

(No Model.)

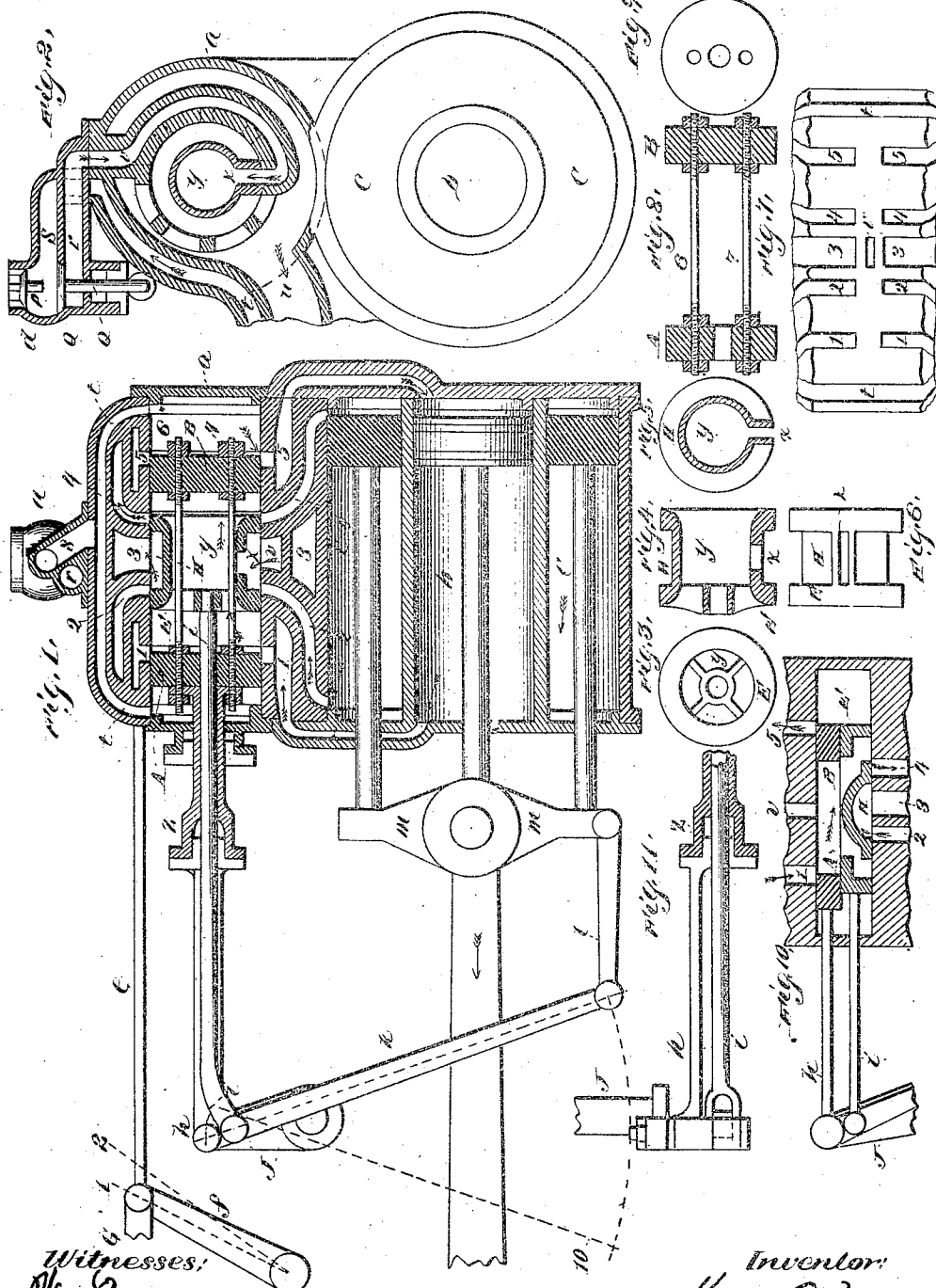
2 Sheets—Sheet 1.

H. MONK.

COMPOUND LOCOMOTIVE STEAM ENGINE.

No. 480,668.

Patented Aug. 9, 1892.



