C. J. RAMSBURG, W. A. PHILLIPS & F. E. SWOPE, JR.

PORTABLE THERMAL FAN.

APPLICATION FILED MAR. 12, 1910.

992,061. Patented May 9, 1911.

2 SHEETS—SHEET 1.

FIG. 2.

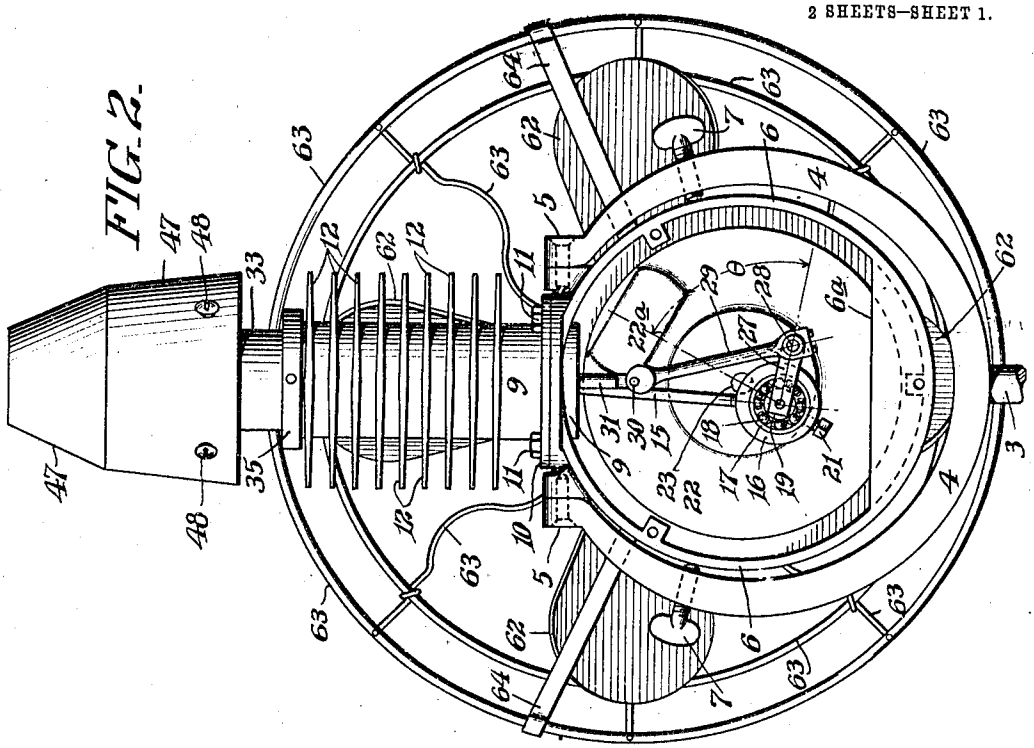
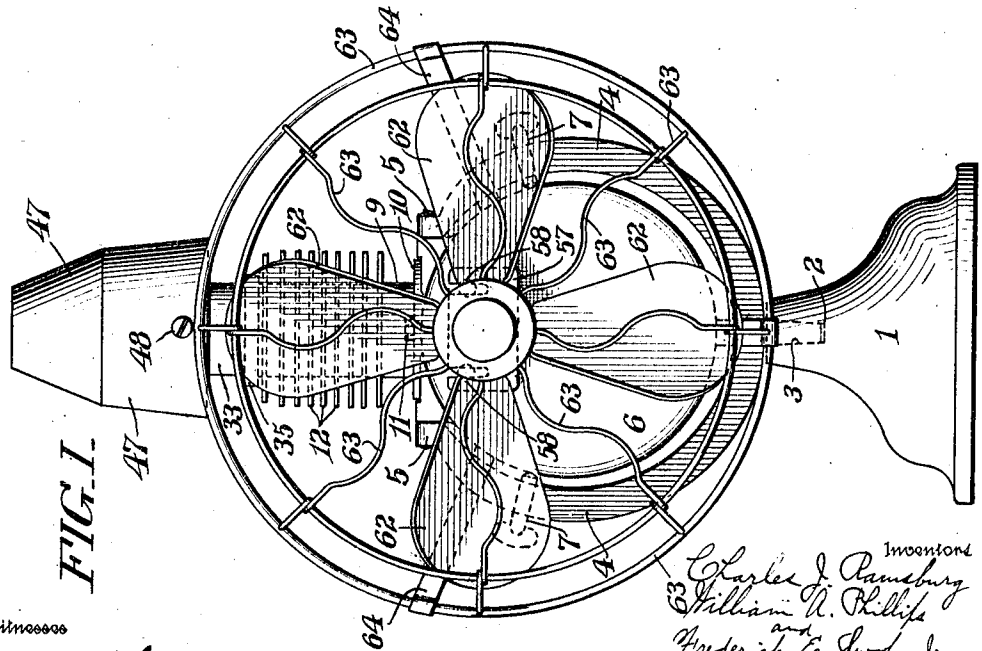


