(No Model.) 4 Sheets—Sheet 1.

C. D. ROGERS.

WOOD SCREW AND METHOD OF MAKING THE SAME.

No. 479,175. Patented July 19, 1892.

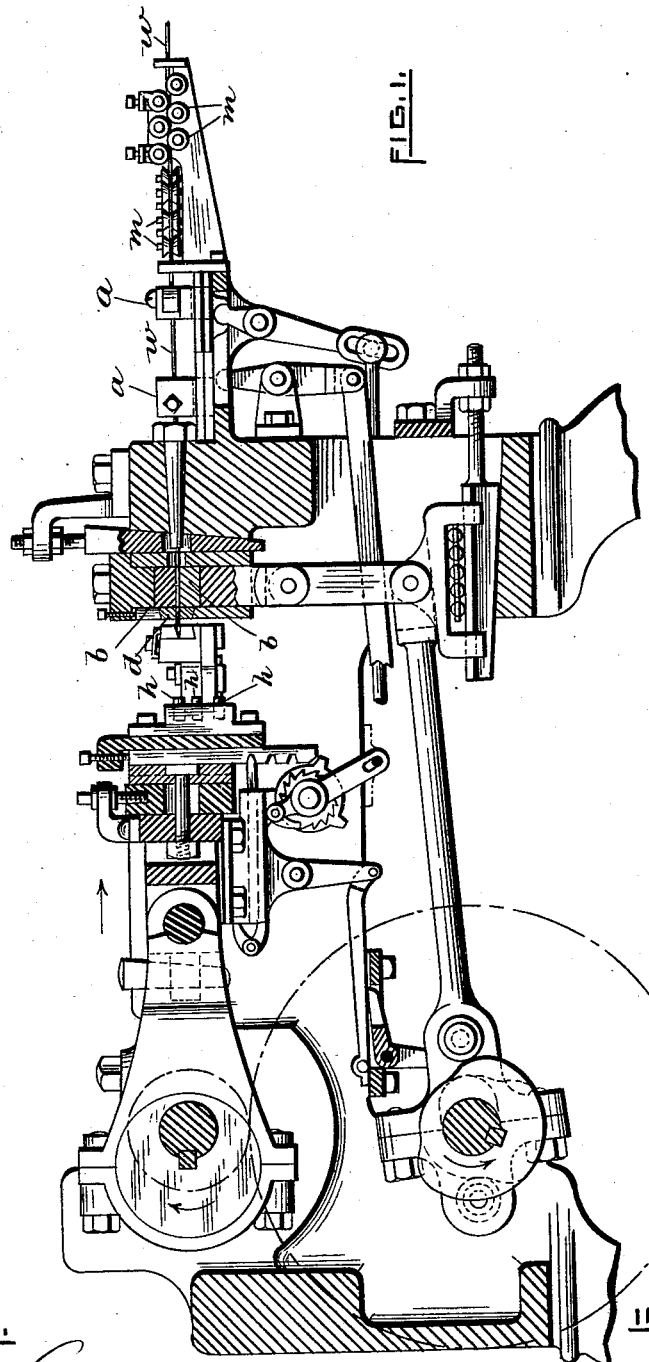

FIG. 1.

WITNESSES.

Charles Hannigan.

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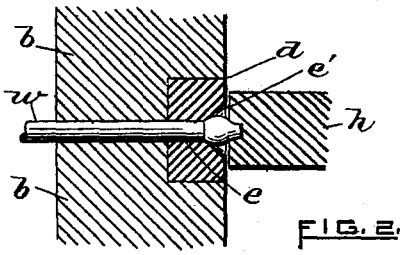

FIG. 2.

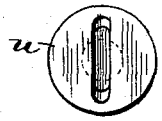

FIG. 9.

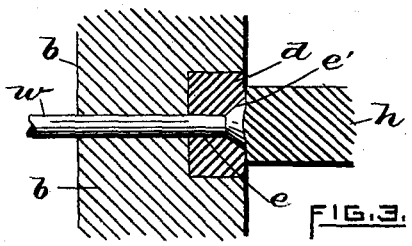

FIG. 3.

