

June 23, 1942.

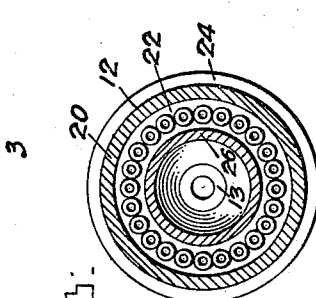
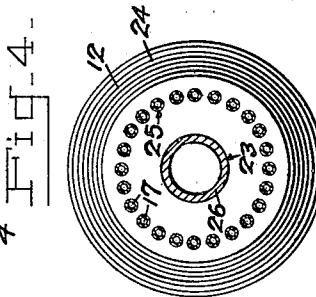
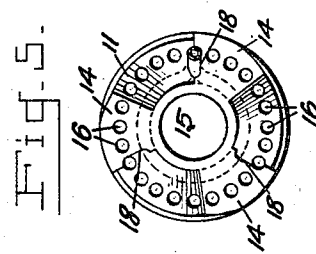
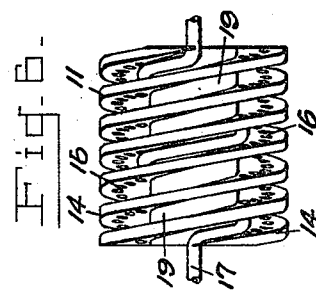
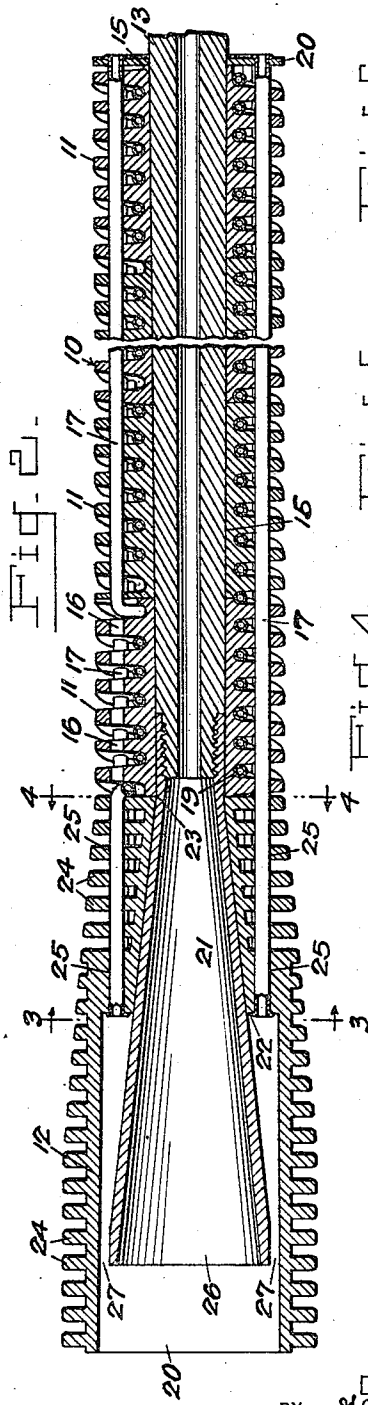
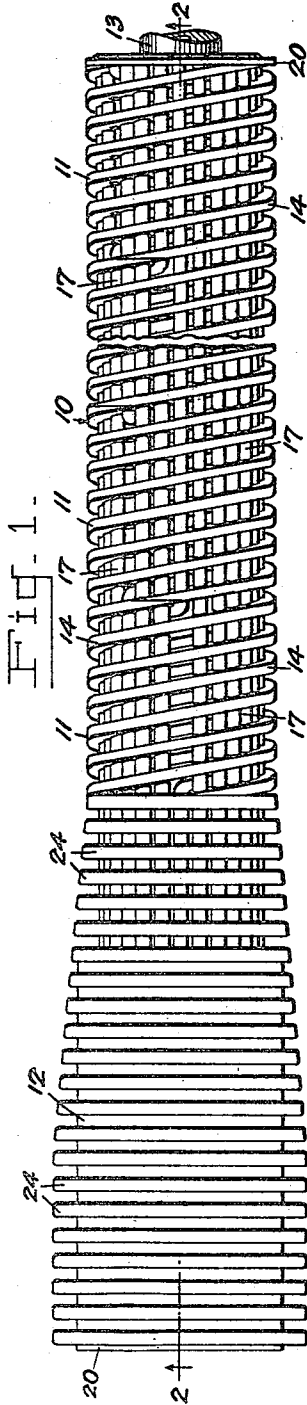
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2,287,066

