HAMMOND ORGAN

A SHORT DESCRIPTION OF THE ELECTRICAL PRINCIPLES AND TONAL COMBINATIONS OF A NEW MUSICAL INSTRUMENT

WORLD PATENTED

INDEX TO CONTENTS

OUTSTANDING FEATURES

It has the full range of organ tone colours.

Its range of expression is many times greater than that of other organs.

It occupies only a few square feet of floor space.

It is ready to play wherever there is an electric outlet.

It cannot get out of tune, having no reeds nor pipes.

It is not affected by atmospheric or temperature conditions.

Its maintenance is negligible.

The standard installation uses about as much current as four ordinary light bulbs.

Its response and repetition are instantaneous-no lag.

It is a beautiful piece of furniture.

It is easily moved,

It is fully guaranteed.

It is made by a well-established organization with a world-wide reputation for precision in manufacturing.

Its price is but a fraction of that which any instrument at all comparable would cost.

But, after all, there is no comparable instrument.

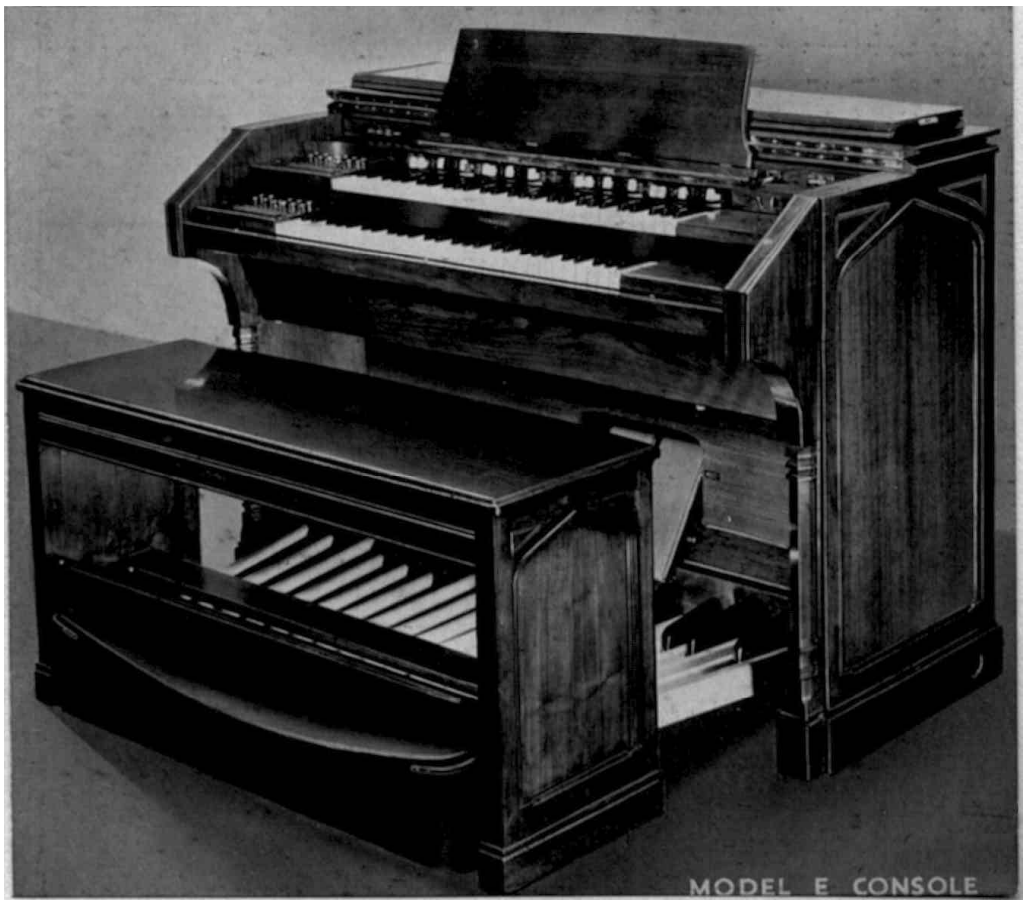
The HAMMOND ORGAN

AN organ that is without pipes or wind may well indeed be called a new instrument. The Hammond Organ, here pictured and described, is not merely new; it represents in itself a revolution so far-reaching as to be quite incalculable New chapters in our social history were opened when, two or three generations ago, the telephone and the typewriter arrived on the scene There can be no doubt whatever that the advent of this new instrument must have an equally startling significance in the world of music

Science and the laws of dynamics have been so harnessed to the inventor's will that he has created an instrument eminently suitable for the drawing room yet, when occasion demands, powerful enough to fill a Cathedral with a tone of great nobility and sweetness It is remarkably adoptable for installation purposes The minimum floor space which it needs never exceeds four or five feet square

The actual "Furniture" of the instrument consists of but two pieces the console and the power cabinet, which is connected to the console by a cable and can be placed in any convenient part of a room or building. The number of cabinets may be multiplied for large buildings, as required.

MODEL A CONSOLE



MODEL E CONSOLE

CHAPTER I

THE TONAL CONTROLS OF

THE HAMMOND ORGAN

EXCEPT where otherwise mentioned, the following descriptions apply equally to every model of the Hammond Organ.

Each of the three models, A, B and E, is ideally suitable for its particular purpose. Models A and B will give every satisfaction in the small church or auditorium or in the home. There is hardly a limit to the scope of music which can be played on either of these two instruments.

Model E console represents the ultimate in organ design and can be termed a professional organist's instrument. Whilst being perfectly suitable for use in the home or in the smallest or largest building, it is so equipped that every description of organ literature may be played with a wealth of dynamic interpretation hitherto unthought of.

It is designed on more ecclesiastical lines than the others, so as to better harmonise with church appointments. Massive in appearance, it is nearly as portable as Model B.

GENERAL ARRANGEMENT.

