

1. A portion of the forest of pipes in the Denver organ. 2. The console of the Philadelphia instrument, with its five banks of keys. 3. Part of the motor equipment of the Denver organ. 4. Another view behind the scenes in the Denver organ; in the insert, a diagrammatic representation of the principle on which the "mouth pipe" works

Some representative views of the great organs in Philadelphia and Denver

## Two Great Organs

### Some Interesting Details of the Philadelphia and Denver Instruments

By J. F. Springer

THE greatest and grandest of all musical instruments is, undoubtedly, the organ. This being the case, Americans may well be proud that in the United States are the two instruments which probably stand at the head of all that have so far been built since the first organs were constructed.

In a great department store in Philadelphia is a gigantic instrument having 17,954 pipes and as many as 232 speaking stops. In fact, this big affair comprises eight different organs—namely, a great organ, a swell organ, a choir organ, a solo organ, an ethereal organ, an echo organ, a pedal organ and finally a chorus organ. The smallest number of pipes occurs in the chorus organ (732) and the largest in the swell organ (4,346). Controlling the 17,954 pipes are six keyboards—five manuals and one set of pedals. There are only a few other instruments in the world with as many as five manuals. They are in Breslau, Hamburg, London, Liverpool, Sydney (Australia), etc.

The operating device from which the organ is played and which contains the manuals, the set of pedals, and the stop handles, is called the console. In the present case, the main console weighs one ton and controls, in addition to the organ itself, a piano, two sets of chimes (major and minor), one set of gongs and a harp. These may each and all be played from the complex keyboard of the console. Of special note is the harp which is played not by striking the strings, but by plucking them after the manner of a hand performer. This type of harp is a new invention, and is, presumably, present only in this organ. The great instrument is distributed somewhat over the building, but if all the parts were gathered together and weighed the weight would be 375,000 pounds.

Originally, this organ was set up for exhibition at the St. Louis Exposition in 1905. The gold medal was awarded to it. But the big organ which then won the gold medal is only a part of the present instru-

ment. The organ as now developed is 80 per cent greater than the original.

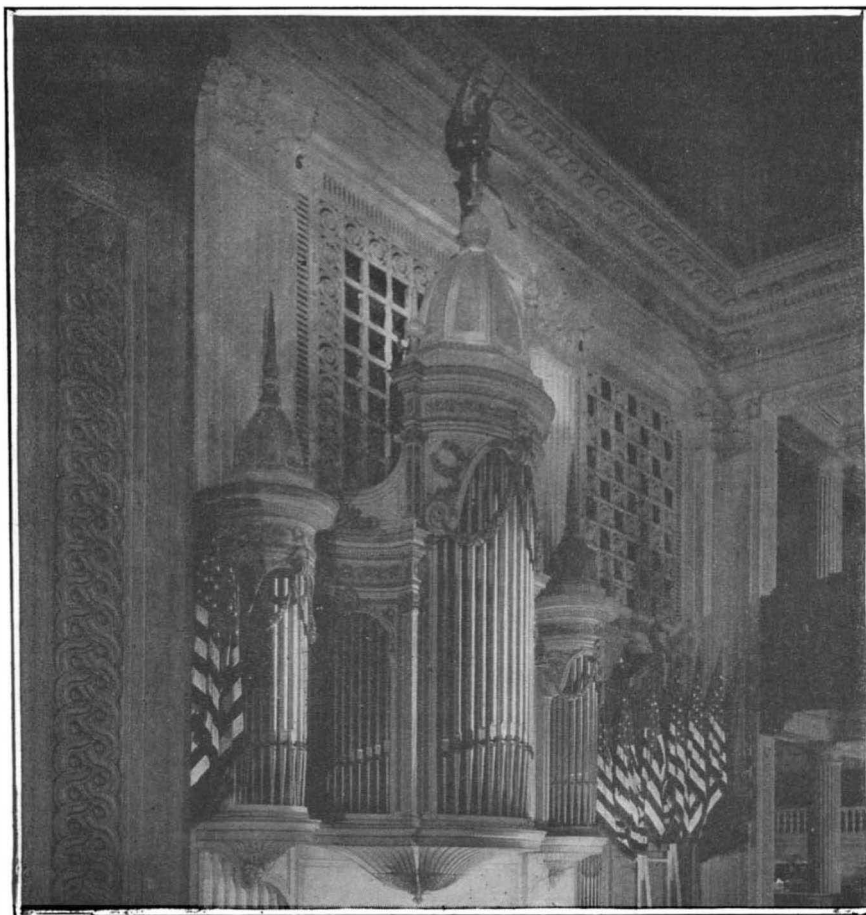
Some may think that the visible metal pipes usually seen above the keyboard of a pipe organ constitute the full complement. But this is seldom or never the case. In the present case, the visible display of piping is more

