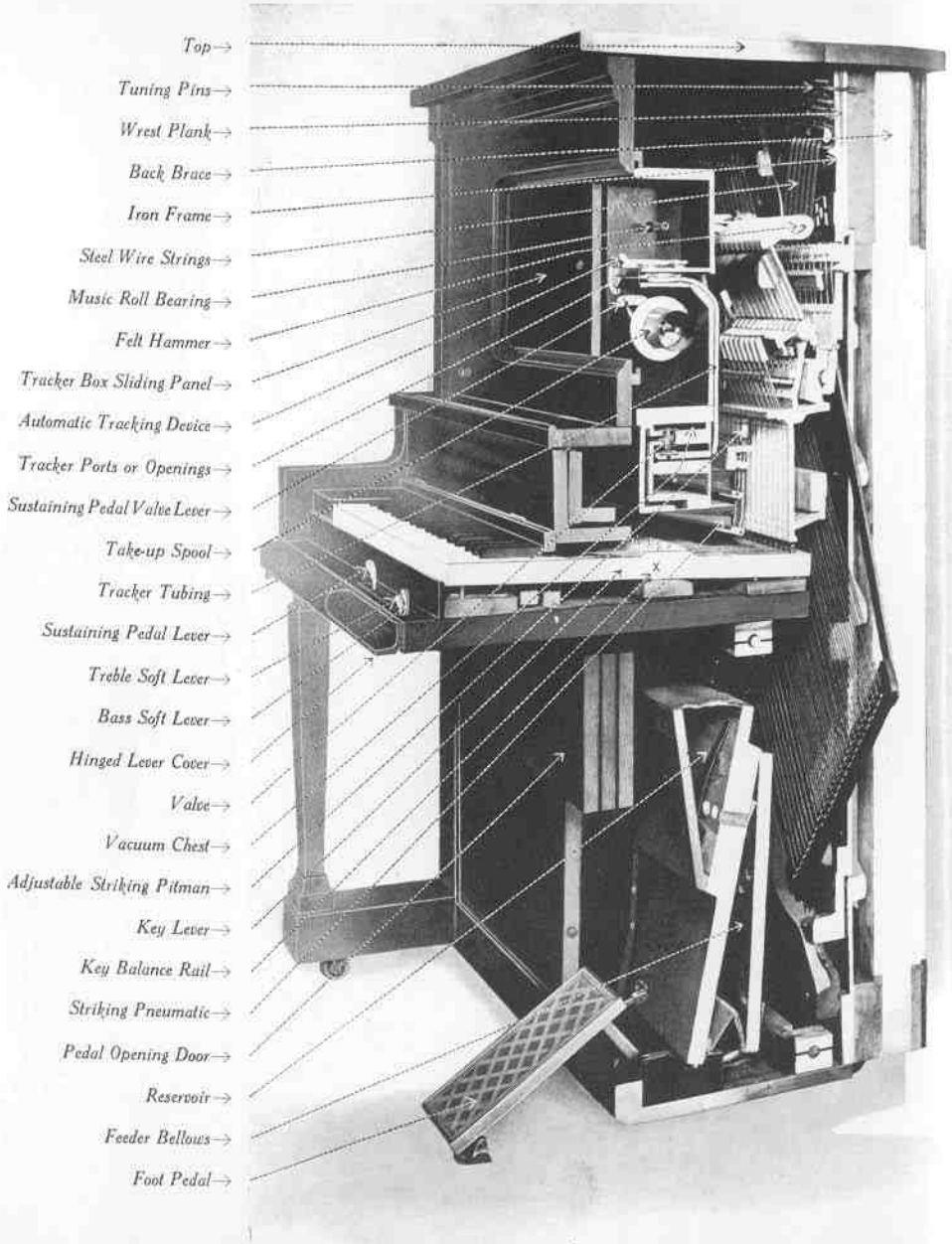

REBUILDING THE PLAYER PIANO

by LARRY GIVENS

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INTRODUCTION

TIME WAS in the United States when no home could really be considered complete without its player piano. From the early years of the Twentieth Century to the closing days of the Roaring Twenties, the player piano reigned supreme as the outstanding medium of home entertainment. Many were the parents who scrimped and saved so that their children might know of the finer things in life by having one of these marvelous instruments at their command.

Of course they were really family affairs. The old folks could pedal away at "Annie Lauric" and "Silver Threads Among the Gold" to their hearts content, after the youngsters had had their turn at the William Tell Overture and Paderewski's Minuet. Of course the younger set probably preferred to spend its time with rolls like the "Dill Pickle Rag" and "Moonlight and Roses," but only after they had absorbed their daily quota of culture would mother be likely to permit of such mundane listening.

During World War I when, as in all periods of crisis, entertainment of any variety was at a premium, the player piano

motor in proportion to the increase in the main supply bellows suction. If the player pianist pumps lightly, this would normally cause the air-motor to slow down—but the governor pneumatic expands, opening the sliding valve and allowing more suction to flow. In this way the suction to the

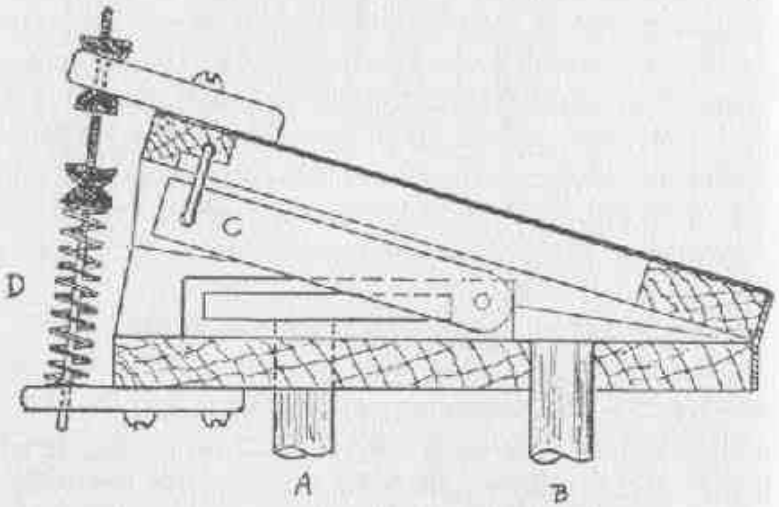


Fig. 5. An Air-motor Governor Unit

A—Channel from suction supply
B—Channel to air motor
C—Sliding valve
D—Adjustable spring

air-motor is always kept constant, regardless of the level of the supply vacuum.

Usually attached to the governor pneumatic is the tempo regulation device, which is simply a sliding valve which partially shuts off the flow of regulated suction, after it has passed through the governor, which operates the air-motor. The position of the sliding valve is determined by the tempo lever. If the music roll being played runs at a high tempo,

the lever is set to the prescribed position on the tempo indicator. This moves the sliding valve such that it allows most of the suction to reach the air-motor. If the tempo lever is set to a low value, little of the suction is allowed to reach the air-motor, thus moving the roll at a slow speed.

When the piano is rewinding, the action cutoff valve shuts off the flow of suction to the upper player action, thus preventing the piano from operating. In foot-powered player pianos, these cutoff valves are usually mechanically operated from the rewind-play lever, although occasionally a pneumatically-operated cutoff is found. Another valve opens a channel which bypasses the governor pneumatic, making the air-motor rewind the roll at a high speed.

The apparatus in the lower part of the piano supplies the necessary suction to operate the player mechanism. Each foot pedal has its own pump bellows, to which it is connected by linkage. When a pedal is pressed, one of the pumps opens, drawing air from the pneumatic stack into it. When the pedal is released, the air with which the pump has filled itself is expelled into the atmosphere. This is accomplished by two simple valves, usually in the form of flaps of leather, which act as check valves to control the direction of flow of the air. Figure 6 is an illustration of the principle of operation of the pumps. A represents the fixed board of the pump, and B represents the movable board, attached through linkage to the foot pedal. Channel C leads through the reservoir to the player action. The leather flap valves D are attached to the boards at their ends, but are free to move away from the boards at their centers. When the pedal is pressed and the pump opens, valve D on the movable board is drawn tightly against its seat, while valve D on the

fixed board is pulled away from its seat, drawing air from channel C. When the pedal is released, the pump has filled itself with air from channel C, and it begins to close. Valve D on the fixed board is then pressed against its seat, while

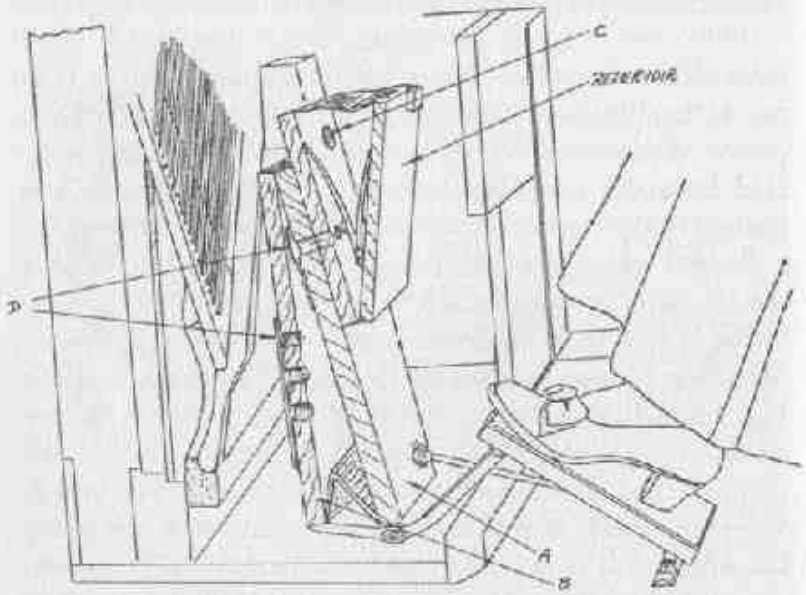


Fig. 6. Main Pump Bellows

A—Fixed Deck
B—Movable deck
C—Channel to player action
D—Leather flap valves

valve D on the movable board moves away from its seat, expelling the air in the pump into the atmosphere.

The reservoir acts as a cushioner and equalizer for the supply of air. The two foot pump bellows supply vacuum only while they are being pushed open, and this would lead to very erratic performance of the piano if there were no means to smooth out the vacuum supply and assure a

reasonably constant suction. The reservoir is a large spring-loaded bellows which "stores" the generated suction inside it. When the piano is playing, the reservoir is partially collapsed. The movable board of the reservoir is in a continually "floating" state, moving in and out quickly as variations in suction occur. If a heavy chord is struck, the reservoir springs snap the movable board out instantaneously to maintain the working vacuum and to keep the piano playing normally. Pianos with small reservoirs usually give the player pianist better opportunity to accent certain notes by quick, hard strokes of the pedals. However, pianos with large reservoirs usually maintain their playing level more uniformly and are better able to handle sudden demands for vacuum. Some player pianos are equipped with two reservoir bellows at the ends of the bellows unit, rather than a single reservoir extending across the unit—but the function is the same in both cases.

The rest of the player piano's mechanism is comparatively simple. The roll drive transmission shifts the control gears from rewind to play position as determined by the control lever. The automatic tracking device shifts the position of the roll to see that its perforations are always in direct alignment with the holes in the tracker bar. Some automatic trackers shift only the upper spool, some shift the tracker bar, and some shift both the upper and lower spools, but their operation is basically the same. Most player pianos are equipped with various "interpretive" devices whereby the operator can make the piano play at different loudness levels at his discretion. These devices are controlled from levers or push-buttons which are located on the control rail in front of the key-bed. These so-called expression controls were

manufactured in literally dozens of forms, and any general description of them would be impossible. However, they all operate by causing the bass and treble sections of the hammer rail to move closer to the strings, or by "strangling" the suction supply to the player action in much the same fashion as the air-motor governor operates.

Many player pianos came equipped with an automatic device for operating the sustaining pedal. This consists of a large pneumatic which is connected to the sustaining pedal mechanism, and which is controlled either by a push-button or lever on the control rail or by a special sustaining pedal perforation cut into most music rolls. This pneumatic actuates the sustaining pedal when the finger button is pushed or when the pedal perforation crosses the tracker bar, the result being the lifting of the dampers from the strings, just as though the regular sustaining pedal had been pressed.

REBUILDING

BEFORE ANY PARTS of the mechanical action can be removed from the piano, the removable case parts must be taken off the front of the instrument. Remove the upper front panel of the piano by lifting it from its brackets or by turning thumb nuts and raising it off its mounting screws. Remove the flat board, if any, above the fallboard, and also the fallboard itself. On some pianos, the two vertical pieces of wood at the two ends of the front of the piano must be removed to allow the upper player action to come out. The bottom front panel should also be removed—and in some cases it is helpful to remove the piano's top, especially if it is a small player.

The player action, or pneumatic stack, is removed from the piano by loosening the control rods at the ends of the action, detaching the air-motor supply hose, removing the bolts or screws at the ends of the action which hold it in place, and then lifting the action outward from the back of the piano and slightly upward at the same time. This procedure may vary with some pianos which have the large vacuum supply hoses attached to the action beneath one or

both ends: naturally, these must be removed before lifting the action out of the piano. Occasionally pianos have supporting brackets which run from the top of the player action back to the iron frame, and these must be detached. Pianos which have an automatic sustaining pedal will be equipped with a tube leading from the spool box to the left end of the player action, thence to the bottom of the piano, and this should be disconnected.

