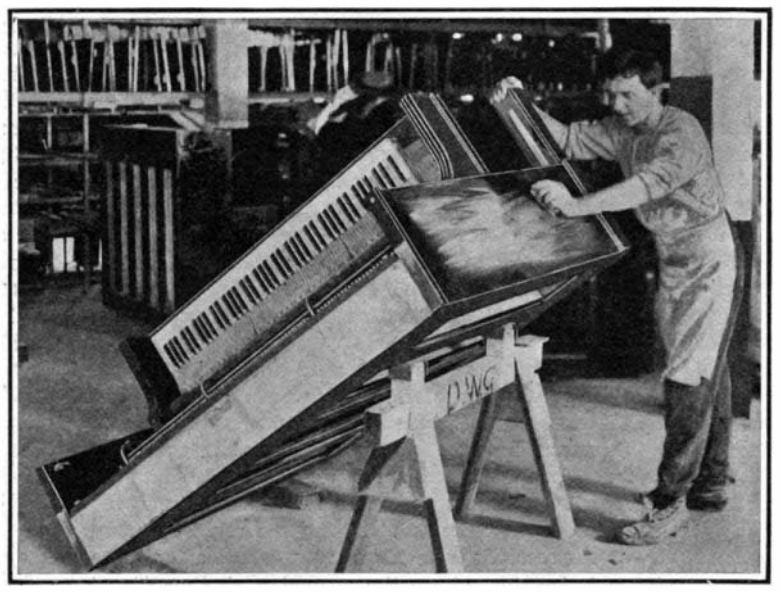
THE ART OF PIANO MAKING.—II.

In the preceding article on the art of piano making, as carried out at the Knabe factory, we showed that great attention is devoted to the selection and preparation of the wood, so that it shall conduce to the tonal qualities of the piano; described the building up of the rast, or frame; the construction and function of the delicate sounding board, "the soul of the piano"; the manufacture of the plate which serves to carry the combined tension of the strings, and hold the whole structure of the piano to its proper line and surface; and, lastly, we discussed the principles of tone production, and dwelt upon the great care that is taken in the manufacture and selection of the wire for the strings, and in the laying out of the scale.



Polishing the Case. Rubbing Down with Powdered Pumice Stone.

THE PIANO ACTION.—One of the most ingenious and carefully designed and constructed elements in the piano is its action, which is the name given to the delicate and complicated system of rods, levers, and hammers, by which the stroke of the player's fingers, with its infinite variations of touch, is conveyed to the sound-producing element, the strings.

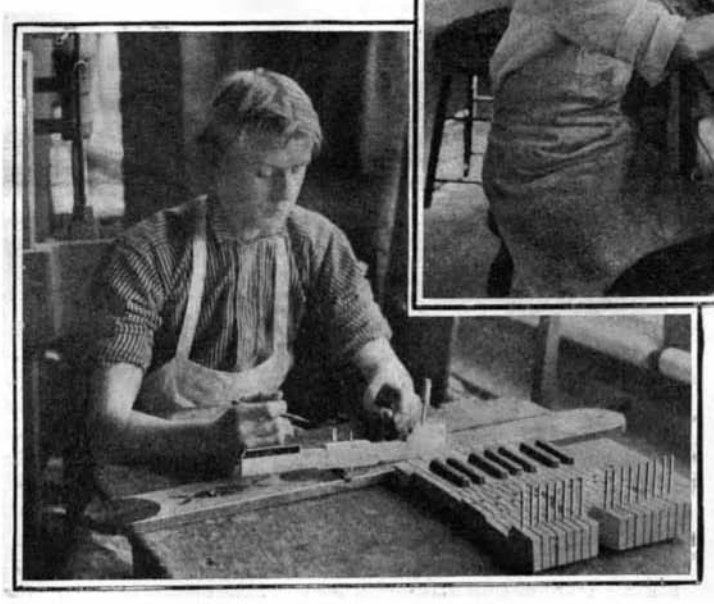
The chief requisites in the piano action are:

1. Lightness, so that the total inertia of the particular key that is struck, and its accessories, shall be as small as possible, and the response to the stroke proportionately quick.

2. Elasticity of touch, or quick return of the key.

3. Sensitiveness to different speeds of attack, so that the performer can produce instantly, and to the proper extent, the effects which he desires.

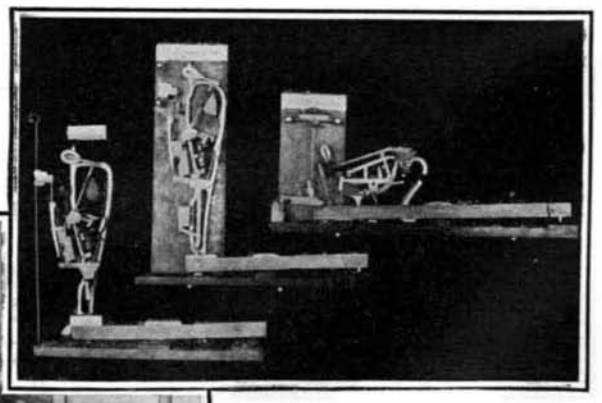
The movement of the action may be briefly summarized as follows: The key, which is struck by the performer, is pivoted at a certain point in its length, and is arranged for transmitting motion from the finger of the performer through the action to the striking hammer. The action is so arranged that the hammer is not driven positively to the string, but to a point which is a short distance therefrom, and the hammer passes over this distance by reason of the momentum already imparted to it by the action. The hammer, after striking the string, rebounds therefrom and is caught by the backcheck and prevented from further movement. When the key is released by the performer, the parts of the action immediately assume the correct position for giving another stroke. Moreover, this position is taken when the key is only partially released, a full return movement of the key not being required before giving another stroke.



Balancing Each Key Individually.

With the striking mechanism for each key is associated a damper, which normally lies in contact with the strings. The same movement of the key that causes the hammer to strike its blow, lifts the damper from the strings just before the blow is struck, the damper closing upon the string when the player's finger is lifted from the key, unless it be prevented from doing so through the operation by the performer of the "loud" or sustaining pedal.