FIG. 1.



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2 SHEETS—SHEET 2.

FIG. 3.

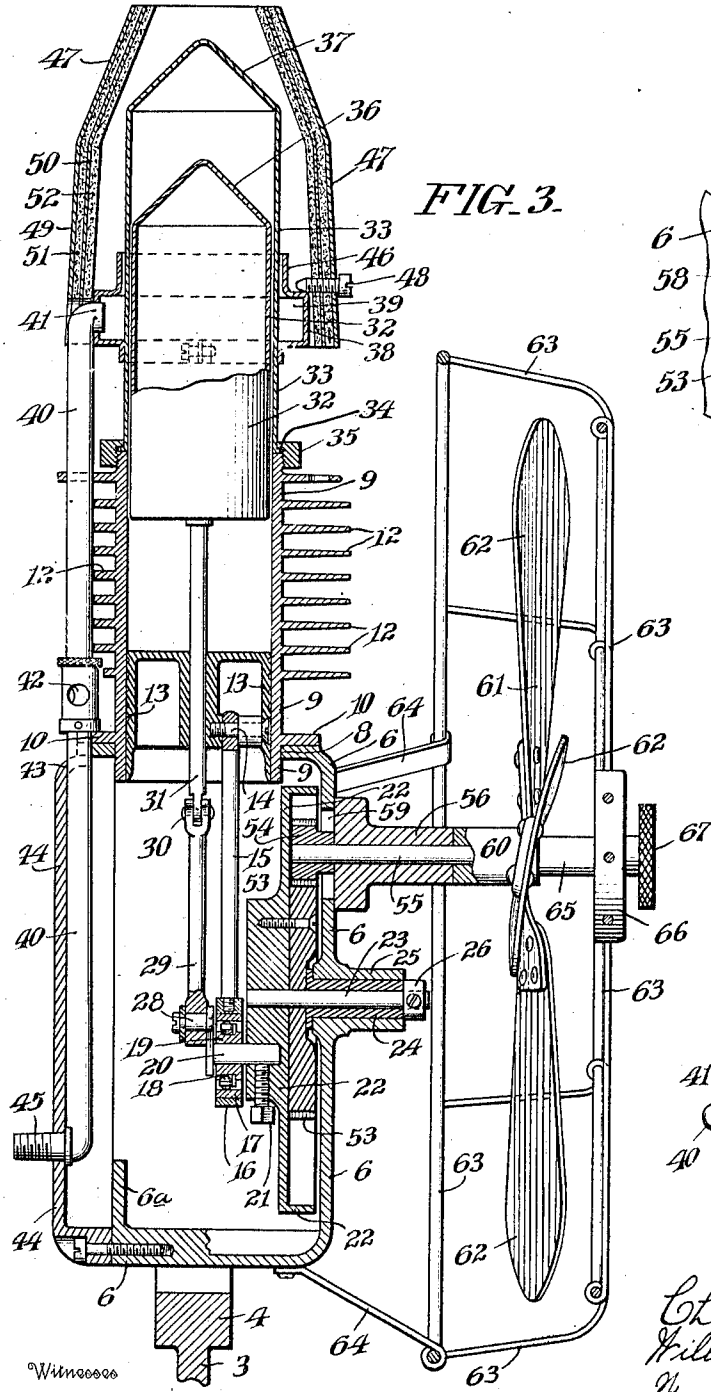

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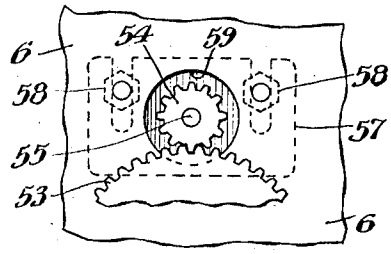
FIG. 4.



