

No. 657,709.

Patented Sept. 11, 1900.

R. SCHULZ.
STEAM TURBINE.

(Application filed July 22, 1898.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 1.

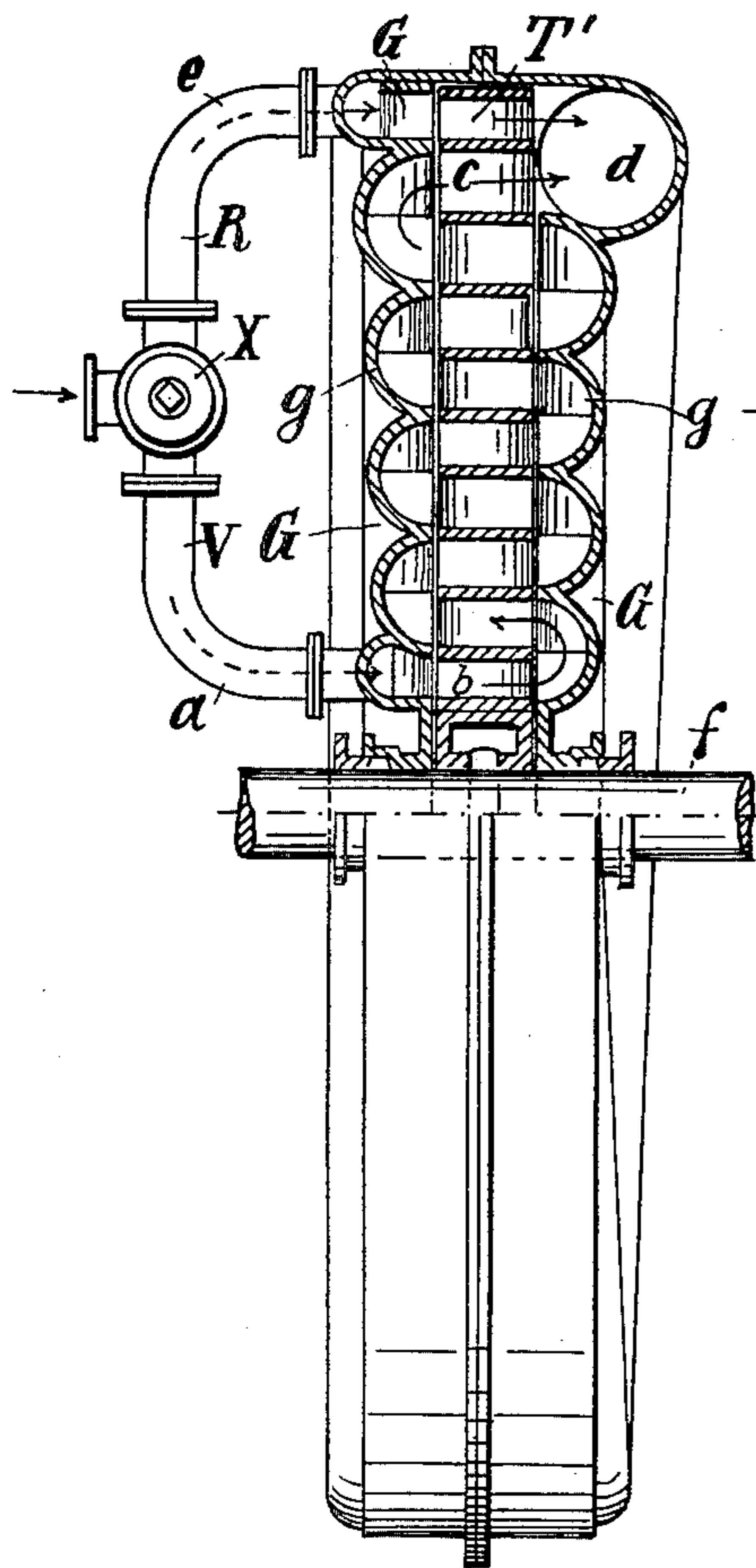
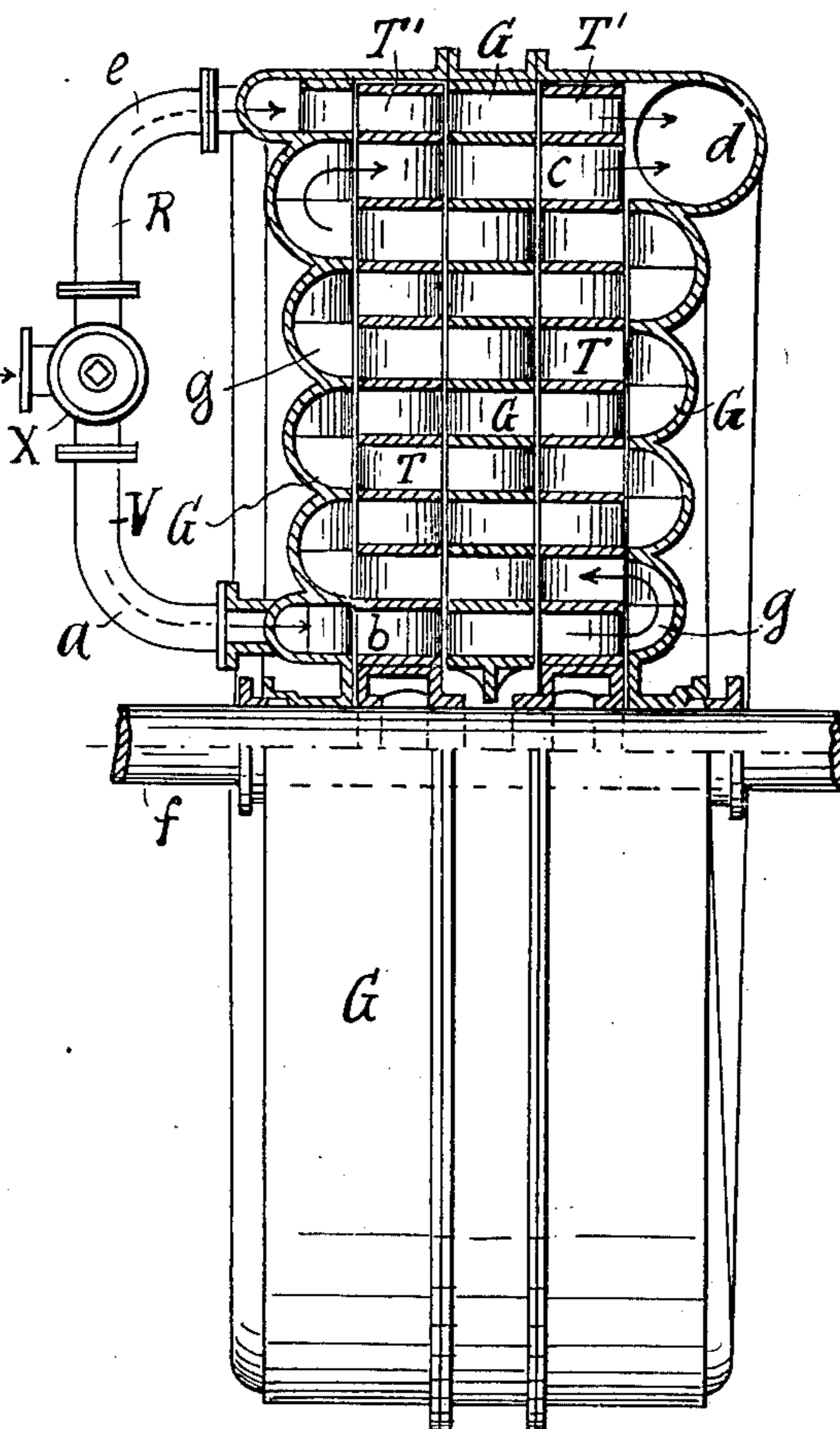


Fig. 2.