Apart from the energy with which the key is struck by the performer, the blow given by the hammer is dependent upon the distance through which it must travel from its position of rest until it strikes the strings. The soft pedal is a device by which the whole of the hammers may be brought forward toward the strings, thus shortening the stroke and softening the tone. This is the system employed in the upright pianos manufactured by this company. In the grand piano the action of the soft pedal is to shift the hammers from the position in which they strike the three strings that go to the majority of the notes, to a position in which they strike but two of the strings. It is impossible within the limits of the present article to enter into a detailed description of all the pieces that make up the complicated action of a piano, and for such information the reader is referred to the many illustrations accompanying this article, and particularly to the one showing the three styles of action as used in the small upright, the large upright, and the grand. In the upright piano the hammers strike their blow horizontally, and the tone waves are thrown toward the sounding board; in the grand piano the blow is delivered upwardly in a vertical plane, and the tone waves are thrown away from the sounding board. For convenience of manufacture and assembling, the individual members of each part of the action are made of the same length between centers, and pivot upon axes that are in the same horizontal line. This enables the whole of the action as assembled to be mounted upon common supporting rails, which are themselves carried in four metal brackets, one at each end and two arranged between them. The system is shown clearly in several of the illustrations, and notably in that entitled "assembling the action."

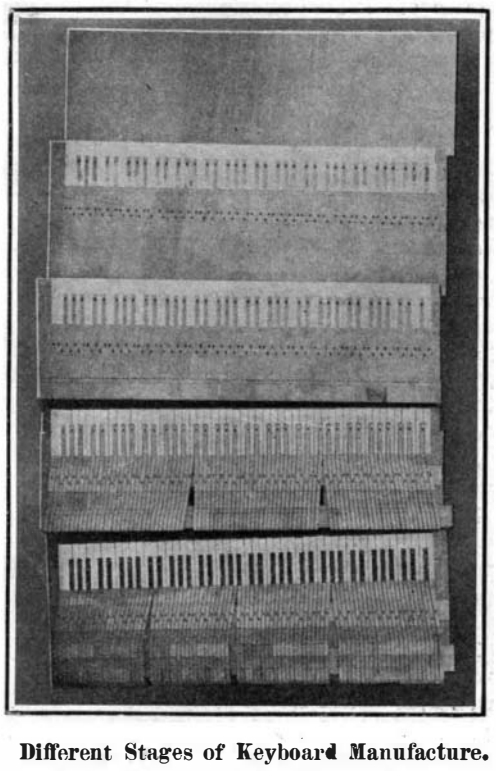


Complete Actions for Small and Large Upright and the Grand Pianos.

Adjusting the Grand Action.

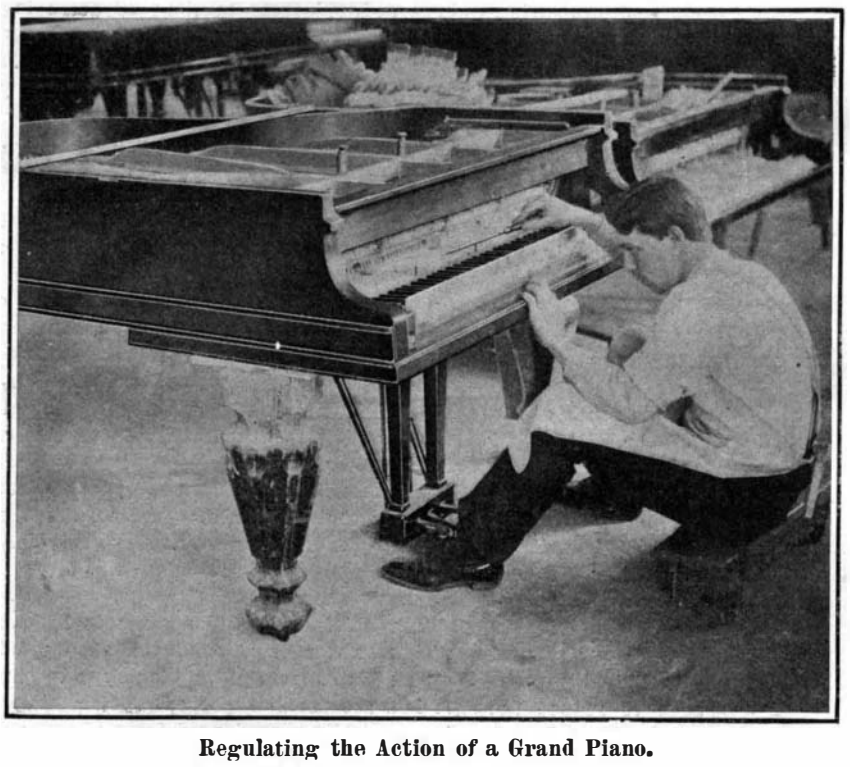
Several different varieties of wood are used in the construction of the action, chief among which are maple, basswood, ash, cherry, and cedar. As it is desirable to make the various parts of the action as light as is consistent with great strength, the wood is so cut that the grain shall, in each member, lie in the direction which is most suitable to the strain which that particular piece must endure. Moreover, the clearance between the separate pieces is so small that the expansion and contraction under atmospheric changes must be reduced to a minimum; and hence, in those parts upon which the maintenance of proper clearance depends, when not inconsistent with maintaining the strength above mentioned, the grain is made to run crosswise of the general plane of the action, wood having practically no expansion or contraction in the direction of the grain.

THE HAMMERS.—The hammers are made with a round shank and a head approximately pear-shaped in profile. The nucleus or center of the head is a small wedge-shaped piece of hard wood, around the point of which is first glued a piece of under felt, which acts as a cushion for the thicker outer felt that does the striking. Because of the severe and long-continued hammering to which it is subjected, it is necessary to use a special grade of felt for covering the hammers. The best quality comes from Germany in the form of large sheets, 4 feet square and tapering in thickness from 1 1-16 inch at one edge to 3-16 of an inch at the opposite edge. The whole set of eighty-eight hammers during the first process of its fabrication is operated upon as one piece. The wedge-shaped strip of wood forming the nucleus of the hammer head is held in the jaws of a specially constructed press, and the inner or cushioning strip of felt is glued on, and then a strip about 5 inches wide, with



Different Stages of Keyboard Manufacture.

Note grain of wood parallel with slope of the keys.



Regulating the Action of a Grand Piano.