HEAT EXCHANGE UNIT

Filed Aug. 21, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 6-

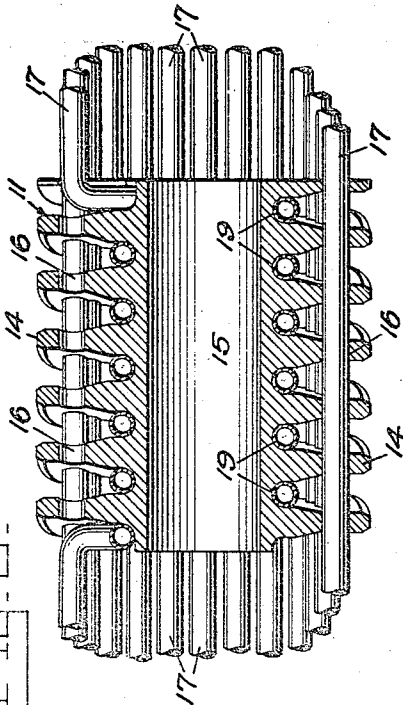


Fig. 7-

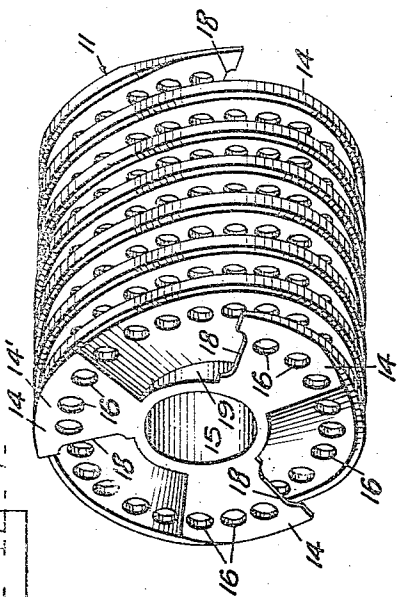
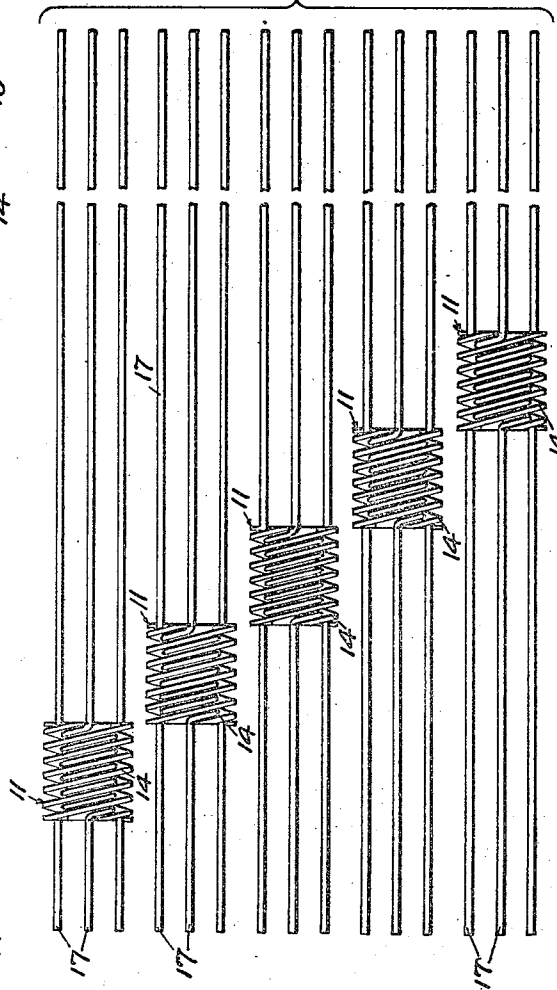


