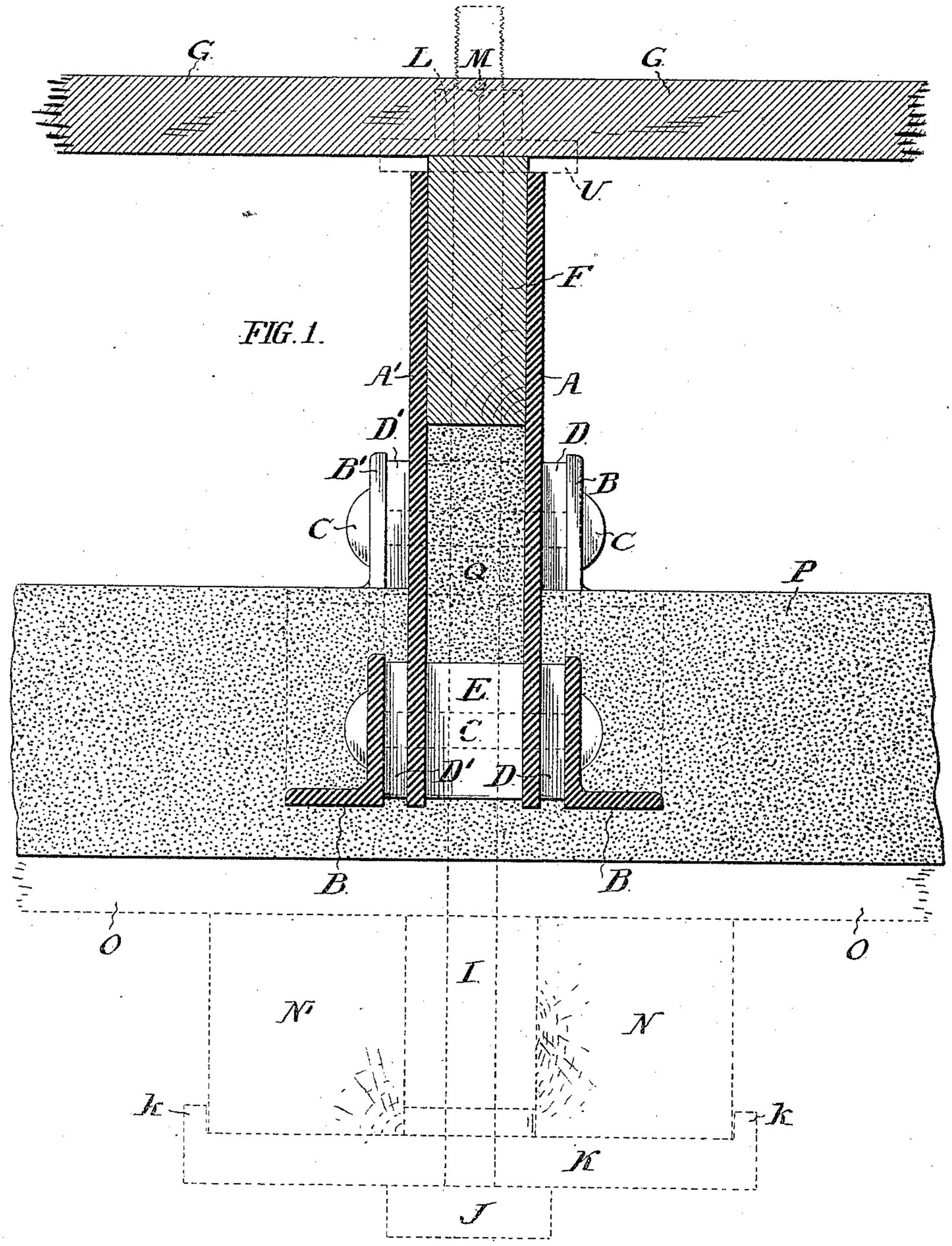
(No Model.) 3 Sheets—Sheet 1.

F. FURNESS.

FIRE PROOF FLOOR.

No. 444,935. Patented Jan. 20, 1891.

FIG. 1.



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(No Model.) 3 Sheets—Sheet 2.

F. FURNESS.

FIRE PROOF FLOOR.

No. 444,935. Patented Jan. 20, 1891.

FIG. 2.

