March 9, 1954 F. J. WINDER 2,671,656

COIL SEPARATOR

Filed May 12, 1950 2 Sheets-Sheet 1

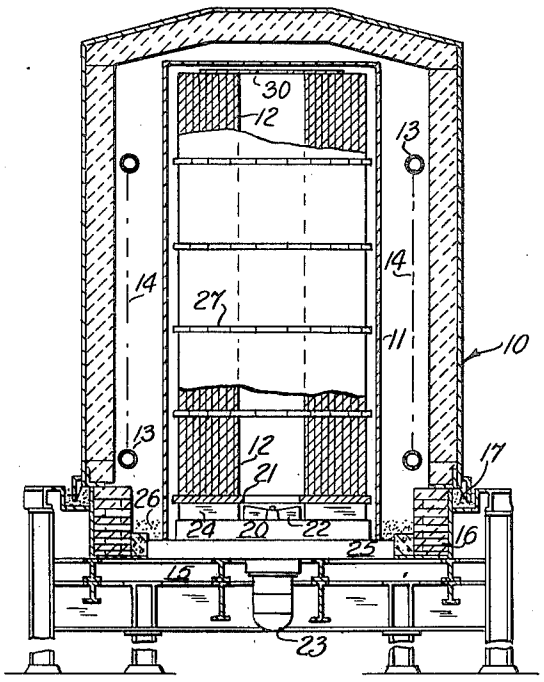


Fig. 1.

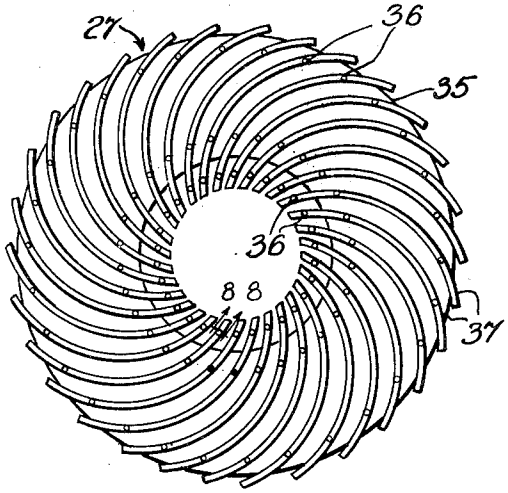


Fig. 2.

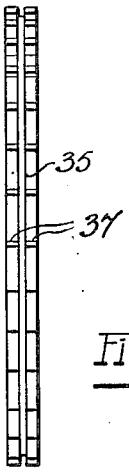


Fig. 3.

INVENTOR.
F. J. Winder.

BY
Charles A. Lind
Attorney

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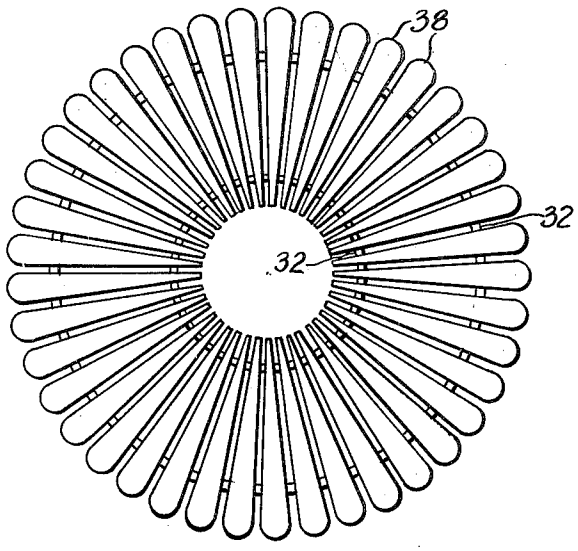


Fig. 4.

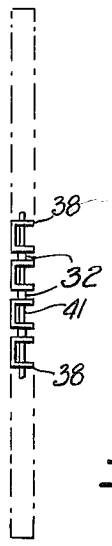


Fig. 5.

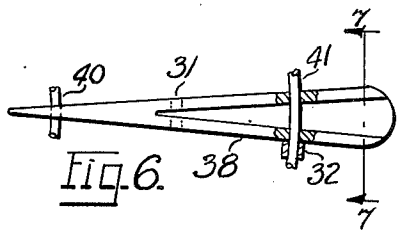


Fig. 6.

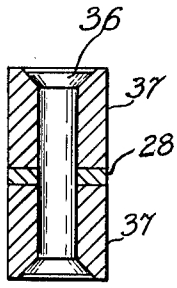


Fig. 8.

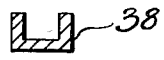


Fig. 7.

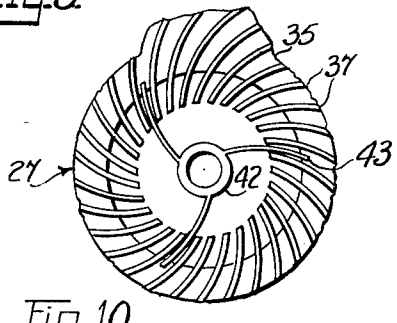


Fig. 10.

