E. BROWN & J. BAASCH.

STEAM TURBINE INSTALLATION.

APPLICATION FILED AUG. 31, 1911.

1,047,740.

Patented Dec. 17, 1912.

2 SHEETS—SHEET 1.

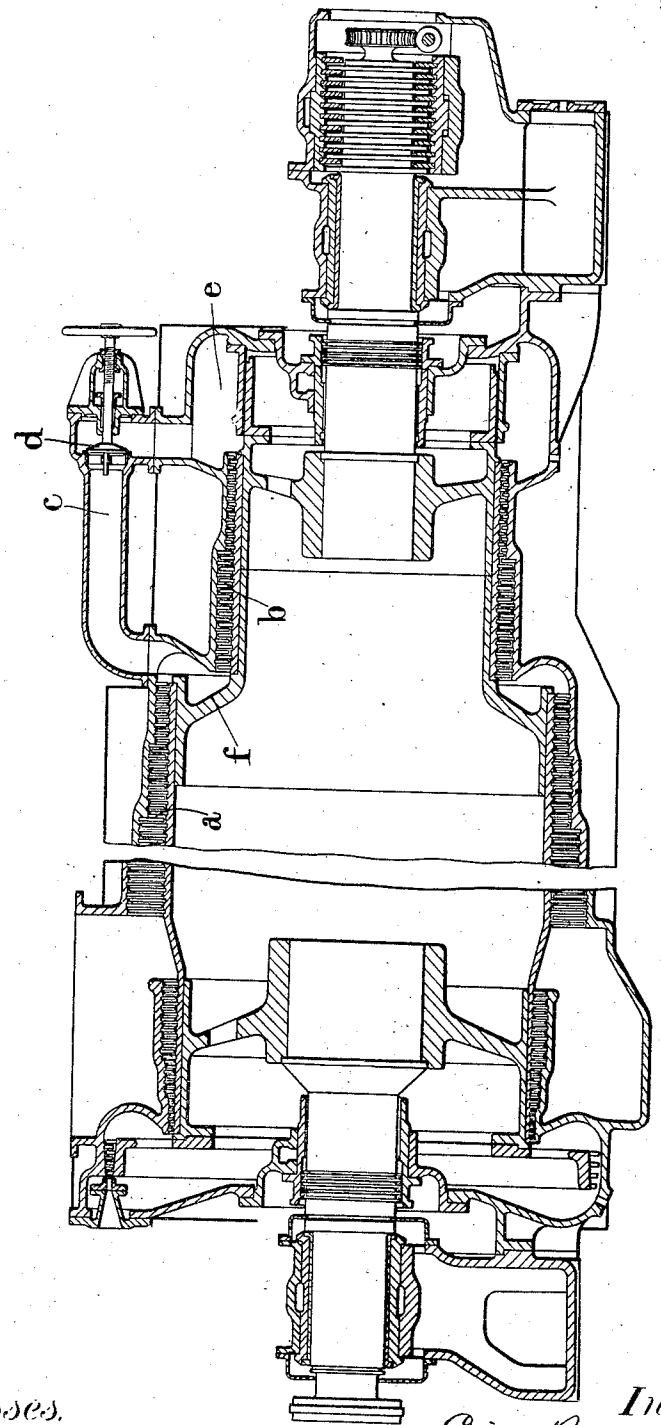

Fig. 1.