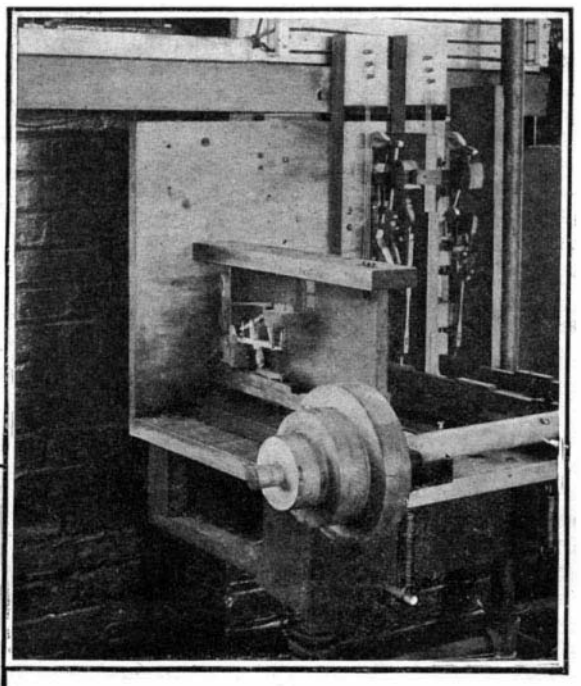
its edges chamfered down, is cut from the sheet of outer felt and glued down, under great pressure, in the jaws of a powerful machine, over the inner felt until it assumes the characteristic pear-shaped profile of the hammers. When the glue has thoroughly set, the felted strip is cut transversely into the requisite number of hammers. The thickness of the felt decreases gradually from 1 3-16 inches in the lowest bass hammers to 3-16 of an inch in the hammers for the highest treble notes. How special a quality of felt must be used in a first-class piano is shown by the fact that each of these sheets costs $125. We explained in the previous article that the scale of the piano strings is so arranged that the points at which the hammers strike the strings shall lie on a straight line; and one of the most careful adjustments is that of regulating the length of the hammer shank, so that the hammer shall strike neither above nor below this line. This adjustment is made by passing a file over the bottom end of the hammer shank until it is lowered to its proper relative position.

THE DAMPERS.—Acting upon each string in its proper relation to the blow of the hammer is a damper, which consists of a piece of soft felt, that normally is held against the string by a light spring, but is lifted from it just before the hammer strikes a blow, and returns to contact when the player's finger is lifted from the key. It is necessary that the tension on the dampers should be mathematically co-ordinated to the force with which the string vibrates, and this adjustment is secured by a careful operation, known as "weighing off the dampers," in which the tension of the spring is tested by means of a weight, each spring being adjusted so that it will exactly counterbalance this weight, and secure an identical speed of action of all the dampers when in use.

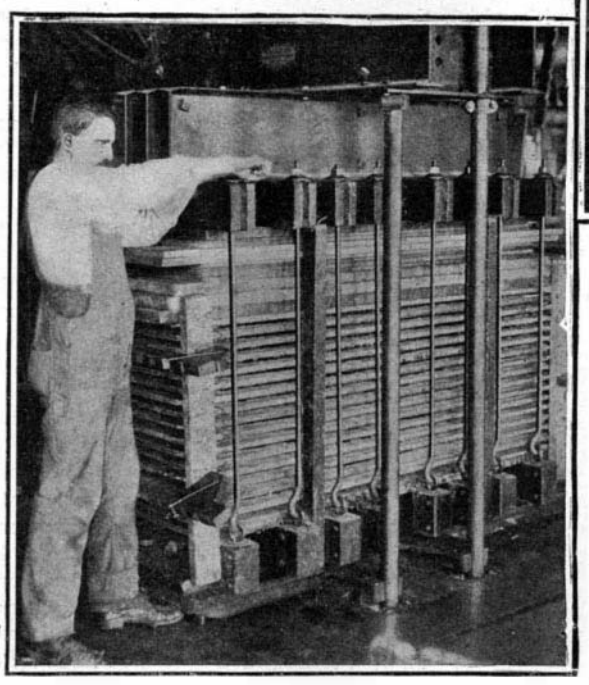
THE KEYBOARD.—As in the case of the hammers, the eighty-eight members of the keyboard are, in the earlier stages of their manufacture, formed in one piece, consisting of a board of white pine, composed of several widths glued together with the grain so arranged that it shall run approximately in the direction of the finished keys. By reference to the engraving showing five stages of the construction of the piano keys, it will be noticed that some of the keys bend to the left, others to the right, and it is necessary to have the grain running in the direction of these bends in order to secure the proper transverse strength. The board, as first glued up, dressed, and finished to size, is about 1 inch thick by 2 feet wide by 6 feet long. The first step is to glue down along one of the long edges of the board a thin ivory strip, after which the top ivory is glued on. The board is then spaced off into the proper number of keys. A double line of holes is then drilled across the board at about its mid-length, for the reception of the pins by which the keys are held in position on the key frame. The keys are now accurately lined upon the board and sawn out with a band or fret saw, after which the ebony keys are glued down upon the proper members. The whole set is now ready for assembling in the piano.

ADJUSTING THE KEYS.—Each key is pivoted at about its mid-lengh upon a rounded saddle, resting on the key frame. It is kept in proper line by means of two nickel-plated pins, one fixed in the saddle and passing up through a slotted hole lined with felt in the center of the key, and the other pin projecting near the forward edge of the key frame, and engaging another slotted and felted hole near the front end of the key. It is necessary, because of the small clearance between adjoining keys, that they all move in a perfectly vertical plane, and one of our photographs shows the workmen employed in the task of adjusting the keys in this respect, the adjustment being made by bending the pins slightly to right or left, as required.

