Sheet 1. 2 Sheets.

A. Connison,

Reciprocating Steam Engine,

No. 2,872, Patented Dec. 5, 1842.

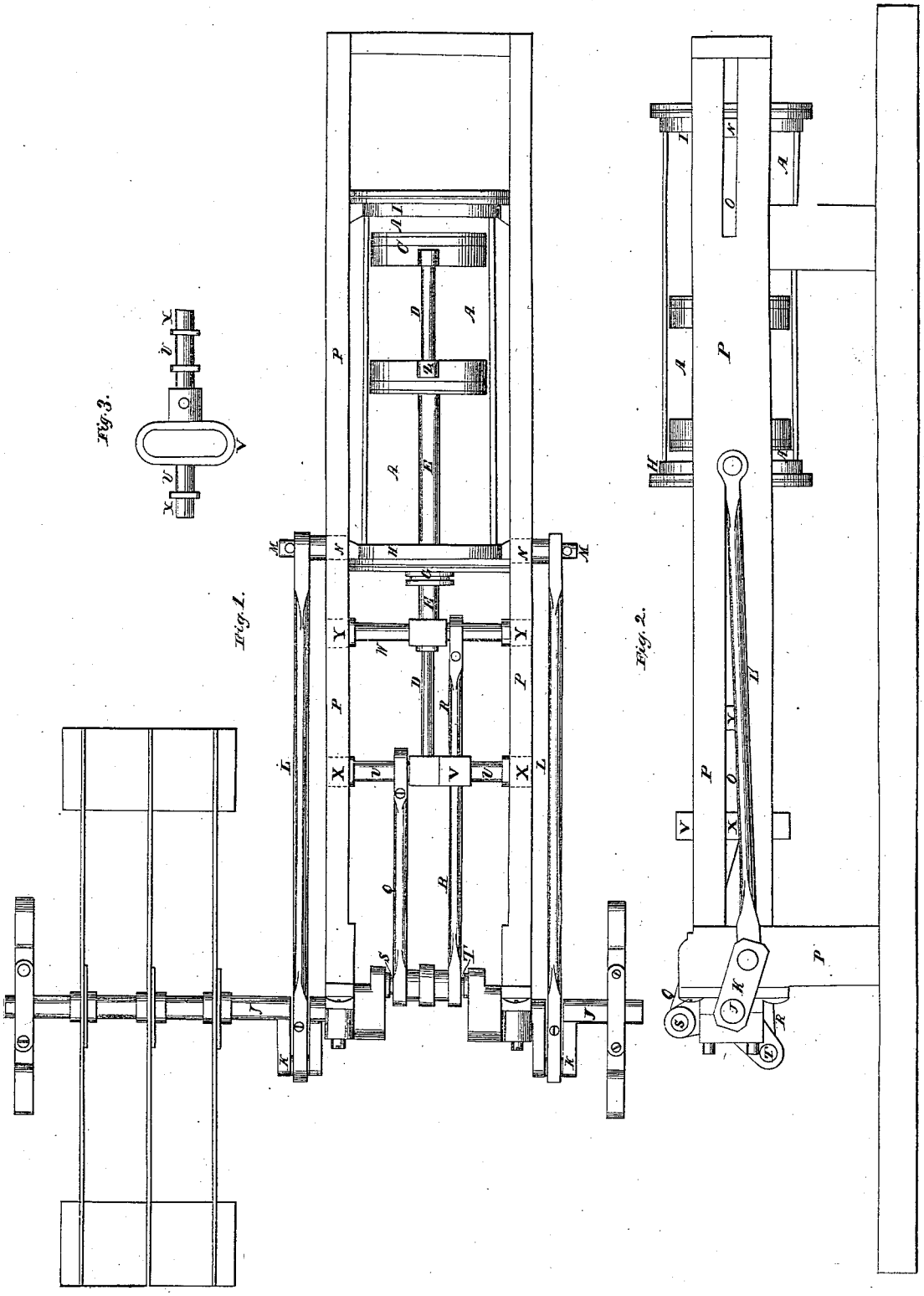

Fig. 1.

Fig. 3.

Fig. 2.

Sheet 2 - 2 Sheets.

