ILLIAC SUITE FOR STRING QUARTET

BY

L. A. HILLER JR. AND L. M. ISAACSON

FOREWORD

The Illiac Suite is a chronological record of experiments carried out from September, 1955 to November, 1956 to determine whether automatic high-speed digital computers such as the Illiac, located at the University of Illinois, can be used to generate music subject only to general instructions derived from logical compositional procedures. The Suite is divided into four movements called Experiments I, II, III, and IV, which illustrate how various musical problems were handled during this research. The musical materials in the four movements were taken from a much larger body of material by unbiased sampling procedures so that a representative rather than a selectively chosen musically superior group of results would be included in the Suite. Thus, it is important to realize when examining this score that our primary aim is not the presentation of an aesthetic unity - a work of art. This music is meant to be a research record - a laboratory notebook.

Automatic high-speed digital computers operate in principle much as do ordinary desk calculators, but with certain significant differences. For example, since a whole computing program is placed into a computer prior to the actual process of composition, delays due to human inspection of output during the actual computation are eliminated. Moreover, automatic digital computers have what is called a "conditional transfer" process. In the Illiac, this is a yes-or-no choice operation to permit the programming of decisions which depend upon whether numbers bear positive or negative signs. It is this operation used repeatedly and sequentially, perhaps more than any other, that permits programs to be written for the computer expressing logical processes of musical composition.

We resolved the process of generating computer music into two basic operations. Initially, the computer is instructed to propagate random integers equated to notes of the musical scale, and also to rhythmic patterns, dynamic effects, and playing instructions such as arco, pizzicato, col legno, etc. These random integers, generated at the rate of about a thousand per second, are then subjected to arithmetic tests expressing various "rules" of composition. Each random integer is screened through a series of tests and either used or rejected depending upon the rules in effect. If accepted, the integer is used to build up a "composition" and stored in the computer until the completed "composition" is ready to be printed out. On the other hand, if it is rejected, a new random integer is propagated and tested. This process is repeated until a satisfactory note is found or until it becomes evident that no such note exists, in which case part of the "composition" thus far composed is automatically erased to allow a fresh start.

The contents of the Illiac Suite can be summarized as follows, noting that the only "arranging" of the music consisted of (a) the selection of formal structures for the four movements, (b) the selection of tempi, and (c) the transposition of all output for the cello downwards one octave and for the violins upwards one octave:

I. Experiment One: Our first objective was to generate a recognizable form of music to demonstrate that the technical problem could be handled. We adapted four-part first species counterpoint to this test situation, since strict counterpoint is a logical abstraction of many basic problems of musical composition. This movement consists of sequences of C major cantus firmus settings. A limited number of strict counterpoint rules were used to generate first cantus firmi alone, then two-part settings and finally four-part settings to illustrate how we progressed from monody to polyphony. The settings, from 3 to 12 notes long, were assigned to the four instruments by means of a four-number random integer table generated by the Illiac. Dynamics were also determined by means of this same table.

II. Experiment Two: The counterpoint program was rewritten to add virtually all the remaining rules of counterpoint. To gain experience with the special problem of cadences, the cadence formula of strict counterpoint was liberalized to permit V - I and III - I cadences as well as VII_6 - I. This movement is a sequence of musical phrases starting with completely random white-note music and with each pair of phrases that is played, counterpoint rules are added until at the end of the movement all the rules are in operation.

III. Experiment Three: This a record of how the problems of rhythm, dynamics and playing instructions were treated. Chromatic writing, at first purely random and subsequently controlled by some simple rules of composition, is superimposed upon the basic rhythm, dynamics and playing instructions output. This movement is an elementary example of how a computer can be used to produce new tonal effects as opposed to the imitation of known musical styles. The movement concludes with an illustration of how the computer can be used to generate twelve-tone rows and similar materials.

IV. Experiment Four: This movement consists of examples of "Markoff Chain music" in which successive note selection depends upon probability functions computed from tables derived from the overtone series and from consideration of vertical interval lengths. These probability functions also depend upon the relationship of successive melodic intervals both to one another and to the tonal center of the movement, which is C. We have attempted here to generalize in a simple way the dependence of melodic profile upon successive note relationships and upon longer range functions which define a species of tonality. Finally, the coda is included as an example of a simple closed structure generated by the computer. This coda is a generalized I - IV - V - I cadence developed from abstract probability formulations.

The technical details of this research and a more complete explanation of the contents of the suite are being published elsewhere.

L. A. Hiller, Jr.

L. M. Isaacson

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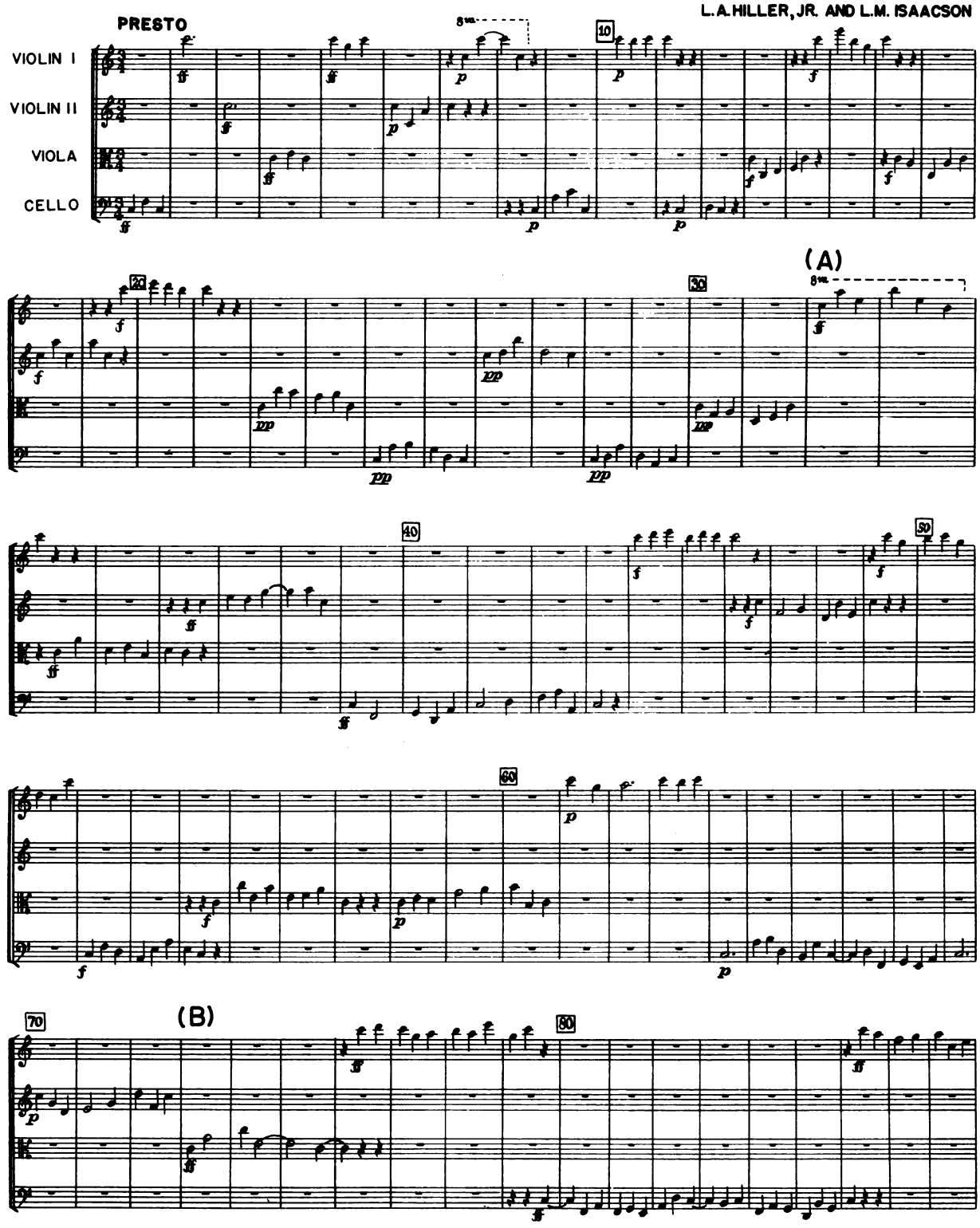
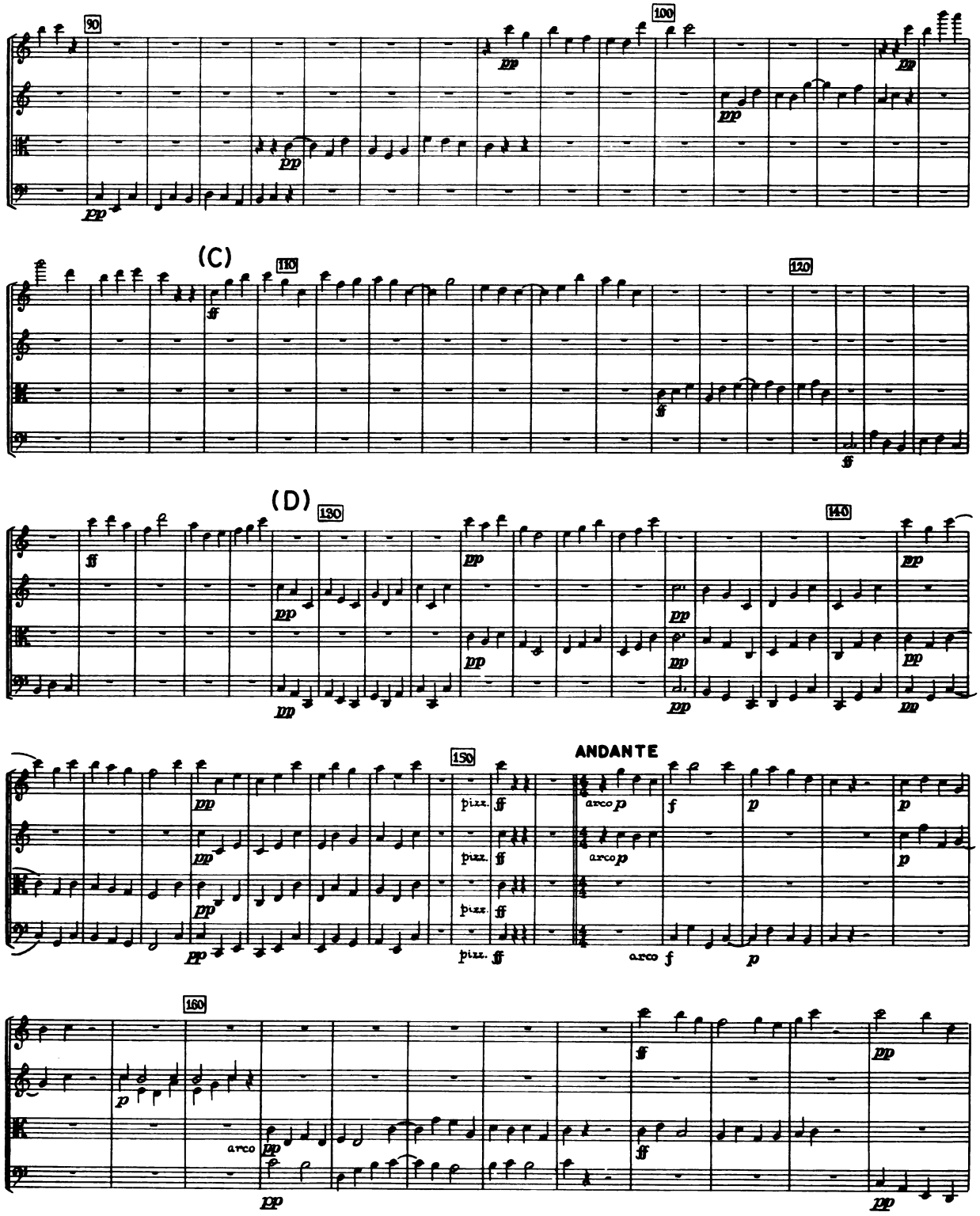
I. EXPERIMENT NO. 1