The lower bellows may be removed from the piano by loosening the screws or bolts which hold the bellows in place, and by lifting the entire unit out of the bottom of the piano. Generally the control rod linkage must be disconnected before the unit can be removed. If the suction supply hose for the automatic sustaining pedal pneumatic runs directly from the bellows unit, it should be removed before the unit is lifted out. Different piano manufacturers varied the structure of their pianos greatly, and any general description of the methods of anchoring units in place or of placement of component parts would be virtually impossible.

All the "accessory" devices, such as the automatic sustaining pedal pneumatic, the expression pneumatics which operate sections of the hammer rail, and any other such mechanisms, should be removed from the piano at this time.

The reader may think it odd that the first step in doing the work on a player piano should involve not the player action, but the piano itself—yet this is indeed the case. This writer strongly recommends that as soon as the repairman has removed all the player mechanism from his piano, he should set the mechanism aside and turn his attention to

the piano itself. It is an undeniable fact that any player is only as good as the *piano* in which it is installed. A perfectly-operating player mechanism cannot give satisfactory musical results if it is coupled to a piano which is in need of attention.

It is not the province of this book to attempt to instruct the repairman in making the necessary adjustments and repairs to the piano action and frame. Suffice it to say that the piano action should be carefully inspected for lost motion and wear in bushings, the hammer butts should be checked for clicking noises, looseness, and sloppy travel, and the backcheck and let-off adjustments should be regulated if necessary. Bridle straps should be replaced if they are worn or broken. All felt parts should be checked for moth damage. The hammers should be dressed, if necessary, to remove grooves cut in their felt by the strings. The sounding-board should be checked, and if it is badly cracked it should be repaired. The piano should be tuned while the player action is removed and the action and strings are accessible. If new bass strings are necessary to replace ones on which the windings have loosened, they should be installed at this time. If the player mechanic does not wish to do this work himself, a qualified piano technician can undertake this part of the job. But the fact should never be forgotten that unless the piano itself is in top condition, the repairman is wasting his time on the player action, for the musical results can only be unsatisfactory.

Figures 7 (a, b, and c) are included here merely for the purpose of giving the inexperienced repairman an opportunity to identify the parts of a piano action.

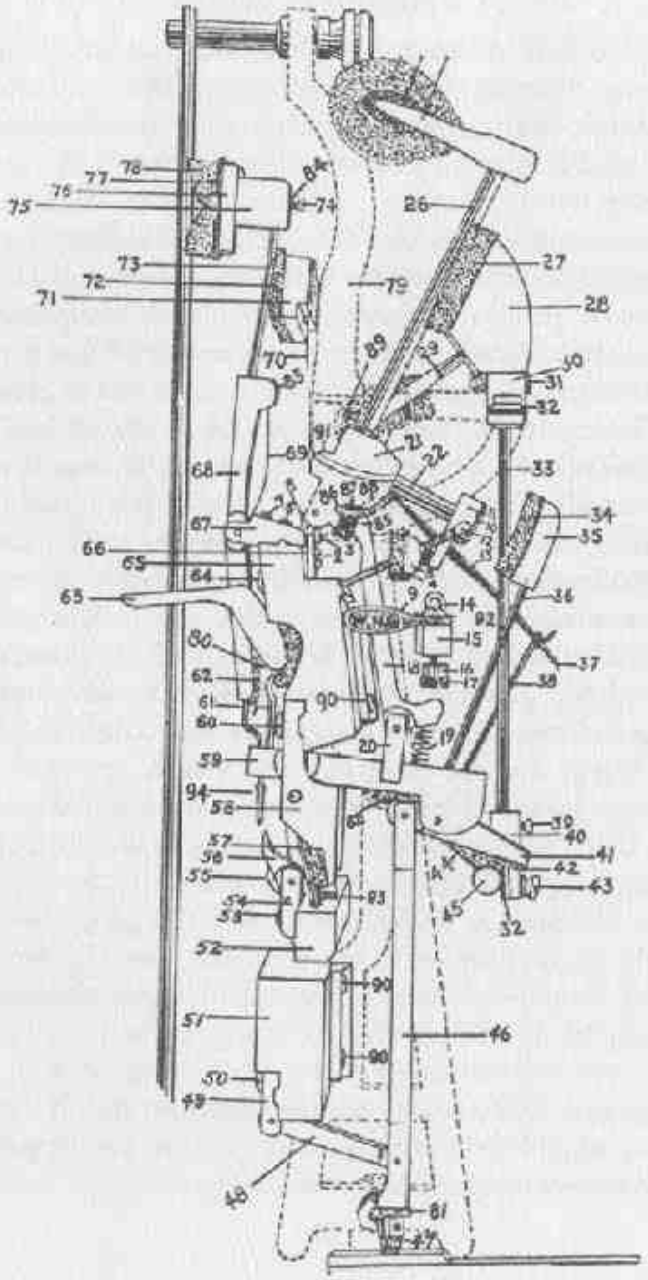


Fig. 7 (a)

DIAGRAM OF UPRIGHT PIANO ACTION

Sectional View

1 Upr. Spoon.
2 Upr. Brass Flange Rail Screw.
3 Upr. Brass Rail Plate.
4 Upr. Block Rail Felt.
5 Upr. Block Rail.
6 Upr. Damper Flange Screw.
7 Upr. Damper Spring Reg. Screw.
8 Upr. Brass Rail Plate Screw.
9 Upr. Regulating Rail Bracket.
10 Upr. Butt Chack (Buckskin) Covering.
11 Upr. Butt Check.
12 Upr. Right & Left Regulating Screw for Block Rail.
13 Upr. Bridle.
14 Upr. Regulating Screw.
15 Upr. Regulating Rail.
16 Upr. Regulating Button.
17 Upr. Regulating Button Punching.
18 Upr. Jack.
19 Upr. Jack Spring.
20 Upr. Jack Flange.
21 Upr. Butt.
22 Upr. Butt Shank.
23 Upr. Hammer Felt.
24 Upr. Hammer Underfelt.
25 Upr. Hammer Head.
26 Upr. Hammer Shank.
27 Upr. Hammer Rail Cloth.
28 Upr. Hammer Rail.
29 Upr. Hammer Rail Hook.
30 Upr. L. M. P. Top Piece.
31 Upr. Hammer Rail Block Felt.
32 Upr. L. M. P. Rubber Bushing.
33 Upr. L. M. P. Connecting Pin.
34 Upr. Backcheck Felt.
35 Upr. Backcheck.
36 Upr. Backcheck Wire.
37 Upr. Bridle Leather Tip.
38 Upr. Bridle Wire.
39 Upr. L. M. P. Set Screw.
40 Upr. L. M. P. Bottom Pin.
41 Upr. L. M. P. Lever.
42 Upr. L. M. P. Cloth.
43 Upr. L. M. P. Rod Screw.
44 Upr. L. M. P. Rod Hook.
45 Upr. L. M. P. Rod.
46 Upr. Extension.
47 Upr. Capstan Screw.
48 Upr. Extension Guide.
49 Upr. Guide Flange.

Fig. 7 (b)

50 Upr. Guide Flange Screw.
51 Upr. Extension Rail.
52 Upr. Sostenuto Rail.
53 Upr. Sostenuto Flange Screw
54 Upr. Sostenuto Flange.
55 Upr. Sostenuto Lever Spring.
56 Upr. Sostenuto Lever.
57 Upr. Sostenuto Rail Hook.
58 Upr. Sostenuto Hook Flange.
59 Upr. Wippen.
60 Upr. Wippen Flange Screw.
61 Upr. Sostenuto Wire.
62 Upr. Damper Lever Cloth.
63 Upr. Damper Rod.
64 Upr. Damper Rod Hinge.
65 Upr. Main Rail.
66 Upr. Brass Rail.
67 Upr. Damper Flange.
68 Upr. Damper Lever.
69 Upr. Damper Spring.
70 Upr. Spring Rail Spring.
71 Upr. Spring Rail.
72 Upr. Spring Rail Felt.
73 Upr. Damper Wire.
74 Upr. Damper Block Screw.
75 Upr. Damper Block.
76 Upr. Bass Damper Plate.
77 Upr. Damper Undercovering.
78 Upr. Damper Felt.
79 Upr. Bracket.
80 Upr. Damper Rod Felt Cushion.
81 Upr. Extension Cloth.
82 Upr. L. M. P. Wippen Cloth.
83 Upr. Damper Lever Punching.
84 Upr. Brass Damper Block Studs.
85 Upr. Butt Felt.
86 Upr. Butt Leather.
87 Upr. Butt (Scarlet) Undercovering Cloth.
88 Upr. Butt (White) Undercovering Cloth.
89 Upr. Bracket Bushing Cloth.
90 Upr. Bracket Screw.
91 Upr. Butt Punching Cloth.
92 Upr. Regulating Bracket Punching Leather.
93 Upr. Sostenuto Lever Felt.
94 Upr. Sostenuto Wire Cloth.

The action from which this diagram was made is a WISSELL, NICKEL & GROSS model.

Fig. 7 (c)

To be discussed at this point is the operation of overhauling and rebuilding the upper action, or pneumatic stack, of the player piano—probably the most important part of the entire job. The pneumatic stack contains delicate, precision parts. Unless these parts are handled and rebuilt with care, the results will be disappointing.

The first step in rebuilding the stack is separating it into

its upper and lower parts. The stack is examined to see where the "break" is located, then separated. Usually the two parts separate at a point near the lower ends of the tubing which runs from the tracker bar into the action, just above the top row of pneumatics. On some actions, this tracker bar tubing may have to be detached at its lower ends before the parts will separate. Examination will determine this. Some ingenuity may be required, as manufacturers' practices varied to such an extent that it is impossible to give any general procedure for this operation.

When the two sections are apart, the upper half should be set aside and work on the pneumatics should be begun.

On many player actions, the decks to which the pneumatics are glued are fastened together by long screws which pass through the junction areas at the ends of the stack, or else by metal brackets outside the ends of the stack. On others, the decks are screwed onto a board which supports all the decks at once. In the latter case, access to the screws which hold the decks to the main board is gained by removing the screwed-on board on the front face of the stack. The screws are in the chamber beneath this board. Occasionally the decks are glued to the supporting board, and must be carefully worked off with a putty-knife and mallet. In any case, examination of the stack will enable the repairman to discover its structure.

Unscrew or otherwise loosen the decks from the supporting body, but do not attempt to remove them from their approximate position.

After all the decks have been loosened, turn the stack upside down, with the pneumatics facing you. Remove the screws from the individual pneumatics' push-rod brackets

and break the brackets free from the bottom of the pneumatics (see Figure 8). Do the uppermost deck first, and after all the brackets have been detached from the pneumatics the deck will be free and can be lifted away from the remaining decks. Care should be taken to number or

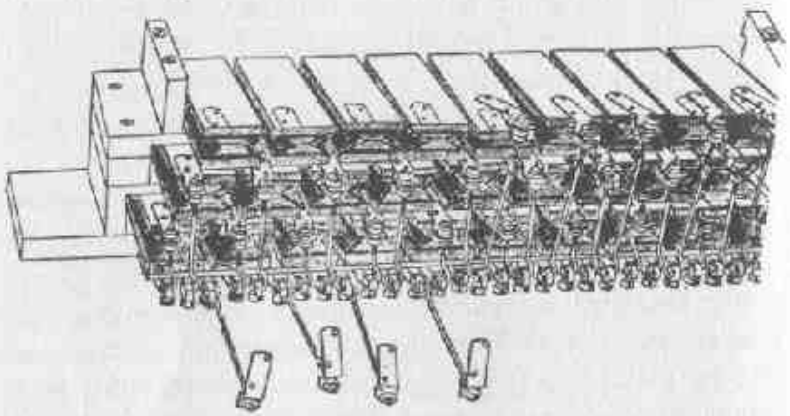


Fig. 8. Removal of Push-rod Brackets

otherwise identify the decks so that they can be replaced in their proper order when the action is reassembled.

Use the same procedure to free the remaining decks, and when the last deck is freed of its push-rods, the long rail holding the push-rod guides should be removed from the top side of the deck, if it is removable. The screws which hold the push-rod brackets to the pneumatics should be put in a small container and placed where they will not be disturbed.

The individual pneumatics should now be removed from the decks, in preparation for recovering them. With a soft pencil or ball-point pen, mark each pneumatic on each deck such that it can be replaced in its proper position when the

decks are reassembled. Number or letter each pneumatic consecutively, using a different identification system for each deck, to prevent confusion later. Make a mark on the end of each deck to indicate where the identification system

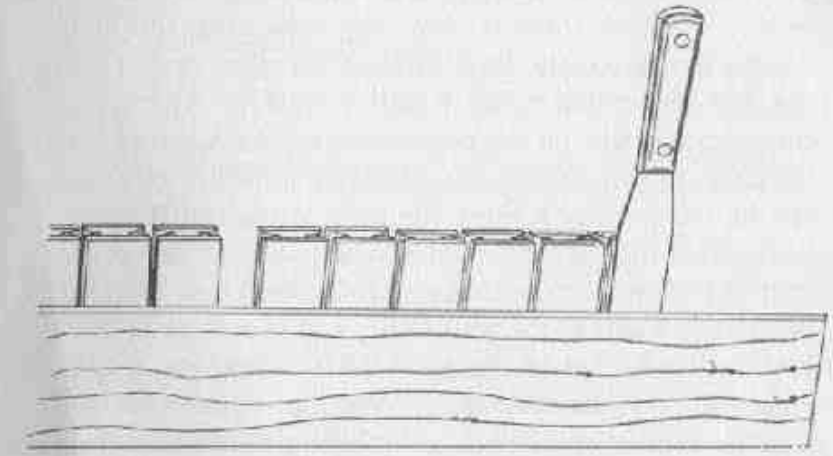


Fig. 9. Removal of Pneumatics from Deck

begins, to prevent replacing the pneumatics in reverse order during re-assembly.

