(No Model.) 2 Sheets—Sheet 1.

L. L. BURDON.

MANNER OF PRODUCING SEAMLESS COMPOUND WIRE.

No. 446,619. Patented Feb. 17, 1891.

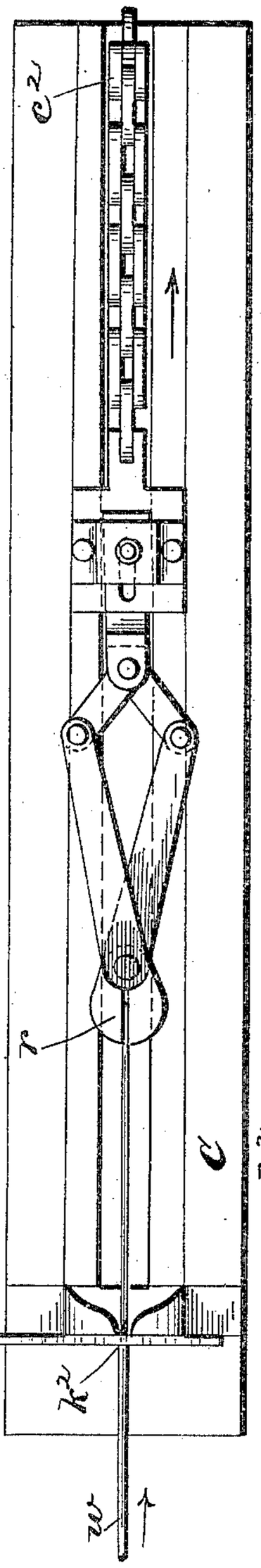

FIG. 5.

