T. McDonough,

Air Engine,

No. 15,771. Patented Sep. 23, 1856.

Fig. A

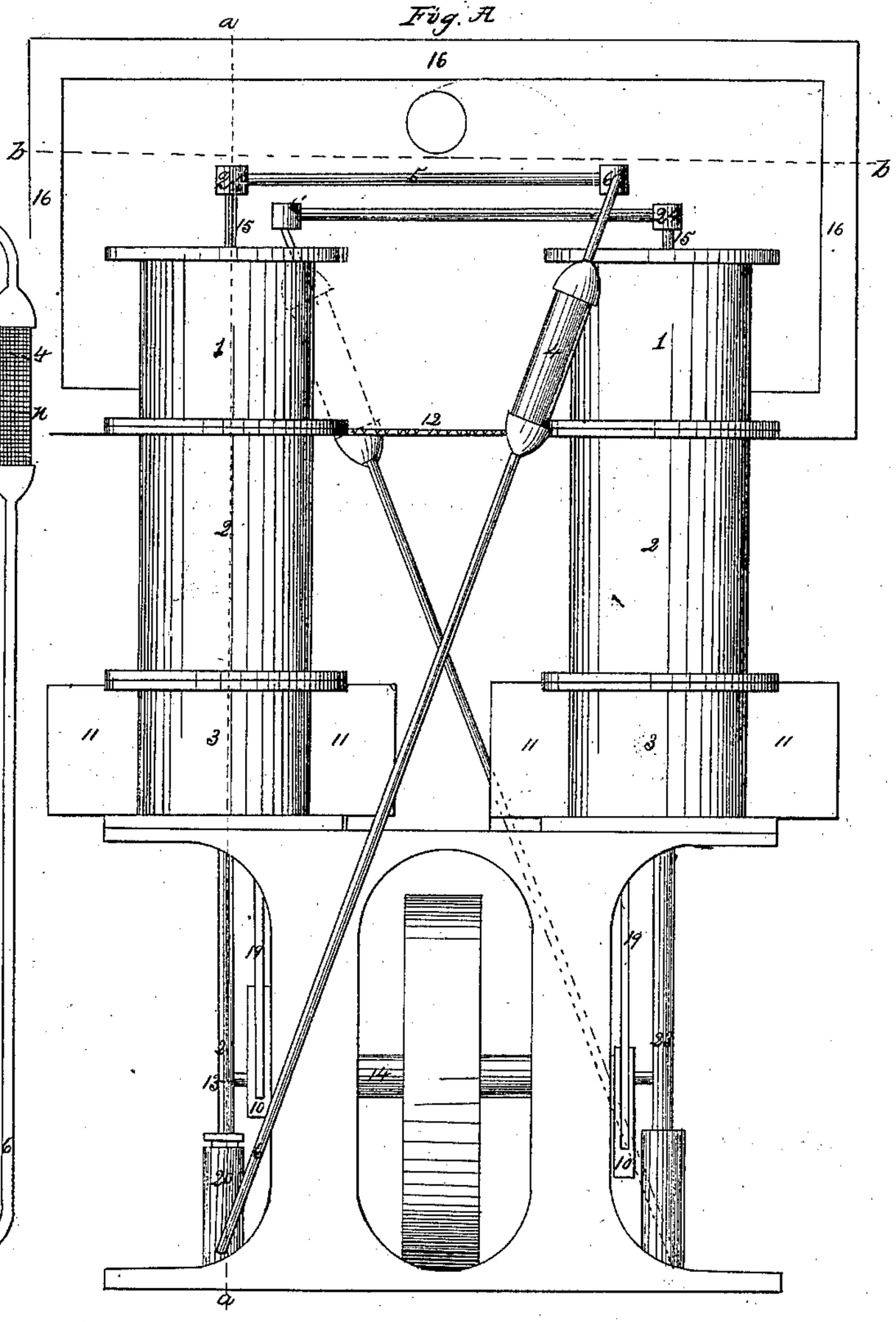