Witnesses:
Wm. Evans
Wm. Cowley

Inventor:
Henry Monk

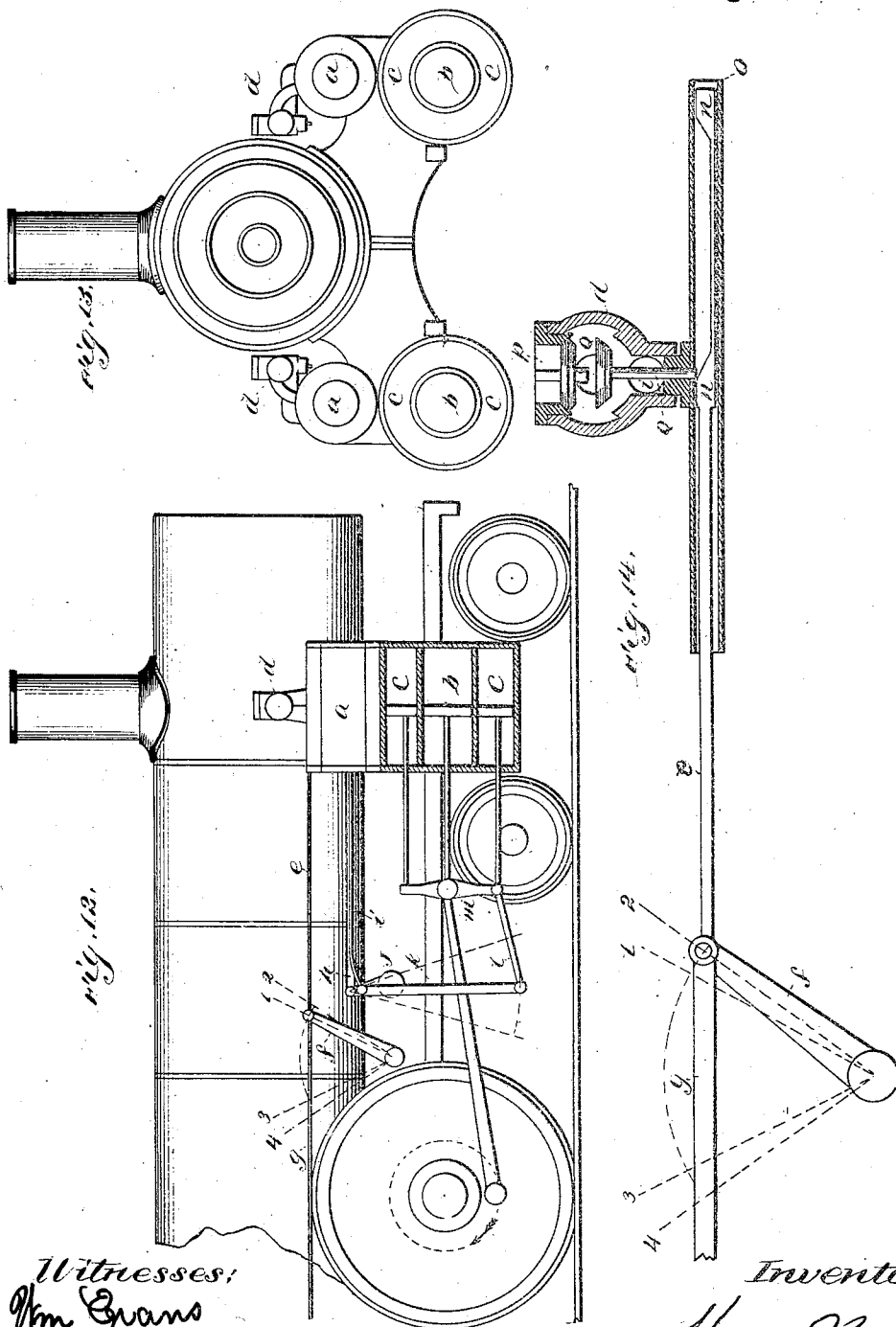
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UNITED STATES PATENT OFFICE.

HENRY MONK, OF ELSDON, ILLINOIS.

COMPOUND LOCOMOTIVE STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 480,668, dated August 9, 1892.

Application filed October 30, 1890. Serial No. 389,864. (No model.)

To all whom it may concern:

Be it known that I, HENRY MONK, a citizen of the United States, residing at Elsdon, in the county of Cook and State of Illinois, have invented new and useful Improvements in Compound Locomotive Steam-Engines, of which the following is a specification.

My invention relates to improvements on a prior patent granted to me and William Monk, No. 273,126, dated February 27, 1883. The improvements are in the combination of the valves and valve-motion, together with the arrangement of cylinders and the construction and operation of a combined auxiliary steam and relief valve.

The object of my invention is to attain an improved distribution of steam in compound engines having a single steam or valve chest by the provision of a valve and valve-motion, in the operation of which the steam can be cut off from the high-pressure cylinder at any part of its stroke, the exhaust to escape and supply the low-pressure cylinder for near its whole stroke, thereby effecting a retardation of steam release and a higher degree of expansion in both cylinders and a reduction of the back-pressure due to compression in both cylinders, especially in the high-pressure cylinder. Excessive compression of steam in the high-pressure cylinder in compound engines of this type when the valve or valves are operated by the ordinary link-motion is one of the greatest deterrents to their success.