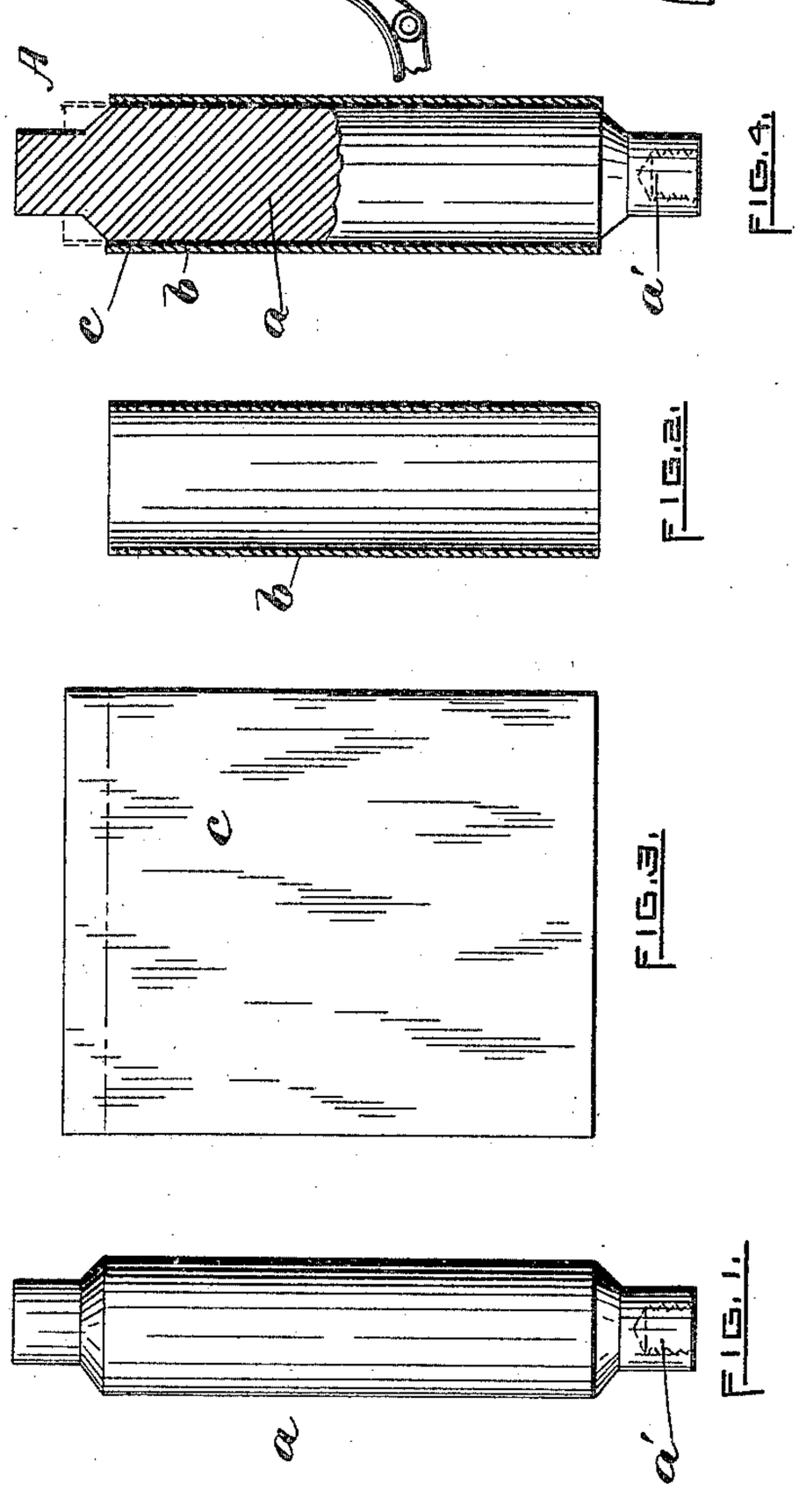

FIG. 4.

FIG. 2.

FIG. 3.

FIG. 1.

FIG. 12.

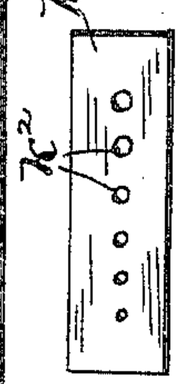

FIG. 13.

WITNESSES.

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(No Model.) 2 Sheets—Sheet 2.

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FIG. 7.