Fig. B

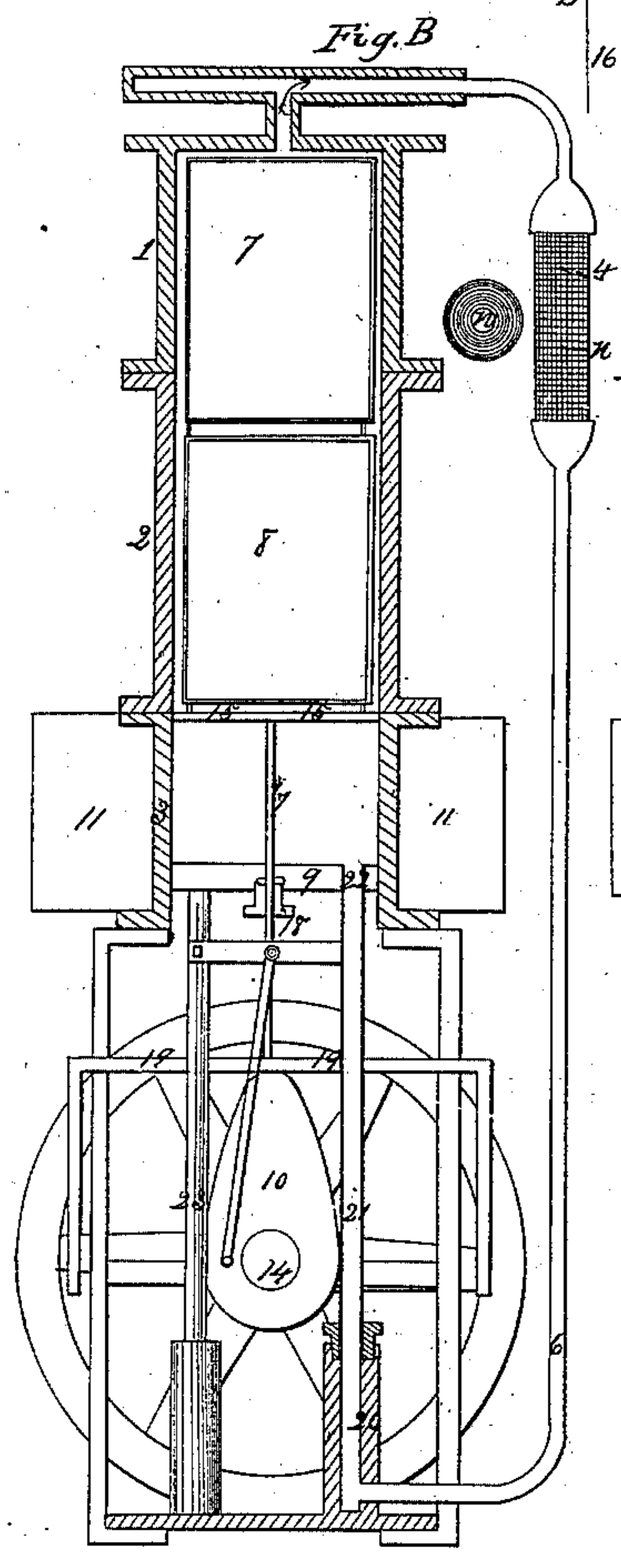
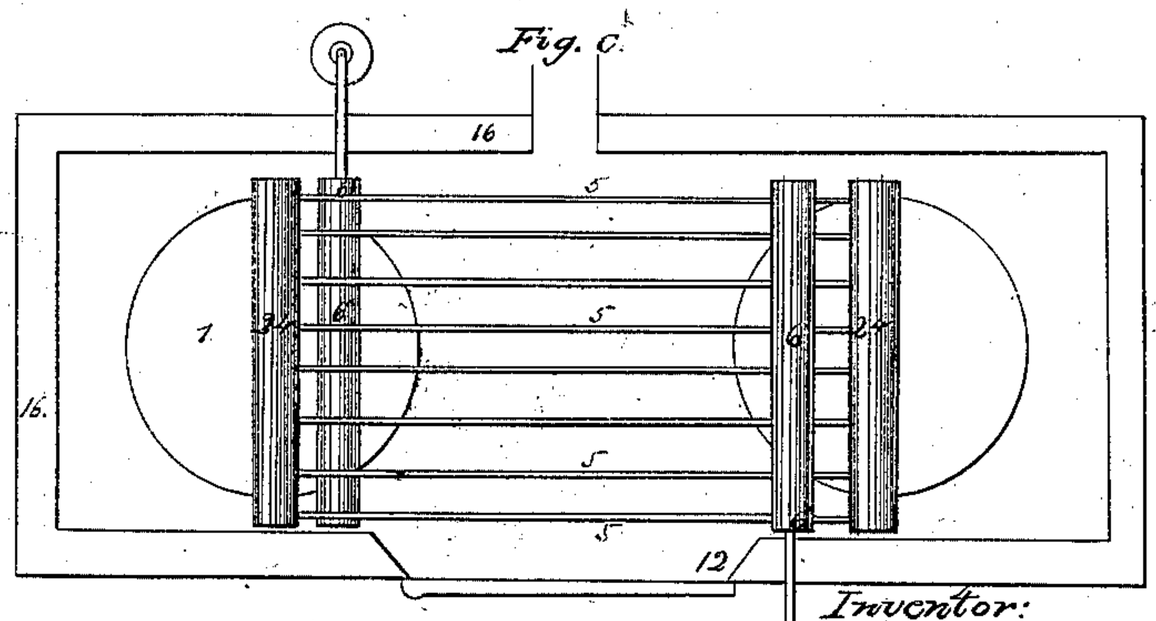


