THE SEMI-AUTOMATIC PIANO-PLAYER.

The advance of civilization has brought with it a more numerous and critical music-loving public. At the same time, in the press of modern business activity, the man of musical tastes does not often have the opportunity or necessary time for mastering a musical instrument. Again, the beginner's appreciation of the art is often so advanced that his discordant and halting efforts are extremely painful to his sensitive ear. In fact, he must suppress his loftiest inspirations by a most mechanical system of scales and finger exercises before he can become even a fair player on such an instrument as the piano. However, necessity is the mother of invention, and the modern semi-automatic players have now come to the rescue by affording us all a ready means of playing the most difficult music with our own individual coloring and expression—this too without the necessity of any tedious preliminary practice. Such instruments are well known and already have their accepted place in the musical world. The principles on which wind instruments are automatically played are quite familiar to the general public, but we venture to say that few understand the workings of the semi-automatic piano-player, and we therefore take pleasure in acquainting our readers with the construction and important features of the Simplex piano-player which is illustrated herewith. A number of important patents on this piano-player have been granted to Mr. Theodore P. Brown, of Worcester, Mass., who is now manufacturing the instrument.

The Simplex piano-player is characterized by its simplicity of construction. One of our views shows the instrument in playing position against the piano, its striker rods being in position over the keyboard and its pedal lever connected to the loud or open pedal of the piano. The music rolls used are identically the same as those used on self-playing organs and the like, because the Simplex is a pneumatically-operated instrument. The music roll consists of a long sheet of paper provided with a series of perforations of such dimensions and locations as to co-operate with the mechanism of the player to produce the desired music. The sheet is passed over what is termed a tracker-board, which is shown at *B* in the illustrations. The tracker-board forms a mouthpiece for a series of tubes which connect with their respective pneumatics, *M*, to which the striker rods are secured. Each pneumatic, under spring tension, holds its respective striker-rod in raised position, but it is deflated and the rod forced downward whenever the vacuum of its respective tube is destroyed. An exhaust mechanism operates to maintain a vacuum in each tube at all times except when a perforation of the music-sheet, while passing over the mouth of the tube, admits air therein. The exhaust is maintained by a pair of treadles which operate the bellows, 6, shown in the rear view of the mechanism. These bellows suck the air from a wind-box, *A*, and a secondary bellows, 5, the latter serving to insure a steady suction and overbalance any irregularities in the operation of the bellows, 6.

A clear idea of the pneumatic operations may be had by a glance at the diagram, which shows a section through two of the pneumatics and their accessory parts. The music roll, *X*, is mounted on bearings at *S*, and the music sheet passes over the tracker-board, *B*, to the winding roll, *T*. The tubes, *C*, which have openings in the tracker-board, lead down to their respective primary chambers, 7, from which they are separated by flexible diaphragms. The air in these tubes is sucked into the wind-box, *A*, through small openings in the ventilating disks, *D*. A constant exhaust is also maintained in the primary chamber, 7, and the tubes, *G*, with which they connect. Normally the diaphragms assume the positions shown, and the

THE SIMPLEX PIANO-PLAYER IN PLAYING POSITION.

poppet valves, *E*, are forced downward by gravity and held in this position by the outside air pressure. Thus the tubes, *G*, are closed to communication with the outside atmosphere, but are open to communication with their respective chambers, 7. However, when air is

