



*The*  
**DUO-ART**  
Reproducing Piano



*Duo-Art Service Department*  
*The* **AEOLIAN COMPANY**  
*Aeolian Hall*  
NEW YORK

# *The* DUO-ART

PIANOLA PIANO

PRELIMINARY INSTRUCTION PAMPHLET



Operation of DUO-ART Dynamic Control

and

How To

TEST and ADJUST

## INTRODUCTION

The object of this pamphlet is to give a clear and concise working knowledge of the Duo-Art Pianola Piano. It is obvious that in these few pages the aforementioned subjects will have to be treated briefly, and that a great deal necessarily will have to be taken for granted that the mechanic already knows, such as a general knowledge of pneumatics, and something of electricity. There is nothing really complicated or intricate about the Duo-Art and once its principles are understood it will be realized what a truly remarkable yet simple instrument it is. These instructions are based upon the upright Duo-Art but would apply generally to the Grand as it differs only in design.

### OPERATION OF DUO-ART DYNAMIC CONTROL

The above subject will be treated under four sub-headings, namely:

1. Dynamic Step Control
2. Accompaniment Control
3. Theme Control
4. Manual Control

### DYNAMIC STEP CONTROL

The Duo-Art dynamic control has 15 steps or degrees of loudness, and with the fundamental or zero degree, sixteen.

By zero degree is meant the normal Duo-Art. The zero degree is not called a step. To put it simply, it is the foundation or basis upon which all the higher degrees are built. As will be explained later in the Duo-Art test, this zero degree should be as low or soft, as possible.

The 15 steps are controlled by four holes in the tracker bar at both the treble and bass ends of bar, above the regular piano notes. (which are inoperative with the Duo-Art lever "ON") The four holes at bass end of bar control the accompaniment side of the expression box and the four in the treble end control the theme side of the box, in conjunction with additional holes in the bar (B Theme & T Theme - see diagram No. 1).

These holes in both bass and treble are numbered from the outside in (see diagram no. 1) Nos. 1, 2, 4, 8. It will be noticed that each number is double its predecessor and that is exactly what they are in dynamic power. From the tracker bar, these dynamic control tubes lead through two cut-off pouch blocks, (see diagram no. 2, no. 4) and from there to dynamic valve box, (no. 28) which controls the accordin dynamics (nos. 26, 27). Each of these accordin dynamics has four small pneumatics, each set to collapse a certain distance by small adjusting screws.

Number one in both accompaniment and theme controls the top or smallest pneumatic of the four and collapses 1/16".

Number two on each side controls the next pneumatic and collapses 1/8".

Number four on each side controls the next pneumatic and collapses 1/4".

Number eight on each side controls the bottom, or largest, pneumatic and collapses 1/2".

This makes a total, with all collapsed, of 15/16". These pneumatics can work separately or in combinations, or all together. There are 15 combinations possible with these dynamics.

### COMBINATIONS

|          |             |                   |
|----------|-------------|-------------------|
| Step 1.  | Valves open | No. 1             |
| Step 2.  | Valves open | No. 2             |
| Step 3.  | Valves open | No. 2 - 1         |
| Step 4.  | Valves open | No. 4             |
| Step 5.  | Valves open | No. 4 - 1         |
| Step 6.  | Valves open | No. 4 - 2         |
| Step 7.  | Valves open | No. 4 - 2 - 1     |
| Step 8.  | Valves open | No. 8             |
| Step 9.  | Valves open | No. 8 - 1         |
| Step 10. | Valves open | No. 8 - 2         |
| Step 11. | Valves open | No. 8 - 2 - 1     |
| Step 12. | Valves open | No. 8 - 4         |
| Step 13. | Valves open | No. 8 - 4 - 1     |
| Step 14. | Valves open | No. 8 - 4 - 2     |
| Step 15. | Valves open | No. 8 - 4 - 2 - 1 |

Number 1 collapses 1/16 inch

Number 2 collapses 1/8 inch

Number 4 collapses 1/4 inch

Number 8 collapses 1/2 inch

Total collapse, 15/16 inch.

It will be observed that the accordin dynamics are connected by a rod at the top of the dynamics to an arm, which when pulled down opens a knife valve (see nos. 16, 17). These knife valves operate over port holes leading to the pump, and the degree to which these holes are opened determines the loudness of the playing. The Duo-Art normally is under low pump tension, drawing in the atmosphere through a spill valve (see no. 18) and exhausting through the pump. This spill valve is completely cut off by either the accompaniment or theme dynamics at the 10th step. Note connection of spill valve to both the accompaniment and theme sides of expression box, and as either knife valve is pulled down, or opened, by dynamics, they push against rocker arms mounted on a shaft at the back of the expression box and the knife valve closes off the intake, or what is termed "spill".

### ACCOMPANIMENT CONTROL

A very important feature of the Duo-Art dynamic control is that either the accompaniment or theme side of the expression box can control the entire keyboard, or one can control the bass while the other controls the treble, or vice versa. This gives great flexibility of control and the advantages of such a system are innumerable. This is a feature found only in the Duo-Art. The regular player action is divided between the 43rd & 44th notes.

The air is exhausted from player action into chambers Nos. 6 & 8 of expression box, through flap valves Nos. 9 & 10 into chamber 7, and down through channel 14 into accompaniment regulator. Here it passes through knife valve 16 and along channel to pump where it is exhausted.

The theme secondary valves (11 & 12) are normally closed.

As has been explained, the degree to which knife valve in the accompaniment regulator is opened determines the loudness of the playing.

### THEME CONTROL

The theme dynamics (No. 27) control the degree with which accented notes are struck, but it is the valves (11 & 12) which are controlled by holes in tracker (marked B theme & T theme) operating theme primary valves (5) that determine when theme shall operate.

The air is exhausted from player action into chambers (6 & 8) of expression box. Now theme control holes in tracker bar are opened admitting atmosphere to pouches under primary valves (5) raising them, and putting secondary valves (11 & 12) under suction, causing them to drop and making a passage for air to channel 13 where it follows to passage 15 into theme regulator. Here it passes through knife valve (17) and into channel leading to the pump, where it is exhausted.

—Showing how accompaniment side can control the treble while theme side controls the bass, or vice versa.—

### ACCOMPANIMENT CONTROL OF TREBLE

The air comes into chamber (8) from player action, and theme valve (12) being closed, passes through flap valve (10) into chamber (7) through channel (14) into accompaniment regulator, through knife valve (16) and to the pump.

### THEME CONTROL OF BASS

Air comes into the chamber (6) from player action and theme valve (11) being open due to bass theme hole in tracker being opened, the air passes into channel 13 and then through passage 15 into theme regulator, on through knife valve 17, and to the pump. It should be understood that the air once in chamber 7 cannot return to chambers 6 & 8. A study of the flap valves 9 & 10 will be self-explanatory.

### MANUAL CONTROL

Other remarkable features of the Duo-Art Pianola Piano are the devices for its manual control. This system is equalled by few, if any, and surpassed by none. This system is controlled by five levers, four of which are in front of the keys and one in the spool box.

The first lever on key front to the left is called the theme modulating lever. This lever controls the degree at which theme notes are played, but unless worked in conjunction with the two little levers on the key front next to the right, one above the other, there is no noticeable result. As will be noticed in the diagram, the theme modulating lever is connected to the theme knife valve regulator, and as the lever is pushed to the right, it pulls down and opens knife valve (17) but as long as valves 11 & 12 are closed, it has no effect.

These two levers to the right, one above the other, control theme primary valves (5). The topmost one controls the bass, and the bottom one, the treble. The modulating lever controls the degree, and these bass and treble levers, the time, when the theme shall operate.

The next lever is called the Temponamic Lever. This controls the tempo by its side motion, and accompaniment expression by its rotating motion.

By turning this disc to the right, it pulls down on arm, regulating the knife valve, and opens a port leading to the pump. The more this port is opened, the louder the playing.

The fifth control is the Duo-Art lever in the spool box. This lever should be in the "Duo-Art ON" position for all Duo-Art rolls to be played automatically. To play Duo-Art rolls with personal expression, have this lever in the central position. For all other 88-note rolls, have this lever at "OFF".

When the Duo-Art lever is thrown to the center, or neutral position (or to the OFF position) the little pneumatic (25) collapses to the point adjusted to by the screw in the moveable board of the pneumatic and pulls down on the arm controlling the accompaniment knife valve, thus making the zero degree louder when the Duo-Art lever is at "OFF". It has no other function.

#### HOW TO TEST AND ADJUST THE DUO-ART

This test will be in a series of steps (12 in number) and will cover all points necessary for a thorough inspection and adjustment of the instrument.

#### STEPS IN TEST

- Step 1. Tracker box gearing and connections.
- Step 2. Electric motor, pump, and connections.
- Step 3. Tracking device.
- Step 4. Tempo.
- Step 5. Sustaining pedal.
- Step 6. Soft pedal. (Hammer-rail lift)
- Step 7. Dynamics.
- Step 8. Accompaniment zero setting.
- Step 9. Theme zero setting.
- Step 10. Notes.
- Step 11. Dynamic Chord test.
- Step 12. Re-roll.

#### IMPORTANT

Before beginning the Duo-Art test, it is advisable to see that the piano action is properly adjusted, and a few words here on that subject would not be out of place.

As is well known, all piano actions are more or less affected by extreme dampness or by dry weather, which tends to alter their regulation, thereby making it difficult for the player to function properly.

Push the hammer rail toward the strings and let it back quickly. If the hammers are slow in returning, the action is damp and swollen, and must be remedied before going further.

See that there is no lost motion in jacks. See that the hammer escapement (let-off) is properly adjusted; it should average 1/8" or less from the strings. Now see that the hammers check about 5/8" from the strings.

These are the most essential adjustments in relation to the player action and under no circumstances should they be overlooked. The more the mechanic knows of piano action regulation the finer results he can get from the player action. Now see that there is no lost motion between the player action pitmans and the wippens on the piano action. See that the stroke on the player is the same as the hammer check on the piano action. This is a common adjustment to all player actions and need not be explained here. Make sure player action is screwed fast; all tubes are secure, rods connected, and working freely.

#### SPOOL BOX GEARING AND CONNECTIONS

##### Step 1.

See that the gearing is properly oiled, and all set screws tightened.

Set the re-roll and play brakes.

See that the sprocket chains are not too loose nor tight.

Have all parts on wind motor free but not noisy. Use no oil on the wind motor.

Pump out tracker bar and insert test roll in spool box.

#### ELECTRIC MOTOR, PUMP AND CONNECTIONS

##### Step 2.

Connect electric cord to conduit in back of piano and make sure the current is on.

Be sure the motor is proper for local current.

Have motor hand level and with enough tension on belts so that they will not slip.

See that motor is properly lubricated and set screw in the pulley is tight.

See that the armature on the motor rotates freely.

Now turn on switch - if motor does not start instantly, turn off switch or motor will burn out.

##### Notes on Duo-Art Motors

There are two types of motors used; 1/4 horsepower motor being used with the six feeder type pump, and 1/8 horsepower with the four feeder pump. Both motors run at 1150 rpm in both AD and DC models.

All AC motors are 60 cycle.

To change rotation of DC motors, reverse leads at brush box.

To change rotation of AC motors interchange two leads coming through bushing cover.

##### (Step 2 continued)

After motor has been inspected, have idler on pump belts set reasonably tight and on slack side of belts. Now see that grease cups on pump are filled and turn plungers down a bit to force grease into bearings. Have pump quiet and time pulsations. A pulsation is the opening and closing once, of one feeder. Six feeder type pump should pulse 70 - 72 times per minute, and the four feeder type 120 times per minute.

To change speed either way it would be necessary to change the size of pulley on motor. Duo-Art motors are furnished with proper size pulley to give required pulsations, and before any change of pulley is made, it would be advisable to make certain that the voltage of current supplied is correct.

#### TRACKING DEVICE

##### Step 3.

Make sure your test roll measures eleven and one quarter inches in width. If not, use a roll that does. Have music spool shaft in center of shifting cam and shifting pneumatics centered. These are adjusted on shifting rod at back and left of spool box, by a small turnbuckle. Now with roll running, adjust tracker lugs so that they just barely touch the edge of the roll.

#### TEMPO DUO-ART LEVER "OFF"

##### Step 4.

Follow tests on roll in rotation. With tempo indicator at 70, roll should run seven feet per minute. Tempo should cut off with indicator at extreme left and just start at ten. To run faster, tighten spring on governor; to run slower, weaken spring.

#### SUSTAINING PEDAL

##### Step 5.

The sustaining pedal is controlled by second hole in bass end of tracker bar. Flat dampers should clear strings about 1/8" with pedal on. Dampers should come back to strings between each bridge in the test roll with tempo set at 70.

It will be noticed that the sustaining pedal, soft pedal and dynamics get their supply from a pneumatic tension regulator. This regulator keeps their supply under even tension. This is done by a spring attached to it. Adjust spring so that pedals and dynamics work quickly but not noisily. To operate faster, strengthen spring; slower, weaken spring.

## SOFT PEDAL

### Step 6.

The soft pedal is controlled by the last hole in the treble end of the tracker. On uprights, rail should move to 1/8" from the strings. On grands, rail should lift 5/8 from normal position.

## DYNAMICS

### Step 7.

#### ACCOMPANIMENT (Duo-Art lever "ON")

The accompaniment dynamics are operated from the bass end of tracker bar, above ordinary piano notes, and are numbered 1,2,4,8. These dynamics should operate in order given.

#### THEME

These dynamics are operated by four holes in the treble end of tracker bar above piano notes and are the same as accompaniment dynamics, 1,2,4,8, and should operate in order given.

#### ACCOMPANIMENT SETTING OF ZERO DYNAMIC

### Step 8.

Tempo at 80

#### Warning:

This is the most delicate and important adjustment in the entire test and great care must be taken in this adjustment. On its setting depends the ability of the instrument to play the soft runs and trills in the music so much desired by all music lovers.

First throw off electric switch and see that regulator springs (21 & 22) have a little tension, just enough to keep them from rattling. Use adjusting rings (23 & 24). Now see that all tension springs on the expression box have a little tension on them. See that the rocker arms controlling spill valve when pushed back move forward again quickly. Also have arms regulating knife valves come back quickly.