Figure 1 shows the various controls marked. The pre-set keys are at the left-hand end of each manual. The tremulant control is located just above the pre-set keys. Immediately over the upper manual are five groups of controls.
There are two groups of harmonic controls of nine draw-bars each, on the left-hand side; these operate on the upper manual. The two groups of nine harmonic controls on the right operate on the lower manual. Between these groups are two other harmonic controls; these operate on the pedals.

THE PRE-SET KEYS , Models A and B Consoles (Figure 1).

At the left end of each manual is an additional octave of reverse colour keys-that is, the naturals are black and the sharps white. These are the pre-set keys. Those to the left of the lower manual are associated with that manual, those above with the upper manual.

When a pre-set key is depressed it stays down. When a second key on the same manual is depressed the first key springs up and the second remains down. Up, the pre-set key is "off "-not functioning. Depressed, it is on." Only one pre-set key should be depressed on the same manual at one time.

The key at the extreme left, C) is the cancel key, used only to clear the pre-set keys when two have been depressed by mistake.

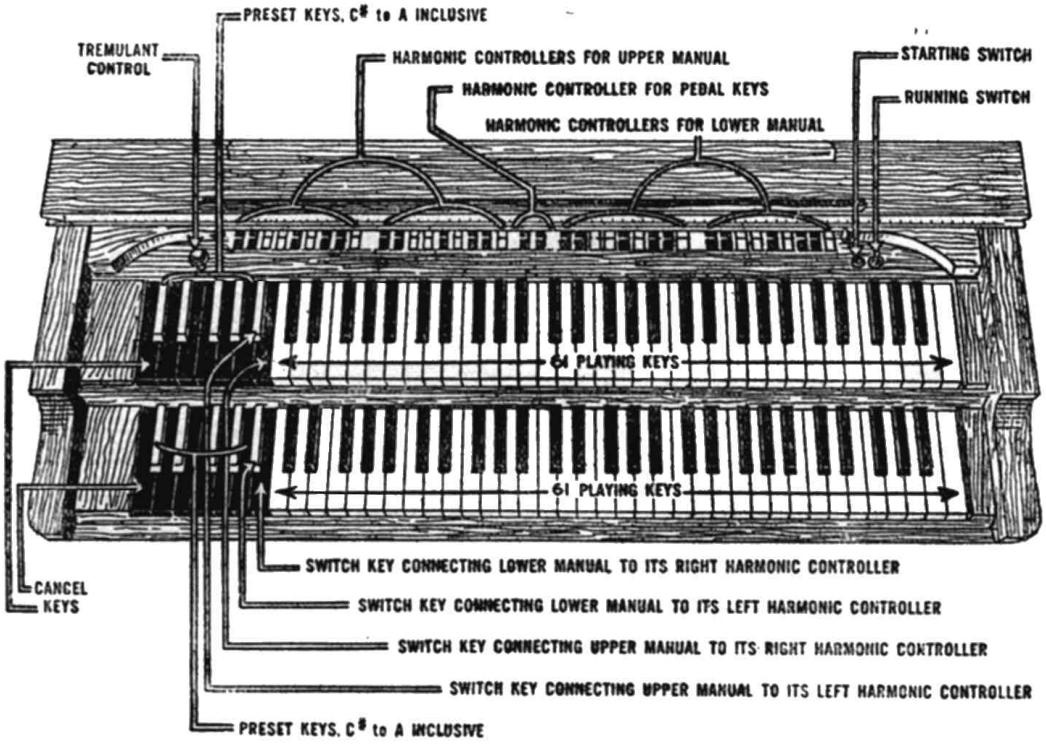


FIGURE 1. PLAN OF CONSOLE (Model A)

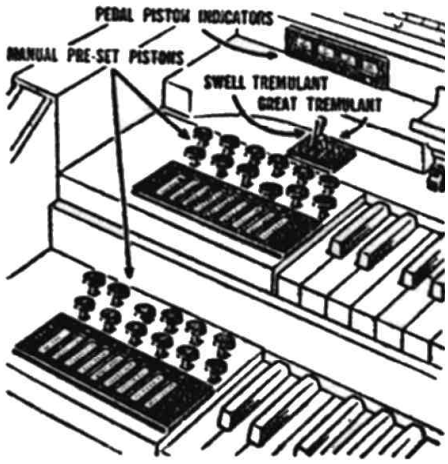


FIGURE 1a.
Model E Console. Manual Pre-set Pistons. Pedal Piston Indicators. Tremulant Levers

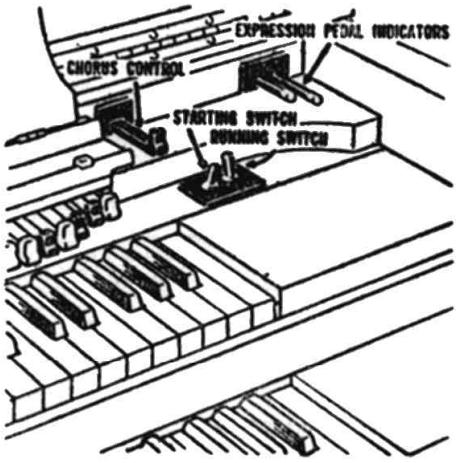


FIGURE 1b.
Expression Pedal Indicators. Chorus Control. Starting and Running Switches.

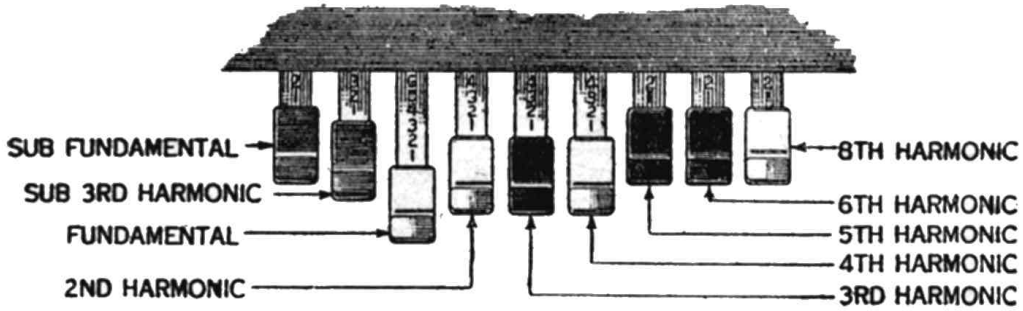


FIGURE 2. A HARMONIC CONTROLLER

The two pre-set keys at the extreme right, A# and B, are really switch keys. when A~ is depressed the organ speaks with whatever tone Colour is set up on the left one of the two harmonic controllers for that manual. When B is depressed the organ speaks according to the right hand controller for that manual.