Fig. C.



Witnesses:

Wm. A. Barlow

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Inventor:

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UNITED STATES PATENT OFFICE.

THOMAS McDONOUGH, OF MIDDLETOWN, CONNECTICUT.

AIR-ENGINE.

Specification of Letters Patent No. 15,771, dated September 23, 1856.

To all whom it may concern:

Be it known that I, THOMAS McDONOUGH, of Middletown, Middlesex county, in the State of Connecticut, have invented certain new and useful Improvements in the Air-Engine, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

Figure A is a front elevation with the outer casing removed to exhibit the arrangement; Fig. B a vertical section taken at the line *a*, *a* of Fig. A; and Fig. C a horizontal section taken at the line *b*, *b* of Fig. A.

The same figures indicate like parts in all the sections.

In my said engine there are two pairs of cylinders 1, 3 and 1, 3, the two cylinders of each pair being placed vertically one above the other with a third cylinder 2 connected with and interposed between them; the cylinder 2 should be made either of very thin metal which can be kept cool by a current of air outside, or made of some bad conductor so that the heat of the upper cylinder will not be conducted to the lower one which is to be kept cool by water in a surrounding vessel 11.

To the lower cylinders 3, 3 are fitted working pistons 9, 9 connected with cranks 13, 13 to impart motion to the crank shaft 14, the two cranks being directly opposite to each other so that as one piston rises the other descends. And to these pairs of cylinders are also fitted what I term dummy pistons, each composed of two hollow cylinders 7, 8 with closed ends and connected together with the lower end of the lower one in the regular form of a piston 15 packed to work accurately in the lower or cold cylinder while the upper end works in the upper or hot cylinder to which it may be packed or not at pleasure.