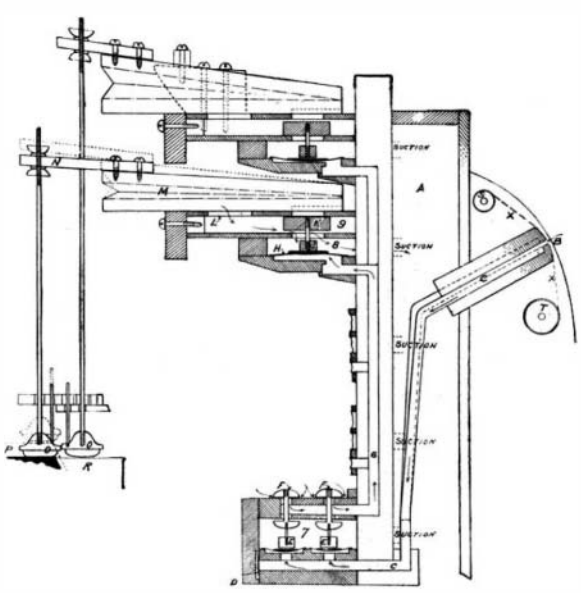


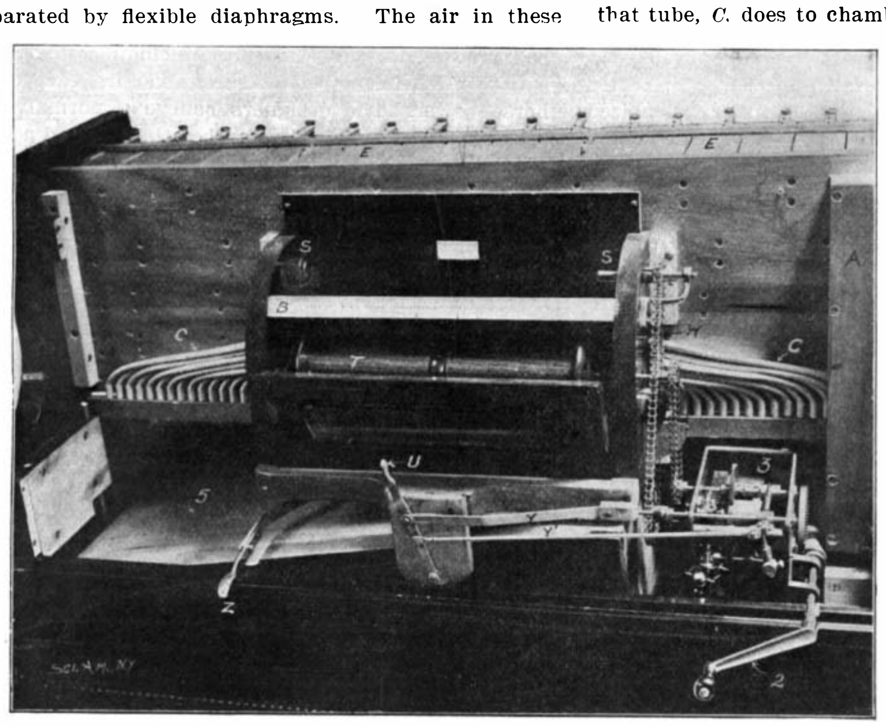
DIAGRAM SHOWING PNEUMATIC CONNECTION BETWEEN MUSIC ROLL AND KEYBOARD.

admitted through the tracker-board to tube, *C*, it flexes the diaphragms upward and thus raises the poppet valves which close the exhaust ports of tube, *G*, and admit air through the inlet port under disks, *F*. The tube, *G*, bears the same relation to the secondary chamber, 8, that tube, *C*, does to chamber, 7, so that when air is admitted therein, diaphragm, *H*, is flexed upward and the poppet valve, *K*, is raised, closing the inlet port of chamber, 9, and opening the exhaust port into chamber, 8. The pneumatic, *M*, is connected by port, *L*, with chamber, 9, and the secondary chamber, 8, is connected with wind-box, *A*, so that when valve, *K*, is raised, the pneumatic *M*, is suddenly deflated and the striker rod secured to the upper board is depressed and strikes the piano-key immediately thereunder. A padded button, *O*, is secured to the lower end of each striker-rod, so that no clicking sound is heard as the keys are struck. As long as any tracker-board opening is uncovered, its corresponding striker-rod will remain depressed, but as soon as it is closed, the diaphragm of the lower chamber, 7, and the valve, *E*, will drop to their normal positions, opening the exhaust port of tube, *G*, and closing its inlet port. The same thing takes place in chamber, 8; the diaphragm, *H*, and valve, *K*, drop down, closing the exhaust port of chamber, 9, and permitting air to flow into the pneumatic, *M*.

