June 9, 1936. C. C. YOUNG 2,043,644

HEAT TRANSFER APPARATUS

Filed Sept. 21, 1933

Fig. 1.

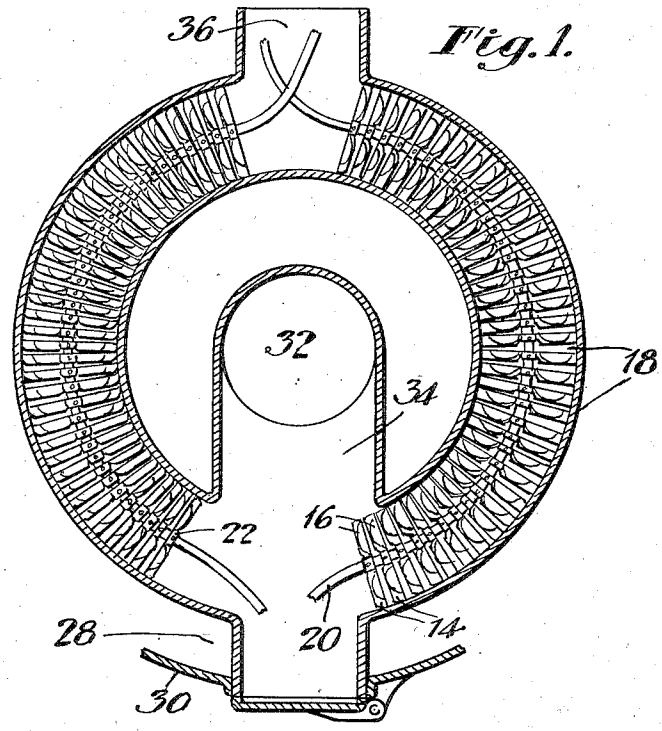


Fig. 2.

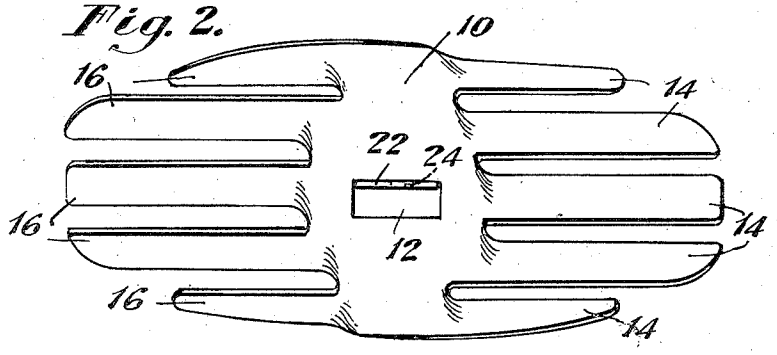


Fig. 3.

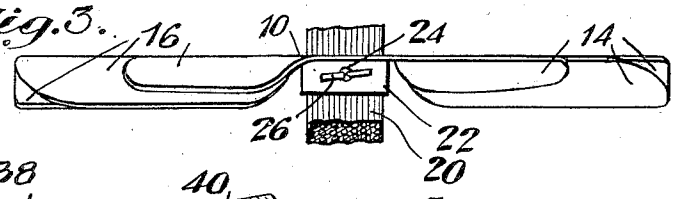
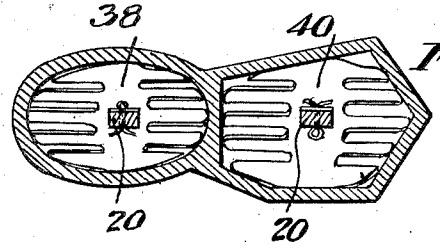


Fig. 4.



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HEAT TRANSFER APPARATUS

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6 Claims. (Cl. 138—42)

This invention relates to heat transfer apparatus and more particularly to apparatus to secure a highly efficient transfer of heat between the products of combustion in a domestic heating furnace and the water, steam or air being heated in the furnace.

Most domestic heating furnaces are formed with flues or radiators through which the products of combustion circulate in passing from the firebox or combustion space to the stack. These radiators are intended for giving extended heat transfer surface between the air, water or steam being heated, and the products of combustion of the burning fuel.

At the present time domestic heating furnaces which were originally designed for burning coal are now being modified and adapted for burning oil, natural gas or artificial gas. The radiators and flue ducts for coal furnaces do not always readily lend themselves for efficiently extracting the heat from the combustion products of all types of fuel. On the other hand a distinct effort is being made to cut down the number of designs of furnaces and arrange the furnaces so that they are adaptable for burning any kind of fuel.