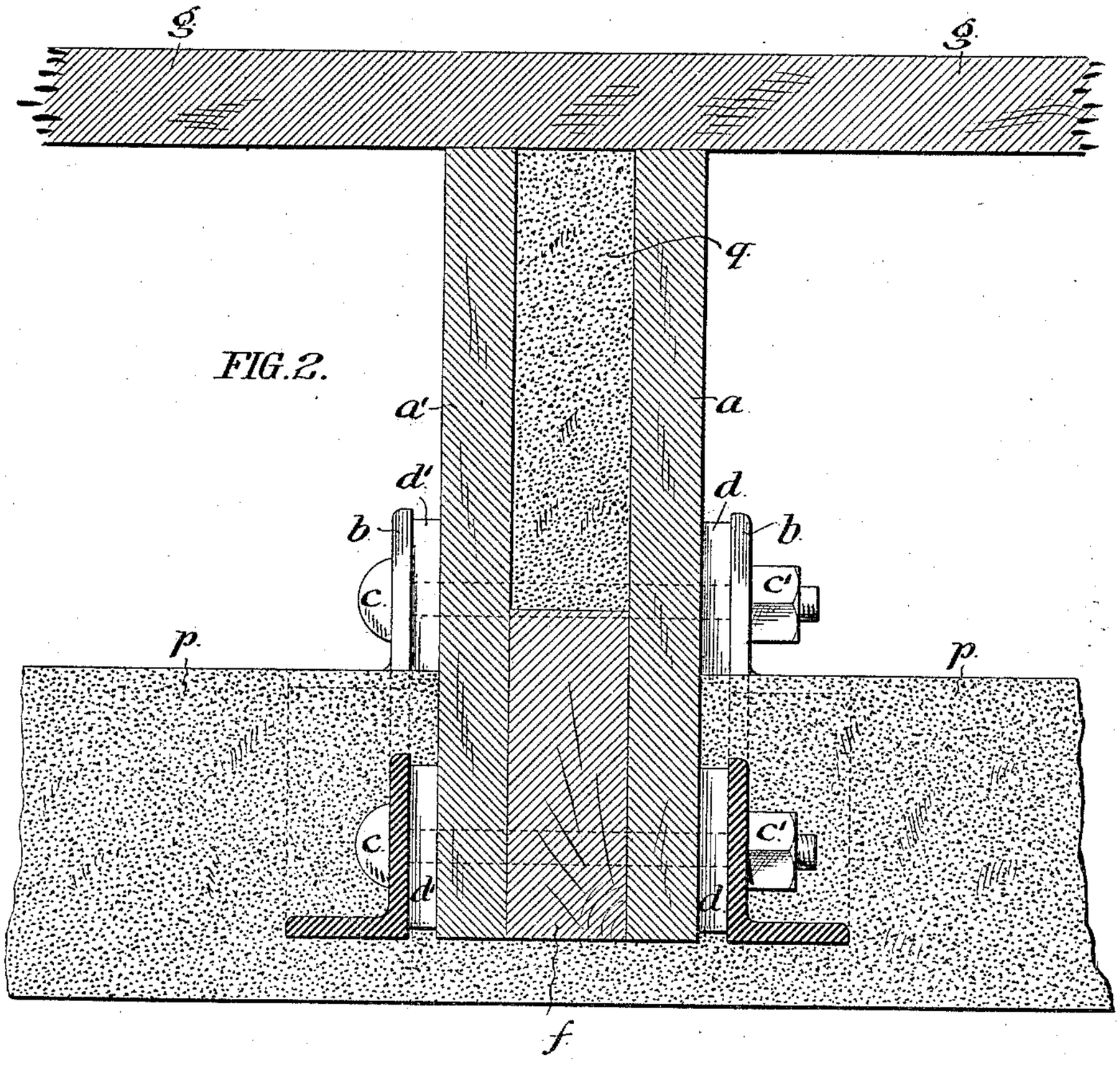