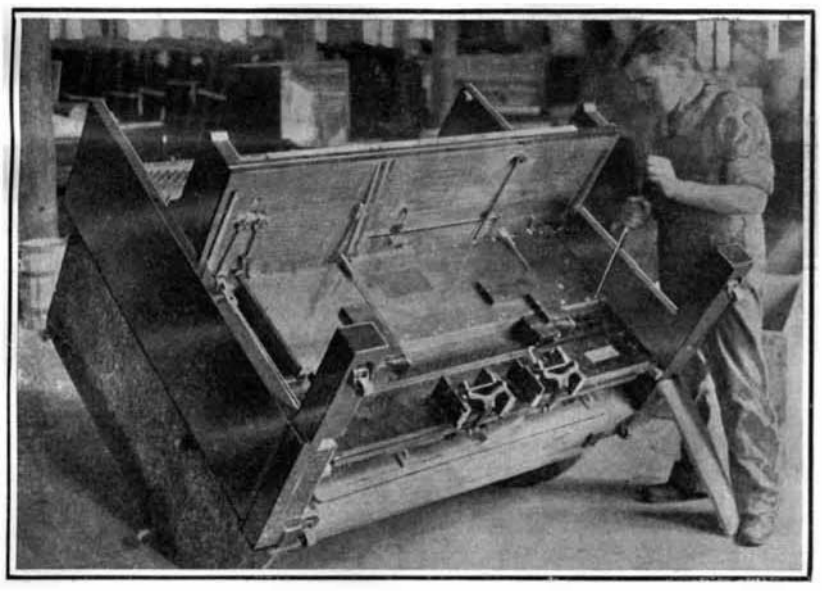
REGULATING FOR TOUCH.—One of the points to which particular attention is paid in the construction of the Knabe piano, is to secure an easy, light, and rapid response of the keys to the stroke of the fingers. Normally, the keys are depressed at the inner end, being held down by the weight of the action above them. As the weight of the action varies greatly, being heavier at the bass end of the scale, it is necessary to weigh the outer end of the keys, so as to bring the excess load on the inner end to the same amount for every key, otherwise it would require greater strength to depress the keys in the bass register than in the treble. This balance is secured by inserting one or more lead plugs on the outer ends of the keys, the amount being determined by an operator who is specially trained for this work. Another important question affecting the touch is the depth of stroke, or vertical distance through which the key is depressed in playing. This regulation is made by interposing little circular washers of felt or other cushioning material between the outer end of the key and the key frame below it. Specially-trained workmen are detailed to do this work, and by long practice their fingers have become so trained, that they can detect the slight change in the depth of the touch amounting to as little as 3-1000 of an inch, due to variations in the down-stroke caused by the insertion or withdrawal of a washer as thin as ordinary tissue paper. Concurrently with this adjustment great care is taken to insure that the



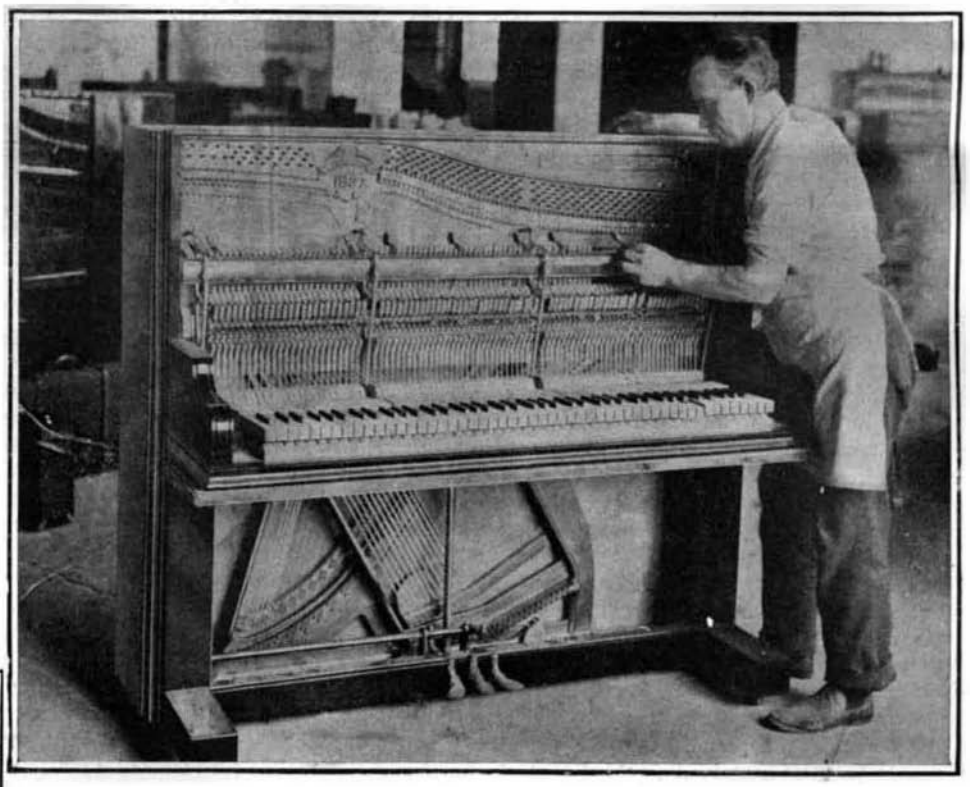
Machine for Testing Action, Hammer, Felt and Cloth.



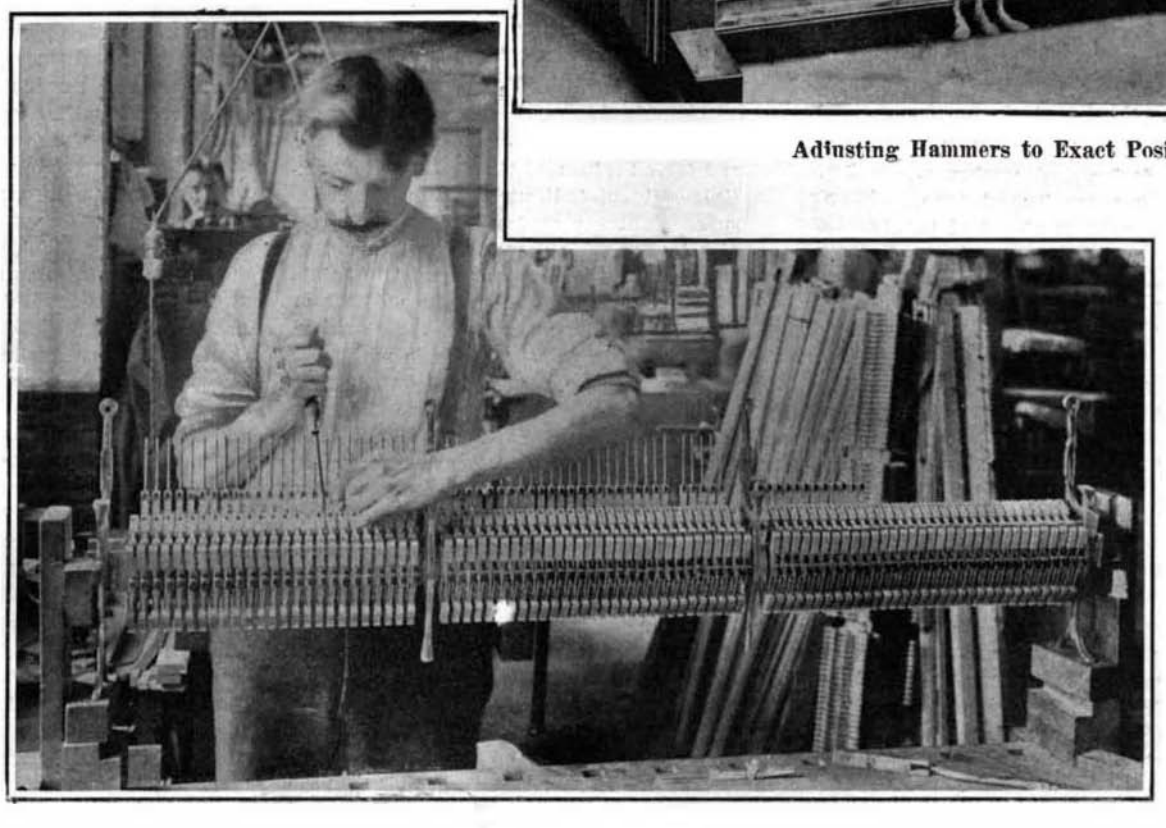
Glueing On Veneer in 120-Ton Hydraulic Press.