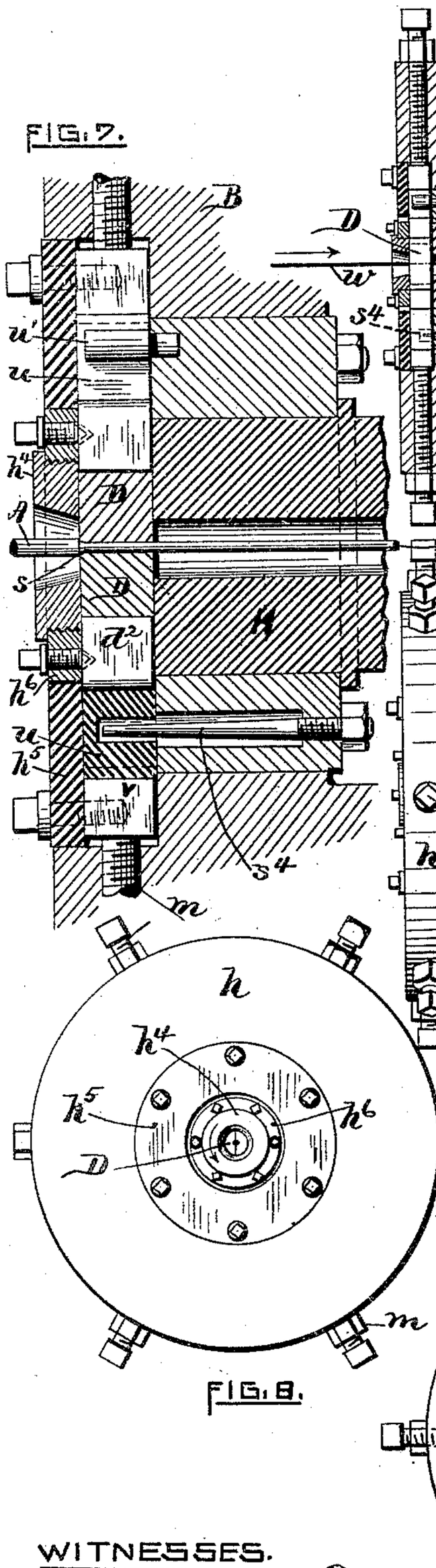

FIG. 8.

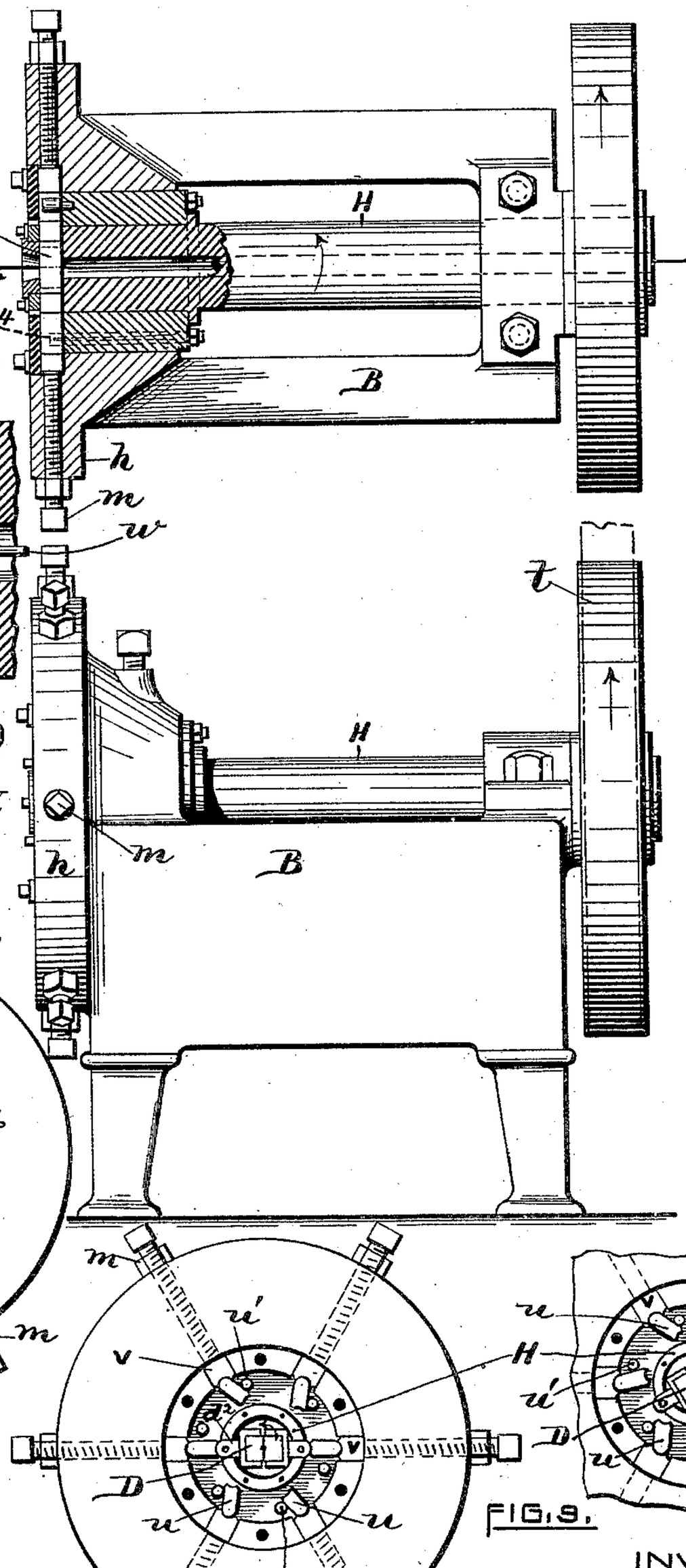

FIG. 11.