After the marking is completed, the pneumatics should be removed from the decks. This is done by gently driving a thin putty-knife or other flat-bladed instrument between each pneumatic and the deck. Most pneumatics were originally attached to the decks with animal glue, which is brittle enough to make them removable without much damage. Stand the decks on edge on the workbench, and gently drive the blade into the point (see Figure 9). Be sure that the blade enters the joint completely parallel with the two mated surfaces, to prevent its digging into the wood. Use a

wooden mallet or other non-metallic hammer, and be gentle. Most pneumatics will pop off the decks without trouble after a few taps of the mallet. Occasionally, however, pneumatics in which the wood grain runs at an angle with the deck will begin to split, rather than come off the deck freely. When this occurs, turn the deck over and begin driving the blade into the joint from the other end, or from the side of the pneumatic, if it is accessible. With a little care and patience, all the pneumatics can be removed from the decks in this fashion. An extremely stubborn pneumatic can be removed by heating the inner surface of the pneumatic. Tear the old cloth off the boards and lay the movable board of the pneumatic back out of the way. Lay a hot iron on the top board of the pneumatic, and in a short time the heat will penetrate to the glued joint and soften it somewhat, aiding in its removal. In case a pneumatic has split badly in coming off its deck, put a little glue on the surfaces of the split and secure it with a small clamp, taking care to wipe away all glue which squeezes out. The decks can now be set aside until the pneumatics have been re-covered. *Do not* plane or otherwise attempt to smooth off the surfaces of the decks from which the pneumatics have been removed. Leave them just as they are—for the pneumatics must later be glued back onto the decks in the exact position from which they were removed, and any disturbance of the mating surfaces of the deck or pneumatic will result in a weakened joint.

The span of the pneumatics should be measured and noted. With a ruler, measure the span of cloth covering the open end of one of the pneumatics, including the boards (see Figure 10). Be sure to stretch the pneumatic open to

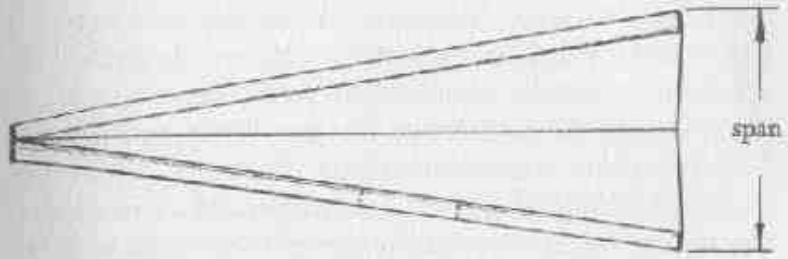


Fig. 10. Measuring the Span of a Pneumatic, with the Old Cloth Stretched Tight

its fullest extent while doing this. This measurement will determine the width of the new strips of cloth which will be glued on.

The pneumatics should now be cleaned. There are a number of methods by which this can be done, but for purposes of illustration the power sander will be used. This writer has found the sander to be by far the most satisfactory method.

If a combination disc and belt table sander is available, this is the ideal tool for cleaning the pneumatics. Figure 11

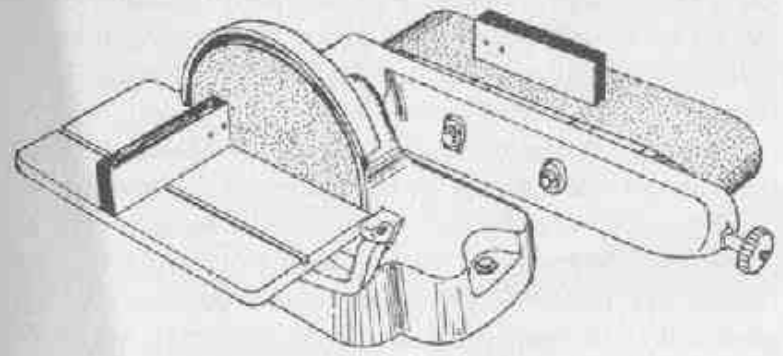


Fig. 11. Cleaning the Old Cloth from a Pneumatic

illustrates the position of the pneumatics on the sander. The two sides of each pneumatic are first cleaned on the sanding belt. Then the ends of each pneumatic are cleaned on the disc. The disc table insures that the cleaned ends will be perpendicular to the sides of the pneumatic, and prevents distortion of the pneumatic's shape. The hinge end of each pneumatic should be pressed lightly against the sanding disc, to prevent sanding into the cloth hinge. This hinge end does not necessarily need to be cleaned down to the bare wood, as this might endanger the hinge. The other three sides, however, should be sanded down to clean wood. Coarse sandpaper should be used. The old pneumatic cloth does not need to be removed before cleaning, as the sandpaper will quickly cut through the dead cloth, and the folded piece in the interior of the pneumatic can be plucked out and discarded.

If a combination sander is not available, a separate disc sander or belt sander can be used, providing care is taken to sand the pneumatics' surfaces evenly and not to distort their shape. If no sander of any type is available, the pneumatics can be cleaned by clamping them in a bench vise and cleaning their surfaces with a hand plane, preferably one of the surface-forming type. The pneumatics must be turned in the vise to clean all four edges.

The strips of pneumatic cloth should now be made. Only the thinnest cloth should be used to cover the stack pneumatics, as they must be perfectly flexible and should offer no resistance to movement. With a pocket tape measure, determine the perimeter of the outer surfaces of one of the pneumatics. All four surfaces must be totaled to determine the perimeter. Add approximately a quarter of an inch

for overlapping cloth at the hinge end of the pneumatics, and this will determine the length of the new cloth strips. The width of the strip is determined by the span of the pneumatics, which was measured before they were cleaned. Lay the large uncut piece of pneumatic cloth on a flat surface, and square off any raggedness on its end. Measure back from the end of the cloth the distance which was determined to be the length of the strips. Draw a straight line across the cloth parallel to its end, on the white side of the cloth. Then, cut the cloth along this line with sharp scissors. Figure 12 shows the pattern of the cloth. With the measuring tape or

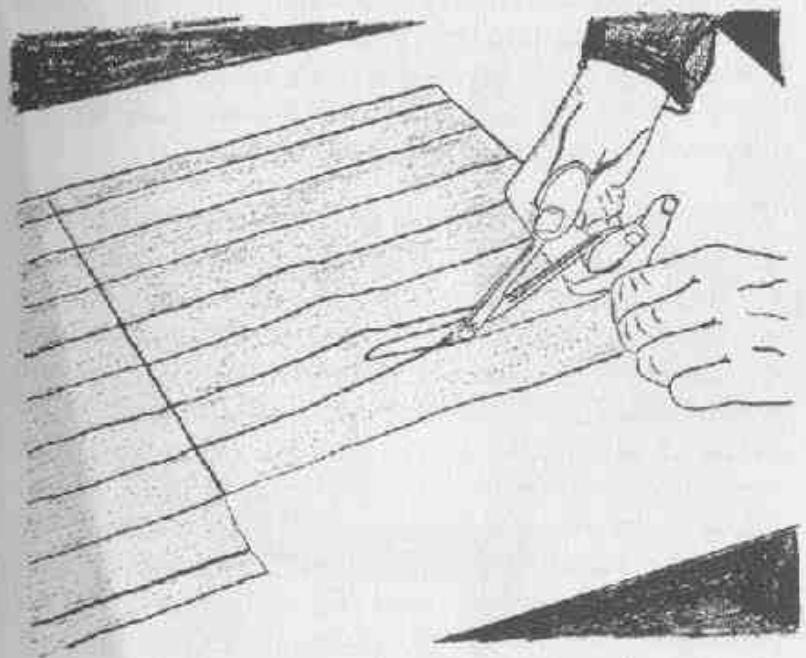


Fig. 12. Cutting Pneumatic Cloth into Strips. It may also be Torn to Size, as indicated in the Text.

yardstick, measure along the cut edge and make a series of small pencil marks at intervals which mark the span of the pneumatics. Then, cut small nicks in the edge of the cloth at these marks. The pneumatic cloth can then be smoothly torn into strips, using the scissor nicks as "starters" for each strip. Repeat the above operation until enough strips to do the entire set of pneumatics have been made.

Pneumatic cloth strips can be torn, rather than cut, and this saves much time. However, it should always be remembered that the cloth can be torn only along its length as it comes from the supplier. The weave of the cloth runs parallel to its edges, and it will tear uniformly along that dimension. If one attempts to tear the cloth cross-wise—i. e., across the strip from edge to edge—the result will be crooked strips which will be useless. Always lay out the strip pattern along the length of the cloth, as shown in Figure 12.

To be discussed at this point is the procedure for covering the pneumatics. *Heed it well!* The repairman should remember that this same basic procedure applies when bellows of *any* size or shape are covered. Throughout any player piano are dozens, often hundreds, of bellows large and small—each of which is covered using this same method. This procedure should become a habit, and the repairman should eventually be able to do it blindfolded, so to speak.

The pneumatics are covered, naturally, one at a time. Lay a strip of pneumatic cloth on a smooth surface with the rubber side down. Spread a layer of glue on the open end of the pneumatic. Place the glued surfaces of the pneumatic on the edges of the center of the strip of cloth. Rock the pneumatic back and forth crosswise to press the entire surface of

each board down tightly against the cloth—being careful, at the same time, not to shift the boards' position on the edges of the cloth. Figure 13 shows the position of the pneumatic when this step is completed.

Lay the pneumatic on one side, folding the lower side of the strip of cloth back underneath the pneumatic and pull-

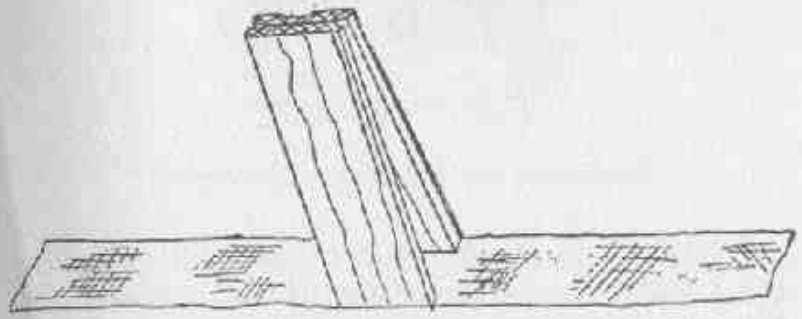


Fig. 13. The First Step in Gluing a Pneumatic

ing it snug to prevent it from loosening where it has already been glued. Spread glue on the uppermost side surfaces of the pneumatic. Taking care to see that the cloth is pulled tight to insure its coming down onto the boards evenly, lay the cloth down on the boards and press it firmly against them with the fingers. Figure 14 illustrates this step completed.

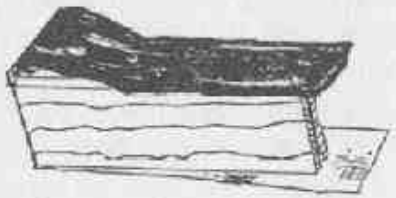


Fig. 14. The Second Step in Gluing a Pneumatic

neatly filled this bill by providing an easy means for wafting into the air such tunes as "Roses of Picardy," "My Buddy," "Over There," and "Goodbye Broadway, Hello France." And players helped entertain the boys, too—one well known battleship had six of them on board! And when the boys came back, every player owner felt obliged to rush to his music store for the latest release of "How You Gonna Keep 'em Down on the Farm—(after they've seen Paree?)"

The player was of course not limited to the homes of America. Enterprising men learned early in the game that the public would part with its nickels and dimes to hear these machines located in places of public entertainment, and thus a whole new industry—the nickelodeon business—was formed. No ice cream parlor, pool room, or speakeasy was worthy of public patronage unless standing there, replete with its gaudy stained glass front and repertory of latest hits of the day, was the coin operated piano or orchestrion waiting to grab the customers' nickels.

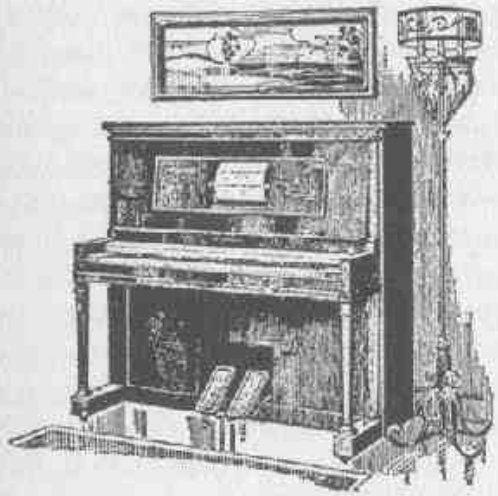
In the homes of the wealthy, for they were the only people who could afford their rather astronomical price tags, were the reproducing pianos—the players capable of exact re-enactment of the performances of the great artists of the day. At a time when the phonograph was barely capable of capturing and playing back squeaks and squawks, the reproducing piano was able to bring into the home magnificent performances from an actual instrument, right there on the spot, exactly as the artist intended.

With the tremendous advances in technology in recent years, this situation has of course changed. Modern high-fidelity electronic equipment has permitted every home to be a veritable music hall of the highest character. But for

just plain fun, coupled with the nostalgia which Americans in their leisure hours are so fond of seeking, the player piano is simply unequalled.