Installing Automatic Piano-Player Action.



Adjusting Hammers to Exact Position.



Assembling the Action.

THE ART OF PIANO MAKING.—II.

"release" acts in its proper time relation with the movement of the key.

Tuning and Tone Regulating.—When the action has been thoroughly adjusted, the piano is taken in hand by the tuners, and as an evidence of the thoroughness with which this important work is carried through at the Knabe works, we may mention that each piano undergoes no less than sixteen separate tunings, viz.: Four chippings or preliminary tunings, ten regular tunings, and two fine tunings. Tone regulating or "voicing" is, perhaps, the most important of the final adjustments to which the finished piano is subjected. The object of tone regulating is to weaken or destroy certain "upper partials" or overtones, which would otherwise give a harsh quality to the tone. This is done by pricking the felt with a needle-pointed instrument to soften the hammer near the point where it strikes the strings. This causes the hammers to remain longer on the strings, and secures the effect of dampening certain of the inharmonic overtones. It is a work that requires a most delicate ear, and the number of really first-class tone regulators in the country is very limited.

Veneering and Varnishing.—Not a little of the charm of a first-class piano lies in its inherent beauty considered as an object of artistic furnishing. The first-class makers recognize the necessity for bringing the form and finish of the piano up to the high level of its musical quality. The piano owes much of its beauty of finish to the art of veneering, and the world is ransacked in the search for fine veneers, mahogany being the most preferred, while rosewood, walnut, birch, English oak, and Hungarian ash are all largely used. The finest veneers are cut from near the root, or from the root itself. The body of the piano case is of quartered ash, and the veneers are all glued on in double thicknesses, the grain of one layer running transversely to that of the other.

The bringing forth of the latent beauty of the grain is due largely to the judicious use of staining; and a large amount of experimental research is always going on in the testing department of the Knabe works for new and more effective stains. Incidentally we might note that this testing department is unique in its way, for we believe that it is the only one of its kind in the world. Among its apparatus we find a Riehle 100-ton testing machine, for tensile and crushing strength of iron or steel; a sonometer, an ingenious machine for determining the breaking strain of steel wire, or the number of pounds strain necessary to pull any certain size and length of wire to a certain pitch or tone; an action-testing machine for testing the durability of felts, cloth, hammers, and other parts of the action; and numerous other devices, all specially built for the one purpose of determining what particular material is the best, and best suited to its particular function.

The varnishing is a slow and costly process, involving seven distinct coats and twenty-one processes. First a coat of varnish is put on with the brush. The brush marks are then rubbed out with pumice stone, the pumice-stone marks by rotten stone, and finally the rotten-stone marks by the hand, there being no polishing agent to equal the human skin. These steps are successively carried out for each of the seven coats; after which the case presents the desired grain and luster.

The finished piano is now subjected to the final examination and test, and as a matter of fact passes through the hands of five different inspectors, after which it is ready for the showroom. The construction of a piano at the Knabe works takes from six months to two years, according to the style and design, the time being reckoned from the day when the rough lumber is taken from the stack to the wood mill. The finished product embodies all that careful attention to details of design and workmanship, and that distinctive singing quality of tone, which, as we have seen, are the qualities aimed at in the production of this instrument.

## Saving "Fireproof" Safes and Their Contents After the Great Fire of San Francisco.

BY ARTHUR INKERSLEY.

Since the great fire of San Francisco burned itself out, the safe experts have been the most important persons in the ruined city. The financial existence and commercial future of many individuals and firms depended upon the contents of vaults or safes warranted proof against any assault of man or the elements. As soon as circumstances permitted, safes were dragged out of the debris and allowed to cool. In many instances the eagerness of their owners proved fatal—the safes were opened before they had cooled sufficiently and, when air was admitted, the contents burst into flames. In other cases, the safes remained buried in the hot debris till their contents were baked and charred beyond recognition. The only chance to rescue anything from a safe buried in hot debris is to get it out as quickly as possible and to cool it by wrapping it in wet sacks or blankets. Then it is fairly probable that, on being opened, the contents will be found uninjured or not hopelessly ruined. But, if the safe is allowed to remain in the smoldering ruins, its contents are "cooked" and crumble into ashes as soon as the safe is opened and air admitted. Even coin is melted into a lump of bullion. A safe that looks all right outside, being neither cracked, dented, nor warped, may yet be "cooked" and its contents useless. If the books and records are burned, the owner may find himself ruined, whereas, if they are in reasonably good condition, he may be able to begin business again without any very serious loss.

It is sad to have to say that the San Francisco fire has demonstrated the worthlessness of many safes and vaults guaranteed by the manufacturers to be proof against burglars and fire. The manufacturers, dealers, and agents have in many instances been shown to have sold "fireproof" safes that were of little more value than wooden boxes, and the "fireproof" compositions with which they are lined might as well have been sawdust. It is to be sincerely hoped that the manufacturers of and dealers in these worse than worthless devices may be put out of business for all time.