L. A. HILLER, JR. AND L. M. ISAACSON





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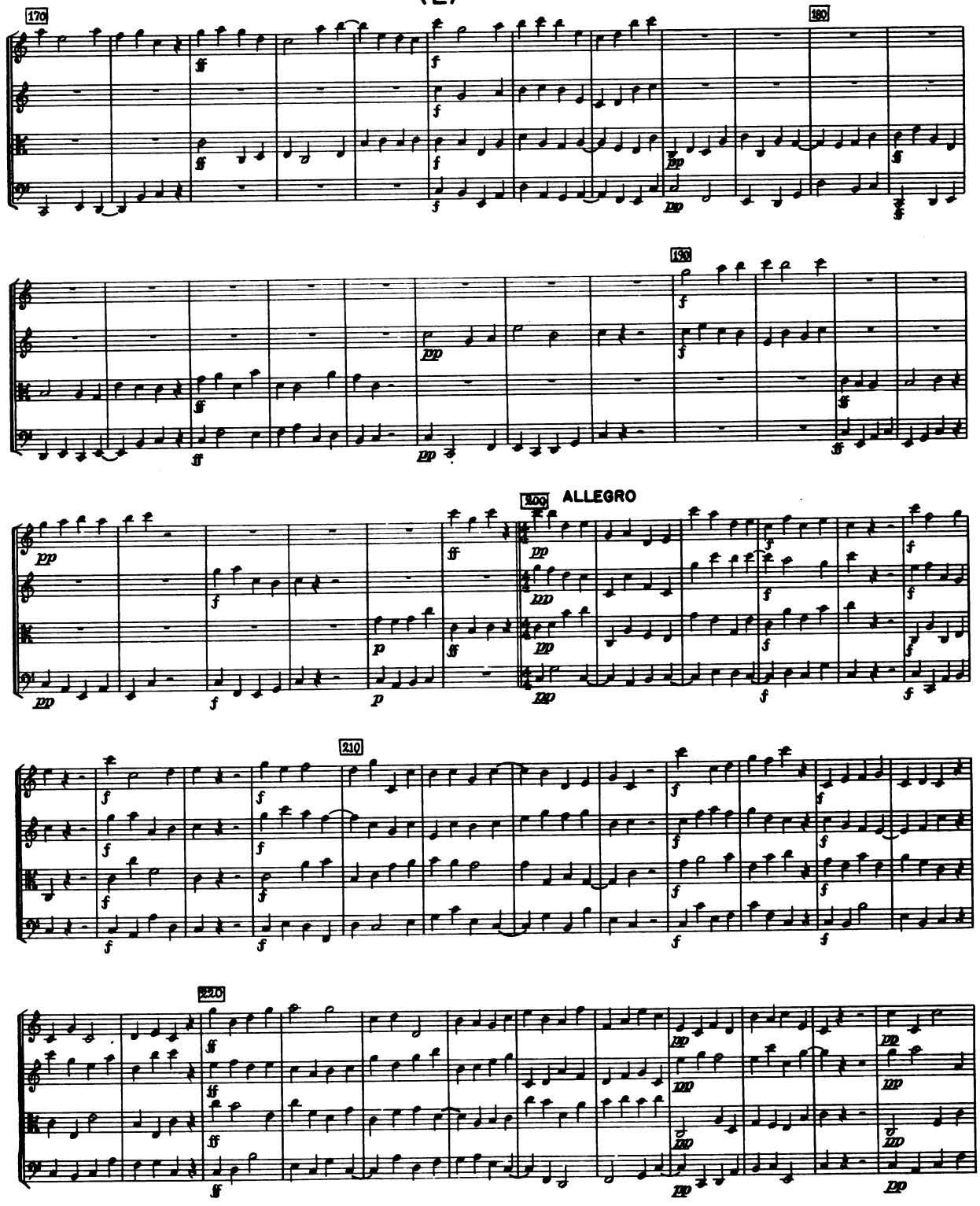