or less impressive, but the real instrument is not on parade. The pipes of a big organ like this one will be, some of them, of wood, and some of them, of metal. They will be big and little. The smallest pipe is a little fellow which may be held in the palm of one's hand. The largest pipes are two in number, both 32 feet in length. One belongs to the pedal organ and the other to the open Diapason register. No organ pipes excelling these in size and power have, it is believed, ever been constructed. The 32-foot open Diapason contains over 1,000 board feet of 3-inch sugar pine and weighs 1,735 pounds. It is some pipe. But this is not the very longest pipe; that distinction belongs to a metal pipe 37  $\frac{3}{4}$  feet long and 17 inches in diameter.

The proper housing of nearly 18,000 separate pipes of such various sizes and forms is something of a problem. Back of the organ screen the greatest part of the pipes are set up in a room 50 feet high and 30 feet deep. The original organ, less than 60 per cent of the present instrument, required 13 freight cars to accommodate it while in transit from St. Louis to Philadelphia.

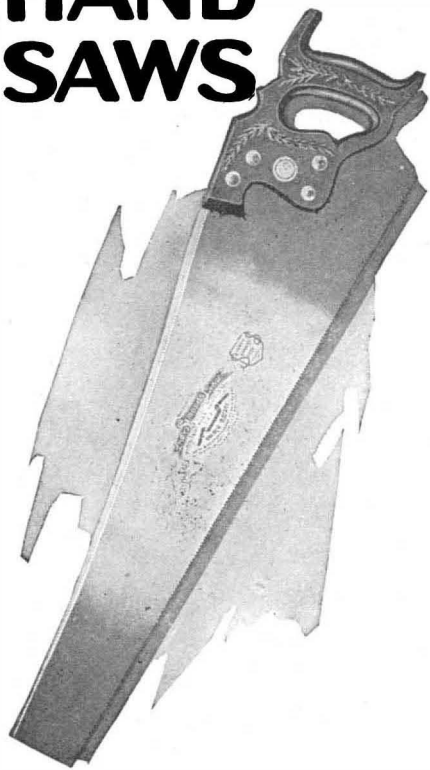
Before going further, it may be well to get before us some fundamental items of information as to the modern organ. The standard sounds are made by or in connection with two classes of tubes—the mouth pipe and the reed pipe. In a mouth pipe, the musical note is generated by the vibration of the contained column of air. The pitch is dependent upon the effective length of the tube and upon nothing else. The diameter of the tube, its cross-section size, the material of which it is made, all have nothing to do with pitch. The tube may not even be straight but curved. But effective length does regulate the pitch. A representative mouth pipe is shown diagrammatically in the vertical section above. The compressed air enters through the opening A and fills the pyramidal or

(Continued on page 443)



The show pipes of the Philadelphia organ as they are seen from the front

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protozoa, when once found and encouraged to develop, will obviate the necessity of killing the organisms by artificial means, and of calling into requisition special treatments to destroy the odors and tastes of the disintegrating animals. It is believed that the further study of the part which the carnivorous ciliate forms play in the reduction in numbers of the smaller protozoa, will prove to be profitable from the standpoint of reservoir water purification.

