(No Model.) 2 Sheets—Sheet 1.

J. R. FRASER.

METHOD OF AND MEANS FOR APPLYING THE EXPANSIVE POWER OF HEAT.

No. 432,182. Patented July 15, 1890.

Fig. 1

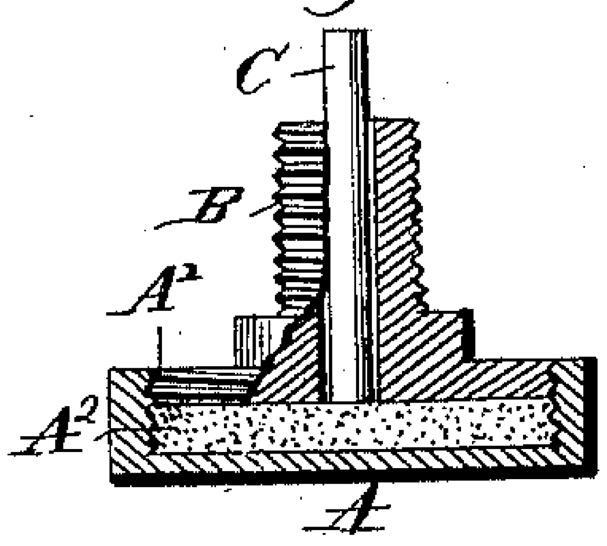


Fig. 2