The intervening pre-set keys, C# to A inclusive, are each associated with a different ready-mixed tone quality set up before the organ is installed. These keys correspond to the pistons on a pipe organ. They are generally useful tone qualities. The artist may, however, substitute any other pre-set quality he prefers for any or all of them by a simple method fully explained in the operating instructions.

The tone of the organ is changed from one quality to another while playing, merely by depressing another pre-set key.

The two manuals are really duplicates of each other, each having its own pre-set keys and two harmonic controllers.

It should be clear from the above that, before playing, the organist must first depress one of the pre-set keys associated with the manual on which he is about to play.

THE PRE-SET PISTONS , Model E Console (Figure la)

On the Model E Console, small pistons (numbered 0 to 11) are employed, instead of the reverse colour keys. A label against each piston indicates the tone quality associated with it. The piston marked "0" is the cancel key and Nos. 10 and 11 are available for any tone qualities that may appeal to the organist by manipulation of the drawbars as explained below.

THE HARMONIC CONTROLLER (Figure 2).

The Harmonic Controller is the device by which the artist is enabled to mix the fundamental and any or all of S different harmonics in various proportions. It consists of 9 drawbars. The third drawbar from the left controls the fundamental. Each of the other drawbars controls a separate harmonic as shown on the diagram. Each drawbar may be set at any one of 9 different positions. If pushed all the way in, against the console, the element it represents is not present in the mixture. It may be drawn out to 8 different positions. These are marked on the drawbar and may be read by the artist. Each position represents a different degree of intensity of the element it controls. When drawn out to position 1, the element it represents will be present in the mixture with minimum intensity, when drawn out to position 2, with greater intensity, and so on, up to position 8.
A tone colour is logged by noting the numerical position of the various drawbars. For instance, the tone set up in the diagram (F:gure 2) is known as tone 23,6444,222. After a tone is so logged it may be made available again by setting up the harmonic controller to that number.

TONE FAMILIES.

In order to make full use of the Hammond method of tone composition, the artist should understand the general characteristics of the various tone families.
The four principal families of organ tones are Flute, Diapason, String and Reed.

FLUTE TONE QUALITY.

The flute tone is a comparatively simple tone. Its harmonic development is concentrated chiefly on the fundamental and second harmonic overtone, with occasionally the addition of one or two other harmonics. The relative proportion of these components varies for the different kinds of flutes.

Combination 00,3500,000 is a quality like that of the pipe organ stop " Flute d'Amour."

Combination 00,5200,000 is a dopple flute quality.
Combination 00,5310,000 is a melodia quality.

The quality 00,5000,000 is, of course, also very flute-like in its timbre. It is a pure fundamental tone, however, without harmonic development and the musician is cautioned against employing it or any other single fundamental. Its total lack of harmonic development is both unnatural and unmusical. For a tone to possess character, it must have some harmonic development, and the player should employ only tone colours containing some such development.

It will be apparent that even in this family, the simplest of the tone families, there is a large number of variations available to the artist from which he may choose that particular quality which pleases him most.

DIAPASON TONE QUALITY.

The diapason quality is a foundational tone of the pipe organ. There are various kinds of diapason qualities. All diapasons have both a strong fundamental and second harmonic with relatively weak upper harmonic development. The diapason qualities differ from each other principally in the number and strength of the upper harmonic overtones.

Combination 00,5521,000 is an example of phonon diapason quality.
Combination 00,5442,420 is an example of violin diapason quality.

In pipe organs, the diapason stops are usually strengthened harmonically by the addition of mixtures or harmonic corroborating tones. The so-called Diapason Chorus" consists of several diapason tones, plus a group of mixture tones.

Combination 24,6777,664 is an example of diapason chorus quality.

Combination 54,6444,222 is an example of such a quality with 16 foot diapason.

STRING TONE QUALITY.

String quality is characterized by large upper harmonic development. The fundamental and second harmonic development are relatively small. A keen string quality will have very little fundamental and not much second harmonic. A string quality always has a complete upper harmonic series present, none of which is unduly strong or weak.

Combination 00,4345,555 is a moderate string quality.
Combination 00,2345,555 is a keen string quality.

REED TONE QUALITY.

The characteristic of a reed tone is its very heavy upper harmonic development. Whereas in a diapason quality the upper harmonic development is only moderate compared to the fundamental and second harmonic, in a reed chorus the upper harmonic development can he as great as the fundamental and second harmonic.

Combination, 77,7777,777 is a chorus reed quality with strong sub-octave or 16 foot tone.

Combination 00,7777,665 is a milder reed chorus.

Combination 35,4687,865 is an example of a very strident reed of the trumpet quality.

The above are examples of chorus reed tones. Solo Reeds, as their name implies, are most effective when played as single notes for solo passages.

Some examples of solo reed tones are:

Combination 00,6270,520, a clarinet quality (note large third harmonic).

Combination 00,3675,210 is an organ oboe quality.

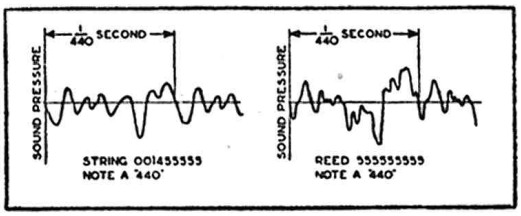


Figure 3. Graphs of the wave patterns of string and reed, pitch "A."