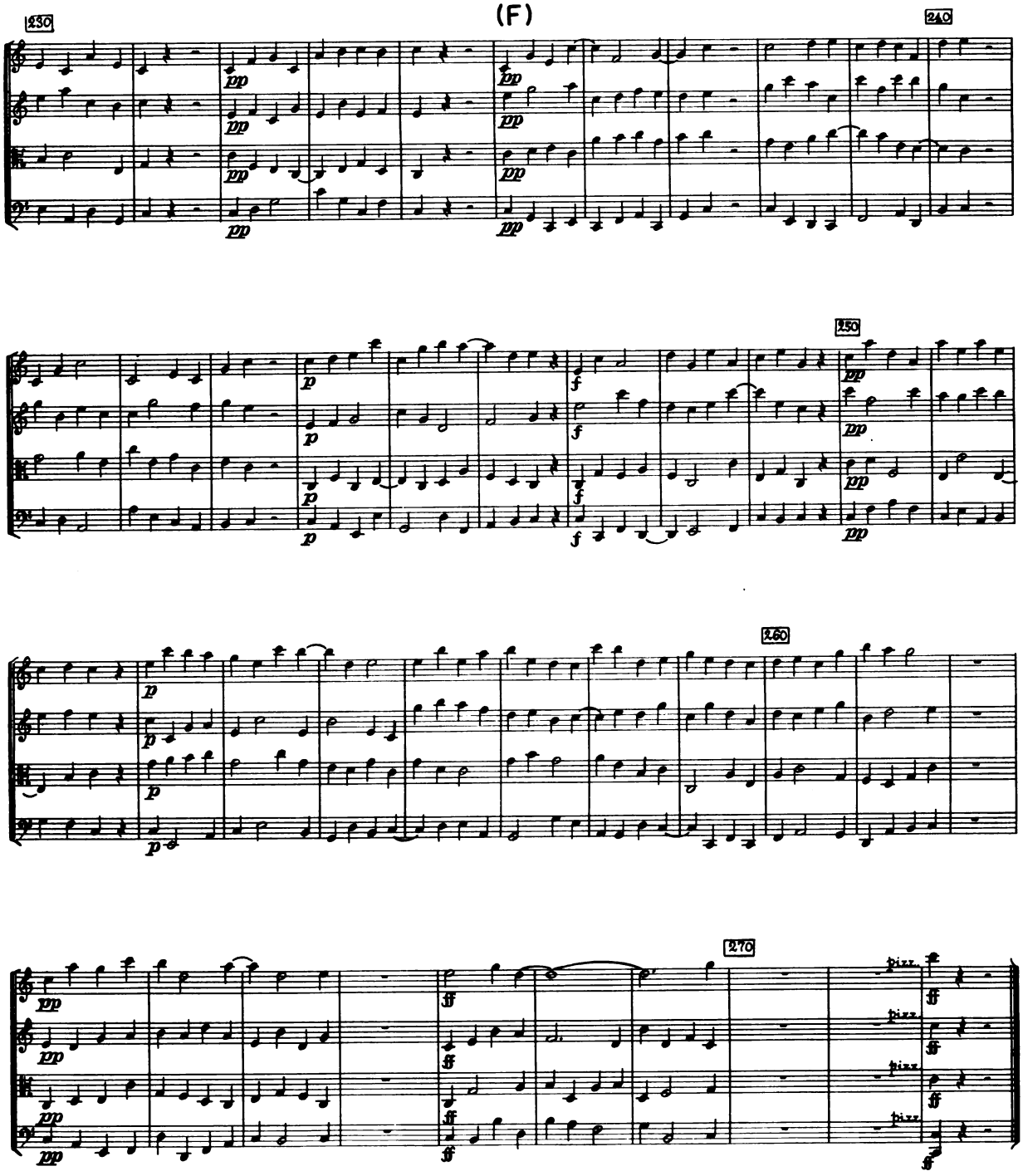

II. EXPERIMENT NO.2

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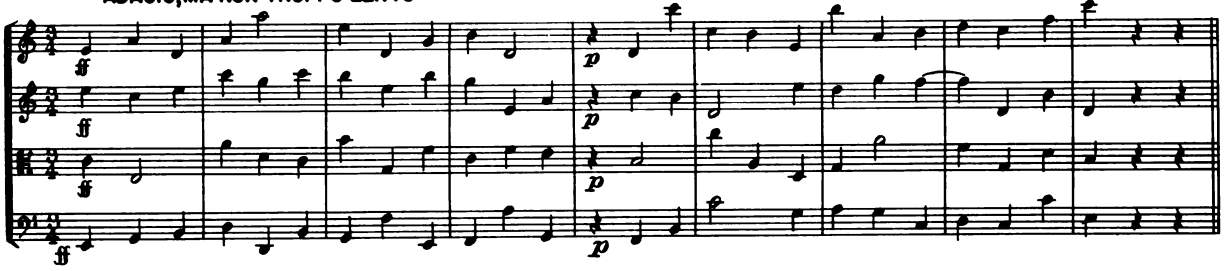

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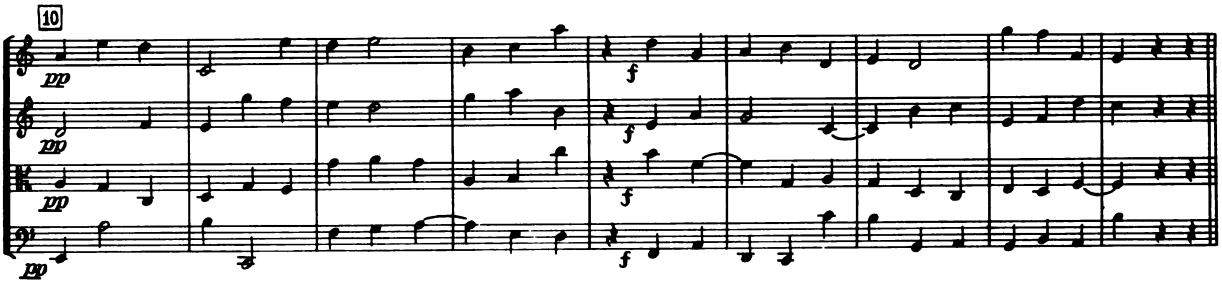

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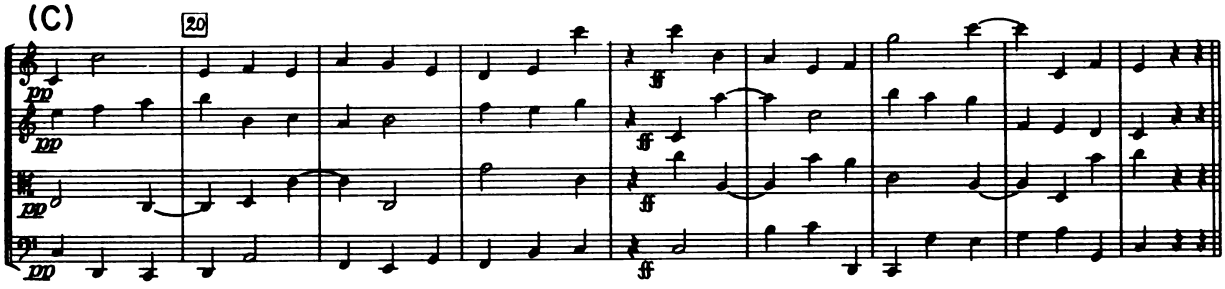

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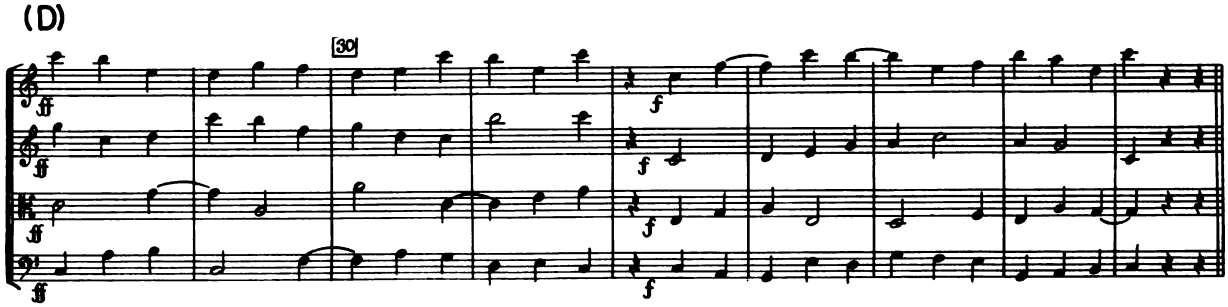