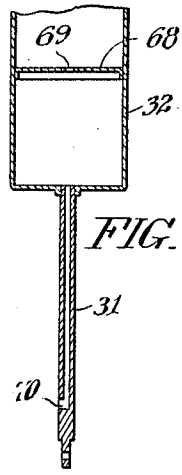
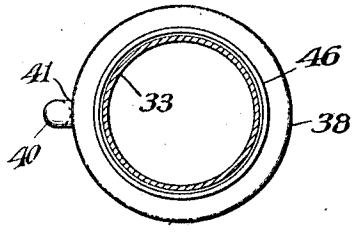


FIG. 6.

FIG. 5.



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UNITED STATES PATENT OFFICE.

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PORTABLE THERMAL FAN.

992,061. Specification of Letters Patent. Patented May 9, 1911.

Application filed March 12, 1910. Serial No. 549,003.

To all whom it may concern:

Be it known that we, CHARLES J. RAMSBURG, WILLIAM A. PHILLIPS, and FREDERICK E. SWOPE, Jr., citizens of the United States, residing in Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented new and useful Improvements in Portable Thermal Fans, of which the following is a specification.

Our invention relates to a fan or blower driven by a thermal engine, and more particularly to a fan or blower so driven which, with the driving engine, shall be compact and portable for use as a domestic or office fan similar to the now commonly used electric fan for like purposes.

It is the object of our invention to provide such a high speed portable fan which may be driven by a thermal engine, in which the combustion of gas, alcohol or other suitable material, is economically employed in connection with an air engine to drive at relatively high economy a fan at suitably high speed, the entire combination of fan and engine to be compact and preferably portable. To this end we have produced a highly efficient and high speed engine of the type described, and have combined the same with a fan in compact and practical manner, whereby a high speed portable thermal fan is produced.

Our invention resides in the features hereinafter described and pointed out in the claims.

For an illustration of one of the many forms our invention may take, reference is to be had to the accompanying drawings, in which:

Figure 1 is a front elevational view of a portable fan involving our invention. Fig. 2 is a rear elevational view of parts of the same, on larger scale, a cover being removed to show parts within a casing. Fig. 3 is a vertical cross sectional view, on a scale larger than Figs. 1 and 2, taken at right angles to Fig. 1. Fig. 4 is a fragmentary view illustrating the mode of fastening the fan shaft to the casing and of introducing the pinion. Fig. 5 is a top plan view of the burner with the upper cylinder shown in horizontal section. Fig. 6 is a view showing a modified form of agitator, having its interior in communication with the outer air.

Referring to the drawings, a base 1 supports the entire apparatus, and such base may be placed upon a desk, mantel, or any other suitable support, the entire fan and base being portable so that it may be easily carried about and placed in any desired position. In the top of the base 1 there is provided a vertically extending hole 2 adapted to receive the pin 3 secured upon or integral with a ring or bracket 4, the ring or bracket 4 supporting the fan and driving motor which may be rotated to point the fan in any direction by rotating the ring 4 upon its pivotal pin 3.

At 5 approximate the top of the bracket ring 4 is pivoted the casing 6 which supports the engine and fan which may swing as a unit about the pivotal axis 5 so as to point the fan upwardly or downwardly or horizontally, as desired, the thumb screw 7 extending through the bracket ring 4 and engaging the outside of the casing 6 serving to hold the parts in adjusted position.

