May 27, 1969 H. I. DURYEE ET AL 3,445,910

METHOD OF MANUFACTURING A WIRE CLOTH REGENERATOR

Filed Sept. 9, 1966

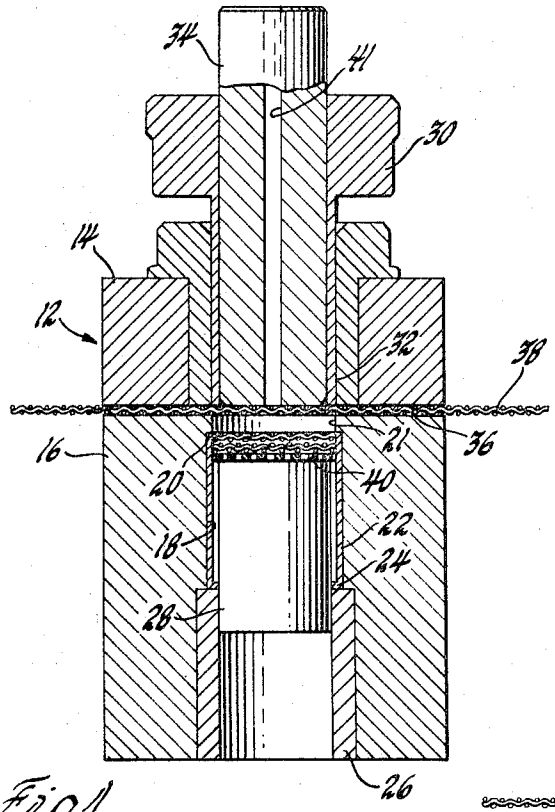

Fig. 1

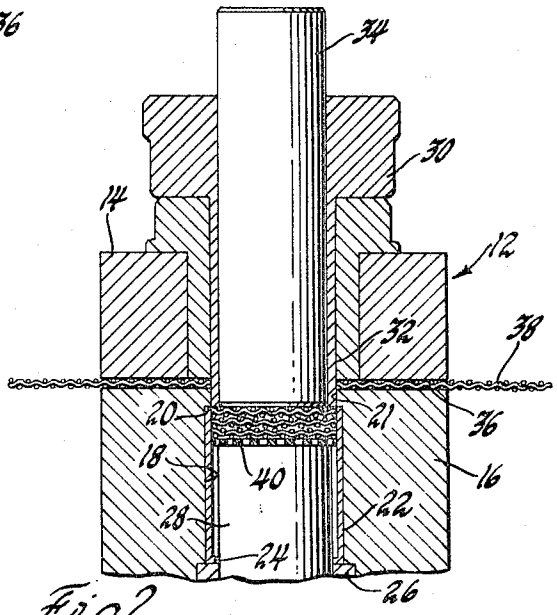

Fig. 2

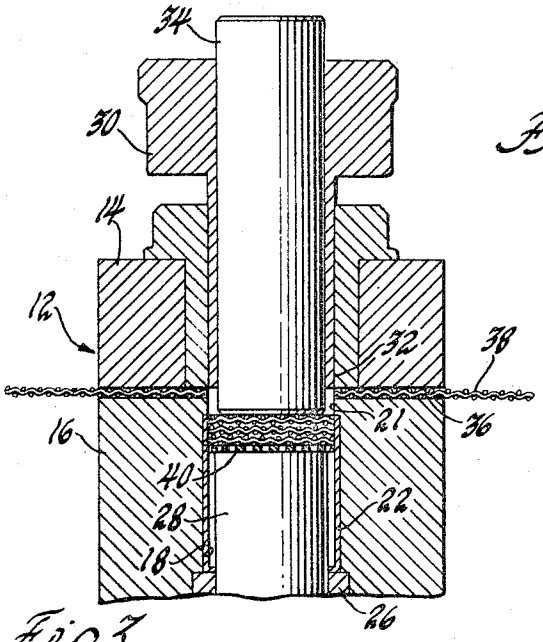

Fig. 3

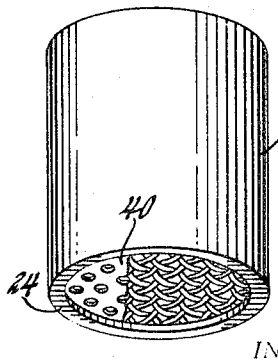

Fig. 4

INVENTORS
Harry I. Duryee &
BY John C. Steiner
F. J. Fodale
ATTORNEY

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METHOD OF MANUFACTURING A WIRE CLOTH REGENERATOR

Harry I. Duryee, Birmingham, and John C. Steiner, Warren, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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U.S. Cl. 29—157.3 6 Claims