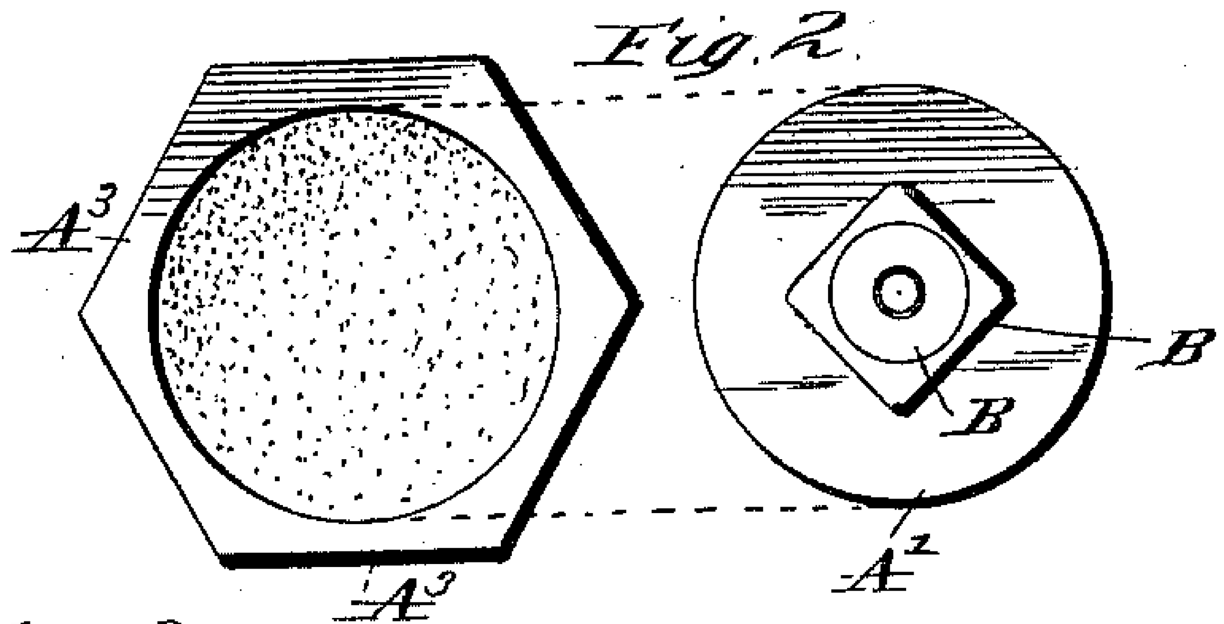


Fig. 3

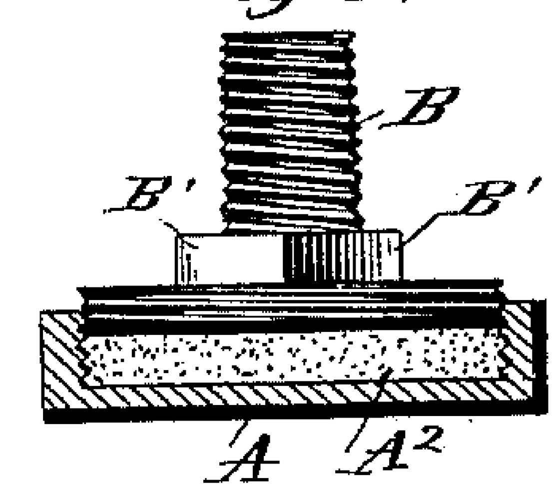
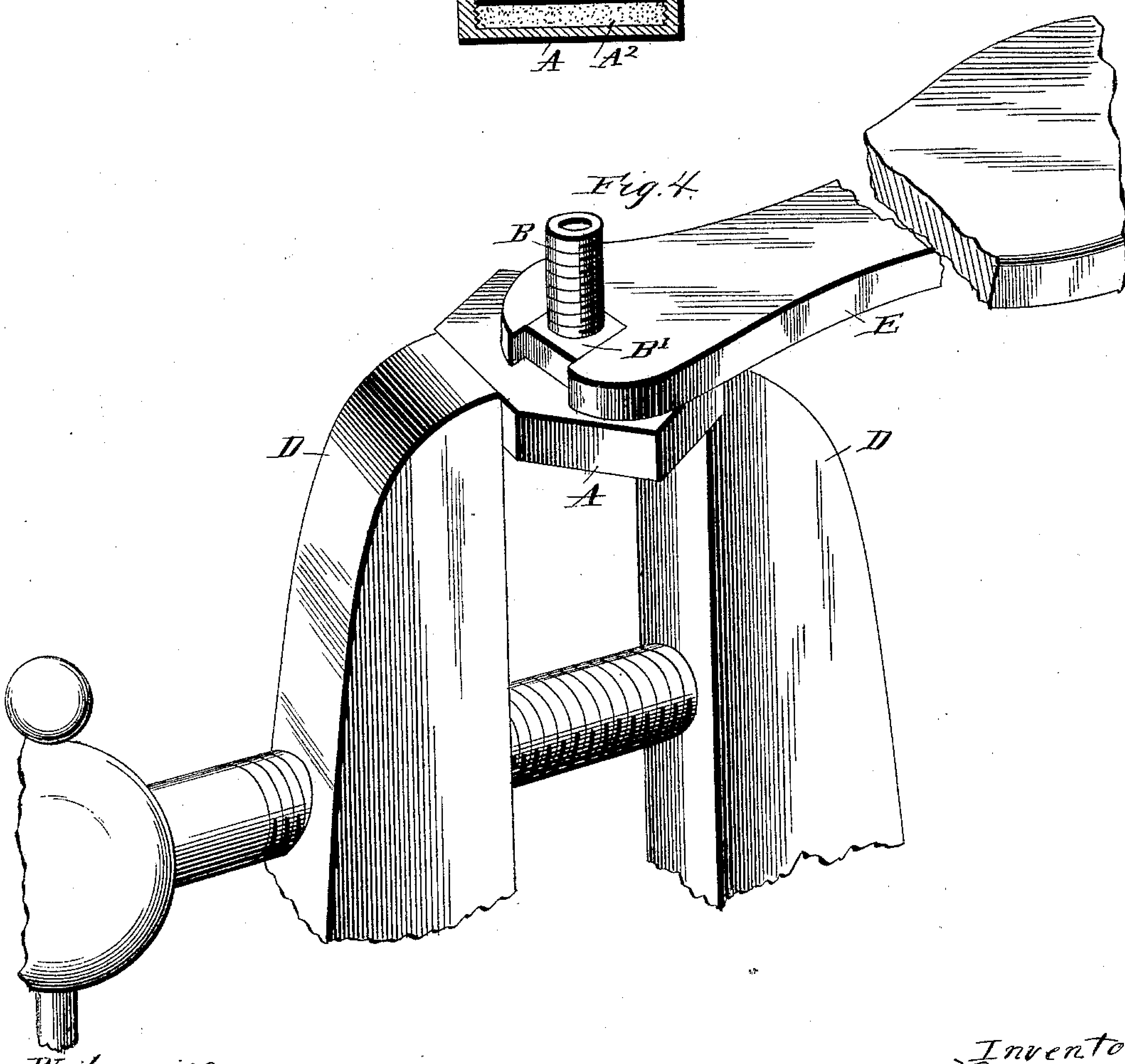


Fig. 4



Witnesses
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(No Model.) 2 Sheets—Sheet 2.