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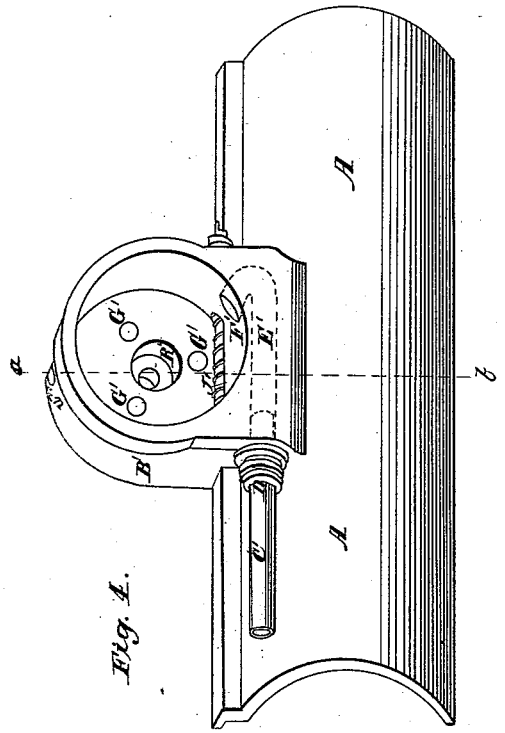

Fig. 4.

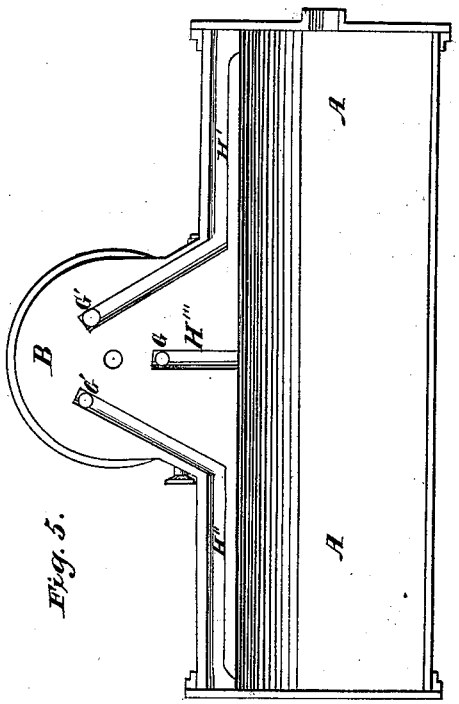

Fig. 5.

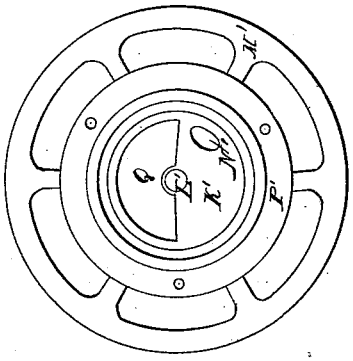

Fig. 7.

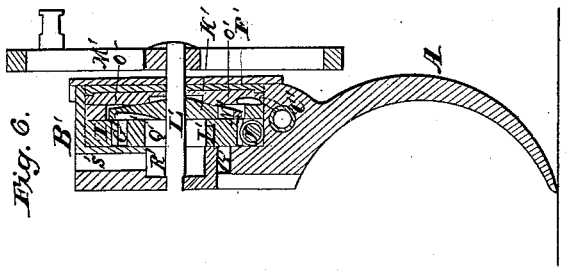

Fig. 6.

UNITED STATES PATENT OFFICE.

ALEXANDER CONNISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN THE STEAM-ENGINE.

Specification forming part of Letters Patent No. **2,872**, dated December 5, 1842.

To all whom it may concern:

Be it known that I, ALEXANDER CONNISON, of the city of Newark, in the county of Essex and State of New Jersey, have invented a new and useful improvement in the manner of combining, arranging, and operating the pistons and cylinder of a steam-engine, and likewise an improved manner of comstructing and aranging a rotary valve adapted thereto; and I do hereby declare that the following is a full and exact description thereof.