ABSTRACT OF THE DISCLOSURE

A method for fabricating a wire cloth regenerator in which a housing having an inturned flange on its lower end and an open upper end is placed beneath a punch. A strip of wire is fed between the punch and the open upper end of the housing and a plurality of discs are individually and successively punched from the wire strip and pushed into the housing. The open upper end is subsequently deformed to lock the plurality of discs within the housing.

Our invention relates generally to a method for making a regenerator especially suitable for but not limited to use with a Stirling cycle engine. More particularly, our invention relates to a method for making a regenerator comprising a number of wire cloth discs stacked in a housing in which wire cloth discs are successively punched from a strip and individually pushed into the housing before the next disc is punched.

In the Stirling cycle engine, a gas flows back and forth between hot and cold cylinders through a regenerator, the hot gases storing heat in the regenerator in one direction and the cold gases removing the stored heat on their return in the opposite direction. Today, the regenerator most suitable for this puurpose is a wire cloth type which comprises a number of wire cloth discs stacked in a case or housing open at both ends for the gas to pass axially through it in both directions. The regenerator absorbs a significant amount of the cost of the Stirling cycle engine and it is the general object of our invention to provide a cheaper method for making the regenerator to reduce the overall cost of the engine.

Another object of our invention is to provide a method for making a regenerator which is relatively inexpensive and which can easily be adapted to automatic mass production techniques.

Another object of our invention is to provide a method for making a regenerator comprising a number of wire cloth discs stacked in a housing which is relatively inexpensive and which can easily be adapted to automatic mass production techniques.

Another object of our invention is to provide a regenerator comprising a member of wire cloth discs stacked in a housing made by a method which is relatively inexpensive, especially adaptable to produce the regenerator and easily adaptable to automatic mass production techniques.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing in which:

FIGURE 1 is a schematic elevation partially in cross section showing a partially fabricated regenerator in accordance with our invention disposed in an apparatus which can be used in carrying out the regenerator manufacturing method in accordance with our invention.

FIGURES 2 and 3 show the movable parts of the apparatus of FIGURE 1 in various positions as the regenerator manufacturing method is being carried out.

FIGURE 4 is a perspective view of a regenerator after it has been completed.

Referring now to the drawings and more particularly to FIGURE 1, there is shown a die indicated generally at **12** having an upper portion **14** and a lower portion **16**. The lower die **16** has a cavity **18** reduced in diameter at its upper end to form a shoulder **20** and a cutting edge **21**. A housing or cylinder **22** having an inturned circumferential flange **24** as its lower end is disposed in the cavity **18**. The inner diameter of the cylinder **22** is preferably a little smaller than the diameter of the cutting edge **21**. A plug **26** is removably secured in the cavity **18** below the cylinder **22** to locate the housing **22** in the cavity **18** so that the upper edge of the housing **22** abuts shoulder **20** and is aligned with the opening of the cutting edge **21**. A loader **28** slidable within the sleeve **26** extends up into the housing **22** through its open bottom.

The upper die **14** includes an annular punch **30** slidably mounted on it in alignment with the cavity **18**. The lower outer circumference **32** of the punch forms a cutting edge which mates with and cooperates with the cutting edge **21** in the lower die **16**. A plunger **34** is slidable within the annular punch **30**. A slot **36** provided between the upper and lower dies **14** and **16**, respectively, is adapted to receive a strip of wire cloth **38** and feed it between the upper punch **30** and plunger **34**, and the lower die **16**.