NEW TONE QUALITIES.

Besides the flute, diapason, string and reed tones, the Hammond Organ can produce coundess tones that have never been heard before in a classical instrument.

In the Hammond Organ any harmonic may be developed independently of the other harmonics. Also, any harmonic may be entirely suppressed. Thus, its tonal possibilities are not limited as are those of musical instruments heretofore developed. For instance, tones are available in which even the fundamental is entirely absent. It is these unfamiliar harmonic absences which make new such combinations as 00,0261,111 or 00,1426,030. There are an endless variety of these unfamiliar tone qualities and the performer must use his own discretion in employing them. While they may effectively be adapted to certain modern music they are not all suitable for classical organ literature.

"CHORUS GENERATOR ."

An additional feature now obtainable on Models B and E consoles is that known as the "Chorus Generator." This imparts a new and extraordinary richness and beauty, instantly noticeable even to the untrained ear.

A Chorus Control drawbar is provided whereby the organist can turn this new effect on or off at will.

The Chorus Generator makes possible a large number of pleasing ensemble qualities. The familiar Voix Celeste and Unda Maris are two of many useful organ stops which utilize the same principle involved in the Hammond Organ chorus effect. String combinations, both solo and ensemble, assume a new depth and beauty. Hitherto, it has been customary to limit such an effect to one or two tonalities. In the Hammond Organ, the chorus effect may be on any or all tone qualities. The tremulant takes on a new charm when used with the chorus effect. When the full organ is used, an added richness and fulness of tone will be instantly observed: an effect of tone emanating from many sources.

The Chorus Generator has been so designed that combinations of a dignified character, such as Diapasons and large scale Flutes are not affected to the extent of the string and reed qualities.

Installation problems will be materially reduced, for the Chorus Effect does much to overcome the disadvantages of smaller rooms or those presenting a "dead" or non-reverberating condition.

The Chorus Generator Unit has its own starting and running motors which operate simultaneously with the motors of the main generator. For each of certain tone-wheels in the main generator there is in the chorus generator a pair of tone-wheels which have their speeds so adjusted that one will produce a tone slightly sharp and the other a tone slightly fiat by comparison with the accurately tuned main generator frequencies. Thus, when the chorus generator unit is turned on and a single frequency sounded from the main generator, the two slightly de-tuned chorus frequencies will also sound and the result is the formation of a complex series of" beats " or " waves " in the tone.

The chorus control is a black drawbar situated at the right of the console lust above the end of the harmonic controllers. When the chorus control is drawn out, the chorus generator unit is switched on. Pushing the control in disconnects the generator unit so that the chorus effect is not heard.

GENERAL.

The above should serve to give the artist an idea of the vast resources of the Hammond Organ. Within each tone family can be discovered an infinite variety of qualities from which the player can choose; he is not limited to relatively few in each family, but is enabled to create that special subtlety of tone-colour which he may want at a particular moment. It is this which makes the Hammond Organ the instrument upon which the artist-organist can best express his own individuality.

THE HARMONIC CONTROLLER FOR THE PEDAL ORGAN.

Here the harmonic resources have been combined into only two harmonic controls. The fundamental 16 ft. pitch and second harmonic are associated with the left-hand control and produce the fundamental depth to the pedal. The third, fourth, fifth, sixth and eighth harmonics are associated with the right-hand control to give higher harmonic quality variations, and a useful 8 ft. solo if used without the left-hand control.

While the possible number of pedal organ tone qualities is, of course, less than those available on the manuals, the player will find the volume quality and tonal depth ample to balance any manual combinations that are used.

THE TOE PISTONS , Model E Console (Figure 4).

Situated to the left of the expression pedals of the Model B Console are four pistons which are placed in the correct position for easy manipulalation for the toe.

The standard settings are:

1. **FF Full 16 ft., 8 ft. and mixtures.**
2. **MF Diapason 16 ft., String 8 ft., Flute 8 ft.**
3. **Great to Pedal 8 ft.**

   (*This piston is especially useful as it enables the organist to couple any of the whole range of tone qualities available on the manuals to the pedals in 8 ft. pitch: 16 ft. tone can be added by using the first pedal drawbar*).

4. **Adjustable. With this piston the two pedal drawbars are brought into action and are used in the manner described in the foregoing paragraph.**

Electrically lighted indicators just above the manuals show which of the toe pistons is in action.

Figure 4 illustrates the position of these toe pistons, the independent swell pedals (*see page 12*) and also the 32-note concave, radiating pedal clavier that is such an outstanding feature of the Model E.

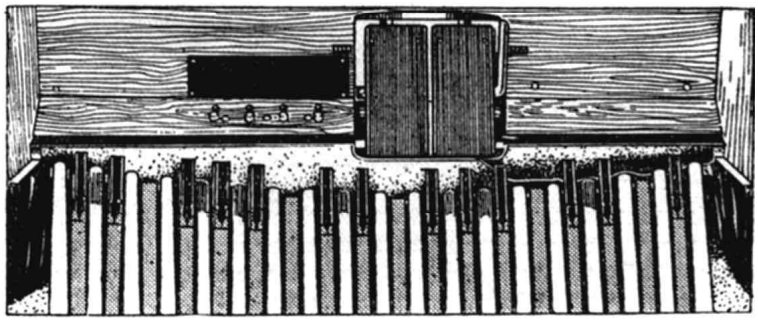


FIGURE 4

THE TREMULANT.

The organist can adjust the degree of tremulant to suit his own musical taste. When the knob is turned as far as possible to the left, the tremulant is entirely off. As it is turned to the right (clockwise direction), the degree of tremulant gradually increases until it reaches the maximum at the extreme right position. The white dot marker on the knob indicates at a glance the degree of tremulant present.

The adjustable feature makes it possible to have a mild tremulant for flute qualities and a more vibrant one for string qualities, etc.