The upper end of the upper or hot cylinder of each pair is connected with the lower end of the lower or cold cylinder by a pipe 6 with what I term a lung 4 interposed in some portion of its length, the said lung being a cylindrical vessel 4 filled with a sheet of wire gauze *n* rolled up and the roll put lengthwise in the said cylindrical vessel. There is one such pipe and lung for each pair of cylinders, and the pipes above the lungs instead of communicating directly with the upper end of the hot cylinders have coils interposed and exposed to the heat of a furnace 12. The upper portion of the pipe 6 runs horizontally and is enlarged as at 6′; its end is closed and to its side are connected a series of parallel pipes 5, 5 which communicate with the side of another transverse pipe 24, with closed ends and which communicates with the upper end of the hot cylinder by a short vertical pipe 15. There are two such series of pipes one for each pair of cylinders. They are placed directly over the furnace 12 so that the products of combustion on their passage to the chimney, from the grate, must pass among the pipes and heat the air as it passes from the lungs to the hot cylinders. The casing 16 of the furnace should surround the upper or hot cylinders so as to maintain them at the required temperature, and if the interposed cylinders 2, 2, be made of thin metal instead of some bad conductor of caloric they should be surrounded each by a jacket communicating with the ash pit of the furnace to induce a current of cold air around them to keep them cool; but I prefer to make these intermediate cylinders of some bad conductor of caloric.

The piston rod 17 attached to the lower end of each dummy piston passes through a stuffing-box 18 in the corresponding working piston and its lower end is attached to a cross head 19 adapted to work in suitable ways and resting on the periphery of a cam 10 on the crank shaft, and each cam is so situated relatively to its appropriate crank, as to suddenly lift the dummy piston as the crank is passing its lower dead point and the working piston begins to ascend.

The lower end of the pipes 6 may communicate directly with the side of the hot cylinders near their lower end; but the better to permit the entrance and escape of the air, when the two pistons in each cylinder are very near to each other, I connect the lower end of the said pipes 6, 6 each with a small cylinder 20 having a closed bottom and a stuffing box at the upper end in which a vertical pipe 21 slides, the said pipe being fitted to a hole in the working piston as at 22. In this way the pipe moves up and down with the working piston. A guide rod 23 is attached to the working piston on the opposite side of the piston rod to balance the pipe 21.

The apparatus being charged with air, the lower cylinders 3, 3 surrounded with cold water, and fire made in the furnace to heat the coils of pipes above the lungs, and also the upper cylinders 1, 1, the engine is in a condition to be started. The cam 10 on one side suddenly forces up the dummy piston, which will be done by a very slight expenditure of force, as the two cylinders 1 and 3 are connected by the pipe 6, and the air whether expanded or contracted will exert its elastic force equally above and below the dummy piston. By the sudden lifting of the dummy piston, the heated air contained in the upper or hot cylinder and in the coil of pipes is caused to pass longitudinally between the several coils of wire gauze constituting one of the lungs 4 in one of the pipes 6. And as the heated air thus passes freely and in thin films between the several coils of wire gauze the large amount of metallic surface thus presented takes up the caloric of the heated air so that after this air shall have passed through such lung and entered the lower or cold cylinder it will have been contracted so that it will be reduced to a pressure considerably below the pressure of the atmosphere. A partial vacuum is thus obtained and while the dummy piston is held up by the cam 10 the working piston is forced up in the cold cylinder 3 by the preponderating pressure of the atmosphere, thus impelling the crank shaft. By the time this has taken place in one pair of cylinders the like operation begins to take place in the other pair of cylinders, while in the first pair an opposite action takes place. The cam by this time will have passed around so that the dummy piston rests on the working piston, and as the working piston is forced up by the pressure of the atmosphere on the other side this one is forced down as the air expands in the hot cylinder 1 by reason of the caloric which it has absorbed in passing in the reversed direction through the appropriate lung and through the heated coil of pipes. In this way the pistons are alternately operated, the working piston being forced up by atmospheric pressure on one side while the other is forced down by the expanded heated air on the other, the dummy piston on each side being forced up to effect the transfer of the air to produce the partial vacuum that the working piston may be forced up by atmospheric pressure, and the working and dummy pistons being then forced down together by the force of the expanded air.

