CHAPTER FOURTEEN

Classical Music

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It would be pretentious to suggest that an account of recording techniques could be in any way definitive. Quite apart from the fact that the variables involved are so manifold as to defy detailed analysis, the results are judged by aesthetic standards upon which there is, at best, agreement in only statistical terms. Furthermore, there is disagreement upon what the ultimate aim of the balance engineer should be. On the one hand, there is the viewpoint that a performance should be transcribed as nearly as possible to the original – that is, the sound as heard by a listener at a certain point in the original location. On the other, it is suggested that a certain degree of artistic licence is permissible, provided that this results in an improvement in sound quality, impact, or whatever.

These are necessarily vague terms and, in fact, there is a range of approaches from one extreme to the other; there are occasions nowadays, for instance, when a composer writes with technical innovations in mind that can only be achieved artificially during recording. Nevertheless, for the most part, 'serious' music recording is concerned with traditional music, for which there is equally a sonic tradition, and it is this aspect of recording that will be dealt with here.

There are essentially two different circumstances in which such music recordings take place; with an audience present and without. In the first case, the performance is presented, whether on record or broadcast, as a unique event, and there is a psychological tendency for the listener to identify with the audience and occasion. For this reason, it can be expected that the listener will not judge matters of balance too harshly, in exactly the same way that it is not reasonable to condemn a performance because of the odd musical mishap. This is perhaps as well, as the engineer's control over positioning, microphone layout, and other factors is extremely restricted. It is natural that the listener should expect the perspective of the balance to reinforce his identification with the audience, and the effect of his involvement in the occasion in terms of his expectations of sound quality should not be underestimated.

However, these observations do not apply equally to recordings made under session conditions. For the listener, the performance tends to assume an abstract, timeless flavour, and the actual location may well be unknown to him. When he selects and plays a record, the performance is for him alone, in his listening room, and there is no atmosphere, such as audience sounds, to encourage an identification with the audience in a concert hall. The direct result of this is a more critical attention to aurally perceived detail, and a heightened sense of dissatisfaction with any imperfections, particularly with repeated playing. For these reasons, there arises the need to transcribe the performance in terms of the recorded medium, with the objective of idealizing the sound quality in the hall, under listening room conditions.

The mere fact that nearly all recordings nowadays, including those made with coincident stereo microphones, are made with the assistance of spot microphones is itself demonstrative of the fact that there is general agreement on this principle, and it follows that any attempt to evolve an ideal microphone technique theoretically is quite irrelevant to the business of making records.

Microphone systems

As the usual technique of music balancing is to obtain an overall stereophonic sound image from the main microphones, and to reinforce this as necessary with spot microphones, it would be as well to examine the two commonly adopted systems. These are the familiar coincident pair, and the less well-documented spaced microphone system, both of which can yield sound of very high quality.

The coincident pair, or stereo microphone, relies on two directional microphones angled respectively to the left and right, to reproduce the sound waveforms that would have impinged upon the ear, at a certain point, from the left and right directions. In spite of the fact that the two signals are reproduced via two loudspeakers, thus introducing significant cross-talk, the stereo image produced is excellent, and positional definition outstanding. Provided that they are used at a reasonable distance from the performance area, all sources are evenly and realistically picked up, and the close proximity of the two capsules to one another results in negligible phase discrepancy between them, which accountsforthe positional stability. Any polar response may be used, subject to certain limitations, but obviously an omni-directional characteristic results in near-mono; some stereo microphones are equipped with infinitely variable polar characteristics, which may be changed remotely from the mixer. The two capsules may be angled with respect to one another and this angle can be chosen to give the desired stereo width or angle of cover.

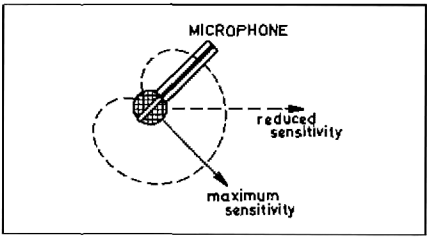
The sum and difference signals may be separated electrically, and the magnitude of the difference signal varied with respect to the sum. By using this technique, the capsule mutual angle may be set to around 90° to 120° and width, as well as polar patterns, may be remotely controlled. The larger angle reduces the risk of degeneration of centre sources as a result of microphone non-linearities off-axis. These facilities make the stereo microphone invaluable for the recording of live performances in particular; it is unobtrusive and, apart from its initial placement, all manipulations may be effected from the mixer.

It is not proposed to deal extensively with stereo microphone parameters here, as they are adequately dealt with in Chapter Thirteen. A cursory glance at the effective parameters for an included angle of 90° will suffice to illustrate some observations on their effectiveness in recording.

The polar diagram for the figure-of-eight position is illustrated in Fig. 13.10, The available angle of cover is 90° at the front, The side quadrants are out of phase, and therefore not useful. The rear 90° quadrant is useful for reverberation pickup but is in antiphase to the front signal.