FIG. 6.

FIG. 10.

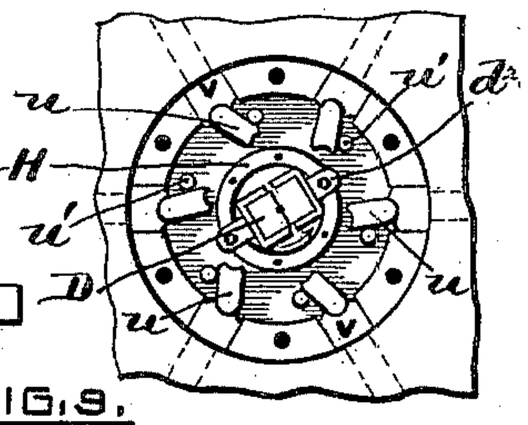

FIG. 9.

WITNESSES.

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UNITED STATES PATENT OFFICE.

LEVI L. BURDON, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO THE BURDON SEAMLESS FILLED WIRE COMPANY, OF SAME PLACE.

MANNER OF PRODUCING SEAMLESS COMPOUND WIRE.

SPECIFICATION forming part of Letters Patent No. 446,619, dated February 17, 1891.

Application filed July 29, 1890. Serial No. 360,273. (No model.)

To all whom it may concern:

Be it known that I, LEVI L. BURDON, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in the Manner of Producing Seamless Compound Wire; 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.

My present invention has relation to improvements in the manufacture of seamless compound ingots and wire produced therefrom. Said invention, however, appertains more particularly to seamless wire in which a core of base metal or other metal having a relatively less value than the outer shell or plate is united to a comparatively thin seamless shell of gold or other suitable metal, such wire being especially adapted for the manufacture of watch-chains, finger-rings, bracelets, pins, &c.

In the operations employed in the reduction to wire of seamless compound ingots it is very desirable that the metal be uniformly acted upon in order to preserve its integrity throughout, especially at the union of the core and outer shell, because otherwise the percentage of waste is so excessive as to preclude the employment by jewelers of such imperfectly united seamless wire in lieu of the common seamed plated wire.

Various attempts have been and are still being made to reduce seamless compound ingots to a piece of continuous wire having a uniform size and quality throughout; but such former attempts, so far as I am aware, have been attended with failure or indifferent results, the product being irregular in size and not sufficiently uniform in quality. Heretofore the practice has been to attenuate or reduce plated ingots, particularly such as are cylindrical in form, to a size adapted to be passed through a draw-plate by means of powerful squeezing-rolls provided with a series of V-shaped circumferential grooves gradually decreasing in size, between which grooves the ingot or rod is successively passed. Sometimes the grooves are semicircular in cross-section, although still other forms of grooves have been used; but in all of them the action is to compress the metal most at two or more parts throughout the length of the ingot, while at the same time the metal not in actual contact with the dies or grooves is distended or squeezed out laterally, thereby tending to separate the atoms or fibers in that direction. Moreover, such method of reduction produces an unequal strain or tension upon the two metals composing the ingot, and frequently results in disuniting them in spots, which latter, after a few passes, develop into places having somewhat the appearance of abrasions, such portions when drawn into wire being cut out as waste stock and possessing no commercial value. In such former methods of reduction the ingot or rod is turned slightly, so as to present a new surface to the rolls at each pass. I have found it to be practically impossible to thus produce wire possessing the necessary homogeneity essential to plated wire adapted to the use of jewelers. Sometimes power-hammers or trip-hammers have been used to reduce plated ingots; but the result is substantially the same as though they had been passed between driven rolls, as before stated.