Having thus described apparatus which can be used to manufacture a regenerator for carrying out the method in accordance with our invention, we shall now describe the various positions of the apparatus parts during various steps of our method. A flanged housing **22** is placed in the die cavity **18** in the position shown in FIGURE 1. In some instances, it is necessary to use a retainer ring **40** which is placed in the housing **22**. The retainer ring **40** is a metal plate having a great number of holes in it. It functions as wire mesh except that it provides greater support, which is sometimes necessary. The loader **28** is extended to its upper position and the upper portion **14** is assembled to the lower die portion **16**. With the die thus assembled, wire cloth **38** is threaded into the slot **36**. The punch **30** and plunger **34** may be manually operated or power actuated with the power actuation being with or without automatic control. Irrespective of the power source, the plunger **34** and punch **30** are moved downwardly together from the position shown in FIGURE 1 to the position shown in FIGURE 2. The hole **41** allows air to escape during the downward motion of the punch **30** and plunger **34**. The hole is provided to insure that the screen disc does not slip and is loaded concentrically into the regenerator cup. This action punches a disc from the wire cloth **38** and pushes the disc into the housing **22**. The punched disc is preferably a little larger than the inner diameter of the housing **22** so that it is pushed into it with an interference fit. The loader **28** is simultaneously indexed downwardly an increment so as to provide a space for the next disc which is punched to be received within the housing **22**. The punch **30** is retracted from the die cavity **18** to the position shown in FIGURE 3. The plunger **34** remains in its downward position to retain the punched disc in the housing **22** as the punch **30** is withdrawn. The plunger **34** is preferably as large as possible so that as much of the disc is held in place as possible to prevent curling of the edges of the disc and also to aid in keeping the discs in alignment in the housing **22**. In the next step, the plunger **34** is withdrawn to the position shown in FIGURE 1 where the lower ends of the punch **30** and plunger **34** are again coplanar. The strip **38** is fed into the die an additional amount

and another disc is punched .The process is repeated until the housing **22** is filled with the required number of discs and the retainer ring **40** abuts the flange **24**. After this occurs, the die is opened and the assembly removed. It may also be necessary to provide a second retainer ring on top of the stacked wire cloth discs. The upper end of the housing **22** is then staked or bent over to sandwich the disc (and retainer rings when used) between the top of the housing **22** and the lower flange **24** to complete the assembly.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. A method for fabricating a wire cloth regenerator comprising the steps of:

placing a housing with an inturned flange on its lower end and an open upper end beneath a punch and in alignment therewith,

feeding a strip of wire cloth between the punch and the housing,

punching a plurality of discs from the wire cloth strip, and pushing each disc into the housing after it is punched and before the next disc is punched, and deforming the open end of the housing after a plurality of punched discs have been pushed into the housing to retain the discs between the deformed upper end and the lower flange.

2. The method as defined in claim **1** wherein the punched disc is received in the housing with an interference fit.

3. The method as defined in claim **1** wherein a first retainer ring is placed in the housing before any punched discs are received therein and wherein a second retainer ring is placed on top of the plurality of punched discs pushed into the housing before the open end of the housing is deformed.

4. The method as defined in claim **2** wherein a first retainer ring is placed in the housing before any punched discs are received therein and wherein a second retainer ring is placed on top of the plurality of punched discs pushed into the housing before the open end of the housing is deformed.

5. The method as defined in claim **3** wherein said first retainer ring is supported in said housing adjacent the upper open end thereof and indexed downwardly as each punched disc is received an amount substantially equal to the thickness of the punched disc.

6. The method as defined in claim **4** wherein said first retainer ring is supported in said housing adjacent the upper open end thereof and indexed downwardly as each punched disc is received an amount substantially equal to the thickness of the punched disc.

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THOMAS H. EAGER, *Primary Examiner.*

U.S. Cl. X.R.

29—163.5, 419, 511

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,445,910 May 27, 1969

Harry I. Duryee et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 37, "puurpose" should read -- purpose --; line 55, "member" should read -- number --. Column 2, line 9, "as" should read -- at --.

Signed and sealed this 14th day of April 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents