To all whom it may concern:

Be it known that I, GEORGE O. GRIDLEY, of Windsor, in the county of Windsor and State of Vermont, have invented certain new and useful Improvements in Stay-Bolts and Processes of Making Same, of which the following is a specification.

This invention has relation to stay-bolts for boilers and to processes for making the same, the main object of the invention being the production of a stay-bolt having provisions for accurate insertion in the walls or sheets of the boiler.

Another object of the invention is the provision of a stay-bolt so formed or constructed as to be more durable and less liable to fracture or cracking when used in boilers than as heretofore constructed.

Other objects of the invention are to provide certain improvements in stay-bolts and in processes for making the same, whereby the stay-bolts may be constructed more easily and cheaply than heretofore and may be provided with certain improvements which render them easier of insertion in the boiler-sheets and capable of indicating their condition.

Up to the present time it has been the practice to tap the adjacent sheets of the boiler by means of a single tap, whereby the internal threads of the sheets are practically continuous of each other; but so far as I am aware no provision has yet been made for accurately threading the bolt to fit in the apertures, since it has been the custom to separately cut the threads on the ends of the bolt. This cutting of the threads not only prevents the accurate location of the threads with relation to each other to render them continuous in all cases, but provides interstices transverse of the axial line of the bolt, which are liable to extend still further into the body of the bolt and eventually separate the ends. According to my invention, however, I thread the two ends of the bolt simultaneously by means which do not cut into the body of the bolt, but compress or compact the outer surface into a tough and durable skin. This is accomplished in my invention by rolling the ends on the bolt between corrugated or threaded plates, whereby in the resulting or finished bolt the threads at both ends are of the same lead or pitch and are continuous of each other, so that when the bolt is screwed into the sheets of the boiler the threads on the ends of the bolt accurately register with the internal threads in both the boiler-sheets. By this formation of the bolt I materially reduce the liability of the bolt to crack at its juncture with or at a point near the boiler sheet, the outer skin being so compacted or compressed as to be tough, and thus lessen the danger of fracture. Consequently the escape of steam or the leakage of water from the boiler is more effectually prevented than has hitherto been possible with stay-bolts as ordinarily made, for it will be readily seen that whereas in previous constructions the formation of threads by a cutting operation left an indurant crack or fracture at the base of each thread, which soon opened and permitted the leakage of water and steam, the rolling of the threads to form a tough and compacted skin renders the stay-bolt strong and incapable of cracking and permits such leakage.

I prefer in many cases to first upset the ends of the bolt prior to the rolling and threading operation in order that the middle portion of the bolt may be of less diameter than the ends, for the bolt is thereby rendered more elastic or resilient, less expensive in construction, and the labor of threading the whole length of the bolt is saved.

I regard it as desirable to form in each end of the bolt a longitudinal aperture, which extends into the middle portion thereof, so that in case the bolt cracks there will be a duct for the escape of steam or water for indicating to the engineer or individual employed about the boiler the condition of the bolt. This aperture may be formed simultaneously with the operation of upsetting the ends of the bolt, and I prefer to so form it, because it saves the separate heating of the bolt and a separate operation. The punching of the aperture is preferable to drilling a hole in the end, as the former is easily done, since the internal wall of the aperture is made tougher and more durable and there is less liability to crack than where the hole is drilled, for the drill seems to leave the shoulders or grooves from which the cracks are apt to start.
In order to provide for driving the bolts in the apertures in the boiler-sheets, provision must be made for receiving the wrench or other tool, and hence in forming the said bolts.

I either square the aperture which extends into the end or else square the end of the bolt, whereby in either case the wrench may be engaged with the tool for turning it.

Referring to the drawings which accompany this specification, Figure 1 represents a cylindrical bar of metal from which the stay-bolt is made. Fig. 2 illustrates a step in the process of manufacturing the stay-bolt, the latter being shown as having its ends upset and a punch driven in said ends to form an angular hole therein. Fig. 3 illustrates one of the threading members or plates. Fig. 4 represents a finished stay-bolt with one end in section. Fig. 5 represents the operation of forming the thread simultaneously on the two ends of the stay-bolt.

Referring to said drawings, I first form a cylindrical blank \( a \), as shown in Fig. 1, of suitable length and of a cross-diameter substantially equal to the diameter of the central portion of the finished bolt. The blank is then placed in a suitable holder, (not shown,) and the ends are upset.