Witnesses.
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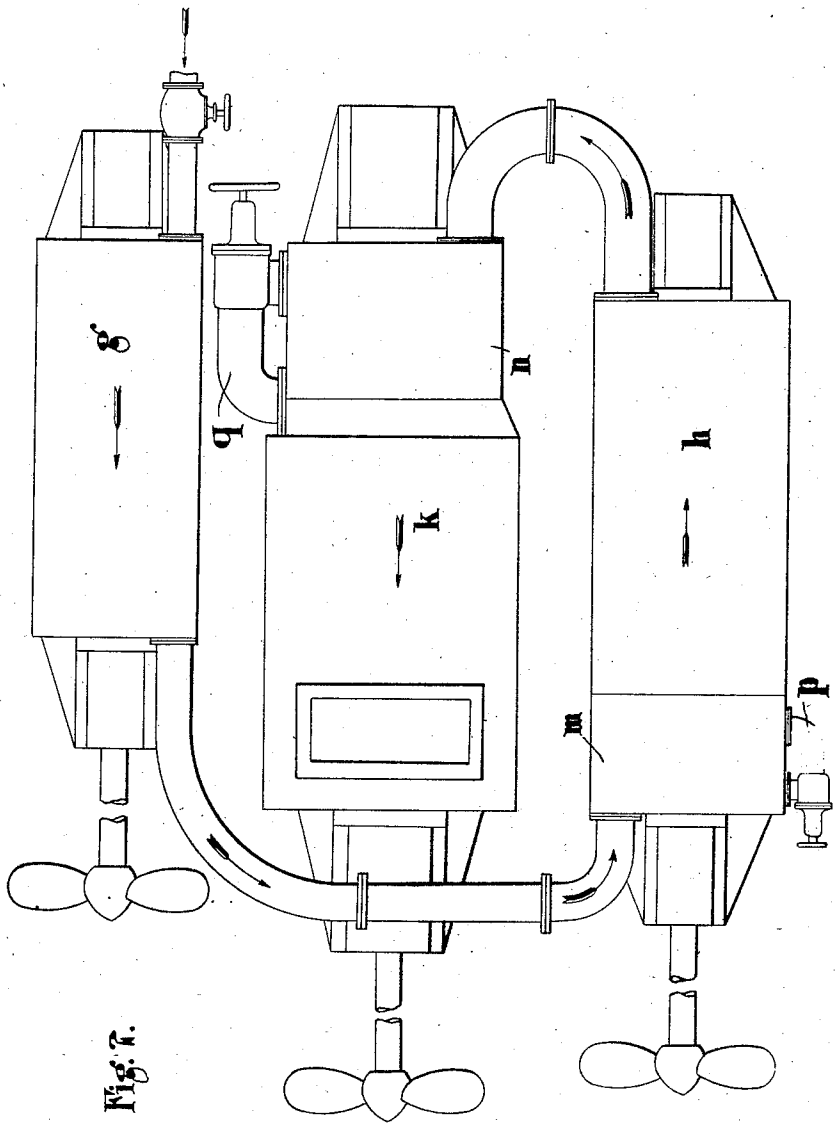

Fig. 2.

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UNITED STATES PATENT OFFICE.

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STEAM-TURBINE INSTALLATION.

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To all whom it may concern:

Be it known that we, ERIC BROWN, of Bahnhofweg, Baden, Switzerland, and JOHANN BAASCH, of Bruggerstrasse 82, Baden, Switzerland, a subject of the King of Great Britain and Ireland and a subject of the German Emperor, respectively, have invented a certain new and useful Marine Steam or Gas Turbine Installation, of which the following is a specification.

In installations having several shafts and a high pressure turbine and a low pressure turbine arranged on separate shafts the power is distributed in such a manner that for maximum power or output equal or approximately equal power or output is assigned to the separate shafts. This determines the initial cross sectional areas in the low pressure turbines. With decreased powers the initial pressure in front of the low pressure turbine decreases approximately in proportion to the quantities of steam at disposal in consequence of the available cross sectional areas, that is to say the drop of heat assigned to the high pressure turbine and consequently its power or output increases in proportion to the total drop of heat with decreasing power or output. For this reason therefore, only a small amount of the drop of heat remains for the low pressure turbine with small powers and for this reason the participation of said low pressure turbine in the total output or power decreases considerably. For instance with 10% of the maximum power, the power or output of the high pressure shaft of a three shaft installation amounts to about 56 to 60% and that of each side or lateral shaft to about 22 to 20%. In addition to this another disadvantage frequently has to be reckoned with viz., that the degree of efficiency of the propeller of the high pressure shaft *i. e.*, of the shaft to which the larger share of the power or output is assigned is considerably worse than that of the propellers of the low pressure shafts. It has frequently been endeavored to remove this disadvantage of the displacement of output or power by providing separate cruising turbines on the shafts of the low pressure turbine as well as by arranging action or impulse stages in a special chamber of the low pressure casing which with small powers or outputs are arranged in front of the high pressure turbine. All these arrangements and measures however do not fulfil their object to the extent achieved by the present invention and they necessitate without exception much more complicated arrangements which take up much space.