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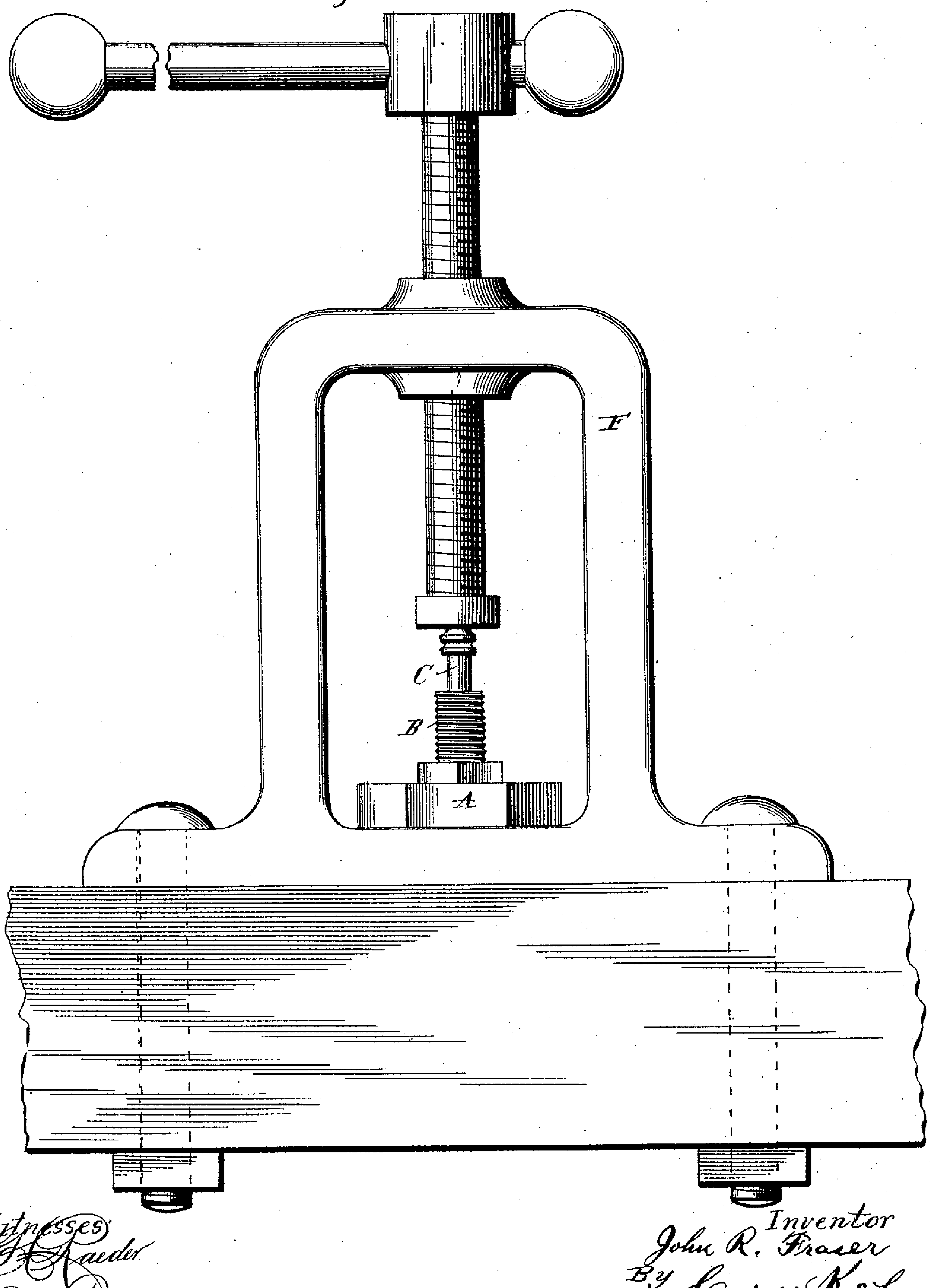
Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN R. FRASER, OF MILWAUKEE, WISCONSIN.