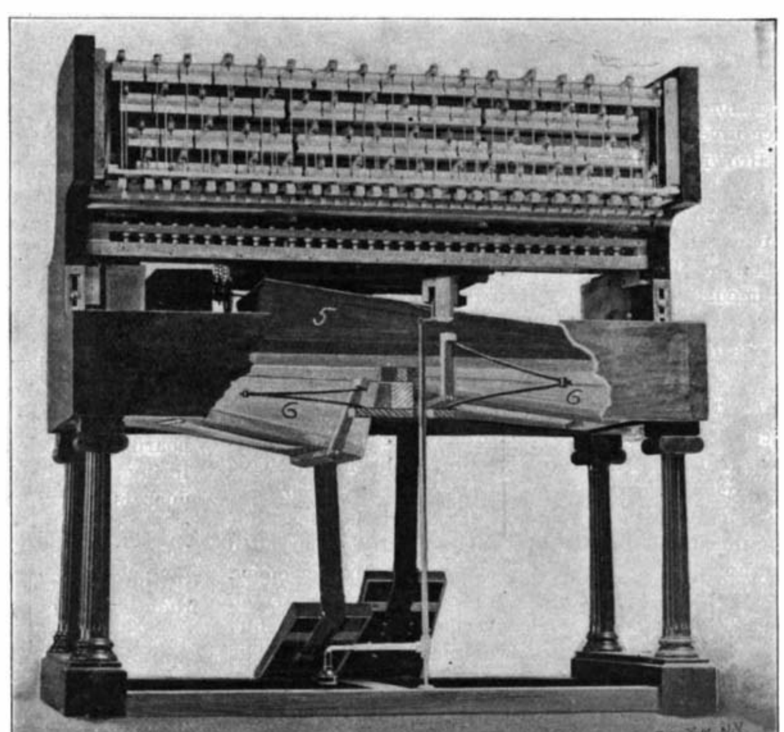
The internal and external air pressure being thus balanced, the pneumatic is free to rise under spring tension and release the finger-key of the piano. It will be noticed in the diagram and also in the rear view of the machine that the pneumatics are located in four tiers. This arrangement is necessitated by the narrowness of the piano keys, which would require the use of very narrow pneumatics where they are all arranged in a single row.

An important feature of the Simplex player, and one which distinguishes it from other instruments, is the mechanism which draws the music sheet over the tracker-board. This mechanism, which is shown at 3 in the front detailed view, is entirely independent of the rest of the machine, being operated by a heavy clock spring which is wound up by a few turns of crank, 2. The action of the motor is completely governed by the lever, *U*, to which two connections, *Y* and *Y'*, are secured. The connecting rod, *Y'*, regulates the speed of the motor. This is effected by means of a bell-crank, of which one arm is pivoted to the rod, *Y'*, and the other has frictional engagement with a disk. This disk is raised and lowered according to the speed of the motor by means of a pair of balls which are centrifugally actuated. By this arrangement it will be seen that the bell-crank arm is continually held in frictional contact with this disk, and that the speed of the motor can be accelerated or retarded at any time by shifting the lever, *U*, to decrease or increase the friction. The winding roll, *T*, is connected by chain and sprocket to the winding wheel of the motor, and the rewinding pin, *S*, is similarly connected to an idler which may be thrown into operation by the connection, *Y*, whenever it is desired to rewind the music sheet. The lever, *U*, has a pin-and-slot engagement with the connection, *Y*, so that the latter will not be shifted until the highest speed of the motor has been attained, when by moving the lever, *U*, to the extreme right two clutches are operated; one, connecting the winding sprocket with the power shaft, is disengaged, and the other, connecting the rewinder, is thrown into operation. The rewinder gearing is adapted to give a very rapid rotation to the music roll, so that very little time is consumed in re-rolling the music at the end of a piece.

With the foregoing details in mind we can clearly



MUSIC ROLL, WINDING MOTOR AND TUBES CONNECTING WITH THE STRIKING MECHANISM.