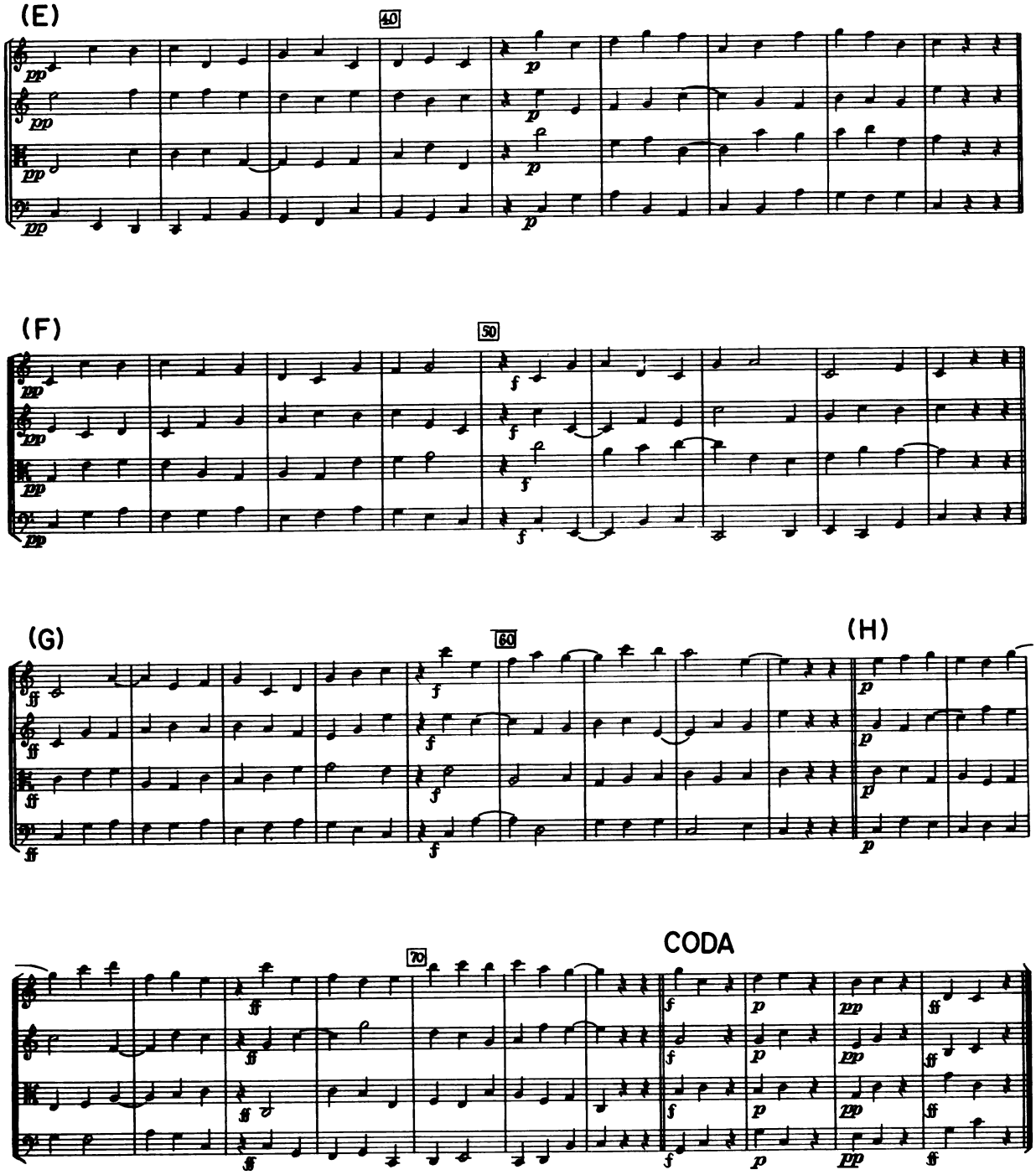

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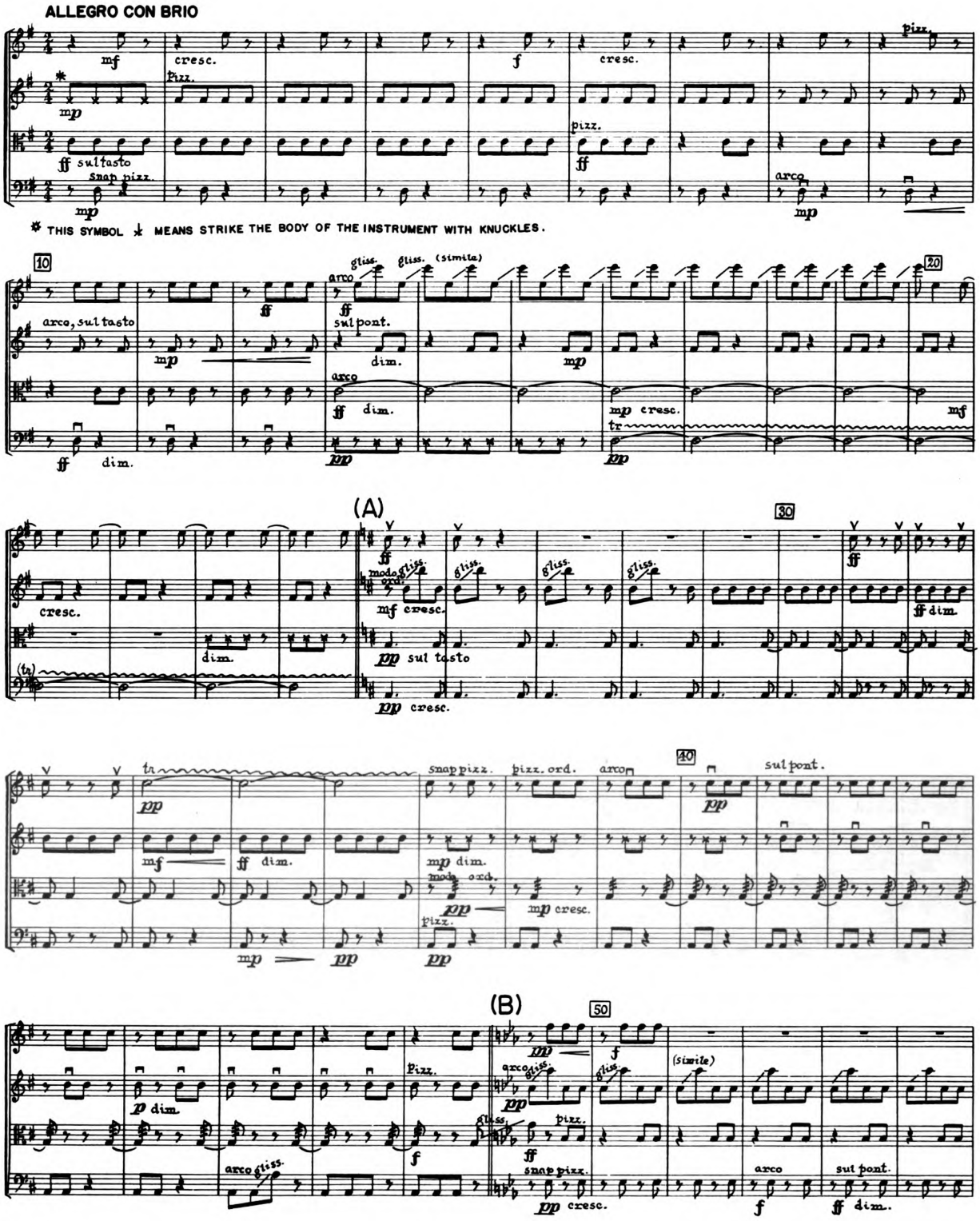