METHOD OF AND MEANS FOR APPLYING THE EXPANSIVE POWER OF HEAT.

SPECIFICATION forming part of Letters Patent No. 432,182, dated July 15, 1890.

Application filed November 22, 1889. Serial No. 331,210. (No model.)

To all whom it may concern:

Be it known that I, JOHN R. FRASER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Applying the Expansive Power of Heat; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention relates to methods and apparatus for applying the expansive power of heat, and has special reference to methods in which the motion is produced by the thermal expansion of a confined fusible solid. It does not, however, relate generally to the application of thermal expansive power by the expansion of fusible solids. It relates only to the use of a compressed fusible solid, as hereinafter fully set forth. It is intended to produce an apparatus the parts of which are positively inert, fixed, and motionless under all disturbing conditions, excepting only when exposed to a certain chosen temperature, to the end that they may be adapted to operate and control mechanism which is required to be operated only at times when the apparatus is by design or as a matter of course exposed to the chosen temperature.

Among the uses to which my improvement may be applied is the operation of automatic fire-alarms and automatic fire extinguishing and controlling apparatus. By the term "fusible solid," as herein used, I mean a material which is under normal temperature solid, or so nearly solid as that it is devoid of mobility, but which when heated becomes mobile, or so nearly so as that when it is subjected to pressure it will conform itself to the shape of a vessel and follow passages after the manner of liquids.

The particular feature of the present invention relates to the method of treating the confined solid for the purpose of obtaining from it the greatest efficiency and accuracy of action. This is accomplished by compressing the fusible solid placed within the expansion-chamber.

It is well known that material bodies vary greatly in compressibility. Generally speaking, gases have the greatest and liquids the least and solids an intermediate compressibility. Gases possess great and liquids practically no compressibility. The compressibility of water is, for example, so small, even under enormous pressure, as to be almost inappreciable. All gases are, on the contrary, of practically unlimited compressibility. It is conceded that all gases may be compressed to smaller and smaller volumes until the gaseous state is given up for the liquid or the solid state. It is a peculiarity of gases that after compression and the removal of the pressure they expand and resume their former volume. This is also true of liquids; but with a large variety of solids or semi-solids this is not the case. A large number of these may be taken at their normal density and compressed so as to reduce their volume to a considerable degree, the decreased volume remaining permanent after the removal of the pressure which effected the compression and the diminution of the volume of the material. It appears that in these materials the normal arrangement of the molecules is not as close as it is possible to make them, and that if they are forced closely together, so as to make them occupy less space, there is sufficient cohesion to cause them to remain in the new position. In this respect these solids differ from gases and liquids. In the latter there is an absence of this cohesion and the molecules are free to respond to the action of gravity and to repulsion.

I have discovered by investigation and experiment that if a mass of the solid or semi-solid of the nature described is subjected to great pressure it will maintain indefinitely the reduced volume effected by the compression, but that when subjected to heat it will expand to its normal volume and density. Suppose a mass of paraffine, wax, soap, or other similar material be melted and poured into a chamber having a neck in which a piston is to be fitted. On pouring said material into said chamber through said neck it will of course cool and harden, or partially harden, at normal density and at its normal volume. If the piston be now placed in the neck sufficiently far to rest accurately upon the material within the chamber and the chamber then heated, the material within the chamber will expand or increase its volume, the change being from the normal volume to a volume greater than the normal volume. The range of motion imparted to the piston by this expansion or increase of volume of the material is limited by the capacity of the material to expand from its normal volume to an abnormally large volume. The range of firm measured movement of the piston is still more limited, for the reason that after the material becomes considerably liquefied and greatly heated and begins to vaporize the movement becomes spasmodic and uncertain. I have ascertained that the total range of movement of the piston may be increased in a great degree by compressing the material within the chamber and behind the piston as much as possible, and I have ascertained that the range of firm measured movement is increased in even a greater degree by thus compressing the material behind the piston. After thus compressing said material there are virtually two stages to the thermal expansion. The first stage is from the abnormally small volume to the normal volume, and the second stage is from the normal volume to the abnormally large volume. I have also ascertained that all of the expansion through the first stage is firm and measured and in no wise spasmodic, and that only the latter portion of the second stage is uncertain and spasmodic. By the second stage I mean here the entire range of expansion from the normal volume to vaporization.