Fig. 9-



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UNITED STATES PATENT OFFICE

2,287,066

HEAT EXCHANGE UNIT

George D. Rogers, United States Army,
Dover, N. J.Application August 21, 1940, Serial No. 353,521
6 Claims. (Cl. 257—263)(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to heat exchange units peculiarly adapted to expedite the radiation and conduction of heat from tubular elements subjected to relatively high temperatures, such for example, as the gun barrels of automatic weapons.

The primary object of the invention is to provide an efficient radiator that may satisfactorily be substituted for the water or other liquid cooling apparatus presently used in the art for cooling the barrels of guns, especially the barrels of heavy automatic guns.

A further object of the invention is to utilize the blast of the gun to force a draft of air or similar gas at atmospheric temperature into conductive relation with the barrel through a predetermined length thereof only so that the maximum cooling effect of the conducting air or other gas may be realized.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

Fig. 1 is a view in fragmentary side elevation showing the heat exchange unit of this invention;

Fig. 2 is a longitudinal sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 2;

Fig. 5 is an end elevational view of one of the radiator sections of the heat exchange unit showing one cooling tube in position;

Fig. 6 is a view in side elevation of the radiator section shown in Fig. 5;

Fig. 7 is a perspective view of a typical radiator section of the heat exchange unit of this invention;

Fig. 8 is a longitudinal sectional view of a typical radiator section of the heat exchange unit of this invention showing its associated cooling tubes.

Fig. 9 is a diagrammatic exploded view of a portion of the heat exchange unit showing the relative positions of the several radiator sections thereof.

Referring now to the drawings by characters of reference there is shown in Fig. 1 a heat ex-

change unit generally designated by the character 10 conforming with the present invention.

The heat exchange unit 10 as herein disclosed comprises a plurality of substantially identical radiator sections 11 and a flash hider 12 assembled in longitudinal juxtaposed relation, with the radiator sections conductively disposed circumjacent of a gun barrel 13.

Each radiator section 11 may be machined from any suitable bar stock of good heat conducting quality to provide one or more continuous helical heat radiating fins 14 and an axial bore 15 tapered toward its muzzle end and adapted to receive a corresponding section of the gun barrel 13 in snugly fitting circumjacent heat conducting relation. As shown in the instant embodiment of the invention the radiator sections 11 are triple threaded to provide three continuous helical radiating fins 14, and while it is preferred to employ three such radiating fins it will be understood of course that only one such fin 14 or any other number thereof may be used if desired so long as they are of helical form. Moreover in lieu of machining the radiator sections from bar stock as above described they may be cast if preferred.

Also each of the radiator sections 11 are provided with a plurality of circumferentially equispaced passages 16 extending through the fins thereof parallel to the axis of the section to receive fluid conduits 17 in the manner hereinafter described. The terminal edges of the fins 14 of each radiator section are recessed as indicated at 18 to accommodate the curvature of the conduits 17 associated with that section and each fin is formed of outwardly converging section in such manner as to provide a seat 19 between adjacent fins next to the bore 15 that will heat conductively receive a conduit 17 and also provide sufficient clearance for introducing the conduit in its seat 19 past the burrs formed in drilling or otherwise providing the passages 16.

As shown more particularly in Figs. 5, 6 and 9 each radiator section 11 has a tubular conduit 17 wound under tension upon each of the seats 19 formed between adjacent convolutions of the fins 14 with the outer end portions of each of the conduits projecting in opposed axial prolongation of passages 16 in alignment with the recesses 18. The conduits 17 project from either end of the radiator sections 11 a sufficient distance to terminate in the plane of the muzzle or breech of the heat exchange unit as the case may be and in the present form of the invention the sections 11 are of sufficient length to receive two

convolutions of each of the conduits 17 wound thereon. The conduits 17 at either end of the sections 11 are upwardly directed from the seats 19 into engagement with outer arcuate portions of the recesses 18, which are of such radius as to permit bending of the conduits into opposed axial prolongation of the passage 16 aligned with the outer arcuate portions of opposed recesses, without deformation of the cross sectional contour of the conduits.

