

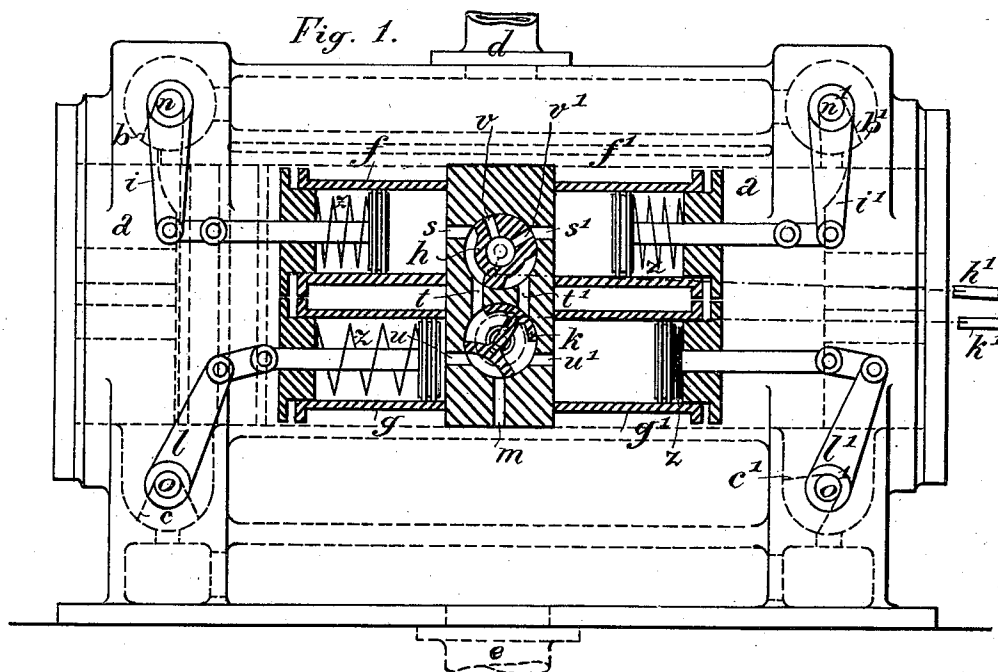
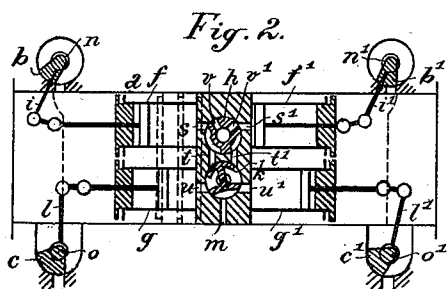
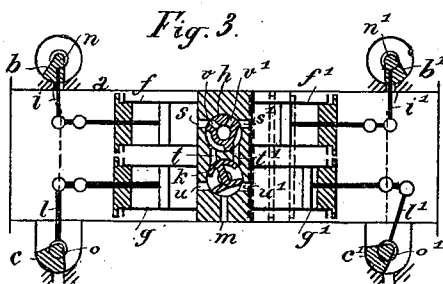
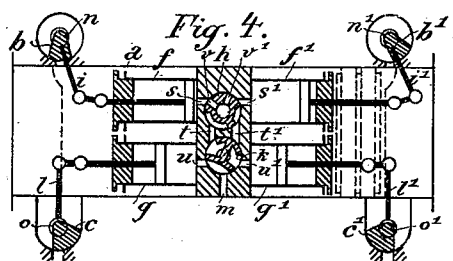
R. KRON.

VALVE OPERATING DEVICE FOR STEAM ENGINES.