Have all rods and shafts on expression box free from binding and squeaking. A very important thing to watch is that there is no pressure against knife valve regulating arms, otherwise the knife valves would open a little and this would make it impossible to properly adjust zero dynamics. Also, there should be no slack in arms resting on knife valve regulators as this is just as bad as the previous condition mentioned. The little leather adjusting nuts on top of accordion dynamics (26 & 27) on rod to knife valves should not be tampered with as they are set properly at the factory and seldom if ever need resetting. If the accordion pneumatics have a little slack or sag, from leather stretching, it is permissible to take this up on these leather nuts, being careful not to put too much tension on the rod as this will open knife valve and this adjustment **must** be made **before** setting accompaniment or theme regulators as it will throw out their setting if done after they are adjusted. It is, however, rare that these nuts will need any adjustment.

Throw on electric switch and observe softness of notes on accompaniment tests. It will be noticed that sustaining pedal is on with the first run of notes, making them easier to play and off with the next run. Notes should play very softly and on the next run should miss most of them, or strike an occasional note. The third run of accompaniment test is similar to the first.. If on the second run of notes in accompaniment setting of zero dynamic all notes strike full, playing is too loud and must be softened. To soften, adjustment is made on knife valve adjusting screw (19) and next to this adjusting screw is a small set screw (19-a). **This must be loosened before trying to turn adjusting screw or thread will be stripped. Immediately after adjusting screw is set, tighten lock screw as there is a little play in knife valve shaft unless this is tightened and it would be impossible with lock screws loose to make fine adjustment.**

On uprights, to soften, turn adjusting screws to left, and to the right to make louder.

On grands it is just the reverse, as the expression boxes are installed just the opposite way. It takes only a slight turn of the adjusting screw to make a great difference.

In making this adjustment always get a blank setting on the test roll, have motor running and tempo cut off. Watch accompaniment regulator pneumatic while setting screw; softening causes it to open and the reverse causes it to collapse. Adjustment can be gauged accordingly. Patience is required in making this adjustment, but with a little practice it comes readily. As will be observed, knife valve has to be adjusted to take first run of notes softly, but skip or miss most of notes on second run.

#### TO SET SOLO OR THEME DYNAMIC

### Step 9.

The theme adjustment is made on adjusting screw similar to accompaniment side (see No. 20). It also has a set screw (20-a) **which must be loosened** while adjusting screw is being set, and tightened **immediately**.

The setting of theme side is dependent upon the setting of the accompaniment as no matter where the latter is set, theme must be one degree louder. Naturally, the conception of "one degree" will vary with the individual, but a uniformly safe rule to follow is to have the theme regulator pneumatic collapse 1/8" more than the accompaniment pneumatic. **Never have theme pneumatic even with, nor opened more, than accompaniment.**

## NOTES

### Step 10.

Notes should all strike evenly and softly on this test. We will not go into a discussion here of the ordinary note troubles as the mechanic is unquestionably able to handle any trouble arising with them.

#### DYNAMICS CHORD TEST

### Step 11.

These chord tests show if dynamics build up evenly. If accompaniment setting of zero dynamic was properly adjusted, the first three chord tests will be found very near right. A slight adjustment on the regulator springs (21 & 22) is permissible, but any radical adjustment will throw accompaniment setting of zero dynamic out, and care **must** be taken to avoid this. It may be necessary to meet chord tests to reset accompaniment and theme zero dynamics a little. The last eight chord tests show evenness of dynamics in building up, and if pump has been properly tested and all adjustments made correctly up to this point, instrument should meet these test.

Following on the test roll are two selections of music especially selected to try out the responsiveness of the dynamic mechanism.

#### RE-ROLL

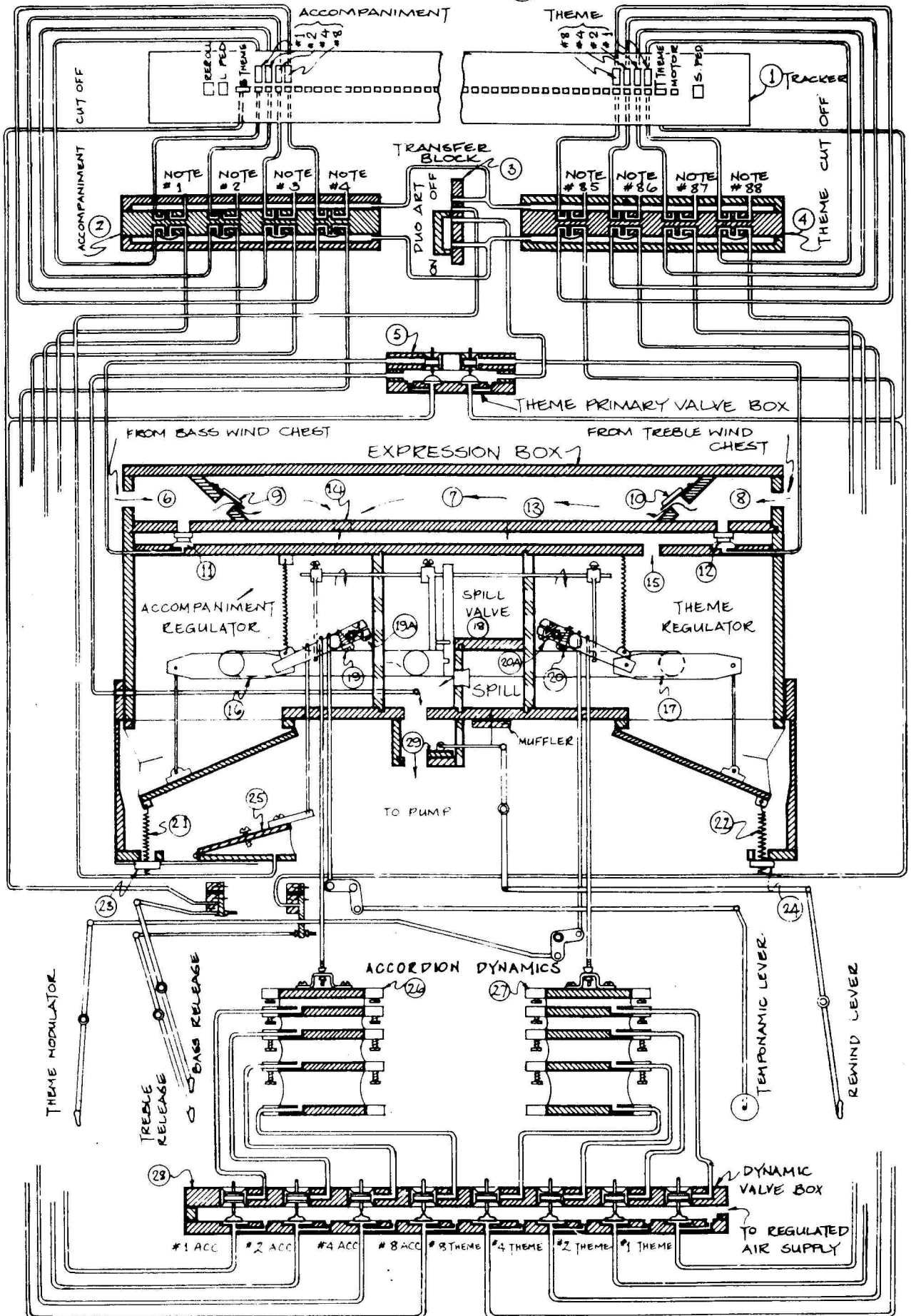
### Step 12.

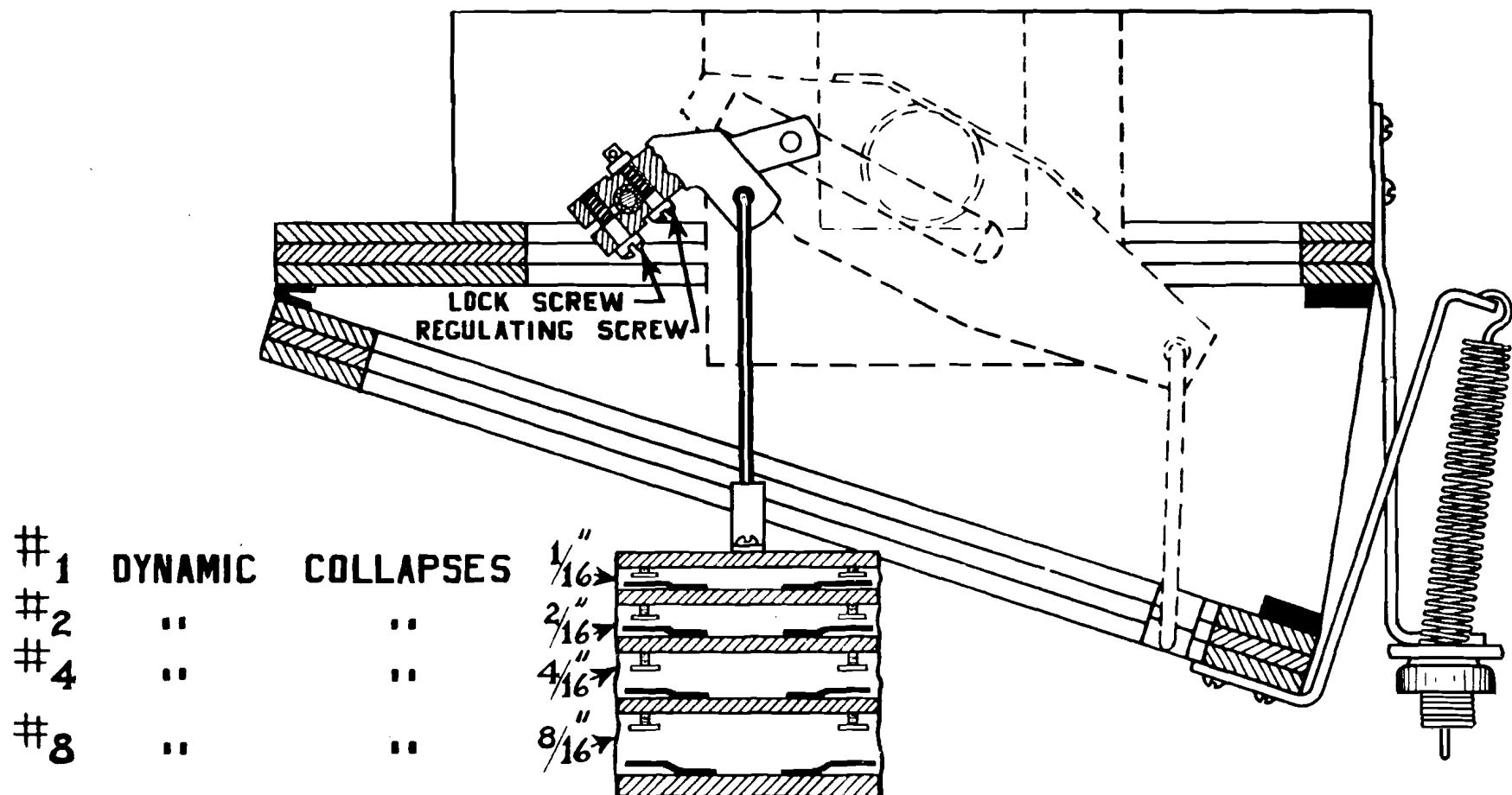
The re-roll is operated by the first hole in the bass end of the tracker bar, and throws the gearing into reverse and cuts off air to action slide valve (29).

If slide valve (29) did not completely cover the port on re-roll, the piano would play in the re-roll mode. This seldom happens, but it is possible. The mechanic should always remember in locating trouble that there is only one sure method to follow without tearing everything to pieces, and that is to locate the trouble by a process of elimination.



# DIAGRAM OF DUO ART EXPRESSION CONTROL DIAGRAM (A)





### *INSTRUCTIONS FOR ACCOMPANIMENT ZERO SETTING*

First see that dynamic lever, on extreme left of keyboard, is on normal. All dynamics should be open. Loosen lock screw by turning to the left. Start piano and turn regulating screw to the right to make "soft" to the left "loud" on the GRAND. On the UPRIGHT piano to the left to make "soft" to the right "loud." When regulation is completed tighten lock screw by turning to the right locking zero setting.

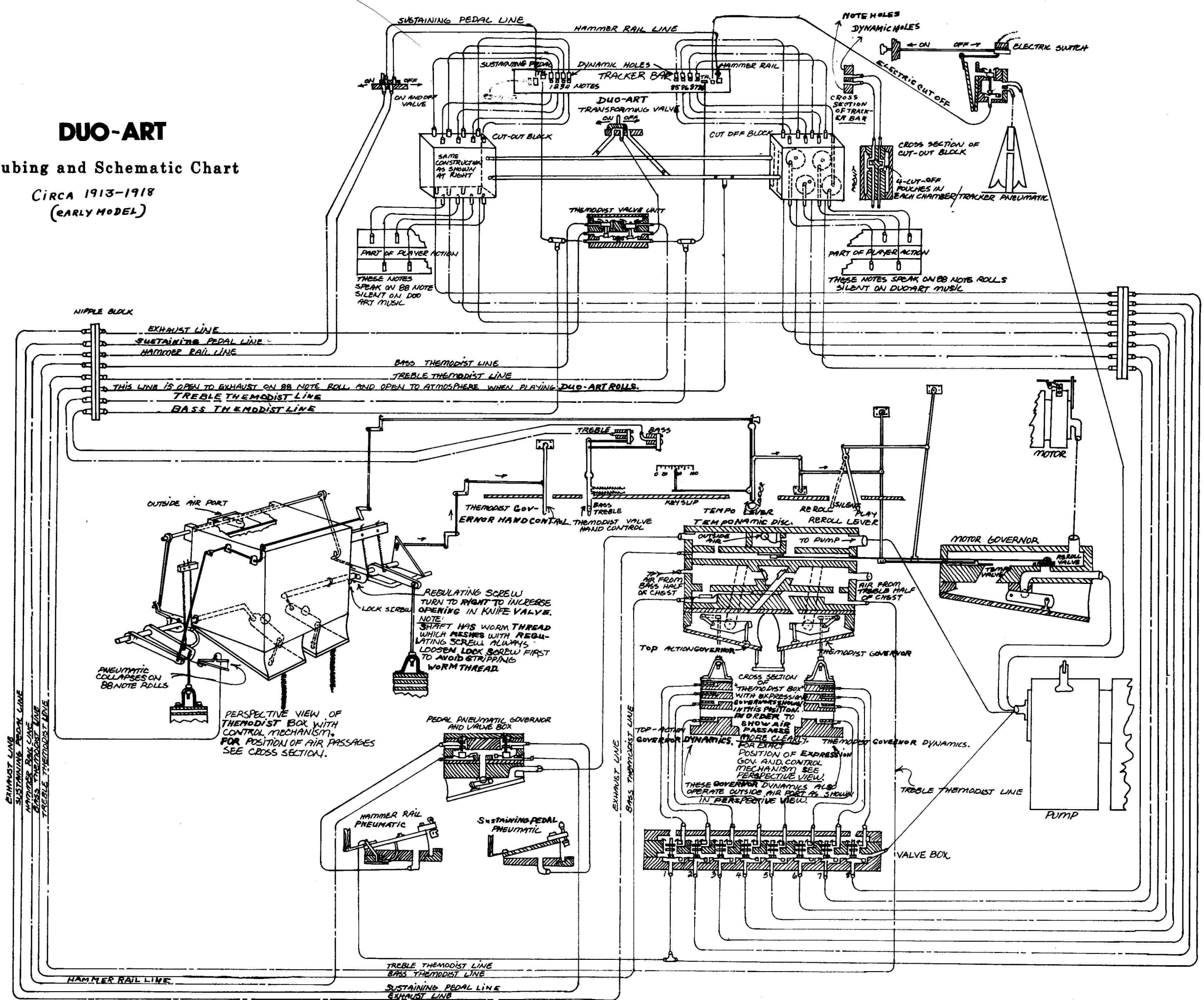
Manual No. 3.

