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## THE MANUFACTURE OF THE HAMMOND TYPEWRITER.

Prominent among the many industries which have grown to large proportions within a comparatively short space of time is that which is devoted to the development and manufacture of the typewriter. This most useful, we might say indispensable invention, which was at first regarded as nothing more than an interesting toy, now gives employment to many thousands of operatives, and entails a heavy investment of capital in numerous large and thoroughly equipped factories. While the various forms of the typewriter, and its busy "click," are familiar to our readers, its internal construction, and the infinite care and nicety of adjustment that enter into its manufacture, may not be so well known. We present in this issue a series of cuts which serve to show the leading details of the well known Hammond typewriter, and the various processes which are adopted in its manufacture.

The Hammond is known as a "typewheel," as distinguished from the "typebar" machines. In the latter, the type is attached at the ends of a series of bars, which are pivoted in a circular frame, each bar carrying one letter and making its own impression upon the paper, which is placed centrally within them. In the Hammond the position is reversed, the type being cast in one integral piece, called the type shuttle (Fig. 4), which is oscillated horizontally upon the outer circumference of an annular ring, called the anvil (Fig. 6), the desired letter being brought into position in front of a hammer which, under the impulse of a spring, drives the paper against the type. The primary object of this arrangement is to secure perfect alignment and an uniform impression.

The first object is gained by arranging centrally and rigidly within the machine a solid steel wheel, or annular disk, called the anvil. This is held in position by a central vertical shaft or pin, which snugly engages an accurately drilled hole in the transverse bar of the anvil. On the outside of this wheel and fitting snugly against its face is a vulcanite shuttle (Figs. 4 and 6), upon which is formed (Fig. 4) the whole of the type which is to be used. On the inside the shuttle is provided with a thin steel web, which is passed

(Continued on page 151.)

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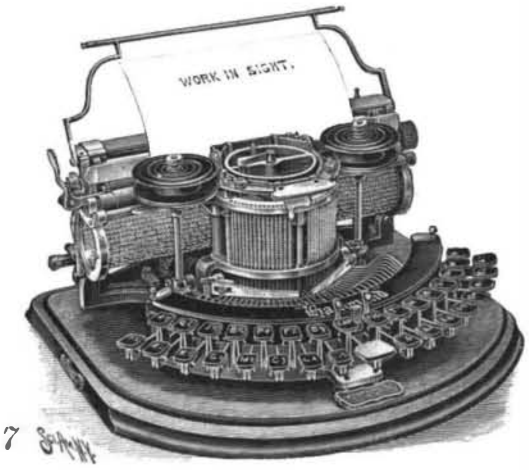


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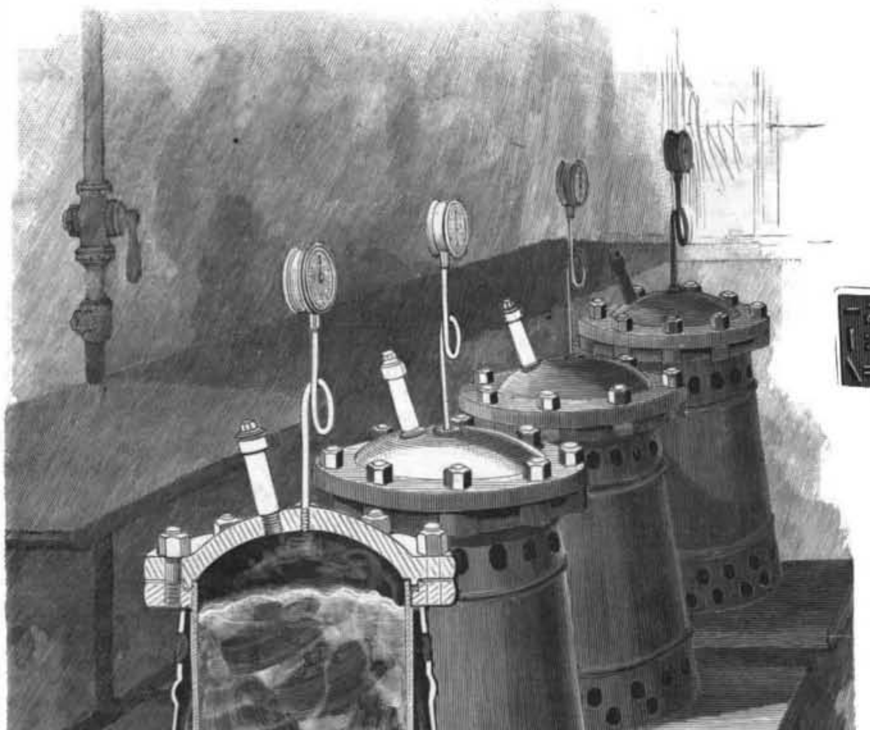