(Application filed Oct. 28, 1899.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses:-

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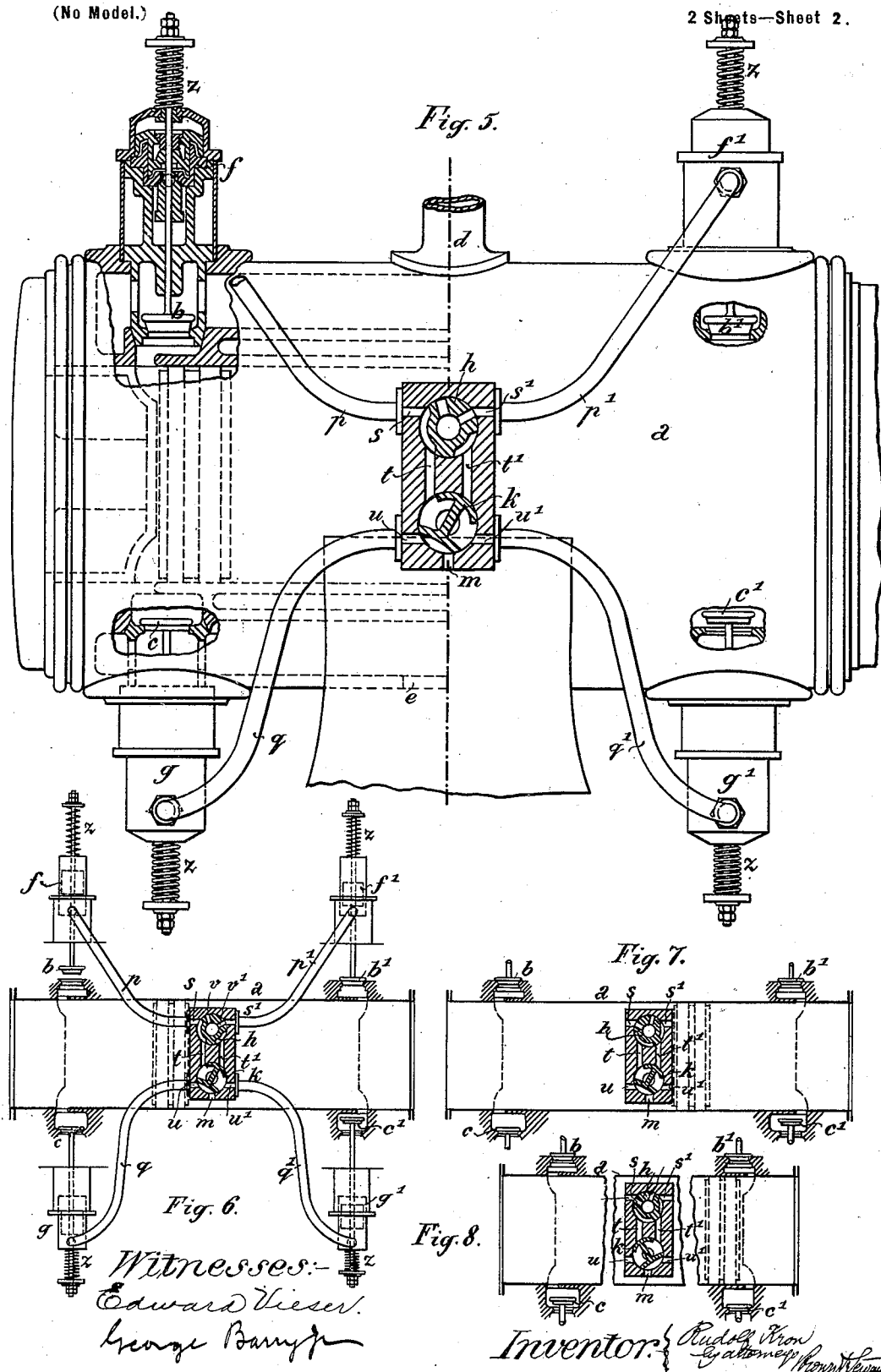
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2 Sheets—Sheet 2.



UNITED STATES PATENT OFFICE.

RUDOLF KRON, OF GOLZERN, GERMANY.

VALVE-OPERATING DEVICE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 651,550, dated June 12, 1900.

Application filed October 28, 1899. Serial No. 735,023. (No model.)

To all whom it may concern:

Be it known that I, RUDOLF KRON, a citizen of the Republic of Switzerland, and a resident of Golzern, in the Kingdom of Saxony, in the German Empire, have invented a new and useful Improvement in Valve-Operating Devices for Steam-Engines, of which the following is a specification.

This invention relates to steam-engines in which the valves are operated by auxiliary steam-engines driven by live steam from the boiler taken from the main supply-pipe or other suitable conduit.