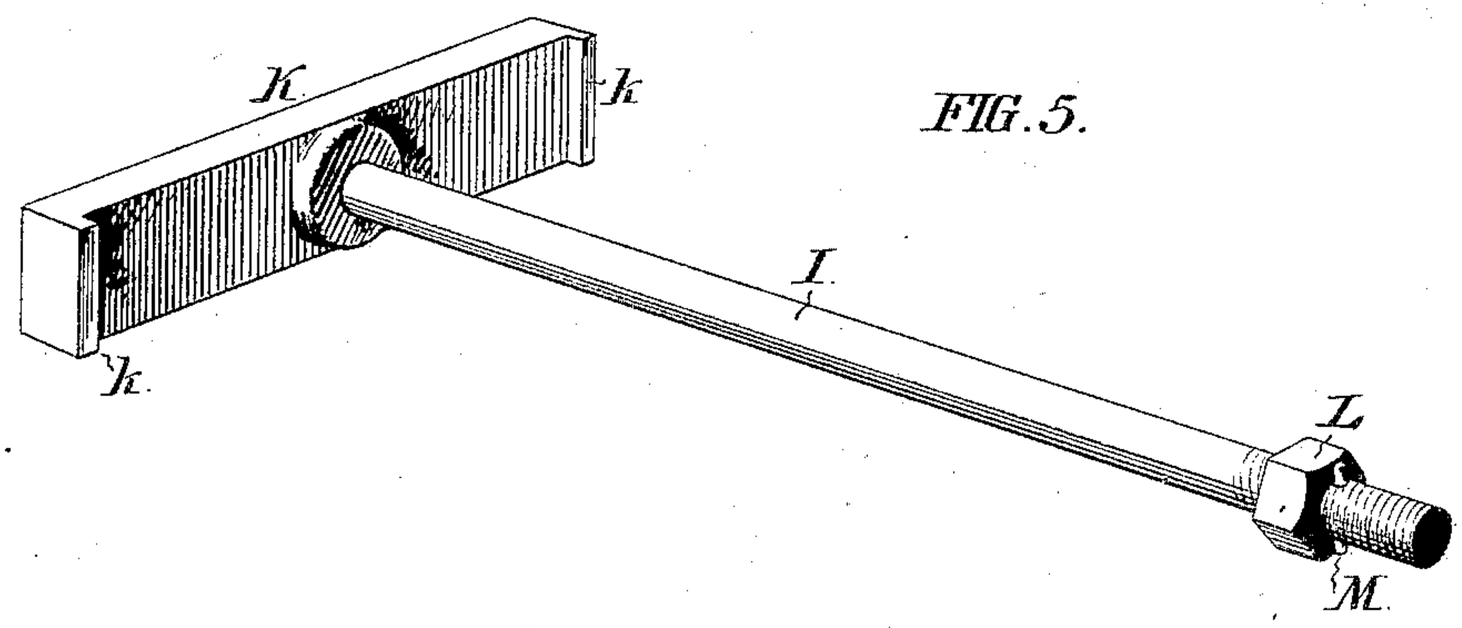