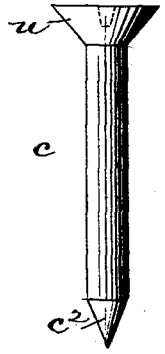

FIG. 8.

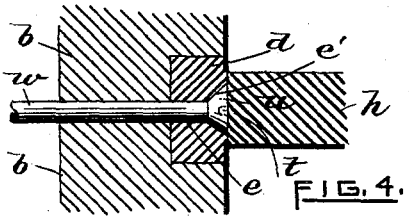

FIG. 4.

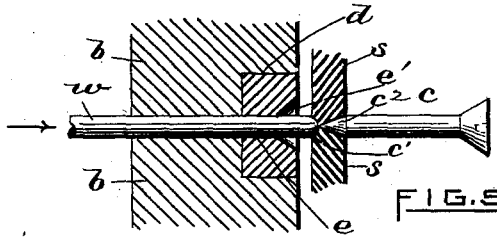

FIG. 5.

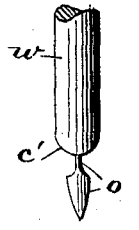

FIG. 6.

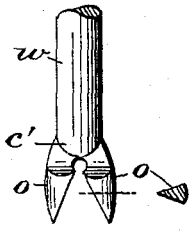

FIG. 7.

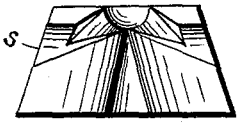

FIG. 5½.

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WOOD SCREW AND METHOD OF MAKING THE SAME.

No. 479,175. Patented July 19, 1892.

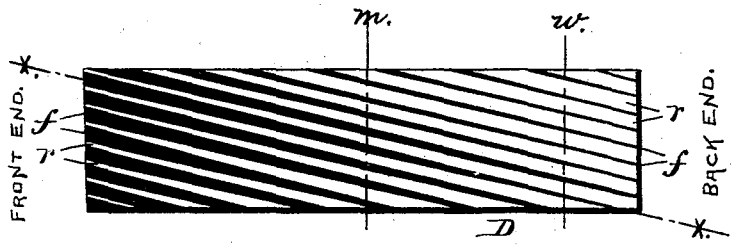

FIG. 10.

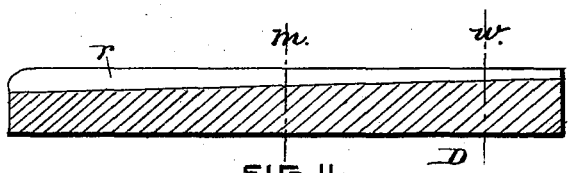

FIG. 11.

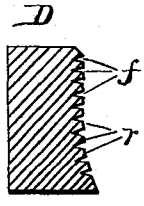

FIG. 12.

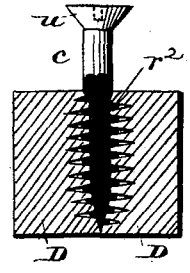

FIG. 13.

WITNESSES.

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C. D. ROGERS.

WOOD SCREW AND METHOD OF MAKING THE SAME.

No. 479,175. Patented July 19, 1892.

FIG. 15.