In my steam-engine I place the cylinder upon slides, so that it may be made to vibrate back and forth or up and down, as the case may be. It is, however, in general intended to be placed horizontally. To this cylinder I adapt two pistons, the piston-rod of one of them being tubular, so as to allow the solid rod of the second piston to pass through it, a stuffing-box being used for the purpose of causing the latter piston to slide through the former steam-tight. For regulating the motion of the cylinder and of the pistons I use a three-throw crank, which is so constructed that the three wrists or operating parts of said crank shall stand at an angle of one hundred and twenty degrees with each other, and therefore divide the circle of their revolution into three equal parts. The crank that is to cause the cylinder to vibrate may be double, so as to employ two connecting-rods attached on opposite sides of the cylinder. The crank carrying the hollow piston-rod I sometimes likewise make double, so as to have two connecting-rods attached to its slide or cross-head, the object in these cases being to secure steadiness of motion. By this arrangement of two pistons in one cylinder the chamber or interior of the cylinder will be divided into three compartments or chambers, within which the steam is to operate, instead of into two, as in the ordinary steam-engine, and into each of these compartments the steam must be admitted through suitable valves and passages and must, in like manner, be discharged therefrom when its action is to cease. The valves used for these purposes may be constructed in a variety of ways. They may, for example, be made in the form of revolving, sliding, or other valves, as may be preferred by the constructor; but I do not intend to limit myself in this particular, my main improvement consisting in the so constructing of my engine as that there shall be three chambers formed within the cylinder, in which chambers the steam is to operate, its operation being governed by a three-throw crank of the kind above noticed, and by means of which the action of the steam upon the crank-shaft will be such as to avoid the influence of what are denominated "dead-points," the action of the engine being thereby nearly equalized without its being necessary to employ a fly-wheel to effect such equalization, although, as above noticed, steam-valves of different kinds may be used with my engine. I have, however, invented a rotary valve, the respective parts of which are so arranged as to adapt it in an especial manner thereto, and which will be presently described.

In the accompanying drawings, Figure 1 is a top, and Fig. 2 a side, view of my engine, supposing the cylinder to be placed horizontally. It may, however, be placed vertically or obliquely when these positions are from any cause preferred.

The cylinder is represented as transparent, for the purpose of showing the pistons within it.

A A is the cylinder, which has within it the two pistons B and C, each of which has its appropriate piston-rod.

D D is the piston-rod of the piston C, and E E that of the piston B. This latter rod is tubular, the solid rod D passing through it, there being a stuffing-box at F to cause the rod D to work steam-tight. The tubular rod E also works through a stuffing-box at G in the head of the cylinder H in the usual manner. I is the opposite head of the cylinder.

The pistons B and C are made to vibrate within the cylinder by means of cranks, and the cylinder itself I also, in general, make to vibrate, the vibrations being effected in a manner to be now described.

J J is a crank-shaft, upon which I, in preference, form four and sometimes five cranks, but in such manner as that it shall still constitute a three-throw crank, two of the cranks—namely, those which give motion to the cylinder—standing in the same direction and being double for the sole purpose of giving steadiness to the vibration by connecting their rods or shackles to opposite sides of the cylinder, and the crank which is to vibrate the piston B, I sometimes make double.

K K are the two cranks, which vibrate the

cylinder, L L being the two connecting-rods leading from them to the sides thereof and embracing the pins M M, attached thereto. The cylinder is sustained and guided by the slide or guide-pins N N, which pass into slots or guide-grooves O O in the frame P P of the engine, or by means of any other suitable supports or slides.

Q and R are two connecting rods or shackles, which connect the piston-rods D and E with the two other cranks on the shaft J J, which cranks are shown at S and T, Fig. 2.

The cranks K, S, and T stand at an angle of one hundred and twenty degrees from each other, dividing the circle of their revolution into three equal parts. They are of equal length, the two pistons and the cylinder each vibrating to the same distance.

U U is a cross-head, to which the piston-rod D is attached, and which is embraced by the shackle Q. This cross-head is shown separately in Fig. 3. Through an eye, V, in it the shackle R passes, said shackle embracing the cross-head W, to which the tubular piston-rod E is attached.

X and Y are the slide-pins or ends of the cross-heads U and W, respectively, these ends being received into and guided by the slot or groove O O.

From the above-described arrangement of the pistons, the cylinder, and the three-throw crank, (the piston-rods being made of the proper length,) the pistons B and C will, when the engine is in motion, be made alternately to approach toward and to recede from each other. The piston B and the head H will also in like manner be made to approach and to recede, and so will the piston C and the head I. The two pistons and heads will divide the cylinder into three chambers or compartments, into each of which the steam is to be admitted, and is allowed to operate expansively in them, after doing which it is to escape through eduction-openings suitably arranged for that purpose. The admission of steam between the two pistons is to commence at the instant of their nearest approach to each other, and this must be continued during that portion of the stroke due to its direct admission, when it is to be cut off and allowed to act expansively during the remainder of the stroke. When the pistons have approached each other, and the steam which is to be admitted between them is about to be let on, they will not at first recede sensibly from each other, nor will they remain at rest, but will travel on together to a certain distance and will then begin to recede. It will be evident, therefore, that the steam cannot be let on at the point of junction between the two pistons or at any determinate point between them for a sufficient space of time unless some special provision be made for that purpose, and this I accomplish in the following manner.