## ACCOMPANIMENT AND THEME ZERO SETTING ADJUSTMENT

# DUO-ART

## Tubing and Schematic Chart

CIRCA 1913-1918  
(EARLY MODEL)



**TOP**

UNIT "CC"  
SEPT PERAL  
PRINCEWYK

UNIT U

51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 **ODD NOS.**  
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 **EVEN NOS.**

### KEY NUMBERS

## NOTES

① ON MODELS 1924 & EARLIER, A SECOND CUT-OFF VALVE BLOCK SIMILAR TO UNIT "X" IS USED TO CUT OFF NOTES 1-2-3-4 & 85-86-87-88 WHEN DUO-ART IS IN "ON" POSITION (UNIT "N") THE CONTROL LINE OF THIS UNIT TIES INTO LINE 130.

② ON MODELS 1925 TO END OF PRODUCTION, THE ABOVE NOTES ARE NOT USED AS SHOWN ON THIS DRAWING.

UNIT "AA"  
BACK WHEN

BASS

| <u>TAKE-UP</u> | <u>SPALL</u> |
|----------------|--------------|
| 1              | 1            |
| 2              | 2            |
| 3              | 3            |
| 4              | 4            |
| 5              | 5            |
| 6              | 6            |
| 7              | 7            |
| 8              | 8            |
| 9              | 9            |
| 10             | 10           |
| 11             | 11           |
| 12             | 12           |
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| 91             | 91           |
| 92             | 92           |
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| 95             | 95           |
| 96             | 96           |
| 97             | 97           |
| 98             | 98           |
| 99             | 99           |
| 100            | 100          |

UNIT "Z"

TREBLE

SH. BY RE. AIR LEVER  
CLOSED ON PAUT  
OPEN ON RE. PAUT.

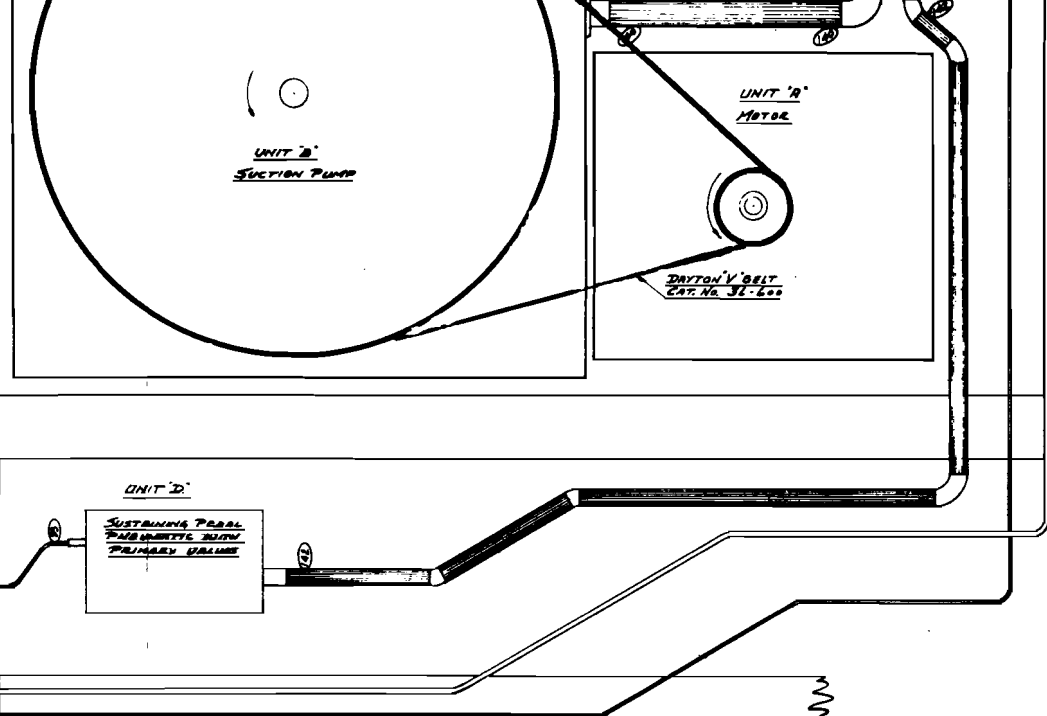
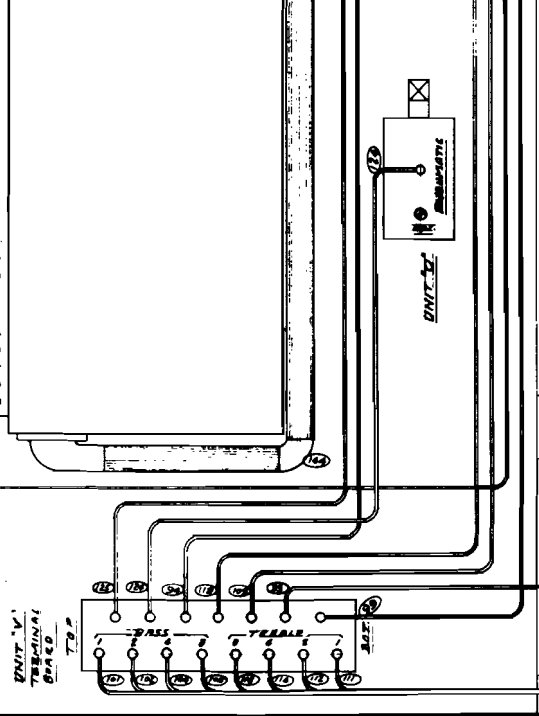
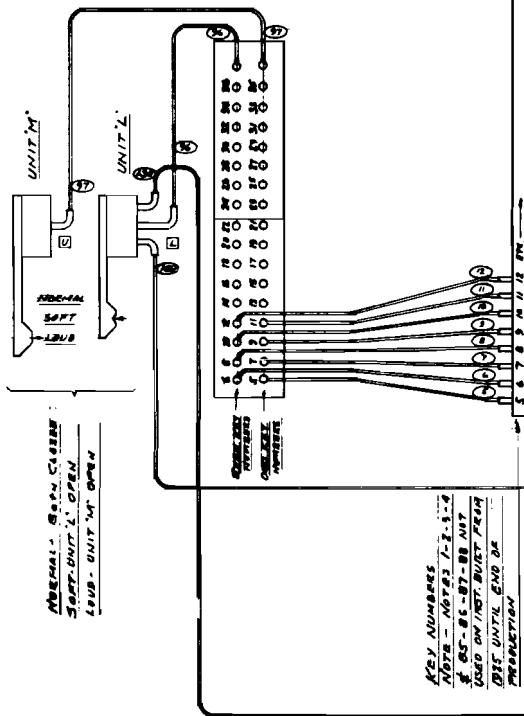
TRIM AIR OR QUANTITY OF  
BOTH NORMALLY CLOSED

ABNORMAL - RE. PAUT. CL. AIR  
SHUT UNIT "L" OPEN  
LOAD - UNIT "M" OPEN

KEY NUMBERS  
NOTE - NOTES 1-3-4  
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

UNIT "V"  
TERMINAL  
GRADE

NOTE 44  
NOTE 45  
DIVISION LINE  
UNIT "P"  
PNEUMATIC STAGE WITH  
PRIMARY VALVES

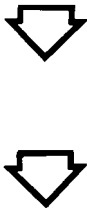


EIGHT SQUARE INCHES

# The Duo-Art

*Editor: Included in Wilberton Gould's series in The Tuners' Journal on "Player Piano Mechanisms" is the following article on the servicing of the Duo-Art.*

*Mr. Gould makes extensive reference to the 1927 Duo-Art Service Manual in this discussion, especially to Illustration "E" therein. Illustrations and sections to which he refers—including Illustration "E"—are reproduced at the end of this section on the Duo-Art.*



## THE DUO-ART

In the servicing of the Duo-Art mechanism, it is absolutely necessary that the technician understand the expression system and the principle under which it functions. The only tools required are a screwdriver, a Duo-Art test roll, and a musical ear. The mention of this last item might seem out of place in this technical series, but experience has proven it to be vital.

The expression box is the heart of the Duo-Art, through which the artist's musical thoughts may be reproduced, and it will be discussed thoroughly here. All references made to the expression box apply both to the grand and to the upright models, with one exception; this exception is referred to in The 1927 Duo-Art Service Manual, and will be discussed later.

The adjustment of the various degrees of shading in the Duo-Art must be approached from a musical standpoint if effective results are to be achieved. Assuming, of course, that mechanical conditions are equal, it is possible through the

unique dynamic control to control the entire register of the instrument either by the accompaniment regulator or the solo regulator.

The keyboard of the instrument is divided musically into theme, or solo, and accompaniment in the same manner as if it were played man-(or Ms.)-ually. For example, carrying the melody from the bass to the treble, or crossing the hands, or carrying the melody from the treble into the bass, is effected through the accompaniment regulator or the theme regulator. There is no duplicate control system in the Duo-Art, a control system for the bass and one for the treble. On the contrary, one regulator, either the accompaniment or the theme in conjunction with the theme valves, may control the entire register. In order to understand how this is accomplished, it is necessary to understand the travel of atmosphere from the pneumatic stack to and through the expression box and also to know what is taking place during the operation.

Referring to the phantom view on page 17 of The 1927 Service Manual (Illustration "E"), it will be noted that figures 19 and 25 are the main supply from the pneumatic stack to the expression box—bass and treble ends. Under normal conditions, when the theme secondary valves (figures 16 and 27) are up against their top seats, they cut off air channels from chambers 20 and 24. This causes the atmosphere entering the nipples (figures 19 and 25) from the pneumatic stack to enter the accompaniment chamber (figure 22) and pass down, as indicated by the arrows, into the accompaniment regulator, through the knife valve port and thence to the pump. By this it will be seen that air travel is through the accompaniment regulator, as long as the theme secondary valves remain against their upper seats, thus proving that normally the instrument is under accompaniment control.

The degree to which the strength of the blow is governed by the movement of the knife valve is controlled by means of the accordion pneumatics 6, 5, 4, 3, 31, 32, 33, and 34 in conjunction with the theme secondary valves 16 and 27. The collapsing travel of the accordion pneumatics being 1/16th, 1/8th, 1/4th, and 1/2 inches, as these accordion pneumatics collapse

## The Duo-Art - continued

they control the opening of the knife valve port. The greater the area of the knife valve port the stronger the blow given.

There are adjusting screws on the cross bars of the accordion pneumatics. These should not be disturbed, as they are set correctly at the factory and should be adjusted only by a set of accurate gauge blocks that are made for that purpose. It is also necessary that there be just enough tension on the springs to bring the accordion pneumatics back to rest snappily, with not too much or too little tension. Care should be exercised in this operation; if there is too little tension, the accordions will not come to rest quickly enough, and if there is too much tension, the accordions will lag in their collapsing, with the result that the knife valve will not open enough, as it should. Likewise, the tension springs on the regulators should not be drawn down to a greater degree than is necessary, but should be just taut enough that they do not rattle. Pulling down the tension springs on the regulators is frequently done because of lack of knowledge. When this is done, it upsets the zero setting of the regulators (*Editor: also read "Steps in Test No. 8"*). If this operation is carried to the extreme, it will ruin the springs for the fine setting of the accompaniment or the theme and it will be impossible to bring down the tone to that softness so much desired by real music lovers. If the springs have been ruined, the only remedy is new springs. Therefore, it is suggested that a player technician tread very softly along this path. *Editor: If new springs are being installed, it is very important that the correct tension, size, and gauge of the new springs be established before they are replaced.*

Before going further into the expression box, the expression control ports on the tracker bar should be explained, so that they may be better understood when referring to the expression box.

Referring to Illustration "E" in The 1927 Duo-Art Service Manual, we find the following:

|                             |   |                    |   |
|-----------------------------|---|--------------------|---|
| Re-roll                     |   | Soft Pedal         |   |
| Sustaining Pedal            |   | Electric Cut-Off   |   |
| Bass Theme                  |   | Treble Theme       |   |
| No. 1 Dynamic Accompaniment |   | No. 1 Treble Theme |   |
| No. 2                       | " | No. 2              | " |
| No. 4                       | " | No. 4              | " |
| No. 8                       | " | No. 8              | " |

It will be noted that the note holes start at the fourth hole from the bass end and the fourth hole from the treble end, reading from the outer edge toward the middle, the first speaking note is No. 5 and the last is No. 84, making eighty speaking notes. This applies to the later type Duo-Art mechanisms. In the earlier models, the speaking scale is full eighty-eight notes on straight eight-eight note rolls, but still remains eighty speaking notes on the Duo-Art reproduction.

Note holes 1, 2, 3, and 4 at the bass end and 85, 86, 87, and 88 at the treble end have each directly above them a perpendicular oblong port. These oblong ports are the accordion dynamic control ports and are connected by tubing to the Duo-Art cut-out pouch blocks directly behind the spool box. These blocks contain a series of four pouches on either side of the blocks, one on the bass end and the other on the treble end, and are connected to the supply from the Duo-Art cut-out block on the left-hand end of the spool box; they are marked "Duo-Art On" and "Duo-Art Off." With the Duo-Art lever at the "On" position, atmosphere is admitted to the top side of the note pouches on the blocks marked 1, 2, 3, 4 notes and 85, 86, 87, 88 notes; this inflates the pouches and cuts off the note holes from the tracker bar. With the Duo-Art switch at the "On" position, atmosphere is admitted through any one of the accordion dynamic control ports above the note ports, passes through the pouch cut-out block, thence to the accordion primary valve box, from there to each of its respective primary valves, then to each of the accordion dynamic pneumatics on the expression box. In the upright model, the dynamic valve box is assembled on the expression box frame. In the grand model, it is attached to the frame of the case as closely as possible.