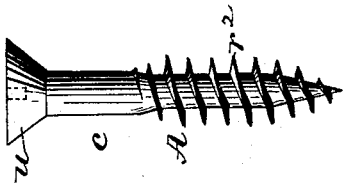
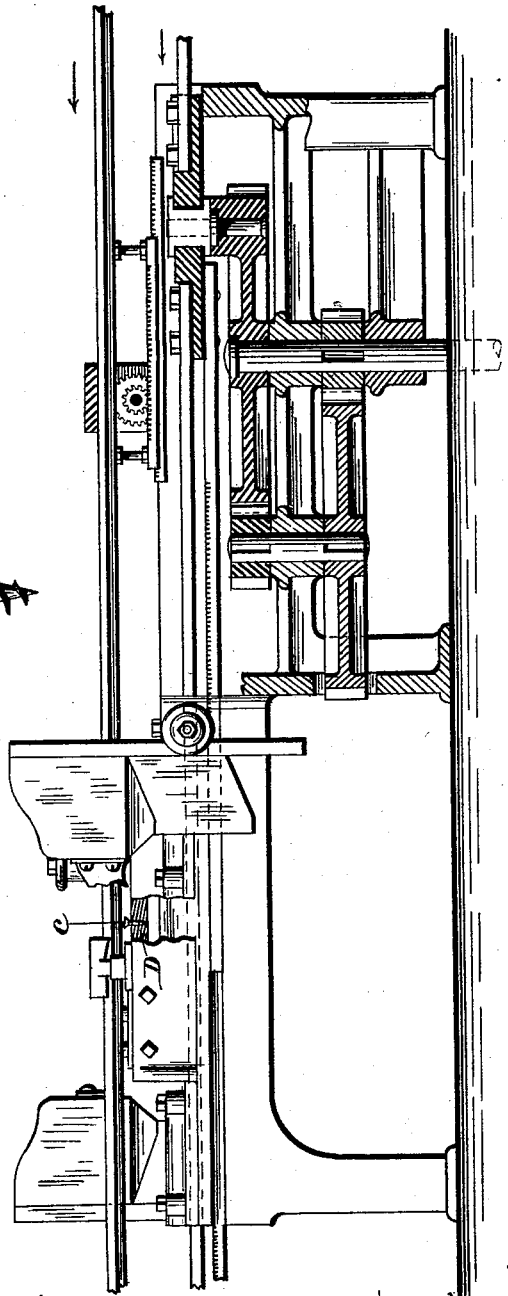


FIG. 14.



WITNESSES.

Charles Hannigan.

Charles H. Runyon.

INVENTOR.

Charles D. Rogers.

by Remington & Henthorn

Attys

UNITED STATES PATENT OFFICE.

CHARLES D. ROGERS, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO THE AMERICAN SCREW COMPANY, OF SAME PLACE.

WOOD-SCREW AND METHOD OF MAKING THE SAME.

SPECIFICATION forming part of Letters Patent No. 479,175, dated July 19, 1892.

Application filed June 21, 1888. Serial No. 277,776. (No model.) Patented in England January 4, 1889, No. 9,271; in France June 11, 1889, No. 198,847; in Belgium June 15, 1889, No. 86,646; in Italy June 30, 1889, No. 25,639, and in Canada November 8, 1889, No. 32,765.

To all whom it may concern:

Be it known that I, CHARLES D. ROGERS, 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 Wood-Screws and Method of Making the Same, (for which I have obtained Letters Patent in Great Britain, No. 9,271, dated January 4, 1889; in France, No. 198,847, dated June 11, 1889; in Belgium, No. 86,646, dated June 15, 1889; in Italy, No. 25,639, dated June 30, 1889, and in Canada, No. 32,765, dated November 8, 1889;) 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 apart of this specification.

Wood-screws hitherto have been made by a series of operations, which may be specified as follows, omitting the drawing of the metal into wire and beginning with the operation which has specific reference to the making of a screw: first, the cutting from wire of a piece required for a screw; second, the swaging of a rough head upon one end of the piece cut off for a screw by upsetting the metal in a die by means of a machine known as a "header" or "heading-machine," (the piece of metal is now called a "screw-blank;") third, the shaving of the entire head thus formed to perfect its form and give it the required size; fourth, the cutting of a slot across the face of the head; fifth, the reshaving of the head to remove the burr formed in cutting the slot; sixth, the cutting away of the metal at the opposite end of the piece to reduce it to a point; seventh, the formation of the thread by cutting a spiral groove around a portion of the body of the wire or "screw-blank," so-called. The cutting-tool is applied to the blank several times, making repeated cuttings to complete the thread. In these operations about forty per cent. of the metal is cut away and becomes waste.

I have devised a new way of making screws by a different series of operations by which a large saving of material is effected, a reduction in the cost of making secured, together with new characteristics and qualities in the screws themselves, which are the result of some of the operations performed and are made necessary by those operations.

As in the old process, screws are made by my new process from wire; but for screws of any specified size the wire is of a smaller diameter, the size having reference to the diameter of the threaded part of the screw; but experience has proved that the size of the head should bear within small limits of variation a certain relation to the diameter of the thread, and the use of smaller wire for screws of specified sizes than that which has been employed in the old process involves the upsetting of the metal to form the head to a greater extent than heretofore and with an accuracy not before required both as to form and surface.