## Two Great Organs (Continued from page 428)

conical portion of the pipe, this portion being known as the foot. The bulk of the pipe is above. The column of air whose vibration produces the sound and whose effective length determines the pitch is measured from the plate ED up to the top of the tube if the tube is open at the top, but up to the top and back to ED if the top is closed. ED represents a plate or diaphragm which extends nearly across the pipe. The air rushing out between D and B strikes against the upper edge C of the slit represented by the opening between C and B. The result is that the air above ED is put into vibration. The law governing such pipes is that halving the effective length raises the pitch exactly one octave. Naturally, this means also that doubling the effective length lowers the pitch one octave. A very low note on the great Philadelphia organ is produced by pipes 32 feet long. One of these belongs to the open Diapason register. If this pipe were halved, the octave above would be produced; if halved again, the next octave above, and so on, by halving the effective length, the successive octaves are produced.

The reed pipe is a different affair. There is a pipe and a reed inside it. This reed may itself be in pipe form; that is, it may consist of a metal tube whose front has been more or less cut away and of a tongue of metal secured at one end and adapted to vibrate in or against the metal of the tube. A common mouth-organ—the harmonica—contains metal tongues of the same general character. The enveloping pipe—the reed pipe proper—may be of metal or of wood. If the tongue does not strike the reed but only the air, it is called a free reed.

A stop is a series of pipes whose quality is alike. There may be many or there may be few. Quality of tone is, from a scientific point of view, dependent upon the number, distribution and relative intensities of the overtones. This seems to be an assured result that will not need modification by further investigation. Assuming it to be absolutely true and adequate, one learns that the notes of any instrument whatever may be successfully imitated, provided we can arrange to have just the right set of overtones, whether the whole combination is got from a single instrument or not. It is generally easier, however, to provide for the proper overtones by the material used in making the sound, its shape and dimensions. There is probably no equal to the possible variations of the quality of organ pipes, since we are free to select the materials, etc. There is thus a continual opportunity for invention. Here we have quality in respect to its possibilities from the standpoint of the organ builder. The organist also has opportunity for developing new and pleasing qualities by combining stops.

A group of stops constitutes one of the subordinate organs into which great instruments like this Philadelphia affair may be divided. In general, each manual controls an organ. But in such cases as that of this giant instrument, where there are eight separate organs, one or more of the manuals may control two organs. Thus, at Philadelphia, the great and the chorus organs are played from one manual. The top bank of keys operates the choir organ; the next bank lower, the great organ; the third, the swell organ; the fourth, the solo organ; and the fifth, or



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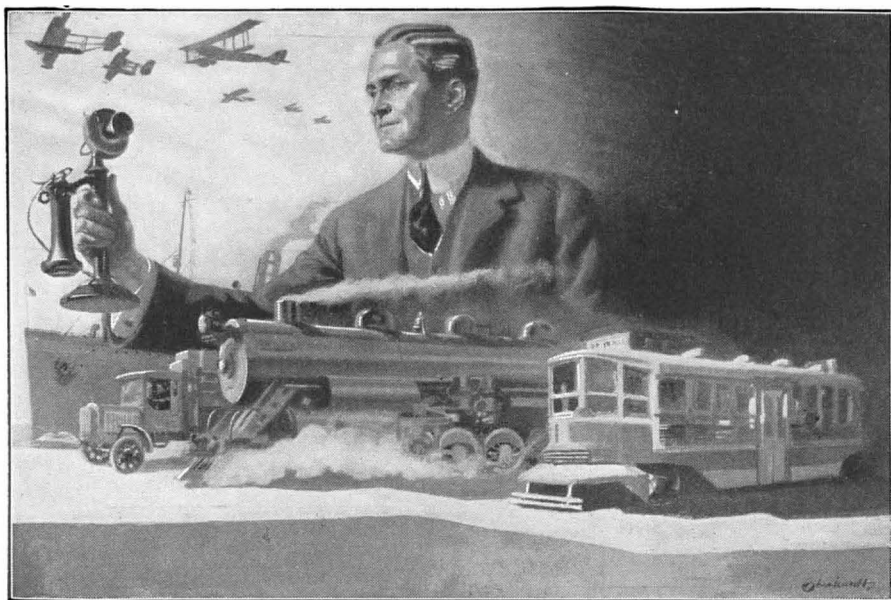
Make this ten-day test. Note how clean teeth feel after using. Mark the absence of the slimy film. See how teeth whiten as the fixed film disappears. In ten days let your own teeth tell you what is best.