As hereinbefore stated, it is my object to effect an expansion which shall be uniform and measured. The first stage of this expansion is therefore wholly of the character sought. Another and secondary advantage in using this double range of expansion is that it enables me to produce the desired range of movement of the piston by the use of a comparatively small instrument. This is important in many applications of the apparatus.

The accompanying drawings illustrate apparatus and appliances concerned in the practice of my improved method.

Figure 1 is a sectional side view of one of the expansion devices. Fig. 2 is a view of the same device, taken apart. Fig. 3 shows one of the devices filled but not yet compressed. Figs. 4 and 5 show appliances for effecting the compression.

Referring first to Figs. 1 and 2, A is an expansion-chamber provided with a tubular neck B. The upper portion of the chamber A consists of a circular section A′, threaded into the chamber A. The space within the chamber A is filled with a compressible solid. A piston C extends downward through the neck B into the chamber A. The circumference of the chamber A is preferably formed into faces A^3 to adapt it to be grasped by a vise or wrench or similar appliance. A portion of the neck B should also be provided with similar faces B′. When thus constructed, the chamber A may be secured in a vise and the section B grasped by a wrench and screwed into the chamber A.

In preparing the instrument for use the chamber A is first filled with the expansive material A^2, a sufficient quantity being put in to allow for compression. The section A′ is then applied by hand, as shown in Fig. 3, until it can be turned no farther by hand. The chamber A is then placed within a strong vise, as D, or similar appliance, and the section A′ grasped by a wrench E or similar appliance, and said wrench turned until the section A′ is turned into the chamber A as far as possible. The piston C is then inserted into the neck B and the device placed into a press F or similar appliance, wherein said piston is driven down into the neck B as far as possible. It will be understood that by the use of the vise, wrench, and press great compressing power may be exerted upon the material contained by the chamber A. When thus filled and compressed, the expansion device is ready for use. Upon heating the chamber A the material A^2 within said chamber gradually expands until it assumes its normal volume and density. Thereafter if additional heat is applied said material will expand as much more as it would have expanded without the compression. Consequently the piston is driven upward, first, through a certain range by the expansion which changes the compressed material A^2 to its normal volume, and, second, by the expansion of the material A^2 from its normal volume to more than its normal volume, or to the volume which it assumes prior to vaporization. As already stated, the expansion through the range from the compressed volume to the normal volume is entirely measured and lacking in spasmodic character, and it is the movement resulting from this expansion that is desirable for a large variety of uses. The compression of the expansive material may also be wholly or partially effected before it is placed within the chamber. By the use of suitable molds operated under sufficiently great power masses of the expansive material may be compressed into blocks, cakes, or lozenges of proper size to accurately fill the chamber. These blocks, cakes, or lozenges may then be placed within the expansion-chamber. When this course is pursued, the mass of material should of course be compressed into such form as to accurately fit the space within the expansion device. The desired form of the expansive material may be produced by using a mold having walls corresponding to the walls of the expansion device.

In practice compounds which expand under the temperatures meeting different requirements may be prepared. The formulas for these compounds are not made a part of the subject-matter of this application.

I claim as my invention—

1. The method of treating a "fusible solid" preparatory to being heated for the application of the expansive power of heat, which method consists in compressing the fusible solid to abnormal density and confining it by fixed walls and a movable solid part, substantially as shown and described.

2. The method of applying the expansive power of heat, which method consists in confining a body of abnormally compressed fusible solid by fixed walls and a movable solid part and then imparting heat to said fusible solid, whereby it expands and moves said movable part, substantially as shown and described.

3. In an apparatus for applying the expansive power of heat, a chamber A, a piston B, fitting into said chamber, and a body of abnormally compressed fusible solid occupying the space behind said piston and within said chamber, substantially as shown and described.

In testimony whereof I affix my signature, in presence of two witnesses, this 16th day of November, 1889.

JOHN R. FRASER.

Witnesses:
CHAS. L. GOSS.
GEO. KNOWLES, Jr.