In my new way of making screws the shaving of the head and the cutting of the slot across it and the reshaving and the cutting away of the metal to form the thread are entirely dispensed with, and the consequent waste of material is entirely obviated. The severing from the wire of each piece required for a screw is effected conjointly with the pointing of the blank by an operation which involves but little waste and bears as much or more resemblance to forging or swaging as to cutting and is entirely different from the common method of pointing a blank by cutting away the metal as in a turning-lathe. At the same time the end of the wire is brought to a shape which facilitates the forging of the next head.

In my new way of making screws the following operations are performed: first, the head of a screw, including the slot, is formed upon the end of a rod or coil of wire which is to be made into screws by swaging or forging; second, such portion of the wire on which a head has been formed as is required for a screw is then simultaneously cut off and pointed to a form and in a manner which will permit a thread to be forged thereon to the point of the screw; third, the thread is formed by rolling the body of the blank be-

tween dies, which force the metal to expand radially into grooves in the die, which give the form required for the thread.

The operation of swaging or forging the head, above referred to as a distinct operation, is, in fact, a complex operation of several steps or sub-operations similar in their nature, each differing from the steps that precede or follow it and requiring a specific device or instrument to effect its specific object, but contributing to the final result—the production of a screw-head completely formed by forging or swaging.

The screw presents a surface of forged or compressed metal at the parts which are subjected to the greatest strains, as at the junction of the head with the shank, in the slot or neck, in the under surface of the head, and in the thread. It is well known that iron or steel articles having such a surface are stronger than articles of the same size and form and of the same material with a surface formed by cutting. Tests which I have made show that screws made by my new method with a forged or rolled surface in the parts above mentioned have greater tensile strength and greater strength to resist the torsional strain of a screw-driver than screws of the same size made of larger wire and of the same material. The diameter of the threaded portion of the screw being greater than the diameter of the unthreaded portion and the thread being thinner, the required hold upon the wood can be secured with less danger of splitting it than with screws of the common form. The slot in the face of flat-headed screws being closed at the ends, the liability of the head to split or break is greatly reduced. The screw-driver is also more readily applied in line with the axis of the screw and with less danger of marring the surface of wood into which a screw is inserted. The surface of the head which rests upon the wood and compresses it, and consequently the area of the compressed section of the wood itself, is larger than in the wood-screws heretofore made by the common cutting operations, and thus the wood is better able to resist the compression of the screw. Other forms of heads can be forged by suitable dies, such as spherical or conical heads, where the slot may be open at the ends in the usual manner. The thin raised thread, which enters the wood more readily than the common cut thread and engages with it more deeply, requires the strength due to the forged surface and the compression of the metal. The relatively small diameter of the wire employed to produce a forged thread by radial expansion of the metal involves the upsetting of the metal to a greater degree to produce a head of the required size and makes it important to secure the strength due to a forged surface of metal.

The difference in the form of screws made by my new process is found in the enlarged head and threaded portion of a screw relatively to the shank or unthreaded portion.

It is obvious that the operations above mentioned must be performed by machinery which has a definite relation to the results to be secured.

To enable others to practice the method of making screws which I have devised and to make screws of the kind above mentioned, I will now describe the operations in detail and specify the machinery and devices required to perform them, much of which I have devised especially for the purpose and have obtained patents thereon or made applications therefor.