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cause there seems little hope for improvement.

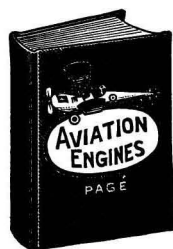
The intricate mechanism of telephone service is, under the most favorable conditions, subject to criticism, for the reason that it is the most intimate of all personal services.

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bottom bank, the echo organ. The second bank of keys, as already said in effect, operates also the chorus organ; the solo manual and also the echo manual may either be used to play the ethereal organ.

Each manual begins, on the left, with C (natural). Similarly, the pedal key-board starts with C. These initial C's correspond to a note two octaves below middle C of the ordinary piano. However, the pipes of a stop may not correspond to the pitch indicated by the keys and pedals. For example, the lowest note in the pedal key-board is C two octaves below standard middle C. But the big 32-foot pipes which may be brought into action after drawing the right stop lever or rod, give the C which is four octaves below middle C of the piano. Similarly, there are stops which when played yield notes an octave higher than what the keyboard indicates. All this is really simplification, as the simple drawing of a stop lever gives octaves above or below as desired. It would be an unnecessary complication to provide, for example, an extra pedal board for the set of heavy base notes beginning with the 32-foot C.

It will be seen from the foregoing, perhaps, that all boards, whether of manual keys or pedals, are standardized to begin with the C which is two octaves higher than the 32-foot C. This means then that all these boards are standardized to begin with an 8-foot C, 8 being the result of dividing 32 twice by 2. There are five full octaves plus one key to each manual. That is, they all begin and end on C natural. As each octave contains 7 white and 5 black keys, the several manuals will each have 61 keys. The pedal board contains about two and one-half octaves, beginning with C natural and ending with G natural. As the highest standard note on the manual boards is five octaves higher than an 8-foot C, the effective pipe length for a mouth pipe may be expected to be found by dividing 8 feet five times by 2. We should then get 3 inches. The smallest length of pipe in the Philadelphia organ is said to be  $\frac{3}{4}$ -inch. Apparently, its pitch is just two octaves above the standard final C on the manuals.

In this great organ, 179 of the speaking stops are understood to be composed of mouth pipes and 53 of reed pipes.

The names of stops refer in general to the quality of the tone and not to the pitch. The *open diapason* is perhaps the stop which may be regarded most characteristic of the pipe organ. The *dulciana* is, or may be, a stop composed of mouth pipes of small diameter, yielding a sweet tone. Reed stops may have such names as *clavion*, *bassoon*, *oboe*, etc. These are supposed to indicate that the quality of tone is the same as or similar to that of the corresponding musical instrument. The *vox humana* is a reed stop supposed to resemble in quality the human voice, as the Latin suggests.

In Denver is a great instrument which is understood to have cost upwards of \$80,000. There are four manuals and 229 stop keys. The largest pipe has an effective length of 32 feet and belongs naturally to the pedal register. It is 40 inches square at the big end and tapers to 6 inches at the other end. It is made of pine and weighs 1,250 pounds. The effective length of the smallest pipe is  $\frac{3}{4}$ -inch. As  $\frac{3}{4}$ -inch is obtainable by dividing 32 feet by 2<sup>9</sup>, we conclude that the two musical notes produced are 9 octaves apart. The little pipe is of metal, has the diameter of a straw and weighs half an ounce.

In addition to the notes properly belonging to a pipe organ, the Denver instrument possesses apparatus capable of producing such percussive effects as are suggested by such names as harps, chimes, xylophones, Glockenspiels, vibrating bells, sleigh bells, drums.

There is an automatic organ player which may be used upon occasion when a skilled organist is not available. This player may be operated in connection with paper music rolls as with the ordinary automatic piano players. A second roll

provides for the orchestration of the various stops.

A special feature of this magnificent instrument consists of the *vox humana* pipes in the echo organ. A *vox humana* stop of single pipes is no novelty; but at Denver, it is possible to go beyond the solo voice and give a full quartet of voices. This is claimed as a unique feature.