In the cardioid position (also shown in Fig. 13.10) the available angle of cover is 270°, but is generally restricted to the front 180° to avoid any off-axis non-linearities. The rear 90° is insensitive.

The hyper-cardioid pattern gives a covered angle of 130° at the front; the side 90° angles are out of phase, and the rear 90° quadrant is not really useful as the rear hyper-cardioid lobe is small.



Showing how the changing sensitivity of a directional microphone (a cardioid in this example) can be used to discriminate between forward and rear sections of the performance area

It will be clear that changes in the microphone position, as well as its polar response, will affect both the stereo width and the reverberation content in the signal. Furthermore, as the figure-of-eight pattern has the rear quadrant in antiphase to the front, there can be a certain cancellation of bass reverberation components, which is undesirable. For this reason, that pattern is not favoured and the remaining patterns, of course, discriminate to some extent against natural reverberation.

Remembering that polar patterns should be thought of as solid, obtained by rotating the pattern through 180° on its own axis, a certain degree of

discrimination between forward and rear sections of the performance area may be obtained by tilting the microphone, as shown in Fig. 14.1.

The interdependence of the parameters, together with the fact that the entire performance area is covered by only two microphones, effectively means that little control over details of balance within the performance area is afforded the engineer, and it can be difficult to optimize one parameter without adversely affecting another. It could also be argued that the discrimination against reverberation may compel the engineer to work at a greater distance from the source than he would wish, or to reinforce reverberation with separate microphones for this purpose. On occasions, when recording larger ensembles, the main pickup image may be reinforced with two omni-directional or cardioid microphones on the left and right flanks.

Spaced microphone systems

In this approach we are effectively sampling the sound at various points across the stereo stage, and recreating the wavefronts between the loudspeakers by panning each microphone to a position corresponding to its physical location. A typical system is illustrated in Fig. 14.2.

Complaint is frequently heard that such a system results in unacceptable phase ambiguities and, while there is a certain amount of truth in this, a careful attention to the geometry can minimize the effect, and positional definition can be very good. The microphones used are omni-directional types, but they should nevertheless be carefully angled towards the area that they are intended to cover since most omni-directional types are, in fact, quite directional at higher frequencies. The central three microphones are the most important, and should be thought of as a single stereo system; a correct balance between them must be maintained, as this is fundamental to correct overall balance and any fader adjustments required are therefore made equally to all three. The extreme left and right microphones are used only as a reinforcement of the outer wings of large ensembles.

There are several major advantages offered by this technique. The omni-directional polar pattern results in a higher and more natural reverberation pickup than is achieved by directional types; it is interesting to note that

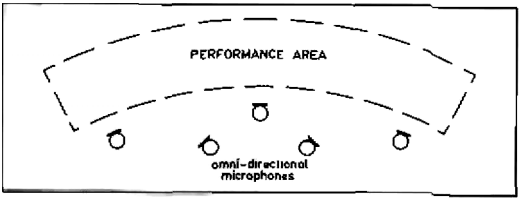


Fig. 14.2
Use of spaced omni-directional microphones for stereo

these pressure sensitive transducers function on the same principle as the ear itself, unlike the directional family. This enhanced reverberation sensitivity effectively means that it is possible to work closer to the source than with cardioids, for the same reverberation content, resulting in clarity without excessive immediacy; indeed, the relatively close working distance of 3 to 4 metres (9 to 12 feet) is essential to take full advantage of the high frequency directional characteristic. It also offers the added benefit that level differentials, between similar signals received by more than one microphone, tend to swamp any phase ambiguities. The fact that the microphones are separated permits quite subtle but worthwhile adjustments to suit each occasion. Layout is rather critical and unique to each situation much of the work being done in placing the instrumentalists themselves, after which the precise microphone placings may be attended to.

These, then, are the two systems in general use; each has its own applications and merits but, for the purposes of records, the spaced system appears to offer important advantages. Were the coincident system able to offer higher sound quality than this technique, the loss of control could be tolerated, but there is no evidence that this is the case; even if the positional definition is marginally superior, it is considered that the sound quality of the omni-directional microphones, together with the creative flexibility of the spaced system, far outweigh this. It is, in any case, open to serious question whether the integrity of the coincident system can be preserved at all when spot microphones are used in addition to them.

In the examples which follow, the spaced technique is used exclusively, but most of the discussions remain valid if a stereo pair is substituted for overall pickup.

Preparations

It is of great value to study the material to be recorded thoroughly before the actual session, with a view to forestalling any technical problems which might arise, The manner in which a piece is written can provide valuable information as to the optimum placement of musicians for stereo, and it will be found that the usual positions taken up by the musicians in performance are by no means always ideal for stereo recording. Clearly, it will be important to create a stereo image in which there is a reasonably balanced activity across the sound stage, and an examination of the score can often suggest a suitable layout. Furthermore there may be artifices required, particularly in opera, which require substantial technical preparation. Fader work may also be necessary at certain points, for which a cue would be very useful, and such areas of likely difficulty may be noted in the score, so enabling the producer to give the necessary cue during the session.