The Model E Console has separate tremulants for each manual. These tremulants are adjustable as to intensity or amplitude.

THE SWELL PEDAL, Models A and B.

The swell pedal, or expression pedal, is located in the customary position and with it the volume of the organ may be controlled over a wide range. It operates on the two manuals and pedal clavier equally; that is to say, once the manuals and pedals are balanced, they retain their relative balance over the entire swell pedal range.

The dynamic range of the swell unit is stupendous. Technically, the power ratio of the swell pedal fully open to fully closed, is 50 decibels. In the most carefully constructed pipe organ swell shades, the power ratio seldom exceeds 15 decibels and is usually considerably less. The range of 50 decibels would correspond to approximately 32 points on a pipe organ, only a very few of which are constructed with a range in excess of 12 points.

The volume increase effected through the swell pedal is dynamically equivalent to a pipe organ crescendo build-up. One noticeable and very desirable difference is the absence of sudden tone quality changes characteristic of the build-up of the pipe organ to orchestral crescendos.

HOW TO MAKE ONE MANUAL LOUDER THAN THE OTHER Models A and B.

Since the swell pedal operates equally on both manuals and on the pedals, this balance is maintained throughout the entire dynamic range of the swell unit. When it is desired to make one manual louder than the other, it is necessary only to select a tone colour which is softer than the one being used on the other manual, whether the softer tone colour be identical in character or different.

To select an identical but softer tone colour, it is necessary only to see that the harmonic controller for that manual is set with the drawbars in the same relationship to each other, but not pulled out so far. For example, tone number 23,6444,222 is of the same quality as 34,7555,333, but softer. You have simply pushed each drawbar in by one position.

This ability to make the same tone colour louder or softer on one manual than on the other is of great advantage musically. The swell pedal, operating equally on both manuals changes the volume of both equally without destroying the balance between them.

The volume of the pedals can be controlled over quite a wide range by the use of the harmonic controls associated with the pedals, in addition to the volume change of the swell pedal.

THE SWELL PEDALS , Model E (*Figure 4*).

The Model E Console has the added advantage of ind~pendent swell pedals, each of which affects its respective manual over the 'vide dynamic range for which the Hammond Org~n is noted. The pedal controlling the Great manual also controls the pedal clavier.

The position of each pedal at any time is clearly shown by indicators situated on the right, above the upper manual (*Figure lb*).

CHAPTER II.

ANALOGY BETWEEN HARMONICS AND PIPE ORGAN MI TURES.

THOSE familiar with pipe organ design will recognise that the harmonic control system of the Hammond Organ is simply an extension of the principle of harmonic corroborating stops or mixture stops on a pipe organ.

In pipe organ phraseology, the fundamental is of 8-foot pitch, the second harmonic of 4-foot pitch, the third harmonic of 2 2/3-foot pitch (twelfth or nazard), the fourth harmonic of 2-foot pitch (fifteenth or super octave), the fifth harmonic of 1 2/5-foot pitch (seventeenth or tierce), the sixth harmonic of 1 1/3-foot pitch (nineteenth or larigot), the eighth harmonic of 1-foot pitch (third octave or twenty-second), the sub-harmonic of 16-foot pitch, and third sub-harmonic of 5 1/3-foot pitch.

The chief difference is that in the Hammond Organ the player is able to control the precise amount of strength of each rank, which is obviously impossible with pipes, because a pipe must either be blown or left silent. To incorporate as many different sizes of pipes for each rank of the harmonic series as are necessary to control the tone quality by harmonic changes alone, would require so many pipes that the expense and difficulty of regulation and maintenance would make it impracticable. The number of pipes required under such a system would be so large that it is actually simpler, and requires fewer pipes, to put the harmonics in the foundation pipes by voicing, and to supply as many ranks of differently voiced pipes as the user wants or can pay for.

THE HAMMOND ORGAN IS A "STRAIGHT" ORGAN.

Without going into any discussion as to the merits of " extension" in a pipe organ, it is obvious that this principle cannot be used to reduce the number of pipes which would be necessary to control the tone quality by harmonic pipes alone; for in the common case where the same frequency reappears twice as a harmonic of different order of two notes in one chord, the single pipe would have to be made to blow twice as hard. This is plainly impossible because the pipe must either be blown the same way or not blown at all.

Owing to the fact that it is much simpler to control the amount of electricity which will flow in an electric circuit than it is to control the amount of sound that will come from a pipe, it has been possible to design the instrument so that one source of a given frequency can be used to put different amounts of electric current into the whole. No matter how many times a certain frequency is called upon to enter into a complex mixture of a chord of tones of one kind, the same source can be used with increasing strength and so represents in itself a large number of pipes which would otherwise have to be available for the purpose. Thus, the Hammond Organ has none of the tonal failings characteristic of the unit pipe organ. It is a straight organ with full and equal tonal resources available on both manuals and pedals.

SEVENTH HARMONIC OMITTED.

The seventh harmonic is not represented on account of tempered scale interference. This harmonic is always eliminated as much as possible in the design and building of musical instruments employing the tempered scale.

SUPER AND SUB-OCTAVE "COUPLER" EFFECTS.

Pipe and reed organs are usually equipped with super and sub-octave couplers. The chief function of a super-octave is to introduce a large second harmonic (octave pitch) into the tone quality. The sub-octave coupler introduces a large sub-fundamental into the tone quality. On the Hammond Organ these harmonics are readily introduced with the appropriate draw bars.

THE BLACK AND WHITE SERIES OF HARMONIC CONTROLS.

In each group of nine controls, the two left ones are coloured brown, while those to the right are either black or white. In the black and white series, the white one on the left is the fundamental of the corresponding note on the manual it controls. The next draw bar to the right controls the second harmonic. The second harmonic is an octave higher in pitch than that of the fundamental. If the fundamental be thought of as "*doh*" in the scale *doh, ray, me*-then the second harmonic is also "*doh*" one octave up. It is coloured white, like the fundamental, and it will be found that every white draw bar is also a " *doh* "either one, two or three octaves up.
The fifth draw bar from the left controls the third harmonic and is coloured black. The third harmonic tone is "*soh*." The seventh draw bar from the left, controlling the fifth harmonic, is black and is a" *me*." The eighth draw bar from the left, controlling the sixth harmonic, is black and is a *soh*."