In the first sheet of drawings hereto annexed I have shown in Figure 1 a sectional view of the parts of a machine in which the operations of forging a head and pointing and cutting off a blank are performed. The machine as a whole is described and shown in an application for patent of the United States which was filed by me July 7, 1887, and serially numbered 243,657. The second sheet represents in Figs. 2, 3, and 4 proper forms of dies for producing flat-faced heads with a forged slot closed at the ends. In Fig. 5 dies are represented for severing a blank from the wire, pointing its end, and molding the end of the standing wire preparatory to the forging of the next head. Fig. 5½ is an end view of one of the dies enlarged. Figs. 6 and 7 show, enlarged, the rounded form given to the end of the wire in separating a blank and the form of the waste material forced out by the closing of the dies. Fig. 8 shows the form of a screw-blank with a finished head and a conical point. Fig. 9 is a plan of the face of a head with a forged slot closed at the ends. In Sheet 3, Fig. 10 shows a plan of the working face of one of a pair of dies for forming the threads of screws. The unshaded parts represent the faces of the ribs which form the grooves in the metal and raise the threads. Fig. 11 is a longitudinal sectional view thereof, taken on line $x\,x$ of Fig. 10. The unshaded portion represents the depth of the grooves or, what is equivalent, the height of the ribs or bars between the grooves. Fig. 12 is an enlarged cross-section of one of the dies, taken on line $w\,w$, the two dies employed being duplicates. Fig. 13 is a cross-section of the two dies and of the screw in the operation of forming the thread, the dies being cut on line $m\,m$. These form the subject of a patent of the United States granted to me September 20, 1887, No. 370,354. Fig. 14, Sheet 4, represents in partial section a portion of a machine for operating such dies and forging the threads of screws. It is described at length in a patent of the United States also granted to me September 20, 1887, No. 370,353. Fig. 15 represents a finished screw.

Referring to Fig. 1, w represents a wire which is to be made into screws. It first passes through a series of straightening-rolls $m\,m$, of the ordinary construction well known to mechanics. From these rolls it passes between reciprocating feeding-clamps a, which

at the proper time grasp the wire and feed forward the length required for a screw. It next passes between a pair of clamping-dies *b*, which grasp it at the proper time and hold it firmly against the action of the heading hammers or dies *h*, which forge the head of a screw. When the wire is to be fed forward, it is released from the hold of the clamping-dies. From the clamps the wire passes into and through a "solid die" *d*, so called, in which the head of a screw is to be formed. This die is formed of a single piece of metal, through which there is a hole *e* of the same diameter as the wire and through which the wire is forced by the feeding devices. On the opposite side from that at which the wire enters the hole is enlarged into an opening *e'*, usually conical, corresponding to the form of the screw-head to be produced, except as to its face. The wire is projected through the die sufficiently to furnish the metal required for the head. In this position it is ready to receive the action of the hammers, which upset the metal, force it to fill the cavity of the die, and give it the form required, the form of the face of the head, including the slot, being given by the last hammer which acts upon it.

Figs. 2, 3, and 4 illustrate the action of each of three hammers which act in succession to produce the most common and familiar screw-head. The first hammer does little more than shorten the portion of wire protruded through the die and enlarge its diameter, as represented in Fig. 2. The second hammer compresses the metal still more and expands it against the surface of the mouth of the die. This hammer also gives a temporary curved form to the face of the head to prepare it for the action of the third and last hammer. The necessity for doing this and the form of the hammer required is explained in an application for United States Patent filed by me July 7, 1887, Serial No. 243,674. The action of the second hammer is illustrated in Fig. 3. In Fig. 4 the action of the final or finishing hammer is illustrated. The face of the hammer rests upon the face of the die and the cavity of the die is completely filled with the metal without overflow. A tongue *t* on the face of the hammer to form the slot is represented by dotted lines. The operation of forging the head *u* of a screw is now complete. If the face of the hammer and the surface of the cavity of the die are smooth, the head of the screw will be sufficiently smooth for the practical use of screws. If a finer finish or surface on the face of the head is desired, it may be given by a suitable polishing or shaving tool without changing the character of the head or the process by which the screw is formed. The head being formed, the wire is next fed forward the proper distance for the length of screw required. The forging of the head expands the metal in the cylindrical part of the solid heading-die and makes it important that the wire shall be started by a feeding device of great power, followed by the action of another device which carries the wire forward the required length for a screw. The blank *c* is then severed from the wire. In connection with the severing I perform the operation of pointing the blank to prepare it for the threading operation.

The operation of severing and pointing is effected by means of a pair of dies *s*, (one of which is represented by Fig. $5\frac{1}{2}$,) which are forced against the wire and compress the metal and bring the end of the blank to a conical point c^2, as represented in Fig. 5. At the same time the end of the wire from which the blank is severed is brought to a globular or rounded form, as represented at *c'* in Figs. 5, 6, and 7. This shape is of advantage in forging the next head. The dies which effect these results are shown by Fig. $5\frac{1}{2}$, as just stated.