This book is the first significant attempt to provide the necessary information to bring these fascinating instruments back to life. Mr. Givens is a real expert in these matters, and readers can rest assured that the instructions contained herein are based on much experience. The Vestal Press has taken the lead in re-introducing the player to the American public through its book "Player Piano Treasury" and various catalog reprints, and this volume is a truly significant addition to its publications in this field.

Harvey N. Roehl
April, 1963



Turn the pneumatic onto its other side, and do the same thing, as shown in Figure 15. Always remember to keep the cloth tight as it is laid onto the boards, as this will prevent any buckling or looseness at the corners of the pneumatic.

Fig. 15. The Third Step in Gluing a Pneumatic

Stand the pneumatic on end. If the cloth has been properly centered, the two portions which fold over onto the hinge end should be approximately equal.

Spread glue onto the hinge end of the pneumatic. Fold one end of the cloth down onto the board and press very lightly. Then lift this end back up off the board, and fold the other end down quickly. Press the second end down tightly onto the board—and then fold the first end over again and press it down firmly. In this way, the first end which is pressed onto the board picks up a supply of glue, and is then lifted off. The second end is then glued down; and the first end, which already has glue on it, is pressed on. This procedure eliminates the tedious and messy job of spreading the glue onto the cloth ends, and it is by far the fastest method of processing the hinge end of pneumatics of any type. Figure 16 shows the pneumatic after the cloth has been glued onto all four sides.

A word about application of the glue should be inserted

here. If the repairman elects to use hot glue, he will, of course, apply it with a brush. However, if he employs any of the white glues, or other non-heated glue, he will experience difficulty in spreading an even layer on the pneumatics and

Fig. 16. The Fourth Step in Gluing a Pneumatic

other parts if he attempts to remain fastidiously clean. The best spreader for glue which has ever been discovered is the *finger*, pure and simple! No repairman has ever rebuilt a player action without getting his hands dirty; and whatever glue sticks to the fingers can be easily removed with hot water and soap.

When glue is applied to the edges of the stack pneumatics and other parts of the action, it should be spread evenly in a layer just thick enough to conceal the surface beneath it, yet not so thick that it will begin to form runs if the surface is raised to a vertical position. When the cloth is pressed onto the pneumatic boards, only a little glue should squeeze out from the joints. If no glue at all shows, probably an insufficient quantity is being used—and if the glue squeezes out in abundance, too much is being applied. Large pneumatics will require a somewhat thicker layer of glue. A little practice will enable the repairman to judge this as he applies the glue.

After the pneumatics have been covered and have dried for at least an hour, they must be trimmed. This is done using a sharp scissors, preferably long-bladed ones which can trim an entire side of a pneumatic in one bite. Place the scissors such that the interior surface of one of the blades is flat against the wooden board of the pneumatic. Cut the cloth perfectly flush with the wood. Figure 17 illustrates the scissors position and the method of procedure. Trim all the edges on one board, then trim the other board, and proceed to do the entire set in this manner.

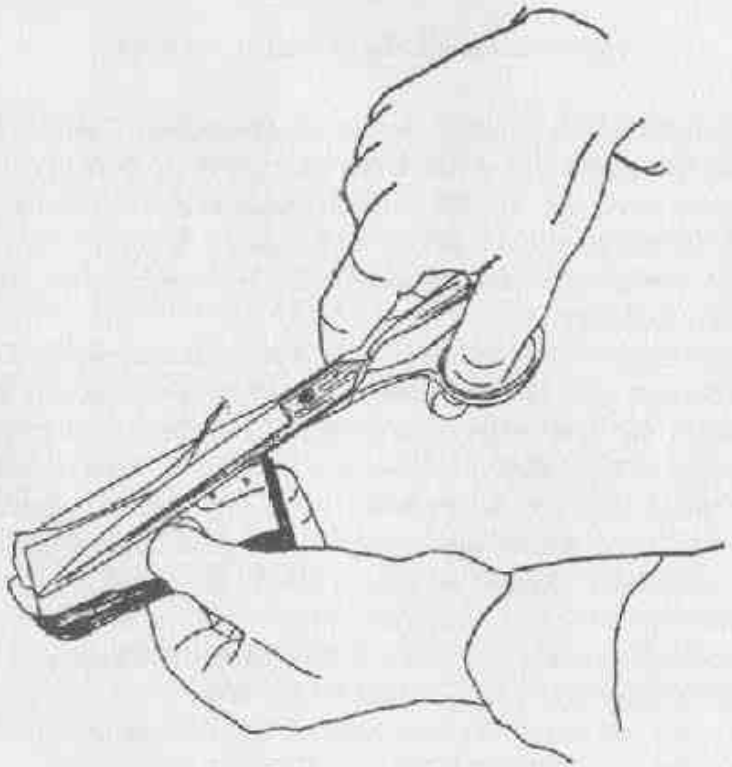


Fig. 17. Trimming a Pneumatic

The pneumatics should then be creased. This is done by holding each pneumatic completely open, and placing the thumb and middle finger on the cloth near the open end. With the forefinger, press the cloth covering the open end

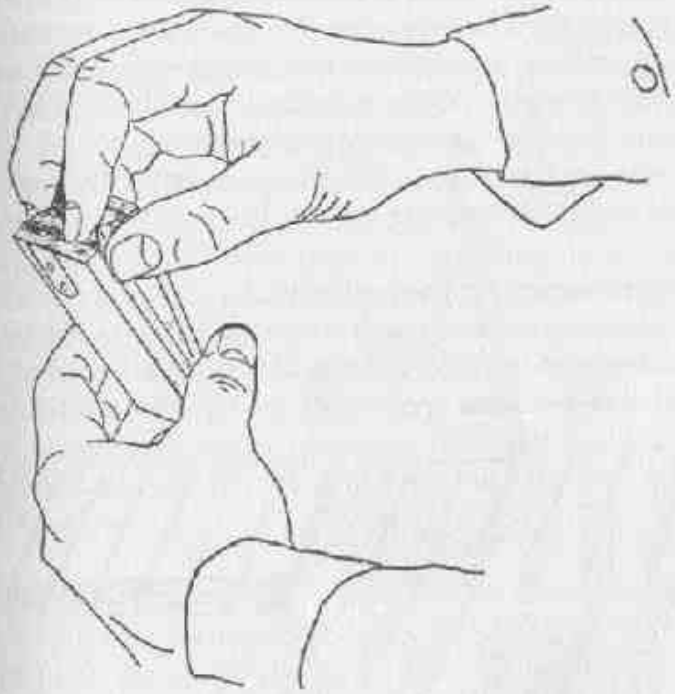


Fig. 18. Creasing a Pneumatic

of the pneumatic downward, back into the pneumatic, as shown in Figure 18. Keeping the cloth in this position, close the pneumatic and squeeze it tightly, which will impart a permanent crease to the cloth.

The pneumatics are now ready to be glued back onto their respective decks. The pneumatics for a single deck are laid out on the workbench in their consecutive numbered or lettered order. The deck is also placed on the bench in front of the pneumatics in its proper position to receive them. Glue is spread onto the mating surface of the deck, and the pneumatics are placed in their respective positions consecutively. This operation is an important one, and the repairman must take care to replace the pneumatics in exactly their former position, with the mating surfaces completely joined. Usually, the repairman can feel the pneumatic slip into its proper place, if the mating surfaces have not been tampered with.

When re-attaching pneumatics to the decks, large spring-type clamps should be used. The repairman should equip himself with at least half a dozen of these, preferably with a throat of three inches or more. Figure 19 illustrates the type

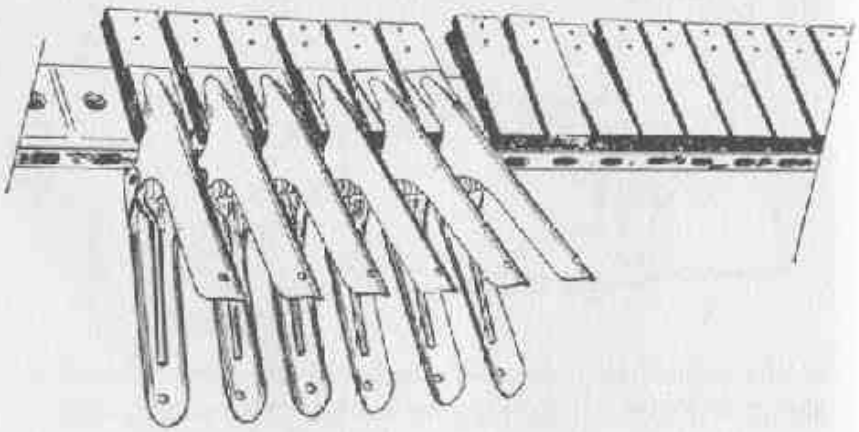


Fig. 19. Re-gluing Pneumatics to a Deck

of clamp required. For re-attaching the pneumatics to their decks, hot glue should be used. After the glue has been applied to the deck and the pneumatic has been pressed into its position, a clamp should be quickly put on to hold the pneumatic under pressure. This should be done in consecutive order, without removing the preceding clamps. When the repairman has used his seventh or eighth clamp, the glue under the first pneumatic will be sufficiently set so that he can remove the clamp from the first pneumatic and use it over again. In this way the repairman can proceed down the line of pneumatics, attaching all of them without interruption. This procedure is usable only with hot glue. White glue must be left under pressure for several hours before the clamps may be removed, and for this reason its use for re-attaching pneumatics is not suggested. Also, the repairman should consider the situation of the person who may be rebuilding the piano again, thirty or forty years hence. It is considerably easier to remove pneumatics which have been attached with hot glue than those on which white glue has been used.

While the pneumatics are drying on the decks, the repairman may turn his attention to the remainder of the lower portion of the stack, containing the valves, pouches, and bleeds. Proper operation of these parts is essential to a well-running player piano.

Ideally, every valve in the pneumatic stack should be inspected and cleaned. Naturally, they must be removed from the stack for this operation. The location and positioning of the valves in player actions differs so widely from maker to

maker that any generalization would be useless. The repairman must use his ingenuity in locating the valves and in determining how to remove them.

Figure 20 illustrates one fairly common method of valve positioning. The view shows the front side of the lower part

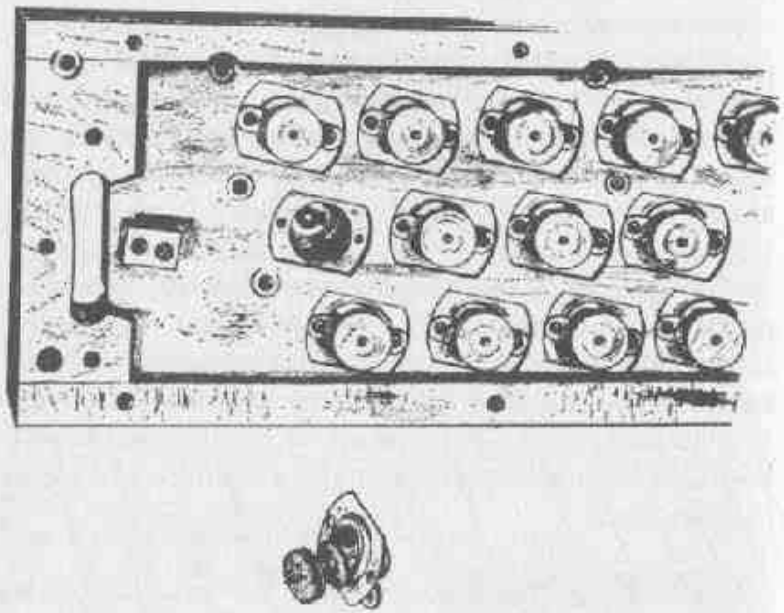


Fig. 20. A Valve Deck with One Valve Removed

of the stack with the long screwed-on pouch board removed. The valves in this type of action travel horizontally. They are removed by unscrewing the wood screws fastening the metal valve seat to the valve deck, and then slipping the valves out frontwards. One valve is shown removed from the stack. The wooden knobs on the front end of the valve

stems merely prevent the pouches from being pierced by the end of the stems.

Figure 21 shows valves of the so called "unit block" type. These unit blocks, which contain the pouch, valve, and bleed, unscrew separately from the front of the pneumatic stack, which makes service on them quite easy. They are found in

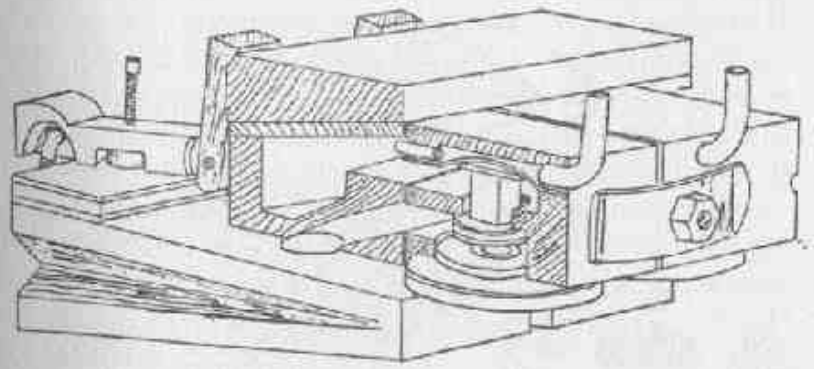


Fig. 21. The Unit-block Type of Valve, as Manufactured by the Amphion Action Company

both upright and inverted styles; the ones in the drawing, with the pouches above the valve, are of the inverted type.

Occasionally the pouches, valves, and bleeds are built into the top of the individual pneumatics. Figure 22 illustrates one of these. Some manufacturers built the valve-pouch-bleed assembly directly into the pneumatic decks. In any case, the repairman must examine the stack to determine the method of construction, and thus the method of removal, of the valves.