The casing 6 is provided at the top with an opening 8 to receive the cylinder 9 having flange 10 secured by nuts or bolts 11 to the top of the casing 6. The exterior of the cylinder 9 may be provided with radiating or cooling devices such as the ribs 12. Within the cylinder 9 is disposed the piston 13 having the horizontal pivotal pin 14 upon which is pivoted the connecting rod 15 terminating at its lower end in a relatively large circular bearing member inclosing the bearing ring 17 which surrounds and bears against the balls 18 suitably spaced and held and bearing on the crank pin bearing member 19 upon the crank pin 20 secured by set screw 21 in the fly wheel 22 upon the shaft 23 having a bearing in the bushing 24 held in the boss or bearing 25 upon or integral with the casing 6, a collar 26 being secured upon the outer end of the shaft 23 to hold the parts in place. Upon the fly wheel 22 may be provided a balance weight 22^a to balance the effect of the connecting rods 15 and 29 and their associating cranks and parts when moving at high speed. Secured upon the crank pin 20 is a crank 27 carrying at its outer end the crank pin 28 upon which is mounted a connecting rod 29 pivoted at its upper end at 30 to the agitator rod 31 which extends freely through the piston 13 and carries at its upper end the agitator or displacer 32, which moves freely in cylinder 9

and also within the agitator cylinder or upper cylinder 33 having at its lower end a flange 34 by which it is held by coupling ring 35 securely to and in alinement with the cylinder 9. The top of the agitator 32 may be made conical as shown at 36, the agitator cylinder 33 being similarly formed as shown at 37, the cone 36 coming very close to the inside surface of the member 37 when the engine is in operation.

The web 6ª extends across the rear of casing 6 to confine therein, when cover 44 is removed, any oil or other matter that may accumulate.

Surrounding and preferably clamped to the agitator cylinder 33 is an annular burner 38 having the annular chamber 39 which receives the gas from the tube or pipe 40, which communicates with said chamber 39 at 41. At any suitable point in the pipe 40, as at 42, adjustable openings to the air may be provided so as to procure a highly efficient mixture of air and gas or other combustible material, on the principle of the Bunsen burner. The pipe 40 extends downwardly through an opening at 43 in the cover 44 of the casing 6 and extends downwardly on the inside of said cover and then turns outwardly through the same and terminates at 45, the nipple or end 45 being suited for the attachment of a flexible hose which may then be attached to any gas fixture or other source of combustible material. It will thus be seen that the engine may be moved about the pivotal axis 5, the flexible hose maintaining the communication with the supply of combustible material.

Above the annular chamber 39 the burner 38 terminates in the ring portion 46 which closely surrounds the cylinder 33, a narrow annular passage being formed for the combustible material which then burns at the top of the ring 46 around the cylinder 33.

A hood or cover 47 is provided around the burner and is supported upon the same by a plurality of screws 48 resting upon the burner 38. The hood or cover comprises, in the case here shown, the outer sheet metal member 49, and the inner metal member 50, asbestos 51, or other poor conductor of heat, intervening between the members 49 and 50, and material 52, similar to material 51, is provided upon the inside of the metal member 50. The hood or cover thus shields the burner from any drafts caused by the fan and confines the heat efficiently to the desired portion of the cylinder 33 and aids in increasing the economy of the engine.

Secured to or integral with the fly wheel 22 is the gear 53 with which meshes the pinion 54 secured upon the fan shaft 55 in the bearing 56 integral with or secured to the member 57 which may be secured by bolts 58 to the casing 6, such member 57 covering a hole 59 in the casing 6, said hole 59 being large enough to allow the free introduction of the pinion 54 meshing in operative relation with respect to gear 53. Upon the outer end of the shaft 55 is secured the fan hub 60 carrying the fan 61 having the blades 62. A wire or other guard 63 surrounds the fan 61 and is supported by brackets 64 upon the casing 6. Secured to the fan 61 or the fan hub 60 is an outwardly extending spindle or shaft 65 which extends through the central hub or connector member 66 of the guard 63, and terminates in the knurled head 67 by which the fan shaft may be rotated slightly by hand, so as to rotate pinion 54 and drive gear 53 and thereby start the engine.