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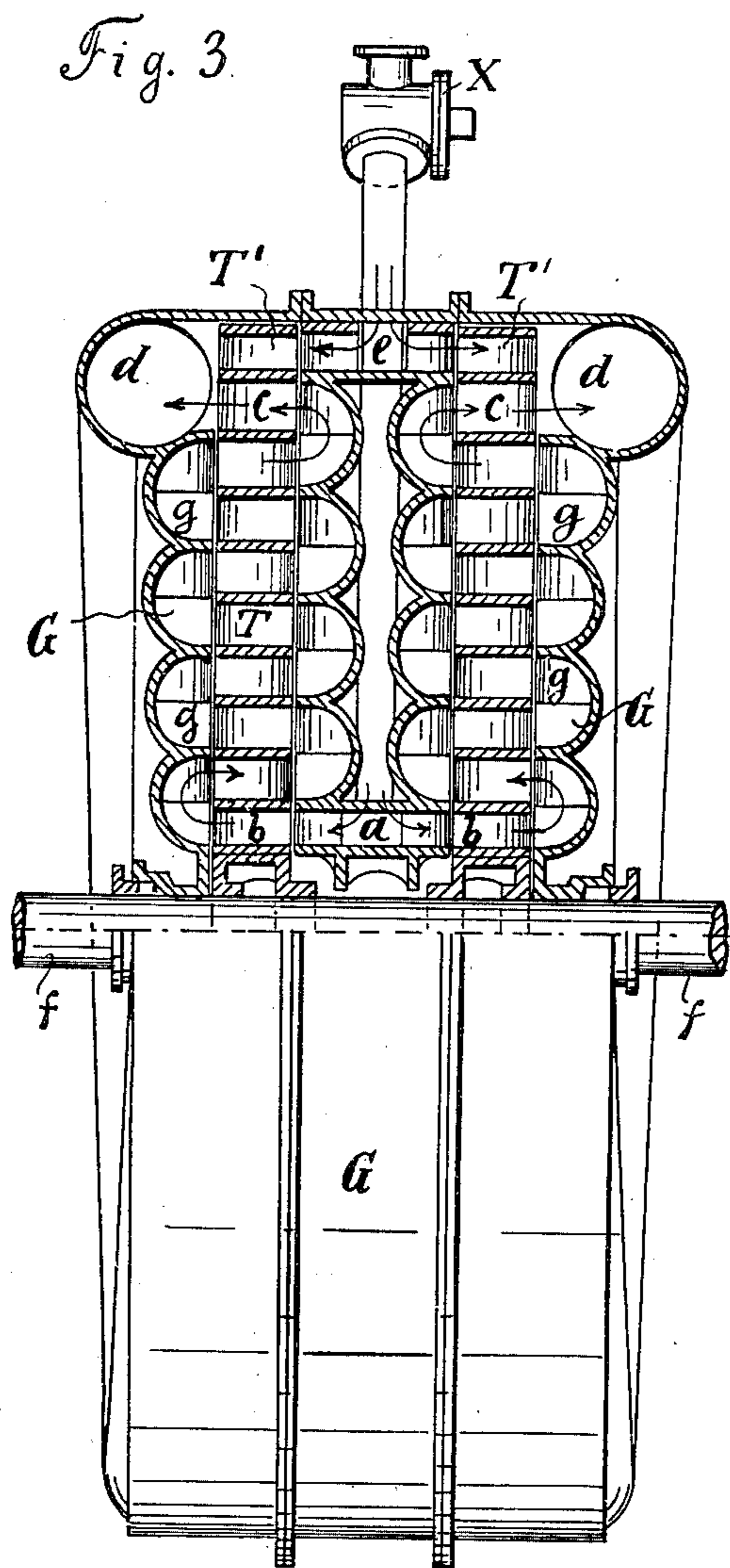