The valves should be removed one by one, and their fac-

ing surfaces brushed with a stiff brush. An old toothbrush is ideal for this purpose. The valves must be replaced in the same units from which they came, so the repairman should remove only one at a time, clean it, and replace it. Every particle of dirt must be removed from the valve facings, and the seats should also be cleaned if necessary.

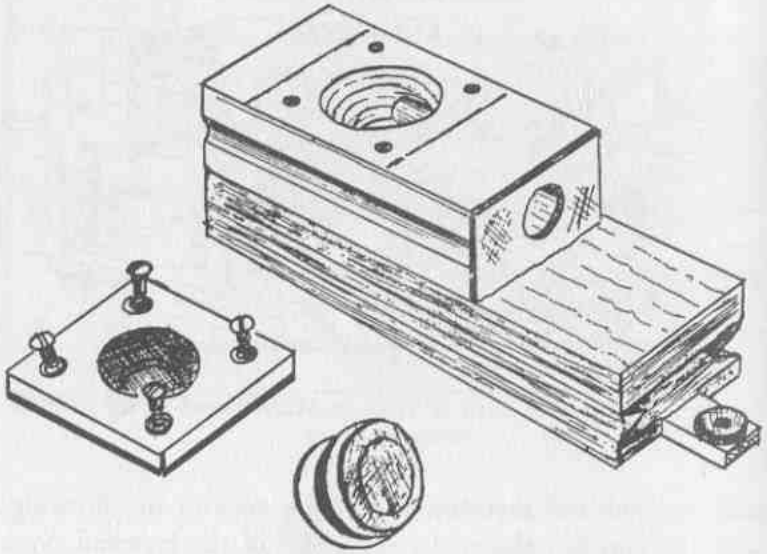


Fig. 22. A Unit Containing the Valve, Pouch, Bleed, and Pneumatic, with Valve Taken Out

If the leather valve facings have deteriorated and are rotten, this will evidence itself by the flaking off of powder from the leather when its surface is rubbed or brushed. In this case the facings must be replaced. In the case of the valves shown in Figure 20, the discs supporting the valve leather must be removed and new leather punchings in-

serted. In the case of the valves shown in Figure 21, the valve stem must be removed, the top and bottom valve faces cleaned with sandpaper, new leather punchings glued to the faces, and the stem replaced with a drop of glue.

When replacing the valves in the stack, care should be taken to get the seal around the valve seats completely airtight. If the valves are the type shown in Figure 20, a little shellac should be used as a seal around the lower seats. If the top seat must be removed to get to the valves, as in the case of those shown in Figure 21, the valve travel should be adjusted when the top seat is replaced. The valve clearance in most pneumatic action valves is $\frac{1}{32}$". Adjust the clearance, then seal the rim of the valve seat with shellac. Occasionally, the repairman will run across valves with flanged seats, made in such fashion that the clearance is automatically correct when the seat is pressed into position.

The pouches are next on the list to be considered. Here again, as with the valves, a generalization as to pouch positioning in player actions is impossible due to the variety of manufacturers' practices. However, since the repairman has already located the valves in the stack, his task is made easier in locating the pouches—as they are positioned at the lower end of the valve stems, perpendicular to them.

Many manufacturers placed their pouches in large removable boards. The board shown in Figure 23, which happens to be the board which covers the valves shown in Figure 20, is such an item. Some makers, however, constructed their pneumatic stacks in such a way that they must be split apart to reach the pouches. The pouches in the valves shown in Figure 21 are located in the lower portion

of the unit blocks, which must be broken apart to reach the pouches and bleeds (see Figure 24). Most players which are constructed with the valve, pouch, and bleed in the upper part of the pneumatic itself are difficult when it comes to pouch replacement. The pneumatic must be split apart (see Figure 25), the pouches replaced, and the pneumatic must then be glued back together.

Fortunately, the pouches in many player pianos are well

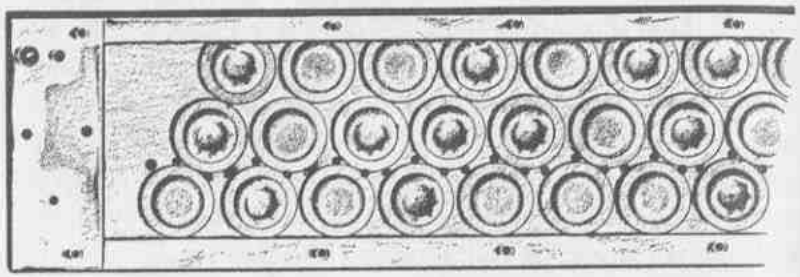


Fig. 23. A Pouch-board

preserved and not in need of replacement. Pouch leather will retain its life over long periods of time, if it is kept inside a box or other unit which prevents the circulation of atmospheric air around it. Players which have the pouches arranged in a single board, as shown in Figure 23, present no problem in checking and/or replacing pouches. The pouches should be felt with a light rotary motion of the finger, to determine whether the leather is still perfectly soft and flexible. Pouch leather which is in good condition should feel very smooth, pliable, and soft. No traces of stiffening should be evident. The repairman should inflate several of the pouches with a short length of tubing to his mouth, and should carefully watch the pouches' travel when

inflated. The entire pouch should rise uniformly and smoothly, with no traces of crackling or stiffness in its motion.

Pouches which are not accessible can also be checked with a short length of tubing, through which the repairman

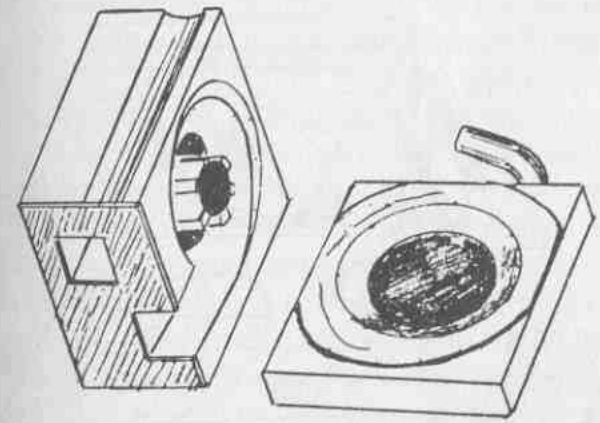


Fig. 24. A Unit-block Broken Apart to Show the Pouch. This is of the "upright" Type, with the Pouch Underneath the Valve.

can inflate the pouches. The action or unit blocks must be held such that the valves are in a vertical position, so that they can move freely. As the valves rise, carefully watch their motion. Any jerking or unevenness in their travel indicates stiff pouches. Any sort of crackling noise also spells trouble. No resistance to the rise of the valves should be noticed. The repairman should be able to hold the end of the tube several inches away from his mouth, blow on it, and watch the pouches and valves rise.

Occasionally piano manufacturers used very thin pneu-

matic cloth for their pouches. In most cases, this has stiffened and should be replaced.

If the repairman determines that the pouches have deteriorated and need replacing, his job is made considerably easier if the pouches are mounted on a single board, as

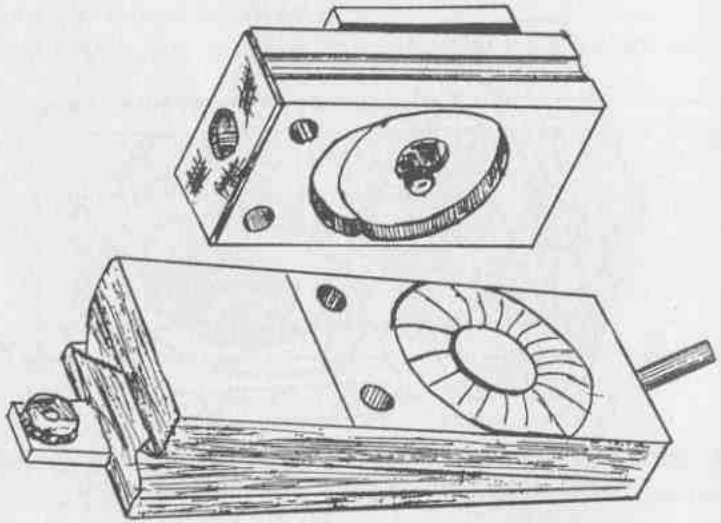


Fig. 25. The Unit Shown in Figure 22, Broken Apart to Show the Pouch

shown in Figure 23. In this case, after removing the fiber disc in the center of some pouches, the old leather is merely scraped off the board, which is then finish-cleaned with sandpaper and blown off with compressed air. Care should be taken to get all the dust and fine scraps of leather out of the crevices. If the pouches are of the inaccessible type, the individual blocks or other units must be broken apart using a mallet and putty-knife. The broken halves of the units

must be kept together and not mixed up, as the two pieces must be replaced against their matching halves. Once the units have been broken apart, the leather is scraped off and the surface cleaned.

While the pouches are off the boards and the air passages are unobstructed, check the bleeds to see that they are clean. The bleeds are usually found directly beside the pouches which they vent, and they are generally small brass cup-shaped objects pressed into the wood in some manner. Occasionally bleeds were made of celluloid, and also of stiff paper—but most player piano actions contain brass bleeds. Some players have their bleeds contained in a separate chamber which is fed by suction from the supply bellows, and which can be located by tracing the tracker-bar tubing through this bleed chamber before the tubing makes its entrance into the pouch units. Run a fine wire through each bleed hole to clear dirt from it, and blow through it, preferably with compressed air. Also blow air through the holes under each pouch to remove dirt or dust which may be there.

The new pouch leather must be cut to the proper diameter. Measure the diameter of a pouch cavity, add ⅜″ to it, and use this figure as the diameter of the new pouches. If the repairman has access to a lathe, an excellent pouch cutter may be made from a piece of scrap pipe of the proper diameter. Turn a sharp edge on the end of the pipe, and cut the leather with a rotary motion against end-grain wood. If no lathe is handy, the pouches can be cut by hand. In this case, a disc of the proper diameter is cut out of a piece of tin or other metal, and is used as a template around which the leather can be cut with scissors to a circular form.

The pouches are applied as follows: spread a thin layer of glue around the edge of each pouch cavity from its rim to about ¼" from its edge. See that the glue is spread completely evenly and not too thickly. Take care that all glue which runs over the rim into the cavity is removed, or the motion of the pouch will be impaired. Centering the pouch over the cavity, lay it into place, smooth side up, without pressing the edges down yet.

If the repairman has a lathe, he can make a very handy tool for imparting the proper amount of "dish" to the pouches. Using wood, metal, or any material which is available, he can turn a flat-rimmed cylindrical tool with a curved bottom (see Figure 26). The depth of the curve on the bottom of the tool's face is 1/64" less than the depth of the pouch cavity in the board. Using this tool, the proper amount of curvature may be uniformly produced in all the pouches,

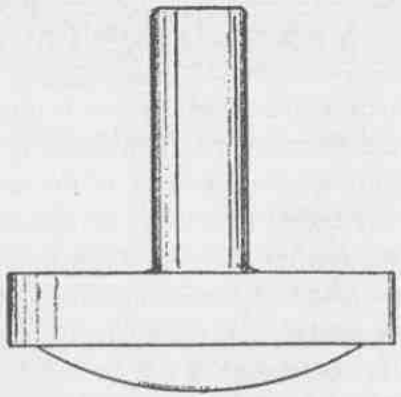


Fig. 26. Tool for Imparting the Proper "Dish" to Pouches

and the rims of the pouches may be pressed against the glued surface of the pouch board.

If no lathe is handy to make a tool, the pouches can be "dished" by hand. After the pouch is laid gently onto the glued surface and centered, press the *center* of the pouch down lightly until it touches the wood beneath it. Holding the center down, smooth the edges of the pouch down and press them gently against the board with a motion away

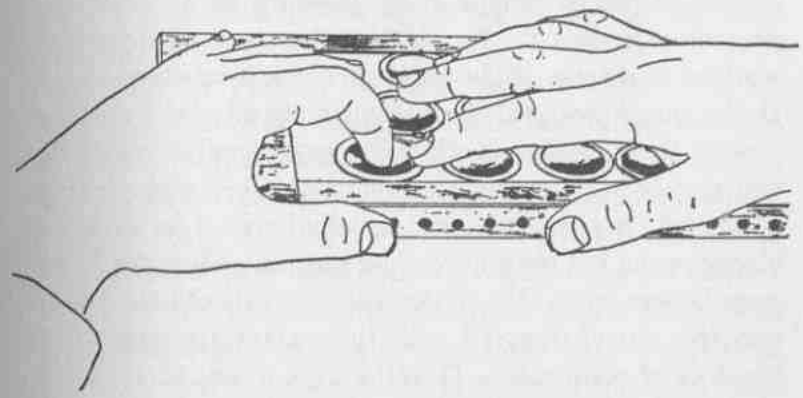


Fig. 27. "Dishing" Pouches by Hand

from the center, thus tending to draw the pouch snug (see Figure 27). See that no wrinkling or unevenness appears in the leather. If the pouch is held down in the center and the edges are smoothed down with the finger, a perfect job will result. With a little practice, the repairman will get the knack of this process. On multiple-pouch boards, the edges of adjacent pouches may overlap, but this will cause no trouble providing the overlap does not extend into the working portion of the neighboring pouches.

After the glue has dried and all the pouches are finished, replace the small fiber discs in their centers, if they were originally so equipped. Use only a tiny drop of glue in the center of the discs, as too much glue will spread onto the exposed leather surface and obstruct the motion of the pouches.