The improvements consist in apparatus for controlling the said auxiliary steam-engines, said apparatus embodying two positively-driven cock-valves, the one working the auxiliary steam-engines for moving the main inlet-valves of the working steam-cylinder, the other one working the auxiliary steam-engines for moving the main outlet or exhaust valves of the working steam-cylinder. The interval between the opening of the inlet cock-valve of the controlling apparatus and the opening of the exhaust cock-valve of the controlling apparatus, which interval being under the control of the governor of the steam-engine determines the period of opening of the steam-passages of the cylinder of the working steam-engine.

The invention is illustrated by the accompanying drawings, in which—

Figure 1 represents a side view of the cylinder of a working steam-engine with rocking inlet and exhaust valves and the auxiliary steam-engines for working said valves, the cylinders of such auxiliary steam-engines and their cock-valves being shown in section. Figs. 2, 3, and 4 are diagrammatic views illustrating the respective positions of the pistons of the auxiliary steam-engines and their positively-driven steam cock-valves during one stroke of the piston of the working steam-engine. Fig. 5 represents a side view of the cylinder of a working steam-engine with inlet and exhaust valves of the puppet kind and the auxiliary steam-engines for working said valves, the cock-valves of said auxiliary steam-engines and one of the said engines itself being shown in section. Figs. 6, 7, and 8 are diagrammatic views illustrating the ac-

tion of the auxiliary steam-engines and the valves of the engine represented in Fig. 5.

Referring first to the example of the invention illustrated by Figs. 1, 2, 3, and 4, *a* is the cylinder of the working steam-engine, *b b'* being the main inlet-valves, and *c c'* being the main exhaust-valves of said cylinder. *d* is the main supply-pipe for live steam. *e* is the main pipe for exhaust-steam. These four valves *b b' c c'*, which are rocking valves, are each worked by one of the pistons of four auxiliary steam-engines *f f' g g'*. These four auxiliary steam-engines have their cylinders *f f'* arranged in one central line and *g g'* in another central line, but all in a plane at right angles to the four valves *b b' c c'*, and the controlling apparatus for said engines is arranged between them. This controlling apparatus consists of one positively-driven cock-valve *h* for the pistons of the auxiliary steam-engines *f f'*, which work the main inlet-valves *b b'*, and another positively-driven cock-valve *k* for the pistons of the auxiliary steam-engines *g g'*, which work the main exhaust-valves *c c'*. The two cock-valves *h* and *k* are driven in the usual manner by rods *h'* and *k'*, receiving their to-and-fro movement from eccentrics on the crank-shaft of the main or working steam-engine, which it is not thought necessary to represent. The cock-valve *k* receives live steam from the main pipe *d* by a branch pipe (not shown) terminating at a central opening of the cock-valve *k*, said steam being distributed in the manner to be hereinafter described in the explanation of one stroke of the engine alternately into the cylinders *f f'* and *g g'* of the auxiliary steam-engines for actuating the pistons in said cylinders, and thereby rocking the main inlet-valves *b b'* alternately by means of links *i i'* on the spindles *n n'* of such valves and the main exhaust-valves *c c'* alternately by means of the links *l l'* on the spindles *o o'* of these main exhaust-valves. The cock-valve *k* is in communication by passages *t t'* with the cock-valve *h* and the latter by the passages *s s'* with the cylinders *f f'* in order to supply and distribute the live steam alternately into the auxiliary cylinders *f f'* and by the passages *u u'*, provided in the casing of the cock-valve *k*, into the cylinders *g g'*

for pushing the pistons in said cylinders, and thereby rocking the respective main inlet and exhaust valves. The exhaust-steam from the cylinders *ff'* escapes through the center of the cock-valve *h* by the passages *vv'* within such cock-valve, whereas the exhaust-steam from the cylinders *gg'* escapes alternately by the passages *uu'* and the passage *m*.

It will be seen that in the arrangement described the pistons of the auxiliary cylinders *ff' gg'* are actuated by steam in their out-stroke only, the instroke being effectuated by means of springs *zzzz*.

