(No Model.)

E. AUSTIN.

SEPARATOR.

No. 537,175. Patented Apr. 9, 1895.

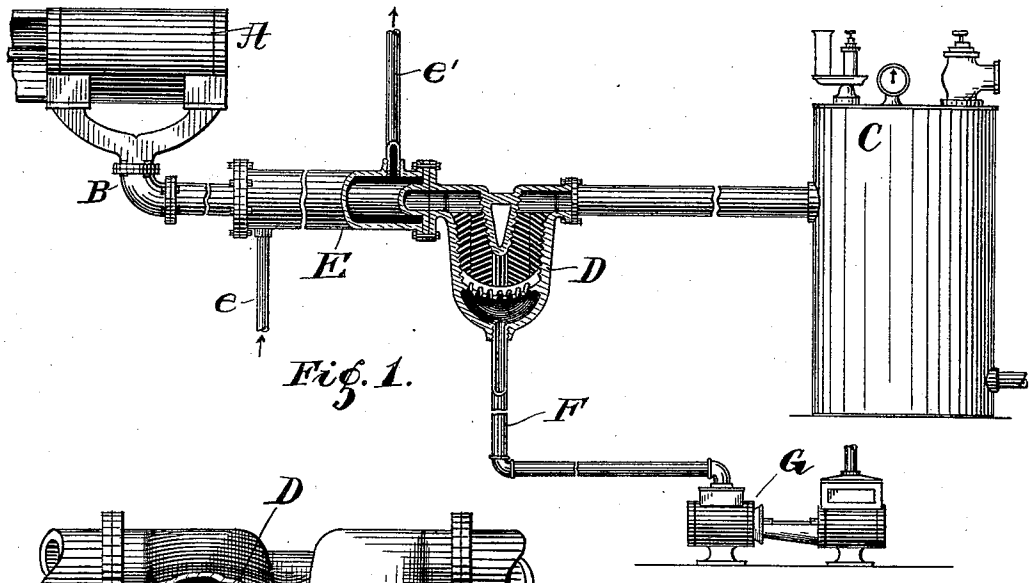

Fig. 1.

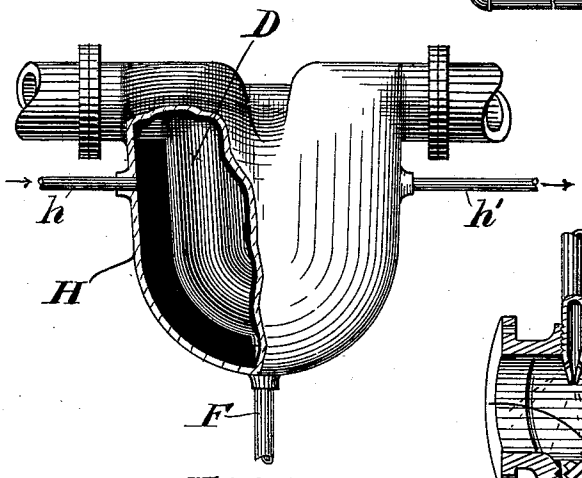

Fig. 2.

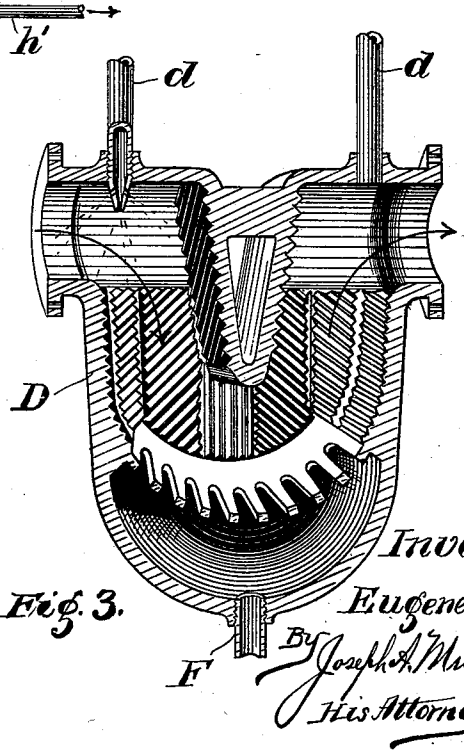

Fig. 3.