The repairman can now begin reassembling the lower portion of the pneumatic stack. Here again, description of procedure is difficult. In general, the stack should be assembled in reverse of the order in which it was taken apart. If the pouch and valve assemblies are of the unit block variety, these can be glued back together and clamped. See that their mating surfaces are entirely together, or leakage will result. New gaskets must usually be used for each unit block, as the old ones have split and torn when the blocks were broken apart. The pneumatic decks should then be assembled. Attach the rail with the push-rod guides to the top deck of pneumatics. Turn the deck upside down on the workbench. Place a little glue under each pneumatic's push-rod bracket, and insert the screws which hold it to the board. Then place the second deck on the assembly, and do the same for it. After the third deck is in place and its brackets attached, the screws, if any, holding the decks to the main supporting boards should be inserted. Then the long screws or bolts holding the ends of the stack together should be inserted. If the pouches are in board form, the board should be screwed onto the assembly. Gaskets should generally be replaced, and they can be made from white gasket leather, which is cut to size and glued to one of the mating surfaces before the joint is tightened. Some rebuilders prefer a cork

composition material, available from the piano supply houses noted in a later chapter. All screws and bolts should be drawn as tightly as possible without tearing the threads out of the wood. Often, where this has happened, pieces of match-stick or toothpick can be forced into the holes, to provide material into which the screw can get a new grip. Tight joints are essential for an easy-pumping player. After the lower half of the player action stack has been reconditioned, it can be re-joined to the upper half in the same manner in which it came apart.

After the two parts of the stack have been re-united, the repairman should turn his attention to the tracker bar tubing. Many players came equipped with metallic tubing, which, in some cases, has oxidized and deteriorated with the passage of time. The repairman should pull off one or two of the metal tubes at their lower ends (if he has not already done so when separating the two parts of the stack) and blow through the tubes vigorously, from the lower end. In most cases, lead was used as the metal from which the tubing was manufactured, and this is especially prone to oxidation. If a white, dusty oxide is blown out of the tracker bar, the tubing has deteriorated on the inside and should be replaced. The lead tubing was originally slipped onto the brass nipples in the back of the tracker bar, then cemented into place. By carefully chipping away the cement, the tubing can be pulled off the tracker bar. Usually the tubing has been inserted into holes in the wood at its lower ends, from which it can be removed after the surrounding shellac or other sealer has been chipped away. If the repairman determines that the lead tubing needs to be replaced, he should remove it and replace it with rubber tubing.

Many pianos were originally equipped with rubber tracker bar tubing. Often this has stiffened and become rock-hard. In this case, the tubing can easily be broken off the tracker bar nipples and the nipples at its lower end, and new tubing can be installed. However, rubber can also deteriorate in such fashion that it becomes soft and sticky. In this condition it will kink easily, and will tear with slight effort, having lost all its strength. Naturally this tubing must also be replaced with new material. If the repairman finds the old tubing sticking to the tracker bar nipples, resisting all efforts to scrape it off, he should cut the old tubing at the tracker bar, remove the tracker bar from the spool box, and soak it for a few hours in gasoline. This will penetrate the old rubber and cause it to lose its grip on the nipples. After soaking, the rubber residue can be removed quickly with a stiff wire brush, which will clean the nipples and leave them ready for the new tubing after the tracker bar has dried.

In general, it can be said that almost all pianos which were originally equipped with rubber tubing should be re-tubed when they are rebuilt. Occasionally a piano will be found with tubing which, inexplicably, is still good. However, if the repairman discovers any traces of hardening, stickiness, or loss of strength, he should proceed to re-tube the piano at once. He should use the phrase "when in doubt, re-tube" as his guide if he is undecided whether to replace it or not. The low cost of tracker bar tubing and the ease with which it is replaced certainly do not warrant taking any chances by leaving old tubing in service after it has begun to deteriorate.

Some pianos were equipped with a transposer, a device which changes the key of the music being played, in case a

singer wishes the music played in a certain key. This transposer is usually a lever at one side of the spool box with several notched positions, which, when moved, shifts the tracker bar from side to side, bringing different holes into alignment on the tracker bar. Pianos with transposing devices invariably have rubber tubing leading to the tracker bar. However, occasionally these pianos have rubber tubing leading only from the tracker bar to the back of the spool box, where, after passing through a row of nipples, it changes to metallic tubing. Sometimes the metal tubing in this arrangement is still good, while the rubber has hardened or otherwise deteriorated. The repairman should make it a strict point to trace the tubing carefully on pianos equipped with transposing devices, to catch any bad rubber tubing which may be in the assembly.

The actual operation of re-tubing the action is a simple one. The tubing is attached to a tracker bar nipple as it comes from the bundle. It is then run to the other nipple, and cut in such fashion that it can be attached to the nipple and still be slightly slack. The tubes are attached in order, and there is very little chance for mix-up. The sustaining pedal tube runs from the large hole at the left of the note holes, and usually goes from the tracker bar to a switch, which enables the player pianist to shut off the automatic sustaining pedal if he so desires. From the switch, it goes to the left end of the action, where it is usually attached to another nipple after the action is replaced in the piano. If the piano is equipped with an automatic tracking mechanism, this may also need to be re-tubed. Simply remove the old tubes to the automatic tracker one at a time, and replace them in this fashion.

PREFACE

THE PURPOSE of this book is to instruct the reader how to rebuild player pianos and related instruments. It is my intent to enable an individual who has had no previous experience in player piano work to do competent rebuilding of most types of roll-operated automatic pianos. This book cannot make an expert repairman out of a person who is unable to change a tire or replace a faucet washer. A certain amount of mechanical ability is essential for player piano work. However, if a reader with a modicum of mechanical ingenuity will follow this book's instructions, he should be able to do a passable job of rebuilding a player piano on his first attempt.

The scope of the book is the *rebuilding* of the player piano, as its title implies. I have not written, nor did I intend to write, a guide to *repairing* the player piano. If the reader expects to find a book full of handy tips for specific, on-the-spot repairing of players, he will be disappointed. This book will not tell "what to do if a Standard Player Action won't track," or "how to fix a stuck valve in an Apollo

player." The only way to learn to do repairing is first to learn to do rebuilding. Therefore, I have attempted to present as clear an account as possible of the processes involved in rebuilding pneumatic player mechanisms. Player pianos, with the exception of the new ones being built today, are "getting old." Many of them have ceased to function because of the deterioration of their pneumatic systems; and those which are still playing on their original systems will eventually need to be rebuilt. As the next decade elapses, fewer and fewer players will still be operating, and more will need rebuilding. I have chosen to concern myself with the complete restoration of the pneumatic actions, rather than with patchwork repairs which may only serve to keep the pianos functioning a little while longer. Any player piano, except the new ones, which is operating thirty years from now will have been *rebuilt*—and it is this facet of the field with which this book deals.

The main focus of the book is on the 88-note upright player piano. In my opinion, any novice should begin his piano-rebuilding career with a simple 88-note pedal player. After he has done several complete jobs on these, he will be ready to advance to more complex instruments such as nickelodeons and reproducing pianos. He should gain his basic, fundamental experience on a few 88-note pedal players before attempting anything else. Pedal players are generally the easiest and least complicated instruments to rebuild; and the novice can be secure in the knowledge that if he should happen to ruin the player mechanism irreparably in his first effort, he has not spoiled a very rare or valuable piece of equipment, as might be the case had he tackled a reproducing piano or a nickelodeon prematurely.

Any other miscellaneous pneumatics around the spool box should be re-covered at this time. Pianos with pneumatic tracking devices have a pair of tracker pneumatics which must be covered. Also, some players have pneumatics which actuate friction brakes on the roll drive transmission frame, to keep proper brake tension on the roll as it rewinds and plays. These pneumatics are re-covered using exactly the same procedure as was outlined in the section on re-covering striker stack pneumatics. The only difference between stack pneumatics and any other pneumatics is one of size and shape. They are all processed using the same technique.

The air-motor should now be removed from the player action for reconditioning. This is one of the most delicate mechanisms in the piano, and it must be rebuilt skillfully and carefully for good results.

The crankshaft brackets are unscrewed from the body of the air-motor, and the entire crankshaft and sliding valve assembly can generally be lifted away from the rest of the air-motor after the connecting rods from the individual pneumatics are disconnected. The repairman must now remove the individual air-motor pneumatics from their deck, after first numbering them to prevent incorrect replacement. Air-motors were constructed in literally dozens of ways, and again the repairman must use his ingenuity in lieu of any procedure which can be given here. Sometimes the pneumatics are screwed to the deck, and sometimes they can be removed after certain metal rods which hold the assembly together have been removed. However, in many cases they have been firmly glued to the deck, and the repairman must patiently attack them with his mallet and putty-knife until

they have been detached. The use of a hot iron to soften the glue, as outlined in the paragraph on removal of the stack pneumatics, may come in handy here.

After the pneumatics have been detached and cleaned, they are covered with new cloth. Large air-motor pneumatics should be re-covered with air-motor cloth, which is a double-weight cloth made expressly for this purpose. Smaller air-motor pneumatics should be covered with the regular thin cloth used on the stack striker pneumatics. The only criterion for judgment in this case is whether the use of the heavier cloth will cause internal friction in the air-motor. The heavier cloth will give longer service and will be less prone to wear out at the corners. However, it will also create considerably more friction and will offer more resistance to smooth rotation of the air-motor crankshaft. Large air-motors which have plenty of power can overcome this resistance, and can safely be covered with the heavier material; but smaller ones are often not able to handle the internal friction and thus operate erratically. A good general rule for this situation is: if the perimeter of the air-motor pneumatics is twenty inches or more, use double-weight cloth. If it is under twenty inches, use thin pneumatic cloth.

When the crankshaft and connecting rods are replaced, they should be inspected for wear. The crankshaft bearings and slide valve bearings usually are equipped with felt bushings, which may be worn. If wear is evident, the bearings should be detached from the shaft and the old felt removed and replaced with new material. Powdered graphite should be worked into the new felt to provide lubrication for the bearings. The felt along the edges of the sliders should be inspected and replaced if worn. If the air-motor jerks or

runs unevenly, check the sliders for warping or sticking. If any warping is detected, remove the defective slider and sand it true on a piece of fine sandpaper placed on a perfectly flat surface. After sanding, powdered graphite should be rubbed into the freshly-sanded wood to allow the slider to operate freely. If the air-motor runs unevenly and no warping of the sliders can be detected, check the adjustment of each slider to see that it is properly timed with respect to the ports which it alternately covers and uncovers. Most sliders operate over three ports, the center of which is the supply port, and the other two connect the suction supply to the pneumatics. Each slider should travel exactly the same distance each way from the center port. Check this adjustment carefully, and regulate it if necessary. Adjustment is usually made by screw threads somewhere in the slider linkage. On some air-motors, the slider rods may have to be bent to accomplish this adjustment. When the air-motor has been properly reconditioned and adjusted, it should operate without the slightest jerking or hesitation. Any irregularity in its operation evinces some defect in it which must be remedied before it is installed in the piano. Nothing is so exasperating to a player pianist as a halting, uneven motor, and the repairman should take special pains to see that the air-motor is perfect before he proceeds to the next step in the job.

At this time it is generally convenient to recondition the air-motor governor pneumatic. This is usually covered with the same material which was used on the air-motor. After the old fabric is removed from the governor, the interior parts of the unit should be thoroughly cleaned and dusted. If the piano has been used in a smoky atmosphere, the in-

terior of the governor will sometimes be sticky and dirty. All foreign material must be removed from the moving parts. Governors which work on the knife-valve principle may need to have the surfaces of the sliding parts sanded true, then impregnated with powdered graphite. If the governor contains screens or grids, they should be cleaned well. Before applying the new pneumatic fabric, the governor should be blown out with compressed air.

After the air-motor and governor are completed, and the stack is given a final check-over (which includes oiling the roll drive transmission and checking the brake adjustments), the repairman can turn his attention to the lower bellows unit, containing the pumps and reservoir.

The first step on the lower bellows unit is to check the bellows fabric carefully, to determine whether it is in need of replacement. Many player manufacturers used good-quality bellows fabric which still retains its life. This can be quickly determined by inspecting the bellows for cracks or holes at the inner creases, and by feeling the fabric. The pump bellows should be opened to their fullest extent and the creases in their inner folds examined very carefully, as this is where the first signs of deterioration occur. Any holes or worn-through spots in the fabric spell replacement at once. Also, any crackling or hardness of the fabric means that its life has vanished and dooms it to replacement.

If no holes or worn spots are visible, and if the fabric feels as though it has retained its life, the bellows may need little attention. This is quickly determined by sealing off all external openings to the bellows, with tape or other material, and by working one or both foot pedals to build up a vacuum

inside the bellows unit. A usable bellows unit should hold its vacuum for at least six or eight seconds, preferably longer. The bellows unit should be carefully checked for cracks in its wood, and if any are discovered they should be sealed by gluing a strip of pneumatic cloth over them, taking care to seal the open end-grain of the crack as well as its length. All screws in the entire unit should be tightened to insure snug, air-tight joints. If the external openings of the unit are tightly sealed off, and if the fabric is in good condition, the unit should maintain a vacuum for considerably longer than six or eight seconds. If the bellows unit meets this test, the fabric does not need to be replaced. The repairman should check the leather flap valves on the movable boards of the pumps, to determine their condition. Often they have become rotten or have curled up into an uneven strip which does not lie flat against the surface of the bellows board. In this case, they should be replaced with new strips of flap valve leather. Often the flap valves inside the pumps are in better condition than the external ones, due to their having been kept away from circulating air.

