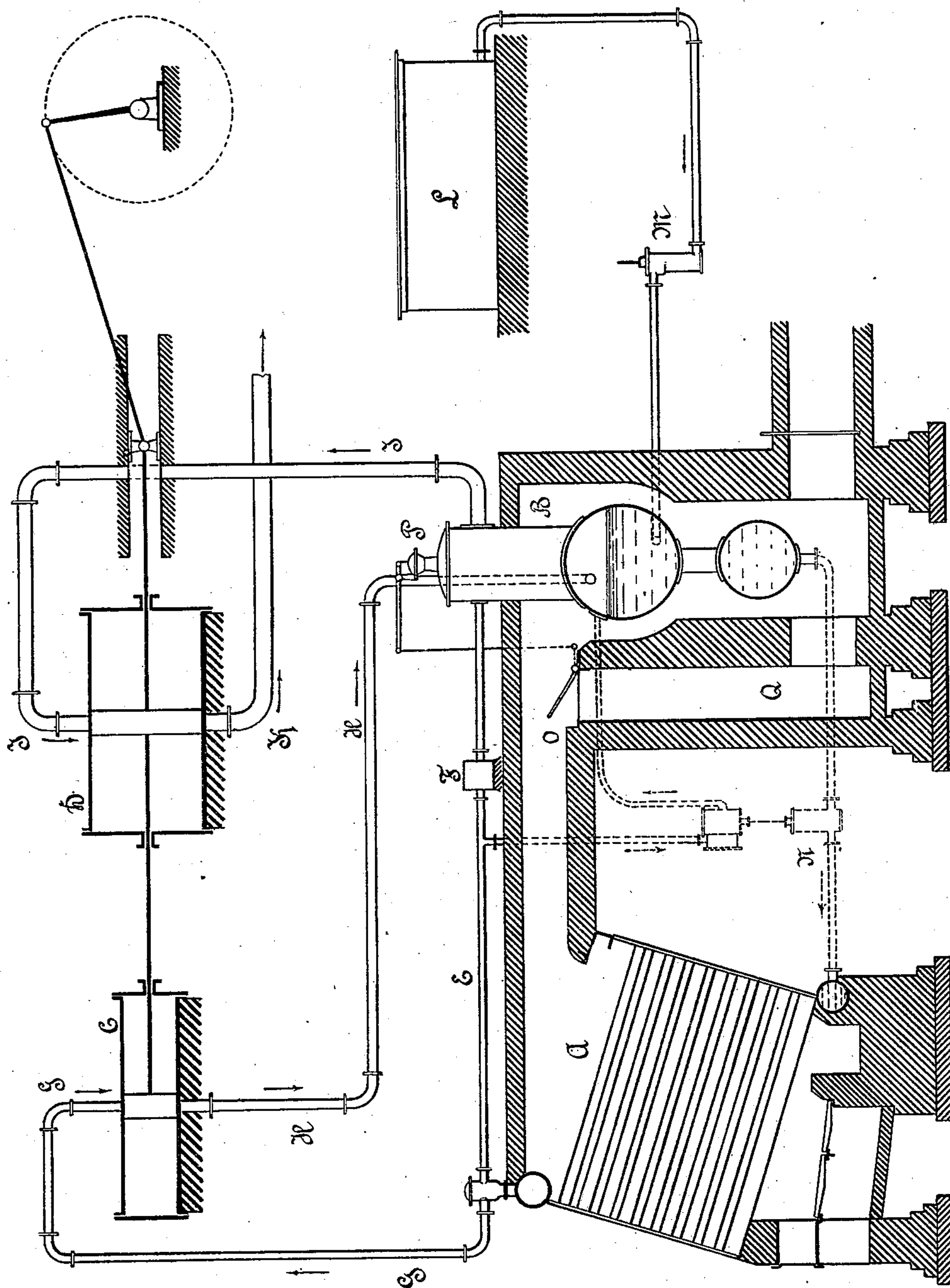


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Compound-Engine.

No. 226,405.

Patented April 13, 1880.



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UNITED STATES PATENT OFFICE.

KONRAD W. JURISCH AND JOHN H. LEWIS, OF WIDNES, ENGLAND, AND
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SAXONY.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 226,405, dated April 13, 1880.

Application filed June 3, 1879.

To all whom it may concern :

Be it known that we, Dr. KONRAD WILHELM JURISCH and JOHN HENRY LEWIS, both of Widnes, England, and Dr. WILHELM RUDOLPH PROELL and CARL JOSEPH SCHAROWSKY, both of Dresden, Saxony, have invented certain Improvements in Steam-Engines, of which the following is a specification.

This invention relates to an improved system of steam-engines, by which steam of very high pressure is utilized more advantageously than hitherto, and which allows the same to be generated with greater regularity in so-called "safety-boilers."