The criteria by which a suitable location for a recording is chosen will not be dealt with in detail here. It should be stressed, however, that a good and complementary acoustic is the most fundamental requirement for music recording, without which all subsequent operations are necessarily compromised. Finding a really good hall, which does not suffer unduly from noise or other problems, can easily be the single most time consuming factor with which the recording team must deal; a useful source of information, in an unfamiliar area, can often be the local fire service, who will be able to point out the halls of any size that could be suitable.

Usually, a great deal may be learned of a hall's acoustic qualities by ear, with the aid of a few judicious handclaps and shouts. Most traditional music appears to be best complemented by an acoustic having a reverberation time of between 2 and 2-5 seconds, with a reasonably even decay throughout the frequency spectrum. Figure 14.3 shows the reverberation/frequency curves of an excellent recording hall; the increase in reverberation time

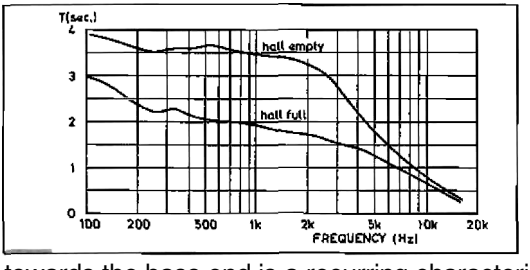


Fig. 14.3
Reverberation/frequency curves of a typical hall often used for recording

towards the bass end is a recurring characteristic of the better halls. Naturally, it is important to ensure that there are no unpleasant slaps, caused by standing waves between parallel surfaces in a hall.

Much thought must be given to the question of space and layout as, with multi-microphone techniques, clarity and separation can be obtained only if it is possible to locate musicians in such a manner that crosstalk between microphones is minimized; a large, unobstructed floor area is therefore important. In the case of large scale recordings involving orchestra, chorus and soloists, accessible balconies and a stage of some kind can be most helpful, as a set-up of this kind could become extremely cluttered if all the musicians are at the same level; in particular, contact between sections could be very problematic.

Turning to the question of microphone types, it must be said that this is largely a matter of individual preference. Microphone technical specifications, although valuable, tell us nothing of their sound quality, and microphones with not obviously dissimilar specifications can sound markedly different. The main microphones are naturally the most important; in the case of

stereo types, many possibilities exist as, of course, any pair of directional types may be used. The quality of the Neumann SM69 is excellent, as is that of a pair of AKG 414 types. For the spaced system, the Neumann M50 is an old favourite, and the KM83 is also very good. Other types may well yield convincing results, but it is important that they should become somewhat directional at high frequencies.

Spot microphones must usually be cardioid, in order to achieve separation, but omni-directional types may sometimes be used if well separated from other performers. The Neumann KM84 is an excellent general purpose microphone, and some engineers favour also the AKG 451. For some percussion instruments, the Neumann KM88 appears to offer an appropriately incisive quality. Sometimes it may be necessary to compromise to some extent in the choice of microphone because of limited availability; if this is necessary, it is obviously best to do so in some minor area, where the effect of the particular microphone is minimal.

For the most part, capacitor microphones are used but occasionally moving coil or ribbon types are selected, either because an engineer has a particular preference for such a microphone in a certain application, or where one is pressed into service for a detail effect, in the absence of a capacitor type.

It is essential that all microphones are connected in the same phase, and a convenient way of checking this is to use an oscilloscope Lissajous display. The 'scope is switched to 'external X', and an oscillator applied simultaneously to the X and Y inputs, to establish the phase of the instrument itself. Some oscilloscopes will display a line sloping upward from left to right, but many indicate the opposite slope, upward from right to left. Whichever is displayed represents the in-phase direction. The X and Y sensitivities should be adjusted to give a 45° slope. The instrument can then be connected with the left signal to the X input, and the right to the Y input.

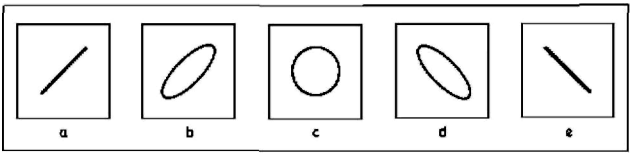


Fig. 14.4
Types of oscilloscope display produced by different amounts of phase shift

If we assume the in-phase display to be as in Fig. 14.4a, any in-phase signal monitored will be thus displayed. Progressive phase shift of one channel with respect to the other causes the display to change as in Figs. 14.4b, c, d and e, according to the degree of shift, providing that sine tones are used.

Thus we have a visual display of relative phase between left and right, which gives an immediate indication of stereo image width and phase.

Naturally., a stereo music signal will be indicated as a 'splash', but this should be discernibly ellipsoid in the in-phase direction, as in Fig. 14.5. If it is ellipsoid in the other direction, then this indicates an out-of-phase connection at some point. If the signal is panned towards mono centre, the 'splash' will narrow in width until finally it becomes a straight line.