If the repairman determines that the bellows unit will maintain a strong vacuum for at least six seconds, and that its external flap valves are good (or have been replaced), he may proceed to re-install it in the piano. However, if all openings have been carefully sealed, the joints tightened, cracks sealed, and the unit will still not meet this test, it needs recovering. The bellows fabric may appear to be perfectly good, but unless the vacuum can be maintained for a minimum of six seconds, the fabric has deteriorated. Bellows fabric can be one of the most deceiving things in a player piano. The fabric can appear to be perfectly good, and can

even feel soft and usable to the touch—yet it can still be porous. When the defective fabric is removed and held up to a strong light, it will be discovered to be full of thousands of tiny holes through which air can leak. The repairman can *never* take for granted that pneumatic fabric is usable simply because it looks good and feels soft. It may be as porous as a sponge. This applies to all bellows cloth, thick and thin.

If the bellows unit is in need of covering, it should be dismantled and cleaned of its old fabric. On large bellows such as pumps and reservoirs, a block plane provides the easiest method of cleaning off old fabric and glue.

Care should be taken when dismantling the reservoir, for it contains one or more powerful leaf springs which can cause serious injury. If possible, the springs should be removed through the inner opening of the reservoir before the old fabric is removed. If this is not possible, the old cloth should be partially cut away, leaving a wide strip to hold the reservoir boards from springing apart until the springs can be removed through the holes in the cloth.

While the pumps are stripped of their fabric, the inner flap valves should be checked. Unless these flaps make perfectly tight seals against their respective bellows boards, leakage will occur which will impair the performance of the piano. The flaps should be inspected for dryness or brittleness in the leather, and especially for any curling or warping. Unless the flaps lie perfectly flat against the boards, they will not be airtight. Any signs of deterioration or curling of the flaps provide immediate cause for replacement. When new flaps are installed, they should be firmly anchored at the fixed end with glue *and* tacks. If both ends are

fixed, the flaps should be stretched tightly across the board before they are finally anchored. If one end of the flaps is spring-anchored, the springs should be under tension at all times, to keep the flaps tight and smooth.

When covering large spring-loaded bellows, the springs can often become troublesome. One way to get around this problem is to attach a piece of strong pneumatic cloth to the open end of the bellows. The cloth should be cut to a dimension equal to the normal span of the open end. It should be wide enough to withstand the full force of the springs, which will tend to pull it apart. The strip of cloth is attached to the open end of the pneumatic with glue and tacks. After it has thoroughly dried, the springs can be inserted into the open bellows through the sides. The bellows will then be held in an open position, and can be covered in the usual way. The fastener strip which is holding the bellows in normal position will not interfere with its operation after it is placed into service, as it can be covered up by the outer layer of cloth with no harm. Of course, the fastener strip should not be glued entirely to the outer cloth, as this would cause binding. It should be glued to the outer cloth only along the edges of the bellows, as in normal covering procedure.

The actual procedure of re-covering the bellows unit is exactly the same as that used in re-covering the strike pneumatics. The strip of heavy bellows cloth is torn or cut to a width equal to the span of the bellows, then glued on in the usual way. After drying, it is trimmed and creased. The spring blocks or any other miscellaneous hardware are then replaced on the bellows boards and the unit is reassembled.

The "accessory" devices are the last individual parts of the player action to require attention. Pianos which are equipped with pneumatically-operated "soft" controls will need repair on these devices. The repairman should keep in mind that these accessory pneumatics are operated and repaired in exactly the same manner as the rest of the pneumatic system. They usually consist of a good-sized pneumatic which does the work of moving the piano action part, a valve and pouch assembly to operate the pneumatic, a suction supply tube, and a control tube leading from the control rail. The pneumatic should be re-covered, usually with air-motor cloth, and the pouch checked, the valve cleaned, and the bleed cleared as usual.

The same procedure applies to the sustaining pedal pneumatic. Occasionally manufacturers used two valves to operate the pedal pneumatic, to provide extra-quick suction flow and prompt, responsive sustaining pedal action. This pneumatic should be re-covered with the medium cloth, and the valve, pouch, and bleed assemblies checked.

The final step in the complete rebuilding of a player piano is the installation, regulation, and testing of the player action parts.

The "accessory" mechanisms should be installed first, and connected to their respective controls. The lower bellows unit may then be installed and secured in its place, and the control rods may be connected to the bellows unit at this time. The pneumatic stack should then be lifted into place and fastened. Care should be taken to see that the striking fingers on the back of the stack and the parts against which they strike are in perfect alignment. Also, there should be no

lost motion between the striking fingers and the upper parts. The piano hammers should begin to move toward the strings the moment the pneumatics begin to collapse, with no lost motion or free play. Some players have an adjustment to lift the stack slightly to take up any lost motion. On pianos which have no adjustment, shims can usually be installed to move the stack slightly.

The stack supply hoses should then be connected, and the air-motor supply hose attached. New supply hose should always be used, as it is false economy to attempt to re-use the old hose. If the piano is equipped with an automatic pedal, the sustaining pedal tube should be connected at the left end of the stack. The upper and lower units should be given a general check-over to see that no rods, hoses, or other things are left disconnected.

The repairman should now test the player action for tightness and its ability to hold suction. The tracker bar should be sealed off with masking tape. The control lever should be moved to the "play" position, with the tempo lever at zero. When the pedals are pumped, the action should build up a strong vacuum inside it. After this has been built up, the repairman can determine how long this suction will maintain itself by watching the reservoir. After a good vacuum has been created and the repairman has stopped pumping the pedals, the reservoir should not reach the entirely-open point for at least five seconds.

No player action can be made entirely airtight. Every substance has a certain amount of porosity, and wood and leather are among the most porous of all materials. Every player action will gradually lose vacuum by "seepage" through the pores of the materials of which it is built. How-

ever, the natural losses of suction in a tight player action are such that it will hold a vacuum for at least five seconds, if the valves and all other external openings are tightly closed.

If the repairman determines that the action will maintain suction for approximately five seconds, he may congratulate himself on having performed a good job of rebuilding the player stack. However, if the reservoir opens in three seconds or less, the repairman should check carefully to determine whether any small leaks exist, which will rob the action of its suction.

If the repairman has a friend in the medical profession, he may be able to obtain a doctor's stethoscope, which is the finest instrument available for detecting and pinpointing vacuum leaks. A stethoscope of the open-end type is advisable, as the type with the closed diaphragm end is not satisfactory for detecting air-transmitted sounds. If a stethoscope is not readily available, a three-foot length of tracker bar tubing with one end inserted in the ear makes a usable leak detector, provided the other ear is plugged with cotton to seal out extraneous noises.

Assuming that the lower bellows unit was carefully tested before it was installed in the piano, the repairman can assume that the leak, if any, is in the upper action of the player, in the pneumatic control devices, or around the joints of the suction supply tubing. With the stethoscope or ear tube, every joint and seam in the pneumatic stack should be checked for leakage. The repairman should reach as far behind the stack as room will permit, to check the valves for hissing or leakage. The services of a second person may be put to good use while making these tests, as the repairman may find it awkward to try to pump the foot pedals, or even

one pedal, while he is checking for leaks—though if necessary it can be done by one person.

If leakage is discovered around any joints or seams, the screws holding the leaking parts should be checked for tightness and if possible drawn quite tightly to eliminate the leak. If any cracks in wooden parts are discovered, they may be sealed by gluing a strip of thin pneumatic cloth over them.

If the leakage is narrowed down to one or more of the action valves, the repairman should run the test roll over the piano several times. Occasionally valves do not seat properly after they have been removed for cleaning, and often the quick repetition section of the test roll will seat the valves well. If this is not the case, and one or more of the valves still loses suction, the stack will have to be removed (if the valves are located in the rear of the stack) and the offending valve taken out, brushed, its seat checked, and re-assembled.

After the repairman has determined that the player action will maintain a vacuum for the required time, he should check the operation and repetition of each individual note, using the test roll. Every note should operate and repeat with approximately the same speed. If any note fails to operate, this means (1) that the tube leading from the tracker bar to the action may be pinched off or otherwise obstructed; (2) that the pouch for that note may have blown out or come loose from its moorings; (3) that the valve for that note is jammed or otherwise prevented from moving; (4) that the pneumatic for that note is punctured or damaged; or (5) the push-rod of the pneumatic is binding against some fixed part of the piano action. The repairman should first check for a pinched tube, and if this is

found to be clear, the other things listed should be checked.

If any note makes a hissing sound while it is playing, this indicates that the valve is unable to seat itself completely against its top seat, due to dirt or some other obstruction. The valve will have to be removed and the foreign matter cleared.

If any note plays continuously and will not return to rest, this indicates (1) that the tube leading from the tracker bar is punctured or has pulled loose; (2) that the bleed is clogged, thus preventing the pouch and valve from returning to rest; (3) that the valve has somehow become jammed or stuck against its top seat and will not drop back again, or (4) that the pneumatic push-rod has jammed itself against some fixed part of the action, preventing the pneumatic from opening after its stroke. Occasionally dirt or foreign matter which is clogging a bleed can be loosened by vigorous pumping with a tracker bar pump; but if it is too firmly jammed into the bleed, the action must be dismantled to clean it out.

When all the notes are playing well, the air-motor and governor should be adjusted and calibrated. This is done using the test roll. After checking the top spool brake and adjusting it so that it maintains a moderate tension on the music roll during play, the repairman should put the test roll on the piano and begin playing it through, alternating every few seconds between very hard pumping and very light pumping. If the governor is adjusted properly, the roll will not vary in speed no matter how the piano is pumped. However, if any variation is noticed, the governor will have to be adjusted.

Governor construction varies immensely, and it is difficult

to give a procedure for adjusting individual units. However, governors may be generally divided into two classes: governors with an adjusting screw which limits the collapse of the governor pneumatic; and governors which have no limiting screw but which have an adjustable spring tension.

If the roll speeds up when the piano is pumped hard, screw the adjusting screw out a turn or two, if the governor is of the limiting-screw type. If it is of the adjustable-tension type, decrease the spring tension on the governor a little bit.

If the roll slows down or stops when the piano is pumped hard, screw in the adjusting screw, or increase the spring tension.

Move the adjustments only a little at a time. Never make more than one turn of the screw or move the spring more than one coil before trying the piano's performance again. Four or five tries may be necessary before the air-motor runs at a perfectly constant speed. Spend plenty of time on this adjustment, if necessary, as it is very important.

After the governor has been properly adjusted, the tempo of the roll should be fairly close to correct. However, it should be exactly calibrated using the tempo-test section of the test roll. This is a measured section which should pass over the tracker bar in a certain time. A tempo of 70 means that seven feet of music roll should pass the tracker bar in one minute; likewise the number of feet at any other setting is obtained by dividing the tempo setting by ten. If the time is more than it should be, the roll is running too slowly; if less, it is running too fast. Adjustment is made at the rod which slides into the tempo box. Move the tempo lever back and forth and watch its linkage in the lower part of the piano. There will be leather-nut adjusters on the threaded end of

the sliding rod which enters the tempo box. To speed up the roll, the sliding rod is *usually* adjusted such that it will pull farther out of the box; however, this varies on some pianos. One trial will enable the repairman to determine which way the adjustment is made.

After a final check of the "accessories" to determine whether the automatic pedal mechanism and the expression pneumatics are operating, the repairman is ready to sample the fruits of his labor. The piano should now play well—and the repairman can discover the glow of satisfaction and pride which comes from a job well done!

This book contains little material on nickelodeons, and none on band organs and other automatic instruments. Since the book is intended to be an instructor in the basic technique of rebuilding pneumatic player instruments, I see no need to include material on specific types of instruments, with the exception of the reproducing piano. The procedure for re-covering a pneumatic is the same whether the pneumatic happens to come from a nickelodeon, a reproducing piano, an 88-note player, or a band organ. Once the basic procedures of rebuilding are learned, the repairman can take any sort of instrument in his stride. For this reason too, this book does not deal with the rebuilding of each individual make of piano. Not only are there far too many brands to deal with specifically, but it is unnecessary to do so. Anyone can figure out how to take a piano's player action apart: what this book attempts to do is to explain what to do *after* it is apart.

The reproducing piano section, dealing with the Ampico, the Duo-Art, and the Welte-Mignon players, does deal specifically with some of the problems which arise in connection with these instruments. Reproducing pianos are extremely sensitive machines, and certain special techniques are necessary in their adjustment and maintenance. Although reprints of the factory service manuals for the Ampico, the Duo-Art, and the Welte-Mignon are available, they all leave much to the imagination, and often are grossly incomplete. Therefore, the reproducing piano section of this book was written as a supplement to the manuals. There is currently a revival of interest in reproducing pianos, and owing to the scarcity of technicians who are thoroughly conversant with the intricacies of their mechanisms, I

deemed it advisable to include a section dealing with their specific service problems.

The section on reed organ repair is admittedly short; but its length is proportionate to the difficulty of the subject matter. Most reed organs can be repaired easily, and the task is more tedious than difficult. Although reed organs are only remotely related to player pianos, I have included information on their repair because of the increasing number of people who wish to restore old organs for use in homes. Since the techniques of repairing organs are not too much different from those of repairing player pianos, it seemed apropos to include them here.

It is highly recommended that entire sections of the book be read at one time. This is advantageous not only in that the reader can carry his train of thought to its conclusion, but also because of the nature of the material presented. Technical material is difficult to compress; and, due to the mechanics of literary presentation, one occasionally has to get ahead of oneself, so to speak. When describing, in detail, the procedure of performing a certain operation, it is not always possible to present the various steps in order. Occasionally, an operation must be begun before the previous one is completed—yet the instructional material would become incoherent if presented in this manner. For this reason, it is wise to read an entire section through to get the general picture of what must be done, before starting to do the described work.