Witnesses,
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UNITED STATES PATENT OFFICE.

EUGENE AUSTIN, OF DETROIT, MICHIGAN.

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SPECIFICATION forming part of Letters Patent No. 537,175, dated April 9, 1895.

Application filed February 11, 1895. Serial No. 537,953. (No model.)

To all whom it may concern:

Be it known that I, EUGENE AUSTIN, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Separating Lubricating Material from Exhaust-Steam; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The object of this invention is to provide an effective means for separating lubricating oils from the exhaust of condensing steam engines.

It is a matter of experience in steam engine practice that where an open (exhaust steam) heater or a surface condenser is employed, the material used to lubricate the cylinder is carried by the exhaust steam into the feed water, and passes with it into the boiler, where it is liable to occasion serious injury by adhering to the boiler plates and repelling the water, allowing the plates to become overheated and distorted and burned. To prevent such injury to the boiler many different devices, technically termed "separators," for eliminating the oily matter from the exhaust steam have been invented and patented. These devices usually work very well when applied to the exhaust from non-condensing engines. The injurious material is not only prevented from entering the boiler, but the separated oil may be filtered and used again, thus effecting an important economy. The one for which United States Patent No. 521,199 dated June 12, 1894, was granted to me has been found particularly effective; but all the various forms of separators hitherto devised have proved practically useless when applied to condensing engines. The cause of their failure not having been understood, there existed prior to my present invention no effectual means for recovering the oil from the exhaust of such engines, nor of preventing the fouling of the boiler when using a surface condenser. Engines of this class usually being of large size the need of a practical device for this purpose has become an urgent one. By careful experiment I have discovered that the successful operation of an oil separator depends upon the capacity of the steam for wetting the inside walls of the separating device. So long as the walls remain dry, the lubricant is not precipitated thereon, but seems to be repelled. The fine particles of oil striking the dry walls rebound and their specific gravity being very little greater than that of the steam, inertia of mass which is depended upon to eliminate water from steam is too feeble to effect their separation. They are carried along with the current to the condenser, and thence with the feed water enter the boiler; but if the walls of the separating chamber be wet the oily particles adhere, and, by a natural law of diffusion, spread over the inner surface, until the accumulation is drawn by the action of gravity to the bottom of the chamber, whence it is carried out by the drain pipe.

In condensing engines the final pressure of steam in the cylinder is usually considerably greater than it is in the condenser, so that when the exhaust valve opens there is a sudden drop in pressure, the steam expanding into the exhaust-pipe and condenser.

It is a well established principle in physical science that when steam expands without doing work it becomes superheated. In other words, the temperature of saturation under the condition of pressure in the cylinder, is so much higher than the temperature of saturation under the condition of vacuum in the condenser, that however wet the steam may be in the cylinder the water is at once evaporated by the fall in pressure and the exhaust steam passes to the condenser dry. Hence the failure of the separator to work when applied to the exhaust pipe of a condensing engine. The cause of the difficulty having been discovered, the remedy is obvious. The exhaust steam must be changed from its superheated dry condition to a supersaturated or wet condition. To bring about the required change the exhaust steam may be cooled below the temperature of saturation, or sufficient water may be added to it to absorb the excess of heat. As means for securing the result sought the exhaust may be passed through a refrigerating apparatus before reaching the separator, or the separator may be surrounded by an envelope through which passes a current of cool water, or, preferably, the separator may be provided with one or