Some of the "fireproof" vaults in office buildings have turned out equally valueless for the purposes for which they were intended. They had imposing steel doors, with locks, bolts, and elaborate combinations, but their backs were the walls of the building. The intense heat of the conflagration, the shock of the earthquake or the concussion of exploding dynamite brought the wall down and there was a "burglar- and fireproof" vault or safe without any back.

F. M. Smith, the "borax king," had three safes in a building at the corner of Sansome and Bush Streets. One of these, containing securities and diamonds, was found uninjured, but the papers and books in the other two were consumed.

The banks and safe deposit companies were, naturally, slow in opening their vaults and strong rooms, not wishing to jeopardize their invaluable contents by haste. In every instance their contents were found to be unharmed. Several of the companies opened their vaults on May 7 and the renters of safety deposit boxes were delighted to find their treasures intact. For many days previously they had been making anxious inquiries, but had been turned away by watchmen and United States soldiers. Some of them took out the money or jewelry contained in the boxes, while others, after poring over their treasures for a little while, put them back again, feeling that their keepsakes and valuable documents, after passing safely through such ordeals as the earthquake and fire, were secure.

In one bank on Market Street the safe deposit boxes were unharmed, but a large vault, extending under the sidewalk and the floor of the bank, was broken by the wall from a neighboring building that fell upon it, crushing the ceiling of iron and cement and allowing ingress to the flames. In this vault were stored silver plate, laces, and other valuable articles, too bulky to be placed in the steel boxes. Many of these articles were in large tin boxes or even in trunks and suit cases. They were ranged on iron shelves, from which they fell and became a prey to the devouring flames.

On the same day (May 7), only seventeen days after the fire died out, the American National Bank resumed business in the quarters that it occupied previously in the ground floor of the Merchants' Exchange Building on California Street, being the first banking corporation to return to the old business center. The building was swept by flames and all the combustible material in it was consumed, yet in less than three weeks a bank was able to open again in it. It proves how rapidly a modern steel and concrete earthquake- and fire-proof structure can be refitted for use. On the opposite side of the main entrance the San Francisco National Bank resumed operations a few days later.

### Preservation of Records from Fire.

Prof. Edmund O'Neill, dean of the College of Chemistry at the University of California, offers some suggestions to persons whose records may have been destroyed partially by fire. He says: "The destruction of organic matter by fire is dependent upon two points—increase of temperature and the presence of air or oxygen. If excess of air be present on the elevation of temperature to igniting point, the whole mass will burn up completely. If the air is kept out, but an elevated temperature is maintained for some time, the paper will be slowly destroyed. Volatile matter is given off and finally the residue of carbon, more or less pure, is left behind. This carbonaceous residue is very friable and difficult to handle. The temperature of decomposition is not very high and varies according to the quality of paper. It begins below 300 deg. F. and becomes more rapid as the temperature increases. But a comparatively low temperature long continued will destroy the paper as effectually as a higher temperature.

"The safety of paper inclosed in so-called 'fire-proof' safes depends upon the heat insulation, and the more non-conducting and the thicker the layer of fire-proof material the longer it will take to transmit the heat to the inner chamber. But if the safe is covered with hot or glowing material, it is simply a question of time when the heat will be transmitted into the inner chamber and cause the paper to decompose. The sooner the safe can be removed from its hot bed and cooled to normal temperature, the better it is for the papers contained therein. The better the safe the more slowly it will cool, and such safes should be left much longer before opening than the small and poorer ones. If air be admitted before the temperature has sunk below the point of ignition, the papers will take fire instantly when exposed to a current of air. The temperature of ignition is about 300 deg. F., and, if it is not certain that the interior of the safe is cooled below that temperature, it will be dangerous to open it. The cooling may be hastened by the withdrawal of the safe from its hot bed. Covering it with sacks or cloth or other porous material and pouring water upon it will also hasten the cooling to a great degree. The ignition may also be stopped by preventing the access of air, but methods for doing this are cumbersome. Steam from wet sacks would probably be the most efficient agent to prevent the access of air. When the interior of the safe is cooled below the igniting point, there is no danger in opening and removing the documents.

"If the paper be charred so that the writing is apparently illegible, the sheets may be removed one by one and laid on plates of glass. Frequently the writing may be read by holding the sheets at a certain angle so that the reflection of light from the inked surface is distinct. The legibility is sometimes increased by moistening the paper with water. Chemical methods of rendering the writing visible may be employed in some cases.

"Inks are of two classes—those in which metallic salts are used, and those in which organic coloring matters, mainly anilines, are employed. Inks of the first class are usually tannates or gallates of iron or logwood bichromates. Many methods have been tried in the laboratory of the University of California to cause the residues to assume a different color from that of the carbonized paper. The most successful results have been attained by brushing the paper with a diluted solution of hydrochloric acid. Subsequent brushing with a solution of potassium ferro-cyanide has sometimes proved effectual. Other reagents that have produced good results in particular cases are tannic acid and ammonium sulphide. It is intended to try the effect of X-rays and Becquerel rays. It is possible that they may prove successful. The problem is a complicated one, the composition of inks being so varied and the qualities and textures of paper so different. Then, the temperature and the time are not always the same, so that the procedure must vary according to circumstances. In some cases the writing is brought out very clearly, while in others the same method is not at all successful."

The importance of the safe expert is shown by the fact that the first business place set up on Market Street, San Francisco, after the fire was that of "Hughson & Merton, Representing Eastern Manufacturers," and of the "G. W. Emmons Company, Safe-Moving and Draying." The establishment consists of a rough wooden shack and a khaki tent set up on granite blocks a few feet from the car tracks.

### San Francisco Notes.

The sub-committee on history of the Committee of Fifty has intrusted to Prof. Henry Morse Stephens, of the University of California, the task of compiling an accurate and complete record of the San Francisco earthquake and great fire and of the relief work necessitated thereby. Mayor Eugene E. Schmitz, of San Francisco, has given an order that all the official documents be turned over to Prof. Stephens, and has asked Gen. Frederick Funston, commanding the Department of California, and the military authorities to co-operate with him in preparing the papers.