The theme valve ports on the tracker bar lead to the theme primary valve box (valves Nos. 29 and 30) and there to the theme secondaries in the expression box. (See figures 17 and 18 in Illustration "E.")

The re-roll port and the port in the take-up spool lead directly to the repeat and re-roll primary valve box underneath the key bed. These valves control the re-roll and repeat pneumatics. In the upright model, the tube leading from the switch cut-out, or motor port, goes to the left and passes through the repeat slide block where if the slide block is in the off position, it con-

nects with the tube leading to the switch valve box (figure 8, Illustration "O" in the 1927 Duo-Art Service Manual).

The sustaining pedal port—*Editor: also known as the loud pedal port*—on the tracker bar leads directly to the sustaining pneumatic in the grand type and to the pedal regulator in the upright model. The soft pedal port leads to the soft pedal primary valve box in the grand model and to the pedal regulator in the upright model. In the later types of Duo-Art grands, the shifting of the action is accomplished by atmosphere being admitted through the soft pedal port in the tracker bar. The raising of the hammer rail is accomplished by placing the modulating lever, on the control slip, in the soft position.

We will now show how the air travel is changed within the expression box when a theme perforation appears on the music roll and what happens when this takes place.

Referring to the phantom view on page 17 of the Duo-Art Service Manual, figures 16 and 27 are the bass and treble theme secondary valves. *Editor: The author is referring to Illustration "E" on page 17 of the 1927 Duo-Art Service Manual. The same reference may be found in the 1925 Duo-Art Service Manual, Illustration "B," figures 20 and 30. Also, on the diagram that is part of the Duo-Art Preliminary Instruction Pamphlet, the same reference is figures 11 and 12.* They are controlled through the bass and treble theme primary valves located in the valve box on the top action, at the left of the tracker box. The theme primary valve box is shown at the right of the expression box on page 17. Figures 29 and 30 are the bass and treble theme valves respectively and are connected to the secondary valves in the expression box and to the tracker bar. As previously stated, under normal conditions the theme secondary valves are against their top seats, thus compelling the atmosphere from the pneumatic stack to travel through chambers 20 and 24, through the flap valves 21 and 23, into chamber 22, down through the channel, as indicated by the arrows and through the knife valve port of the accompaniment regulator and to the pump.

The question may arise: How do the secondary valves remain seated against their top seats? As stated above, there is a theme primary valve box located on the top action at the left of the

tracker box. Under normal conditions, the valves in this box are at rest, or down against their bottom seats. Atmosphere is admitted over the tops of the valves, passes through connecting tubes and inflates the pouches under the secondary valves, thus holding these secondary valves tightly against their upper seats and preventing any passage of air from the pneumatic stack to the theme regulator. The inflation of the theme secondary pouches just mentioned is accomplished by the action of the theme regulator suction which entirely surrounds the top surfaces of both theme secondary pouches. The moment theme perforations appear on the music roll, atmosphere is admitted through the theme ports in the tracker bar to the primary pouches, inflating them and raising the primary valves to their upper seats. This action cuts off the atmosphere which was admitted through the top cups and permits the suction of the theme primary box to exhaust the secondary valve pouches through the bottom cups, causing the secondary valves to drop and thus momentarily open a channel between the pneumatic stack and theme regulator. The opening of this channel is the action whereby the air from the pneumatic stack is changed from the accompaniment regulator to the theme regulator.

The moment one or both of the theme secondary valves drop, since the theme regulator suction is usually of a higher intensity than that of the accompaniment regulator, this stronger suction will draw the flap valves (21 and 23) to their seats and cut off channel 22 from the pneumatic stack. Thus, momentarily, the stack may be entirely cut off from the accompaniment regulator. This occurs only when the stack is opened to the theme regulator. When this occurs, the air from the stack entering chambers 20 and 24 will pass down and over the theme secondary valves and into the channel underneath and directly behind the accompaniment channel (this channel is shown but is not numbered on the phantom view, but is indicated by the arrows from the theme secondaries), through the port shown leading into the theme regulator, and there to the pump and exhaust.

This condition can happen collectively or singly, as the case may be, according to the perforations on the music roll. The strength of the blow is governed by the movement of the knife valve within each of the regulators. This

## The Duo-Art - continued

movement is controlled by the collapse of the accordion dynamics. The theme valves determine the note or notes that are to be accented by accenting any note or group of notes whenever a direct passage is opened through the theme regulator to the pump.

If, as has been shown, the path of the atmosphere can be changed within the expression box, it is then proved that the theme regulator may control every note in the register. While the accompaniment regulator does likewise, the theme may accent any note without interference from the accompaniment regulator and may accent any individual note in either the bass or treble action, thus proving that this mechanism is truly based on a musical principle and that it will reproduce exactly the performance of the artist upon the keyboard of the instrument.

Manual control of the Duo-Art is obtained by means of a system of levers situated on the key control slip of the instrument. Normally, they are used only when a roll other than a Duo-Art is used and then only with the Duo-Art switch in the spool box at the "Off" position. *Editor: In this "Off" position, 88-note rolls of standard roll width, 11¼ inches, may be played.*

These levers give the operator direct control over the movement of the knife valves in both the accompaniment and the theme regulators as well as control over the theme valves. Illustration "G" (page 21 of the service manual) shows one of the regulators, accordion dynamics, and manual control lever. It must be remembered that the levers have a down pull on the heels of the knife valves the same as do the accordion dynamics, and the levers control the movement of the knife valves and the opening of the ports.

The more the levers are moved from their normal position, the greater is the intensity of the suction built up in the regulators and correspondingly the stronger will be the force of the blow of the striking pneumatic.

The theme levers control the movement of their respective pallet valves underneath the key bed, allowing atmosphere to be admitted through the ports of the pallet valves directly to the primary valves instead of through the tracker bar. By the use of these levers, it is possible to pick

out any single note in either the accompaniment or the theme and accent it at will. This follows the same principle as the expression perforations cut in the Duo-Art music rolls.

The spill valve, or atmospheric intake, is located in the rear of the Duo-Art expression box. It is properly adjusted at the factory and should not be tampered with. As either the theme or accompaniment regulator intensities increase, this valve begins to close and when the intensity of either regulator reaches the tenth degree it is fully closed, remaining closed from this tenth degree through the fifteenth. Below the tenth degree, it is either closing or opening as the regulator intensities are increasing or decreasing, being fully open when no accordion dynamics are collapsed. This spill valve is returned to its normal position by the action of a coil spring, which should be adjusted just strong enough to give it a positive return motion. If it is adjusted too strong, it may retard the motion of the accordion dynamics and thus affect the normal expression. (See illustration "J" on page 28 for the method of connection and its operation.)

The tracking device shown in illustration "L" on page 32 is simple and positive in action, and when understood correctly is very easy to adjust. It should not be condemned if it fails to operate correctly. It should be remembered that not only this type of tracking device, but every other type, was tested under many and varied conditions and that when installed in the instrument it did its work. The greatest trouble encountered in adjusting any tracking device is lack of knowledge of the principle under which it operates. In adjusting the Duo-Art tracking device the power should be on and the tracker bar covered with a roll. The tempo should be set at zero and the tracker ears moved away from the edges of the paper. The tracker pneumatics should be centered exactly and the top drive shaft at the right of the spool box should be at center of the shifting cam (Figure 8). Figure 1 shows a turnbuckle, which adjusts the position of the cam. This turnbuckle has left and right threads and is supplied with lock nuts, which should always be set tight after the adjustment of the cam has been made.

When the tracker pneumatics have been centered and other adjustments made so that the note holes in the music roll align with those in the tracker bar, the tracker ears should be set. These ears should be so adjusted that they just touch the edges of the paper, and the screws (figures 2 and 3) should be tight. Under no condition should the tracker ears be bent into position with a pair of pliers or anything else. This would not only be bad practice and show a lack of knowledge on the part of the service man, but there would be danger of damaging the ears to such an extent that they might have to be replaced with a new set. Many music rolls have been ruined through faulty and incorrect setting of the tracker ears and the blame placed on the tracking device.

*Editor: The section on the Duo-Art tracking device was printed in February, 1929. The 1929 model of the Duo-Art did not have ears protruding from the tracker bar. This was replaced by holes in each end of the tracker bar. For adjusting the tracking on either model, make sure the width of the roll you are using is exactly 11¼ inches wide. After tracking adjustments are completed, check that the perforations on the roll center directly over the holes in the tracker bar.*

### **The Duo-Art Upright Governor**

The Duo-Art governor is extremely sensitive and positive in operation. Reference to illustration "M" on page 35 of the Duo-Art 1927 Service manual will show that the atmosphere from the wind motor enters the governor at channel No. 6, passes through channel No. 3, provided the tempo port is open to ten or more, through knife valve port No. 5, and out through channel No. 8 to the pump. Spring No. 9 is the opposing suction in the governor pneumatic. Figure No. 3 is the tempo port, No. 2 is the tempo control slide valve, No. 4 is the reroll port and No. 7 is the reroll slide valve. Figure No. 1 is a bleed channel connecting with the outside air. Its function is to prevent the wind motor from creeping when the tempo is at O, but this channel is cut off when the tempo is advanced three or four points. Adjustment of the governor will be taken up later under the caption "Testing."

In the grand Duo-Art the governor is practically the same, except that the action cut-out is in the modulator box underneath the bed next to the rotary pump, and its function will be discussed under the heading "Duo-Art Grand Modulator Pneumatic."

### **Sustaining and Hammer Rail Lift**

The entire layout of the tubing and control of the sustaining pedal and the hammer rail lift will be found in illustration "N" on page 37. There are three valves in the sustaining pedal valve chamber and two in the hammer rail valve chamber. Those who are familiar with the Duo-Art since its inception will readily see the advantage of this arrangement over the older model.

Quietness of operation is highly desirable; it is obtained through the medium of the multiple valve control in conjunction with the pressure regulator. A knife valve and a regulator spring are attached to the pressure regulator pneumatic. Adjustment of this spring will control the action of the sustaining pedal, the accordion pneumatics and the hammer rail lift as regards snappy action and quietness. The sustaining pedal and the hammer rail are also controlled through the stop buttons, figures 2 and 3. Too great a tension on the regulator spring No. 1 will cause noise and valve clatter. Too little tension will produce sluggishness of the action. In this unique control there is regulated and unregulated atmosphere.

In the upright Duo-Art, in conjunction with the soft pedal or hammer rail lift is a pallet valve (not illustrated). The function of this valve is to collapse No. 2 accompaniment accordion pneumatic on the expression box to compensate for the lost motion created by the hammer rail lift. In the grand model the sustaining and hammer rail lift pneumatics are controlled from the modulator pneumatic, performing the same duty as stated above.

In illustration "O" page 38, are shown the tubing layout, valve control and the position of the repeat slide valve block of the upright Duo-Art, located on the left side of the roll box. In this illustration the switch valve block is mounted on the right-hand side of the case, and shows the

pneumatic and the valve box as a unit. In the grand model, the switch unit and the switch pneumatic are separate units. The principle remains the same, no matter how the units are assembled.

### **Grand Duo-Art Modulator Control Pneumatic**

The modulator control box (illustration "P," page 41) is shown only in the grand model and only in instruments of late manufacture. Its function is to modify, or soften the normal Duo-Art without affecting any of its dynamic gradations. It also controls and regulates the supply of atmosphere to the accordion dynamics and the sustaining pedal and contains the cut-off valve which cuts off the top action on reroll. A pallet valve block is situated underneath the key bed at the front, left-hand end of the case and is connected with levers marked "Concert," or Normal, "Soft," or Dance. This pallet valve block is known as the dynamic valve block, and is made up of two pallet valves, with four nipples on the later types, and three on the older types. When the dynamic lever is at the "Soft" position, the pallet is opened, and the atmosphere is admitted to the valves of the hammer rail and No. 2 accordion pneumatic on the accompaniment side. Through another nipple, atmosphere is also admitted to valve No. 10, which raises and forces the air entering chamber No. 13 to pass through the knife valve port No. 17, and cuts down the dynamic power of the expression one-half. When the dynamic lever is at the "Concert" position, it has no effect on the modulator control box, but collapses the accompaniment accordion pneumatic No. 8, so that the softest power of expression is power eight.

Attached to the grand governor tempo control box and to the grand modulator control box are two small pneumatics, one (No. 14) on the modulator box and the other on the governor box. Pneumatic No. 14 on the modulator box collapses and opens port No. 3 on the modulator box, and is a pump relief on reroll when these two pneumatics are teed together.

The spring No. 20 on the modulator is

set correctly at the factory, and set so that the degree of modulation is one-half the full volume of the Duo-Art. This will correctly control the action of the accordion pneumatics on the expression box and the action of the sustaining pedal, and one should not tamper with it. Should it be necessary to get at valves No. 10 and No. 5 on the modulator box, access may be gained by removing the lower cap, where slide valve No. 4 is situated. As these valves are of considerable size, however, this should seldom be necessary.

### **Grand Crash Unit**

While the expression box of the grand is constructed somewhat differently from that of the upright, due to the different designs of the pianos, there is no difference in the principles of the expression control. The grand expression box has a crash valve unit which acts only when power fifteen comes on, that is, when all the accordion pneumatics on the theme or solo side are collapsed. The action of the crash valve gives a direct passage to the pump, and when the crash comes on, it cuts around the theme knife valve direct to the pump. In this way, it causes the maximum hammer blow.

When the crash valve is set, all theme pneumatics should be collapsed, valve arm No. 6 (see illustration "R," page 45 of the Duo-Art service manual) should be up, and the adjusting screw in the arm should just raise pallet valve No. 5. Should it not be the case that the adjusting screw in the arm just raises pallet valve No. 5, one or two turns of regulating screw No. 6 should be sufficient. Rough adjustments may be made with regulating screw No. 7, and fine adjustments with screw No. 6. Care should be exercised that the upward travel of arm No. 7 is not so great that it will act when power fourteen comes on; in other words, the pallet valve should not rise more than one-sixteenth of an inch.