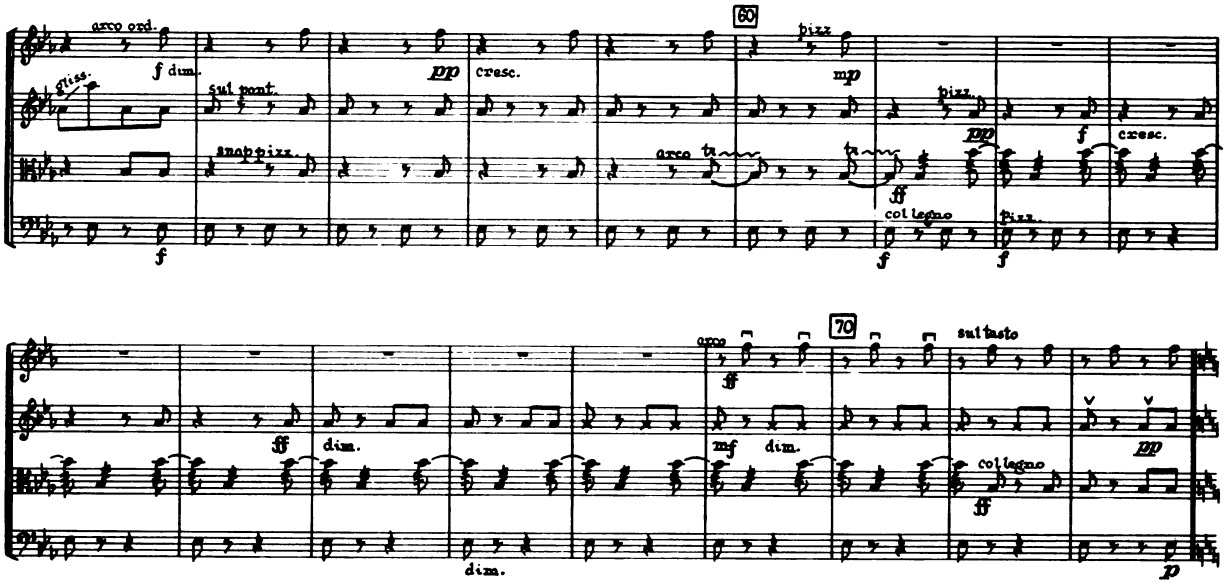

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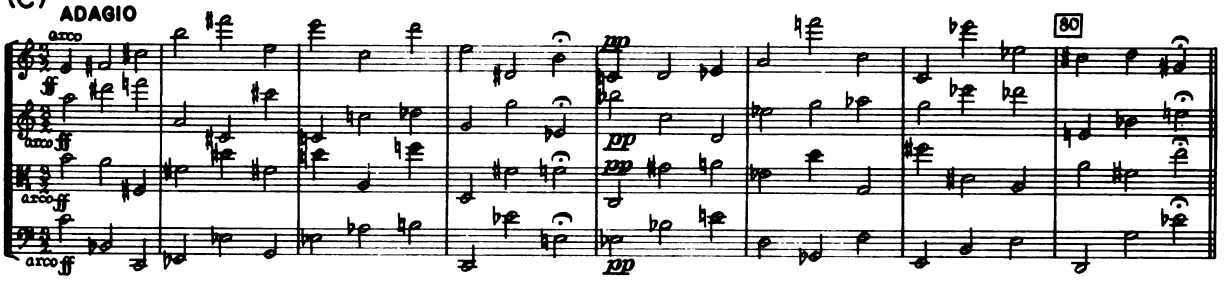