It should be borne in mind that the metal is worked cold, although it is frequently annealed during the reducing operation. I am aware that when a bar of iron or other metal is thus acted upon, although it is usually worked hot, the result is practically satisfactory; but when a compound ingot is substituted and worked cold the result is quite different, for reasons before given.

I have discovered by extensive experimenting that in order to reduce a compound ingot into wire which is well adapted for jewelers' purposes a what may be termed "swaging process" produces the best results. Usually in working metals cold the effect seems to be to harden it, whereas by the swaging process about to be described it appears to soften the metal, because after a considerable amount of swaging the pieces of metal can then be bent more readily than metal reduced to the

same extent by other methods. The swaging mechanism which I have employed in reducing compound ingots requires a series of dies in halves, the die-cavities thereof gradually decreasing in size. The dies are mounted in the end of a strong hollow shaft adapted to revolve rapidly. The dies are fitted to move slightly in a lateral direction, each half being backed by a steel block or dog. Arranged around the head of the machine are a number of normally stationary cams or swage-blocks susceptible of adjustment, each having a spring which serves to maintain the cams in position except for the instant when they are in contact with the dogs. Now upon introducing the end of the ingot between the revolving dies the traveling dogs successively engage the free ends of the cams, thereby at each engagement slightly reducing the metal by compression and elongation, the ingot meanwhile not being revolved. After the ingot has been acted upon by one pair of dies the latter are removed and the next smaller pair substituted and the ingot again acted upon, the operation being repeated until the desired reduction is attained or until the size of the rod renders it susceptible of being passed through a draw-plate. By this method of reduction or swaging all parts or portions of the metal acted upon are subjected at the same time to the same or a uniform degree of pressure, thereby producing a practically perfect homogeneity of the metal. It will be observed that the action of the mechanism is to squeeze the dies together upon the metal from opposite sides at each successive engagement of the dogs and cams, the rate of speed being several hundred compressions per minute. By reason of such compressive action there exists no counter tendency to stretch or tear the metal at some other part at the same time, as is common to the usual hammering, rolling, and drawing processes. Moreover, when rolls and hammers are employed, they further serve to harden the surface of the metal, thereby forming a "skin," which renders the rod or ingot very stiff, which is especially undesirable in compound ingots. With the aid of compressing mechanism no such skin is formed, the compression being a squeeze and not a blow, and as the dies are nearly cylindrical it follows that nearly all the atoms or particles of the metal are simultaneously acted upon from circumference to center at a uniform pressure. I would state, further, that each individual squeeze does so little of the aggregate work of reduction that there is no violent action upon the metal such as accompanies other cold-working methods. Swaging by this improved method not only reduces the metal by squeezing it toward the center from all directions while in contact with the dies, but it also serves to hold the ingot centrally until it has received the extreme degree of pressure from the dies. Still another advantage derived from the cold-swaging process is that as it acts to condense or compress the entire mass equally there are no fire cracks or seams developed in the metal during the several annealings. When, however, the metal is worked cold, as in rolling, hammering, or drawing, fire-cracks frequently occur in annealing the metal. In some cases the percentage of waste is so great from this cause alone as to preclude the manufacture of certain grades of compound ingots.

The object I have in view is to overcome the hereinbefore-described defects or disadvantages inherent in the former methods of producing seamless compound wire. To that end my invention consists, essentially, in the following-named steps, viz: first, forming a core or center portion of suitable metal and a seamless exterior shell or tube of metal having a greater relative value than the core portion; next, suitably preparing the contiguous surfaces of the core and outer shell and uniting them together, thereby producing the ingot; then repeatedly subjecting the ingot to a squeezing or swaging operation, which acts to gradually and uniformly reduce it from circumference to center, and at the same time elongating it, and, finally, subjecting the thus reduced ingot to drawing mechanism, which still further elongates it to seamless wire having the desired form and size cross-sectionally, all as will be more fully hereinafter set forth and claimed.