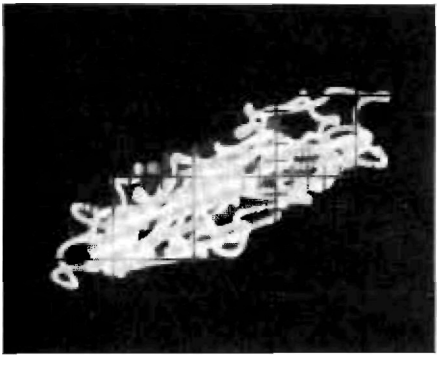


Fig. 14.5
Ellipsoid shape of oscilloscope trace during music with microphones properly in phase

It will be evident that the relative phase of a pair of microphones may easily be checked, using this instrument, by placing them close together and observing the display. In addition to this, however, the instrument gives a visual display of many parameters simultaneously; apart from left-right balance, phase and stereo width, excessive use of spot microphones and frequency dependent phase problems, resulting from poor layout, are immediately obvious. It is therefore worthwhile to have a Lissajous display available throughout a recording session, by connecting an oscilloscope to the left and right signals as described.

We have so far examined some of the more important aspects of recording in very general terms, and can now proceed to an examination of some particular examples. The only justification offered for the approaches described is that they have been used successfully, and the results have withstood the test of general critical scrutiny.

Solo performers

There is little difficulty in recording most solo instruments, as there can be no conflict of interests in the choice of microphones or placement. Microphones of any characteristic may be chosen, according to taste, and used in pairs to render the random phase reverberation stereophonically. Whilst a coincident pair may perfectly well be used, there is really no need to angle the two microphones at all; for example, a pair of omni-directional microphones placed a foot apart, and both pointing at the source, can produce a richly stereophonic image, as a Lissajous display will show. As the significant

stereo information is contained in the reverberation, the phase difference at the two points is accepted by the ear as stereo information, and the direction from which it emanated is unimportant; in these circumstances, there is a good case for keeping the source on the microphone axes. Omni-directional types would normally be chosen for their natural quality and, if it were necessary to resort to directional types, this would tend to imply that the acoustics were not really suitable.

There may be occasions when it is desirable to create an atmosphere of space in a solo recording; for example, a solo vocalist may be required to sound in a rather operatic perspective. This may be achieved by placing a main microphone system at some considerable distance from the performer, and obtaining focus by the use of a pair of spot microphones, rather as though the main system were placed to cover an imaginary orchestra.

Singers, generally, are extremely variable in their vocal power and the differences in the optimum distance from the microphone can be very considerable. Unfortunately, the closer that it is necessary to work, the greater become the dynamic variations from the microphones, particularly between low and high notes, when there is any tendency to dynamic unevenness in the voice itself. There are vocalists who, on certain notes, peak perhaps 6-8 dB above their average level, and it may be exceedingly difficult to focus the lower registers without being in constant danger of sudden overmodulation. In the worse cases, the only answer may be a pair of limiters with a fast attack time, but matters are rather serious if one is forced to this resort, which is always to be discouraged. In most circumstances, the voice is followed on the faders, with the assistance of cues from the producer, and a good memory!

Some vocal qualities benefit from gentle equalizer assistance, particularly the rather ‘edgy’ quality encountered with some voices, but it is important not to turn too readily to equalizers to solve problems, when better solutions might be found in other areas. It may well be, for instance, that a slightly different microphone placement, or the choice of a different microphone, will provide a superior improvement.

The piano is notoriously difficult to record, but again an omni-directional pair is recommended. Tastes seem to differ widely here, and very different qualities of sound may be obtained, both by placement of the microphones and the position of the instrument itself. Experience has shown that different artists playing the same piano, under identical conditions, may require different microphone placement to be adopted, and changes in repertoire often suggest complementary balance changes. Furthermore, the sound quality of individual instruments, even of the same manufacture, is enormously variable.

All these factors should be borne in mind when seeking a balance, and a constantly experimental approach is likely to be the most successful. It can also be very helpful to keep a note of the serial numbers of the various instruments encountered, and their individual tone quality, so that it may be possible to obtain one that is known to be good, for subsequent recordings.

Figure 14.6 illustrates recommended microphone positions. Towards the middle of the piano case, the sound quality is quite bright and it generally becomes warmer towards the tail end; the exact position between these extremes may be varied according to circumstances. Worthwhile improvements may be obtained by moving the microphones only a few inches one way or the other and, by exercising a little diplomacy, most artists may be persuaded to co-operate in allowing sufficient balancing time without becoming too impatient.

It is a simple matter to arrange alternative types of microphone simultaneously, in closely grouped pairs, to evaluate the differences in their sound qualities, and it may even be found that two pairs, of different types, offer some enhancement of quality when used simultaneously.

