

Nov. 17, 1953

C. K. WILSON
GUN CONSTRUCTION FOR GAS BLAST SPRAYING
HEAT-FUSIBLE MATERIALS

2,659,623

Filed Dec. 7, 1948

2 Sheets-Sheet 1

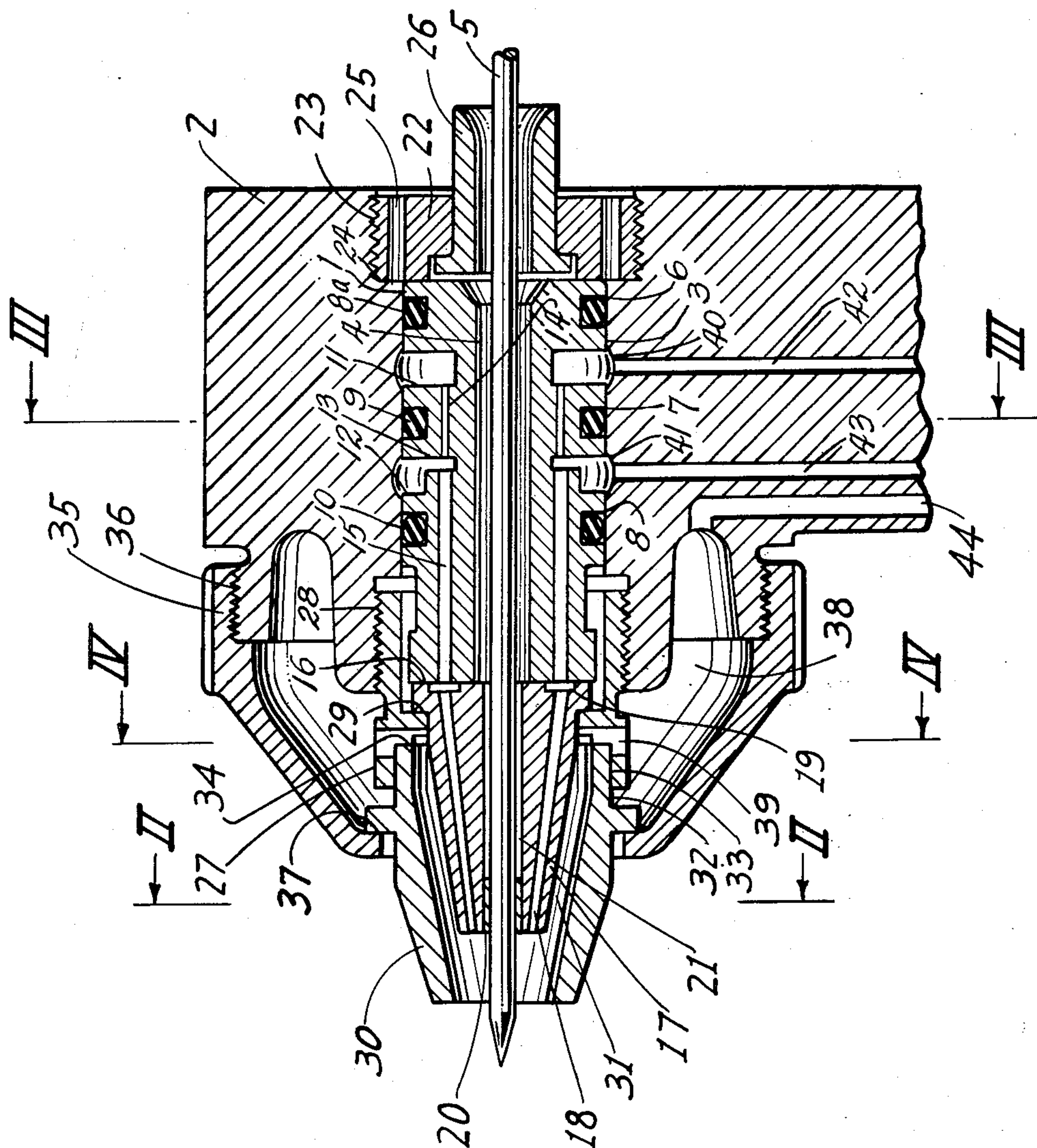


Fig. 1--

INVENTOR.
Charles K. Wilson
BY *Burgess & Dischlag*
Attorney

Nov. 17, 1953

C. K. WILSON
GUN CONSTRUCTION FOR GAS BLAST SPRAYING
HEAT-FUSIBLE MATERIALS

2,659,623

Filed Dec. 7, 1948

2 Sheets-Sheet 2

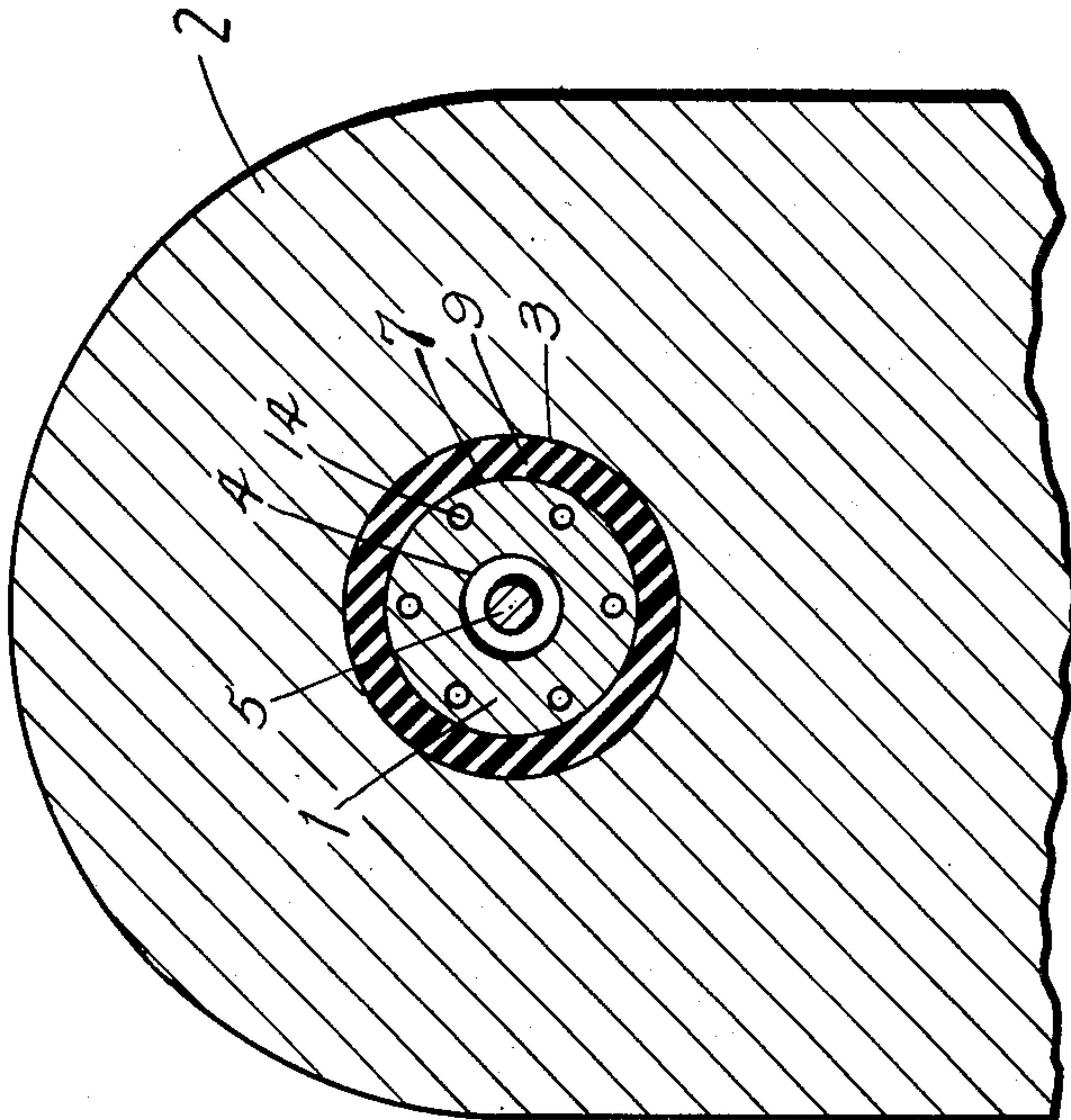


Fig. 3-

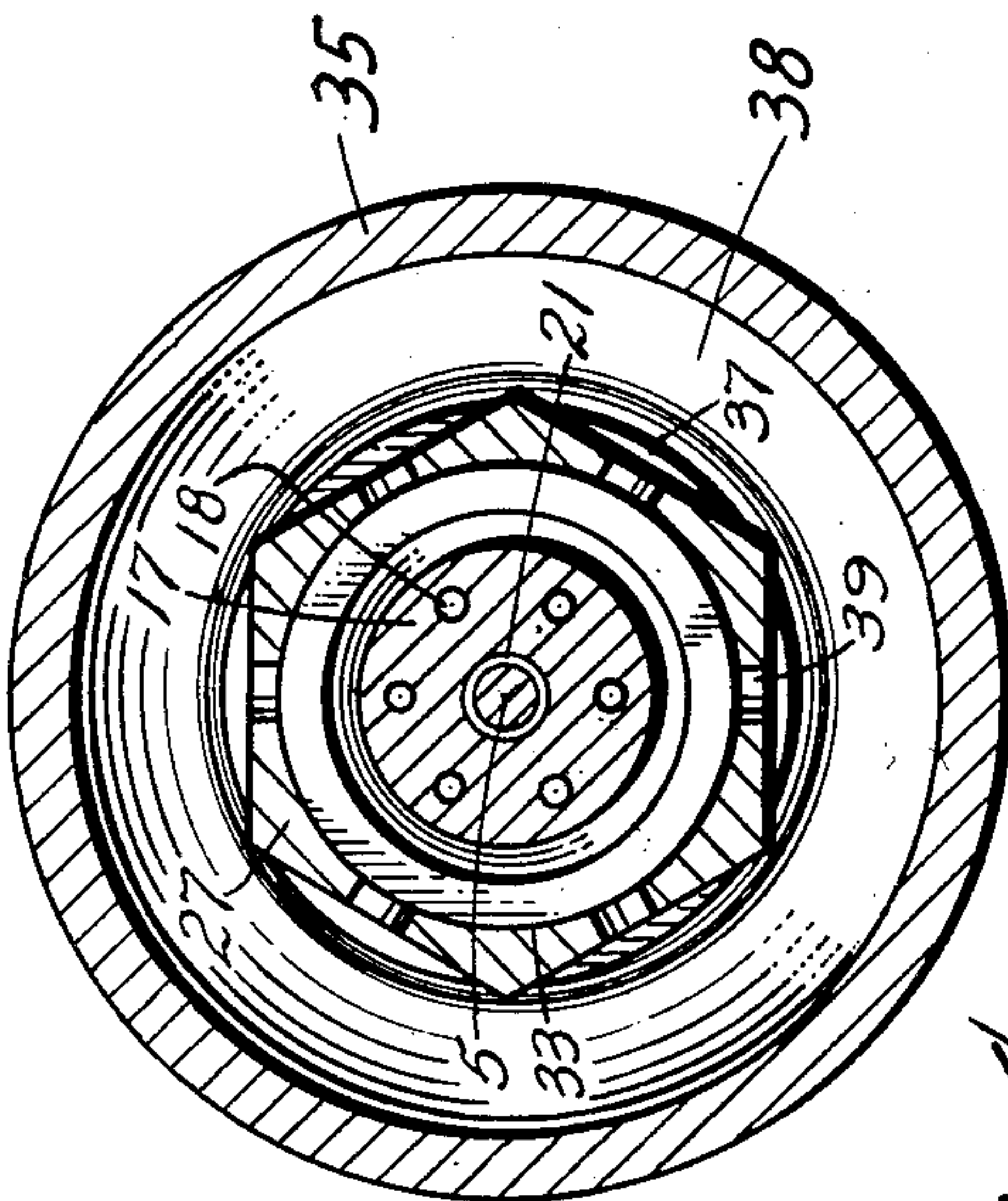


Fig. 4-

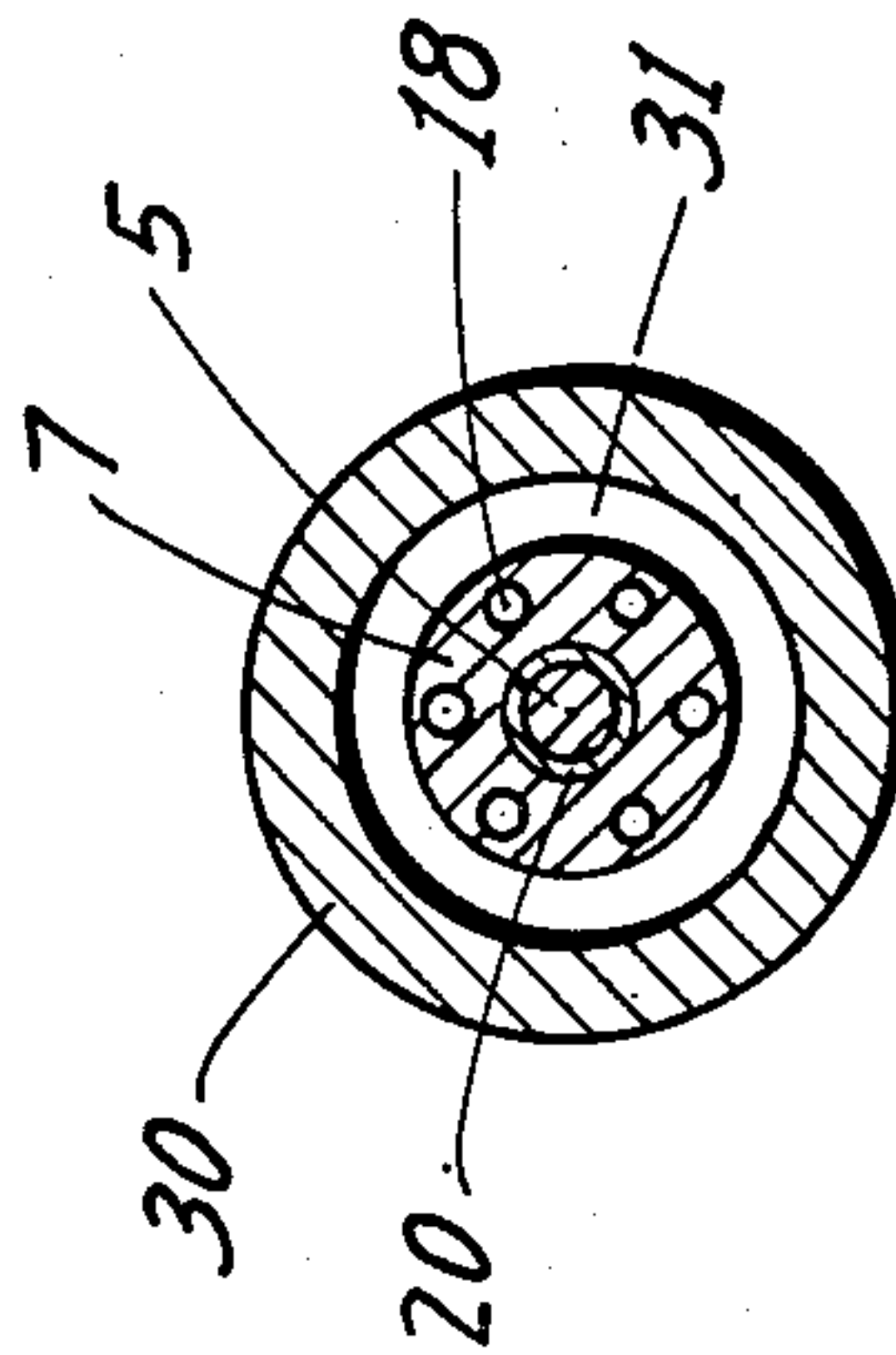


Fig. 5-

INVENTOR.
Charles K. Wilson
BY *Burgess & Dinklage*
Attorneys

UNITED STATES PATENT OFFICE

2,659,623

GUN CONSTRUCTION FOR GAS BLAST
SPRAYING HEAT-FUSIBLE MATERIALSCharles K. Wilson, East Williston, N. Y., assignor
to Metallizing Engineering Co. Inc., Long
Island City, N. Y., a corporation of New Jersey

Application December 7, 1948, Serial No. 64,006

10 Claims. (Cl. 299—28.8)

1

This invention relates to improvements in gun construction for gas blast spraying heat-fusible materials.

Heat-fusible material spray guns of the gas blast type are devices in which such material is fed into a melting zone in which it is melted, being thereafter expelled from the gun in subdivided form by a blast of air or other gas. The materials to be sprayed may