### Trailers in Texas Oil Fields and Washington Forests

(Continued from page 430)

wholesale grocers and the great metropolitan milk companies are also standardizing their hauling with short-wheelbase motor trucks and semi-trailers. Some of the large industrial plants which have widely separated departments inside the same factory yard are using trucks and tractors for hauling from one department to another.

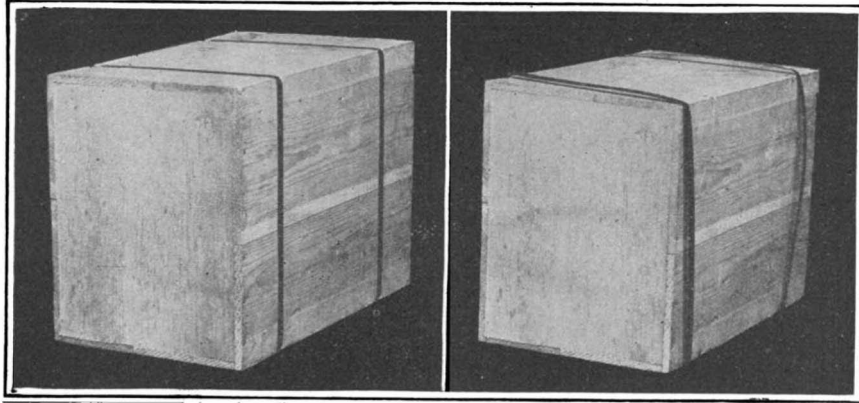
In the lumber business, both in hauling from the woods to the mill and from the lumber yard to the building job, the number of trailers in use constantly increases. This was one of the first fields to take up the trailer hauling principle and it promises to be the first that is completely equipped with trailers. Illustrations show the use of truck and trailer combinations in handling both rough and finished lumber. The logging outfit shown is operated in South Prairie, Washington, and has done very good work. The length of the haul, at present, is about two miles, of which some two thousand feet is planked. The steepest grade is 15 per cent and the average grade for the hill, which is one and one-half miles long, is 9 per cent. Loads are hauled down hill. Except for shortage of railroad cars, this truck has not lost a single day since it started to work. As high as twelve trips per day have been made, but the average will be about eight or nine.

### A Molding Machine Which Throws the Sand

IT will be possible before long to pour a casting without the use of a mold, so rapid are present advances. We have molding machines which are the work of several molders and now we have a sand throwing machine for filling molds. The experienced molder knows the effect and the practical value of throwing the sand in place, a handful at a time. So thrown, the sand needs no further ramming. A machine to do this more expeditiously and with equal precision has been designed, and, after passing the test of several months' experience in some of the Chicago foundries, has been put on the market.

The sand is thrown into the mold with considerable force by mechanical means. Hence a large quantity can be handled in a unit of time, so that finished molds should be turned out quickly. Obviously the density of the ramming can be regulated by controlling the speed of the impeller. The essential element of the machine is the throwing head, which is mounted on a double-jointed arm, allowing it to be swung into any required position over the mold. This head is connected by a shaft to an electric motor which runs at a high speed. It is cast with three arms, on one side of which is a pair of brackets, to which the impeller is bolted.

When in use, the whole of the head is enclosed in a combination cast-iron and sheet-iron hood. The sand, entering from a chute at the top, is violently ejected by the rapidly revolving impeller through a hole in the underside of the hood. For ordinary gray iron, a suitable speed is from 1,200 to 1,400 revolutions a minute; for steel castings a higher speed is required. The sand may be rammed at varying densities over the different parts of the pattern by passing the head slowly or quickly over the parts. Two standard types, one a tractor, the other stationary, are constructed.



This box was bound up with iron straps so tightly that the straps cut into the wood; but see what the sun did to it!

### When Packing Boxes Shrink

**P**ACKING boxes often shrink, with unfortunate consequences at times. The accompanying illustrations serve to show the loosening of box strapping due to excessive shrinkage.