MUSICAL SIGNIFICANCE OF BLACK AND WHITE SERIES.

The black and white harmonic series has a very real musical significance. The harmonics associated with the white draw bars are all of octave relations. When playing a chord, for instance, the introduction of these harmonics does not in any way change the concordance of the musical effect. The effect is one of coupling the first, second, and third octaves to various degrees of strength. The change in tone colour brought about by changing from one white draw bar to four white draw bars is analogous to the difference between a single note and a double-octave of that note. The tonal brilliance is greatly increased, but the general effect of consonance is the same.

The introduction of the harmonic pitches associated with the black draw bars brings about a dissonant effect. For instance, supposing we are playing the triad C-E-G with only the white draw bars out. All pitches involved will then be either C, E, or G.

Now let us introduce the third harmonic which is the first in the black series. It introduces the pitches G, B and D one octave up. B and D are obviously" dissonant." Now suppose we draw the black fifth harmonic control. It introduces the pitches E, G# and B two octaves up. G# and B are dissonant. The black sixth harmonic draw bar introduces G, B and D two octaves up. B and D are dissonant. The purpose of this illustration is to show the dissonant effect produced by the black series. It must not be concluded, however, that the draw bars of the black series

are unmusical. The mellowness of a horn, the pungency of strings, and the brilliant and strident tone of reeds are all traceable to harmonics of pitches other than octaves together with those of octave pitches.

BLACK SERIES SHOULD NOT BE STRONGER THAN WHITE.

However, the black series should not be of strengths larger compared with the white series. The reader will understand that the combination 00,1282,882 will have so many strong dissonant pitches in it that when playing a chord the effect will be so discordant that the listener will not even know what notes are being played. In order that the effect be musical and consonant, the black series should be employed as sparingly as possible. If a black draw bar is employed, it is a good rule to draw the adjacent white draw bars to strengths within two steps of the black.

NO SINGLE HARMONIC PROMINENT.

It is not true in general that the prominence of any single harmonic necessarily characterizes a given tone quality. For instance, the combination 00,5484,211 is of a mild reed quality. when played as a solo, the effect is musically satisfactory. However, when this combination is used in playing chords particularly below middle C) the dissonance caused by the large third harmonic makes it unsuitable. If this combination is changed to 00,5575,211 (increasing the adjacent white draw bars by one step and decreasing the black draw bar by one step) the quality as a solo will remain for all intents and purposes the same. Only on a quick switch-over test can any difference be detected in quality. However, when playing chords, the dissonance is considerably reduced. Supposing the combination is further altered by increasing the adjacent white draw bars by one more step and decreasing the black draw bar by one more step: the combination here becomes 00,56,211. The original solo character is still maintained. The objectionable dissonance, however, is now entirely removed, making the quality useful both for solo and ensemble purposes. From this illustration one learns that the quality or timbre of a musical sound is determined more by the general distribution of energy over the harmonics than by the concentration of energy on any one harmonic. The player who will select combination numbers in which the black draw bar numbers are not too prominent will always find the musical results satisfactory.

THE BROWN HARMONIC CONTROLS.

In addition to the black and white series of controls, there are two brown controls on the left of each group. These are used to produce combinations of sub-octave tonality comparable to the addition of 16-ft. stops in a pipe organ. The control on the left is the sub-octave of the fundamental and is of pitch "*doh*" and thus can be treated like one of the white series. The right brown control is the third harmonic of the sub-octave and is of "*soh*" pitch and this should be treated like one of the black series of draw bars.

HARMONIC CONTROLS UNLIKE PIPE ORGAN STOPS.

It is essential not to confuse the harmonic controls of the Hammond Organ with the stops of a pipe organ. They are not at all the same. No single control produces more of a flute or more of a string tone than any other. The flute may be produced by a certain *combination* of controls, the strings by another *combination*, or both flute and strings may be played by still a different *combination*.

CHAPTER III.

A FEW INTERESTING TONE COLOURS.

THE following is a list of tone combinations and effects which have been found pleasing to many musicians. The organist is urged to explore the tonal possibilities of his instrument, and work out those combinations which not only satisfy his own taste but suit the acoustical environment in which the organ may be placed.

For example, the oboe combination given below may not at all fit the player's particular concept of what that tone-colour should be; and it may be affected by the acoustical surroundings. If, however, the organist takes this log number" as a point of departure, and experiments with it-perhaps intensifying some of the harmonics a little, perhaps repressing others-he will soon discover the particular tone he prefers.

Here are a few starting points for a voyage of discovery:

FLUTES.

Gedeckt Aetheria	. 00,3000,000
Holi Flute	. 00,3100,000
Orchestral Flute	. 00,3811,000
Wald Flute	. 00,4700,000
Stopped Flute	. 00,7030,000
Clarabella	. 00,5210,000
Doppel Flute	. 00,6100,000
Concert Flute	. 00,6300,000
Melodia	. 00,2311,000
Gross Flute	. 00,8321,000
Flute d'Amour	. 00,5020,000
Tibia	. 00,8760,000
Tibia with 16	71,7721,000

DIAPASONS.

2nd Open	. 00,6633,200
Diapason	. 00,4432,100
3rd Open Diapason	. 00,4413,110
Geigen Diapason	. 00,6731,110
Horn Diapason	. 00,7753,111
Phonon Diapason	. 00,5745,100
Bell Diapason	. 00,5442,200
Violin Diapason	

STRINGS.