### **Key Frame Shift**

As was previously stated, the key frame shift (see illustration "S" in the Duo-Art service manual) is installed only in the grand

Duo-Art and only in the later models. In conjunction with the hammer rail lift, however, this attachment permits very fine shading of the music. The key frame shift operates only when No. 1 treble end port is open. There is a separate valve box for this unit located in the rear of the case near the sustaining pedal pneumatic. Lost motion of the shift unit may be controlled by adjusting screw No. 6 on arm No. 5. This unit is silent, powerful, and positive in action.

#### Preparations for Test Roll Use

Before attempting to adjust the Duo-Art with the test roll, it is absolutely essential that the piano action be in proper regulation. See that the hammers travel correctly, that all flanges are tight, and that the junction block under the key bed on the grand is tight in order to avoid leakage. Inspect all supply tubings for leakage. Be careful not to overhaul any of the screws. Clean the spool box gearing of dirt, grease, and oil, and inspect the ladder chains for excessive lag. Do not squirt oil on the transmission. This is a bad practice, as oil is apt to reach the gum tubing and to destroy the body of the tubing. Use a good quality of lubricant, but not too much of it. Do not use oil or grease on the air motor.

On new set-ups or demonstrations, be sure that the correct type of electric motor is installed in the instrument and that the voltage and cycle are correct. Eliminate all undue motor noises. Also see that the belt travels true from the motor to the pump and that it is just tight enough that it does not slip on a full load. In the later types of the Duo-Art, the belt slack is taken care of automatically by springs, while in the older types, provision is made for taking care of this adjustment. Make sure also that the motor frame does not touch the piano frame, as this contact would cause an annoying hum.

Be sure to pump out the tracker bar ports with a reliable pump.

#### USING THE DUO-ART TEST ROLL

Place a Duo-Art test roll on the carrier

shaft, and with the lever at "Play" and the tempo at 0, test for quietness. Eliminate any undue noise. Set the tempo at 70, and with the roll running, test the speed of the tempo; correct if necessary. For this test, the Duo-Art lever must be at the "Off" position, and the test roll should run seven feet a minute, or three and one-half feet in one-half minute. If the tempo is too fast, decrease the tension of the governor spring. If it is too slow, increase the tension of the spring. (Refer to illustration "M," page 35, of the 1927 service manual.) The tracking device may also be tested at this time. (Refer to pages 32 and 33 of the service manual.)

#### Sustaining and Soft Pedal Test

With the sustaining and soft pedals in the "On" position, the wedge dampers should clear the strings by at least one-eighth of an inch, and the hammer rail should move forward to within one inch of the strings. In the grand, the hammers should lift five-eighths of an inch from their normal position. Spring No. 1 (illustration "N," page 37 of the service manual) controls the speed of the sustaining and soft pedals in the upright, and spring No. 20 (illustration "P," page 41 of the service manual) controls the speed of the sustaining pedal in the grand. (See also above discussion of the Modular Control Pneumatic.)

#### Accordion Dynamics

With the Duo-Art switch lever at the "On" position, the accordion dynamics should collapse in the order, Nos. 1, 2, 4, 8, on both the accompaniment and the theme sides. Should they fail to operate in the given order, test directly at the primary accordion valve box, removing the tubing leading to the dynamic that is not operating, and correct.

#### Accompaniment Zero Setting, Tempo 80

As this setting is the most important, it is essential that on the first arpeggio test, the notes should speak evenly, distinctly, and softly. Watch for weak notes in the second run, and correct any that are too loud. When making adjustments, do not

tamper with the leather nuts on the accordion dynamic support rod. (See No. 14, illustration "E," page 17 in the service manual.) They are set correctly at the factory, and should be left alone. Regulator springs Nos. 2 and 35, as well as all other springs, were covered earlier in this series. Carefully read instructions on this test on pages 23 and 24 of the service manual.

Adjusting screws Nos. 7 and 8 are two different colors; one is blue metal, and the other is white. (See illustration "F," page 17 of the service manual.) Screw No. 8 is a lock screw, and must be loosened before it is possible to adjust the movement of the knife valve through the medium of screw No. 7. Failure to loosen screw No. 8 is apt to damage adjusting screw No. 7. After the arpeggio test is set correctly, tighten lock screw No. 8. In the upright model, turn screw No. 7 to the left to make the tone soft, and to the right to make it loud. On the grand, turn adjusting screw No. 7 to the left to increase, and to the right to decrease the volume.

In setting the arpeggio test as above, observe the movement of the accompaniment and theme regulator pneumatics. As the volume increases, the pneumatics tend to close, and as it decreases, they tend to open. This applies to both grand and upright models.

### Theme Zero Setting

As was stated above, the theme zero setting is one degree louder than the accompaniment. When adjusting the theme zero setting, follow the same procedure as when setting the accompaniment. It will be noticed that the loud pedal is on with the first run of notes on the theme arpeggio, then off with the next run; this makes it considerably harder to play than the accompaniment run with the loud pedal off. The reason is that the notes are shorter and consequently play faster. In the second run of the accompaniment with the loud pedal off, there are nineteen notes played, and in the theme run, there are fifteen shorter notes played in one-half the space. It is easily seen that more pressure is needed to play the

second run of the theme with the pedal off and the shorter notes. If the theme zero is then set so that it plays about every other note on the second run with the pedal off, the one degree louder has been obtained as described in test No. 8, Theme Zero Setting, page 24, of the service manual. If both accompaniment and zero settings are properly regulated, the accordion dynamic chord test which follows will meet the requirements of the chord test in the roll. Note tests carefully, and also test reroll and repeat in the order given in the service manual.

### Key Slip Control Levers

Test key slip manual control levers to see that they move freely and do not bind. In extremely damp weather, the bushings may become swollen and the levers may bind. This binding must be eliminated, as any constraint on the freedom of these levers will affect the movement of the knife valves in both the accompaniment and theme regulators.

Now a final word about any and all adjustments and regulations of the reproducing mechanism: know what you are doing and why you are doing it. Be honest with yourself; if you do not know how to make the adjustments, do not attempt them. It will be safer.



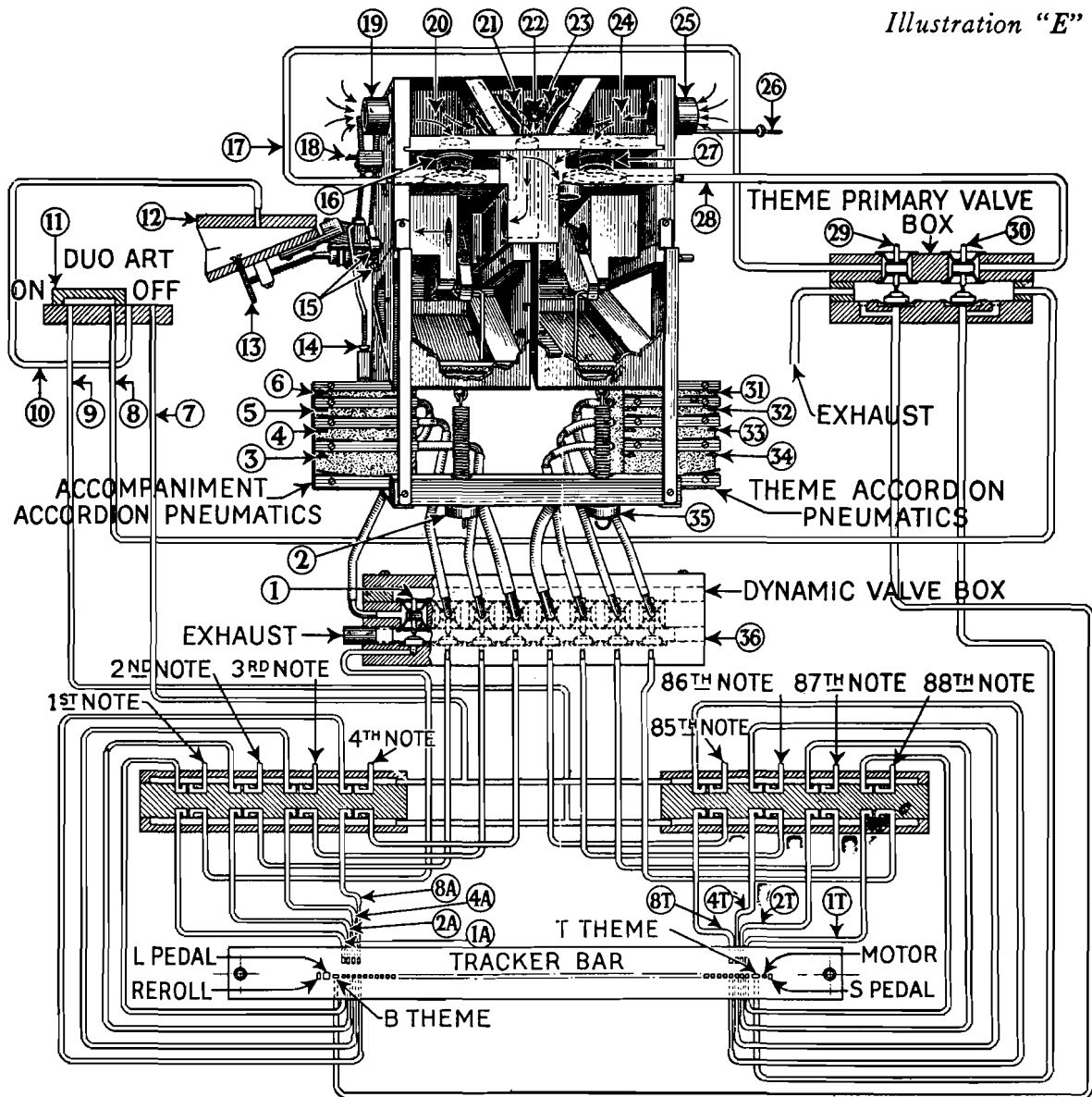
*Editor: This concludes Wilberton Gould's discussion of The Duo-Art. On the next pages will be found relevant reproductions from The 1927 Duo-Art Service Manual and other illuminating illustrations of The Duo-Art.* 

# Illustration "E"

## from the 1927 Duo-Art Service Manual (page 17)

UPRIGHT DUO-ART EXPRESSION BOX AND CONNECTIONS

Illustration "E"



*EDITOR: Continuous changes were made to the Duo-Art system. For Duo-Art mechanisms produced prior to 1926 and for additional information on all Duo-Art systems, refer to*

1. 1925 Duo-Art Service Manual; 2. Preliminary Instruction Pamphlet— Operation of Duo-Art Dynamic Control and How To Test and Adjust. This pamphlet contains additional detailed information and a more detailed diagram of the Duo-Art control system; 3. For the combination foot impelled and electric Duo-Art, refer to Export Supplement To Service Manual, No. 3 of 1927. The expression box is different in this type from the standard Duo-Art expression box shown in the Illustration No. "E" on this page.

NOTE: 1, 2 and 3 are included in this publication.

## THE DUO-ART DYNAMIC CONTROL SYSTEM

Refer to Illustration "E"

The Duo-Art Reproducing Mechanism is built upon an entirely different mechanical principle than any other device of its kind. It is based upon the musical principle of dividing the music musically into Theme and Accompaniment, instead of dividing it mechanically into right and left sections, commonly called bass and treble expression controls.

The control of the Theme notes is independent of the Accompaniment notes. Through this control the Theme may be made to sing out clearly above the Accompaniment either in the bass, middle register or treble to any degree of expression desired, and at the same time any degree of power may be given to the Accompaniment.

The dynamic perforations at the right and left hand edges of the Duo-Art music roll control the dynamic mechanism, and by their arrangement and dynamic value, determine whether notes shall be controlled by the Accompaniment or Theme regulator. The accordion pneumatics control the movement of the knife valve heel in both the Accompaniment and Theme regulators. At the front of these regulators is a rod attached to the movable board of each pneumatic. It is also fastened to the front or toe of each knife valve. See rod No. 6 in illustration "F", page 18. This rod conveys to the knife valve the equalizing or governing effect of the regulator pneumatic, and it is obvious that through the use of this ingenious device, very fine and delicate crescendos or diminuendos are easily obtained.

When we speak of the zero degrees in the Duo Art, we mean the gradation of loudness attained without the use of the accordion pneumatics, which control all of the gradations above zero. Their adjustment is independent of the other gradations and will be fully explained later.

The zero degrees might be termed the foundation of the dynamic structure, as all of the higher or louder gradations in the Accompaniment and Theme mechanisms are built upon them. Each gradation in the Theme registers slightly louder than the corresponding gradation in the Accompaniment mechanism.

## THE DUO-ART DYNAMIC GRADATION CONTROL

Refer to Illustration "E"

The gradations in the accompaniment are controlled by the four large holes in the bass end of the tracker bar, set above the regular note ports. (See tubes marked 1-A, 2-A, 4-A and 8-A.)

The Theme gradation control ports in the tracker bar are shown in the lower right hand corner of the illustration and are marked 1-T, 2-T, 4-T, 8-T. They control the Theme in conjunction with the holes in the tracker bar marked 'B Theme' and 'T Theme.'

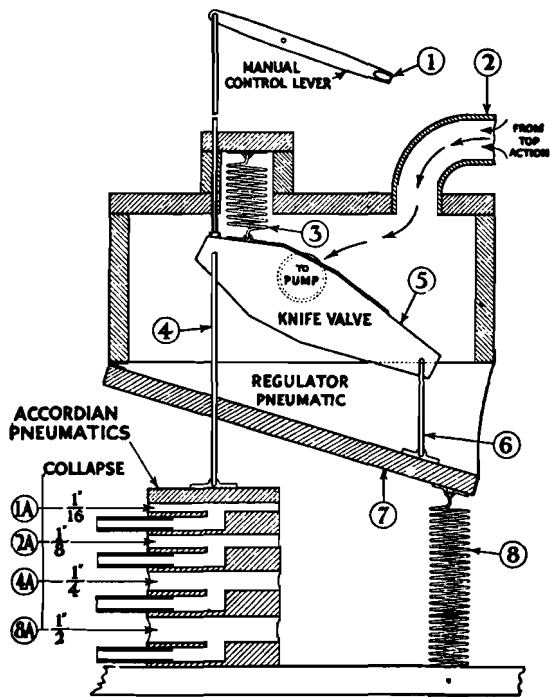
## CHART SHOWING DYNAMIC GRADATIONS

| No. | 1  | Zero       | setting adjusted to test roll |
|-----|----|------------|-------------------------------|
| "   | 2  | Ports open | No. 1 Accordions collapsed    |
| "   | 3  | "          | "                             |
| "   | 4  | "          | "                             |
| "   | 5  | "          | "                             |
| "   | 6  | "          | "                             |
| "   | 7  | "          | "                             |
| "   | 8  | "          | "                             |
| "   | 9  | "          | "                             |
| "   | 10 | "          | "                             |
| "   | 11 | "          | "                             |
| "   | 12 | "          | "                             |
| "   | 13 | "          | "                             |
| "   | 14 | "          | "                             |
| "   | 15 | "          | "                             |
| "   | 16 | "          | "                             |

It will be noticed that each number in the Dynamic Gradation control is double its predecessor and that is exactly what they are in their dynamic power. From the tracker bar these dynamic control tubes lead through two cut-off pouch blocks. From these pouch blocks the tubes lead to the dynamic valve box No. 36. These tubes control the accordion pneumatics and each of these accordion dynamics has four small pneumatics, each set to collapse a certain distance by small adjusting screws. These pneumatics can work separately or in combination to reproduce every gradation of piano expression.