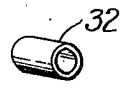


Fig. 9.

INVENTOR.
F. J. Winder.

BY
Charles A. Lind
Attorney

Patented Mar. 9, 1954

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COIL SEPARATOR

Frank J. Winder, Ottawa Hills, Ohio, assignor to Surface Combustion Corporation, Toledo, Ohio, a corporation of Ohio

Application May 12, 1950, Serial No. 161,540

2 Claims. (Cl. 263—47)

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This invention relates to apparatus for annealing a stack of cylindrical coils of flat material such as steel strip. It has long been recognized that radial heat flow through the laminations of a strip coil is relatively slow as compared to the heat flow parallel to the laminations heated from the edges and it has been proposed to provide channelled separators between the coils to permit heat to be applied to the edges of the laminations by heat carried by gases flowing through the channels or gas passages of said separators.

When such coil separators are not coincident with the adjacent annular ring of the stacked coils, when the spacers are too small at the outside diameter or too large at the inside diameter the outer or inner wraps of the coil drop and cover the spacer gas passage inlets or outlets, thus making the spacer ineffective. For this reason the spacers are customarily made to cover the coils and to extend there beyond sufficient to allow for various inside diameters of coils and for collapsing of the inner wrap of coiled strip as well as to allow for variations in coil size or outside diameters. This results in an extension of the spacer beyond the coil surfaces and into the central gas passage through the stack of coils. The central orifice of the spacer thus acts as a restrictive orifice to gas flow, reducing the gas flow through the coil separator gas passages for a given gas circulating fan power input and consequently by loss of heat transfer efficiency greatly increasing the time required to heat and to cool a stack of coiled strip. The outer edges of the coil separators form a similar restriction with the next adjacent furnace wall or inner cover, but this is relatively insignificant due to the larger gas flow area at the outside of the stack of coiled strip.

The present invention is directed to provide an improved coil separator and to avoid the foregoing difficulties in a relatively simple and practical manner.

For a consideration of what I consider to be novel and my invention, attention is directed to the following specification and the claims appended thereto.

In the accompanying drawings forming part of this specification,

Fig. 1 is a vertical sectional view of a typical annealing furnace for annealing a stack of cylindrical coils of strip material.

Fig. 2 is a plan view of an improved separator according to the present invention.

Fig. 3 is an edge view of the separator shown in Fig. 2.

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Fig. 4 is a plan view of an alternate separator according to the present invention.

Fig. 5 is a partial edge view of the separator shown in Fig. 4.

Fig. 6 shows a plan view of one of the ribs of the separator of Fig. 4.

Fig. 7 shows a cross sectional view of the rib of Fig. 6 on the line 7—7.

Fig. 8 is a sectional view of the separator of Fig. 2 on the line 8—8.

Fig. 9 shows a rib spacer for the separator of Fig. 4.

Fig. 10 shows a central portion of the separator of Fig. 2 with a central aperture grid inserted.

The annealing furnace shown in Fig. 1 comprises a portable heating hood 10 for heating a bell type muffle 11 disposed over a stack of cylindrical coils 12 of sheet steel which is to be annealed. (The thickness of the laminations of the coils has been greatly exaggerated for illustrative purposes.) The source of heat carried by the heating hood will ordinarily comprise internally fired radiant tubes 13 distributed along the side walls of the hood. For simplicity of illustration only the upper and lower tubes are shown, but as indicated by the vertical connecting line 14, there will be additional tubes therebetween.

The base of the furnace is generally indicated at 15 and comprises an upstanding peripheral wall 16 on which the heating hood 10 is seated, the seat being surrounded by a conventional sand seal 17. The furnace base also comprises a stand 20 for supporting a column of coils 12, the stand being shown in elevation except for the top plate 21 which is shown in section. This top plate has a central aperture coaxial with a circulating fan 22 which is driven by a motor 23 carried by the underside of the coil stand. The top plate 21 is spaced from the lower portion of the coil stand by radial spacers 24 whereby to provide radial gas passages below said plate for the gas circulated by the fan 22. The muffle 11 is shown supported on a ledge 25 which surrounds the coil stand and the foot of the muffle is shown as surrounded by a layer of granular sealing material 26 to prevent objectionable leakage of gas from the muffle. Some seepage of gas from the muffle is not objectionable, but rather desirable. A nonoxidizing gas is supplied to the muffle by a supply pipe not shown but which extends through the coil stand 20 from below.

It will be readily understood that unless the coils 12 are spaced apart to provide gas flow passages therebetween all of the gases circulated by

the fan **22** must enter at the top of the coil stack for downward flow therein. In Fig. 1 the coils are spaced apart by separators **27** and an orifice plate **30** is placed on top of the coil stack. The purpose of the orifice plate **30** is to restrict the entry of circulated gas to the inside of the stack by way of the top thereof whereby to cause part of the circulated gases to flow laterally inward through the channels formed by the coil separators **27**.