The number of passages 16 formed in each radiator section 11 is the product of the number of conduits 17 wound upon each section 11 and the number of sections employed to constitute the heat exchange unit 10. For example in the present embodiment where the radiator sections 11 are triple threaded and therefore have three conduits 17 wound upon each section and the heat exchange unit is comprised of eight radiator sections each section 11 will have twenty-four passages 16 as indicated in Figs. 3 to 5 and 7. It is not to be understood, however, that the embodiment shown is limitative in character for the sections 11 may be arranged to have any suitable number of conduits 17 wound thereupon one or more convolutions and the heat exchange unit may comprise any desired number of sections 11, but the number of passages 16 in each section 11 as hereinafter made apparent must be the product of the number of sections 11 and number of conduits 17 convoluted upon each section 11.

With the radiator sections 11 formed as described and the conduits 17 wound upon the seats 19 thereof as aforesaid, reference is made to Figs. 1, 2, 8 and 9 which clearly show the method of assembly of the sections in the assembled heat exchange unit. The upper leftmost section of Fig. 9 viewed in its normal position and hereinafter referred to as the muzzle radiator section is retained in the position shown in Fig. 9 and the next consecutive radiator section 11 is assembled in axial juxtaposed relation with the muzzle section 11 by projecting the muzzle end portions of the conduits 17 wound thereupon through those passages 16 of the muzzle radiator section which will be aligned with the conduits 17 of the succeeding section when the beveled ends 14' of the threads or fins 14 of the adjacent ends of the sections are in complementary abutting relation. Successive radiator sections 11 are assembled in juxtaposed relation with preceding radiator sections in the same manner as the muzzle radiator section 11 and its succeeding radiator section are assembled. The muzzle end portions of the conduits 17 of each succeeding radiator section 11 project forwardly a sufficient distance to be inserted through cooperating aligned passages 16 of the preceding radiator sections and terminate in the plane of the projecting muzzle end portions of the conduits 17 wound upon the muzzle radiator section 11, likewise the breech end portions of the conduits 17 project through cooperating aligned passages 16 of succeeding radiator sections 11 and terminate in a plane adjacent the breech end of the breech radiator section 11. It will of course be obvious that the sections 11 need not be assembled with their beveled end portions 14' in complementary abutting relation, however, this method is preferred inasmuch as the fins 14 will then be disposed to form a smooth helical surface from muzzle to breech.

At the breech end of the heat exchange unit thus far assembled the conduits 17 are all passed through a plate 20 conveniently of the same di-

ameter as the outside diameter of the radiator sections 11 and secured thereto by a rolling operation similar to that employed in securing boiler tubes to a boiler.

The flash hider 12 comprises an outer member having a forward portion 20 of generally cylindrical tubular form of greater diameter than a bore 15 of a radiator section 11 and a rearwardly projecting axially disposed portion 21 taper bored in such manner as to form the annular shoulder 22 adjacent its junction with the cylindrical portion 20 and a rear or apical opening 23 of the same diameter as a bore 15. The portions 20 and 21 are provided with annular heat radiating fins 24 which are preferably graduated in outside diameter from rear to front so as to form a continuation of the fins 14 over the entire heat exchange unit which is smooth in longitudinal sectional contour as shown in Fig. 2.

The fins 24 of the conical projecting portion 21 and shoulder 22 are bored to provide a circumferential row of passages 25 adapted to form prolongations of the passages 16 and receive the conduits 17 projecting forwardly of the muzzle radiator section 11. As shown in Figs. 1 and 2 the outer member of the flash hider 12 is assembled in axially juxtaposed relation forwardly of the muzzle radiator section 11 with the conduits 17 inserted through the passages 25 and rolled over in secured engagement with the shoulder 22.