It is well-known that steam of high pressure presents material advantages with regard to an economical utilization of the heat which it contains; but when the pressure exceeds certain limits the boilers, if made of cylindrical shape, become excessively heavy, and are nevertheless insecure in respect to danger from explosion. If, on the other hand, a safety-boiler consisting of a number of externally-heated tubes or sections of other shape is used, the space for water as well as for steam is reduced to such an extent that it is practically impossible to maintain the steam at a uniform pressure whenever any variations in the resistance of the engine occur.

The object of the present invention is, now, to regulate the generation and the pressure of steam in a boiler of the latter class by combining with it, in a special manner, a second boiler or reservoir of comparatively large size, and containing an amount of water and steam which is adequate to compensate for the deficiency in the high-pressure boiler, the steam in the second boiler being of a lower pressure than in the first one. For this purpose the steam from the high-pressure boiler is caused to act expansively in a high-pressure cylinder, and thereupon to exhaust into the second boiler. Hereafter the steam is utilized in a second cylinder in the usual manner.

This combined system of boilers and cylinders is represented in general outlines in the drawing.

A is the high-pressure tubular safety-boiler;

B, the steam and water reservoir or boiler, containing steam of a pressure equal to, say, one-half the pressure in A, and which we shall henceforth simply call the "low-pressure boiler." This boiler may be of any suitable shape, and under certain circumstances it may even be designed on the principle of safety or tubular boilers. In general, however, we prefer to make the same of simple cylindrical shape, or as shown in the drawing.

C is the high-pressure, and D the low-pressure, cylinder, the latter being of larger size than the former. The two pistons are or may be connected with each other by a piston-rod, from which motion is transmitted by a connecting-rod to a crank-shaft.

The steam from the boiler A passes by pipe G to cylinder C; but only so much steam is admitted that, after having expanded, it may have the tension of the steam in boiler B. It is thereupon exhausted by pipe H into this boiler, where it mixes with the steam contained in the same, and is subsequently utilized expansively in cylinder D in the ordinary manner. From D the expanded steam passes off into the atmosphere or into a condenser.

Under ordinary circumstances the low-pressure boiler B is heated from the outside by the combustion-gases passing off from boiler A; but, if preferred, it may have a grate of its own. Nevertheless, it is not, strictly speaking, a steam-generator, as the heat applied to it mainly serves to raise the temperature of the feed-water supplied by pump M. A part of the heat necessary for this purpose is, however, obtained by condensation of a certain amount of the steam entering into the boiler from cylinder C.

In certain cases it may be preferable not to heat the said boiler from the outside at all, but to maintain the water which it contains at the temperature of its contents of steam by supplying it with a certain surplus of steam from the high-pressure boiler. In this case it is simply a steam and water reservoir in which no generation of steam takes place.

The manner in which the low-pressure boiler B regulates the tension of steam in the high-

pressure boiler A will be understood from the following considerations: When the resistance which the engine has to overcome is temporarily increased an additional quantity of steam will be required for overcoming such increase. 5 This quantity may be supplied entirely or for the greater part from boiler B, which holds a large amount of steam in reserve. Moreover, the water contained in B will generate steam 10 by its own heat as soon as the pressure to which it is exposed begins to decrease. Let it be supposed, on the other hand, that the resistance decreases, and that, in consequence, the consumption of steam falls below the average. 15 In this case the large steam-space in boiler B is adapted to retain the surplus of steam with comparatively small increase of pressure, and, besides, the water, being subjected to such increase, however slight, will, 20 on account of its large quantity, take up a material amount of heat from the steam, whereby a portion of the latter is condensed.

For the purpose of causing the variations in the consumption of steam to act entirely or 25 chiefly upon the low-pressure boiler, the engine is provided with a self-adjusting expansion-gear, which either regulates the admission of steam to the low-pressure cylinder only, or which causes such admission to be 30 varied to a greater extent than the admission to the high-pressure cylinder.

It is evident that by the described arrangement fluctuations in the consumption of steam from the high-pressure boiler will be moderated in comparison to the fluctuations which 35 would otherwise ensue, and that consequently the steam-pressure within the same will be maintained far more uniform than otherwise.

In case the pressure in boiler B should fall 40 below a certain degree it may be considered necessary to allow the boiler A to make up for the deficiency. For this purpose both boilers have been connected with each other by a pipe, E, in which a pressure-regulator is inserted, which allows steam to pass from A 45 into B whenever the fixed lowest degree has been attained.

When the pressure in boiler B rises above the average the valve O is opened by a regulator, P, consisting of an elastic corrugated 50 disk or other appliance, designed on the principle of common steam-gages, the combustion-gases being thereby compelled to pass partly or entirely into the flue Q, instead of circulating around the boiler. 55

The low-pressure boiler B is fed, in ordinary manner, with water from the condenser or from a tank or feed-water heater, L, by the pump M, while boiler A is supplied with water from 60 boiler B by a pump, N. The latter arrangement affords the advantage that boiler A receives feed-water of a very high temperature—*i. e.*, of the temperature of the steam in B. If it should, however, be preferred under certain circumstances, the feed-water for the 65 boiler A may be obtained from any other source.