Z Z are notches or cavities made in the peripheries of each of the pistons, which cavities will coincide when the pistons are brought together, and are to be immediately under the induction-opening. To allow of the formation of these cavities, I give a greater width or thickness to the pistons on the sides which are toward each other than on their reverse sides, and their packing is consequently not in the centers of their peripheries. This increased width should be no greater than is necessary for the admission of steam, and its proper extent can be readily ascertained.

The dotted lines at Z Z, Fig. 2, show the form in which the cavities in the pistons may be made, although this form is not essential. A like effect would be produced by beveling the edges of the two pistons all round; but this would cause a waste of steam. The steam is in like manner to be let into the compartment A when the piston B has made its nearest approach to the head H, and into the compartment A″ when the piston C is nearly in contact with the head I. The induction of steam into the three chambers will take place at equal intervals, as will also its eduction or escape therefrom. It may of course be cut off at any part of the stroke; but I am of opinion that as a general rule the cutting off at one-eighth of the length of each of the compartments, reckoning said length at the points where the two pistons or the respective pistons and the heads of the cylinder are at their greatest distance from each other, will be found to be the best mode of procedure, employing the steam with the greatest economy.

I will now proceed to describe my improved rotary or revolving valve, and the manner in which I apply it to my vibrating cylinder.

Fig. 4 is a sectional view of a part of the exterior of my steam-cylinder, together with a portion of the apparatus constituting the rotary valve and the seat thereon. Fig. 5 is a similar view of the inner portion of a part of the steam-cylinder, valve-seat, and steam-ways, these sections being made through the axis of the cylinder longitudinally and through the middle of the valve-seat. Fig. 6 is a transverse section through the line *a b* of Fig. 4, the respective parts of the valve being shown in place. Fig. 7 is a view of the revolving valve, its stationary cap, and a fly-wheel attached to its shaft, as seen on its inner side.

A A is the steam-cylinder.

B′ B′ is the valve seat or box.

C′ is the steam-pipe, leading from the boiler to the valve-box.

D′ is a stuffing-box, through which the pipe C′ slides steam-tight, the tubular space (represented in the lower part of the valve-box by the dotted lines E′) being of sufficient depth to allow of the passing in and out of the steam-pipe C′ under the requisite vibration of the cylinder. This tubular space leads into the valve-box through an opening at F′.

The three openings G′ in the valve-box lead to the three steamways H′ H″ H‴, Fig. 5, which constitute the induction and eduction passages, the ways H′ and H″ leading to the ends of the cylinder and H‴ to the chamber

between the two pistons. To regulate the size of the openings G′, I place a disk (seen in section at I′) in the bottom of the box B′, said disk having three openings through it corresponding with the openings G′, and this disk constitutes the proper seat of the revolving valve. The object of it is to obtain the means of regulating the size of the openings G′, and for this purpose the disk is made to revolve to a small distance by means of a tangent screw, J′, acting on its periphery, and thus opening or closing the apertures G′ to any desired extent.

K is the rotary valve, which is made fast to the axle L′, said axle having on it also the fly-wheel M′. The valve K′ is ground to fit closely on the seat I′. The induction-opening through this valve is shown at N′. The length of the opening will determine the point at which the steam shall be cut off. The space O′ O′ between the cap-plate P′ and the valve K′ constitutes the steam box or chamber, which receives the steam from the induction-opening F′. The cavity Q′ in the inner face of the valve K′ covers two of the openings G′ and effects the eduction or escape of the steam in the same way as in the ordinary slide-valve. There is an opening, R′, through the center of the valve-seat I′ and into the cavity R′ of the box B′, which cavity leads to the opening S′, through which the waste steam is to escape. The axle or shaft L′ fits closely in its bearings in the cap P′ and the box B′, and may be provided with stuffing-boxes. The valve K′ may be made to revolve by means of a crank and shackle-bar.