The operation is as follows: Upon connecting the flexible hose, connected at 45 to the pipe 40, with a gas outlet, and upon turning on the gas, air is admixed at 42 with the inflowing gas, the mixture then filling the annular chamber 39 of the burner 38, and passes upwardly between the ring 46 and the exterior of the cylinder 33 and burns at the top edge of the ring 46. The upper portion of the cylinder 33 is heated, while a lower portion of the cylinder 33 is maintained at lower temperature and the cylinder 9 is maintained cool. The burner having been lighted, after a few moments the cylinder 33 is heated to suitable temperature and then the knurled head 67 may be turned slightly whereupon the engine starts and soon comes up to full speed driving the fan 61 at high speed. Then due to the angular or phase relations of the agitator or displacer 32 and the piston 13, the air within the cylinders 9 and 33 is alternately heated and cooled, thus alternately forcing the piston 13 outwardly and drawing the piston 13 inwardly. The piston 13 in its movement communicates power through the connecting rod 15 to the crank pin 20 and thus to the fly wheel 22, the agitator or displacer 32 being actuated from the crank pin 20 in definite angular or phase relation with respect to the piston 13. The alternate thrusts and pulls upon the connecting rod 15 rotate the fly wheel 22 causing gear 53 to drive pinion 54 and thereby rotate the fan 61 at high speed, causing a draft of air for ventilating, cooling, or other suitable purposes.

Part of the air moved by the fan 61 as so driven by the engine aids in cooling the cylinder 9, but from the position of the fan the upper portion of the cylinder 33 is not within the path of the air moved by the fan 61, so that the fan 61 does not deliver heated air, but air at room temperature and aids in maintaining the cylinder 9 cool.

The apparatus herein described makes commercially practicable a portable high speed fan driven by a simple valveless and silent thermal engine. And we have so

combined and arranged the parts as to attain such end with simplicity and inexpensive construction.

The ordinary hot air engine, even of the type herein described, has defects which render it unsuitable for operating at high speed. The possible speed of such ordinary hot air engine is low, and the speed being low necessitates either a larger volume of air working through a small temperature range, or, if a small volume of air be employed, through a great temperature range, in order to have any appreciable power. In the case where a large volume of air is worked through a small temperature range, the engine becomes too bulky, heavy, and too expensive; and in the second case, where a small volume of air is worked through a wide or great temperature range, a very high temperature must be used. And in this latter case the metal walls or parts subjected to the high temperature, if thin enough to effect efficient heat flow and greater engine economy, soon fail under the high temperature either by decomposition or physical change. Or, if the walls or other parts subjected to the high temperature be thick enough to withstand the physical or chemical change at the high temperatures, the heat conductivity is lowered to such a point that the engine economy becomes impracticably low.

Our engine herein described is so constructed and proportioned as to run at high speed, yet with the employment of temperature so moderate and metal thicknesses so thin that the defects above referred to do not appear. In our engine the temperature range worked through is relatively low, and the power per stroke or cycle is relatively low, but the speed is high. This allows the use of thin metal, with resultant high efficiency in heat conduction and engine economy, and the temperature employed is so low that the metal subjected to the highest temperature is not affected. This high speed is attained by proportioning the heating surface, the strokes of the piston and agitator, phase or angular relation of the piston and agitator with respect to each other, the clearance of the displacer or agitator within its cylinder, and, to a minor degree, the shape of the agitator or displacer. Another factor lending itself to high speed is the direct coupling of the displacer or agitator and the power piston to the fly wheel. And a further factor is the volume of air employed with regard to the diameter and strokes of the piston and agitator, and the volume displaced by the agitator.

By way of example merely, and without restricting or limiting our invention, except where so specified in the claims, and as illustrative of proportions which secure a relatively high speed, as above described, it may be stated that we have employed cylinders 9 and 33 of two inches internal diameter; diameter of piston 13, two inches; diameter of agitator 32, practically one and fifty-seven sixty-fourths inches; length of agitator 32, four inches to base of cone; cylinder 9, four and one-half inches in length; cylinder 33, four and five-eighths inches from flange 34 to base of cone 37; stroke of piston 13, one and one-half inches; stroke of agitator 32, two and one-quarter inches; thickness of cylinder 33, one-thirty second of an inch; thickness of cylinder 9, one-eighth of an inch; gear 53 and pinion 54 having a ratio of four to one; fan, twelve inches diameter, four blades. With the consumption of three and four-tenths cubic feet of commercial illuminating gas per hour (approximately 650 British thermal units per cubic foot) the fan was driven at a speed of fourteen hundred revolutions per minute, the engine running at a speed of three hundred and fifty revolutions per minute.