To this end, in a compound engine having a single steam or valve chest, the chief feature of my invention, generally stated, consists in a valve composed of two independent sections movable relatively one to the other, one of said sections controlling the admission and exhaust of steam from a high-pressure cylinder, the other having its movement similar to that of the former, but having a reduced degree of lap and a shorter range of traverse with a longer period of dwell and controlling the admission of steam from the high-pressure cylinder to a low-pressure cylinder and the exhaust from the latter, means being provided to operate the said valve-sections independently of each other.

My second improvement is the combination of the cylinder, valves, steam ports and passages, and steam-chest for a locomotive steam-

engine occupying little space. The radiating area and the condensation of steam are thereby reduced to a minimum. Third, the construction and operation of the auxiliary steam and relief valves, which are so arranged that the engineer in charge cannot abuse this great starting power, if he so desired, and are so constructed that they cannot be tampered with. The object is to prevent undue strains on the reciprocating motion and waste of steam. Fourth, to provide a thorough relief to the high and low pressure cylinders when the engine is in motion with steam shut off.

In the accompanying drawings, Figure 1 is a side view in section, showing cylinders and valves, together with their connections. Fig. 2 is an end view of Fig. 1. Fig. 3 is an end view of low-pressure valve. Fig. 4 is a side view in section of Fig. 3. Fig. 5 is an end view in section of Figs. 3 and 4. Fig. 6 is a bottom view of Figs. 3, 4, and 5. Fig. 7 is a bottom view of valve-cylinder face. Fig. 8 is a side view of high-pressure valves. Fig. 9 is an end view of Fig. 8. Fig. 10 is a side view of double-faced flat slide-valves with connections. Fig. 11 is a top view of valve connections. Fig. 12 is a side view of locomotive with my improvements. Fig. 13 is an end view of Fig. 12. Fig. 14 is a side view in section of the combined auxiliary steam and relief valves with connections.

Similar letters and figures refer to similar parts throughout the several views.

Referring to Fig. 1, the valves are piston-valves, which have suitable packing-rings to keep them steam-tight. The high-pressure valve-sections A and B are connected at a calculated distance apart by bolts 6 and 7. The section A has a hole through the center large enough to permit valve-spindle *i* to work freely through it. Low-pressure valve-section E is two pistons cast together with a hollow cavity 11 and passage *y*. A longitudinal port is in the bottom of this valve for the purpose hereinafter described. Valve E is connected by spindle *i*, which passes through valve A and hollow valve-spindle *h*. This hollow valve-spindle is provided with packing-box *z* to allow spindle *i* to move freely, yet steam-tight. The object of this arrangement is to have an independent motion for low-pressure valve E. This motion is obtained from cross-head *m*.

which has a short rod *l*. This is attached to fulcrum-rod *k*. This rod is suspended to the ordinary rocking arm *J* by the same pin that connects spindle *h*. Valve-spindle *i* is connected to fulcrum-rod *k* directly underneath spindle *h*. The reciprocating movement of the cross-head *m* thereby partly controls the movement of low-pressure valve *E*. The high-pressure valve *A* and *B* is connected by hollow spindle *h* directly to the rocking arm *J* in the usual manner. The rocking arm *J* is operated by the ordinary link or any other valve-motion. The method for setting valves *A* and *B* is the same as usual, the lap on the steam edges of these valves being, say, one and one-fourth inches; inside lap, say, one-eighth of an inch; the lap on the steam edge of low-pressure valve, say, one-fourth of an inch, and the exhaust edge line and line. I obtain a perfect lead for the valves under the above-mentioned conditions by fulcrum-rod *k*, which by the action of cross-head *m* retards the travel of valve *E* at certain points and at others assists it to travel more quickly. The piston and cross-head *m* are shown in the drawings at the extreme front end. At this point the high-pressure valve *A* and *B* will have traveled, say, one and three-eighths inches, whereas the low-pressure valve *E* has only traveled three-eighths of an inch, caused by the action of cross-head *m* and fulcrum-rod *k*, which compensates for the reduced lap of the low-pressure valve *E*.