## ACCORDION DYNAMIC CONTROL OF THE KNIFE VALVE SHOWING SIMPLICITY OF DUO-ART EXPRESSION CONTROL

Illustration "G"

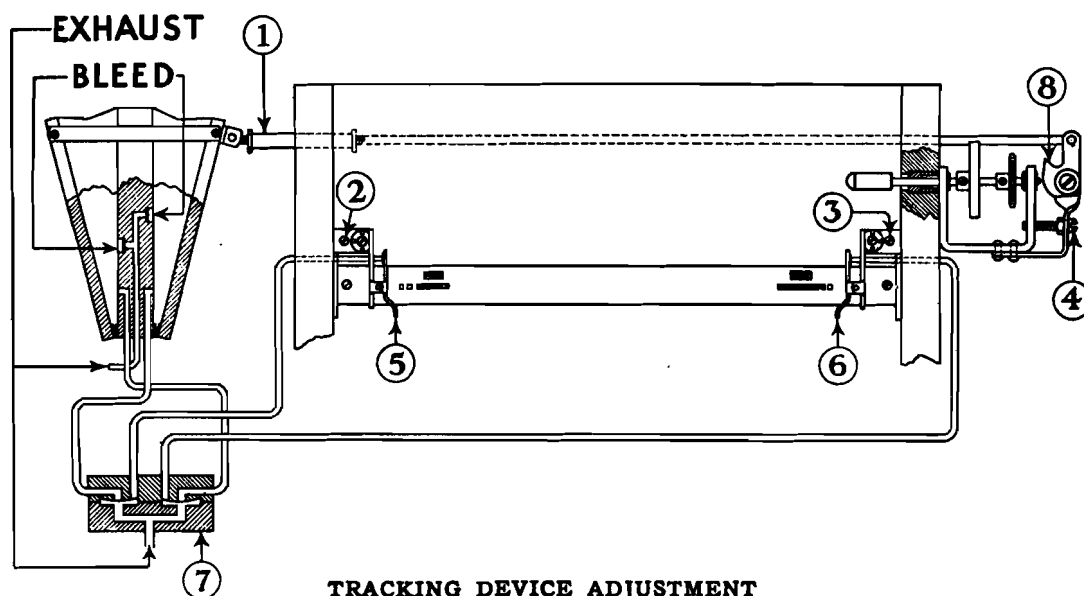


Key Chart

- 1—Manual Control Lever.
- 2—Exhaust from Top Action.
- 3—Knife Valve Tension Spring.
- 4—Accordion Pneumatic and Knife Valve Connecting Rod.
- 5—Knife Valve.
- 6—Knife Valve and Regulator Pneumatic Connecting Rod.
- 7—Regulator Pneumatic.
- 8—Regulator Pneumatic Coil Spring.

## TRACKING DEVICE

*Illustration "L"*



### TRACKING DEVICE ADJUSTMENT

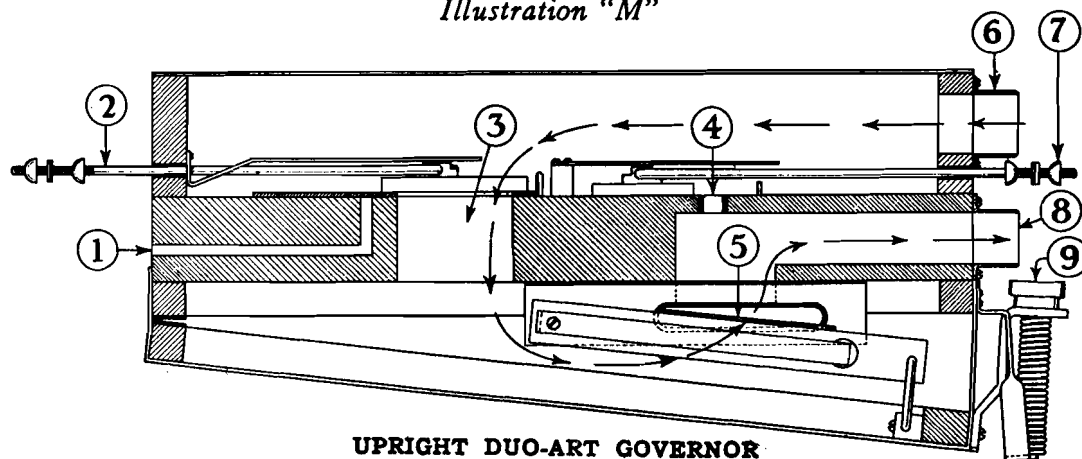
Refer to Illustration "L"

Insert a test roll or music roll measuring 11¼-inches in width in the spool box. Loosen up screws No. 2 and No. 3 on tracker triggers and push away from music roll. Hold tracker pneumatics at center and note if right hand music spool carrier is at center of shifting cam No. 8 as shown in diagram, if not, adjust turnbuckle No. 1. Turn on electric current and set tempo at 70, then adjust set screw No. 4 so that holes in music or test roll align with holes

in tracker bar. Next adjust tracker triggers No. 5 and No. 6 so that they almost touch edge of music roll, then tighten screws No. 2 and No. 3. It is advisable to play a few music rolls to make sure that tracker adjustments average up correctly. By keeping a very loose take up spool brake and a slow speed on reroll, the edges on the music roll will be materially preserved.

## UPRIGHT DUO-ART GOVERNOR

*Illustration "M"*



### UPRIGHT DUO-ART GOVERNOR

Refer to Illustration "M"

The purpose of the Governor is to assure an even speed to the music, regardless of the tempo in which it is played. All pneumatic player actions have a device of similar purpose. The Duo-Art Governor is very simple in design and sturdy in construction.

The air enters the Governor from the wind motor at channel No. 6 and passes down channel No. 3, providing the tempo port is open to point ten or more. The air then passes to the knife valve port No. 5 and out channel No. 8 to the pump. The spring No. 9 controls the Governor. Weakening it slows up the speed, and strengthening it speeds up the tempo. When the Duo-Art is in "play," the reroll port No. 4 is closed by slide No. 7, and when rerolling, it is open, making the reroll much faster than if the air had to pass through the tempo port

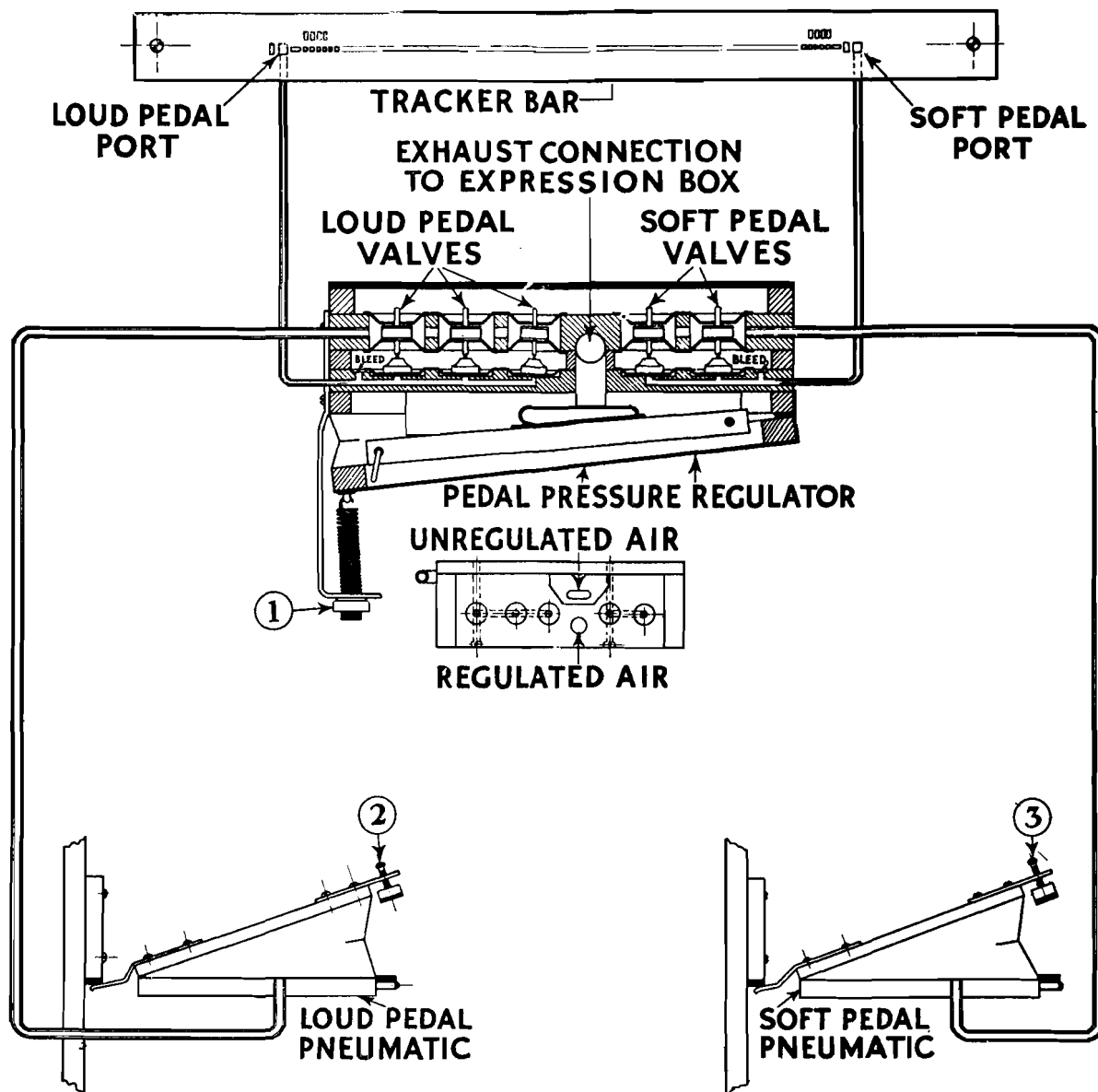
### Test No. 4, Tempo Test

Push Duo Art Lever in "Off" Position

Follow tests on roll in rotation. With tempo indicator at 70, roll should run seven feet per minute or 3-½ feet in thirty seconds. Tempo should cut off with indicator at extreme left and just start at ten. To run faster, tighten spring on governor; to run slower, weaken spring. Refer to treatise on Motor Governor page 34 with illustration "M" page 35.

## UPRIGHT LOUD AND SOFT PEDAL CONTROL

*Illustration "N"*



## UPRIGHT LOUD AND SOFT PEDAL CONTROL

Refer to Illustration "N"

The loud pedal is controlled from the second hole (in) from bass end of tracker bar, and the soft pedal from last hole in treble end of bar. The supply to the loud and soft pedal pneumatics is controlled by the pedal pressure regulator, the purpose of which is to govern the air pressure operating the loud and soft pedals and the accordion pneumatics on Duo-Art expression box. Spring No. 1 controls pressure operating loud, soft and accordion pneumatics and should be set strong enough to operate these pneumatics fast and snappy but not noisily. Adjusting screws No. 2 and No. 3 on pedal pneumatic controls lift of dampers and soft rail.

It will be noted that there are three loud pedal valves. The reason for this is to shorten the valve motion insuring quietness and speed in loud pedal operation. The soft pedal does not operate as fast as the loud pedal, therefore, two valves are sufficient

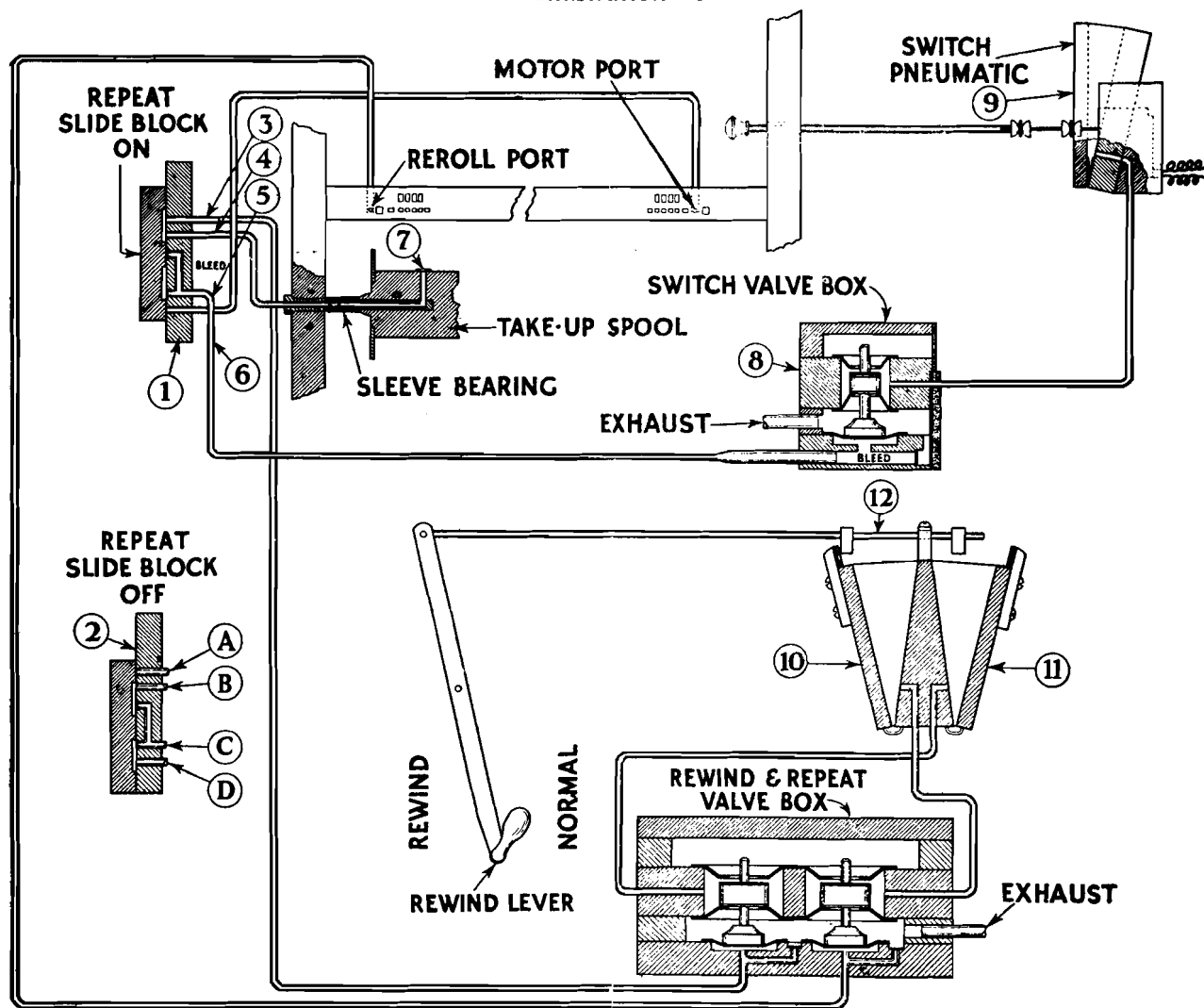
for this device. Illustrated below the pressure regulator pneumatic is a top view of the valve box showing the regulated air and unregulated air channels. Do not have spring No. 1 pulled too tight as the loud and soft pedals will operate in a noisy manner. On old instruments where the loud pedal functions noisily, shorten the valve travel.