The invention consists in this that the low pressure turbine or the low pressure turbines are provided, in cases where decreased powers and speeds or number of revolutions are required, with additional expansion stages, while in case of maximum powers the surplus quantity of steam not passing through these additional stages, is conducted through one or several by-pass members to the stage for the main (or high pressure) turbine, for the purpose of equalizing the powers of the individual shaft, that is to say to increase the power of the low pressure shafts and to obtain moreover a better factor of economy by increasing the number of stages with decreased speeds.

Referring now to the accompanying drawings, Figure 1 shows in sectional elevation a turbine provided with additional stages for the purpose of the present invention, while Fig. 2 shows a three shaft marine installation according to the present invention.

In carrying the invention into effect a low pressure element of the installation (such as the turbine, *a*, shown in the accompanying drawing) is provided with additional stages, *b*, which can be by-passed by a conduit, *c*, controlled by a suitable valve *d*. During normal outputs, the steam exhausted from a higher pressure element of the installation is delivered into the chamber *e*, in front of the additional stages, *b*. The valve, *d*, being now open, the stages, *b*, are by-passed and the steam passes directly through the low pressure turbine, *a*. At decreased powers however, the by-pass valve, *d*, is closed and the steam passes from the inlet chamber, *e*, through the additional stages, *b*, and the low pressure turbine, *a*.

One example of a complete installation having turbine elements of the type above described is shown in Fig. 2 in which a three shaft marine installation is provided with high, intermediate and low pressure elements, *g*, *h* and *k*, respectively, all of which are arranged in series. In front of the intermediate pressure element, *h*, there are placed additional stages, *m*, which during increased outputs are by-passed by means of the valve controlled by-pass, *p*, while the low pressure

element, *k*, is provided with additional stages, *n*, adapted to be put out of action by the valve controlled by-pass, *q*, these by-passes being arranged in the manner described with reference to Fig. 1. In such an arrangement during smallest outputs, the steam passes in series through the element, *g*, additional stages, *m*, intermediate pressure element, *h*, additional stages, *n*, and the low pressure element, *k*, while for slightly increased outputs, the stages, *m*, are put out of action by opening the by-pass, *p*, and finally the greatest output is obtained when both by-passes, *p* and *q* are open.

Obviously the turbine elements, *g* and *h*, form in themselves a complete installation according to the present invention, since the element, *h*, is the lower pressure element of the two and is provided with the additional stages. Similarly the element, *k*, is the lower pressure element of the two elements, *h* and *k*, and is provided with the additional stages, these elements thus representing an installation in which the higher pressure element is also provided with additional stages.

It will be understood of course that the present invention may be applied to installations having any number of shafts which are driven by any number of turbine elements, arranged in any desired manner.

By thus providing additional stages the distribution of the available heat over the various turbine elements at decreased outputs enables a more constant ratio to be maintained between the circumferential blade velocity and the steam velocity so that no reduction in efficiency occurs during decreased outputs. Further the additional stages now receive low pressure steam, and on account of the comparatively large volume of the latter, the additional stages can be provided with blades sufficiently long to prevent the losses due to leakage and the like which always occur when the additional stages receive high pressure steam, as in previous arrangements. The rotor of the additional stages is still however of less diameter than that of the succeeding low pressure turbine so that if desired the annular area, *f*, between the two rotors may be used as a balancing surface.