To clearly understand the operation of this engine, it must be supposed that steam has been admitted from the boiler through steam pipe or passage *t*, which communicates with both ends of valve cylinder or chest *a*, and that the engine has made several revolutions. The drawings represent the engine at the forward center. The valve *A* and *B* is operated by the ordinary link-motion. Steam is just being admitted by valve-section *B* into steam-port 5, which connects with the front end of the high-pressure cylinder *b*. The exhaust from the back end of this cylinder passes through steam-port 1, through passage *y* in low-pressure valve *E*, and is admitted through steam-port 4 to the front end of low-pressure cylinder *c*. The exhaust from cylinder *c* is escaping from the back end up steam-port 2, then under the hollow *H*, and escapes to the atmosphere through exhaust-passage 5 and exhaust-pipe *u*. The steam works vice versa when the piston has traveled to the opposite end of the cylinders. The cross-head *m* is shown at the extreme front end and fulcrum-rod *k* has traveled in proportion thereby, retarding the travel of the low-pressure valve *E*. Rocking arm *J*, spindle *h*, and high-pressure valve *A* and *B* at this point have traveled about one and three-eighths inches, whereas the low-pressure valve *E* has only traveled about three-eighths of an inch. This valve only having one-fourth of an inch lap and the high-pressure valves one and one-fourth inches lap, it will be seen

that by the action of fulcrum-rod *k* the lead to the valves are the same. When cross-head *m* commences its outward movements, fulcrum-rod *k* is forced back also. This then gives a double quick action to low-pressure valve *E*, which opens the steam and exhaust ports very quickly, and these ports are kept open for near the whole stroke, even when the high-pressure valve is made to cut off at a very early point by reducing its travel. When the pistons and cross-head *m* have completed the outward stroke, fulcrum-rod *k* will then be in the position indicated by the dotted line 10, and though the high-pressure valves have traveled inward one and three-eighths inches the low-pressure valve has been retarded and only traveled about three-eighths of an inch. Thus the valves all have an equal lead at both ends.

It will be clearly seen even if the high-pressure valve *A* *B* has its travel greatly reduced to cut off very early it will but slightly affect the movement of low-pressure valve *E*, which will keep the low-pressure ports open for near the whole stroke thereby obtaining a full clearance for the steam during the whole stroke of its piston, thus avoiding all compression of the steam, and the exhaust cannot escape from the low-pressure cylinder until its piston has nearly completed the stroke, no matter how early steam is cut off by the high-pressure valve. This motion and valves, as shown in Figs. 1 and 10, will operate any two-cylinder compound steam-engines wherein the pistons move simultaneously or when the pistons are moving in direct opposite directions, connected to two opposite cranks placed at one hundred and eighty degrees. In the latter case the steam-passages 1 and 5 or 2 and 4 will have to be cast so as to communicate with the opposite end of the cylinder.

Referring to Figs. 1, 2, 12, and 14, puppet-valve box *d* is shown. Figs. 1, 12, and 14 show reversing shaft-arm *f*, which is connected by reach-rod *G* to reversing-lever in the cab. This is not shown in the drawings. At the upper end of reversing shaft-arm is connected rod *e*, which connects to the wedge-rod *n n*. (Shown in Fig. 14.) Rod *n n* is placed inside a tube *O* to prevent the wedge-rod *n n* from being raised, so that puppet-valve *q* cannot be opened in any other way than the manner herein described. The coupling-pins to the connections can be sealed to stop any one from tampering with them. Puppet-valve *q* has a small spindle which protrudes through a suitable hole in tube *O*. The wedges *n n* are made at a given distance apart, so that the reversing-lever or reversing shaft-arm *f* can be moved in any position between dotted lines 1 and 3 without opening puppet-valve *q*; but the instant the reversing-lever or shaft-arm *f* is placed at either extreme position indicated by dotted lines 2 and 4 the wedges *n n*, sliding in the tube *O*, force open the auxiliary steam-valve *q*. Boiler-steam then rushes from

steam-pipe *t* into passage *s*, past puppet-valve *q* into passage *r* and steamway *V*, and then through the longitudinal port *X*, which communicates with the passage *Y* in low-pressure valve *E*. By this arrangement boiler-steam is admitted into the low-pressure cylinder when extra starting power is required, and the instant the reversing shaft-arm *f* is raised slightly toward the center (shown by dotted lines 1 and 3) the pressure of the steam instantly closes the puppet-valve *q*. The low-pressure piston then derives its powers from the exhaust of the high pressure. An arm *f* and the auxiliary steam and relief valves are placed on each side of a locomotive.