be fed into the melting zone either in the form of a rod or wire or in the form of powder. A mixture of fuel gas and combustion supporting gas such as a mixture of acetylene or propane and air or oxygen is fed to the melting zone through suitable jets which discharge the combustible gas mixture which when ignited causes the melting of the material. When powder is used, the same may not always be completely melted as in some cases only some of the powder is melted, or some of the particles of powder may be only partially melted or heat softened. In cases where a wire or rod is used, air or other gas is forcefully directed against the molten material at the tip of the rod or wire in such manner that it impinges sharply against the tip to thereby substantially blast the material into fine particles. The construction of heat-fusible material spray guns of the gas blast type usually includes a combustible-gas nozzle or burner tip which is provided with a material feeding conduit and a multiple number of combustible-gas jets, substantially surrounding the axis of the feeding conduit, and a blast gas nozzle surrounding the combustible-gas nozzle and the feeding conduit. In a gun construction of this type, the blast gas nozzle and the combustible-gas nozzle are mounted on a portion of the gun construction known as the "gas head." Both the combustible and the blast gases pass through this head to the nozzle. Such a gas head may be either an integral part of the gun construction involving the material feeding mechanism or it may be a separate part of the gun. In either case, the gas head is the part of the gun assembly upon which the blast gas nozzle and the combustible-gas nozzle are mounted. It is to such construction that this invention primarily relates. Spray guns of the above described type are well known for the spraying of metal, and for convenience the following description is made in connection with metal spray gun constructions, it being understood that the principles of the invention are applicable to constructions using other heat-fusible materials as, for instance, plastics.

One type of spray gun of the gas blast type

2

which has been hitherto used involves construction in which some part or parts of the gas head have been separate removable pieces, and in which the passages for the combustible-gas and the combustion supporting gas have existed, at least in part, in grooves or channels in such removable parts. In these, a portion of the head is removable from the remainder of the gas head. This construction has permitted grooving and drilling the removable section, and drilling and, if desired, grooving the remaining portion of the gas head so as to produce practically any desired arrangement of mixing chambers, mixing jets, and syphon jets and Venturi tube combinations.

The difficulty with gas head constructions of this type with removable sections has always been, however, that no adequate or satisfactory means has ever been developed for sealing the removable portion to the remainder of the gas head. One method which has been used in the past in an attempt to solve this problem has involved the use of a removable section of the gas head, provided with a tapered portion thereon, which seats with a corresponding tapered seat in the remaining portion of the gas head. Construction of this type requires very strong holding means to firmly hold the tapered portion in its taper seat. One typical holding means for this purpose has been a threaded nut which screws on to a threaded stem extending from the removable section beyond its tapered portion. Such a fastening means, however, has required an adequate gas tight and heat resistant packing, and in a construction of this type it has been a common practice to use a solid copper metal packing to seal between the threaded stem of the removable section of the gas head and the remaining portion of the gas head.