I have so far described my said engine so charged with air that when the air is expanded by heat it shall occupy the entire space within the engine at or about the pressure of the atmosphere, that when contracted by depositing the caloric in passing through the lungs a partial vacuum will be formed at each operation, that one of the working pistons may be forced up by atmospheric pressure. But instead of this the air or other permanent gas may be charged into the apparatus under pressure so that the whole action will take place in the engine above atmospheric pressure, in which case the working piston in the cold cylinder of one pair will be forced up by the pressure of the expanding heated air in the hot cylinder of the other pair.

It will be seen that by placing cylinders for the expansion of the heated air above, and the cold cylinders below, and placing the engine in a vertical or nearly vertical position, with the lower cylinders surrounded with cold water, that the parts are in the best position, as heated fluids always have a tendency to rise; hence all the heated particles will rise to the upper part of the apparatus, and there will not be the slightest possible tendency to heat the lower cylinders by conduction, while all tendency to heat the water which surrounds the lower cylinders, by circulation will be entirely avoided, as the heat radiated onto the top of the surrounding jackets can be readily prevented by the interposition of bad conductors, and even if not so protected the tendency to heat water by the application of heat to the top would be so slow as not to present a serious practical difficulty.

It will be obvious that many merely formal changes may be made in the construction of the apparatus without changing the principle on which my said engine depends for its efficient action. As for instance the dummy pistons instead of being composed each of two hollow cylindrical vessels connected together, may be composed of one, or more than two, or they may be solid if composed of some bad conductor of caloric, or it may be composed of two pistons connected by rods, one of the said pistons fitting the cold cylinder below and the other the hot cylinder above. And so with the intermediate cylinder connecting the hot and cold cylinders constituting each pair; any variation in the mere construction of this part may be made so long as it is employed to prevent the one from affecting the temperature of the other. And so with the coils of pipes to heat the air in passing from what I term the lungs to the hot cylinder, the structure may be varied at pleasure as the sole object is to expose a large amount of surface to the heat evolved from the furnace with the view to economize fuel. The connection of the pipes with the upper end of the hot and the lower end of the cold cylinders may be varied at pleasure although I prefer the arrangement herein specified. The rapid lifting motion may be imparted to the dummy pistons by any suitable me-

chanical means which will act as the equivalent of the cams, although I prefer the cams for this purpose.

I am aware that the alternate expansion and contraction of atmospheric air and other permanent gases has been employed as a motive agent in engines of various constructions, and I am also aware that the gases so employed have been made to pass alternately in opposite directions through a vessel presenting a large amount of metallic surface, so that in passing in one direction such metallic surfaces should take up caloric from the heated gas when passing in one direction, and transfer it back to the said gas when passing in the opposite direction. And I am also aware that such metallic surfaces have been composed of a series of disks or sheets of wire gauze but so arranged that the air or gas had to pass through the meshes of the wire gauze which had the effect of impeding the passage. I do not therefore wish to be understood as making claim to any of these things.

What I do claim as my invention and desire to secure by Letters Patent is—

1. Combining the hot and cold cylinder (or cylinders) by an interposed cylinder, substantially as described, to prevent the one from being affected by the temperature of the other, as set forth.

2. I also claim the working piston (or pistons) working in the cold cylinder in combination with the dummy piston (or pistons) which extends from the cold to the hot cylinder, substantially as and for the purpose specified.

3. I also claim the vertical position of the pairs of cylinders, substantially as described, that the heated part of the engine may be above the cold parts, for the purpose set forth, in combination with the means herein described for keeping the lower part of the engine cold substantially as described.

4. And I also claim the arrangement of the metallic surfaces through which the air or other gas passes by making such metallic surface of sheets of wire gauze rolled up and placed in a surrounding vessel, so that the air or other gas shall pass in films between the several coils, substantially as and for the purpose specified, in contradistinction to passing through the meshes of wire gauze, as set forth.

THOMAS McDONOUGH.

Witnesses:

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A. P. BROWNE.