In the conditions illustrated by Fig. 1 the piston of the working cylinder *a* is at the left end of its stroke, ready to begin its movement to the right end of the stroke. In this position the pistons of the auxiliary cylinders *ff'* are in their middle position, whereas the pistons of the auxiliary cylinders *gg'* are at the right-hand end of their stroke. In consequence of such positions the position of the main valves is as follows: The admission-valve *b* is ready to be opened, the admission-valve *b'* is just closed, the exhaust-valve *c* is fully closed, and the exhaust-valve *c'* fully opened. In this period the connection between the cylinders *ff'* and *gg'* and the cock-valves *h* and *k* is as follows: Cylinder *f* is in direct communication with the live steam from the supply-pipe *d* by the passages *t* and *s*. Cylinder *f'* communicates by the passages *s'* and *v'* with the exhaust-pipe *e*, and the cylinder *g* by the passages *u* and *m* also with the exhaust-pipe *e*, whereas the cylinder *g'* has received live steam from the case of the cock *k* by the passage *u'*. At the beginning of the admission period in the working cylinder *a*, Fig. 2, the admission-valve *b* is opened by the action of the live steam exhausting through the passage *t* from the passage *s* and remains opened, whereas the admission-valve *b'* remains closed. The steam within the cylinder *f* escapes by the passages *s'* and *v'* to the exhaust-pipe *e*. The exhaust-valve *c* remains closed during the movement of the stroke of the cylinder *g*, actuated by live steam entering the passage *u*, and the exhaust-valve *c'* remains fully opened by the live steam acting through the passage *u'* on the piston of the cylinder *g'*. During the first part of the expansion period of the piston of the working cylinder *a*, Fig. 3, the valves *b'*, *c*, and *c'* remain in the position shown in Fig. 2, whereas the admission-valve *b* is closed by the action of the spring *z*, effectuating an exhaust of the steam from the cylinder *f* through the passages *s* and *v*. Such steam escapes through the center of the cock-valve *h*. At the end of the stroke of the piston of the working cylinder *a*, Fig. 4, the exhaust-valve *c* is closed by the spring *z* of the cylinder *g'*, causing an exhaust of the steam within such cylinder through the passages *u'* and *m*. After the exhaust of the steam from the working cylinder *a* the admission-valve *b'* is fully opened by steam through the passages *t'* and *s'* from

the cock-valve *k*. The return stroke of the piston of the working cylinder *a* is effected in the same manner as described heretofore, during which return stroke the exhaust-valve *c* remains closed.

In the example of my invention illustrated by Figs. 5, 6, 7, and 8, which I will now proceed to describe, the cylinders *ff'* and *gg'*, instead of being arranged in a plane at right angles to the plane in which the valves *b c* and *b' c'* are arranged, are arranged in one central line with each of the main inlet and exhaust valves *b b' c c'*, for the reason that these valves in this instance are puppet-valves, so that they move in one axial line with the pistons of the auxiliary cylinders *ff'* and *gg'*. The controlling apparatus in this example, as far as its position relative to the working cylinder *a* and the cock-valves *h* and *k*, their passages *vv'* and the passages *ss' uu'* in their casing, and the steam admission and exhaust to and from such cock-valves is concerned, is exactly the same as in the case Figs. 1, 2, 3, and 4; but instead of being in close proximity with the auxiliary cylinders *ff' gg'* said apparatus is connected with the latter by means of pipes *pp' qq'*, through which the steam is conducted and distributed alternately to the auxiliary cylinders mentioned and returned as exhaust-steam in order to finally escape through the passage *m* or the center of the cock-valve *h*. It will be seen from the part of the working cylinder *a* shown in cross-section, Fig. 5, that the puppet-valve *b*, as the other valves *b' c c'*, is in a plane with the auxiliary steam-cylinder *f* and its piston. If now steam is admitted from the casing of the cock-valve *k* through the passage *t* and the pipe *p* into the auxiliary cylinder *f*, the piston of the latter will shift the valve *b* upward, thereby creating an air-cushion in the upper part of the latter-named cylinder, which cushion, if the steam in the cylinder *f* is exhausted through pipe *p* and passages *s* and *v* into the cock-valve *h*, will expand and return the said valve *b* to its initial position for the next stroke of the piston in the auxiliary cylinder *f*, assisted by the coiled spring *z*. This procedure will take place alternately with the auxiliary cylinders *ff'* and with the said valves *b b'* for admitting steam into the main working cylinder *a*. The exhaust-steam from the cylinders *ff'* is returned, as already explained, through pipes *pp'* into the cock-valve *h* by the rocking movement of said cock-valve, whereas the cock-valve *k* directs by its rocking motion live steam through the passages *uu'* and passages *qq'*, alternately, into the auxiliary cylinders *gg'*, in order to move by the pistons of the latter the exhaust puppet-valves *c* and *c'*, which are returned to their seats by the air-cushions, formed in the same manner as with the admission-valves *b b'*, assisted by the coiled springs *z*. The mode of operation of this modified arrangement of the main working cylinder *a*, provided with puppet-valves *b b' c c'*, is as follows: At the be-