It is a well-known fact that wood shrinks upon drying, but it is nevertheless frequently overlooked. We find this especially true in certain branches of the packing box industry, mainly in those branches where boxes are liable to be made up far in advance of actual need and then stored, and in many miscellaneous instances where the art of boxing and crating is not thoroughly understood. The shrinkage of wood causes not only the loosening of the straps, but also the loosening of the nails. This latter feature is especially troublesome where the boxes are made up out of green wood quite a long time before they are used. Of course, it is not always the fault of the boxmaker that the wood in boxes shrinks and causes trouble. The conditions of storage and handling after the box has been packed are frequently responsible; thus boxes that have been stored in a fairly damp place for several months and are then transferred to a warm, dry place are sure to shrink appreciably and may cause considerable trouble.—By S. R. Winters.

### Fiddling the Saw for Music

**T**HE conventional saw has recently appeared in a new rôle, namely, as a musical instrument. Indeed, one of the leading novelties of a current New York musical revue is the musical carpenter who uses his saw as a violin, as shown in the accompanying illustration.

After protracted experimentation and untiring practice, Sam Moore of New York City, has succeeded in getting very agreeable music from the ordinary car-



Method of fiddling a saw to obtain pleasing music

penter's saw. He holds the saw handle between his legs, as shown, holds the tip of the saw in one hand and works the usual violin bow with the other. The vibrating steel blade emits soft, appealing notes the pitch of which is varied by



Crushed German steel helmets make good road surfaces

changing the curvature of the blade. All sorts of queer effects can be obtained by the adept manipulation of the blade; in fact, the music derived by this means can hardly be described. If anything, it resembles the human voice; then again, it has the queer wail of the Hawaiian ukelelee. All in all, the effect is startling and pleasing.

### Pavements of Crushed German Steel Helmets

**A**LL manner of odd uses have been found for German steel helmets. Flower pots, cuspidors, indirect lighting fixtures, wash basins—these and many other uses have served to make the German helmet a peacetime adjunct of some value.

Now comes the little town of Croydon, England, where much of the spoils of war have been placed, with the suggestion of using German steel helmets as road material. In fact, this township has gone to work and made some roads from German helmets with good results, according to reports. The helmets are arranged in the manner shown in our illustration, after which they are crushed up fine by a heavy road roller. Tens of thousands of these German helmets taken during the closing days of the war, serve to pave an appreciable amount of road surface. But after all, this is simply a "stunt" of questionable value.

### Mortality Statistics of the United States

**T**HE death rate of the United States for the year 1918 was 18 per 1,000 population, according to the bulletin on "Mortality Statistics" recently issued by the Bureau of the Census, Department of Commerce. This rate is based on statistics in the registration area of the United States, exclusive of Hawaii, which comprises 77.8 per cent of the total estimated population of the United States. The record of deaths in this area in 1918

totaled 1,471,367, including 26,209 soldiers, sailors, and marines.

The mortality rate for the registration area in 1917 was 14.2 per 1,000 population. The increase in 1918 is entirely attributable to the pandemic of influenza.

The greatest mortality occurred in children under five years of age, the total in this class amounting to 306,143. The second greatest mortality by age periods was among those from 25 to 29 years of age, and the third greatest mortality occurred among those between the ages of 30 and 34 years, inclusive. There were 733 deaths at the age of 100 years or over. Approximately 5.7 per cent of deaths occurred at the age of 75 or over. The average age at mortality was between 34 and 35 years.

The total number of deaths from influenza in the registration area (exclusive of Hawaii) was 234,290; from pneumonia in all its forms, 222,400; organic diseases of the heart, 124,514; tuberculosis, 107,602; acute nephritis and Bright's disease, 79,192; cancer, 65,282.

The report is known as Bulletin 141, Mortality Statistics, and can be obtained from the Bureau of the Census, Department of Commerce, Washington, D. C.