In the appended two sheets of drawings, illustrating my invention, Figure 1 shows a side elevation of the center or base metal core portion. Fig. 2 is a longitudinal sectional view of the outer seamless shell of metal having a relatively greater value than the core. Fig. 3 shows a thin piece of solder adapted to be wrapped around the core. Fig. 4 shows the ingot in partial section before being soldered. Fig. 5 shows the same in reduced scale, mounted in a furnace and being subjected to a flame to fuse the solder. Fig. 6 is a side elevation of a swaging or squeezing machine adapted to uniformly reduce the ingot from circumference to center, thereby at the same time elongating it. Fig. 7 is an enlarged transverse sectional view taken through the head portion of the machine, showing an end of the seamless ingot introduced between the dies and in the act of being slightly reduced and correspondingly elongated. Fig. 8 is an end view of the front head of the machine. Fig. 9 is the same with the front plate or cover removed, the dies being represented at the instant of their engagement with the reduced ingot or wire. Fig. 10 is a similar view of the parts, the revolving dies, however, being disconnected from the dogs at the instant, as in successively passing from one cam to another. Fig. 11 is a plan view of the machine, the head portion being in horizontal section. Fig. 12 represents in plan view a portion of a drawing-machine—that is, a machine provided with a draw-plate in which is formed a series

of holes gradually diminishing in size, through which the wire is successively passed; and Fig. 13 is a front view of the draw-plate itself.

A manner of constructing the seamless ingot preparatory to being reduced to compound seamless wire is as follows: The core portion *a* of the ingot is usually composed of brass or base metal. The core may have any practical form and size—as, for example, it may be cylindrical or tapering and round or polygonal cross-sectionally. The outer shell *b* of the ingot consists of a seamless tube of fine metal or suitably-alloyed metal, its form transversely being substantially like that of the core portion to which it is to be united. Sometimes the shell *b* itself is composed of plated or compound stock, thereby making it of less relative value than the tube first referred to. There are several ways of uniting the core and shell, one manner of attaching them being to snugly fit the core into the shell, leaving a space or chamber at the top, in which loose solder is placed, which latter melts and runs down around and between the contiguous surfaces upon being subjected to a proper temperature. Another way is to make the core a little smaller in diameter than the bore of the tube and introduce between the adjacent surfaces a layer or sheet *c* of thin solder, (see Figs. 3 and 4,) which fuses upon the proper application of a suitable degree of heat. Still other ways of uniting the parts are to first cover or coat the core with solder, or the inner surface or bore of the outer shell itself may be lined with solder, the core being next introduced and the whole subjected to heat, as before stated. Again, the two parts *a* and *b* may be fitted together and then united by sweating—that is, a union of one or more of the low-fusing metals with which the core and shell are alloyed. It is obvious that the surfaces of the metal in any case must first be suitably prepared or treated, as with borax, in order to facilitate the union of the parts. The ingot A may be attached by an end *a'* to a revolving gear-driven spindle a^2, the whole being inclosed within a hood or furnace *f*, provided with an aperture through which the flame of a burner *d* is directed onto the revolving ingot, as in Fig. 5.

After the outer shell is properly attached to the core, substantially as before stated, the ingot is removed from the furnace and its end introduced cold between a pair of dies D, Figs. 6 to 11, mounted in the front end of the hollow shaft H of a swaging-machine B, which acts to slightly squeeze and reduce the metal of the ingot from circumference to center by reason of the rapid successive engagement of the oppositely-arranged pivotally-mounted dogs d^2 with the series of normally stationary adjustably-mounted spring-resisted cams or swage-blocks *u*. The contiguous surfaces of the dogs and cams are preferably so curved that they will roll into each other, the rolling action being similar to the epicycloidal curve frequently used in gearing. As the dogs pass each cam a straight spring s^4 in each, Fig. 7, vibrates them rearwardly to the normal position against their respective stops *u'*. (See Figs. 9 and 10.) The cams are backed by adjusting-blocks *v*, into which the cams are fitted to swing or vibrate somewhat. Said blocks are adjusted by means of strong bolts *m*, passing radially through the head *h* of the machine. The dies are prevented from moving endwise by a follower h^4, screwed into a flange h^6, secured to the front end of the hollow shaft or spindle H.