We have found also in connection with the engine above specified, and we believe it to be quite generally true for high economy and speed, that the angle Θ between a line drawn through the center of shaft 23 and center of main crank pin 20, see Fig. 2, and a line drawn through the center of crank pin 20 and center of crank pin 28, shall be practically seventy degrees, this relation determining the relation of movement of the agitator 32 with respect to piston 13. We have found also that a relatively slight change in the diameter of the agitator with respect to the bore of its cylinder greatly changes the economy and speed of the engine. In an engine proportioned as above described, a variation of this diameter of the agitator to the extent of only one or two sixty-fourths of an inch is accompanied by an appreciable change in economy and speed of the engine.

For engines of sizes comparable with the engine described above, we have found that the relation between the radius of the agitator and the radius of the cylinder bore may be expressed as follows:

$$r = R\sqrt{1-\frac{L}{21}}$$

where r is the radius of the agitator, R is the radius of the bore of the cylinder, and L is length of stroke of the agitator. This formula may be employed for determining the proportions of an engine, but we do not wish to limit ourselves to these proportions except where so definitely expressed in the claims.

The cylinder 33 may be made of copper, though iron or steel, brass, or other materials may be employed, and should be made as thin as possible consistent with

necessary strength and durability. The cylinder 9 may be of iron, brass, or other suitable material. The agitator 32 may be made of material which is a poor conductor of heat, such as asbestos, porcelain, or any suitable material, or may be comprised in part of such material.

At the joint 34, 35 between the cylinders 9 and 33 a washer of heat insulating material may intervene between the two cylinders for minimizing the heat conduction from the hot cylinder to the cooler cylinder. And it is preferred that this region of isolation between the hot and cooler cylinders, be located at such a point that the bottom of the agitator comes substantially opposite such joint when at the end of its stroke farthest into the cylinder 33.

It will be noted also that the piston 13 is of hollow construction, which aids in cooling the air when it comes into the cylinder 9, the face of the piston being thin as shown, thus aiding conduction to the outer air. It will be noted also that the piston 13 serves as a guide for the agitator rod 31.

As shown in Fig. 6, the agitator 32 may be divided into upper and lower compartments, either completely isolated from each other by the diaphragm or partition 68, or an aperture, as 69, of greater or less size may be employed. And whether or not the agitator be supplied with the diaphragm or partition, the agitator rod 31 may be made hollow, as shown, and have an opening to the outer air at 70, so that the interior of the agitator is in communication with the outer air, thus further aiding in cooling the air in certain positions of the stroke so as to increase the economy of the engine, by increase of range of temperature worked through under a given set of conditions.

When the dividing diaphragm or partition 68 is employed it is preferred that it shall be so located that when the agitator is at the end of its stroke, when it extends farthest into cylinder 9, shall come substantially opposite the joint 34, 35 or other point where the hot and cool cylinders are divided from each other.

It is evident also that our mechanism is very simple, in that the piston and agitator rods and their connections are simplified and parts used in connection with engines of this type of the prior art are omitted; these features constituting a further factor lending itself to compactness and economy suitable for portable fans and like relations.

While we have shown our engine as vertically disposed with the cylinder 33 at the top, it is to be understood that we may use the engine in other positions, and that it may be used up-side down as compared to the relation shown in Fig. 3, in which case the cylinder 33 and cylinder 9 would be below the casing 6.

It is to be understood that our invention is not limited to the employment of gas as the combustible material, but that alcohol or any other suitable material may be employed.

What we claim is:

1. A portable thermal desk fan comprising a high speed hot air engine delivering relatively to that speed low power per stroke, a high speed low pitch fan driven thereby, said engine and fan assembled as a unit upon a portable base.

2. A portable thermal desk fan comprising a high speed hot air engine delivering relatively to that speed low power per stroke, a high speed low pitch fan driven thereby, a portable base upon which said fan and engine are assembled as a unit, and means for pivoting said engine and fan as a unit upon said portable base.

3. A portable thermal desk fan comprising a high speed hot air engine delivering relatively to that speed low power per stroke and comprising alined cylinders, a fly wheel directly connected with said engine, a high speed fan constituting substantially the entire load upon said engine, and a portable base carrying said fan and engine.