When the products of combustion pass out of the furnace to the stack at a comparatively high temperature a large proportion of the heat available in the fuel is lost on account of the passage of the hot products of combustion out of the chimney. An important factor therefore is to obtain a transfer of the heat of the gases to the products being heated through the radiators in order to effectively absorb the heat of the combustion gases before they pass out of the furnace.

The primary object of the present invention is to provide a baffle for use in radiators or ducts of furnaces whereby an efficient transfer of the heat from the combustion products to the water, steam or air being heated can be effected.

A further object of the invention is to provide a baffle arrangement for furnace flues or radiators whereby the temperature may be effectively reduced in the products of combustion without interfering with the draft of the furnace or the resistance of the flow of the combustion gases through the flues or radiators.

Another object of the invention is to provide a baffle arrangement by which the combustion gases may be held in a constant state of agitation to continuously bring the hot products into contact with the metal surfaces for conducting the heat from the gases and to provide means for transferring the heat by both convection and direct conduction between metal baffles being heated and the metal forming parts of the flues or radiators.

With these and other objects in view, one feature of the invention contemplates the use of a series of perforated metal plates which are supported and spaced upon a flexible holder in such a manner that the plates may be located in ducts of irregular shape and effectively form mixing passages for the flow of flue gases through the ducts.

This and other features of the invention will be understood from the following specification as illustrated in the accompanying drawing in which:

Fig. 1 is a view in cross section of a duct or radiator of the usual hot air furnace in which the improved baffle string of the present invention is located in the duct, the baffle being shown in plan view;

Fig. 2 is a front elevational view of one plate of the improved baffle;

Fig. 3 is a top plan view of the baffle plate shown in Fig. 2 and showing the mounting of the baffle plates upon a flexible carrier or cable; and

Fig. 4 is a cross sectional view showing the use of the improved baffles in furnace radiators or ducts of different cross sectional shapes.

The baffle forming the subject of the present invention consists primarily of a flat metal plate 10 which may be made as a stamping with a die press. When the plate is stamped from sheet metal a central opening 12 is formed in the body of the plate and a series of louvres 14 are formed on one side of the plate having the openings between the louvres so shaped that gases passing through the openings will pass in an upward direction as illustrated in Fig. 2. In the same stamping operation a series of louvres 16 are formed on the opposite side of the plate 12 with the louvre openings arranged to direct the gases downwardly as illustrated in Fig. 2. If the plates were positioned in the radiator with the long axis in a vertical position then the louvres 14 and 16 would tend to direct the gases transversely of the radiator duct. The shape of the stamping dies is such that the plates 10 have substantially the same outline as the cross-sectional shape or area of the flue into which the plates are mounted.

As illustrated in Fig. 2 the plate 10 is stamped to have substantially an elliptical shape, the same as the cross-sectional area of the flue or radiator 18 of the hot air furnace illustrated in Fig. 1.

In mounting the baffle in the radiator 18 the baffle is supported upon and held in spaced rela-

tion upon a cable or flexible supporting member **20**. To accomplish this a supporting flange **22** is struck out of the body of the plate **10** and is provided with a hole **24** (Fig. 3) by which the plate may be secured to the cable with a cotter pin **26**. Preferably the opening **12** is rectangular so that it will fit on a rectangular flexible supporting member and thus hold the plate in a definite fixed supporting position on the cable. With a series of plates mounted on the flexible carrier a baffle string is formed which may be readily worked into an irregularly shaped radiator or duct and thus form an efficient heat transferring medium that will accurately conform itself to the shape of the duct or radiator. Such a flexible baffle string can be readily inserted into and removed from a radiator. The baffle string can be made of any desired length to fill a radiator or duct. Furthermore each of the plates of the baffle string is flexible which helps in getting the baffle into position in the radiator even though the radiator surface has irregularities.

Although the shape of the baffle does not conform exactly to the cross sectional shape of the duct the baffle string substantially fills the duct and some of the baffles are in contact with all of the metal walls of the radiator. When the gases pass through and around the baffle string the metal plates get hot and by conduction carry the heat to the walls of the radiator. At the same time the hot gases heat the radiator walls by convection.

By having the louvre spaces arranged to direct some gases upwardly and other gases downwardly a constant agitation and stirring of the gases is secured so that a high velocity of the gases is effected and a more efficient heat transfer carried out.