I do not regard the severing and pointing of the blank simultaneously to be an essential part of my process. Neither is it in my judgment essential that these operations should follow the heading operation; but I think the order I have indicated to be the best way of practicing my process.

The only waste of metal which attends my way of making screws occurs in the severing and pointing of the blanks, and is represented at *o o* in Figs. 6 and 7.

The final operation is the forging or swaging of the thread. This is effected by means of two dies D, between which the blank *c* is rolled. These dies are represented in Figs. 10, 11, 12, and 13. Fig. 13 exhibits the blank in the operation of rolling and shows how the metal is forced to expand into the grooves *f* of the dies. Fig. 10 is a plan of the working face of a die. The light spaces represent ribs *r*, which enter the metal at their narrow ends (the left being the entering end) to the depth required to produce the thread r^2 of a screw. Fig. 13 is a transverse sectional view taken through a pair of dies, showing the screw in the early part of the operation of forming the thread. These dies, as before stated, form the subject of a patent granted to me September 20, 1887, No. 370,354, where they are more fully described. I would state, however, that by the employment of my improved dies the pressure upon the metal toward the axis of the blank is limited to the commencement of the rolling operation and to a comparatively small part of the metal displaced. The working parts of a die D are the ribs *r* between the grooves *f* and the inclination of their adjacent sides to each other, which is constant from one end of the die to the other. The work of raising the thread is mainly performed by these sides. The angle of the inclined sides is the same in all and the same from one end of the die to the other; but the height of each rib and the width of its face or top varies throughout its length and is determined at every point by the depth of the grooves adjacent to it. This top face, which is substantially

level, has the form of a truncated wedge very narrow at the end (at the left) where the rolling commences and much wider at the opposite end. This width or face of the ribs *r* at the finishing end is the same width as the core of the screw lying between two adjacent threads.

In order to roll threads upon a blank *c*, the latter are placed in a hopper connected with a machine provided with suitably-mounted rolling-dies D. A machine of this character is indicated by Fig. 14, a portion of the machine being broken away to show the actuating mechanism, and also showing a blank in the act of being operated upon by the rolling-dies. To roll a screw, the blanks are fed to a holder or support and held in a vertical position between the opposed ends of the dies, and (supposing one die to be stationary) as the movable die is carried or forced ahead the blank is seized and rolled along between them until the movable die passes the opposite end of the fixed die, when it drops from them completed, as indicated by A in Fig. 15. At the commencement of the operation the narrow ribs of the dies are forced into the metal to the maximum depth required, and as the rolling progresses the metal between the ribs is more and more compressed and gradually expands into the grooves of the dies, until at the end of the operation it fills them and the thread is completed. It will be seen that in this series of operations all parts of the metal which are changed in form are subjected to compression to effect that change, and that thereby a large reduction in the waste of metal is effected, and that, also, an important increase in strength is secured, due to the fact that at the parts especially where the strain in the use of the screw is most severe a surface of compressed and compacted metal is obtained and preserved, resulting from the forging operations. This increase in strength, together with the improved form which results from the raising of the thread radially by rolling in the manner described, and the consequent change in the size of the head with reference to the wire from which it is formed, makes an improved screw distinctively and substantially different from the screws heretofore made by the process of shaving and cutting.

I claim—

1. The method of forming screws herein described, by forging a finished screw-head, including the slot, upon the end of the wire from which screws are produced, cutting off from the wire and pointing by compression between dies a piece of the required size to form a screw, and forging a thread thereon by rolling it between dies, the ribs of which at the commencement of their operation penetrate the metal to the required depth and then force the metal by lateral compression to expand radially and give the required form to the thread.

2. The wood-screw herein described, having the surfaces of its solid thread, which is raised from the body of the blank by rolling it between dies that compress laterally the metal to form the thread and force it to expand radially from the blank into grooves in the dies having a form transversely the counterpart of that to be given to the thread, of the top and under side of the head, of the slot in said head, and of the portion of the shank adjacent to the head of the thread all composed of compressed metal, substantially as described.

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

CHARLES D. ROGERS.

Witnesses:
JOSEPH SANFORD,
GEO. H. REMINGTON.