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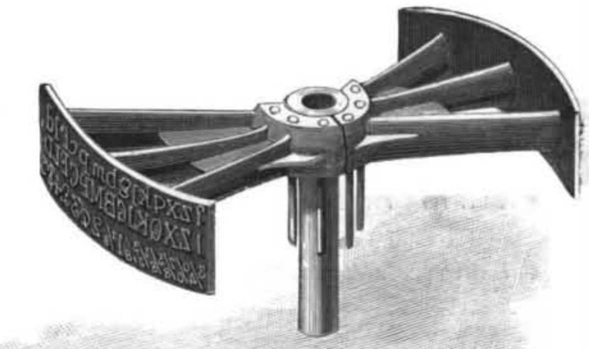

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1. Marking the location of the type. 2. Steel wheel, with type engraved. 3. Vulcanizing plant. 4. Vulcanite shuttle, showing steel web. 5. Original form of shuttle, in two parts. 6. Detail view of type bar and hammer mechanism. 7. The Hammond typewriter complete.

THE MANUFACTURE OF A TYPEWRITER.

## THE MANUFACTURE OF THE HAMMOND TYPEWRITER.

(Continued from first page.)

through, and slides freely within, a horizontal slot, which is cut through the anvil and provides an accurate horizontal guide for the shuttle.

A shuttle arm, B, is provided, which is pivoted upon the same central shaft as the anvil, and by means of a vertically projecting pin at its outer end engages the above mentioned shuttle web. The inner end of the shuttle arm extends beyond the anvil wheel and slides freely upon a circular frame, which is perforated with as many holes as there are vertical lines of type in the shuttle; the relative distance between these holes corresponding, with the very greatest accuracy, with the horizontal distance between the separate type on the type shuttle. Working vertically in these holes are a series of index pins, C, which are held down upon the keybars, D, by spiral springs. Returning to the shuttle arm, B, it will be seen that, just to the rear of the pin upon which it rotates, it is provided with two slots, one on each side, which are engaged by two vertical arms which receive their motion from the key bar, D, through the arm, F. The action of the machine is as follows:

The depression of the bar, D, raises the corresponding index pin, C, and also lifts the arm, F, which drives the above mentioned vertical arm forward and thereby turns the shuttle arm, B, round until it is arrested by said pin, C. The proper letter on the shuttle is now in position for the impression, and the further depression of the bar, D, raises the lever, E. The further end of this lever depresses the piece, G, which actuates a pawl and ratchet arrangement for releasing the impression hammer. The hammer is impelled by a coiled spring against a rubber impression strip, which presses the paper against the type on the shuttle. The tension of this spring, and, consequently, the force of the blow, is regulated by a suitable screw. Upon releasing the key bar, D, all the parts return automatically to their normal positions.

It will be seen that the perfect alignment of this machine is dependent upon the absolute level of the horizontal slot, which serves to guide the shuttle web—upon the exact location of the hole in the web which is engaged by the shuttle arm—and upon the true relation of the letters on the type shuttle to the index pins which serve to arrest the shuttle at the proper place for impression.