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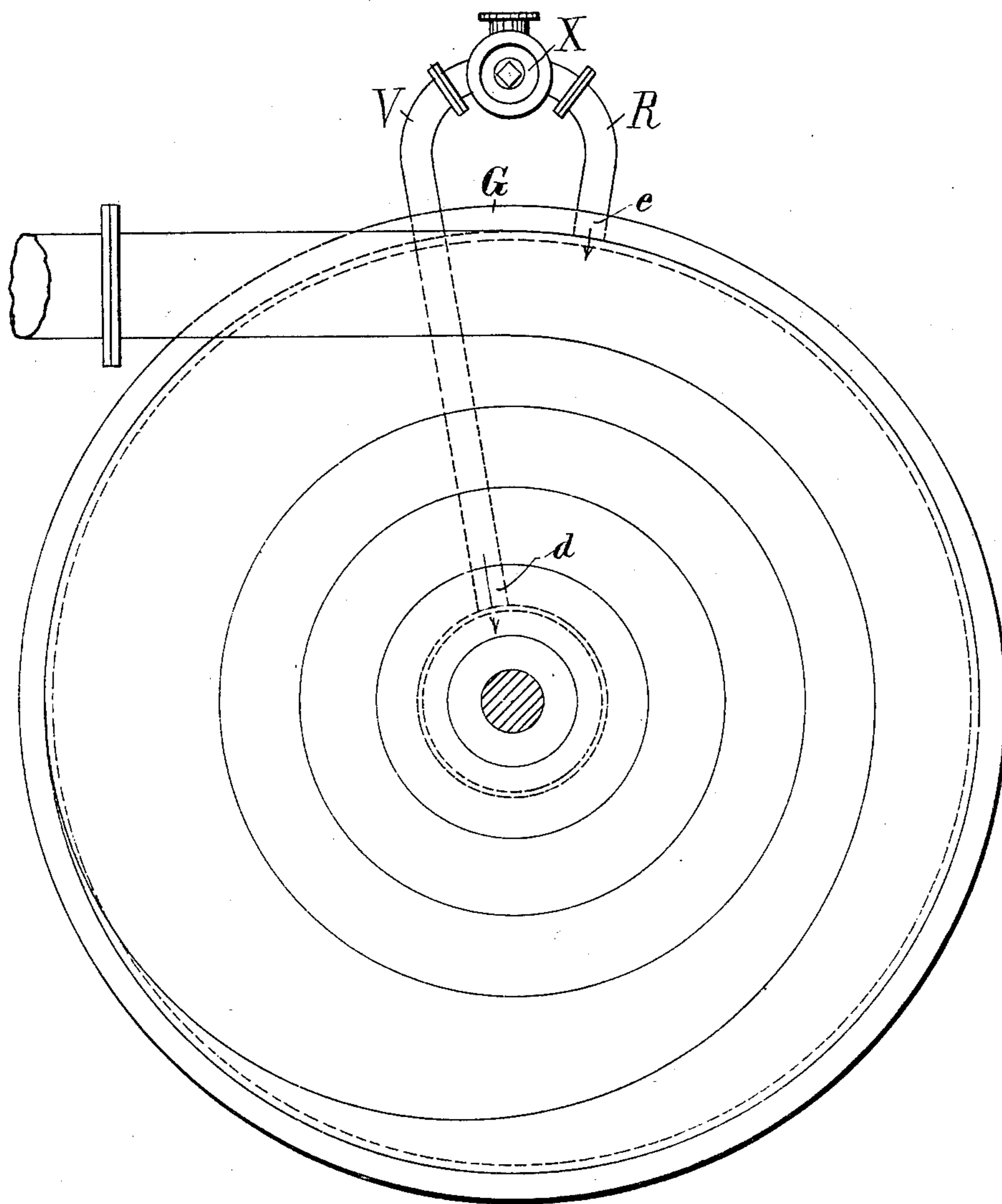