As the regularity of the generation of steam in boiler A is promoted by causing the same to be fed continuously with water from boiler B, we prefer to make the feed-pump N of 70 such a size that it may work without interruption; and, in analogy to the mode of using the steam in the high-pressure cylinder C, the steam for this pump should also be taken from boiler A and exhausted into boiler B, so that 75 no steam may be lost.

The cylinders C and D may either be combined in the manner shown by the drawing, or they may belong to two separate engines, or to engines coupled by a common crank- 80 shaft.

Moreover, instead of using but two boilers and two cylinders, three or more boilers may be employed, each containing steam of a lower pressure than the preceding one of the series, 85 and each being combined with a separate cylinder. The steam, after having acted in the first and second cylinder, as described, is in this case exhausted from the latter into the third boiler, whereupon it operates in the third 90 cylinder, &c.

It would also be possible to use a set of two or more cylinders with each boiler, or two or more boilers containing steam of the same pressure with any one of the cylinders or sets 95 of such.

An arrangement of boilers and cylinders apparently similar to the one described has already been applied by I. Frost in the year 1841, according to the American patent specification No. 2,323. Frost's invention, how- 100 ever, is different from ours precisely in the point which constitutes the nature and the importance of the latter. The high-pressure boilers which we combine with other boilers 105 or reservoirs containing a comparatively large quantity of steam and water are the high-pressure tubular or sectional boilers, (so-called "safety-boilers,") a system of boilers which was not at all in use when Frost took out his 110 patent.

According to Frost's specification, the two reservoirs of lower steam-pressure are supplied with a small quantity of water for conversion into steam, and, moreover, according 115 to the drawing, the greater part of the reservoirs is filled with steam, the quantity of water which they contain being but small. The reservoirs can therefore only serve to restore to the steam more or less heat which it has 120 lost during its operation, and to evaporate a certain additional amount of steam. In our invention, on the contrary, the low-pressure boilers or reservoirs not only present a large steam-space, but they also contain a relatively 125 large quantity of water, (in general, much more than the high-pressure boiler,) and it is especially this large quantity of water by which the object of the invention is attained—*i. e.*, the regulation of the generation and the pressure of steam in the high-pressure boiler. 130

By our combination we obviate the difficulty

hitherto encountered of providing for a sufficiently large space for steam and water when high-pressure steam is to be generated.

In a higher degree even than the arrangement of Frost, the one described in the English patent specification No. 1,386, A. D. 1860, differs from our invention. The system of tubes inserted, in this case, between two successive cylinders serves solely for the purpose of reheating the steam passing from one cylinder to the other. The specification states nowhere that the apparatus is to contain water or to fulfill any other purpose besides the one mentioned.

It may yet be observed that the described steam-engine system presents certain similarities with the system described in the specification of the English Patent No. 3,462, A. D. 1877, granted to two of us—viz., to K. W. Jurisch and J. H. Lewis; but there is a material difference in the two systems, inasmuch as in the one described in the said specification an exhausting-cylinder is applied for extracting steam from the low-pressure cylinder and forcing a part of it back into the low-pressure boiler, while in the present system there is no exhausting-cylinder, and all the steam from the low-pressure cylinder passes off into the atmosphere or into a condenser. Besides, in the former system the high-pressure cylinder is used for working the piston of the said exhausting-cylinder, whereas in the new arrange-

ment it is called upon for doing useful work directly.

We claim as our invention—

A high-pressure tubular or sectional boiler, (so-called "safety-boiler,") or boilers of this kind, and one or more other boilers or steam and water reservoirs, or sets of such boilers or reservoirs, each containing, in succession, steam of a lower tension and a larger quantity of water than the preceding one, or than the high-pressure boiler, in combination with as many steam-cylinders or sets of cylinders as there are boilers or reservoirs, or sets of such, as and for the purpose described.

In testimony whereof we have signed our names to this specification in the presence of the subscribing witnesses.

DR. KONRAD WILHELM JURISCH.
JOHN HENRY LEWIS.
DR. WILHELM RUDOLPH PROELL.
CARL JOSEPH SCHAROWSKY.

Witnesses as to the signatures of Dr. K. W. Jurisch and J. H. Lewis:

FRED. CRIPPS,
IBBENON CRIPPS,
Both of Liverpool.

Witnesses as to the signatures of Dr. W. R. Proell and C. J. Scharowsky:

ANSEL POLSTER,
GUSTAV PRESSPRICH,
Both of Dresden.