The peculiar type of the Hammond machine, and the great accuracy aimed at, have necessitated the establishment of a special plant, which possesses features of great interest. The desired type (which is of great variety, including many of the foreign alphabets) is first engraved upon a steel wheel (Fig. 5). As the location of the type on the wheel is a matter of the greatest nicety, a special tool, shown in Fig. 1, has been designed for the purpose.

This consists of a circular plate (Fig. 1) upon which is arranged a central raised disk, provided with an arm which reaches to the outer periphery of the plate, the disk with its arm rotating concentrically upon the plate (Fig. 1) at its periphery. The plate is perforated with holes corresponding to the index holes in the typewriter, and the arm is provided with a pin, by which it can be held in a position corresponding to the letter whose place on the steel wheel is to be marked. The wheel is placed on the center disk, and as the projecting arm is shifted to the successive holes, the operator marks with a scriber the position of the type on the wheel. The accuracy of this machine is said to be gaged to $\frac{1}{1000}$ of an inch.

A type metal matrix is then formed from the engraved wheel. The segments of this matrix are arranged around the inner circumference of a circular mould, and strips of a special composition of rubber are forced into them. The thin strip of steel, which forms the shuttle web, is pressed into the rubber, and the moulds are then clamped up and placed in the vulcanizers (Fig. 3), where they are subjected to a heat equivalent to a pressure of 100 pounds to the square inch. The vulcanizer consists of a steamtight drum, provided with a detachable cover. Water is placed in the drum, together with the articles to be vulcanized, and the desired heat is obtained by a Bunsen burner as shown. When this process is complete the vulcanite shuttle, with its thin steel web in place, is taken out and placed in the same machine (Fig. 1) in which the steel wheel was engraved, for the purpose of stamping out the hole, shown in Fig. 6, by which it is engaged by the shuttle arm, B. This, again, is a matter of the greatest nicety, as the slightest variation of this hole to the right or left of its proper position relative to the type would throw every letter out of truth. This relative position is found by means of a die and plunger. The plunger is a permanent fixture upon the bottom plate, and points to the center of the plate. The shuttle is placed on the raised disk upon which the steel wheel was previously cut, and turned around until the plunger is opposite the letter I of the type. This brings the steel web into its proper position beneath a punch, which cuts the desired hole. It will thus be seen that the all-important matter of the location of this hole is rendered very exact.

This great accuracy of manufacture, combined with the fact that the type is successively presented for impression at a common point and from a common center, and that the impression blow is delivered by one and the same hammer and with a constant momentum, secures that perfect alignment and evenness of print for which this machine is justly celebrated.

To change one type shuttle for another, the anvil is raised until the type shuttle web clears the end of the shuttle arm, when the web of the shuttle can be drawn forward out of the groove in the anvil and another shuttle put in place. As each shuttle contains a complete alphabet, the variations that are possible are very numerous. The Hammond Company show a specimen of work in thirty-seven styles of type and in fourteen languages.

An interesting feature of the machine is the fact that, if a customer should require some letter on the shuttle changed, a shuttle is cast with a raised blank in place of the particular letter, and the new character is engraved thereon.

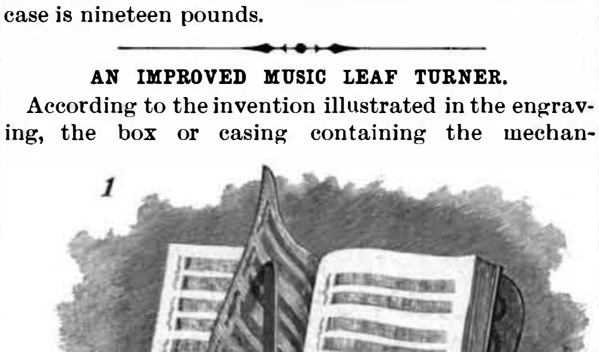
The Hammond machine is furnished with either the "Ideal Keyboard," which is the type recommended by the makers, or, if preferred, with the "Universal Keyboard," in which the keys are arranged as in other well known machines. In the Ideal Keyboard, as shown in the attached cut, the keys are arranged in circular form, in two banks, the letters most frequently in use being arranged under the right hand and near the center of the board.