In Fig. 2 represent oppositely-moving dies which engage the ends of the blank and compress the metal to cause it to swell at the ends and properly fit in the holder. The dies carry the punches \( c \), which are square in cross-section and have tapering points \( c' \) to project well into the body of the stay-bolt. The action of the dies and punches is to form a blank having the ends \( a' \) of relatively large diameter, the body portion \( a^2 \) of less diameter, and the shoulder \( a^3 \) at the juncture of the ends and the said central portion. The punches \( c \) form in the ends of the blank apertures \( a' \), which are larger at their mouths and contract as they extend longitudinally into the blank. A square aperture is thus provided at each end of the stay-bolt for the reception of a square tool, by means of which the finished bolt may be screwed home in the sheets of the boiler. It is not essential that the aperture may be squared at both ends, and, in fact, I square it in practice at only one end.

After the blank has been upset at the ends and the apertures have been punched therein it is ready for the threading operation.

To perform this operation, I provide two plates or threading members \( d \) and \( d' \), which are arranged in parallelism, one of said plates being movable in its plane with respect to the other. The two opposing surfaces of the two members are provided with a plurality of parallel V-shaped grooves and A-shaped teeth, which are slightly inclined with respect to the squared ends of the plates to correspond to the pitch or lead of the threads to be formed on the ends of the stay-bolts. These members are wide enough to cover both ends of the stay-bolt, and the grooves or corrugations in the faces of the said members are continuous from edge to edge.

By placing the blank between the two members, in which the grooves are exactly similar to and of precisely the same inclination, one of the plates or members is moved transversely of the axis of the stay-bolt, and the stay-bolt is therefore rolled along the surface of the plate or member. This rolling operation causes the formation of threads upon the upset ends of the stay-bolt, the said threads being exact continuations of each other by reason of the grooves and teeth being continuous in the threaded members from edge to edge thereof.

The rolling of the threads is the most important feature of my invention, for I thereby not only accomplish the formation of threads at the two ends of the bolt which are continuations of each other, but I also compact or compress the outer surface at the end of the bolt so as to form a tough and durable skin, as previously stated, and, so far as I am aware, I am the first to have manufactured or formed a stay-bolt in this way.

I do not limit myself to the employment of any particular mechanism for accomplishing the various steps in the process which I have described for the manufacture of the bolt, for any machines or tools may be used which will accomplish the several results set forth.

By the provision of the elongated central apertures \( c' \), which extend into the body of the stay-bolt between the threaded ends, provision is made for the escape of water in case the said bolt should by imperfection in the stock become cracked or otherwise defective, so that the engineer or fireman may be made aware of such crack or defect.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. The herein-described method of making a stay-bolt for boilers which consists in simultaneously rolling the threads at both ends of the said stay-bolt and thereby making said threads continuous of each other and forming on the said bolt a surface or skin which is compacted or compressed.

2. The herein-described method of making a stay-bolt for boilers which consists in upsetting the ends of a cylindrical blank, and simultaneously rolling the threads on the said upset ends, whereby said threads are continuations of each other.

3. The herein-described method of making a stay-bolt for boilers, which consists in simultaneously upsetting and preparing an end of a suitable blank for a tool for turning it, and then threading the said upset ends.

4. The herein-described method of making stay-bolts for boilers, which consists in providing a cylindrical blank, upsetting the ends thereof, and simultaneously rolling threads.
on the two ends of the partially-formed stay-bolt, whereby the threads thereon are practically continuations of each other, and the surface or skin of the threaded part is compressed or compacted.

5. The herein-described method of making stay-bolts for boilers, consisting in providing a suitable cylindrical blank, simultaneously upsetting an end and punching a hole in the said end of the said blank, and then rolling threads on the upset ends.

6. As a new article of manufacture, a stay-bolt for boilers having its ends larger than its middle, and having threads rolled on said ends whereby the surfaces of said ends are compressed or compacted.

7. As a new article of manufacture, a stay-bolt for boilers having its ends upset and longitudinally apertured by a punching process, said apertures projecting into the body of the said bolt beyond the upset ends, said stay-bolt having the said upset ends provided with threads which are rolled thereon and which are in effect continuous.

In testimony whereof I have affixed my signature in presence of two witnesses.

GEORGE O. GRIDLEY.

Witnesses:

W. O. TUXBURY,

F. M. SMITH.