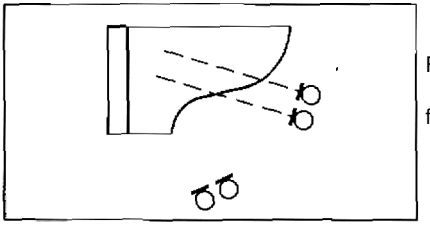
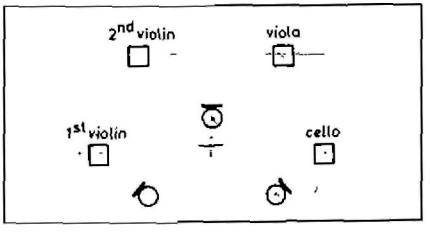


Fig. 14.6
Alternative positions for a pair of microphones for the piano

Chamber music

There are, of course, very many different kinds of ensemble under this heading, and a beginning can be made by considering the string quartet or quintet. As with any relatively quiet music, one of the greatest problems is finding a location which is both acoustically appropriate and free of excessive ambient noise. Really good halls are, in any case, hard to find and one is fortunate indeed if there is no difficulty with extraneous noises such as traffic, trains, or aeroplanes, to name a few regular offenders. Even in relatively secluded locations, there may be a great deal of noise from wind, rain, or even birds. When assessing a possible hall, therefore, any such noises should be listened for and investigation made of the feasibility of eliminating them at source. Low frequency noise may be reduced to some extent by the use of steep cut bass filters, provided that care is taken to ensure that they do not significantly affect the recorded sound quality.

There is little point in placing microphones on individual instruments, as it is usually important to preserve the intimate character of this kind of



Fig, 14.7
Use of three omni-directional microphones for a string quartet

music and to avoid any suggestion of sensationalism. The stereo trio of microphones described earlier can be arranged to cover the group, at a height of between 2-5 and 3 metres (8 and 10 feet), and the instruments arranged around it as shown in Fig. 14.7. Finer points of balance may then be dealt with by moving individual instrumentalists rather than microphones.

In practice, the best grouping may be rather more widely spaced than is usual for performance, to obtain clearly defined positional information in stereo; the difference is not great and most musicians adjust comfortably to it.

In the case of music involving a piano with other instruments, it may be difficult to control the powerful piano sound in relation to the other instruments. If there are several other instruments, such as in a piano quintet, the arrangement shown in Fig. 14.8a is safest, presenting the dead side of the piano to the omni-directional trio on the strings. If, however, there is only one other instrument, the arrangement in Fig. 14.8b is more satisfactory. It is possible to use a pair of cardioid spot microphones on such an instrument, discriminating against the piano to some extent. With a little care, adequate separation may be achieved, the omni-directional pair on the piano providing most of the bloom. Thus an intimate, integrated sound can be obtained, whilst at the same time preserving the all-important aural contact between the musicians.

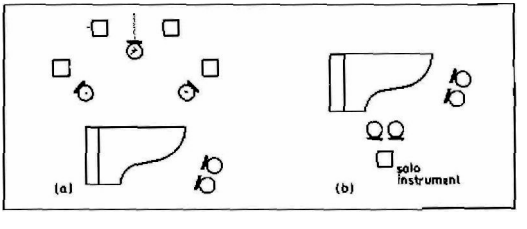


Fig. 14.8
Possible arrangements for chamber music with piano: (a) a piano quintet, and (b) a solo instrument sonata

One factor which is not always considered is the quality of the piano itself. Apart from the differences between those of different manufacture, there may well be a case, in some circumstances, for using a rather smaller piano than the usual full-sized concert grand.

Early secular music can turn up a very large range of instruments, many

of which are very quiet, and there may be little relevance in attempting to create a concert balance; much of the material is very intimate and personal, and not greatly enhanced by reverberation. The usual omni-directional trio may therefore be used at a considerably lower height, and very close spot microphones may be required on some instruments. In such cases, difficulty may be experienced with finger noises on plucked instruments, or breathing noises, and optimum microphone positions may be found by standing near each instrument whilst it is being played, and listening at different points. The very high degree of amplification required for some instruments can make the slightest ambient noise obvious, but this is offset to some extent by the fact that bass filters can be used at higher cut-off frequencies than is possible with the more modern instruments.

Orchestral music

As with chamber ensembles, a good physical layout is of fundamental importance and the recording team should set out all seats and music stands before the arrival of the orchestra. A typical layout is shown in Fig. 14.9.

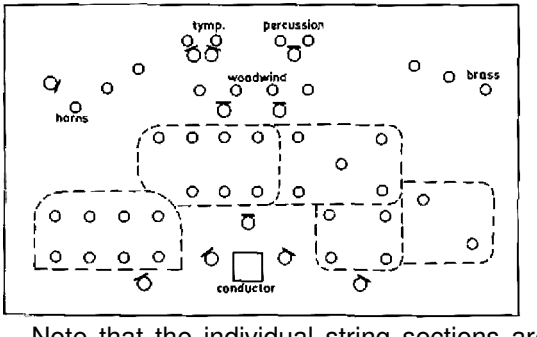


Fig. 14.9
One possible arrangement of microphones for a symphony orchestra

Note that the individual string sections are well defined, and the omni-directional main microphone system arranged so that each microphone has a definite duty area for which its placement is optimized. It is very important to provide depth as well as width in the layout, as this will be reflected in the stereo sound, giving a natural perspective to the orchestra and a good body of strings in the central area, as well as at the sides. The basses are best kept well back from the main microphones, and provided with their own omni-directional spot microphone to locate and clarify them.