Prof. Stephens proposes to divide the history into three sections, devoted respectively to the earthquake, the fire, and the relief work. The history will end with the restoration of normal conditions and the beginning of the projected rebuilding of a greater San Francisco. Prof. Stephens will be assisted by C. H. Parker and D. E. Smith, readers in the history department of the University of California. Mr. Parker will collect the data, with copies of official proclamations and orders, and Mr. Smith will segregate and catalogue them. Both will have the help of several deputies.

A. C. Lawson, professor of mineralogy and geology at the University of California, is making an investigation of the movements and effects of the earthquake, gathering the personal opinions of various officials on duty during the disaster, and commenting on the manner in which affairs were managed during the period immediately following the catastrophe. Prof. Lawson's contribution will be added to the general history.

A large deposit of clay has been discovered in Monterey County, California, from which can be manufactured an absolutely fireproof brick. A house built of these bricks cannot catch fire from the outside and flames inside are quenched by a vapor that rises from the brick when heat is applied to it. The brick is an excellent non-conductor, and remains cold an inch be-

low the surface while a hot flame from a gasoline torch is directed against it. Experiments have been made with the new brick, of which a report has been presented to the Merchants' Association of Monterey. The deposits of clay from which the brick is made are very extensive and the brick can be manufactured cheaply.

The Merchants' Association will conduct further experiments, and, if the bricks prove to be satisfactory, the building of fireproof structures will be revolutionized.

One of the remarkable incidents of the great fire of San Francisco was the immunity from damage of an old wooden shack owned by the American Marine Paint Company at the corner of Main and Harrison Streets. The ramshackle, half-century-old building stands unharmed, a little island in a sea of desolation. It reeks with oil and is filled with highly inflammable materials. Quite near to it a great pile of coal caught fire and burned for nearly a week. The officials of the company felt so certain that the place had fallen a victim to the devouring flames that they did not even attempt to visit it until two weeks or so after the conflagration, and then it was mere curiosity to see what the ruins looked like that led them there. Their astonishment when they saw their oil-soaked wooden store standing unharmed amid the ruins of "fireproof" buildings can easily be imagined.

### California Fruit as Affected by the Earthquake.

The writer has made careful inquiry concerning the present prospects of the California fruit crop, and the response to each inquiry is to the effect that the recent convulsion will not diminish its value by a single dollar. The only considerable locality where fruit was the leading commercial interest was in the Santa Clara Valley, where the property losses were large, but fruit suffered no injury whatever. Apricots, the earliest fruit to ripen, will not be in large supply this year on account of climatic peculiarities, the result of too abundant rains, unseasonably prolonged. Cherries, at the present moment, are in splendid condition and the prospect, barring future eventualities, is most excellent. Plums, should every indication be fulfilled, will be in larger supply and better in quality than for many years. In each of these fruits, now in an advanced stage, a careful inspection of the orchards over a wide area fails to show that a single apricot, peach (also in large prospective supply), cherry, or plum, was shaken from the branches by the shock which prostrated some of the finest and largest buildings in every community where its violence was greatest. It is yet too early to make observations on the future of the grape crop. It is invariably the rule in European countries, that "an earthquake year always assures a full vineyard," and if the rule proves good in California, the grape crop of the present year should prove a phenomenal one. A competent authority estimates the quantity of wine consumed in the late San Francisco fire as exceeding 20,000,000 gallons, or nearly one-half year's production, mostly of old, high-quality wines; therefore there will be demand for every gallon which the vineyards can produce. The excellent prospect in every agricultural product is distinctly encouraging to the State, though many months must elapse before mercantile interests will benefit from the new supplies.

### The Current Supplement.

The current SUPPLEMENT, No. 1586, opens with an article on the damage sustained by the Leland Stanford, Jr., University during the recent earthquake. Very striking pictures accompany the article showing the condition of the University buildings before and after the catastrophe. Some simple tests for the detection of food adulterants are published, which will enable the housewife to ascertain whether or not her provisions are pure. Mr. James P. Maginnis's article on Reservoir, Fountain, and Stylographic Pens is continued. An excellent article is published on the utilization of solar heat for industrial purposes by means of a new plane mirror reflector. A novel device for the making of curved stereotype printing plates for newspapers is described and illustrated. A new seating arrangement for street cars is described and illustrated. Mr. William L. Larkin presents a very complete account of concrete mixing machinery. A scientific account of the San Francisco earthquakes is published.

### Paper Gas Pipes.

An interesting employment of paper relates to the production of gas pipes. Manila paper cut in strips, of a width equal to the length of the pipes to be made, is put in a receiver filled with fused asphalt and rolled solidly and uniformly around a rod or core of iron until the desired thickness is obtained. After the pipe thus produced has been submitted to strong pressure, the exterior is covered with sand and the whole cooled in water. The core is removed and the outer surface covered with a water-proof product. These pipes, it appears, are perfectly tight and more economical than metal pipes.—Rev. de Chimie Industrielle.

## Correspondence.

### Spontaneous Combustion.

To the Editor of the SCIENTIFIC AMERICAN:

A curious case of spontaneous combustion came under my notice a few days ago. A number of matches which were lying loose upon a shelf ignited and burned without apparent friction or contact with a flame of any kind. The day, March 30, about 11 A. M., was foggy and cloudy. I was seated with my back toward the shelf, when I suddenly noticed a flash not unlike that which takes place when a large lamp is lighted, and on looking around I saw the matches blazing on the shelf.

Had this occurrence taken place at night among papers, or in some person's pocket, it might have been the origin of one of those unaccountable fires which appear to be unpleasantly prevalent. Of course, spontaneous combustion is neither novel nor always unexplainable, and possibly may occur more easily with matches than with other articles. This appears to prove, however, that matches should be packed and handled with greater care than is usually given to them.

At the time that the case I mention took place, there was no fire near the shelf, nor anything on the same that would appear to be capable of causing friction. Is it possible that the ignition was due to an atmospheric cause, or could it be owing in any way to the chemical composition of the match or matches which ignited first?

This seems to me to be a rather serious question for fire insurance companies, as well as factory owners and householders generally. Matches should be handled with far greater care than is usually the case, and should, for instance, be kept entirely out of reach of children. I am convinced from what I saw in this case that certain kinds of matches at least are extremely liable to be ignited spontaneously.