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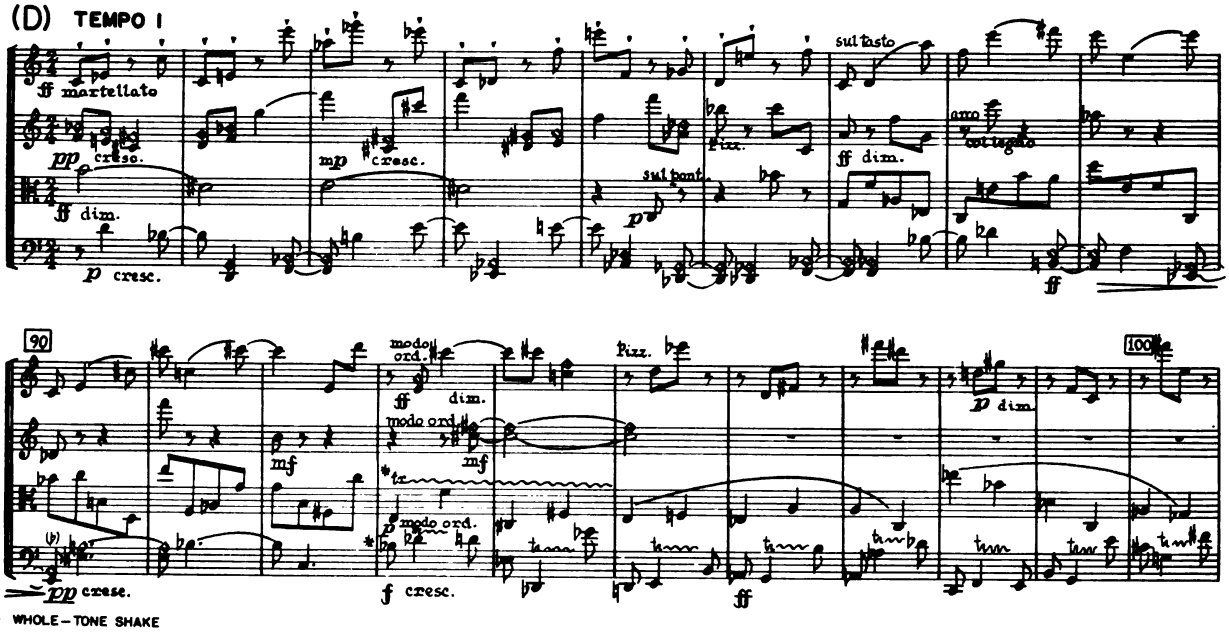
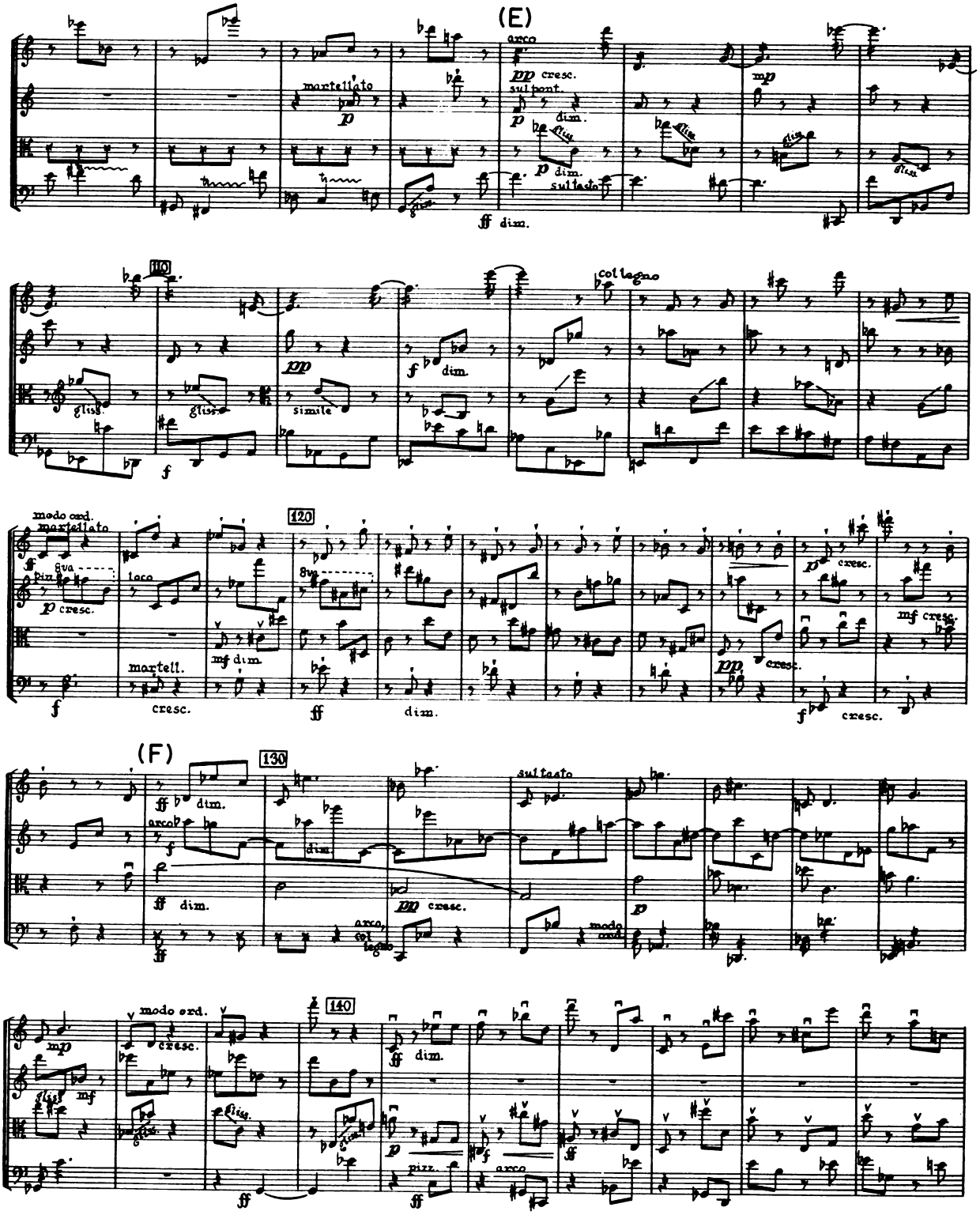
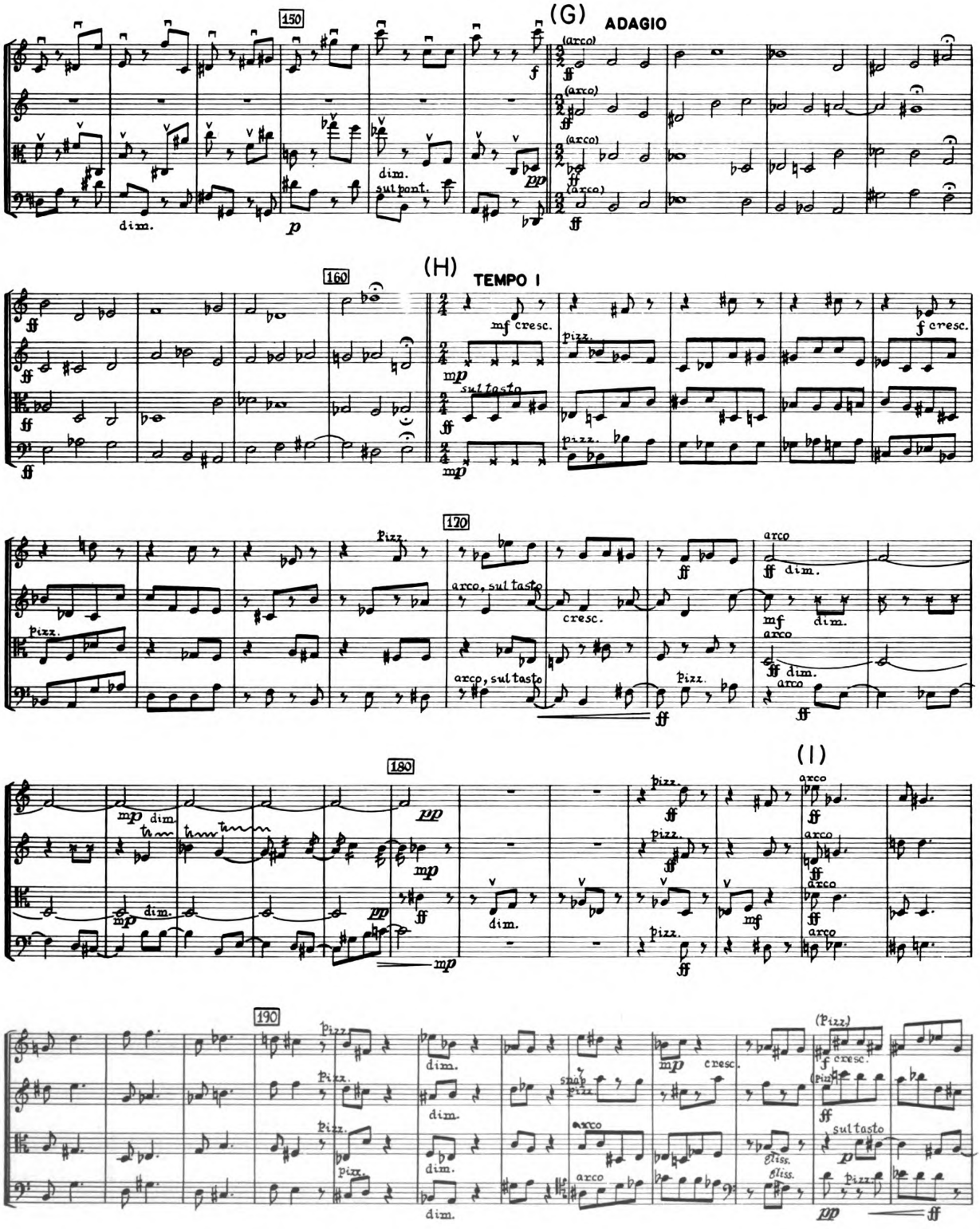
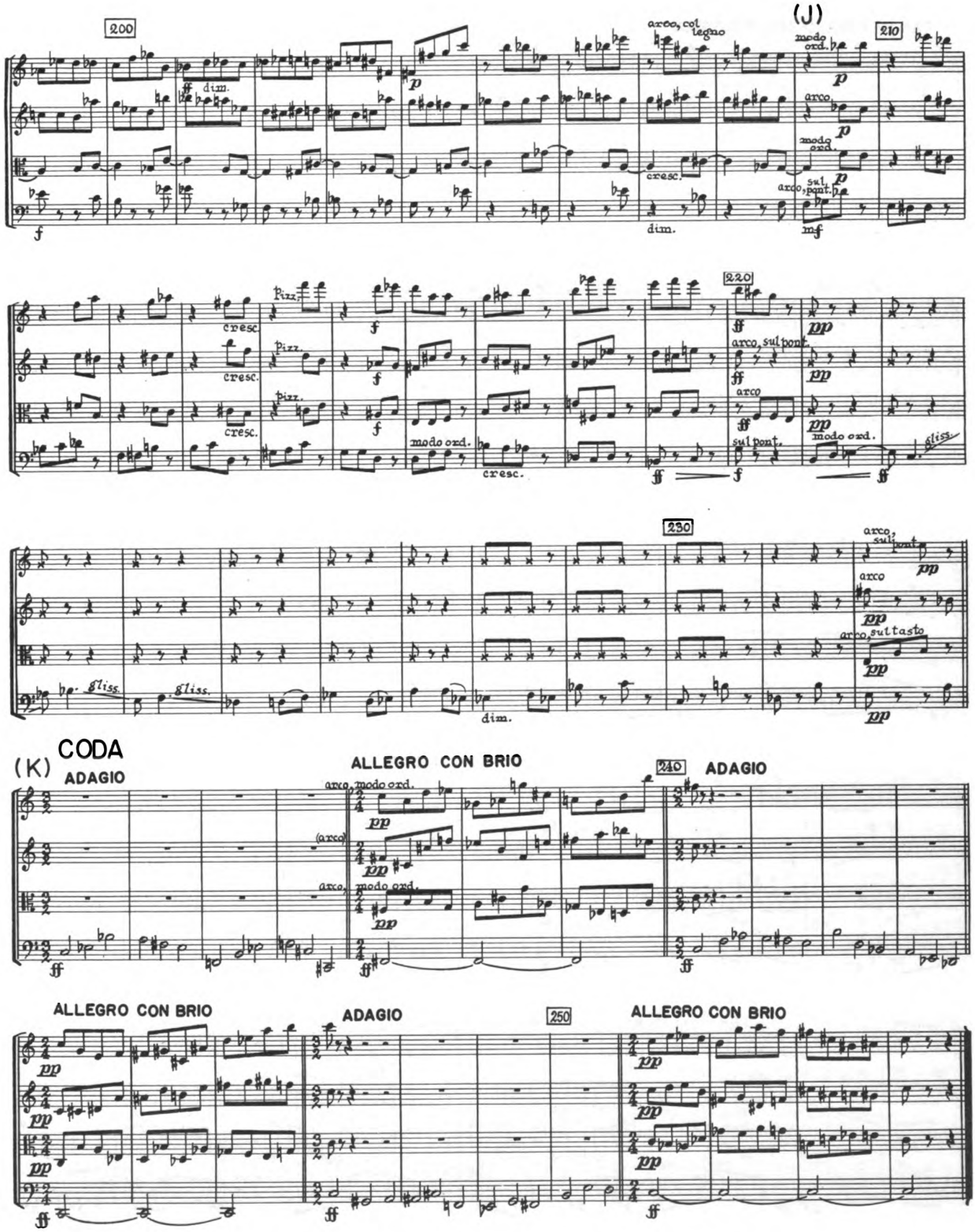