The woodwind layout may be varied according to numbers, and it can be advantageous to arrange them in two rows, if they are many. It is not a good thing to place them too far back, as they should be well represented

through the main microphones, whilst some control over their relative balance may be achieved, without destroying their perspective, by means of a fairly high pair of cardioid spot microphones, as shown in the diagram.

Incidentally, it is worth noting that the use of spot microphones in pairs, wherever possible, affords the opportunity of creating stereo images for sections, rather than relying on a conglomeration of mono panned signals.

The positions of the horn and brass sections, still farther back, may be interchanged as musically appropriate, but the left position for the horns is usually chosen as, in this position, their bells are pointing away from the rest of the orchestra, reducing the risk of their sound quality 'swimming'. The use of cardioid microphones, focussed on the bells from the rear of the players, can enhance the quality of their sound but they should be used discreetly in order to avoid distorting their perspective. The brass section, being comparatively powerful, can often be placed in such a manner that spot microphones are unnecessary; their sound quality is entirely dependent upon an adequate and focussed main microphone pick-up, and details of balance may often be dealt with by asking the players themselves to change their dynamics.

Percussion and timpani may be placed more or less as desired at the back and sides of the orchestra, the arrangement shown in the diagram being one commonly adopted possibility. In the case of timpani, a pair of cardioid spot microphones may be better than one, if there are more than two instruments used, and a suitable position is above the skin, but not over the centre where the sound quality is not particularly good. A recurring problem is a certain thick quality in the timpani sound, which is more a consequence of the omni-directional technique than anything else. Nevertheless, matters can often be greatly improved by asking the player to use harder sticks. It is in cases like this that an ability to relate amicably with musicians is of paramount importance. Co-operative players may often take an active interest in their recorded quality during a session, and adjust their technique accordingly, should this be beneficial.

Similar considerations apply to the rest of the percussion section; the dynamic latitude in recording is not as great as in performance, and any corrections necessary must be made by the musicians. Provided that the dynamics are kept low enough, good detail control over the sound quality and dynamics should be available, using spot microphones. A further useful observation is that percussion instruments are frequently bunched together, to keep them within the reach of a single player. It may be more appropriate, for stereo, to spread them more, and it may be necessary to be aware of this well in advance, so that additional percussionists can be made available at the time of the session.

One aspect of recording technique which is well worthy of attention is the choice of orchestra size. While composers sometimes specify this precisely, and in other cases it is governed by tradition, it should be remembered that these directives relate to live performance. In the recorded medium, an orchestra can often sound far larger than it actually is, depending on the acoustics, and numbers should be chosen with this in mind; authenticity is of little value if the quality of the end result is degraded by the thick quality characteristic of excessive numbers.

Harpsichord continuo presents an interesting problem; correctly balanced, it is barely audible – it has been said that one should not hear it but, if it were missing, one should miss it! For this reason, it is best positioned towards the rear of the strings, possibly near the basses with which musical contact is often important. A cardioid spot microphone, placed under the body of the instrument, can be used for fine control of quality.

Concertos, naturally, demand that the solo instrument be placed at the front, close to the main microphones; a pair of cardioid spot microphones can be used to focus the instrument, although omni-directionals can be effectively used if desired, provided that they are well separated from the orchestra. It is as well to give consideration to the question of what degree of soloist dominance is required well before the session, in conjunction with the producer and artists. Some concertos are very soloistic, with the orchestra in very much an accompanying role, whereas others are more symphonic in structure; such differences should be reflected in the balance, and can be adjusted by means of alterations to the soloist's proximity to the orchestra, and appropriate use of his spot microphones.

In conclusion, then, the fundamental balance in orchestral recordings should be obtained through the main microphone system by means of sensible positioning and internal balance; any attempt to correct a deficiency in these areas by means of spot microphones is a certain recipe for disaster.

Opera

A few observations were made at the beginning of this chapter about the fundamentally different listener conditions pertaining respectively to the recorded medium and live performance. It is in modern opera recording techniques that these principles reach their highest development, in terms of traditional music, for it becomes the clear duty of the recording team to utilize every available technological artifice creatively, to compensate the listener for the absence of the visual element, and the consequently depleted dramatic impact. There are nearly always stage movements in the action which must be convincingly rendered in stereo; in addition, there may be various effects, such as off-stage events, which require imagination and

meticulous preparation if they are to succeed without the aid of the visual factor.

The cost of recordings on this scale can be enormous, and the scheduling extremely tight. Artists are ever-increasingly internationally mobile, and plan their commitments sometimes years in advance; key singers may be available only on a very few specified sessions, during which their performances must, at all costs, be safely recorded. As a consequence, it is always vitally important to ensure that no time is unnecessarily wasted. The producers and engineers normally spend lengthy sessions in consultation, long before the recording, planning the technical and artistic approach to each session. Often, apart from the main producer, a second producer will remain on the stage during the recording, co-ordinating the activities of the soloists, with the aid of a marked-up score and telephone contact with the control room; there may well be two balance engineers also, one dealing with the orchestra, and the other the voices. Clearly, a good working relationship between all involved is of primary importance.