more nozzles through which jets or sprays of cool water may be injected into the steam to absorb the excess of heat contained. The quantity of cooling water required for either method will be comparatively small. Thus in a hundred horse-power condensing engine the weight of the exhaust steam would be about eighteen hundred pounds per hour. The final pressure may be seven pounds absolute and the vacuum twenty-seven inches—conditions not unusual in practice. The thermal content of the steam at release would be fourteen millions three hundred and twelve thousand three hundred and forty heat units per hour. The thermal content of the same weight of steam under twenty-seven inches vacuum is fourteen millions two hundred and ninety thousand three hundred and eighty heat units. The difference, twenty-one thousand nine hundred and sixty heat units, is the amount of superheating by the expansion of the exhaust into the condenser. To absorb this amount of heat four hundred and forty pounds of water applied externally, so that its temperature would be raised from, say 60° Fahrenheit to 110°, or about one quarter of the weight of the steam would be sufficient. Probably a considerably less quantity applied in a water-jacket to the separator would suffice to cause precipitation upon and wetting of the interior walls. Injected into the steam, so that it would be vaporized from 60° Fahrenheit in a vacuum of twenty-seven inches, only about twenty pounds of water, or less than one-and-one-quarter per cent. of the weight of the steam, would be required. In either case efficient means must be supplied for removing the oil and water of condensation from the separator. For this purpose I attach to the drain pipe of the separator a pump of the proper capacity and proportions to maintain as high a vacuum as exists in the condenser. The pump may be operated by steam, or by a mechanical connection with the air or circulating pump of the condenser, or with any other moving part of the machinery. When thus arranged the separator is found to perform its work as effectively for the exhaust steam from a condensing engine as it ordinarily does for a non-condensing engine.

The accompanying drawings show a practicable arrangement of an engine, separator and condenser with details illustrative of several modes of carrying out my invention.

Figure 1 is a view in side elevation of the cylinder of an engine having its exhaust pipe connected with a separator and thence with a condenser. The exhaust pipe is shown as passing through a water jacket placed between the cylinder and the separator. The separator and portions of the exhaust pipe and of the jacket are sectioned in order to better illustrate the construction. This figure shows the separator connected with a pump. The several parts are arranged diagrammatically in this figure for convenience of illustration. Fig. 2 is a modified construction in which the separator is surrounded with a water jacket. The representation is on a larger scale than used in Fig. 1 and a portion of the jacket is broken away to show the separator within. Fig. 3 is a view in vertical section and slightly in perspective of the separator provided with spraying nozzles by which water is introduced within the separator. The dotted lines represent the jets of water issuing from the nozzle.

Like letters of reference refer to like parts throughout the several views of the drawings.

Referring to Fig. 1, A is the steam engine cylinder; B, the exhaust pipe; C, the condenser, and D, the separator, which may be of any suitable construction, preferably that covered by my patent before referred to.

At E is shown a refrigerating apparatus consisting of a piece of larger pipe surrounding the exhaust pipe, the space between the two being filled with a current of cool water flowing in through the pipe *e* and discharged through the pipe *e'*. The cooled steam passes on through the separator D, the oil and water of condensation being removed by means of the pipe F and pump G.

Instead of the refrigerator E, the separator may be surrounded by a water-jacket H, supplied with cool water through the pipe *h* and discharged through the pipe *h'*, as clearly shown in the modification illustrated in Fig. 2; or, and as I believe, preferably to either of the foregoing methods of reducing the temperature of the steam, the separator may have jets of water sprayed into it through the pipes *d*, *d*, as shown in Fig. 3, the water passing out with the oil and water of condensation. The drawings show the arrangement so clearly that an extended description seems unnecessary.

I claim—

1. The method of separating lubricating materials from exhaust steam by first reducing the steam from the superheated or dry condition to the supersaturated or wet condition, then extracting the oil and water of condensation, substantially as shown and described.

2. As a means for separating lubricating oils from exhaust steam, the combination of a separator D, spraying nozzles *d*, *d*, pump G and pipe F connecting the pump with the separator, substantially as shown and specified.

In testimony whereof I affix my signature in presence of two witnesses.

EUGENE AUSTIN.

Witnesses:
FRANK H. GODDARD,
WM. H. MAYBURY.