FIG. 5.



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(No Model.) 3 Sheets—Sheet 3.

F. FURNESS.

FIRE PROOF FLOOR.

No. 444,935. Patented Jan. 20, 1891.

FIG. 3.

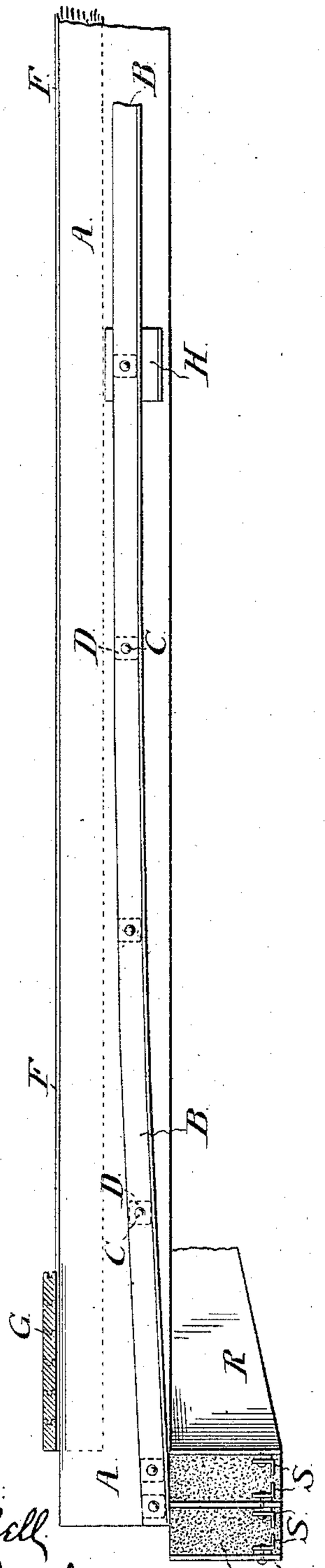
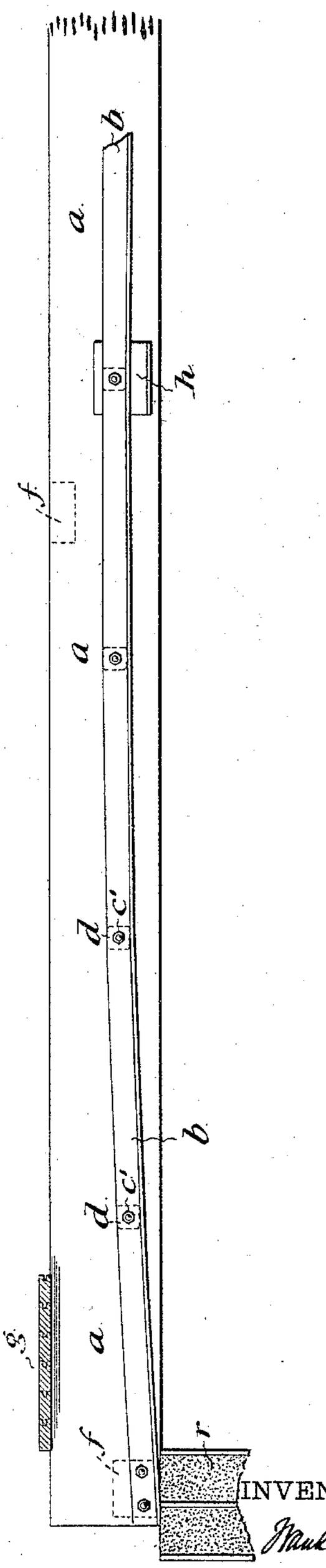


FIG. 4.



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UNITED STATES PATENT OFFICE.

FRANK FURNESS, OF PHILADELPHIA, PENNSYLVANIA.

FIRE-PROOF FLOOR.

SPECIFICATION forming part of Letters Patent No. 444,935, dated January 20, 1891.

Application filed November 4, 1890. Serial No. 370,299. (No model.)

To all whom it may concern:

Be it known that I, FRANK FURNESS, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Fire-Proof Floors, whereof the following is a specification, reference being had to the accompanying drawings.

In said drawings, Figure 1 represents a vertical section through the floor at right angles to one of the supporting-joists, showing also in dotted lines features which relate to the method of laying the floor and which are not permanent parts of the structure. Fig. 2 is a similar section through a floor, the same in principle as that shown in Fig. 1, but differing slightly in detail. Fig. 3 is a side view of one of the joists when the construction indicated in Fig. 1 is followed, Fig. 4 being a similar side view of the joists according to the structure shown in Fig. 2. Fig. 5 is a view in perspective of the suspension-rod and gage used in the process of construction.

In my Letters Patent, No. 424,286, dated March 25, 1890, I have described a fire-proof floor comprising joists of wood or iron upon whose sides are secured cambered angle-irons with a continuous slab of concrete or artificial stone completely enveloping the bottom of the joists. I have also described the method pursued in laying said floor, which involves the leaving embedded in the concrete certain gage-strips which determine the thickness of the concrete layer beneath the joists. Said strips, though useful adjuncts for laying the floor, constitute no structural portion thereof, but are perforce allowed to remain and may require further application of material to conceal them.

The present invention consists in a modification of the joists themselves, and among its objects are, first, to obtain greater strength from a given amount of wood or metal, and when wood is used a more perfect resistance to fire; second, to permit a method of construction which is not only much more economical than that formerly described and which can be used under conditions where the former would scarcely be practicable, but which, furthermore, enables me to remove entirely the temporary supports relating only to the process of formation and which are not desirable as permanent parts of the structure.

Referring now to the drawings and to the type of the invention which is illustrated in Figs. 1 and 3, I construct the floor as follows:

A A′ represent two parallel iron plates or strips along whose opposite sides are secured by means of riveted bolts C the angle-irons B, which are preferably bent or cambered so as to rise toward the middle of the span, as fully described in my patent before referred to. Said plates A A′ are separated and their parallelism maintained by means of metal blocks E, of any desired diameter, arranged between them at the points through which the bolts C pass, said blocks being thus supported by the bolts. I also prefer to insert washers D D′ between the angle-irons and the outer faces of the plates A A′ for the purpose described in my former patent. If the span is a long one, I suspend at or near its center a flanged plate H, which serves as an additional support for the concrete where the rise of the camber brings the flange of the angle-iron some distance from the bottom.