Technically, in order to provide a degree of insurance against balance imperfections, a multitrack master is taken simultaneously with the stereo, with such areas as orchestra, soloists, chorus and off-stage locations on separate pairs of tracks; this also enables the engineers to meter the individual sections as required. However, the aim is to obtain a stereo master

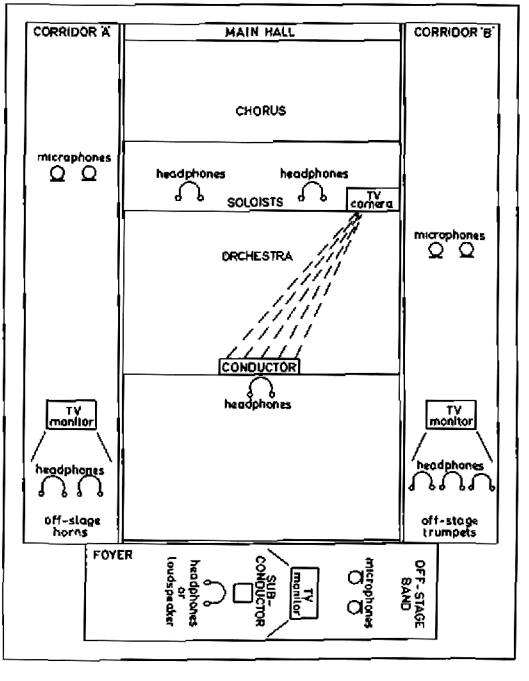


Fig. 14.10
Opera recording in an outside location where three ofi-stage sub-areas are used, helped by TV cameras and headphones or speakers

in the first instance, and it is therefore this signal which is monitored. Any reductions which might be required can then be edited, as necessary, into the stereo master which remains mostly first generation.

Remembering that the recording may be spread over several weeks, or even months, and that it must be possible to inter-edit the tapes, the entire technical arrangements must be meticulously logged, so that they can be reproduced exactly at any subsequent time. In particular, for any session subsequent to the first, the tape machines should be lined up to the frequency run made during the first session, rather than the standard alignment tape; this is of paramount important when noise reduction systems are used.

It has already been mentioned that good recording halls are hard to find and, in the case of opera, this problem is further augmented by the large numbers of performers involved and the consequently high sound levels. The absorption of the performers themselves, together with the enormous climaxes which occur in some works can result in acoustic saturation of the hall. This., of course, degrades the apparent reverberation time and adversely affects the stereo perspective.

In order to overcome these problems, in the absence of more suitable halls, it has become necessary to exploit existing locations to the utmost, with the aid of the increasingly sophisticated machinery available.

Figure 14.10 illustrates a set-up in which the available resources of a location have been exploited in this manner. Three off-stage locations are used, all of which are in contact with the conductor by means of closed-circuit television; the musicians are able to hear the main orchestra by means of foldback feeds from the mixer. Artists may become somewhat alarmed when these arrangements are suggested, but usually they will co-operate happily once the advantages are clear to them. While it may be perfectly possible to achieve the effect required by means of suitable placement within the main hall, the distance between the off-stage groups and the main orchestra may well lead to ensemble difficulties as a result of the time taken for sound to travel between them; the foldback arrangements, of course, allow all the musicians to hear the main microphone signals. In addition to this, it is likely that the television picture of the conductor will be a good deal clearer than the view an off-stage musician might expect to have in a cluttered hall.

The recording benefits are, of course, enormous; full attention, in terms of microphone technique, may be paid to each group, without the problems of crosstalk between microphones, and full advantage can be taken of the acoustics of the individual locations. Each group may be recorded on separate tracks of a multitrack machine, to provide for any balance alterations which

may be required later, and their individual autonomy permits the engineers to place them, spatially or in perspective, in any manner of their choosing.

For larger off-stage bands, it has proved more efficient to use a sub-conductor to control the ensemble of the group, relaying the main conductor's beat with the aid of closed-circuit television and foldback; it is usually quite in order to use a small loudspeaker in place of the headphones, if this is preferred by the artists.

In the main hall, the orchestra may be laid out more or less as described earlier, and the stage and chorus sections placed typically as shown in Fig. 14.10, at some distance, and with their own spot-microphone arrays. While separation is obviously important, it should not be sought to an extreme degree, as the sound quality of both the stage and chorus sections is dependent upon their adequate representation through the main microphones; their spot microphones are used to clarify and focus them, but should never dominate. It is usually helpful, in the interests of musical contact, that all the vocalists should be raised relative to the orchestra and, to this end, it may well be necessary to have temporary stage areas or extensions built for the recording,

The question of stage movements requires some thought and, while it is possible to achieve this to a certain extent by means of the pan-pots, it is a rather dangerous method, as the electrical positioning may conflict with the information given by the main microphones. Usually, the necessary moves are noted in the stage producer's score, and he can thus prompt the soloists to make the moves physically at the correct time. The main producer should, however, simultaneously prompt the balance engineer, in order that he can track the moving voice on the faders.