Construction of this type involving tapered seats and metal packings to seal between the removable section of the gas head and the remaining portion thereof have not proved satisfactory in the past. One reason for this has been the fact that the tapered seats must fit very precisely and consequently have been very expensive to manufacture and also to maintain. Since the seats are metallic, the slightest scratch on either of the mating surfaces will cause serious and sometimes dangerous leaks. Another reason why constructions of this type have not proven satisfactory is due to the fact that all burner tips are subject to flash-back which means that the fire will flash back inside of the jet openings and burn at the point where the combustible-gas and combustion supporting gas are first mixed.

3

Since this point of first mixture is inside the gas head, very intense heat is generated within the head when flash-back occurs. This intense heat frequently causes sufficient expansion of the fixed portion of the gas head to permit gas to leak across the tapered seat. Such intense heat and subsequent cooling can also cause permanent deformation of the mating seats producing a permanent leak between them.

A further disadvantage of these gas head constructions involving tapered seats and metallic packings is that the metallic packings do not permit ready disassembly for cleaning and reassembly by the operator. To perform this function of sealing, metallic packings, such as copper packings, must be deformed each time they are tightened in place; and hence they make removal of the parts difficult and usually require replacement of the packing upon each reassembly. Such packings are also dangerous in that they are subject to improper sealing and hence subject to leaks.

One object of this invention comprises, inter alia, a heat-fusible material spray gun of the gas blast type construction which overcomes the foregoing and other disadvantages.

A further object of this invention is a heat-fusible material gas blast spray gun with a gas head construction comprising a removable portion and a remaining portion of such gas head which overcomes the foregoing and other disadvantages.

Another object of this invention is a gas blast gun gas head construction comprising a removable portion and a remaining portion of such gas head which seals adequately and quickly between the two said portions, and which avoids the use of tapered seats and metallic packings.

Still another object of the invention is a spray gun gas head construction of the type referred to in which the removable portion of said gas head is readily removable by the operator.

This and still further objects of the invention will be more thoroughly understood from the following description read in conjunction with the drawings illustrating a preferred embodiment of the structure in accordance with the invention.

Fig. 1 is a central section taken longitudinally through the gas head part of a gas blast gun in accordance with my invention;

Fig. 2 represents a section through the part of the gas blast gun shown in Fig. 1 in the plane II—II;

Fig. 3 is another section of the part of the gas blast gun shown in Fig. 1 taken from the plane III—III;

Fig. 4 is another section of the part of the gas blast gun shown in Fig. 1 taken from the plane IV—IV.

Referring to the Figs. 1, 2, 3 and 4, numeral 1 designates a removable gas head seat which in this construction is a removable portion of the gas head. The remaining, or fixed portion of the gas head, is designated by numeral 2. Gas head seat portion 1 has a cylindrical outer surface at 3 which fits the cylindrical bore of the fixed portion of the gas head 2. The fit between these two cylindrical surfaces is a free or sliding fit with a very small amount of clearance between these surfaces at 3.

Gas head seat portion 1 has a longitudinal hole 4 through its center which constitutes a conduit for the material being fed to the nozzle end of the gun for spraying. In the embodiment of this

4

invention shown in the figures, the material being fed to the flame is in the form of a rod or wire 5.

On the outer periphery of gas head seat portion 1 are three annular grooves, 6, 7, and 8, respectively. Mounted in these annular grooves are three annular resilient packing rings, 8a, 9 and 10, respectively. These rings have a section parallel to the ring axis which is normally circular when the rings are in a relaxed position. The annular grooves 6, 7 and 8 are so proportioned, however, that when these resilient rings 8a, 9 and 10 are in position in the grooves, they are compressed to an oval shape between the bottom of the grooves and the cylindrical bore of the fixed portion of the gas head 2.

In the particular embodiment of the invention illustrated in the figures, the gas head seat portion 1 has a large annular groove 11. It also has an annular groove 12 which extends into a narrower annular portion at 13. A multiple number of relatively small jets or passages 14 are provided in gas head seat portion 1 extending parallel to the axis of seat portion 1 from annular groove 11 to annular groove portion 13. Passages 15 extend in gas head seat 1 and parallel to the axis thereof from annular groove portion 13 to the forward end 16 of said gas head seat. There are the same number of passages 15 as there are jets 14, and each passage 15 is in line with a corresponding passage 14. Combustible-gas nozzle 17 is mounted on gas head seat 1 at its end 16. Nozzle 17 is provided with a multiple number of jets or passages 18 which lead from end to end of said nozzle and which converge toward the flame end. Nozzle 17 is provided with an annular groove 19 at its base or seat where it contacts gas head seat 1 at 16. Nozzle 17 is also provided with a relatively hard bushing 20, permanently mounted in a central longitudinal hole 21. Hole 21 acts as a conduit for wire material 5, and bushing 20 acts as a guide for such wire.