Aeoline	. 00,2221,100
"	. 00,3322,000
Dulciana	. 00,3221,000
Quintadena	. 00,0320,000
Gemshorn	. 00,3421,100
Violin	. 00,4645,320
"	. 00,1455,542
" (solo)	. 00,2434,332
Cello	. 00,2645,400
"	. 00,0577,542
"	. 00,0455,411

REEDS.

English Horn	. 00,2574,310
Clarinet	. 00,6070,330
Sarusophone	. 00,2380,330
Vox Humana	. 00,1200,432
" " (Wooden)	. 00,0564,000
French Horn	. 00,7522,000
Corno d'Amour	. 00,6751,000
Bassoon	. 08,8000,000
" "	. 00,2484,321
Fagotte	. 00,3630,000
Muted Horn	. 00,3760,000
Clarion	. 00,4567,000
Trumpet	. 00,5674,000
" "	. 00,4666,400
Tuba	. 00,8887,500
Saxophone	. 01,8761,210
Bass Horn	. 75,8410,000

TONE COLOUR COMBINATIONS.

Soft Accompanying	.	Strings with 16'	. 13,8545,430
Flutes	. 00,2220,000	Flutes and Strings	. 00,4535,222
	. 00,4321,000	Soft Flutes and	.
Flutes, 8' with soft	. 00,5201,000	Strings	. 00,2321,021
4'	. 00,8524,000	Very Soft Full Swell	.
Flutes, 8' and 4'	. 00,3512,000	with 16'	. 21,2212,110
Soft Flute, 8' with 4'	. 00,7615,113	A Full Solo Com-	.
Flutes, 8', 4' and 2'	. 00,4555,430	bination	. 27,2225,220
Oboe and Flute	.	Full, reedy swell	. 14,5645,553
16' with dolce	. 50,2001,110	A Diapason Chorus	.
mixture	. 00,1233,333	with 16'	. 22,8865,421
Soft Strings	00,0111,111	Diapasons	. 00,8877,532
" "	01,1333,210	Soft Diapason with	.
" "	00,2434,332	4' principal	. 00,6503,020
" "	00,1455,542	A Full Swell Com-	.
Keen Strings	00,0343,333	bination	. 00,7764,321
" "			

Below is given a small list of further tone-combinations which may be found pleasing, according to taste. They are merely representative; there are thousands more of each type and the artist will, no doubt, make many discoveries and experiment with those that best suit his purpose.

Flute Harmonique	. 00,6500,000	Open Diapason	. 00,7755,220
Flutes 16 ft. and 4 ft.	. 62,5720,000	Salicional	. 01,4433,220
Oboe	. 00,3675,210	Soft Swell with Dolce	.
Clarinet	. 00,6470,520	Cornet	. 14,5645,553
English Horn	. 00,1355,430	Full Swell	. 00,4222,111
French Horn	. 00,7431,000	Diapason Chorus with	.
Trumpet	. 01,4765,530	Mixtures	. 01,5656,342
Solo Violin	. 00,3335,331	Full Organ	. 67,7778,677
Violin Diapason	. 00,4413,110	Soft Flute	. 00,3210,000
Soft Strings	. 01,2221,300	Medium Flute	. 00,5220,000

According to the order received-whether for church or home use-a nicely-balanced setting5 which in our opinion is appropriate for each purpose, is provided on the organ as it leaves the factory, but the owner may either call upon us to re-voice any tonal combination when installed or, with a few moments' instruction, be capable of so doing himself.

CHAPTER IV.

THE ELECTRICAL PRINCIPLE OF THE HAMMOND ORGAN

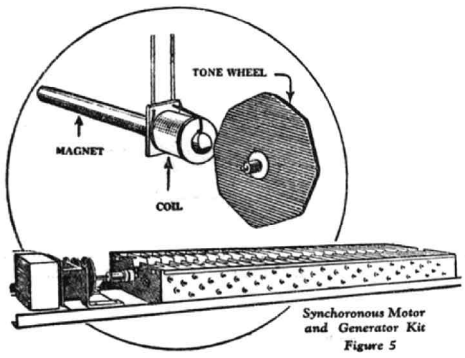
HOW MUSICAL TONES ARE CREATED.

WHEN you pull out one drawbar of a controller and depress a playing key, a minute single alternating current generated in the console is carried through the cable to the power cabinet. Here it is amplified by the use of normal amplifying methods and caused to operate standard speaker cones and produce audible sound. The characteristics of the minute current generated are such that the sound produced at the speakers is a musical tone perfect in pitch and free from all overtones and harmonics. In other words, it is a pure fundamental tone.

To this the artist, by using the other drawbars may add other pure tones which are selected harmonics of this fundamental and thus produce complex musical tones of a wide variety of qualities. The quality of a musical tone depends upon its harmonic content. This harmonic content is added to the fundamental by combining the proper minute electrical currents at the console through use of the controls provided.

THE GENERATOR.

Let us now consider the generator, located in the console, and see how it produces the minute electrical currents which create the musical tones. Refer to Figure 5. A metallic plate (the Tone wheel) about the size of half-a-crown is arranged so that it will rotate in close proximity to a permanent magnet. About the permanent magnet is wound a coil. The illustration clearly shows this arrangement of plate, magnet and coil. This plate is not circular but has a number of high points equally spaced around its periphery, as shown. As it rotates it does not touch the permanent magnet, but these high points pass close to the magnet. Each time a high point passes the magnet it varies the magnetic field and induces a minute flow of current in the coil. Should the tone wheel be rotated at such a speed, for instance, that 439 high points pass the magnet each second, a minute alternating current of a frequency of 439 would be generated in the coil and flow in the circuit with which it is associated. Such a frequency of 439 when converted into sound would be "New Phillharmonic" Pitch "A."



Synchoronous Motor and Generator Kit
Figure 5

Now in the generator there are 91 such plates, all permanetly geared together

and driven by a constant speed synchronous motor. Their speeds of rotation and the number of high points on each are so calculated that each disc produces one of the 91 frequencies necessary for the 91 pitches which are used in the fundamentals and harmonic overtones.

THE GENERAL ELECTRICAL OPERATION.