The structure thus described constitutes the frame-work of the joist, the hollow interior of which is subsequently to be filled, to a greater or less extent, with the concrete at the same time that the main body thereof, constituting the floor, is poured between the joists, and which is to become integral with said main body.

The joist-frames having been supported in any desirable manner at their ends, I proceed to apply the concrete as follows: A number of hanging supports are suspended between the plates of each joist-frame, as indicated by the dotted lines in Fig. 1. Each of these supports (see Fig. 1) consists of a rod I, having at the bottom a head J, upon which rests a cross-bar K, having at each end a projection or flange *k*. The upper end of the rod is threaded to receive a nut L and should be provided with a removable gage-pin M, fitting one or more holes through the threaded portion. The rod is hung from the top of the plates A A′ by means of a transverse piece U, upon which the nut rests. Each piece U being of uniform thickness, and the nuts being run upward till they strike the gage-pins

M, a uniform length can be obtained for the several supports. Upon the transverse bars K timbers N N′ are placed, running parallel to the joists, and on these is laid the false floor O, which is thus suspended beneath the bottom of the joist-frames at a given and uniform distance. The concrete is then poured in, both into the hollow interior of the joist-frames and into the spaces between the several joists. It flows around the under side of the joist-frames, thus completely enveloping them beneath and uniting in a solid mass with the concrete within them. When the concrete is set, the pin M is removed from the suspension-rods I, and the nuts L are run out to a sufficient distance to permit the descent of the false flooring O, which, together with the timbers N N′, is then lifted off from the bars K. The nuts L are then run completely off from the upper ends of the rods I and the latter are drawn downward through the concrete, leaving only small holes through the same between the joists. I then drop into the open space between the upper portion of the plates A A′ a wooden stringer F, which may project slightly above the level of the tops of said plates in order to afford "nailing" for the wooden flooring G, which is then applied in the usual manner. Thus each joist is a composite structure consisting of the iron frame with the intermediate mass Q of concrete, which said intermediate mass is integral with the exterior slab P of concrete, that constitutes the main body of the floor. The holes which have been left by the removal of the suspension-rods I can readily be either filled with concrete or plastered over, so that I thus obtain the desirable feature of complete envelopment of the bottom of the joists by the concrete, gaged to a uniform depth, without leaving the gage-pieces for the temporary floor therein, as was required by the method of construction formerly patented.

In Fig. 2 the system of construction is substantially the same, except that the framework of the joists consists of wooden planks *a a′*, separated by means of blocks *f*, through which pass the screw-bolts *c*, having nuts *c′*. The angle-irons *b* are similarly constructed and arranged, being preferably separated from the sides of the joist-frame by means of washers *d d′*. The method of suspending the temporary flooring and applying the concrete is the same as that which has just been described in the case of the iron joist-frames; but where wood is used for the joist-frames I prefer to entirely fill up the intermediate space between the planks *a a′* with concrete *q*, instead of leaving an open space above the concrete for the insertion of a "nailing-strip," since in the present instance the flooring *g* may be nailed directly to the tops of the planks.

In Fig. 3 is also shown a convenient and desirable form of girder, which may be used for supporting the ends of the joists, and which consists of the parallel iron plates R, (shown in perspective,) having interior angle-irons S, which face each other and extend the whole length of the plates. Concrete T is poured into the open spaces between said plates (a temporary bottom being suspended therefrom in any convenient manner—as, for instance, by the use of the suspension-rods above described) and thus a composite girder as well as a composite joist is obtained.

In Fig. 4, *r* represents the concrete corresponding to that indicated by the reference-letter T in Fig. 3.

I have found that by the use of the concrete as an integral part of the joist itself great strength is obtained, and thus the quantity of wood or iron used is economized. Obviously the greater the percentage of concrete in the floor as a whole the more perfect is its resistance to fire.

Having thus described my invention, I claim—

In a fire-proof floor, the combination of a series of hollow joist-frames open at top and bottom, substantially as set forth, a pair of flanged angle-irons secured along each of said joist-frames, and a body of concrete extending into the hollow interior of the joist-frames, enveloping the bottom edges and angle-iron flanges thereof, and also extending from joist to joist, the concrete within said joist-frames being integral with the exterior body thereof, substantially as set forth.

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