### Test No. 5, Loud and Soft Pedals (Tempo 70)

With loud pedal "on," wedge dampers should clear strings  $\frac{1}{8}$ -inch. Dampers should come back to strings on each bridge in pedal test for speed. Spring No. 1 in illustration "N", page 37, controls the speed of the loud and soft pedals in the upright Duo-Art, and spring No. 20 in illustration "P", page 41, controls the speed of the loud pedal in the grands. On uprights, soft pedal should move hammers up to one inch from strings. On grands, soft rail should raise  $\frac{3}{8}$ -inch from normal position.

## REROLL, REPEAT AND SWITCH CUTOUT DEVICES

Illustration "O"



### REROLL

Illustration "O"

The reroll mechanism is controlled by the first hole in the bass end of the tracker bar and is tubed up direct to the reroll valve in the rewind and repeat valve box. It controls the reroll pneumatic No. 10 which throws the spool box gearing into reverse and operates the cutout valve to top action.

### REPEAT AND SWITCH CUTOUT

The repeat mechanism is controlled by the hole in the left end of takeup spool No. 7; this hole is bored to center of spool and then proceeds to the left through a tubular bearing which supports spool, and on to the 'Repeat' block No. 1, which, if in the 'On' position, allows the atmosphere to go through tube No. 4 and down tube No. 3 to the valve operating 'Repeat' pneumatic No. 11. This pneumatic throws the spool box gearing into 'Normal' position and repeats playing of music. An examination of 'Repeat' block No. 1 shows that when it is placed 'Repeat On,' the electric motor controlled by the second hole 'in' on the right side of tracker bar cannot be shut off when the motor hole is exposed on

reroll. This allows 'Repeat' hole in takeup spool to function and music is replayed.

With 'Repeat' block No. 2 at the 'off' position, the block slides over and connects the motor port in the tracker bar tube 'D' with tube 'C' that leads to switch valve in box No. 8. Tube 'C' has a bleed that reduces the atmosphere entering tube 'D' through motor port in tracker. This bleed, however, is smaller in size than the bleed in the switch valve so the atmosphere entering tube 'C' through tube 'D' is not sufficient to neutralize bleed in switch valve.

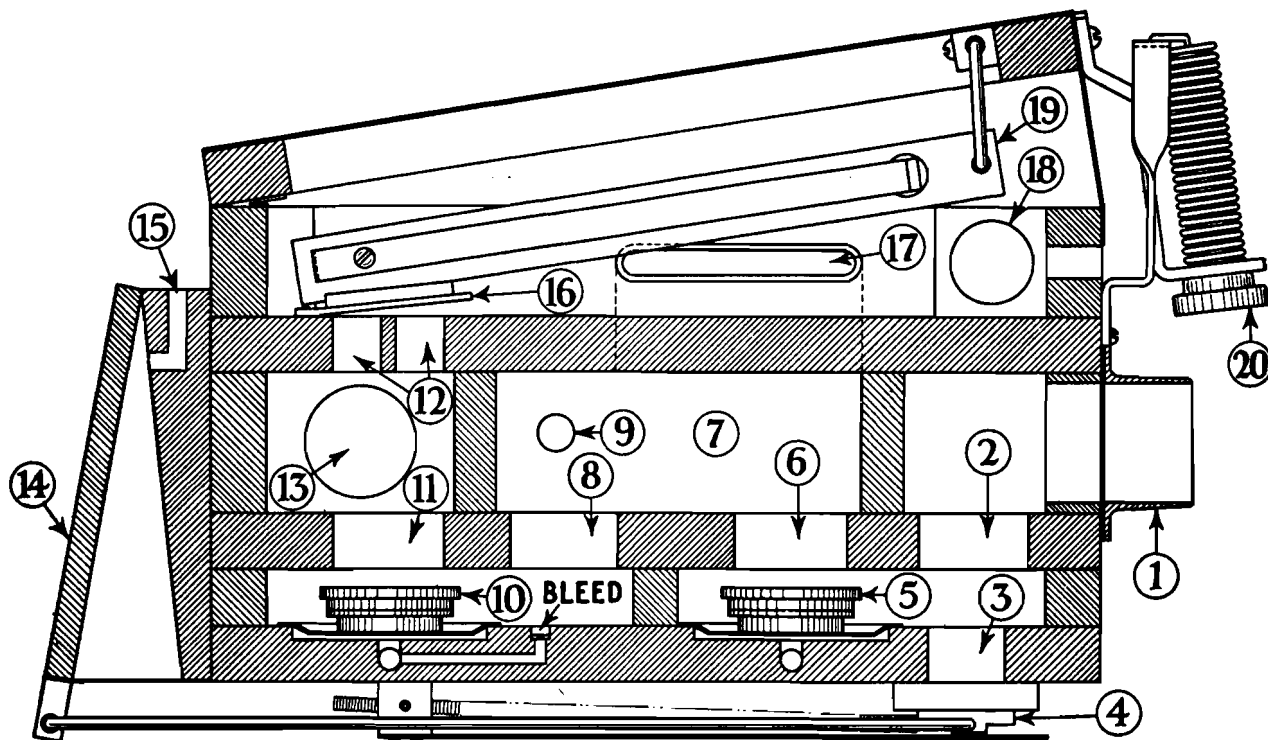
When port No. 7 is exposed by music roll, atmosphere enters through tube 'B' which also has a bleed, combined with the atmosphere entering bleed in tube 'C' neutralizes and overcomes the bleed in the switch valve in Box No. 8 and causes the valve to raise, thereby collapsing pneumatic No. 9 and cutting off electric switch.

### Test No. 11, Reroll

The reroll is operated by the first hole in the bass end of the tracker bar and throws the spool-box gearing into reroll. For details see treatise on page 39 with illustration "O" on page 38.

# GRAND DUO-ART MODULATOR PNEUMATIC

## Illustration "P"



# GRAND DUO-ART MODULATOR PNEUMATIC

Refer to Illustration "P"

The Modulator covered by illustration "P" will be found only in the Grand Duo-Arts. The Modulator Pneumatic provides a means whereby the normal Duo-Art may be modified or softened without losing any of the dynamic gradations. It also acts as a supply regulator for the loud pedal and accordion pneumatics, and it is equipped with a cutout valve for the pneumatic action on reroll.

The illustration has been distorted somewhat to show channel No. 8 which actually is back of channel No. 11.

With the "Dynamic Lever" in front of Duo-Art at the "Concert" or normal position, the modulator valve No. 10 is open and allows the air entering chamber No. 13 to pass down through channel No. 11, then up through channel No. 8 into chamber No. 7, where it passes down channel No. 6 and up channel No. 2 to outlet No. 1, then it passes to the pump and is exhausted.

With the "Dynamic Lever" in front of Duo-Art at "Soft" or modulated position, valve No. 10 raises and closes channel No. 11. The air entering chamber No. 13 now passes up through channels covered by No. 12 and the flap valve No. 16, "which is closed when valve No. 10 is open," is now raised and the air passes to the knife valve port No. 17, where the pressure is cut down or softened. From channel No. 17 the air passes to chamber No. 7, then down No. 6, up No. 2 and out No. 1 to the pump. The spring No. 20 controls the degree of modulation which should be one-half the full volume of the Duo-Art. If the spring No. 20 is set so the degree of modulation is one-half the full volume of the Duo-Art, it will be found that there is enough spring tension to operate the loud pedal pneumatic and the Accompaniment and Theme Accordion pneumatics so they will work fast enough and still remain quiet in their operation. With the Dynamic Lever at "Concert" position, the modulator pneumatic has no effect upon the volume of the Duo-Art.

The action cutout valve No. 5 closes on "reroll" and pneumatic No. 14, which operates slide covering channel No. 3, collapses, which lets in the outside air and eliminates any excessive load on the electric motor.

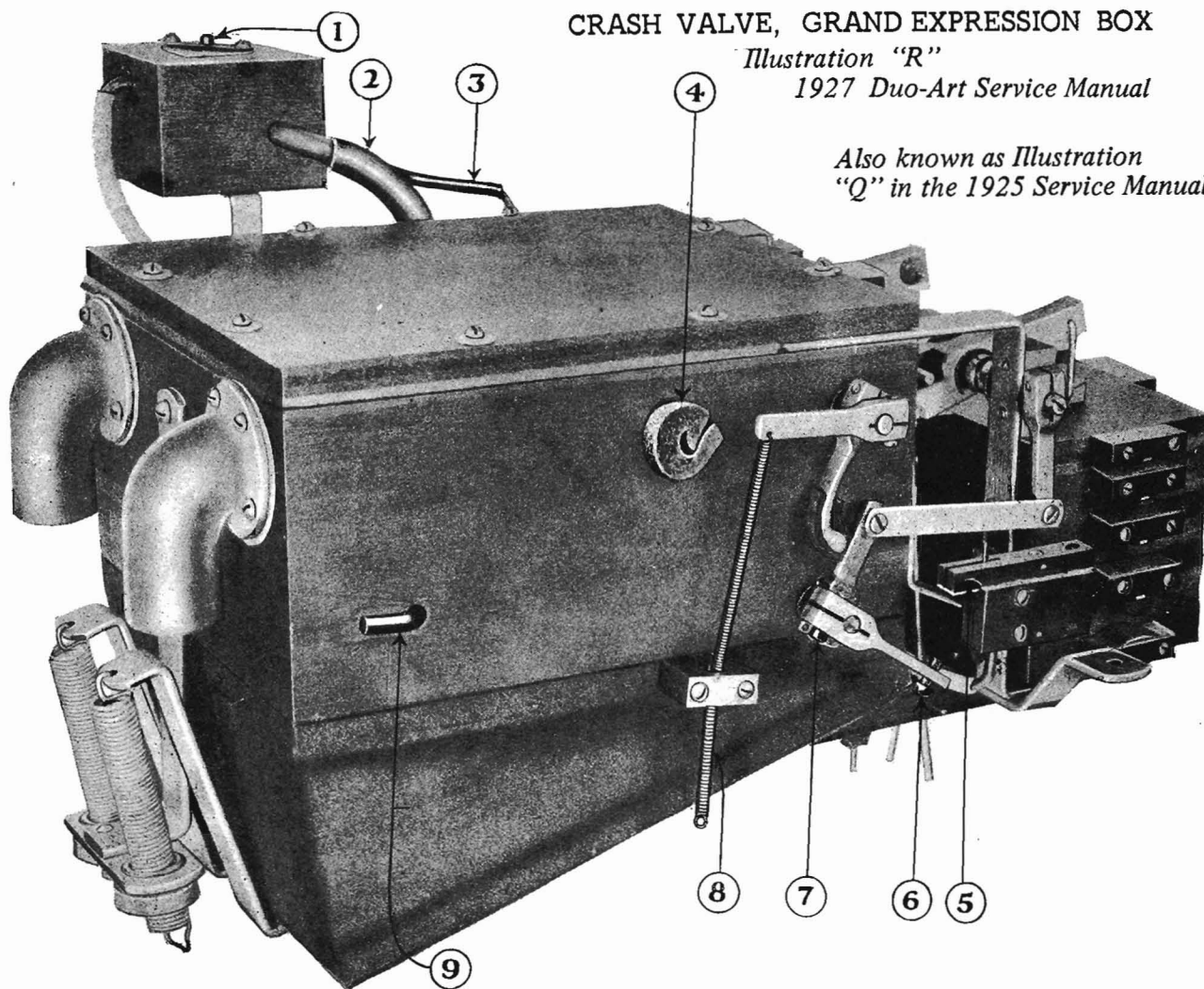
The loud pedal is supplied from port No. 18.