REAR VIEW BROKEN AWAY TO SHOW THE MAIN BELLOWS AND THE SECONDARY BELLOWS FOR OPERATING THE KEY RODS.

understand the method of operating the machine. The player is rolled up against the piano and properly positioned with its striker levers over the keyboard and the pedal lever set. The desired roll of music is now secured between the bearings, *S S*, and the end of the music sheet is passed over the tracker-board, *B*, and secured to a hook on the roller, *T*. The motor having been wound up, a slight movement of the key-lever, *U*, starts the mechanism and slowly draws the music over the tracker-board. The desired speed is now obtained by shifting the speed-lever. For the benefit of the beginner a celluloid strip is provided behind the lever, *U*, on which eight different speeds are registered and indicated by musical terms ranging from *largo* to *presto*. On the music roll the required speeds are printed, and by shifting the speed-lever to the positions called for, the proper tempo will be obtained. Open pedal effects are had by the lever, *Z*, which is operated with the left hand. The *piano* and *forte* effects are controlled by the operation of the pedals. The greater the suction in the wind box, *A*, the more rapid will be the action of the pneumatics and consequently the more vigorously will the keys be struck; a quick thrust of the treadle gives an immediate response. On the other hand, a slow movement of the pedals results in a sluggish action of the pneumatics, which produces a *pianissimo* effect. Directions are printed on the music roll to guide the beginner in these different shades of expression, but if he has a musical feeling, these directions are soon disregarded by the performer, and his own time and expression are unconsciously embodied in the music. Especially is this so with regard to the loud and soft effects, for even the most unmusical among us know how difficult it is to keep our feet still when listening to a thrilling march, and how listlessly we move when a dreamy waltz is played. This in crude form is what musicians term "expression" or "feeling." The Simplex piano-player makes use of this peculiarity, and employs the natural impulses of a performer to express his musical feeling.

We can therefore appreciate the importance of using an independent spring-actuated winding motor; and to this in large measure is attributed the success of the Simplex player; for by using a spring motor in place of the usual wind motor, the bellows may be made sensitive to sudden changes in force, thereby giving opportunity to express the music and phrase it as one would if playing manually. Players using wind motors are confined to a given tension of the bellows at all times; otherwise, the motor would change in speed as the bellows change in tension, the result being that they must obtain their expression through mechanical levers and resistance.

The Current Supplement.

The current SUPPLEMENT, No. 1394, is a number remarkable for the diversity of the subjects treated. M. Jacques Boyer has specially prepared for this SUPPLEMENT a review of the methods of making natural and artificial perfumes—a subject which has received but too little attention from the technical press. A paper on the chemistry of the protection of steel against rust and fire by concrete is one of exceptional value. Automobilists will no doubt read with interest a description of the Holden motor cycle. The very full illustrations and the exhaustive explanation of the various parts, give to the article a certain thoroughness which is not always characteristic of descriptions of motor carriages. "The Roman Galleys of Lake Nemi" is the title of an archæological article distinguished for its scholarliness of treatment. One of the greatest improvements in the transmission of messages by long-distance submarine cables since the introduction of the siphon recorder is the automatic relay translating device invented by Mr. S. G. Brown. The paper which Mr. Brown read before the Institution of Electrical Engineers, describing his invention, is reproduced in full. Particular pains have been taken to illustrate the paper adequately. Prof. Conklin's paper on the relation of the psychic life to the nervous system is concluded. Mr. Otto F. Hunziker begins a valuable series of papers entitled "A Review of the Existing Methods for Cultivating Anærobic Bacteria."

The Summer Complaint Bacillus.

Victor H. Bassett, of Johns Hopkins University, and Charles Duval, of the University of Pennsylvania, have discovered the germ of the disease which is popularly known as "summer complaint." After the death of his grandson, John D. Rockefeller donated $200,000 to found an institute of medical research in bacteriology. With the means provided by the Rockefeller fund, Mr. Bassett and Mr. Duval have been enabled to make their discovery. The germ is found to be the same as that which causes acute dysentery in adults.

Wireless Telegraphy Between Italy and England.

The Marconi Wireless Telegraph Company announces that it has received perfect messages at Poldhu, Cornwall, from Gibraltar and Spezia.

AN IMPROVED DRYING OVEN.

BY EDMUND S. SMITH.