In the hot air furnace section illustrated in Fig. 1 the air to be heated passes upward around the radiator **18** entering a duct **28** which is formed between the radiator and an outer wall **30**. The gases for heating the air rise through a central duct **32**, pass outwardly through a duct **34** and then through both branch ducts of the radiator **18** in passing to an outlet **36**. In passing through the radiator **18** the combustion gases pass through and in direct contact with the individual plates of the baffle strings and by getting an efficient heat transfer the gases are cooled to a lower temperature than they would be cooled if the gases passed through the radiator **18** which had no baffles therein. By actual test it has been found that the spaces formed by the louvres in the baffle plates give adequate spaces for the passage of combustion gases so that a comparatively low pressure drop results in the passage of the gases from the combustion chamber to the outlet flue.

It has been found that when a comparatively large flue or duct is provided for the passage of combustion gases that even though the flue has an irregular shape the outer shell of the combustion gases in contact with the walls of the radiator will be rapidly cooled and form a cooled stream of gases which follows the radiator wall while the central core of gases is hot and remains hot while it passes through the flue. With a baffle arrangement for breaking up the streamline flow of the gas a very much more efficient heat transfer of the products of combustion to the walls of the radiator is effected.

In Fig. 4 are illustrated a baffle plate **38** for use in a flue of substantially oval cross section and a baffle plate **40** for use in a radiator or flue duct having an irregularly shaped hexagonal passage. The shape of the baffle plates can be made substantially any shape that is desired but it has been found in practice that a comparatively small number of baffle plate shapes are sufficient for use in most of the different types of flues or radiators in domestic boilers and furnaces.

The baffle plates are preferably coated with an aluminum paint or with a high temperature resin condensation product such as phenol formaldehyde resins. The baffles also may be coated with aluminum or zinc metals. Such coatings are particularly useful in resisting corrosion. The metallic coatings furthermore do not interfere in any way with the heat transferring ability of the baffle plates.

The preferred form of the invention having been thus described what is claimed as new is:

1. A domestic heating furnace having flues or radiators comprising ducts for combustion gases whose longitudinal axes are curved, baffle plates arranged transversely of the ducts and having a shape substantially conforming to the cross sectional area of the ducts, a flexible cable passing through the baffle plates, said baffle plates being fixed to and held in spaced relation upon the cable in such a manner as to readily conform a baffle string to the shape of the duct in which the baffle is located and openings in the baffle plates having deflecting members arranged to agitate and change the direction of flow of combustion gases passing through the openings.

2. A domestic heating furnace having flues or radiators comprising ducts for combustion gases whose axes are curved, baffle plates arranged transversely of the ducts and having a shape substantially conforming to the cross sectional area of the ducts, a flexible cable with said baffle plates fixed to and held thereon and so arranged that a string of the baffle plates will readily conform itself to the shape of the ducts, and louvre openings formed in the greater part of the area of the baffle plates.

3. A domestic furnace having flues or radiators comprising ducts for combustion gases whose axes are curved, substantially flat flexible baffle plates arranged transversely of the ducts and having a shape substantially conforming to the cross sectional area of the ducts, a flexible cable passing through the plates, the plates being fixed upon and held in spaced relationship on the cable, the flexible plates forming a baffle string capable of readily conforming itself to the shape of the duct and openings in the baffle plates having deflectors adjacent thereto arranged to agitate and change the direction of flow of combustion gases through the openings.

4. A domestic heating furnace having flues or radiators comprising ducts for combustion gases whose axes are curved, and flexible baffle plates with louvres formed in the major portion of the area of the plates and arranged transversely of the ducts, a flexible carrier with said baffle plates being fixed at their central portion upon and held in spaced relationship by the carrier to form a baffle string arranged to readily conform itself to the shape of the axis of the ducts.

5. A baffle for a furnace duct or radiator comprising a flexible cable, a series of flexible plates having a shape and cross sectional area of approximately the shape and cross sectional area of the duct in which they are to be used, mounted upon the cable and held in fixed spaced relation

thereon, openings for flue gases formed in the body of the plates with deflecting members adjacent the openings, said plates having a corrosion-resisting surface.

6. A baffle for a furnace duct or radiator comprising a series of flexible plates having a shape approximating the shape of the duct in which they are to be used, a flexible carrier passing through the central portions of the plates, means holding the plates in a spaced relationship thereon, said plates having a series of louvres formed of the major portion of the surface of the plates.

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