* WHOLE-TONE SHAKE







IV. EXPERIMENT NO.4

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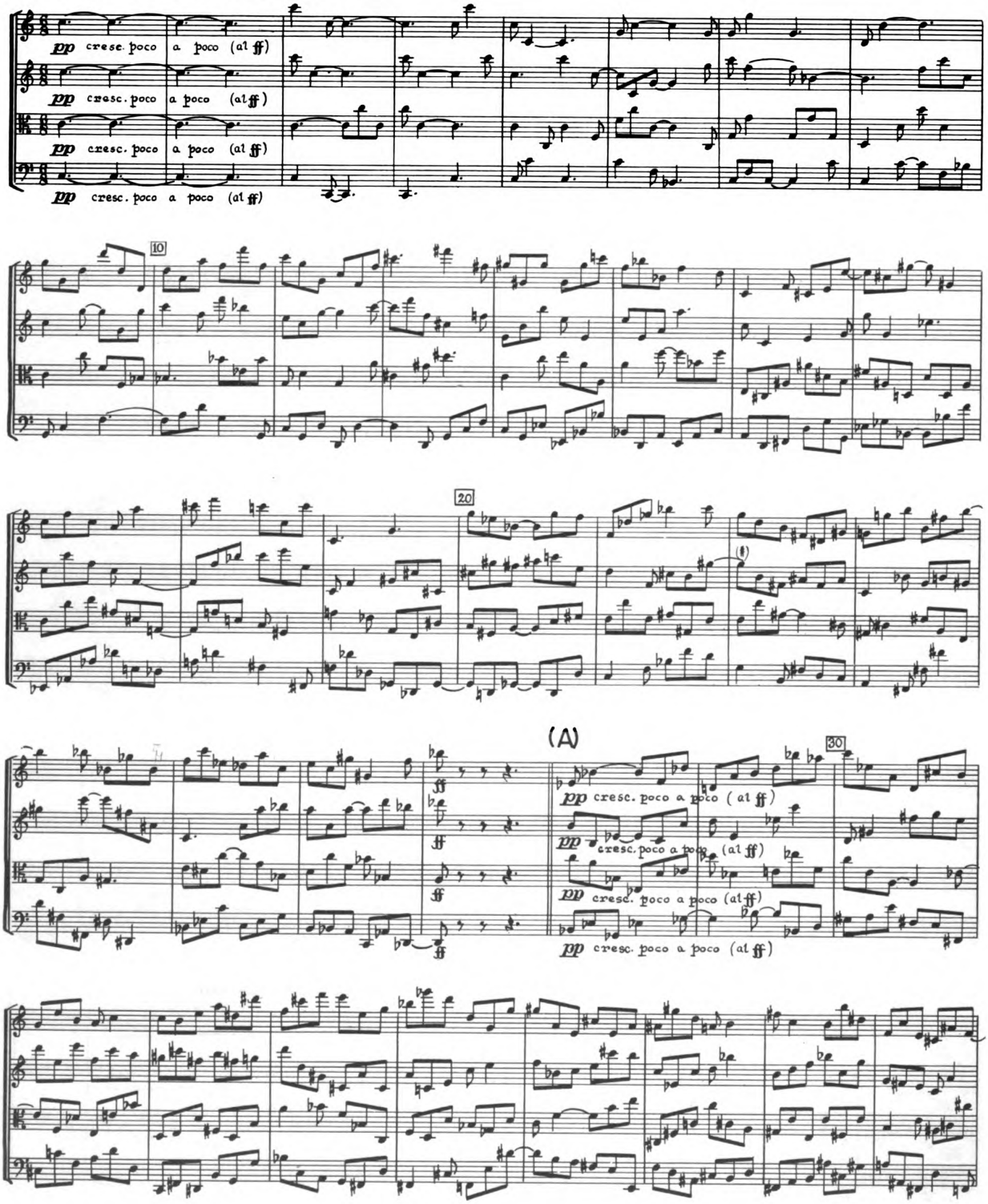

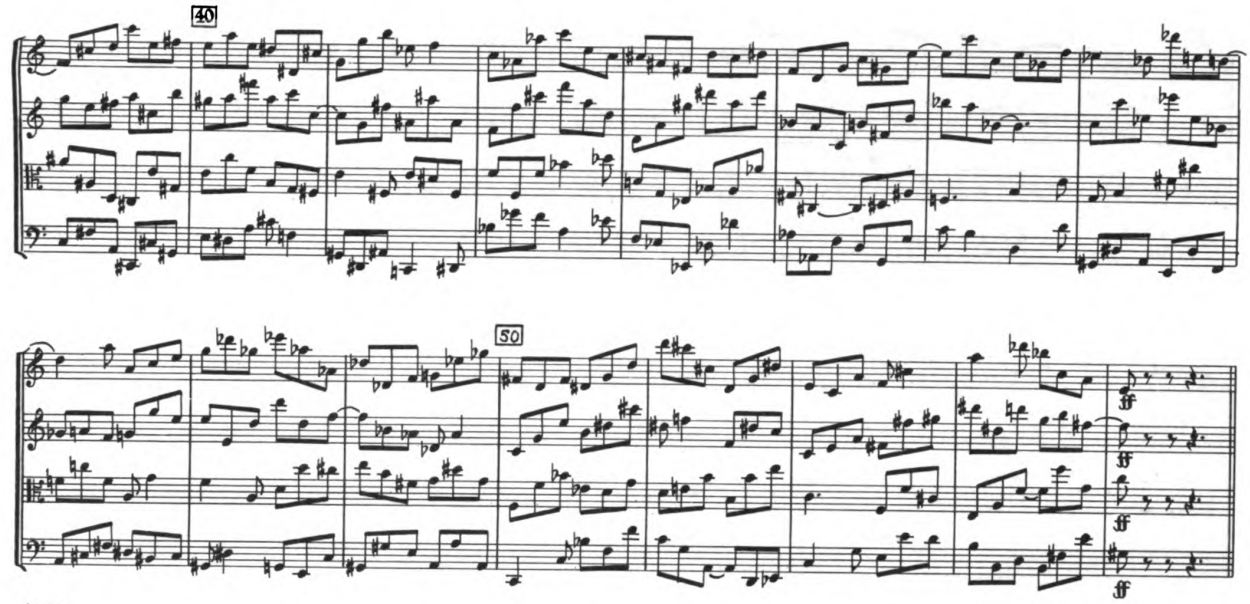

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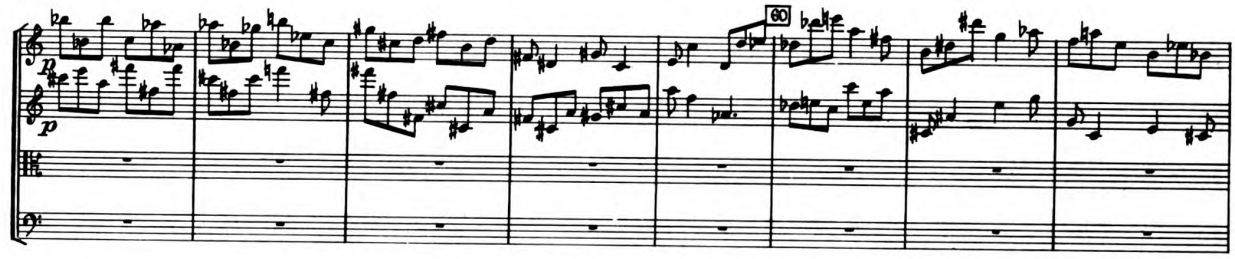

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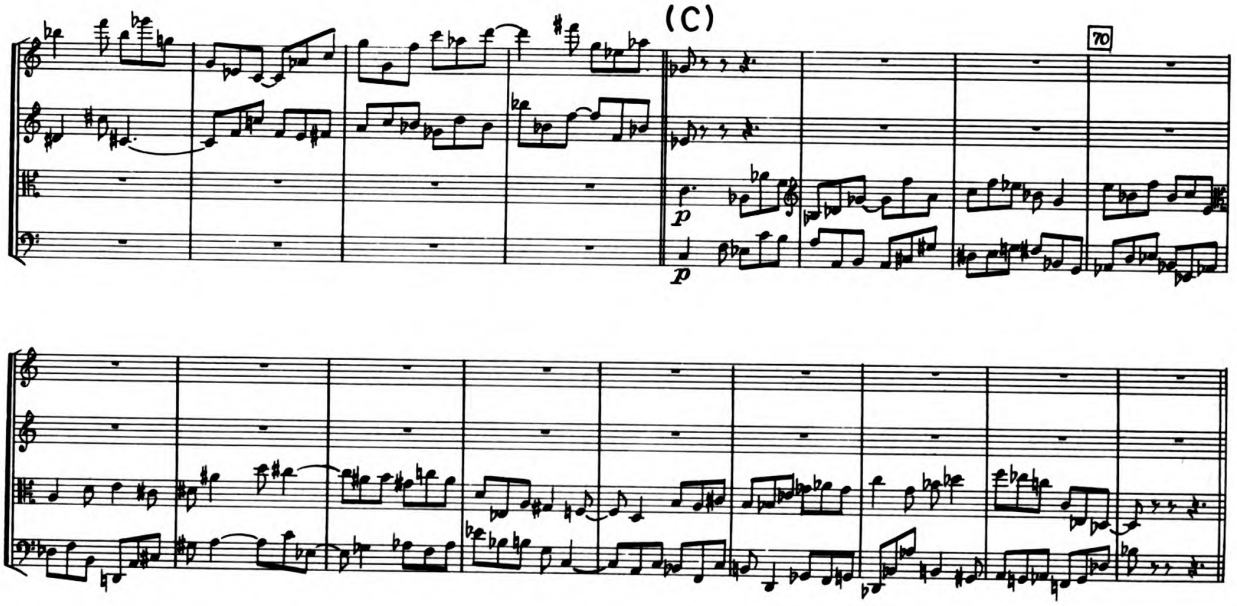