For the benefit of chemists and others who desire a more convenient apparatus than the gas-heated air-baths commonly in use for drying precipitates, coal and coke samples, clays or any other substances requiring only a moderate degree of heat, a simple and easily constructed oven is described below.

The heating agent employed is the ordinary incandescent lamp, thus eliminating the troublesome "scaling" and "burning" of the common gas-heated oven bottom. Nor are cleanliness and durability its only advantages. The temperature obtained is practically constant, and there is no danger from overheating, a fault not infrequently found in direct-heated ovens when the gas pressure fluctuates. In the bath here described two 110-volt, 20-candle power lamps are employed. One lamp will heat the oven to 70 deg. C. (158 deg. Fahr.), while two lamps yield a temperature of 110 deg. C. (230 deg Fahr.). By the use of other sized lamps or by increasing their number, it is obvious that quite a range of temperature may readily be obtained.

In the oven made by the author, the box was 9½ inches high, 7½ in width and 6½ inches deep, cut and shaped in one piece from No. 28 galvanized iron and lined with asbestos. (See Fig. 1.) The edges of the iron on the front side are bent over for a distance of ⅝ of an inch, making a wide seat for the door. At the back of the bottom is a jog 3 inches high and 2 inches deep to carry the lamp sockets, as shown in Fig. 2, which is a side elevation of the box with the wall removed. The back wall is protected at *a* by soldering a strip of galvanized iron to the wall. This strip extends the full width of the box and is also soldered to the side walls, hiding the jog from all points of view except the bottom, which is shown in Figure 3. This strip is drilled with two ⅝-inch holes to carry the outer

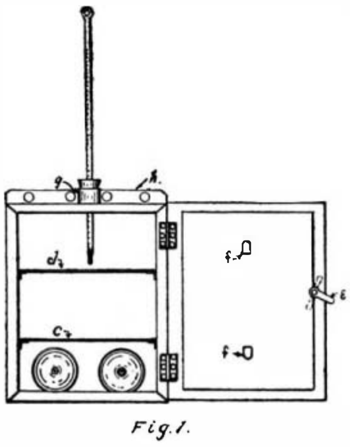


Fig. 1.

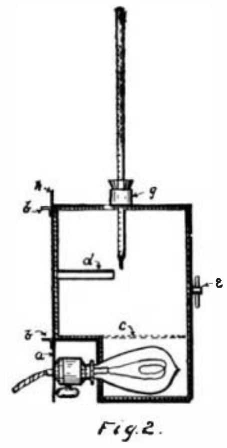


Fig. 2.

DIAGRAM OF IMPROVED ELECTRIC DRYING OVEN.

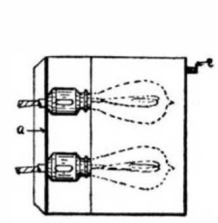


Fig. 3.

ends of the lamp-sockets, while the inner ends of the sockets are held in place by the lamps passed through the holes in the front wall of the jog, of just sufficient size to hold them securely. No rubber fittings of the socket must pass within the box-lining, since the heat within would soften them. The lamp keys are accessible from the bottom only.

As the bath is designed to hang upon a wall, the small angle-irons soldered to the back at *b b* furnish clearance for the lamp connections and at the same time afford protection against overheating the supporting room-wall.

The shelf, *c*, made of perforated sheet iron or coarse wire screen, is supported by small tin or galvanized iron angles soldered to the side walls. The upper shelf, *d*, is but 3½ or 4 inches wide and is drilled and slotted to hold funnels containing precipitates, etc.

The door is hung by small brass hinges soldered in place. (See Fig. 1.) The latch, *e*, carried by the rotating handle engages the door-seat when closed, tightly locking it.

When the box is completed it is lined throughout with asbestos board ¼ inch thick. If proper care be used in cutting, no rivets will be necessary, as the board is sufficiently stiff to support itself. The side-linings will hold the top in place. The inside of the door is covered with asbestos board, of just sufficient size to fill the opening inside the door seat. This board is held in place by two small clips, *f f*, soldered to the door. These pass through the asbestos and are then bent over to secure it firmly.