ginning of the stroke of the piston of the working cylinder *a* live steam will issue from the casing of the cock-valve *k* through the passages *t* *s* and the pipe *p* to enter underneath the piston of cylinder *f* and raise such piston for giving an upward movement to the admission-valve *b*, so that live steam may enter from the supply-pipe *d* into the working cylinder *a* to actuate its piston. At the same time the other admission-valve *b'* was closed by exhausting the steam from the cylinder *f'* through the pipe *p'* and the passage *s'* and the passage *v'* of the cock-valve *h*. The exhaust-valve *c* was closed by the exit of the steam from the cylinder *g* to the pipe *q* and to the passages *u* and *m*, whereas the other exhaust-valve *c'* is fully opened by the live steam acting against the piston of the cylinder *g'* through the passage *u'* and pipe *q'*. The admission-valve *c*, moved upward by the live steam from the passages *t* and *s*, remains in this raised position during the admission period, Fig. 6, in which the valves *b'* and *c* remain closed, whereas the valve *c'* remains opened during the entire stroke of the piston of the working cylinder *a*. At the beginning of the expansion period of the live steam in the cylinder *a* the admission-valve *b* is closed by the action of its coiled spring *z* under the exhaust of the steam within the cylinder *f* to the pipe *p* and the passages *s* and *v* and through the cock-valve *h*. This period is shown in Fig. 7. At the end of such expansion period the valve *c'*, belonging to the cylinder *g'*, is closed, the steam in such cylinder issuing through pipe *q'* and the passages *u'* and *m*, whereas the valve *c*, belonging to the cylinder *g*, is fully opened by the live steam from the cock-valve *k* acting through the passage *u* and the pipe *q* for the purpose of issuing the worked steam from the working cylinder *a* when its piston begins its return stroke by live steam entering the admission-valve *b'*.

What I claim as my invention is—

1. In a steam-engine, the combination with its main valves, of auxiliary steam-cylinders and pistons contained therein to be operated by live steam, connections between such pistons and said main valves, two cock-valves for controlling the admission and exhaust of

the steam to and from said cylinders, and means for positively operating said cock-valves by the steam-engine, substantially as herein described.

2. The combination in a steam-engine having puppet main valves, of auxiliary steam-cylinders the axial lines of which coincide with the axes of such valves, pistons in said cylinders to be operated by live steam, connections between said pistons and the said valves for actuating said valves, two independent cock-valves for controlling the admission and exhaust of the steam to and from said cylinders, and means for positively operating said cock-valves by the steam-engine, substantially as herein described.

3. The combination in a steam-engine having separate inlet-valves and separate exhaust-valves for each end of the engine-cylinder, of four auxiliary steam-cylinders one for each of said valves, pistons in said cylinders to be operated by live steam, connections between said pistons and their respective inlet and exhaust valves, two cock-valves for controlling the admission and exhaust of the steam to and from said four auxiliary cylinders and means for positively operating said cock-valves by the steam-engine, substantially as herein described.

4. The combination in a working steam-engine having separate inlet-valves and separate exhaust-valves for each end of the engine-cylinders, of two auxiliary steam-engines one for operating each of said inlet-valves, two auxiliary steam-engines one for operating each of said exhaust-valves, one cock-valve common to the two auxiliary engines of the inlet-valves, one cock-valve common to the two auxiliary engines of the exhaust-valves and means for positively and separately operating said cock-valves by the working engine, substantially as herein described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 11th day of October, 1899.

RUDOLF KRON.

Witnesses:

RUDOLPH FRICKE,
A. KRAUSS.