T′ is a crank-pin on the fly-wheel M′, which has the same throw or radius with the cranks that vibrate the cylinder and pistons. The shackle or connecting rod, one end of which embraces the crank-pin T′, is at its other end connected with a joint-pin, which is attached to the frame-work, and is stationary, the vibration of the cylinder giving the necessary throw to the crank-pin T′, and causing the valve to revolve.

In order to reverse the motion of the engine, I make my valve double in all its parts—that is to say, the box B′ and all its appurtenances are repeated on the side of the cylinder, (not shown in the drawings,) the steam-ways H being common to both. The shafts L′ of each of these valves are coupled together by a feather or otherwise, and by shifting the induction from one of these valves to the other the motion of the engine will be reversed in a manner well known.

It will be manifest that the cylinder-heads in an engine constructed in the manner of that herein described perform, in part, the office of pistons as they vibrate back and forth, and in so doing the cylinder is made to operate upon the crank-shaft J J as decidedly as do the pistons B and C. I have in fact made these heads to operate in the manner of pistons by causing them to slide within a stationary cylinder, instead of causing the cylinder to vibrate. In this case the two heads are fitted into the cylinder, and are packed as pistons, and they are made to vibrate simultaneously to the same distance and in the same direction, just as the two heads H and I are made to vibrate with the cylinder in the within-described engine. This vibration of the piston-heads, every machinist will perceive, may be effected by connecting the shackles or rods L L, Fig. 1, by means of cross-heads or otherwise, with the two heads so fitted as pistons into a stationary cylinder. Under this modification of my machine a rotary valve similar to that herein described may be employed for the induction and eduction of the steam with no other change in its arrangement than that which would necessarily result from the cylinder being stationary; but valves of other kinds may be employed. After due consideration, however, I have given the preference to the plan of making the cylinder itself to vibrate, as being less complex, attended with less friction and less loss of steam, than with the vibrating heads, as a portion of steam will be condensed when the heads are made to vibrate by the cooling influence of the atmosphere to which both surfaces of the cylinder ends will be exposed during a part of every stroke.

Having thus fully described the nature of my invention and set forth the manner in which the same is carried into operation, I do hereby declare that I do not claim the employment of two pistons within one cylinder, this not being in itself new; nor do I claim the use of a tubular piston-rod admitting another piston-rod to work through it, these having been previously used, but not under an arrangement and combination similar to that adopted by me.

What I do claim, therefore, is—

1. The manner herein described of combining the two pistons and the cylinder with a three-throw crank, the acting portions of which are at the distance of one hundred and twenty degrees apart, in such manner as that the two pistons and the cylinder shall be made to vibrate to equal distances, and so as to allow of the introduction of steam into three compartments or chambers within the cylinder to operate therein for the purpose and in the manner set forth. I also claim as a modification of this plan the causing of the piston-heads to vibrate within a stationary cylinder, said heads being fitted to the cylinder in the manner of pistons and their vibrations being simultaneous, such heads traversing without the cylinder in the same manner in which they would traverse with it under the first-described modification and effecting the same purpose as the vibration of the heads with the cylinder, and by means substantially the same, there being in either case three distinct motions—namely, that of the two cylinder-heads and those of the two pistons—produced by a three-throw crank, constructed and proportioned as set forth.

2. The manner in which I have combined

and arranged the respective parts of my rotary valve, as herein described. I do not claim to be the first inventor of a rotary valve; but I do claim the combining of the tangent screw, the valve-seat, the openings through that seat and through the valve-box, so as to be capable of adjustment and to cause them to operate as set forth. I claim the manner of causing this valve to revolve by means of a shackle-bar held on a stationary joint-pin at one end and embracing a crank-pin on the other, by which motion shall be given to the valve-shaft.

3. The manner of letting the steam on between the two pistons by means of a device substantially the same with that represented at Z Z in the accompanying drawings, and described in the specification, by which means the introduction of steam between the two pistons may be continued during the time required for that purpose.

I have thus made known what I consider to be the best manner of constructing, arranging, and operating the respective parts of my engine; but I do not intend by this description to limit or confine myself to the precise forms or proportions herein given, but to vary these as I may think proper, while I attain the same end by means substantially the same.

ALEXANDER CONNISON.

Witnesses:

THOS. P. JONES,

P. K. MORSELL.