Adaptation is the process of change in the system that allows it to obtain the best or at least acceptable level in the system's operation under changing conditions. Attribute 4 of POIN indicates that the system is functioning when region A (the actual POIN) is constantly changing and, as we mentioned earlier, the system must satisfy this changing POIN. Unfortunately, the dynamics of changing the actual POIN is not known; hence, it is impossible to obtain an analytic expression (say, a function) of POIN change in time (otherwise it would be possible to use program control). In other words, the documentary IR system is trying to satisfy actual POIN without precise knowledge about the POIN (attribute 2) and with unpredictable changes occurring in its boundaries (attribute 4). Furthermore, we also cannot assign to the system some theoretically best state for which search would be optimal at a given moment of time (in this case it would be possible to use a servo system), because information about the given state cannot be introduced earlier into the system (there is no information for this), nor obtained in the process of its operation during formation of the output (there is no information for this). This is exactly the type of situation where the problem of adaptation arises. One should especially emphasize that we are speaking about control in a system and adaptive attributes of the system. In other words, we are speaking about the adaptation of the system to the user (to the user's actual POIN) and not about adaptation of the user to the system.

Thus, the properties of POIN and the requirement of giving the user optimal output assume that a mechanism of adaptation exists in the system; that is, it means that a documentary IR system is an adaptive system. The mechanism of adaptation in an IR system in essence solves two problems. First, by choosing the best state of the system, the mechanism provides the best output for the user, even when the quality of the request is low. (It is clear that in this case the best answer may not satisfy the user.) Second, the system adapts to a changing POIN even when the system is in the best state for a given user. In other words, if the first problem is with optimization, and this problem assumes that only one choice of the state (best) of the system will be sufficient for further service of an individual user, then the second task is the problem of carrying out iterative retrievals and correction of the discrepancy before each iteration. The second problem must be solved after the first and it must be solved more than once. We especially emphasize that, in addition to the discrepancy, the second problem takes into account the iteration requirement following from attributes 3 and 4 of POIN. In fact, attribute 3 implies that even when we give the user all pertinent documents available in the system, as a rule the POIN will not be completely satisfied, and in some cases it may grow. Therefore, a consideration of attribute 3 indicates the usefulness of SDI, which is the form of iteration when the collection of documents changes; and a consideration of attribute 2 indicates the usefulness of the iterative searches for a constant collection of documents. Attribute 4 of POIN points to its change over time and again signifies the necessity for iterations. In the following, when we talk of "adaptation" we will have the second problem in mind.
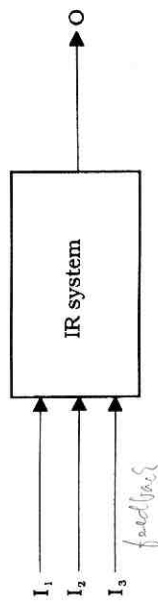
Figure 4.5
Documentary IR system.

Now that we already know that a documentary IR system must include a mechanism of feedback, we will consider the structure of this system. In Figure 4.5, a documentary IR system is represented in the form of a black box.

Notice that in this system there are already not two, but three inputs. Inputs 1 and 2 are already known to us, because they were considered in our earlier discussion (see Figure 4.2); and input 3 is used to enter information for the mechanism of feedback. This information is the reaction of the user to the output obtained from the system. (Incidentally, we note that in adaptive systems, information for control originates, as a rule, from the object to which the system is adapting.) On the basis of information obtained by the system through the feedback line, the following occurs:

1. The system is transformed into the best state (optimization).
2. The system is adapting to the imprecise representation of the user's POIN.

Since a documentary IR system is a control system, and any control system consists of an object of control and a mechanism of control, in Figure 4.6 the documentary IR system is represented as a control system.

The mechanism of control is the mechanism of feedback, consisting in turn of a mechanism that optimizes retrieval and adaptation to POIN. If the
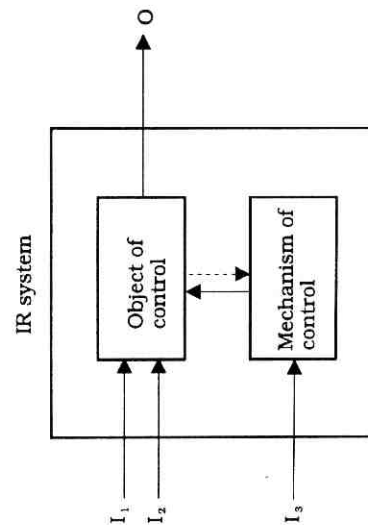

Figure 4.6
Documentary IR system as a control system.