4. A portable thermal desk fan comprising a high speed hot air engine delivering relatively to that speed low power per stroke, a high speed low pitch fan driven thereby, a portable base upon which said engine and fan are assembled as a unit, a horizontal pivot carried by said portable base about which said fan and engine are swingable, and a vertical pivot on said portable base about which said fan and engine are swingable.

5. A portable thermal desk fan comprising a portable base, a casing supported thereon, a high speed hot air engine delivering relatively to that speed low power per stroke supported upon said base by said casing, a fly wheel driven by said engine and supported within said casing, a high speed low pitch fan supported upon and outside of said casing, and driving connections between said fan and said fly wheel.

6. A portable thermal desk fan comprising a portable base, a casing supported thereon, a high speed hot air engine delivering relatively to that speed low power per stroke supported upon said base by said casing, a fly wheel driven by said engine and supported within said casing, a high speed low pitch fan supported upon and outside of said casing, driving connections between said fan and said fly wheel, and means for pivoting said engine, casing and fan as a unit upon said portable base.

7. A portable thermal desk fan comprising a portable base, a casing supported thereon, a high speed hot air engine delivering relatively

to that speed low power per stroke supported upon said base by said casing, a fly wheel driven by said engine and supported within said casing, a high speed low pitch fan supported upon and outside of said casing, driving connections between said fan and said fly wheel, and means for pivoting said engine, casing and fan as a unit vertically and horizontally upon said portable base.

8. A portable thermal desk fan comprising a portable base, a casing supported thereon, a high speed hot air engine delivering relatively to that speed low power per stroke supported upon said base by said casing, a fly wheel driven by said engine and supported within said casing, a high speed low pitch fan supported upon and outside of said casing, driving connections between said fan and said fly wheel, and a pivotal support approximate the junction of said engine and said casing for pivotally supporting said engine, casing and fan as a unit upon said portable base.

9. A portable thermal desk fan comprising a portable base, a casing supported thereon, a high speed hot air engine delivering relatively to that speed low power per stroke supported upon said base by said casing, a fly wheel driven by said engine and supported within said casing, a high speed low pitch fan supported upon and outside of said casing, driving connections between said fan and said fly wheel, and a supporting member carried by said base and embracing said casing and supporting said engine, casing and fan as a unit approximate the junction of said engine and casing.

10. A portable thermal desk fan comprising a high speed hot air engine, delivering relatively to that speed low power per stroke, a casing supporting said engine, a high speed fan supported upon said casing and driven by said engine, a portable base, a supporting member pivoted upon said base, and said engine, casing and fan pivoted as a unit upon said supporting member.

11. A portable thermal desk fan comprising a casing, a high speed hot air engine delivering relatively to that speed low power per stroke supported upon said casing, a high speed fan supported upon said casing and driven by said engine, a burner for said engine above said casing, a conduit for combustion material communicating with said burner, said conduit extending from said burner within said casing, and a connection to said conduit outside of said casing.

12. A portable thermal desk fan comprising a casing, a high speed hot air engine delivering relatively to that speed low power per stroke supported thereon, a wheel driven by said engine within said casing, a high speed fan outside of said casing, a connection from said fan through said casing to said wheel, and a handle outside of said casing for starting said engine and fan.

13. A portable thermal desk fan comprising a casing, a high speed hot air engine delivering relatively to that speed low power per stroke supported upon said casing, a gear wheel within said casing driven by said engine, a high speed fan secured upon said casing outside thereof, and a pinion connecting with said fan and meshing with said gear wheel within said casing, said casing having an opening through which said pinion may be inserted while attached to said fan.

14. A portable thermal desk fan comprising a casing, a high speed hot air engine delivering relatively to that speed low power per stroke supported thereon, a fan outside of said casing driven by said engine through means within said casing, a guard surrounding said fan and secured upon said casing, and a handle secured to said fan and extending outside of said guard for starting said engine and fan.

In testimony whereof we have hereunto affixed our signatures in the presence of the two subscribing witnesses.

CHARLES J. RAMSBURG.
WILLIAM A. PHILLIPS.
FREDERICK E. SWOPE, Jr.

Witnesses:
Daniel Webster, Jr.,
A. E. Steinbock.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."