The number of jets 18 may, if desired, correspond to the number of passages 15, or may be some other number. If desired, jets 16 may correspond in number to passages 15 and may also be so located that the entrance end of each jet 18 is in direct alignment with each corresponding passage 15. If desired, means may be provided (not shown in the illustrations) for locating nozzle 17, with respect to gas head seat 1, so that such jet and gas passage alignment be assured. Such alignment is not necessary, however, but in the event that such alignment is not provided for, then annular groove 19 must be sufficiently large to provide for proper distribution of gas flowing from passages 15 to jets 18.

At one end of fixed portion of gas head 2 is provided a threaded plug 22 which is threaded into fixed gas head portion 2 at threads 23. Plug 22 shoulders tightly against shoulder 24. A multiple number of holes 25 are provided in plug 22 to permit the use of a spanner wrench for tightening or loosening this plug. Centrally mounted in plug 22 is wire guide tube 26.

A threaded clamping tube 27 is provided which threads directly into fixed gas head portion 2 at threads 28. This clamping tube is provided with a shoulder 29 which clamps directly to the shoulder of combustible-gas nozzle 17. Clamping tube 27 is provided with a hexagon external shape to fit a wrench.

When clamping tube 27 is tightened in place it clamps nozzle 17 tightly against face 16 of gas head seat portion 1 and simultaneously clamps gas head seat portion 1 firmly against plug 22

which forms a solid bottom or seat at the end of the cylindrical bore in fixed gas head portion 2.

Blast gas nozzle 30 is constructed with a conical internal bore which is spaced apart from the conical external surface of nozzle 17 to form a conical passage 31. Nozzle 30 has an extended external cylindrical portion 32 which fits into a corresponding bore 33 in clamping sleeve 27. The end of nozzle 30 seats against shoulder 34 in clamping sleeve 27. Blast gas nozzle clamping ring 35 is threaded on to fixed gas head portion 2 at threads 36 and clamps nozzle 30 in place by pressing against shoulder 37 of nozzle 30.

Gas space 38 is formed between clamping ring 35 and fixed portion of the gas head 2.

A multiple number of radial holes 39 are provided in clamping tube 27 extending radially therethrough at the point where shoulder 34 is provided therein.

Slight annular grooves 40 and 41 are provided in the bore of fixed gas head portion 2 and are so located longitudinally that they are in line with annular grooves 11 and 12, respectively. A gas passage 42 is provided in fixed gas head portion 2 leading from a source of combustion supporting gas (not shown) to annular groove 40. Gas passage 43 is provided in fixed gas head portion 2 leading from a source of combustible-gas (not shown) to annular groove 41. Gas passage 44 is provided in fixed gas head portion 2 leading from a source of blast gas (not shown) to gas chamber 38.

In operation, the material to be sprayed is fed progressively in the form of a wire through wire guide tube 26, wire conduit 4, wire conduit 21, and through bushing 20, from whence it emerges into the flame zone in front of combustible-gas nozzle 17. A combustible gas such as acetylene is fed into passage 43 whence it flows into and fills annular groove 12 and the extension 13 thereof. A combustion supporting gas such as oxygen is fed into passage 42 from whence it flows into and fills annular groove 11. From annular groove 11, the combustion supporting gas flows through the multiple jets 14 across annular groove portion 13 and into passages 15. As combustion supporting gas flows across groove portion 13 it draws with it combustible-gas which also enters passages 15. Both these gases are mixed as they flow through passages 15, forming a gas mixture of combustible-gas and combustion supporting gas. This gas mixture flows from passages 15, through a portion of annular groove 19 and into jets 18, from whence it emerges at the end of nozzle 17 to burn and form the necessary heating zone.

Compressed blast gas, such as air, is fed into passage 44 from whence it flows into chamber 38, through multiple holes 39, and thence into conical space 31, where it emerges at the end of nozzle 17 in the form of a cone of blast gas exterior to and surrounding the flame. As the blast gas continues to flow it emerges from the end of blast gas nozzle 30 and converges upon the flame surrounding the end of the wire 5 at its heated tip with sufficient force to atomize the heat softened material of said wire and to propel the atomized particles of material to the surface being sprayed.

In normal spraying operations, the operator takes frequent occasion to remove the combustible-gas nozzle 17 either for changing the nozzle to a different one to accommodate a different size wire, or for cleaning the gas jets 18. To do this, the operator simply first removes the clamp-

ing ring 35 and picks off the blast gas nozzle 30, and then removes clamping tube 27 and picks off nozzle 17. If for any reason he should then desire to remove the gas head seat portion 1, he may then do so by simply sliding it out of the cylindrical bore of fixed gas head portion 2. By pressing on the end of wire guide tube 26, the operator can easily force gas head seat portion 1 forward far enough so that it can be easily pulled out from the front end. The removable mounting of gas head seat portion 1 is such that usually but little pressure on guide tube 26 is required. Light tapping, however, may be sometimes required. It is necessary to remove seat portion 1 and clean the passages in the event that a flash-back has occurred.