Since this is the first publication dealing with player piano rebuilding which approaches book length, I have had no predecessors on whom to build or to enlarge. As is generally the case with "firsts" in any field, this book will probably be

criticized as incomplete or inadequate in certain sections of its subject matter. In defense of this criticism, I can only say that the book has been written solely from my personal experience as a collector and restorer of automatic pianos. If my experience has been somewhat one-sided in any aspects of the field, I have no doubt that it will show up in this book. However, one has to begin somewhere; and the need for a technical treatise on rebuilding the player piano is presently so great that this book, adequate or not, will, I hope, perform its intended service.

I am grateful to the individuals who have encouraged and assisted my efforts. In particular, I wish to thank Durrell Armstrong, Roy Haning, and Harvey Roehl for their contributions of needed information and advice.

LARRY GIVENS
January, 1963

HOW IT WORKS

BEFORE BEGINNING to discuss the technique of rebuilding the player piano, it may be well to give the reader a brief illustrated outline of its operation. An understanding of how the player piano works—what makes it play—is essential for a repairman who expects to produce a good job.

The player piano operates using vacuum, or suction, as its motive power. In most players, the vacuum is created by pedaling with the feet, which operates suction bellows in the lower portion of the piano. This vacuum is channeled through large supply hoses into the upper action of the piano, where it does the work of playing the keys.

Probably the most important parts of the player piano are its valves and pneumatics. These parts utilize the vacuum and actuate the piano's notes. Each note has its individual valve and pneumatic unit. The valve controls the suction which collapses the pneumatic on cue from the music roll. The pneumatic, which is nothing more than a small bellows with a push-rod attached, operates its piano note by suddenly collapsing, due to the rapid admission of vacuum to its interior. The note strikes with a loudness

which is proportional to the degree of suction which actuates its pneumatic.

Figure 1 is a drawing of a typical valve and pneumatic unit, in schematic form. The tube A leads from the suction supply bellows, and provides motive power to actuate the valve B and collapse the pneumatic C. Tube D leads from the tracker bar (the brass or wooden bar over which the music roll plays). When a perforation in the music roll passes over the tracker bar, air is admitted through tube D. This air allows the pouch E (a flexible diaphragm of very thin leather) to rise, due to the vacuum above it. Pouch E, in rising, carries with it the valve B, lifting the valve away from its lower seat and throwing it upwards against its upper seat. This seals off the hole in the upper valve seat, and allows vacuum to rush up past the valve stem through the hole in the lower valve seat, and into the pneumatic C. Thus the pneumatic collapses, and pushes rod F upwards which plays a note on the piano. When the perforation passes away from the tracker bar, the tube D is once again sealed off, and vacuum is admitted to the chamber underneath the pouch E through the small hole G, called the bleed (usually a small stamped brass cup with a hole in its base). Atmospheric pressure on top of the valve B forces the valve downward onto its lower seat. This seals off the suction supply to the pneumatic C, and allows atmosphere to rush into the pneumatic through the hole in the upper valve seat, thus opening the pneumatic again.

Figure 2 is an actual cross section of the modern Pianola, reproduced by permission of the Hardman-Peck Company, its manufacturer. Note that it operates on the single-valve principle.

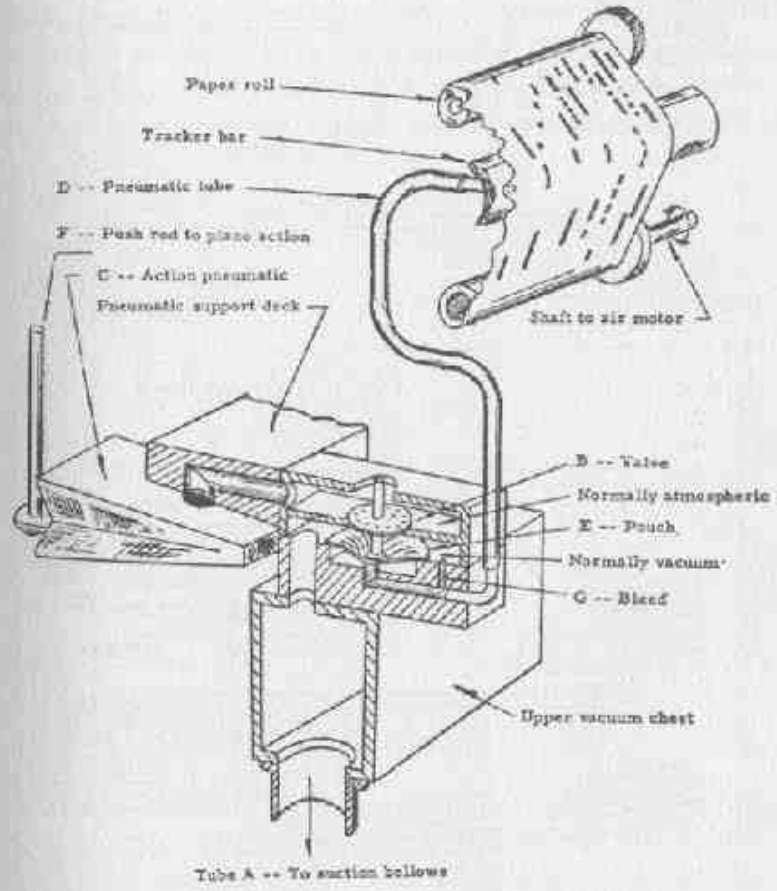


Fig. 1. Single Valve Pneumatic System

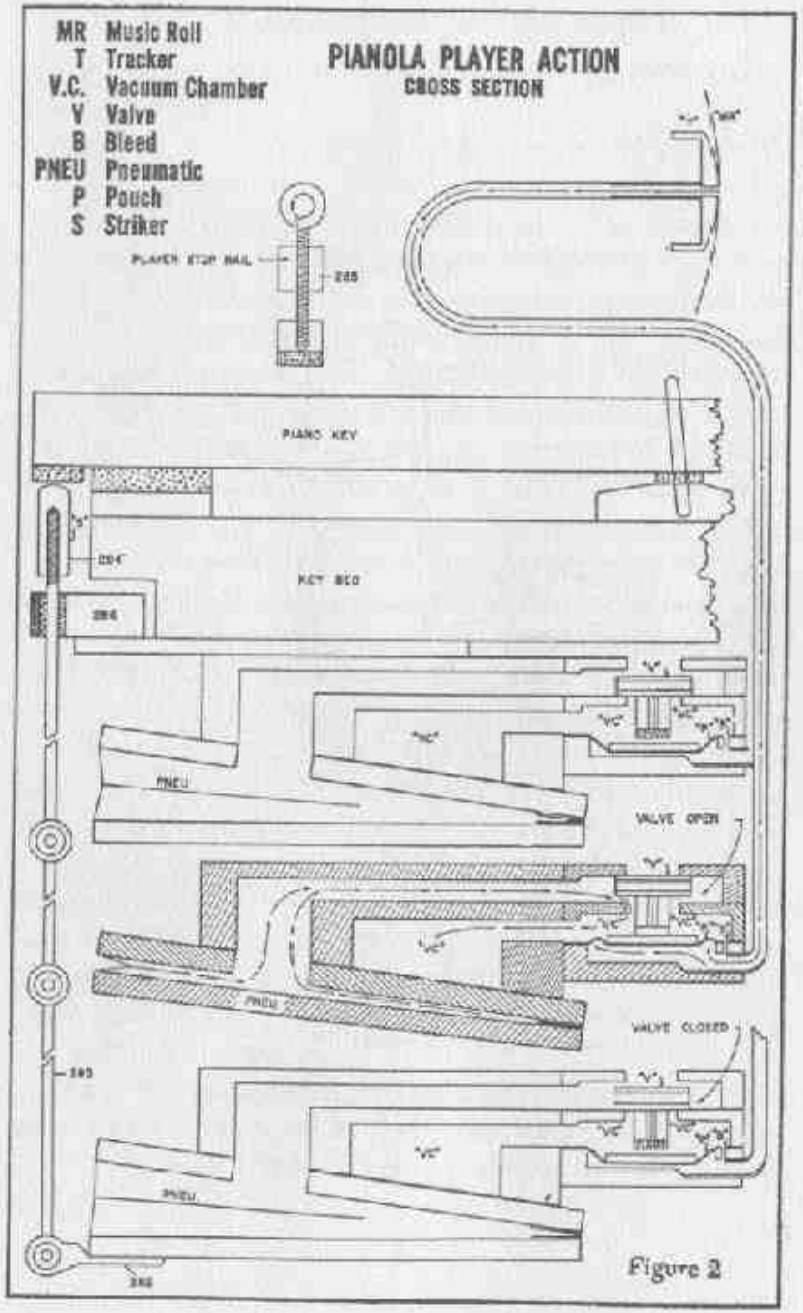


Figure 2

HOW IT WORKS

A variation on this mechanism is found in pianos which are built with a double-valve action. In this case, two valves per note are used. The first, or primary, valve actuates the main, or secondary, valve, which operates the pneumatic in normal fashion. Figure 3 is a drawing of a typical double-valve action. The two tubes A are suction supply tubes. Tube B leads from the tracker bar. When a note perforation

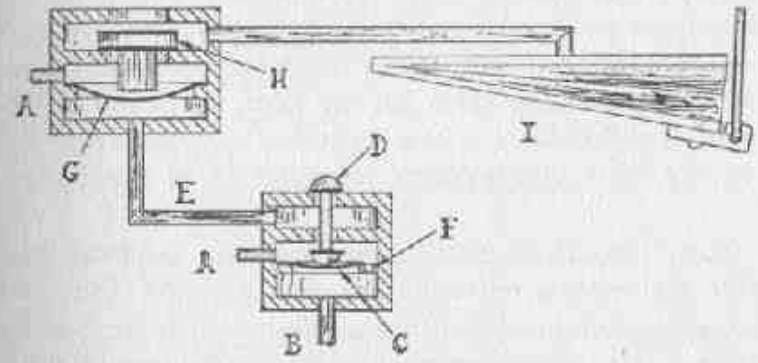


Fig. 3. A Typical Double-valve Action

A—Suction supply
B—Tube from tracker bar
C—Primary pouch
D—Primary valve
E—Channel from primary to secondary valve
F—Primary bleed
G—Secondary pouch
H—Secondary valve
I—Pneumatic

opens the tracker bar hole, primary pouch C rises, lifting primary valve D. As the valve moves, its top part is lifted away from the upper valve seat, admitting atmosphere into channel E. At the same time the lower part of the valve is thrown against the lower seat, shutting off vacuum to channel E. The effect of this is to admit atmosphere to the chamber beneath the secondary valve pouch G, causing

it to rise and to throw secondary valve H against its upper seat, closing off atmosphere to pneumatic I and admitting suction to it. Thus the pneumatic closes. When the perforation passes away from the tracker bar, the bleed F restores the vacuum beneath the primary pouch C, the primary valve D drops to its rest position, and atmosphere in tube E is sealed off. Vacuum is admitted to tube E, and this pulls secondary pouch G down again, allowing secondary valve H to drop to its position of rest and admit atmosphere to pneumatic I, causing it to open. In the double-valve player action, the secondary valve has no bleed, as the secondary pouch is pulled down to its rest position by vacuum from the primary valve, thus making a secondary bleed unnecessary.

The air-motor provides motive power for the music roll. This air-motor is nothing more than a series of bellows connected to a crankshaft in such fashion that the bellows collapse in a certain order when vacuum is alternately admitted and shut off by a series of eccentric-driven sliding valves, causing the crankshaft to rotate. The vacuum supply to the air-motor is channeled through a governing device which assures constant speed of the air-motor regardless of what vacuum may be present in the main supply bellows (i. e., regardless of how hard the player pianist pumps the pedals). Different types of governors are found in player pianos, but the basic principle of their operation is always the same. They control the flow of vacuum to the air-motor, thus controlling its speed. The governor is usually a fairly large pneumatic, through which the vacuum supply to the air-motor flows. Inside this pneumatic is some sort of "strangling" device, usually a sliding valve made of wood

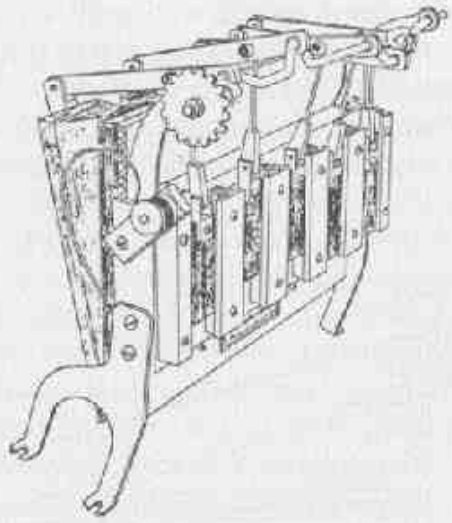


Fig. 4. An Air-motor

or metal—see Figure 5. A spring attached to the pneumatic exerts constant force on it, tending to keep it open at all times. As the player pianist pumps, the suction to the air-motor flows into the governor pneumatic through a supply hose, and out again through another hose, after passing through the sliding valve inside the pneumatic. This suction tends to partially collapse the pneumatic, against the force of the spring. This collapsing of the pneumatic moves the sliding valve's position, and partially constricts the flow of suction through the pneumatic. If the player pianist pumps harder, the air-motor would naturally tend to speed up, due to higher vacuum turning it. However, in this case the governor pneumatic collapses farther, moving the sliding valve so that it closes off the suction supply opening still more, thus reducing the supply of suction to the air-