# CRASH VALVE, GRAND EXPRESSION BOX

Illustration "R"

1927 Duo-Art Service Manual

Also known as Illustration  
"Q" in the 1925 Service Manual



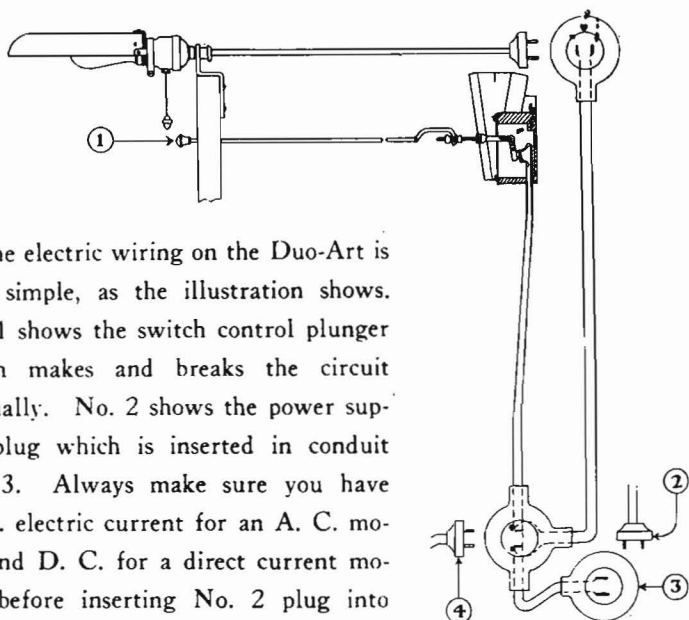
## CRASH DEVICE, GRAND EXPRESSION BOX

Refer to Illustration "R"

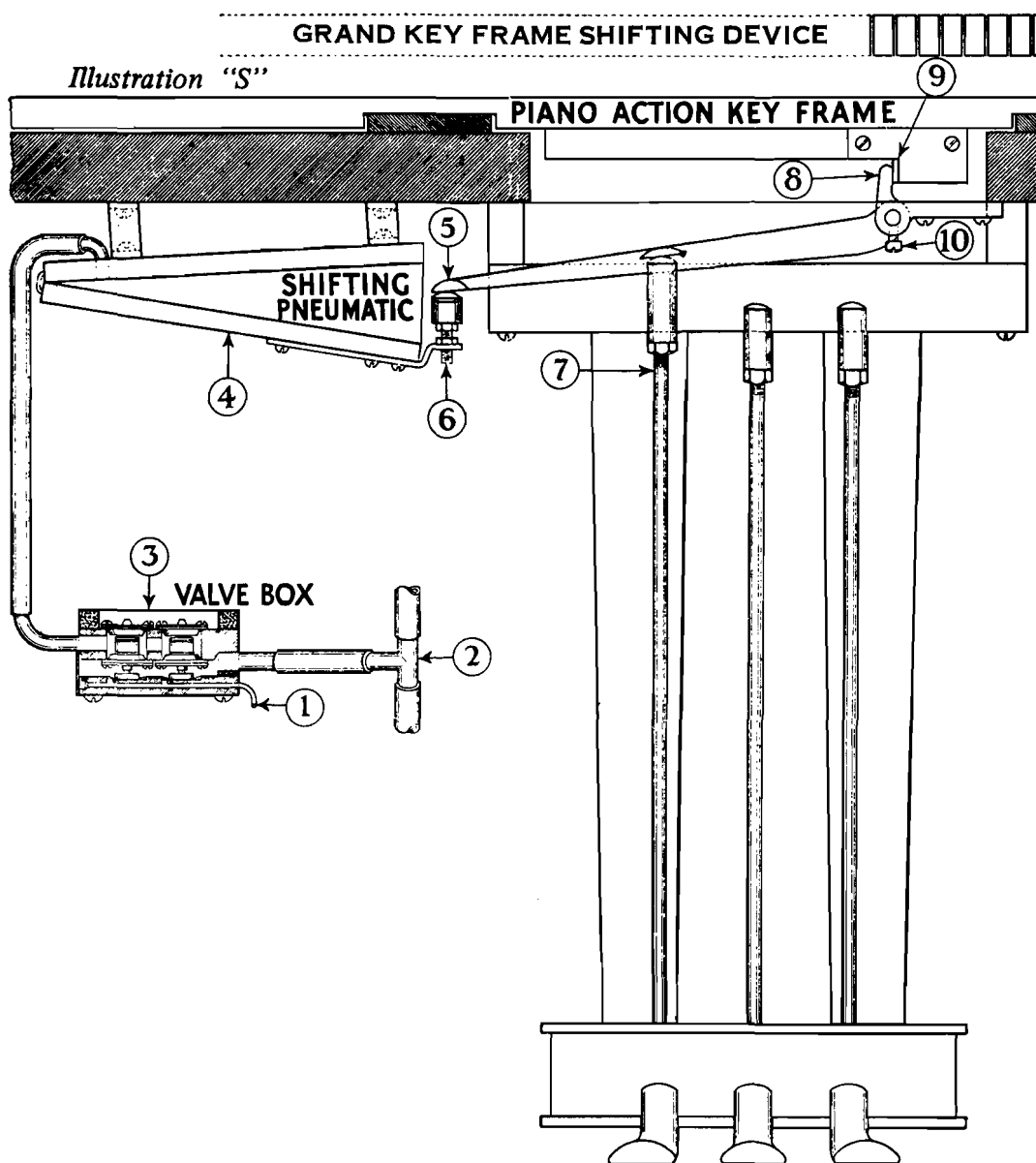
The Grand Duo-Art Expression Box is constructed differently from the upright box, due to the difference in design of the two instruments, but the basic principles are the same in both expression boxes. The grand expression box has a crash valve which functions when power No. 15 on the Theme side appears in the music roll. No. 1 in illustration "R" shows the crash primary valve box.

No. 6 shows the connecting arm and screw which is attached direct to the knife valve shaft and, as the accordion pneumatics collapse, it raises this arm closer to the pallet valve No. 5, but until power No. 15 appears in the Theme side, it should not operate. With the regulating screw No. 6, this adjustment can be made so that at power No. 14, the crash is "off" and at No. 15, it comes "on" and this adjustment should be made after any regulation of the Theme knife valve. When the crash valve operates it makes a channel direct from the pneumatic action to the pump cutting around the Theme knife valve, and very quick loud accents can be obtained with this device.

No. 2 shows the supply tube to the crash valve primary. No. 3 shows the tube which connects to the pallet valve No. 5. No. 7 shows the set screw on crash arm and rough adjustments can be made here of regulating screw No. 6 to pallet valve No. 5. No. 4 shows the atmosphere intake or "spill" on the grand expression box. No. 8 shows the spring which pulls the spill valve back to normal. No. 9 shows the nipple to the Theme secondary valve on the treble side.



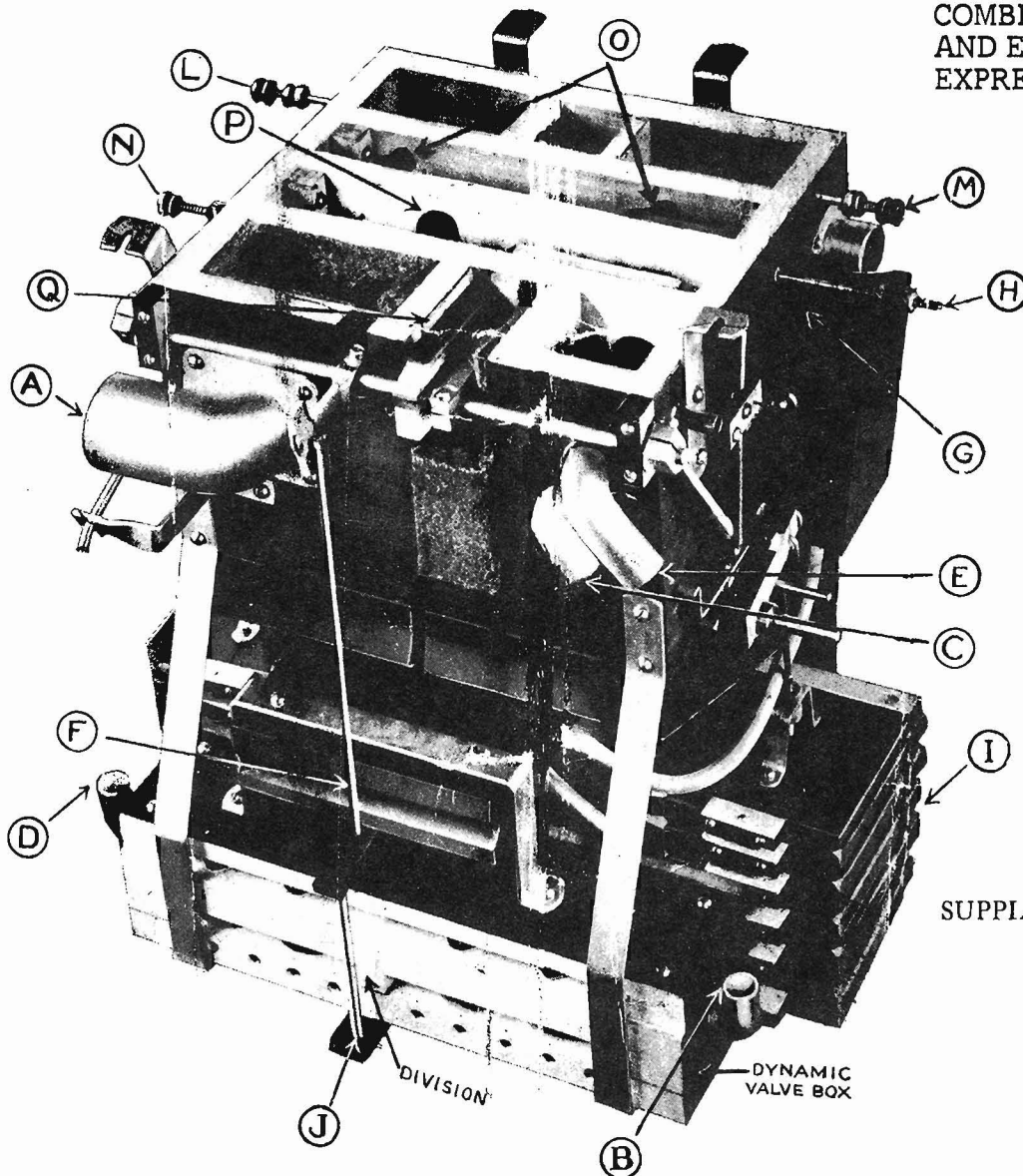
The electric wiring on the Duo-Art is very simple, as the illustration shows. No. 1 shows the switch control plunger which makes and breaks the circuit manually. No. 2 shows the power supply plug which is inserted in conduit No. 3. Always make sure you have A. C. electric current for an A. C. motor and D. C. for a direct current motor, before inserting No. 2 plug into No. 3. The grand Duo-Arts are not equipped with an electric light but aside from that the wiring is very similar to the upright. No. 4 shows the electric motor plug.



Above illustration, "S," shows the grand key frame shifting device; this was installed only in the late model grand Duo-Art.

*Illustration "T"*

**COMBINATION FOOT IMPELLED  
AND ELECTRIC DUO-ART  
EXPRESSION BOX**



SUPPLEMENT TO SERVICE MANUAL  
No. 3

**COMBINATION FOOT IMPELLED AND  
ELECTRIC DUO-ART EXPRESSION BOX**

REFER TO ILLUSTRATION "T"

The combination foot impelled and electric Duo-Art expression box is slightly different from the standard Duo-Art expression box found on page 17, illustration "E," with treatise on pages 19 and 20. The difference is as follows:

Spill valve pneumatic "F" with connections and pneumatic "G" which opens a channel between the unregulated supply and the Theme chamber with slide valve "H" opening port "P." The two ports "O" are used for graduated expression manually, with slide valves "L" and "M" which are connected to the "Bass" and "Treble" levers on the keyed, when used as a pianola piano. The Dynamic or

Expression primary Valve Box is divided near the center with four valves on the Theme side and five on the Accompaniment side, adding an additional ¼ inch accordion pneumatic on the Accompaniment side. Nipple "B" is the exhaust supply for the Accompaniment side of the Dynamic Valve Box and nipple "D" the exhaust supply for the Theme side.

*Further information on illustration "T" may be found in the special supplement to the 1927 Duo-Art service manual; this supplement is available through the publishers of this book.*

NOTE: ALL NOS. REFER TO RUBBER TUBE CONNECTIONS

- 1 - TO MEMBRANE BLOCK CONTROLLING DYNAMIC PRIMARIES NO
- 2 - SUCTON TUBE TO DUO-ART SIDE OF DOUBLE MEMBRANE BLOCK, SINGLE MEMBRANE AND DYNAMIC MEMBRANE.
- 3 - PRIMARY CONNECTION.
- 4 - TREBLE THEMODIST.
- 5 - BASS THEMODIST.
- 6 - 7 PEDAL PRIMARY TUBES THROUGH JUNCTION BLOCK
- 8 - SUPPLY TO THEMODIST SIDE OF THEMODIST BOX
- 9 - SUPPLY TO TRACKING DO. DO.
- 10 - SUCTON TO P.P. SIDE OF DOUBLE MEMBRANE BLOCK
- 11 - SUPPLY TO DUO-ART CUTOFF BLOCK
- 12 & 14 P.P. THEMODIST
- 13 & 15 DUO-ART THEMODIST
- 16 - LEADS TO GRADUATION CUTOFF VALVES
- 17 - CONNECTION TO RETARD ATTACHMENT FOR REWIND

NOTES

ON THE ACTION OF THE DECOY BOX

WHEN THE HOLE MARKED A ON THE TRACKER BAR AND THAT MARKED B ON THE SPOOL ARE BOTH EXPOSED, THE MOTOR IS PREVENTED FROM RUNNING.

BUT WHEN EITHER OF THE HOLES A OR B IS CLOSED BY THE MUSIC ROLL, THE MOTOR COMES INTO OPERATION

SHOULD THE MUSIC ROLL PAPER LEAVE THE TRACKER BAR WHEN RE-ROLLING, HOLE B STILL BEING COVERED, THE MOTOR IS PREVENTED FROM SWITCHING OFF DIRECT FROM THE BAR

**NOTE: ALL NOS. REFER TO RUBBER TUBE CONNECTIONS**

- 1 - TO MEMBRANE BLOCK CONTROLLING DYNAMIC PRIMARIES NO. 1**
- 2 - SUCTION TUBE TO DUO-ART SIDE OF DOUBLE MEMBRANE BLOCK, SINGLE MEMBRANE AND DYNAMIC MEMBRANE.**
- 3 - PRIMARY CONNECTION.**
- 4 - TREBLE THEMODIST .**
- 5 - BASS THEMODIST.**
- 6 - 7 PEDAL PRIMARY TUBES THROUGH JUNCTION BLOCK**
- 8 - SUPPLY TO THEMODIST SIDE OF THEMODIST BOX**
- 9 - SUPPLY TO TRACKING DO. DO.**
- 10 - SUCTION TO P.P. SIDE OF DOUBLE MEMBRANE BLOCK**
- 11 - SUPPLY TO DUO-ART CUTOFF BLOCK**
- 12 & 14 P.P. THEMODIST**
- 13 & 15 DUO-ART THEMODIST**
- 16 - LEADS TO GRADUATION CUTOFF VALVES**
- 17 - CONNECTION TO RETARD ATTACHMENT FOR REWIND**