The flash hider 12 also comprises an inner truncated conical member 26 adapted to be received in the taper bore of the portion 21 of the outer member and be secured to the muzzle end of the barrel 13. The muzzle end of the inner member 26 is formed to provide an annular passage 27 between the interior of portion 20 of the outer member and the exterior of the inner member 26 leading from the exterior of the flash hider to the exit ends of the conduits 17 secured to the flash hider.

In operation the barrel 13 may be of the stationary or recoiling type as in either case the muzzle blast in firing will cause a reduction in pressure in the vicinity of passage 27 whereupon atmospheric pressure existing in the vicinity of the breech ends of the conduits 17 will force air through the conduits from breech to muzzle. Due to the novel construction of this heat exchange unit a single conduit in making only a few convolutions in direct heat conducting relation with the portions of the radiator sections 11 in direct bearing with the barrel will prevent the air passing through the conduits from being raised to a temperature where it is incapable of absorbing heat from the barrel and at the same time because of the close spacing of the convolutions of the different conduits 17 the barrel will be more effectively cooled owing to the relatively cool air passed through the convolutions by this method.

Also as the barrel is heated and expands linearly it will engage the taper bores 15 of the radiator sections in better heat conducting relation.

Having now described what is at present considered a preferred embodiment of the invention I claim:

1. A heat exchange unit comprising an axially bored radiator section, a plurality of radiator fins formed on said section in outwardly projecting relation thereto and being provided with spaced openings arranged in longitudinally aligned relation, a plurality of tubular conduits inserted through the openings in certain of said fins and wound around the portion of the sec-

tion between adjacent pairs of certain other of said fins in heat conducting relation.

2. A heat exchange unit comprising a metallic radiator portion, said radiator portion being formed to provide a longitudinal passage adapted to receive means for heat exchange, said radiator portion also being provided with a plurality of outwardly extending radiator fins, said fins each having a plurality of spaced openings disposed in longitudinally aligned relation, and a plurality of tubular conduits, each extending longitudinally through certain of said openings and having a part of their intermediate portions disposed between certain adjacent pairs of said fins in heat conducting relation to the metal between said pairs of fins.

3. A heat exchange unit adapted for use in cooling a gun barrel comprising a metallic radiator portion, said radiator portion being formed to provide a longitudinal passage adapted to conductively receive a gun barrel, said radiator portion also being provided with an outwardly extending helical radiating fin comprised of a plurality of convolutions, each of said convolutions having formed therein a plurality of helically spaced openings disposed in longitudinally aligned relation, and a plurality of tubular conduits each extending longitudinally through certain of said openings and having a part of their intermediate portions disposed between certain of adjacent convolutions of said helical radiating fin in heat conducting relation to the metal between the convolutions of said fin.

4. In a heat exchange unit, a radiator portion comprising a plurality of axially bored radiator sections disposed in axially aligned juxtaposed relation adapted to receive the barrel of

a gun in heat conducting relation, each of said radiator sections also being provided with helical radiator fins, said radiator sections being so relatively juxtaposed that the fins thereof will provide continuous helical radiator fins of a plurality of convolutions relative to the radiator portion, continuous helical conduit seats formed between the convolutions of the continuous helical radiator fins, each of said convolutions being provided with a plurality of spaced openings disposed in longitudinally aligned relation to form passages extending from end to end of said radiator portion, a tubular conduit wound upon each conduit seat portion of each radiator section, opposed end portions of said conduits of each radiator section being aligned with certain of said openings in the fins of the section and disposed within and extending from end to end respectively of the radiator portion of the heat exchange unit through the passages in the other radiator sections.

5. The structure of claim 4, including an arrangement wherein the forwardly projecting end portions of the conduits of each section succeeding the forward radiator section are extended through the passages next adjacent to the opening with which the rearwardly extending portions of the preceding section are aligned.

6. The structure of claim 4, including a flash hider adapted to be secured to the muzzle of said gun barrel comprising spaced concentric inner and outer members juxtaposed in axial prolongation of the forward radiator section and said conduits are extended from the forward radiator section through said outer member in communication with the space between said members.

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