East Orange, N. J. WILLIAM DEWART.

### Fertilizing Power of the White Ant.

To the Editor of the SCIENTIFIC AMERICAN:

Your article of February 17 last regarding the fertilizing powers of the white ant is correct. I left Montpelier, Idaho, in 1887, and since then have lived among the natives of this African east coast. Every season I have seen the wonderful effects the white ant hill produces on the Kafirs' maize and corn. Whenever there happens to be an ant hill in their gardens, its immediate vicinity can be at once distinguished, as the maize and corn are fully double the size of the surrounding crop. The statement that some parts of the country are uninhabitable on account of the white ants is incorrect so far as this vicinity is concerned, as they are easily prevented from entering buildings, and do not attack green crops to any extent. The bush country a few miles from this place is swarming with white ants, and has also a large native population, and my experience is that the ants do more good than harm if necessary precautions are taken with buildings.

REG. SPRINGLE.

Mbabane, Swaziland, South Africa.

### Earthquake at the Home of Luther Burbank.

BY ENOS BROWN, CALIFORNIA CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Nowhere in the limited area to which the late California earthquake was confined were the terrific destructive powers of the convulsion manifested with greater violence than at Santa Rosa, the capital of Sonoma County and one of the most beautiful rural communities in the State. Santa Rosa has been the home of the most wonderful of horticulturists for over thirty years, and the scene of all those remarkable developments which have, in recent years, astonished naturalists throughout the civilized world. Notwithstanding the appalling catastrophe which has brought misery and misfortune to many friends and neighbors, the renowned scientist welcomed the representative of the SCIENTIFIC AMERICAN with great cordiality, and proceeded at once, to the exclusion of all other subjects, to talk upon the strange features of the shock as exhibited under his own personal observation. "I arose at 5 o'clock, as invariably my custom," said Mr. Burbank, "and was looking out of my window at the moment the shock began. A great spreading elm tree in the back yard seemed trying to uproot itself, and swayed in every direction. First the branches turned half way around to the right, and then reversed in the contrary direction; again the great tree marched toward the east, and then back to the west. The trunk then appeared to rise from the ground and try to eject itself from the earth, and did not cease from its extraordinary motions until all movement of the ground had stopped. I then rushed into the garden, and naturally expected that a terrible scene of destruction would meet my gaze, but to my amazement not the tenderest leaf or the most delicate plant had been broken. Not even a single pane of glass in any of my greenhouses suffered from fracture, neither had a solitary flower-pot been thrown from the shelves, yet within two blocks of my house, right in sight, a mile of the most substantial brick buildings in the county had been prostrated to the ground and were a few minutes later in a blaze. The beautiful court house was all but destroyed, while hotels, business blocks, theaters, and many private dwellings shared in the common ruin, all this happening in a space not exceeding one and one-quarter minutes.

"The first shock came from the west and then turned and came back from the east, afterward appearing to twist around in a circle, racking the buildings and involving them in utter destruction."

Not a brick or stone structure in a space 3,000 feet in length and 600 feet wide escaped destruction; the heart of the city was involved in a minute and one-quarter in total ruin. Strangely enough, frame buildings, those even of the lightest construction, were comparatively unharmed, suffering no greater damage than from broken plaster or breakage of rotten timbers. The financial loss to the beautiful city will reach from $3,500,000 to $4,000,000 but a more dreadful consequence was the fatality attending the catastrophe, which cannot be accurately determined. Seventy-eight bodies were recovered. Had Santa Rosa been the only locality involved in the catastrophe, the loss of life and property would have caused it to have been recorded as the most terrible earthquake visitation known to the history of the State; but, overshadowed by the tremendous upheaval at San Francisco, the magnitude of the Santa Rosa cataclysm is almost lost to sight.

The work of rebuilding is now proceeding in energetic fashion, and a different aspect than at present afflicts the spectator will soon be presented. Hundreds of workmen are busily engaged in erecting one, two, and three-story buildings, and it will not be many months before all visible signs of the disaster will have vanished. Every hotel of any pretension—and there were a number of them—was either destroyed by the shock or by fire, but the proprietor of one was equal to the emergency. The new St. Rose is the first to rise from its ashes, not as a structure of brick or mortar as before, but in the shape of a great tent, capacious enough for 250 bedrooms and fitted with every appurtenance of modern travel and comfort, with the added novelty of perfect ventilation and safety from seismic disturbances. The energetic citizens have determined on a new plan for their city, in which wide streets will be a prominent feature.

### AN AUTOMOBILE SCHOOL.

The remarkable development in the automobile industry, and the swift advances in automobile construction within recent years, have produced unexpected and unforeseen conditions, and one of the most striking phases in the situation is the lack of men trained to manage and care for the high-powered cars which are being turned out of the factories by the thousand here and imported from abroad. The high salaries that have been offered for drivers and experts, and the pleasant character of the work itself, have attracted the attention of young men of all classes, and hundreds of these have applied to factories and garages with offers to work without compensation merely in order to acquire mechanical training in this line. The superficial automobile engineering education thus obtained has been accepted on the principle that a half-trained chauffeur is better than none at all. Manufacturers of popular cars have estimated that three-quarters of the troubles reported to them by automobile owners are the results of inefficient handling rather than of inherent defects in the mechanism; and to-day the selection of a driver has become almost as important as the choosing of the car. It was to relieve this condition that the New York School of Automobile Engineers in New York city was incorporated, and Prof. Charles E. Lucke, of the Department of Engineering of Columbia University, was invited to plan courses and to supervise a general scheme of instruction that would give thorough training in the principles involved in the construction and handling of automobiles of all types, as well as in the solution of the many practical problems confronting the chauffeur. That the plan of the school has been successful in attaining the object for which it was designed, is attested by the fact that of over a hundred students who have completed the course, none has failed to give satisfaction to his employer.

The building occupied by the school is equipped with shops and laboratories that cover the entire field, and students are accepted for the eight weeks' course only after an examination that proves sufficient ability to grasp the work. Various departments of the school are illustrated in the accompanying engravings.

The men are formed into graded squads of from twelve to fifteen each, and the course is divided into five departments, which include lectures and recitations, practice in the workships, and the study of transmissions and engines, of carburetion and lubrication, and of ignition. The men pass through this cycle four times a week. Various other phases of automo-