To enable the operator to see his work the circular frame surrounding the anvil, which holds the typeshield, J, and the ribbon, is arranged so that it can be temporarily depressed, rerurning to position again on being released. In this way the work is kept in sight, and the lifting of the body of the machine is avoided.

In cut No. 5 is shown another form of shuttle. It is in two segments, and each segment carries one-half of the type. The two right and left vertical lever arms each engage one of the segments. This was the earlier form, the single shuttle being a later development. The total weight of the machine with its traveling case is nineteen pounds.

## AN IMPROVED MUSIC LEAF TURNER.

According to the invention illustrated in the engraving, the box or casing containing the mechanism by which the leaves of music may be readily turned is adapted to be placed upon a piano or other instrument, the leaf-turning arms before commencing to play being adjusted between the sheets, as shown in Fig. 1, when the leaves may be turned in succession by touching the lever at one side. The improvement has been patented by P. H. Adams, of Osorno, Chile. The casing has a cover at one end only, and the leaf-turning arms are fulcrumed side by side on a cross rod, resting, when not in use, upon the open end of the casing. Attached to each arm above its pivot is a cord which passes over a pulley at the end of the casing and is then connected to a spring, the springs normally holding the arms in their lower or horizontal position. In the covered end of the casing is a shaft which carries a drum or cylinder, and on the end of the shaft is a pointer which moves over a dial plate, to indicate the number of leaves that have been turned over. Arranged spirally upon the cylinder, as shown in Fig. 2, is a series of pins, and in each end of the cylinder are openings corresponding in number and position with the pins, the right hand end of each opening being straight and its left hand end inclined or tapering. A lever mounted loosely on the shaft has an angular spring catch adapted to enter the openings, the catch, as the lever is pressed downward, engaging the shoulder of an opening and turning the cylinder the distance between two teeth, the lever, when released, being returned by a spring to its normal position, and carrying the catch backward to engage with the next hole. Locking arms or latch bars, adapted to be engaged by the pins of the cylinder, are fulcrumed in such relative position to the music leaf-turning arms that when the latter are elevated they press down the inner ends of the locking arms, maintaining the leaf-turning arms in vertical position, but as the cylinder is turned, on touching the lever, a pin lifts the rear end of a locking arm to release the leaf-turning arm, which is then, under its spring tension, carried to one side with the leaf of music, passing across the face of the sheet, smoothing it out and holding it in its turned position. Each time that the cylinder is turned to turn a sheet it is indicated on the dial, the shaft rotating with a step-by-step movement corresponding to the distance apart of the pins.



ADAMS' MUSIC LEAF TURNER.

## Emery.

Emery is one of the few valuable rocks not yet produced in important quantities in America. Large amounts are yearly brought from Turkey and the Greek Islands, where it has been quarried since history began. Its wonderful properties were no secret to the ancients, who used it for cutting and polishing; but their methods of working are not certainly known. Curiously, modern methods of mining this substance have made no progress, and to this day ledges of emery have been heated by huge fires and the hot rock cracked by douches of cold water.

During the middle ages, and for many years afterward, the properties of emery, while not forgotten, could not be utilized. The old art of working was lost, and ingenuity was unable to give useful forms to this intractable substance. It long defied every effort. Slowly, however, emery again came into use, first as a polishing and cutting powder, and later, in the form of small grains, was attached to fabrics like a sandpaper. Means were afterward found to cement and mould its small particles into wheels. Emery wheels soon came into use, their remarkable cutting properties proving at once the great industrial importance of the invention.