In order to utilize as much as possible the available boiler pressure with decreased powers, the additional stages may of course also be provided in a known manner in the high pressure turbine.

The additional stages in the low pressure turbine or turbines may be constructed on the action *i. e.* impulse principle or on the reaction principle or form a combination of both systems. Altogether the present invention may be applied to various systems of turbines.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:—

1. A marine turbine installation having a higher and a lower pressure element, additional stages on said lower pressure element means connecting the high pressure element, additional stages and lower pressure element in series during decreased outputs of the installation, and means by-passing said additional stages in order to obtain increased outputs.

2. A marine turbine installation having a higher and a lower pressure element, additional stages on said lower pressure element, means connecting the higher pressure element, additional stages and lower pressure element in series during decreased outputs of the installation, a valve-controlled conduit between the inlet to said additional stages and that to the lower pressure element, whereby on opening said conduit the additional stages are by-passed and a greater output is obtained from the installation.

3. A marine turbine installation having a higher and a lower pressure turbine, additional stages placed in front of the lower pressure turbine and delivering exhaust working fluid thereto, a conduit by which the working fluid exhausted from the higher pressure turbine is delivered to the inlet of said additional stages, a conduit between the inlet to said stages and the inlet to the lower pressure turbine and a valve in said conduit, whereby on opening said valve the additional stages are by-passed and increased outputs of the installation are obtained, while by closing said valve the additional stages are placed in series with the higher and lower pressure turbines and decreased outputs obtained.

4. A marine turbine installation having a higher and a lower pressure element, additional expansion stages on said lower pressure element, said stages being by-passed when it is desired to obtain a greater output from the lower pressure element, and a balancing surface adapted to balance the propeller thrust at all outputs of said lower pressure element.

5. A marine turbine installation having a higher and a lower pressure element, additional stages placed at the inlet to said lower pressure element and mounted on a member of less diameter than that of the lower pressure element, thereby giving an annular balancing surface subjected to the pressure of the fluid exhausted from the additional stages or that at the inlet to the lower pressure element, and means for by-passing said stages when it is desired to increase the output of the lower pressure element.

6. A marine turbine installation having a higher and a lower pressure element, additional stages placed at the inlet to the latter

and mounted on a member of less diameter than that of the lower pressure element, thereby giving an annular balancing surface subjected to the pressure of the fluid exhausted from the additional stages, or at the inlet to the lower pressure element, a valve-controlled conduit between the inlet to the additional stages and that of the lower pressure element, whereby on opening said conduit the additional stages are by-passed and an increased output is obtained from the installation.

7. A marine turbine installation having a higher and a lower pressure element, additional stages placed at the inlet to the latter and mounted on a member of less diameter than that of the lower pressure element, thereby giving an annular balancing surface subjected to the pressure of the fluid exhausted from the additional stages or at the inlet to the lower pressure element, a conduit between the inlet to the additional stages and the inlet to the lower pressure element, and a hand-operated valve adapted to close said conduit when decreased outputs are required, but enabling said conduit to by-pass the additional stages during increased outputs.

8. A marine turbine installation having a high, an intermediate and a low pressure element, additional expansion stages on the intermediate and low pressure elements, said stages being by-passed when it is desired to obtain a greater output from said intermediate and low pressure elements.

9. A three-shaft installation having a high, an intermediate and a low pressure element, the latter of which is mounted upon the central shaft, additional stages on said intermediate and low pressure elements, said stages being by-passed when it is desired to obtain greater outputs from the installation.

10. A three-shaft installation having a high, an intermediate and a low pressure element, the latter of which is mounted upon the central shaft, additional stages on said intermediate and low pressure elements, said stages being by-passed when it is desired to obtain greater outputs from the installation, and a balancing surface adapted to balance the propeller thrust at all outputs of the elements having the additional stages.

In testimony whereof, we affix our signatures in presence of two witnesses.

ERIC BROWN.
JOHANN BAASCH.

Witnesses:
CARL GUBLER,
HENRY PHILLIPS.