Ninety-one frequencies are thus continuously available at the generator. when a key is depressed it selects the proper frequency for the fundamental of the note it represents, together with the proper frequencies for eight harmonics of that note as set up on the harmonic controller or on a pre-set key. These frequencies then flow through the contacts made by the key, each to its proper drawbar, of the harmonic controller. The position of the drawbar (which is under the control of the artist) determines the intensity of each frequency. After leaving the harmonic controller these various frequencies are superimposed upon one another, or mixed, and flow as a single complex electrical wave to the pre-amplifier, also located in the console. From here the wave (amplified somewhat) flows through the connecting cable to the amplifiers located in the power cabinet where it is further amplified and caused to operate the speakers.

The swell pedal control is located between the pre-amplifier and the power cabinet. Its operation varies the strength of the electric wave flowing to the power cabinet but does not change any of its other characteristics. Varying the strength of this wave varies the volume of the organ.

Notice that the operation is entirely electrical. No sound is created in the console-only electrical wave forms. The music first appears as sound at the power cabinet.

SI ES AND WEIGHTS OF THE HAMMOND ORGAN

THE sizes and weights of the Hammond Organ Consoles given below will, in themselves, explain the remarkable adaptability of the instrument in the matter of installation and the small space occupied.

MODEL A CONSOLE

Dimensions: Length, 48" Width, 29" Height, 37 ½ "
Weight (*without bench and pedal clavier*): 275 lbs.

Used with one or more power cabinets. The first cabinet is connected with 6-conductor console-to-cabinet cable. Succeeding cabinets are connected by 3-conductor cable and external power circuits.

MODEL B CONSOLE

Dimensions: Length, 48" Width, 29" Height, 37 ½ "
Weight (*without bench and pedal clavier*): 341 lbs.

Differs from Model A only in that it is equipped with chorus generator for optional use. May be connected to one or more standard power cabinets, using 6-conductor cable to the first cabinet and 3-conductor cable and external power circuits for additional power cabinets.

MODEL E CONSOLE

The Model E is particularly well adapted for use in churches, schools and colleges, large auditoriums, orchestral playing, in fact wherever the organist desires to play any type of organ literature, without limitations. Model E contains such additional equipment as two expression pedals, a 32-note concave and radiating pedal clavier, separate adjustable tremulants for each manual, Great-to-Pedal coupler and a new type console. The organist who seeks the ultimate in organ design will find it in this model of the Hammond Organ.

Dimensions: Length, 58" Width, 39" Height, 41"
Weight (*without bench and pedal clavier*): 441 lbs.

APPRECIATIONS

SIR THOMAS BEECHAM, Bart.

ROYAL OPERA HOUSE
COVENT GARDEN
W.C.2

"I think you will be glad to know that) since the Organ has found its right and proper place after some experiment, it not only sounds exceedingly well in the Theatre but that it most adequately fulfils all the purposes for which we acquired it.

It is now possible to obtain the utmost variety of effect, from the most subdued pianissimo to a fortissimo capable of filling the largest building. Without doubt it is not only a remarkable, but an wholly practical invention, and you should have no difficulty in achieving a complete success with it."

EUGENE GOOSSENS

Conductor, Cincinnati Symphony Orchestra.

"The Hammond Organ, with its resonant volume of tone range, is to my mind the most important instrumental development in music of recent years . . it offers possibilities of which the modern composer will certainly not be slow to avail himself. Congratulations on a fine achievement!"

DR. SERGE KOUSSEVIT KY

Conductor, Boston Symphony Orchestra.

"I want you to know how satisfied and delighted we were with the Hammond Organ, used for the first time at our concert in a performance of Liszt's 'Faust' Symphony. My congratulations on your remarkable achievement."

CANON F. WILKINSON

St. Augustine's, Darlington.

"It is now over five months since we had the Hammond Organ installed and I want to tell you how pleased we are with the instrument. The soft tone effects are delightful, while there is a reserve of power that is remarkable in so small an instrument."

MR. WESTLAKE MORGAN

in" The Church Musidan."

"I think the Hammond Organ is a Godsend to Churches that are confined as to organ space."

APPRECIATIONS

THE LATE
SIR RICHARD R. TERRY

Mw.D.(Dunelm), F.R.C.O.,
in" G.K.'s Weekly."

" Every variety of organ tone is at the disposal of the player to the same extent as on a cathedral or concert hall instrument. It is this variety of tone colours that is, to my mind, one of the most wonderful things about the Hammond invention."
" So here at last we have a real organ, suitable alike to the largest building or the smallest home.
" Aesthetically, it is completely satisfactory. Financially, it is a tenth of the cost of a pipe organ of equal power."

MR. . RHYS LEWIS

General Secretary, The Royal National Eisteddfod of Wales.

"The performance of the Hammond Organ was really magnificent. It was one of the most thrilling moments of my life to hear the choir singing ' Worthy is The Lamb 'and the' Hallelujah Chorus' to the accompaniment of the organ, and that thrill was largely due to the full tone of the Hammond Organ."

REV. WILLIAM . CAMMELL

Minister, Nottingham Baptist Tabernacle.

I am writing to express our delight and entire satisfaction with the Hammond Organ recently installed. All you said of it has been more than justified. It is really a marvellous instrument and we feel we have an organ equal to any in the City."

THE RIGHT REV.
THE LORD BISHOP OF BLACKBURN

In answer to your letter I have to say that although it has not been possible for me to visit your premises, I have heard your Organs elsewhere, and have been greatly impressed by their excellence. They have, I believe, a great future."

DR. ROBERT HEAD

Organist, St. Mary's Cathedral, Edinburgh.

"The Hammond Organ is a 'creative 'instrument. The player can create for himself different tones, with varying degrees of loudness and softness of such tonal combination operated by the crescendo pedal. The joy and fascination of being able to do this was indescribable. I appreciated the purity of the various tonal qualities of the instrument and the endless possibilities in variety of these."