The valve-box *d* has an atmosphere-relief valve which opens the instant steam is shut off from the boiler. Air then centers into passage *s* and passage *t* to both ends of valve-cylinder *a*. Atmosphere relief is hereby given to the high-pressure piston. By the reversing lever or shaft-arm *f* being placed right forward or back auxiliary steam-valve *q* is open and the air rushes through passages *r* and *v* and port *x* into passage *y* through the low-pressure valve *E*, and then into the low-pressure cylinder *e*. By this combination and by having relief-valve *p* arranged so that it is in communication with the auxiliary valve *q* and steam-passage *v* and longitudinal port *x* a thorough atmospheric relief is thereby obtained for the low-pressure cylinder. One relief-valve thus acts to give relief to the high and low pressure pistons simultaneously when the engine is running with steam shut off.

I lay no claim to the relief-valve; but I claim the method of placing it in combination so that it gives relief to both cylinders.

Referring to Figs. 1, 2, 12, and 13, the high-pressure cylinder *d* is centrally placed inside of the low-pressure cylinder *c*, one valve-cylinder or valve-chest *a* acting for both cylinders. By this arrangement less space is required and less surface for radiation. The cylinders all act to superheat each other, thereby avoiding condensation of the steam. I am aware that this mode or arrangement of placing the high-pressure cylinder centrally within the low-pressure cylinder has been in use for marine engines, and therefore do not claim the above arrangement, broadly; but I claim this arrangement in a compound locomotive steam-engine using four cylinders, and also this arrangement in combination with one valve-cylinder or valve-chest. I am aware of valve-motion wherein fulcrum-rod *k* is used. In these cases it acts as a lead-rod and makes the valve cut-off more quickly, the method of connecting it to the valve-spindle and its action being directly opposite from my method and arrangement.

What I do claim as my invention, and desire to secure by Letters Patent, is as follows:

1. In a compound locomotive and other compound engines having the single steam or valve chest, the valves comprising two independent valve-sections, one of said sections

controlling the admission and exhaust of steam to and from a high-pressure cylinder and the other section controlling the admission of steam from the high-pressure cylinder to a low-pressure cylinder, and the exhaust from the low-pressure cylinder, in combination with any means for operating the said valves independently of each other, substantially for the purpose as shown and described.

2. In a compound locomotive steam-engine having the single steam-chest and a valve composed of two independent valve-sections, the valve for the low-pressure cylinder having a reduced degree of external lap in comparison to the high-pressure valve, in combination with means for obtaining a simultaneous lead, substantially as set forth.

3. In a compound locomotive having the single valve-chest and a valve composed of two independent valve-sections, the outer section for the high-pressure cylinder and the inner section for the low-pressure cylinder, the inner low-pressure valve-section having connection to an independent valve stem or spindle, in combination with any means for operating said valves independently of each other, substantially for the purpose set forth.

4. In a compound engine having the two independent valve-sections, the fulcrum or compensating rod *k* and the hollow valve-rod *h*, in combination with the said valves and cross-head *m*, substantially for the purpose set forth.

5. In a compound locomotive-engine having the single steam or valve chest, the steam and relief port *x* in valve *E* and the passage *v*, in combination with the auxiliary steam and relief valves *q* and *p*, substantially for the purpose as set forth.

6. In a compound locomotive having the single valve-chest, the combination of the auxiliary steam-valve *q* and the atmospheric relief-valve *p*, in combination with means for operating valve *q*, substantially for the purpose as set forth and described.

7. In a compound locomotive having the auxiliary steam or starting valve *q*, the rod *e* or wedge-rod *n n*, having connection to the reversing-gear or shaft-arm for the purpose of operating auxiliary steam-valve *q*, substantially for the purpose as set forth.

8. In a compound locomotive having the wedge-rod *n n*, the tube or guard *o*, in combination with the auxiliary steam-valve *q*, substantially for the purpose as set forth.

9. In a compound locomotive having the single steam or valve chest, the combination of the relief-valve *p*, and the auxiliary-valve *q*, placed in one valve case or box and acting in combination with each other, substantially for the purpose as shown and described.

10. In a compound locomotive having the single steam or valve chest, the combination of the high-pressure cylinder placed within the low-pressure cylinder, steam-passages leading from opposite ends of each of said cylinders to a valve-seat face, an exhaust-

passage leading from said valve-seat face, and a distribution-valve composed of two independent valve-sections and controlling the valve-seat ports, said valve providing a passage for steam between the sections from the high to the low pressure cylinder, the low-pressure-valve section having a less degree of lap and a shorter range of traverse than the high-pressure valve, and the fulcrum or compensating rod *k*, acting in combination with the cross-head and other valve-motion to retard and accelerate the action of the low-pressure - valve section, substantially as set forth.

27th day of October, 1890.

HENRY MONK.

Witnesses:

ARTHUR MUMMERY,
ALBERT MUMMERY.