### What a Falling Steel Girder Can Do

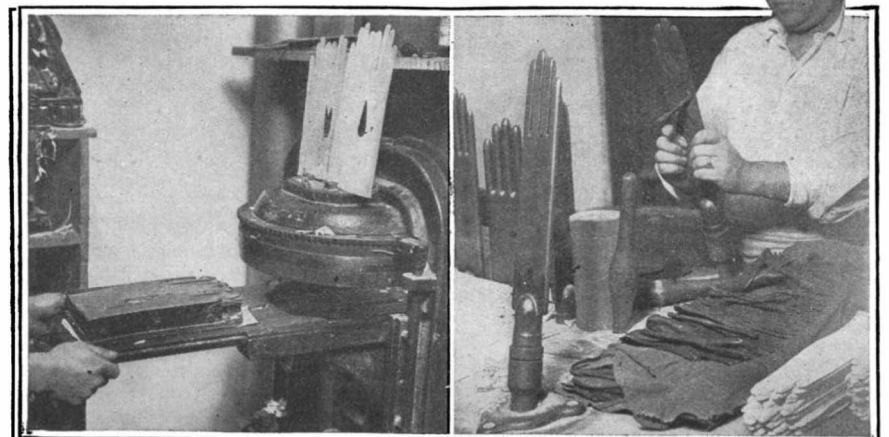
**P**EDESTRIANS of Regent Street, London, recently witnessed an accident that will long be remembered, when a girder weighing six and a half tons fell fifty feet to the sidewalk. The girder was being hoisted by a crane. Defective construction caused part of the crane to collapse, with the consequent drop of the beam. Curiously enough, the beam fell end on and pierced the pavement for some distance, as shown in our illustration. Fortunately, no one was hurt.



This girder, weighing 6½ tons, fell 50 feet and pierced the sidewalk

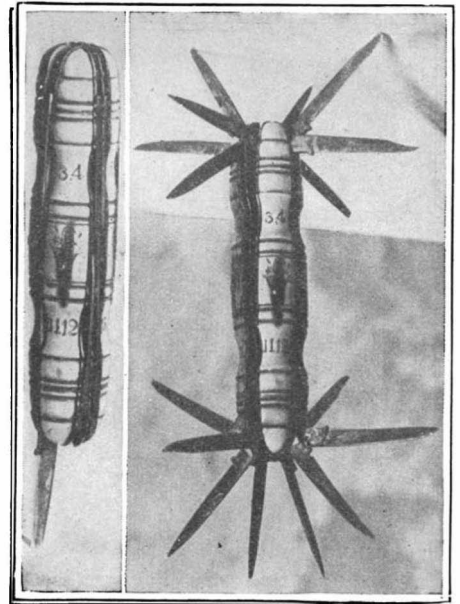
### Standard Blood-Pressure Gages

**T**HE U. S. Bureau of Standards has recently undertaken an investigation of the various types of blood-pressure gages in use throughout the country. The Bureau has constructed what is believed to be the first fundamental mercurial standard for testing sphygmomanometers.



Copyright, Publishers Photo Service

Stamping and pressing operations in the manufacture of leather gloves



Sixteen-bladed pocket knife which was used by Washington

### Washington's Sixteen-Bladed Pocket Knife

**Q**UITE aside from the fact that it was George Washington's pocket knife, the piece of cutlery shown in the accompanying illustration is interesting because of its sixteen blades. The many blades, it will be noted, are arranged to fold into four slots placed at right angles to each other in the handle. The knife was presented to our first President in 1784 by Captain Samuel De Wees, and is now the property of George De Wees of Chicago, Ill., a descendent of said Captain De Wees.

### Our Leather Gloves in the Making

**T**HE making of gloves has been placed on a quantity production basis, just as have most of our other everyday industries.

The first step in glove making is the selection of the leather skins which, after being passed on, are roughly marked off for the number of gloves to be made from them. The skins are then passed to the stamping machine, which, provided with the proper sized and shaped dies, cuts the material for each glove. It will be noted from the first of the accompanying illustrations that in this stamping operation all but the thumb is accounted for. The glove is made in one piece for the four fingers, the thumb being a separate operation. Following this operation the material is folded over and sewed into a glove.

The nearly finished glove is then steam treated, to give it the proper shape. A hollow metal form over which the dampened gloves are stretched, presses the gloves by steam heat after a few minutes' treatment. The gloves are then ready to be finished, including the attaching of suitable metal clasps.