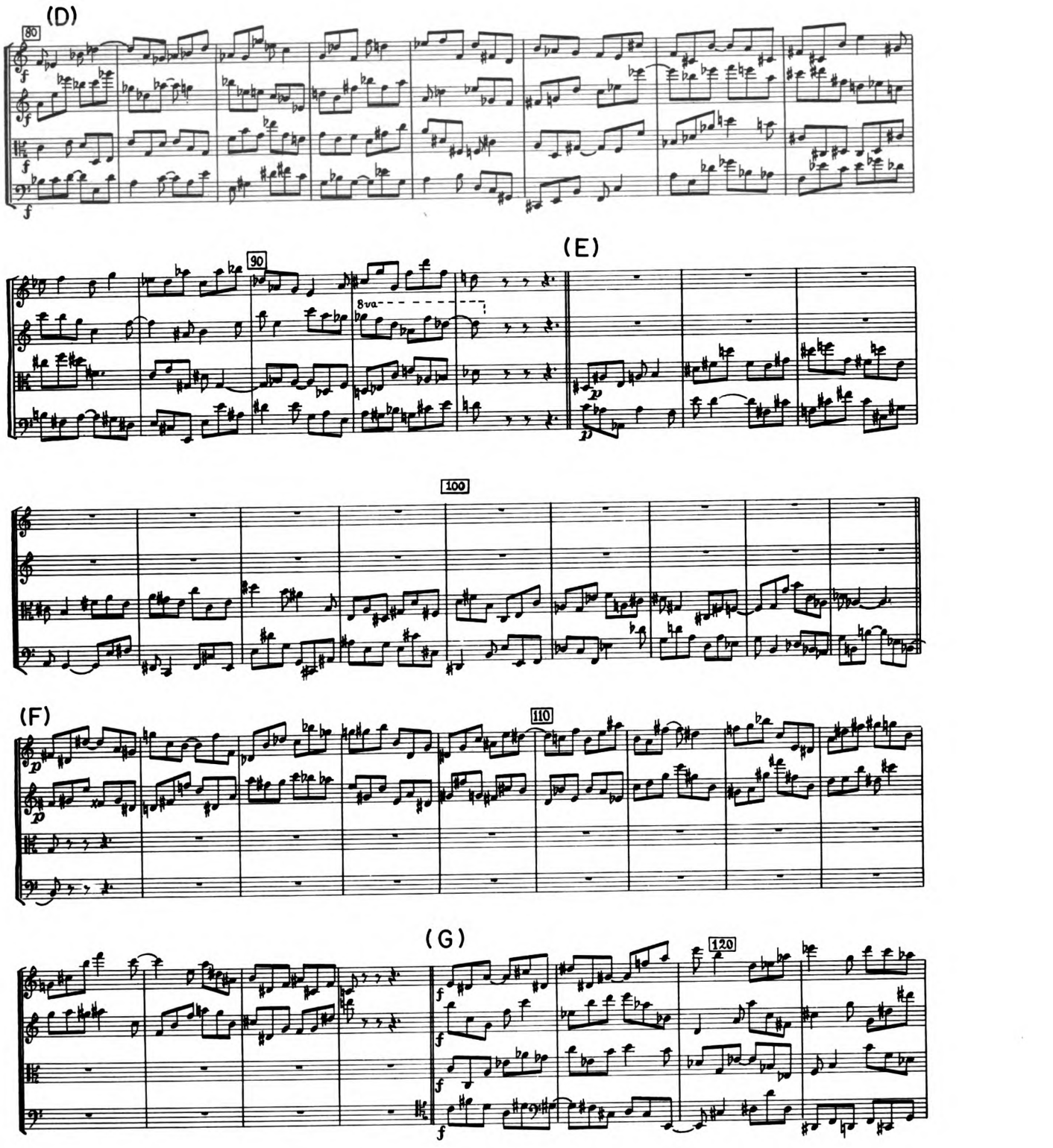

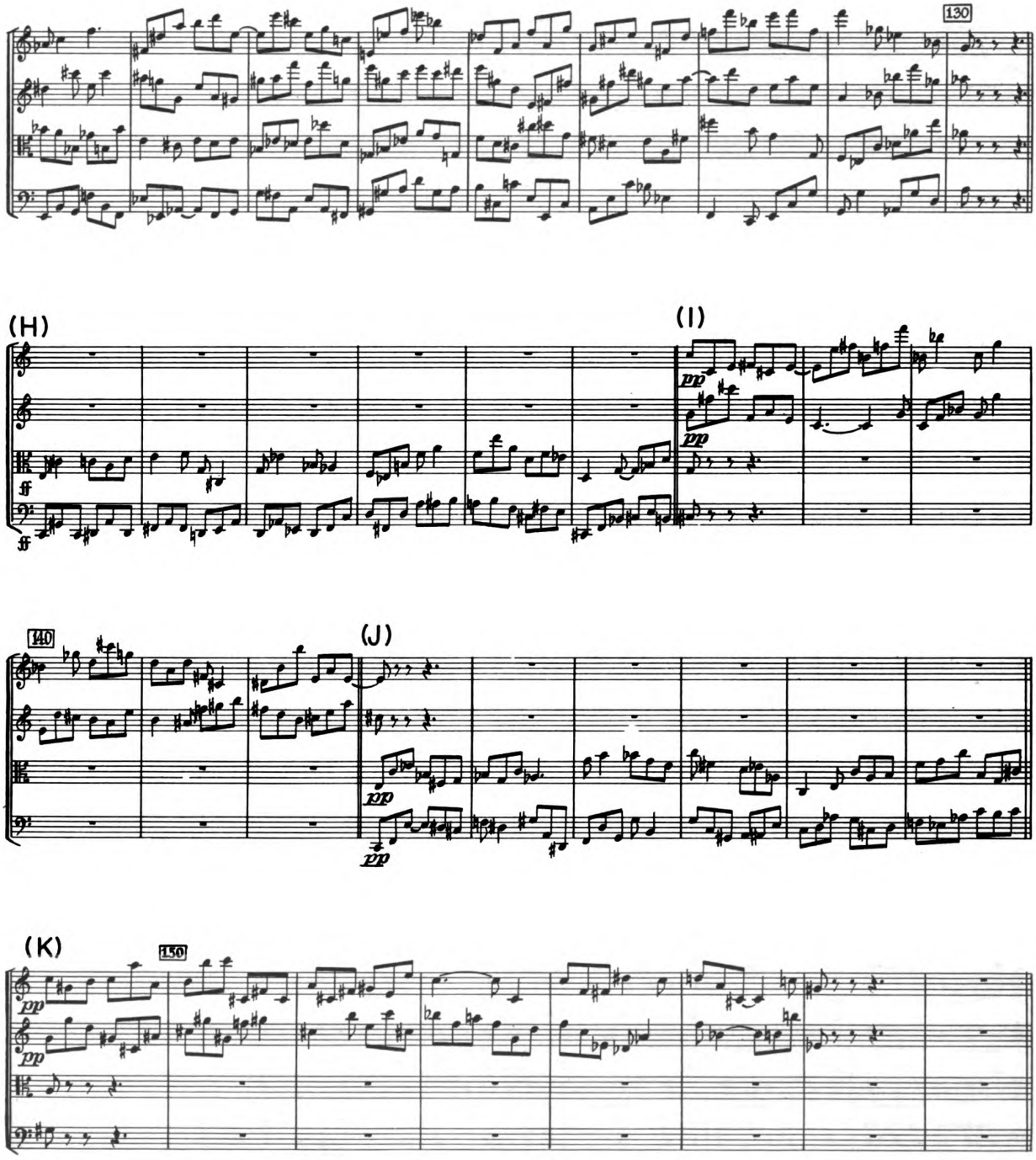

CODA

(L)