Years elapsed, however, before the emery millstone could be made; but, at length, this too was accomplished, and a practical emery stone was brought out in England. Later, Yankee ingenuity improved upon this and produced the present successful rock emery millstone, which is built up of large blocks of emery set in strong metal.

These millstones grind fast because the emery face is always sharp, and as they are not damaged by heat, they can be run at high speed.

Many new uses will doubtless be found for emery; but probably it can take no more important place than that of the emery wheel and the emery millstone, the one cutting and polishing in the shops the hardest surfaces and the other grinding the surface to any degree of fineness.

## Leather Belt Cross Section Needed.

This useful table shows what area of cross section of leather belt is needed to give various horse powers, with various arcs of contact on cast iron pulleys, at a belt speed of 3,000 feet per minute, the fastenings being single leather lacings.

From it, having decided on the thickness, the width may be determined, or vice versa, by simple division.

| ARC. | HORSE POWERS. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| Degrees. | Sq. in. | Sq. in. | Sq. in. | Sq. in. | Sq. in. | Sq. in. | Sq. in. | Sq. in. | Sq. in. | Sq. in. |
| 30 | 0·90 | 1·79 | 2 68 | 3·58 | 4·48 | 5·37 | 6·27 | 7·16 | 8·06 | 8·95 |
| 45 | 0·63 | 1·26 | 1·88 | 2·51 | 3·14 | 3·77 | 4·40 | 5·02 | 5 65 | 6·28 |
| 60 | 0·49 | 0·99 | 1·48 | 1·98 | 2·97 | 2·96 | 3·46 | 3·95 | 4·45 | 4·94 |
| 75 | 0·41 | 0·83 | 1·24 | 1·64 | 2·07 | 2·49 | 2·90 | 3 28 | 3·73 | 4·14 |
| 90 | 0·36 | 0·73 | 1·09 | 1·45 | 1·82 | 2·17 | 2·55 | 2·91 | 3·26 | 3·64 |
| 105 | 0·33 | 0·65 | 0·98 | 1·31 | 1·63 | 1·96 | 2·29 | 2·61 | 2·94 | 3·27 |
| 120 | 0·30 | 0·60 | 0·90 | 1·20 | 1·50 | 1·80 | 2·10 | 2·40 | 2·70 | 2·99 |
| 135 | 0·28 | 0·56 | 0·83 | 1·11 | 1·39 | 1·67 | 1·94 | 2·22 | 2·50 | 2·78 |
| 150 | 0·26 | 0·52 | 0·78 | 1·04 | 1·30 | 1·56 | 1·82 | 2·09 | 2 35 | 2·61 |
| 165 | 0·25 | 0·50 | 0·75 | 0·99 | 1·44 | 1·49 | 1 74 | 1·99 | 2 24 | 2·49 |
| 180 | 0·24 | 0·47 | 0·71 | 0·95 | 1·20 | 1·42 | 1·62 | 1·90 | 2·13 | 2·37 |
| 195 | 0·23 | 0·46 | 0·68 | 0·91 | 1·14 | 1·37 | 1·60 | 1·83 | 2·05 | 2·28 |
| 210 | 0·22 | 0·44 | 0·66 | 0·88 | 1·10 | 1·32 | 1·54 | 1·76 | 1·98 | 2 20 |
| 240 | 0·21 | 0·42 | 0 62 | 0·84 | 1·05 | 1·25 | 1·46 | 1·68 | 1·87 | 2·09 |
| 270 | 0·20 | 0·40 | 0·60 | 0·80 | 0·99 | 1·20 | 1·49 | 1·60 | 1·80 | 1·99 |
| 300 | 0·19 | 0·39 | 0·58 | 0·77 | 0·97 | 1·16 | 1·35 | 1·54 | 1·74 | 1·93 |