Referring now more particularly to Figs. 2 and 3, the improved coil separator comprises an annular plate **35** whose surface extends over substantially the whole area of the adjacent coils and to which are affixed, as by rivets **36**, curved ribs **37** on either side of the plate, the ribs being aligned one over the other whereby to transmit load from coils above through one rib, through an adjacent section of the annular plate **35** and through a rib adjacent and in line below the plate. It is preferred to space the ribs to maintain uniform width of the passages between the ribs, as will be accomplished by ribs of uniform width formed to the curve of an involute. The same structural shape may be obtained by welding ribs to a central plate or by casting and subsequently machining a unitary structure, but the riveted structure is preferred as less prone to warp in service. The ribs of the separator are shown to extend a short distance beyond the plate at either end of the ribs, and a spacer **28** may be placed between vertically adjacent ribs whereby the load of an out-size coil may be supported by the rib extensions, yet with a coil which does not extend to the ends of the ribs the separator will not greatly obstruct flow of gases at the inner core of the stacked coils or at the outer edge and adjacent the muffle **11**, it being understood that of the two the inner aperture is more sensitive to resistance to gas flow by extensions of the coil separators because it has a lesser total area of flow.

While a separator having a single annular plate with ribs attached to each side is a distinct improvement over separators having two annular plates with ribs therebetween, for the reason that there is no pocket between the separator and the coil ends for gas to accumulate in and to act as an insulator, and yet the annular plate serves to absorb heat from recirculating gases and to re-radiate heat to the coils, it will be appreciated that the ribs of a two plate separator may likewise be extended beyond the plates and expanded to give support to work which overhangs the plates. Although the stiffness or rigidity of the single or double plate separator is a distinct advantage in handling the separators themselves, an alternate separator according to the present invention is illustrated in Figs. 4, 5, 6 and 7 which utilizes no annular plate. A series of individual unitary ribs **38** of suitable shape, which may be that of the curved ribs of Fig. 2 or may be wedge or tear drop shape as shown in Fig. 4, and more particularly in Fig. 6, are held together by ring members **40** and **41** passing through each rib. Spacers comprising short cylindrical tubes **32** are threaded over the rings and between the ribs. Individual ribs may be hollowed for a portion of their length with ventilating holes **31** at the end of the hollow sections, through the rib sidewalls and communicating with the gas passages between the ribs. Separators of this design provide a maximum of efficiency in space for gas circulation and coil support by the ribs, with a minimum of obstruction of the gas flow spaces inside the stacked coils and outside them adjacent the muffle **11**. Further, while the weight of the stacked coils is generally sufficient to prevent warpage of the load carrying ribs, warpage of separator plates is quite common. The separator of Fig. 4, having no plates, is not susceptible to warpage, and its life is limited only by the life of the easily replaceable concentric rings **41**. The separator of Fig. 2, the single plate type, is not very susceptible to permanent warpage like a two plate separator, but has sufficient give to accommodate it to the coils it carries.

The separators shown by Figs. 2 and 4 are the preferred construction and serve to prevent the inner wraps of the coils from dropping and covering the gas passages through the separator, but in some cases it may be preferred to insert a separate central aperture grid **42** shown in Fig. 10 having a plurality of supporting arms **43** into the central aperture of the coil separator **27** to supplement or replace the rib extensions thereof and effectively prevent the inner wraps of the coils from dropping and obstructing the gas passages between the coils as maintained by the coil separators **27**. The arms **43** may be placed on the plate **35** of the separator as shown or may rest directly on the inner wraps of the next lower coil. The number and shape of the arms of the central aperture grid **42** will of course be accommodated to the needs of the coils and the separators being used and to the strength of the arms **43** at the annealing temperatures to which the grid is subjected.

What is claimed as new is:

1. A coil separator for separating coils in a stack of coils to be heated, comprising an annular plate whose surface extends over substantially the whole area of the adjacent coils, and two aligned series of generally radial ribs adjacent to and on either side of the plate, said ribs forming between adjacent ribs gas passages of substantially uniform width intermediate the terminal ends of the ribs and co-operating with each other to form top and bottom sides of the separator for engagement with the coils to be heated.

2. A coil separator for separating coils in a stack of coils to be heated comprising, in combination, a planar series of generally radial ribs cooperating with each other to form at least one side of the separator for engagement with a coil to be heated, and means for maintaining the ribs in assembled and spaced relation whereby to provide between the ribs from end to end thereof passages for circulating gases, said ribs being substantially in the form of wedges having uniformly divergent sides to provide in each rib substantially more area for support of the coils near the outer portion of the separator than near the inner portion of the separator.

FRANK J. WINDER.

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