Occasionally, dynamic changes in the vocal quality of a singer might be required – usually taking the form of a recession into the distance, or vice versa, Sometimes this kind of change can be satisfactorily achieved by arranging that the singer moves in relation to his spot microphone, but frequently, an echo chamber or plate, used exclusively on the particular voice, can be the most effective solution.

It falls to the producer to co-ordinate the activities of the large number of participants, in various locations, and this task, in itself, can be formidable in view of the inevitably high ambient noise between takes. By providing comprehensive talk-back and telephone communications to all locations, from the producer's desk, this problem can be greatly eased and, where the facilities are available, closed-circuit television monitoring of the various locations can be of enormous benefit. A further communication refinement is the provision of talk-back facilities from the conductor to the stage and chorus areas, in order to improve the clarity of the conductor's directions to them.

At the mixer, the orchestra section provides the basic sound field, and this is therefore usually attended to first. Subsequently, the various other locations and sections can be balanced separately within themselves, before an integration of the overall image is attempted. A really good understanding between engineers is essential, if fader creep – the process of always increasing the level of the weaker section rather than reducing the excessively strong one – is to be avoided.

One of the great benefits of using multitrack machines is the possibility of adding new material subsequently to the main recording. The very considerable scheduling problems have already been mentioned, and there is the ever present risk that an artist might fall ill at the crucial time when he is required, and re-scheduling may well be prohibitively expensive. However, it is quite possible to record the main material in the absence of the indisposed artist and, at any convenient time later, record the missing information on a vacant pair of tracks on the multitrack machine. The previously recorded orchestral tracks may be sent, via the sel-sync facility, to a pair of headphones or a small loudspeaker, and the artist is thus able to synchronize his performance to the main material. It is by no means easy to record the orchestral tracks in such a way that 'space' is left for the new part, and care is also necessary to avoid imparting an unnatural prominence to the overlaid voice. Any shortcomings in this respect will sound offensive, quite apart from completely giving the game away! The microphone technique adopted for superimpositions of this kind requires a little thought; in order to render the artist as he would have been recorded had he been present at the original recording, it is necessary to simulate the crosstalk between microphones that would have occurred. It is therefore important to set up the main microphones, in roughly the position that they would have occupied had the orchestra been present, in addition to the usual soloist's microphones.

Naturally this technique need not be used solely as a buffer against illness and other disasters; there may well be reasons for using it to achieve a particular brilliance and clarity on an instrument, where the scoring is such that a worthwhile improvement over normal recording technique can be effected. This is sometimes the case with percussion instruments, when they are used in a particularly dramatic or soloistic manner; it can be difficult to obtain a really incisive quality when such instruments are picked up excessively by the main microphones.

There may be cases when material of some kind must be superimposed on the original, but no spare tracks are available on the multitrack machine. Whilst it is perfectly possible to make an immediate reduction to stereo simultaneously with the superimposition, this may not necessarily be desirable, as no subsequent remixes would then be possible. In such a case, an

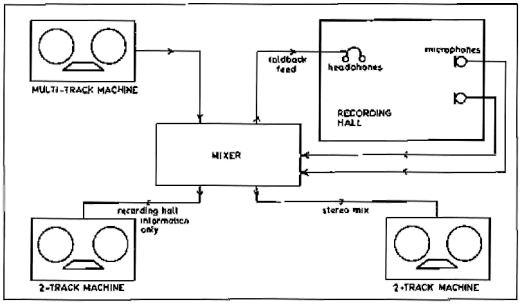


Fig. 14.11
Arrangement for superimposing a new recording on a multi-track original and recording a trial stereo mix, without affecting the original

arrangement as shown in Fig. 14.11 may be used; the multitrack machine is connected through the mixer as for a normal reduction, and the synchronization tracks sent to the artist in the hall by means of the mixer foldback circuits. The replay heads are, of course, used in place of the sel-sync system mentioned earlier. Thus, a stereo reduction is produced at the time, incorporating the new part, but the new recording is also preserved independently on a second stereo machine. Should further remixing be necessary, it is only necessary to obtain the same stereo and multitrack machines, and align the tapes for synchronization; good machines can be relied upon to hold synchronization for at least a few minutes, which is quite adequate for most superimpositions,

The techniques which have been outlined here serve to illustrate the increasing complexity of large-scale recordings and, with the imminence of quadraphony, both techniques and machinery are likely to become still more sophisticated. It is perhaps pertinent, in conclusion, to observe that while great fluency in the manipulation of machinery is essential to the balance engineer, the most gifted engineer will invariably subjugate his technical fluency and facilities to the needs of the music; any technical innovation is worthwhile, provided that it serves this master alone.

Acknowledgement
I should like to acknowledge the co-operation I received from James Lock of the Decca Record Company in the writing of this chapter.