The resilient packing rings 8a, 9 and 10 are preferably made of a synthetic rubber such as "neoprene." The slight annular grooves 40 and 41 are provided so that these rings will slide easily past the port ends of the passages 42 and 43 when assembling or disassembling.

The very slight space or clearance between the cylindrical outer surface 3 of gas head seat 1 and the corresponding bore of fixed gas head portion 2 is made as small as is practical but still permit easy sliding of the seat member within the bore. This very small clearance is maintained so that only a very small amount of gas could leak across between the cylindrical portions of the seat plug 1 and the bore.

Tests have been conducted for leaks of constructions in accordance with this invention which were purposely assembled with the resilient packing rings 8a, 9 and 10 omitted. It was found that no leaks sufficiently serious to cause hazard in the normal operation of the equipment developed. These tests were made as a precaution since it is clearly recognized that the resilient packing rings may be of a material which would be deteriorated by the heat resulting from a flash-back in the equipment. It is one of the outstanding advantages of the construction in accordance with this invention that the safety in use of this construction does not depend upon the maintenance of the resilient rings in good condition. The rings should, of course, be maintained in good condition, however, to obtain normal and efficient operation of the equipment. Further tests have been conducted of a construction in accordance with this invention wherein the resilient rings were properly assembled and it was found that no leaks whatsoever developed across the surfaces sealed by these rings. It should be noted that one of the advantages of this construction lies in the fact that no tightening means or other adjustment is provided for tightening these resilient packing rings. These rings are sufficiently loose to permit easy sliding of the gas head seat portion 1 in the bore of gas head fixed portion 2. However, this construction is such that as pressure is applied to a resilient ring, the forces are such as to deform the ring so that it presses still more firmly against the side of its annular groove and against the bore in gas head fixed portion 2. As the pressure increases, the ring is pressed still more firmly against the bore in gas head fixed portion 2 and against the corner or edge at the top of the side of the annular groove in seat portion 1. The result is that the greater the gas pressure, the greater is the sealing pressure of the rings and hence no leak can develop.

Another advantage of the construction in accordance with the invention is the fact that flash-

7

back can occur and the burning may continue inside the gas head for a considerable time without causing serious damage to the equipment. In no case will any serious warpage of the metal parts occur which will prevent proper sealing since the final sealing is by means of the resilient packing rings. In fact, the fire may burn inside the gas head for some little time without damaging these rings due to the high rate of heat conductance of the metal in the gas head. Even if the rings are eventually damaged they may be easily and quickly replaced and are by their nature inexpensive.

Throughout the foregoing description reference has been made to the material to be sprayed as being in solid wire form. This same construction is readily adaptable, however, when spraying material which is in granular form, such as in the form of a powder. In such cases, the finely divided material is conveyed through the central hole in wire guide tube 26, through conduits 4 and 21, and out through the hole in bushing 20 to the heating zone in front of nozzle 17. Such finely divided material may be thus conveyed either in the form of relatively packed material or may be conveyed by means of a carrier stream of gas.

While the structures shown in the illustrations are necessarily specific, my invention applies broadly to gun construction for gas blast spraying heat fusible materials and preferably metal, and essentially comprises the improvement therein of a gas head for said gun having a first portion with a substantially cylindrical bore surface and a second portion with a substantially cylindrical outer surface substantially fitting said bore surface, first gas duct means for combustible gas and second gas duct means for combustion supporting gas in each of said first and second portions, each of said duct means terminating at one of said surfaces with said first duct means in said first and second portions in gas passing registry with each other and said second duct means in said first and second portions in gas passing registry with each other, at least one annular groove on at least one of said surfaces between the terminal portions of said first and second gas duct means thereon, at least one resilient packing means in said groove compressed therein between said first and second portions, and means for removably holding said second portion in substantially fixed gas duct registry position with said first portion.

Thus, within the broadest concept of the invention the annular grooves for holding the packing means and preferably resilient packing rings of, for instance, synthetic rubber, may be cut into the bore of fixed gas head portion 2 or into the external surface of gas head seat portion 1, or, may be cut part way into each of these surfaces. Within the preferred embodiment of the invention shown, however, it is preferred to cut the grooves into the external surface of gas head seat portion 1.

While the construction illustrated shows the seat portion 1 with a single diameter for the outer cylindrical surface at 3, it is obvious that this outer surface may, if desired, be made with several diameters of cylindrical surfaces and that the bore in fixed portion 2 would also have different diameters to correspond to the outer surfaces of the seat portion 1. As an example, the cylindrical surface adjacent the ring groove farthest from the gas head nozzle could, if desired,

8

be of a different diameter than the cylindrical surfaces adjacent the other ring grooves.