Fig. 3a

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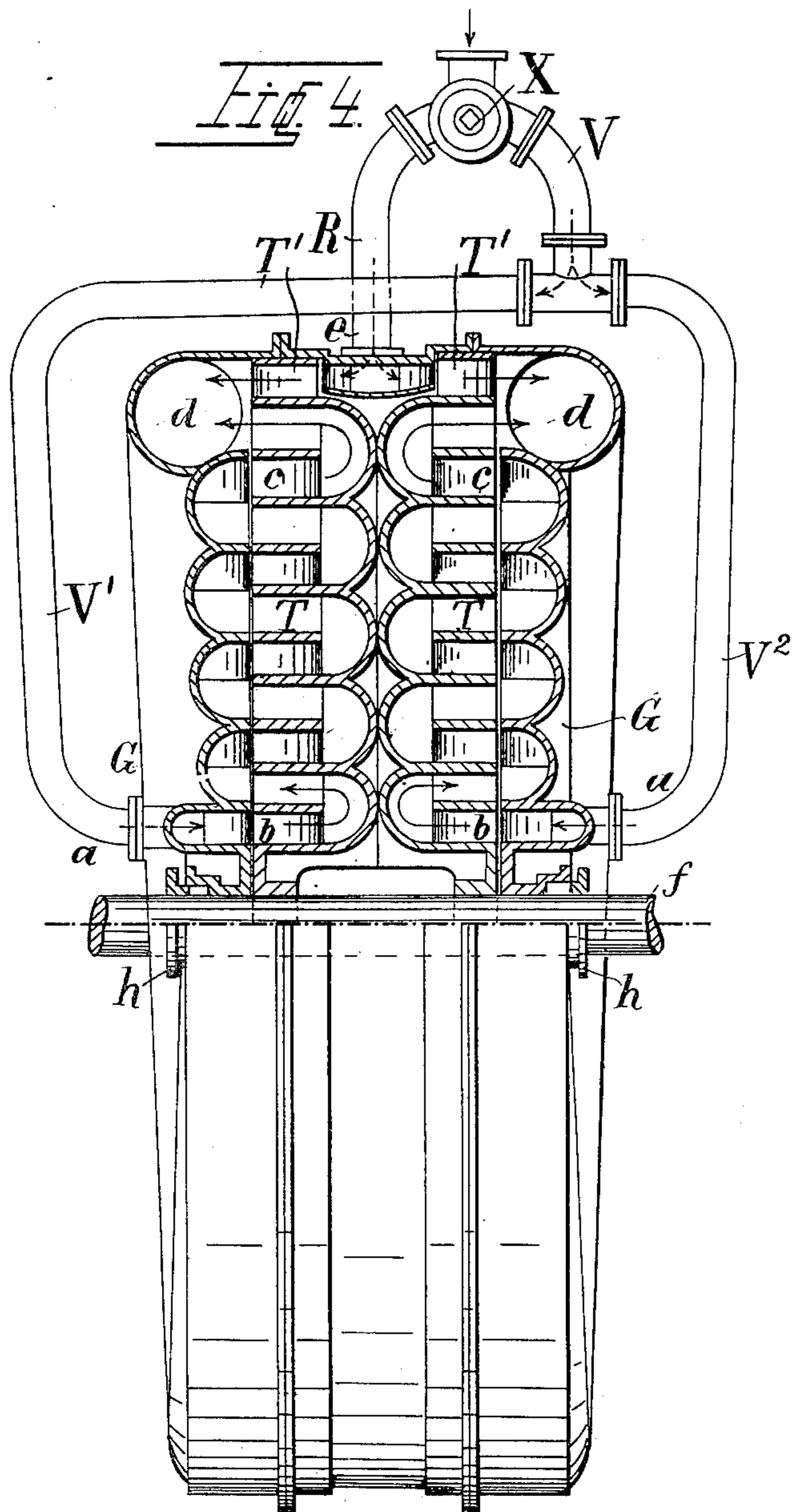
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UNITED STATES PATENT OFFICE.

RICHARD SCHULZ, OF BERLIN, GERMANY.

STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 657,709, dated September 11, 1900.

Application filed July 22, 1898. Serial No. 686,574. (No model.)

To all whom it may concern:

Be it known that I, RICHARD SCHULZ, a subject of the Emperor of Germany, and a resident of Berlin, German Empire, have invented certain new and useful Improvements in Steam-Turbines, of which the following is a full, clear, and exact specification.

Ships' engines generally only require economy in steam consumption when moving ahead, while for backing less economy is afforded in steam consumption, because the engine while manœuvring works irregularly, while the working of the boilers cannot be regulated to correspond, and the boilers therefore usually develop more steam than necessary, which must be carried into the open air or into the condenser in order not to be lost. This defect is overcome by the compound steam-turbine which forms the subject of the present invention. This turbine is arranged for high expansion and for both forward and backward movement and is characterized by a great number of turbine rings, which are so arranged relative to the necessary guide-rings, firmly connected with the casing, that an excess of steam may be carried off in the simplest manner by means of the steam-turbine itself, the majority of the turbine rings serving for as economic a forward movement as possible and only a few of the turbine rings for a less economic, but as energetic as possible, backward movement. Some examples of construction of such steam-turbines are shown in the accompanying drawings, partly in section in the direction of the shaft and partly in elevation.

Figure 1 shows a vertical section of a turbine wheel made with several concentric rings for the forward movement and another turbine ring or rings arranged outside the same for the backward movement. Fig. 2 is a similar view with two turbine wheels in the same casing having each two sets of rings. Fig. 3 is view similar to Fig. 1 of a modification with two separate compartments and turbine wheels in each of the same. Fig. 3^a is a side elevation of the casing seen in the direction of the shaft. Fig. 4 is a further modification with two separate compartments and a turbine wheel in each of the compartments.

In all the examples the turbine ring lying next the shaft *f* is indicated by *b*. This ring has the smallest diameter. The turbine ring farthest removed from the shaft *f* and belonging to the turbine body or section T for forward movement and which has the largest diameter is indicated by *c*. Between the rings *b* and *c* there are a number of rings concentric with them. All of these rings—*i. e.*, *b c* and the intermediate ones—constitute the section T, which has all of its vanes so set as to cause forward rotation. The rotating turbine-section T is keyed fast on the shaft. The turbine-section for backward movement is indicated by T'. This is connected with the section T, but has its vanes set reversely to those of the section T. The shaft *f* projects from the casing G at the ends, and the joints are made tight by means of stuffing-boxes *h*. The steam is conveyed in the ordinary manner before entering each turbine ring of the rotating body or section T through the casing G, having suitably-shaped guide-passages *g*, through which the steam on entering the turbine rings is delivered to the paddles or vanes of the rings in the most effective direction. The pipes V and R, in which a three-way reversing-cock X is inserted, serve, respectively, for the forward and backward movement. In all the foregoing examples the steam-supply for the forward movement enters by way of the three-way cock X and pipe V through a nozzle *a* into the turbine ring *b* of smallest diameter. The last and largest turbine ring of the section T for forward movement in which the steam enters is the ring *c*. The steam in its course through the turbine wheel traverses larger rings in succession—that is to say, rings or sets which increase successively in diameter and, if desired, also in height and width—and the steam finally escapes from the largest ring *c* of the turbine-section T to the condenser or into the open air. The guide-vanes *g* of the casing and the guide-passages of the set of rings *b c* of the turbine-section T may be of any suitable form. This is determined by the pressure of steam available and the number of revolutions of the shaft *f* which is desired or possible. The lower the number of revolutions the greater must be the number of turbine rings *b c*, always successively increasing in di-

ameter or capacity, if the steam is to be utilized as economically as possible and to the fullest extent of its expansion power. The present examples fulfil this object very effectively. If necessary, several such apparatuses may be arranged on one or more shafts to work in conjunction in order to obtain, if desired, the necessarily-large number of turbines for a correspondingly-low number of revolutions.

The form of construction of the turbines must suit circumstances of space in each case. Where the room is limited, it is advisable to make use of the form of construction shown in the drawings. In these the turbine rings *b c* of section *T* and the ring or rings of section *T'* lie concentrically to one another, and the turbine has the form of a perforated disk mounted on the shaft *f*, which lies between the sides of the casing *G*, containing the guide-vanes and the guide-passages. In the case of a greater length of space the form of construction shown is to be preferred; but here the turbine wheel *T*, containing the turbine rings *b c*, has usually the form of a perforated hollow conical casing which lies inclosed in a corresponding truncated conical casing *G*, with a small and large closing cover *i i'*. All the turbine-sections *T* are provided for the backing or reversing movement with one or more rings *T'* of the largest possible diameter as close as possible to the steam-exit *d*, Fig. 1. The direction of the paddles or vanes of this backward section *T'*, and accordingly the direction of the passages of the casing *G* belonging thereto, is self-evidently different from that of the forward section *T*. The ring or rings of section *T'* are so arranged that in the forward movement they are entirely ineffective or non-working and only come into action when the steam-inlet is closed toward *a* by the reversal of the cock *X*, and steam is admitted through the pipe *R* at the point *e* into the casing. For each ring of the backing or reversing section *T'* a suitable ring with corresponding guide-vanes adapted for the most effective admission of the steam must be provided. As each turbine apparatus has two different inlet-passages and only one outlet for the forward and backward movement the utilization of the steam for moving ahead and backing or reversing and intermediate maneuvers is very simple. The three-way cock *X* may be brought into various positions by means of simple motions, so that the steam may be entirely shut off or admitted to the forward section *T* or the backing section *T'*. These intermediate positions may also easily serve to convey the major part of the steam to one of the sections *T* and the minor part to the other section *T'*. By this means the maneuvers for rapid and slow movement of the ship are greatly facilitated.

The turbine shown in Fig. 1 has practically no thrust in an axial direction. It has a forward turbine-section *T* with several rings *b c* and a backing turbine ring *T'* outside the latter.

In the example shown in Fig. 2 two such wheels with forward turbine-sections *T* and with an outer backward section *T'* are contained in the same casing *G*. In a similar manner three or more such turbine wheels may be mounted on the same shaft *f*.

The forms of the construction shown in Figs. 3 and 4 have turbine-sections *T* with a backward-turbine section *T'* in a symmetrical arrangement, each in a separate compartment in the casing *G*. In each compartment steam enters from the forward pipe *V* through branch pipes *V'* and *V''*, and in each compartment coming from the respective branch pipe it passes to and fro through the corresponding turbine wheels, flowing in at *a* in proximity to the shaft and escaping to the outside of the casing *G* at the point *d*.

All the examples hereinbefore mentioned are suitable not only for operating ships' propellers, but also for many other purposes, more particularly for the numerous winches (stationary and on board ship) for forward and backward movement, and when necessary such apparatuses may be formed with a larger number of turbines, also for the backward movement.

The forms of construction hereinbefore described are suitable both for rapidly-running apparatuses with one direction of rotation, such as dynamos, ventilating-fans, centrifugal pumps, and the like. In this case the backward turbine-section *T'* is omitted.

The examples of construction hereinbefore described are finally suitable not merely for high and low pressure steam, but also for compressed air and other suitable gases.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

A turbine comprising a series of concentric rings of vanes, means for introducing the steam to the ring of vanes nearest the center of rotation, means for directing the steam laterally in respect to the turbine first from one side and then from the other, a reversing ring of vanes at the outer periphery of the turbine, means for directing the steam thereto laterally, a reversing-valve controlling the steam-supply and an exhaust arranged at the outer edge of the turbine, said exhaust being large enough to communicate with the two outer rings of vanes, substantially as described.

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Witnesses:

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