In reducing the compound ingot A to seamless wire *w*, adapted to be passed through the holes of a draw-plate *k*, the ingot is first repeatedly passed through the swaging-machine, the dies D thereof being changed each time for others, the several die-cavities *s* gradually decreasing in size until the desired reduction is attained. The ingot or rod which is suitably annealed is held and prevented from turning by the attendant during each pass through the dies, the result being an attenuated rod practically true and homogeneous throughout its length, no seams, blisters, or abrasions being apparent. The action of the dies, as hereinbefore stated, is to gradually squeeze the metal or atoms composing it from circumference to center as contradistinguished from ingots reduced by the action of blows, as in hammering, which latter not only hardens and crystallizes the metal, but also acts to distort it from a true shape, the latter being particularly true when the reduction is effected by rolling processes.

After the swaging-machine has reduced the ingot to a rod or wire *w* having the desired size it is then subjected to a drawing process—that is, an end of the rod is inserted through a hole k^2 of a draw-plate *k*, mounted in a drawing-machine, Figs. 12 and 13. Machines of this type are well known. The jaws *r*, attached to the driving-chain c^2, seize the end of the rod and pull it through the draw-plate, thereby slightly reducing the rod transversely, but at the same time elongating it. The repeated passage of the wire through the gradually-diminishing holes k^2 of a suitable draw-plate finally reduces it to the desired form and size cross-sectionally, the product being compound wire composed of a seamless exterior surface of gold or other fine metal of uniform thickness united to an inner portion of low-grade metal. I would state that it is obvious the ingot and wire should be properly annealed at intervals during the process of reduction.

I make no specific claim herewith to the manner of producing seamless compound ingots adapted to be reduced to seamless wire, as ingots of this class have been previously patented—as, for example, see United States Patents Nos. 294,722, 327,655, 381,527, 391,736, 419,598, 422,713, and 432,690. Neither do I

claim herewith the swaging mechanism represented and described for reducing the ingot to a size adapted to a draw-plate.

I claim as my invention and desire to secure by United States Letters Patent—

1. The improvement, substantially as hereinbefore described, in the reduction by cold-working of compound ingots to rods or wire, the same consisting in repeatedly subjecting the suitably-prepared ingot to a squeezing or swaging operation, which acts to gradually reduce it from circumference to center, and at the same time attenuating the ingot until the desired size is attained.

2. The improvement, substantially as hereinbefore described, in the reduction by cold-working of compound ingots to rods or wire, the same consisting in repeatedly subjecting the prepared ingot to a squeezing or swaging operation, which acts to gradually and uniformly reduce it from circumference to center and at the same time elongating it, and next successively passing the prepared rod thus reduced through drawing mechanism which still further elongates it and gives to the wire the desired form and size cross-sectionally.

3. The improvement hereinbefore described in the manufacture of seamless compound wire, the same consisting in first producing a seamless exterior shell of alloyed fine metal, or even a seamless compound tube; next introducing a suitable metallic core into said shell, then uniting the core and shell, thereby forming the ingot; next repeatedly subjecting the suitably-prepared ingot to a squeezing or swaging operation, which acts to gradually and uniformly reduce it from circumference to center and at the same time elongating it, and finally subjecting the reduced ingot to drawing mechanism, which acts to still further elongate it and gives to the seamless wire thus produced the desired form and size cross-sectionally.

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

LEVI L. BURDON.

Witnesses:

CHARLES HANNIGAN,

GEO. H. REMINGTON.