The removable gas head seat portion 1 is made of a single piece in the preferred embodiment of this invention and is so illustrated in the figures. If desired, such as for convenience of manufacture, it may be made in two or more pieces within the scope of this invention.

While the foregoing description was made with reference to a particular jet construction for mixing and conveying combustible-gas and combustion supporting gas, it is obvious that this part of the construction can be varied as desired, and that any suitable means of conveying and mixing these two gases may be used in the construction in accordance with this invention. It is also evident that any suitable gas blast nozzle construction desired and any suitable combustible-gas nozzle construction may be used as desired in the construction in accordance with this invention.

The foregoing description is furnished by way of illustration and not of limitation, and it is therefore my intention that the invention be limited only by the appended claims or their equivalents wherein I have endeavored to claim broadly all inherent novelty.

I claim:

1. Improvement in gun construction for gas blast spraying heat fusible materials comprising a gas head for said gun having a first portion with a substantially cylindrical bore surface and a second portion with a substantially cylindrical outer surface substantially fitting said bore surface, first gas duct means for combustible gas and second gas duct means for combustion supporting gas in each of said first and second portions, each of said duct means terminating at one of said surfaces with said first duct means in said first and second portions in gas passing registry with each other and said second duct means in said first and second portions in gas passing registry with each other, at least one annular groove on at least one of said surfaces between the terminal portions of said first and second gas duct means thereon, at least one resilient packing means in said groove compressed therein between said first and second portions, and means for removably locking said second portion in substantially fixed gas duct registry position with said first portion.

2. Improvement in accordance with claim 1 in which there are provided additional annular grooves on at least one of said surfaces, each having at least one of said packing rings therein and at least one of said additional grooves and rings being positioned between each end of said second portion and the thereto nearest terminal gas duct portion thereon.

3. Improvement in accordance with claim 2 in which said annular groove is provided on the cylindrical outer surface of said second portion.

4. Improvement in accordance with claim 3 in which said packing means are at least one packing ring for each of said grooves.

5. Improvement in gun construction for gas blast spraying heat fusible materials comprising a gas head for said gun having a first portion with a substantially cylindrical bore surface and a second portion with a substantially cylindrical outer surface substantially fitting said bore surface, first gas duct means for combustible gas and second gas duct means for combustion supporting gas in each of said first and second portions, each of said duct means terminating at

9

one of said surfaces with said first duct means in said first and second portions in gas passing registry with each other and said second duct means in said first and second portions in gas passing registry with each other, at least one annular groove on at least one of said surfaces between the terminal portions of said first and second gas duct means thereon, at least one resilient packing means in said groove compressed therein between said first and second portions, additional annular grooves on at least one of said surfaces, each having at least one of said packing rings therein and at least one of said additional grooves and rings being positioned between each end of said second portion and the thereto nearest terminal gas duct portion thereon, combustible gas jet ducts in said second portion supplied by said first and second gas ducts, and means for removably holding said second portion in substantially fixed gas duct registry position with said first portion, said holding means including a combustible gas nozzle removably seated against one end of said second portion with its gas jet ducts in gas passage registry with the gas jet ducts of said second portion, stop means carried by said first portion positioned for retaining said second portion against movement away from said nozzle, and means secured to said first portion for clamping said second portion between said nozzle and said stop means.

6. Improvement in accordance with claim 5 in which said annular groove is provided on the cylindrical outer surface of said second portion.

7. Improvement in accordance with claim 6 in which said packing means are at least one packing ring of synthetic rubber for each of said grooves.

10

8. Improvement in accordance with claim 5 in which said second portion and said nozzle define a heat fusible material feeding conduit, in which said stop means substantially define a plug carrying a wire feed bushing adjacent said second portion in registry with said feed conduit, and in which said bushing is slidable in the direction of said second portion and secured against motion away from said second portion.

9. Improvement in accordance with claim 8 in which said annular groove is provided on the cylindrical outer surface of said second portion.

10. Improvement in accordance with claim 9 in which said packing means are at least one packing ring of synthetic rubber for each of said grooves.

CHARLES K. WILSON.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
976,717	Anderson	Nov. 22, 1910
1,118,215	Mossman	Nov. 24, 1914
1,310,106	Russell	July 15, 1919
1,414,454	Brown et al.	May 2, 1922
1,564,363	Miller	Dec. 8, 1925
1,958,044	Hendricks	May 8, 1934
2,176,813	Hammon	Oct. 17, 1939
2,196,647	Snyder et al.	Apr. 9, 1940
2,227,753	Ingham	Jan. 7, 1941
2,231,199	Smith	Feb. 11, 1941
2,258,340	Smith	Oct. 7, 1941
2,397,165	Shepard	Mar. 26, 1946
2,483,312	Clay	Sept. 27, 1949
2,539,487	Shepard	Jan. 30, 1951