A small tube, *g*, soldered around a hole in the center of the top holds a cork carrying the thermometer, as in other drying-ovens. The box is hung from the drilled strip, *h*.

If a higher temperature than 110 deg. C. is desired, it is suggested that ¼-inch asbestos board be used for lining, as the loss of heat by conduction with ⅛-inch board is quite appreciable.

A Single-Phase Railway.

A contract has recently been awarded for the equipment of an important interurban road with alternating current apparatus throughout. The road in question is the Washington, Baltimore & Annapolis Electric Railway, which is to operate a line from Washington to Baltimore, about 40 miles in length, with a branch to Annapolis, 15 miles in length.

This contract marks a great step in advance that has long been awaited by engineers, both in this country and in Europe. In the ordinary method of operating street railways direct current is fed to the trolley line for the car motors. For city lines and densely populated districts, the current is often generated as direct current, but for long-distance interurban roads this would involve a cost of copper conductors entirely prohibitive. To meet the latter objection a system has been used thus far in this country involving the generation of alternating currents at high pressures of from 10,000 to 30,000 volts and the transmission of the same to substations, where by means of transformers and rotary converters the current is supplied to the trolley wire as direct current at the usual railway voltage from 500 to 650 volts. The rotary converter substation, however, has always been an undesirable feature, chiefly on account of the cost of the apparatus and building and the attendance required. The plans that have been proposed to do away with this feature are numerous, but before this, none have appealed to practical American street railway engineers.

In Europe the polyphase induction motor has been used to some extent, but it implies the use of two or three overhead wires, and, moreover, the characteristics of the induction motor in regard to starting and average efficiency in railway service are said to be not of the best. Other systems which have been proposed involve the use of single-phase motors upon the cars driving generators which in turn supply power to the motors on the axles. However, this involves the placing of a substation upon the car itself, and so cannot be considered a great improvement over the ordinary alternating current-direct current system.

For the road which is now being constructed between Washington and Baltimore, single-phase, alternating current will be generated in a main power house, located at Hyattsville, by three 1,500-kilowatt, single-phase, Westinghouse generators, delivering current at 15,000 volts and drived by cross-compound, Hamilton-Corliss engines. This station is of more than average size and is in no sense experimental. The power house will be built of brick with stone and concrete foundations, and will contain in addition two 125-volt direct-current generators to be used as exciters for the alternators and a large switchboard with electrically-operated oil switches, circuit-breakers, lightning arresters, etc. Current will be distributed from the power house at 15,000 volts to transformer stations located at suitable intervals along the line. These transformer stations will contain only stationary transformers with the necessary switches and fuses, but no moving machinery, and will, therefore, not require the presence of an attendant. From these stations current will be fed to the single trolley wire at 1,000 volts. The pressure of 1,000 volts which has been adopted for the trolley wire is not a necessary part of the system, as a much higher voltage could have been used if it had been deemed advisable by the engineers of the road.

The cars will probably be sixty feet in length and weigh about fifty tons each. They will be supplied with Master Car Builders' trucks designed for high speed. The track is laid with 80-pound rails, and it is expected that the distance of thirty-one miles will be made in forty-five minutes, including stops. The cars are to be equipped with four motors, each of 100 horse power. The designers believe a normal speed of forty to forty-five miles can be attained, and a speed of sixty miles reached when necessary. The motor, which is the novel part of the equipment and the key to the entire system, is a variable-speed motor having characteristics adapted to railway service and in all respects equal to the present direct-current railway motor. It has been developed and tested in severe service during the last few years by the Westinghouse Electric and Manufacturing Company, under the supervision of Mr. B. G. Lamme, assistant chief engineer.

It is to be remarked that this latest development in electric railroading follows in a path already traced by electric lighting. The first electric lighting systems employed direct current at low voltage, but as the area to be supplied increased, this involved an increased cost of copper cables. To meet the difficulty, alternating-current distribution at high voltage was adopted, with rotary converter substations, to enable the current to be distributed on the existing mains as direct current. However, most electric power plants now being installed distribute low-voltage alternating current directly to the lamps and motors, thus avoiding the expensive rotary-converter substations.

The results obtained on the first trials of this line will be awaited with interest.